Traffic Impact, Access, and Parking Study

The Dascomb Road Project

Andover, Massachusetts

THE DASCOMB ROAD PROJECT

Prepared for: **Town of Andover, Massachusetts**
36 Bartlett Street
Andover, Massachusetts 01810

On Behalf of: **Lupoli Companies**
280 Merrimack Street
Lawrence, Massachusetts 01843

Prepared by: **TEC, Inc.**
146 Dascomb Road
Andover, Massachusetts 01810

This document has been prepared under my direct supervision and responsible charge. I have reviewed this document as it relates to the traffic impact analysis and have determined that the conceptual transportation mitigation to be safe for public health and welfare in conformity with accepted engineering standards.

COMMONWEALTH OF MASSACHUSETTS
SAMUEL W. GREGORIO
CIVIL
No. 51109
REGISTERED PROFESSIONAL ENGINEER

Samuel W. Gregorio, P.E., PTOE
Senior Traffic Engineer

October 16, 2018

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

No. Title

I. INTRODUCTION

TEC, Inc. (TEC) has been retained by the Lupoli Companies (the "Applicant") to prepare a Traffic Impact, Access, and Parking Study (TIAPS) for the proposed Dascomb Road Project (the "Project"), located at #146 Dascomb Road in Andover, Massachusetts. The 16.2-acre site is located within the Industrial D2 (ID2) zoning district which was adopted by the Town of Andover in 2013 with unanimous support from the Planning Board and Board of Selectmen. The stated goal of the ID2 zoning district is to create targeted development opportunities. The ID2 zone was created to make Andover more attractive for businesses by allowing additional amenity uses/services to support office and industrial uses.

This TIAPS has been prepared to assess the traffic impacts of the proposed mixed-use redevelopment project and the extensive transportation improvements to be located adjacent to the site along Dascomb Road and Frontage Road in both Tewksbury and Andover, Massachusetts.

PROJECT OVERVIEW

Building Program and Access

The existing site currently consists of ±188,960 square feet (SF) of mixed office and industrial uses with associated on-site surface parking. The existing office and industrial space on-site are presently underutilized. A 27,300 SF office tenant is currently the properties primary occupant. A ±90,000 SF (not included in the above square footage) Restaurant Depot facility, who partially shared driveways connections with the site, operates on the property located adjacent to and south of the site at #148 Dascomb Road. The #146 Dascomb Road site is currently accessed via five (5) site driveways along the easterly side of Smith Way, south of Dascomb Road.

The Project consists of razing the existing ±188,960 SF of underutilized office and industrial space and constructing a 524,000 SF mixed-use redevelopment; comprised of a 100-room business-centric hotel; 293,000 SF of office space; 80,000 SF of general retail space; a 30,000 SF fitness center; a 35,000 SF neighborhood grocery store; and 20,000 SF of restaurant space. The Project proposes to modify the access/egress to the property, providing two (2) full-access/egress driveways, a shared full-access/egress driveway with Restaurant Depot, and a loading dock driveway along the easterly side of Smith Way. All full-access/egress driveways for the Restaurant Depot facility along Smith Way will be retained. Additionally, a full-access/full-egress driveway for the proposed redevelopment will be provided immediately

opposite Frontage Road, becoming the fourth leg at the signalized intersection on Dascomb Road.

Parking

The existing site currently includes 247 on-site surface parking spaces to service the underutilized ±188,960 SF of mixed office and industrial uses. The Project looks to significantly reconfigure the parking at the site and will provide 1,760 parking spaces to service the 524,000 SF mixed-use redevelopment. A large quantity of the on-site parking, 1,256 spaces, will be structured in order to maximize the amount of green space within the project while still maintaining opportunities for patrons, employees, and visitors to park efficiently without overflow. Access/egress to/from the structured parking will be provided at multiple locations within the redevelopment so to disperse traffic volumes throughout the site and the site's main access/egress points.

Proposed Transportation Mitigation

The Applicant is committed to implement and construct transportation mitigation measures to improve traffic operations and safety based for both existing and future deficiencies for all users. This includes off-site roadway improvements along the both the Dascomb Road and Frontage Road corridors between East Street to the west and Clark Road to the east. The proposed improvements will include, but is not limited to, reconstructing / widening Dascomb Road into a multimodal roadway that will accommodate healthy transportation alternatives such as walking, bicycling, and public/shared transit. In addition, the Applicant has committed to several Transportation Demand Management (TDM) measures aimed to reduce single-occupancy vehicle (SOV) trips and overall vehicular traffic to/from the redevelopment site and better manage traffic generated by the proposed project. Finally, the Applicant has committed to implementing a Traffic Monitoring Plan (TMP), which is intended to monitor traffic operations and parking occupancy throughout the construction and for a period following completion of the Project. A detailed review of these mitigation measures is further defined in this TIAPS.

CONTEXT

Transportation design, traffic operations, and traffic safety are primary components to the Dascomb Road Project. Off-site mitigation is proposed within State Highway Layout (SHLO) and along direct access/egress points of the Interstate Highway System, requiring review by the Massachusetts Department of Transportation (MassDOT) and the Federal Highway Administration (FHWA) in the form of a Permit to Access State Highway and a Project Framework Document (PFD), respectively.

As this project is anticipated to generate more than 3,000 new vehicle trips per day (vpd) along the adjacent roadway network, will include the construction of more than 1,000 new parking spaces, directly abuts state-owned property, and provides direct access/egress to a state-owned roadway, the Project will require review by the Massachusetts Environmental Policy Act (MEPA) office in the form of an Environmental Notification Form (ENF) and mandatory Environmental Impact Report (EIR) under the following MEPA Review Thresholds:

- 301 CMR 11.03(6)(a)(6) – Generation of 3,000 or more new ADT on roadways providing access to a single location; and
- 301 CMR 11.03(6)(a)(7) – Construction of 1,000 or more new parking spaces at a single location.

METHODOLOGY

TEC has evaluated the traffic operations for the study area under existing and future conditions consistent with the *Transportation Impact Assessment (TIA) Guidelines* issued by MassDOT[1] and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports. The future planning horizon examines traffic operations under existing conditions (2018), as well as an 8-year planning horizon (2026) for traffic-volume projections; which includes an evaluation of the No-Build conditions (without the proposed project), Build conditions (with the proposed project), and Build with Mitigation conditions (with the proposed project and any proposed mitigation). TEC has utilized an 8-year horizon, as opposed to a 7-year horizon typically utilized under MassDOT's *TIA Guidelines*, as the MEPA review process is not intended to be finalized until 2019.

[1] *Transportation Impact Assessment (TIA) Guidelines*; Massachusetts Department of Transportation; March 13, 2014.

II. EXISTING CONDITIONS

TRAFFIC STUDY AREA

A comprehensive field inventory of existing traffic conditions on the study area corridors and intersections was conducted during various site visits by TEC staff from October 2016 to September 2018. The field investigations consisted of existing roadway geometrics, operating characteristics, study area safety concerns, and multi-modal accommodations. The study area was selected to contain the major roadways providing local access/egress to/from the project site.

Study Area Intersections

The study area was selected to contain the major roadways providing local access/egress to/from the project site. This includes an evaluation of intersection in which the site-generated trips increase the peak hour traffic volume by more than 5 percent and/or by more than 100 vehicles per hour per MassDOT's *TIA Guidelines* (Section 3.I.C). These thresholds are met to the east at the intersection of Dascomb Road / East Street / Shawsheen Street, to the north at the intersection of Frontage Road / Interstate 93 SB Ramps, and to the west at the intersection of Dascomb Road / Andover Street. The following intersections were therefore evaluated as part of the study area:

1. Dascomb Road / East Street / Shawsheen Street [Town of Tewksbury]
2. Dascomb Road / Hewlett Packard Site Driveway
3. Dascomb Road / Smith Way [Smith Drive]
4. Dascomb Road / Frontage Road
5. Dascomb Road / Interstate 93 NB Ramps [Interchange 42]
6. Frontage Road / Interstate 93 SB Ramps [Interchange 42]
7. Dascomb Road / Lovejoy Road / Acorn Drive
8. Dascomb Road / Clark Road / Bannister Road
9. Dascomb Road / Andover Street

The study area intersections and project limits are shown graphically in Figure 1.

Further evaluation of the merge and diverge locations for Interstate 93 Interchange 42 will be examined during the state's MEPA review; as well as the Permit to Access State Highway and PFD with MassDOT.

GEOMETRY

The field inventory included collection of existing roadway geometrics, pedestrian and bicycle accommodations, traffic volumes, sight distances, and safety data for the existing study area. A description of the existing roadway and intersection inventory is provided below.

Roadways

Dascomb Road

Dascomb Road is a northeast-southwest urban minor arterial roadway maintained by the Town of Andover. For the purposes of this study, the cardinal direction of the corridor is to be noted as east-west. MassDOT maintains a segment of the corridor between Frontage Road and the I-93 NB Interchange 42 Ramps. To the southeast and northwest of these intersections, the corridor in maintained by the corresponding municipality (Tewksbury or Andover). Within the Town of Tewksbury, the corridor is signed as East Street. The corridor provides a local connection between Tewksbury Center to the west and Andover Street / Andover Center to the east. Dascomb Road ranges from approximately 42 to 55-feet wide and features a posted speed limit of 40 miles per hour (mph) within the vicinity of the project site. Land uses along Dascomb Road include a mix of residential, light retail, office, and industrial uses. Dascomb Road / East Street to the west carries a significant level of heavy commercial vehicle traffic as a result of the Market Basket headquarters and distribution warehouse approximately 1-mile west of the study area.

Frontage Road

Frontage Road is a north-south local roadway maintained by the Town of Andover. MassDOT maintains a short segment of the corridor between Dascomb Road and the I-93 SB Interchange 42 Ramps. To the north of the I-93 SB Ramps, the corridor in maintained by the Town of Andover. The roadway provides a local connection between Osgood Street and the Raytheon facility to the north and Dascomb Road to the south as well as direct regional access to the I-93 SB Interchange 42 Ramps. Frontage Road is approximately 53-feet wide and does not feature a posted speed limit within the vicinity of the study area. Land uses along Frontage Road are predominantly industrial and/or commercial in nature. Immediately north of Dascomb Road, Frontage Road provides access/egress to a MassDOT Park and Ride facility.

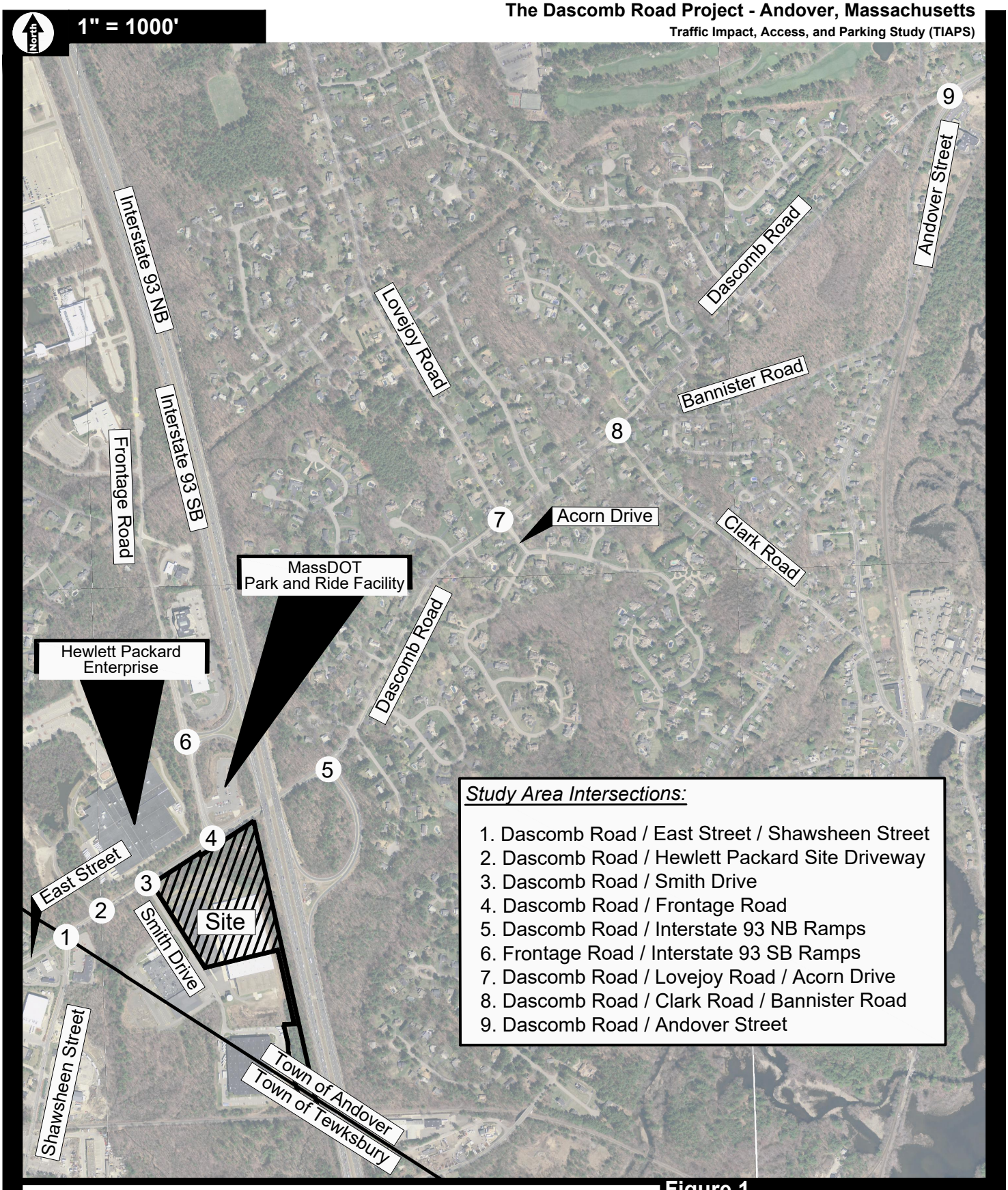

Figure 1

Project Location Map & Study Area Intersections

TEC
The Engineering Corp

T:\T0525\CAD\Highway\Graphics\ENF\T0525_Locus Map 9/25/2018 10:16:31 AM

Intersections

Dascomb Road / East Street / Shawsheen Street

The intersection of Dascomb Road / East Street / Shawsheen Street was recently reconstructed and signalized in 2014/2015 as part of MassDOT Project #606298. Shawsheen Street intersects Dascomb Road and East Street to form a three-way, T-type, fully-actuated signalized intersection. The traffic signal at this location is under the operation of the Town of Tewksbury. The East Street eastbound approach consists of a through lane and an exclusive right-turn lane, with directional flow separated by a striped median. The Dascomb Road westbound approach consists of an exclusive left-turn lane and a through lane, with directional flow separated by a marked centerline. The Shawsheen Street northbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane, with directional flow separated by a marked centerline. Bicycle shoulders are provided along both sides of each roadway on all three intersection approaches. Sidewalks are provided along both sides of East Street and Shawsheen Street, with crosswalks connecting them on the eastbound and northbound intersection approaches. Sidewalks are not provided along Dascomb Road to the east of the intersection. Although the traffic signal is programmed for coordination, the traffic signal currently operates under free operation. At present, the master controller unit is located at this intersection; however, it will be transferred to the Frontage Road intersection per MassDOT direction upon further improvements to the corridor signalization.

Dascomb Road / HP Site Driveway

The HP Site Driveway intersects Dascomb Road to form a three-way, T-type, unsignalized intersection. The HP Site Driveway operates under stop-control while the Dascomb Road approaches are free-flowing. The Dascomb Road eastbound approach consists of a single general-purpose travel lane with directional flow separated by a marked centerline. The Dascomb Road westbound approach consists of a through lane and a channelized right-turn lane with directional flow separated by a marked centerline. The HP Site Driveway southbound approach consists of a single general-purpose travel lane with directional flow separated by a marked centerline. Sidewalks and crosswalks are not provided along any of the roadways or intersection approaches.

Dascomb Road / Smith Way

Smith Way (also referred to as Smith Drive) intersects Dascomb Road to form a three-way, T-type, unsignalized intersection. Smith Way operates under stop-control while the Dascomb Road approaches are free-flowing. The Dascomb Road eastbound approach consists of a shared through / right-turn lane, while the Dascomb Road westbound approach consists of an exclusive left-turn lane and a through lane. Directional flow along Dascomb Road is separated by a raised concrete median. The Smith Way northbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane, with directional flow separated by a marked centerline. Sidewalks and crosswalks are not provided along any of the roadways or intersection approaches.

Dascomb Road / Frontage Road

Frontage Road intersects Dascomb Road to form a three-way, T-type, fully-actuated signalized intersection. The traffic signal at this location is under the operation of MassDOT. The Dascomb Road eastbound approach consists of an exclusive left-turn lane and a through lane, while the Dascomb Road westbound approach consists of two through lanes and a channelized right-turn lane, which generates an add-lane along Frontage Road. Directional flow along Dascomb Road is separated by a marked centerline. The Frontage Road southbound approach consists of an exclusive left-turn lane and a channelized right-turn lane, which operates under yield-control. Directional flow along Frontage Road is separated by a raised concrete median which transitions to a marked centerline. Sidewalks and crosswalks are not provided along any of the roadways or intersection approaches. Although the traffic signal is programmed for coordination, the traffic signal currently operates under free operation. The master controller unit currently located at the Dascomb Road / East Street / Shawsheen Street intersection will be transferred to this intersection per MassDOT upon further improvements to the corridor signalization.

Dascomb Road / Interstate 93 Northbound Ramps [Interchange 42]

The I-93 Northbound Interchange 42 Ramps (I-93 NB Ramps) intersect Dascomb Road to form a three-way, T-type, unsignalized intersection. The Dascomb Road eastbound approach consists of a through lane and a channelized right-turn lane, which operates under yield-control. The Dascomb Road westbound approach consists of an exclusive left-turn lane and a through lane. Directional flow along Dascomb Road is separated by a marked centerline. The I-93 NB Ramps northbound approach consists of an exclusive left-turn lane and a channelized right-turn lane, which operates under yield-control. Directional flow along the I-93 NB Ramps is separated by a landscaped median which transitions to a raised concrete median. Sidewalks and crosswalks are not provided along any of the roadways or intersection approaches. Upon observation, the queue for the left-turn movement along the I-93 NB Ramps is extensive during the commuter peak periods. As a result, many side street roadways along Dascomb Road to the east are signed for prohibited reverse movements. Although much of the off-ramp is striped as one-lane, left-turning vehicles will queue against the far-left shoulder allowing right-turning vehicles to bypass.

Dascomb Road / Lovejoy Road / Acorn Drive

Lovejoy Road and Acorn Drive intersect Dascomb Road to form a four-way, actuated signalized intersection. The traffic signal at this location is under the operation of the Town of Andover. Both the Dascomb Road eastbound and westbound approaches consist of a single general-purpose travel lane. Directional flow along Dascomb Road is separated by a marked centerline. Both the Acorn Drive northbound and Lovejoy Road southbound approaches consist of a shared left-turn/through lane and an exclusive right-turn lane with directional flow separated by a marked centerline. Sidewalks are provided along the southerly side of Dascomb Road through the intersection and along the northerly side of Dascomb Road, west of the intersection. Sidewalks are also present along the westerly side of both Lovejoy Road and Acorn Drive. Crosswalks are present across both the Dascomb Road eastbound and Acorn Drive northbound approaches.

Dascomb Road / Clark Road / Bannister Road

Clark Road and Bannister Road intersect Dascomb Road to form a four-way, skewed T-type, unsignalized intersection. Clark Road operates under stop-control while the Dascomb Road approaches are free-flowing. Bannister Road approaches the intersection at an acute angle from the southeast providing one-way flow exiting the intersection. Both the Dascomb Road eastbound and westbound approaches consist of a single general-purpose travel lane. Directional flow along Dascomb Road is separated by a marked centerline. The Clark Road northbound approach consists of a single general-purpose travel lane with directional flow separated by a marked centerline. A sidewalk is provided along the southerly side of Dascomb Road, west of the intersection and along the westerly side of Clark Road. No crosswalks are present at the intersection. There is currently truck exclusion signage posted for both Bannister Road and Clark Road at the intersection.

Dascomb Road / Andover Street

Dascomb Road intersects Andover Street to form a three-way, skewed, unsignalized intersection. The driveway for Wingate of Andover, a medical care facility, intersects Andover Street by bisecting the median along the opposing Dascomb Road approach. As this driveway does not directly oppose Dascomb Road and generally experiences a limited number of vehicular trips, it has not been included in the subsequent traffic impact analysis. Dascomb Road operates under stop-control while the Andover Street approaches are free-flowing. The Dascomb Road eastbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane separated by a raised median which also allows for opposing / turning traffic from Andover Street northbound to access Dascomb Road between the eastbound traffic travel lanes. Directional flow along Dascomb Road is separated by a marked centerline and second raised landscaped median. The Andover Street northbound and southbound approaches both consist of a single general-purpose travel lane with directional flow separated by a marked centerline. The receiving lane for Dascomb Road from Andover Street southbound is geometrically set to allow for high-speed and non-deflecting traffic movements. For the purposes of this study, this receiving lane has not been analyzed as a channelized right-turn lane to provide a conservative analysis condition. Sidewalks and crosswalks are not provided along any of the roadways or intersection approaches.

Frontage Road / Interstate 93 Southbound Ramps [Interchange 42]

The I-93 Southbound Interchange 42 Ramps (I-93 SB Ramps) intersect Frontage Road to form a three-way, T-type, unsignalized intersection. The Frontage Road northbound approach consists of a through lane and a channelized right-turn lane, which operates under yield-control. The Frontage Road southbound approach consists of a shared left-turn / through lane and a through lane. Directional flow along Frontage Road is separated by a marked centerline. The I-93 SB Ramps westbound approach consists of an exclusive left-turn lane and a channelized right-turn lane, which operates under yield-control. Directional flow along the I-93 SB Ramps is separated by a landscaped median. Sidewalks and crosswalks are not provided along any of the roadways or intersection approaches. Upon observation, the queue for the left-turn movement along the I-93 SB Ramps can be extensive during the commuter peak periods; however, it is not to the same degree as seen on the I-93 NB Ramps at Dascomb Road. This queue has been noted to back-up onto I-93 SB along the breakdown lane which does block

traffic during the weekday morning peak hours when this breakdown lane is legally utilized for commuter travel.

PUBLIC TRANSPORTATION ACCESS

The Massachusetts Bay Transportation Authority (MBTA) provides Commuter Rail service to the Town of Andover via the Haverhill Commuter Rail Line. Commuter rail route and schedule data are included in Appendix A and a summary of the route is provided below.

- *Haverhill Commuter Rail Line* - The MBTA Commuter Rail provides connections from North Station in Boston with stations at Malden Center, Wyoming Hill, Melrose/Cedar Park, Melrose Highlands, Greenwood, Wakefield, Reading, North Wilmington, Ballardvale, Andover, Lawrence, Bradford, and Haverhill. Inbound service from Haverhill runs between 5:05 AM and 11:55 PM, and outbound service from Boston runs between 6:43 AM and 1:19 AM, with headways of approximately 20 minutes to 100 minutes on weekdays. On Saturdays and Sundays, inbound service from Haverhill runs between 7:15 AM and 11:16 PM, and outbound service from Boston runs between 8:40 AM and 12:38 AM, with headways of approximately 170 minutes to 200 minutes. The Ballardvale Station is located at #195 Andover Street, approximately 1.6-miles east of the Dascomb Road Project site. The Andover Station is located at #11 Lewis Street, approximately 3.2-miles northeast of the Dascomb Road Project site.

The Lowell Regional Transit Authority (LRTA) provides bus service near the Dascomb Road Project site via Route #11 – IRS / Raytheon via Route 133. Bus route and schedule data are included in Appendix A and a summary of the route is provided below.

- *Route 11 – IRS / Raytheon via Route 133* – The LRTA bus service provides connections from the Kennedy Center in Downtown Lowell with large business complexes located along Route 133 in Lowell, Tewksbury, and Andover; including the I-495 Business Center, Ames Pond Corporate Park, Raytheon, and the Internal Revenue Service (IRS). Four (4) roundtrips are offered on weekdays, with two (2) in the morning (between 6:00 AM and 8:00 AM) and two (2) in the evening (between 3:00 PM and 5:00 PM). Due to the office-focused nature of the route, weekend service is not provided. Although service is not provided directly to the Dascomb Road Project site, the Raytheon bus stop is located only 1.4-miles north of the Project site.

The Merrimack Valley Regional Transit Authority (MVRTA) provides bus service near the Dascomb Road Project site via Routes #21 – Andover Shuttle and #32 - Andover. Bus route and schedule data are included in Appendix A and a summary of the route is provided below.

- *Route 21 – Andover Shuttle* – The MVRTA bus service provides connections from the North Andover Mall in Lawrence/North Andover with commuter destinations along Route 114, Route 133 and Route 28 in Lawrence, North Andover, and Andover; including the YMCA, Shawsheen Plaza, Andover MBTA Commuter Rail Station, the Andover Senior Center, and Shawsheen Center. Nine (9) roundtrips are offered on weekdays between 8:10 AM and 6:40 PM. Weekend service is not

provided to-date. Although service is not provided directly to the Dascomb Road Project site, the Andover MBTA Station bus stop along Railroad Street is approximately 3.2-miles northeast of the Dascomb Road Project site.

- *Route 32 – Andover* – The MVRTA bus service provides connections from the Buckley Transportation Center in Lawrence with commuter destinations along Route 28 in Lawrence and Andover; including the Shawsheen Plaza, Andover MBTA Commuter Rail Station, the Andover Square, and Shawsheen Center. Twenty-one (21) roundtrips are offered on weekdays between 5:30 AM and 7:26 PM, at 30 to 60 minute headways. Saturday service is provided between 7:00 AM to 6:41 PM at 60 minute headways. Sunday service is provided between 9:00 AM to 5:41 PM at 60 minute headways. Although service is not provided directly to the Dascomb Road Project site, the Andover MBTA Station bus stop along Railroad Street is approximately 3.2-miles northeast of the Dascomb Road Project site.

MassDOT operates a Park-and-Ride service lot along Frontage Road, immediately north of Dascomb Road, adjacent to the Project site. The Park-and-Ride facility provides 154 surface parking spaces. Bicycle racks are also provided for those commuters who use bicycles. Commuter bus services do not stop at this Park-and-Ride service lot. Information related to future and proposed public transportation services near and to/from the Project site is provided in the "Proposed Improvement" chapter of this TIAPS.

EXISTING TRAFFIC VOLUMES

Turning Movement Counts

To establish existing traffic-volume conditions within the study area, manual turning movement counts (TMCs) were conducted at the study area intersections on Thursday, September 13, 2018 during the weekday morning (7:00 AM – 9:00 AM) peak period; on Thursday, September 20, 2018 during the weekday evening (4:00 PM – 6:00 PM) peak period; and on Saturday, September 22, 2018 during the Saturday midday (11:00 AM – 1:00 PM) peak period. TMCs were additional conducted during the typical full-weekday (7:00 AM – 7:00 PM) jointly between Thursday, September 13, 2018 and Thursday, September 20, 2018 at the intersections of Dascomb Road / Smith Way, Dascomb Road / I-93 NB Ramps, Dascomb Road / Clark Road / Bannister Road, and Frontage Road / I-93 SB Ramps. These counts were conducted over multiple days due to the Greater Lawrence Gas Disaster which is further summarized below. Area schools were in regular session during the time of the traffic counts. A detailed summary of the TMCs, partitioned into 15-minute intervals, is provided within Appendix B.

Automatic traffic Recorder Counts

Automatic Traffic Recorder (ATR) counts were conducted concurrently with the TMCs from Wednesday, September 12, 2018 through Thursday, September 13, 2018 to gather daily traffic-volume, vehicle classification, and speed data for the study area roadways during a continuous 24-hour time period at various corridor locations including:

- Dascomb Road, west of Smith Way
- Dascomb Road, below Interstate 93
- Dascomb Road, east of Surrey Lane
- Frontage Road, north of Dascomb Road

ATR counts were not collected for the typical Saturday in 2018 due to constraints of the Greater Lawrence Gas Disaster, the over-pressurization of a low pressure gas line impacting Andover, North Andover, and Lawrence, that occurred in mid-September.

A summary of the weekday ATR traffic data is presented in Table 1. A detailed summary of the ATR counts, partitioned into 15-minute intervals, are provided in Appendix C.

Table 1 – Existing Weekday Traffic Volume Summary

Location	Weekday Traffic Volume[a]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		Traffic Volume[b]	K Factor[c]	Directional Distribution[d]	Traffic Volume	K Factor	Directional Distribution
Dascomb Road, west of Smith Way	23,610	1,879	7.0	51.1% EB	1,981	8.4	50.4% WB
Dascomb Road, below Interstate 93	22,783	2,036	8.9	54.5% WB	1,864	8.2	52.3% EB
Dascomb Road, east of Surrey Lane	15,752	1,684	10.7	55.4% WB	1,470	9.3	60.7% EB
Frontage Road, north of Dascomb Road	16,920	1,562	9.2	56.5% NB	1,198	7.1	53.9% SB

[a] Daily traffic expressed in vehicles per day
[b] Hourly traffic expressed in vehicles per hour
[c] Percent of daily traffic volumes which occurs during the peak hour
[d] Percent of peak-hour volume in the predominant direction of travel
EB = Eastbound; WB = Westbound; NB = Northbound; SB = Southbound

Dascomb Road, in the vicinity of Smith Way, carries between 15,750 vpd and 23,600 vpd on an average weekday. The range of traffic volumes in this short segment is significant and directly related to the location of interchange ramps for Interstate 93. Directional distribution along the roadway was roughly split 50-50 during both peak hours near the ramps and to the west; however the split in directional distribution becomes more prominent east towards Andover Center with 55 percent of morning traffic heading towards Interstate 93 and 60 percent of evening traffic heading away from Interstate 93.

Frontage Road, in the vicinity of the I-93 SB Ramps, carries approximately 16,900 vpd on an average weekday. An overwhelming majority of this traffic is to/from the I-93 SB Ramps. As shown in Table 1, traffic volumes on Frontage Road are approximately 30 percent greater during the weekday morning peak hour than during the weekday evening peak hour. Directional distribution indicates larger traffic volumes heading toward Boston during the morning peak hour and larger traffic volumes coming from New Hampshire during the evening peak hour.

Disclosure of Greater Lawrence Gas Disaster

Manual TMCs and ATRs for the project were originally being collected on Thursday, September 13, 2018 before and during the Greater Lawrence Gas Disaster which resulted in gas leaks, fires, and explosions in South Lawrence, Andover, and North Andover. Interchange closures along Interstate 93 and Interstate 495, as well as mass evacuations of the general public from the affected area, caused a significant traffic impact on the Dascomb Road and Frontage Road corridors starting at approximately 4:15 PM on that date. TEC visually witnessed the abnormal traffic build-up and immediately terminated traffic volume collection efforts and rescheduled traffic counts the following Thursday, September 20, 2018 when traffic operations for the Dascomb Road and Frontage Road corridors were back to normal.

As traffic counts had already begun on Thursday, September 13, 2018, much of the traffic volumes were judged to be unaffected by the Greater Lawrence Gas Disaster. TEC provided its engineering judgement to only utilize traffic counts on this day up to 3:00 PM, approximately one-hour before the first gas leak, fire, or explosion occurred. Therefore, all weekday morning and early afternoon TMCs on this date where deemed acceptable, as well as ATR data up to the 3:00 PM cut-off. All TMC counts as defined after 12:00 PM were obtained from the rescheduled traffic counts collected on Thursday, September 20, 2018.

Seasonal Adjustment

In accordance with MassDOT standards, traffic volumes are typically adjusted to reflect average-month conditions for preparation of a traffic impact assessment. A review of historic traffic-volume counts collected by MassDOT at a permanent count station along Interstate 93 in Andover[2] indicated that traffic volumes in September are approximately 3.5 percent greater than average-month conditions. Although these counts are along a freeway roadway, Dascomb Road and Frontage Road through the study area generally operate consistent with commuter seasonal patterns. Therefore, the September 2018 traffic volumes were left unadjusted to reflect a conservative analysis scenario. The compiled seasonal adjustment data is provided in Appendix D. The resulting 2018 Existing Condition traffic volumes are shown graphically in Figure 2.

Tewksbury Street Bridge Detour

During the execution of traffic volume counts in September 2018, elevated traffic levels were observed along the Dascomb Road corridor. This is due to the MassDOT indefinite closure of the Tewksbury Street Bridge over the Pan Am Railroad tracks in Andover, Massachusetts; which commenced in early August 2018. MassDOT is currently working on a repair plan to allow the bridge to be reopened to one-way, alternating traffic. Until that plan is developed, MassDOT has set-up detours passing along the subject corridors as follows:

[2] MassDOT Permanent Count Station 5022 – Andover – Rte. I-93 – north of Rte. 125

- Tewksbury Street westbound traffic will be directed to follow Andover Street; left onto Dascomb Road; left onto Shawsheen Street and follow to its intersection with Vale Street in Tewksbury Street.
- Tewksbury Street eastbound traffic will be directed to follow Shawsheen Street; right onto Dascomb Road; right onto Andover Street and follow to its intersection with Tewksbury Street in Andover.

Traffic volume data collected in 2016 along the Dascomb Road corridor does not provide a significant evaluation of the percent of traffic that the detour route is redistributing. TEC has therefore not calculated any reduction in traffic volumes through the study area. The traffic volumes along the Dascomb Road corridor as presented in this study can generally be assumed to represent a conservative scenario as they have not been adjusted-down to remove detoured volumes that would not generally be observed during prevailing conditions.

SAFETY ANALYSIS AND REVIEW

A comprehensive traffic safety analysis was conducted for the study area intersections. The traffic safety analysis included the compilation and examination of study intersection crash data, a general safety review with consideration given to items on the MassDOT Safety Review Prompt List, and sight distance measurements. Details of each step in the traffic safety analysis are described in the following section.

Crash History and Data

Crash reports for the study area intersections were compiled and analyzed for the most recent consecutive seven-year period (2011-2017) of complete data on file from MassDOT. Crash reports were also compiled for 2011-2017 by both the Tewksbury and Andover Police Departments. To date, 2018 are not completed crash years of data and therefore have not been included in this safety review. The motor vehicle crash data was reviewed to determine if any crash trends exist within the study area. Summaries of the vehicle crash data and intersection crash rates are provided in Table 2.

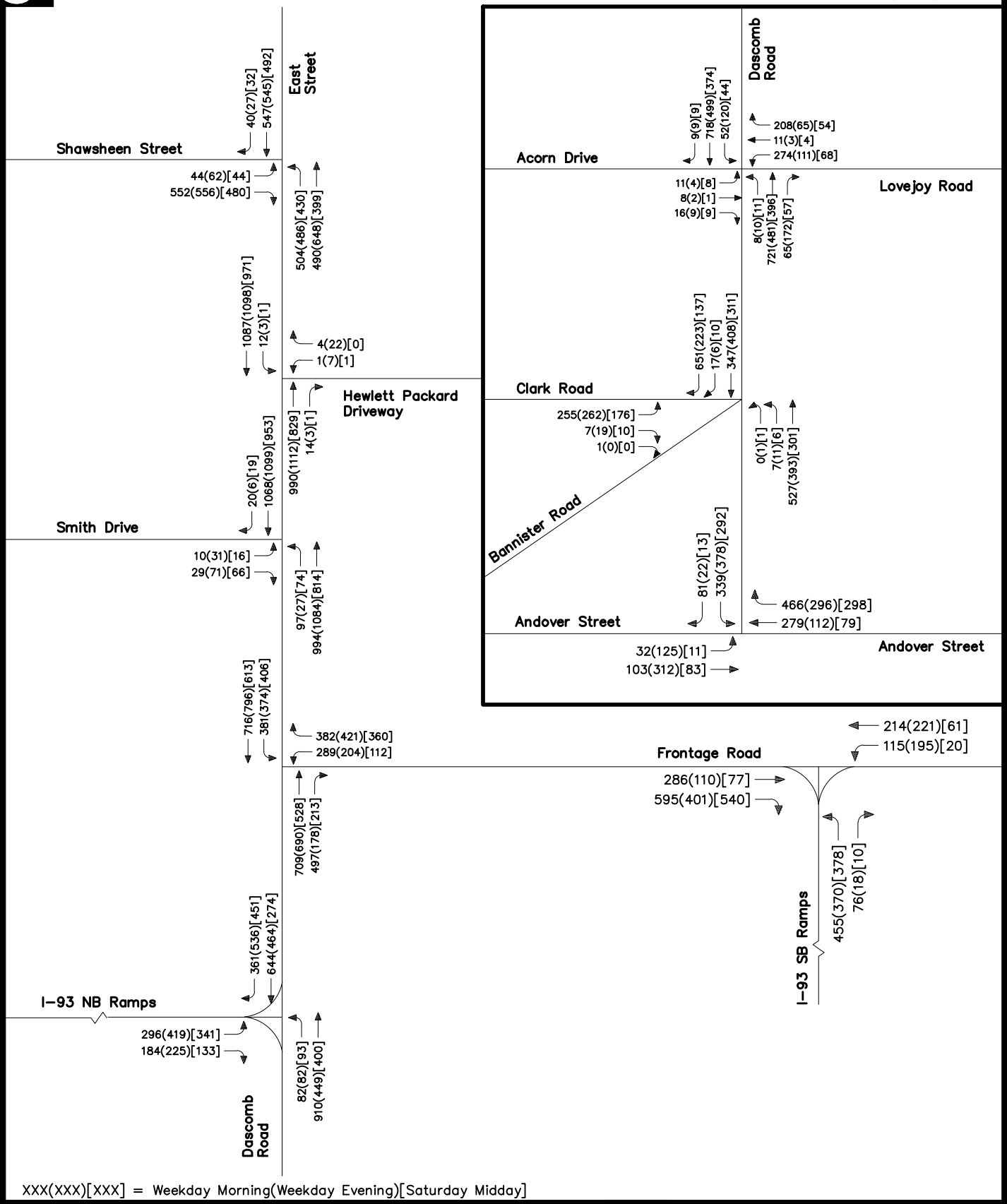

Figure 2

**2018 Existing Conditions
Weekday Morning, Weekday Evening
and Saturday Midday
Peak Hour Traffic Volumes**

The Engineering Corp

Highway Safety Improvement Plan Eligible

In August 2005, the transportation act entitled the "Safe, Accountable, Flexible, Efficient Transportation Act - A Legacy for Users" (SAFETEA-LU) was passed. This act provides guidance and funding for the implementation of a State Highway Safety Improvement Program (HSIP). As part of this program, all states are required to develop a Strategic Highway Safety Plan (SHSP). The MassDOT guidelines require a Road Safety Audit (RSA) to be conducted where HSIP-eligible crash clusters are present within the study area of a private development sphere of influence, prior to finalizing the MEPA process. An intersection is defined as HSIP-eligible if the intersection is within the top 5% of clusters in its respective Regional Planning Commission (RPC) boundaries based on Equivalent Property Damage Only (EPDO). EPDO rates crashes based on the collision severity.

Based on the MassDOT online crash cluster database, the Dascomb Road / Smith Way intersection and I-93 Interchange 42 are considered 2015 Highway Safety Improvement Plan (HSIP) eligible (current crash years of HSIP-eligibility). Upon further review of the compiled crash reports, many of the crashes that were geocoded within the MassDOT crash portal to the intersection of Dascomb Road / Smith Way by MassDOT were incorrectly placed. Crash reports narratives and diagrams indicate that most of these crashes actually occurred at or within the influence of the Dascomb Road / Frontage Road intersection. TEC identified this error with the MassDOT Traffic Safety Section in October 2016. As part of this TIAPS and subsequent traffic related documents, the intersection of Dascomb Road / Smith Way is not considered HSIP-eligible; however, the intersection Dascomb Road / Frontage Road is to be considered as HSIP-eligible.

Similarly, many freeway interchanges across the Commonwealth are noted as HSIP-eligible locations; however, this is generally the result of crashes being geocoded on the center of the interchange, as opposed to the specific crash location along a freeway segment, along the ramps, or other location of the interchange. Although the interchange does experience a large number of crashes, TEC examined the crash reports to denote the actual crash location along the different portions of the interchange. This examination indicates that the surface intersection of Dascomb Road / I-93 NB Ramps is 2015 HSIP-eligible separate from the interchange as a whole.

Prior to this TIAPS, TEC and the Applicant facilitated an RSA for the intersections of Dascomb Road / Frontage Road and Dascomb Road / I-93 NB Ramps in coordination with the MassDOT Traffic and Safety Engineering Section. An RSA, as defined by the FHWA, is the *formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team*. The RSA meeting for both HSIP-eligible locations within the study area was held on December 14, 2016. A copy of the RSA, as approved by MassDOT, is provided in Appendix E.

Table 2 - Crash Data Summary

		Dascomb Road / East Street / Shawsheen Street	Dascomb Road / HP Driveway	Dascomb Road / Smith Way	Dascomb Road / Frontage Road	Dascomb Road / I-93 NB Ramps	Dascomb Road / Lovejoy Road / Acorn Drive	Dascomb Road / Clark Road / Bannister Road	Dascomb Road / Andover Street	Frontage Road / I-93 SB Ramps
Crash Year:	2011	4	0	1	8	5	-	-	-	0
	2012	0	2	0	13	3	-	-	-	0
	2013	1	2	0	12	2	-	-	-	0
	2014	4	2	1	13	3	-	-	-	0
	2015	2	4	4	10	7	2	0	7	3
	2016	1	12	3	25	10	1	0	7	1
	2017	2	3	0	19	3	0	1	5	1
	TOTAL	**14**	**25**	**9**	**100**	**33**	**3**	**1**	**19**	**5**
Annual Average		***2.00***	***3.57***	***1.29***	***14.29***	***4.71***	***1.00***	***0.33***	***6.33***	***0.71***
Crash Rate (MEV):		***0.20***	***0.37***	***0.13***	***1.21***	***0.49***	***0.17***	***0.06***	***1.30***	***0.11***
Significant:		**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**Yes**	**No**
Type:	Angle	4	10	2	52	22	0	0	8	4
	Rear-end	6	7	4	35	3	0	0	1	1
	Sideswipe	3	1	1	4	1	1	0	0	0
	Single	0	2	2	4	3	1	0	0	0
	Head-On	1	0	0	5	1	0	0	2	0
	Ped / Bike	0	0	0	0	1	0	0	0	0
	Not Reported	0	5	0	0	2	1	1	8	0
	TOTAL	**14**	**25**	**9**	**100**	**33**	**3**	**1**	**19**	**5**
Surface Conditions:	Dry	14	17	8	70	27	0	0	9	4
	Wet	0	4	1	25	2	0	0	1	1
	Snow/Slush/Ice	0	0	0	3	2	2	0	1	0
	Other / Unknown	0	4	0	2	1	1	1	8	0
	TOTAL	**14**	**25**	**9**	**100**	**33**	**3**	**1**	**19**	**5**
Severity:	PDO	14	20	8	66	23	3	1	16	5
	Non-Fatal Injury	0	5	1	34	10	0	0	3	0
	Not Reported	0	0	0	0	0	0	0	0	0
	TOTAL	**14**	**25**	**9**	**100**	**33**	**3**	**1**	**19**	**5**
Day of Week:	Monday-Friday	12	23	7	82	26	1	0	17	5
	Saturday-Sunday	2	2	2	18	7	2	1	2	0
	TOTAL	**14**	**25**	**9**	**100**	**33**	**3**	**1**	**19**	**5**
Time of Day:	6:00AM-9:00AM	1	8	2	20	6	0	0	4	2
	9:00AM-12:00PM	1	2	3	10	2	1	0	1	1
	12:00PM-3:00PM	6	5	0	10	6	1	0	4	0
	3:00PM-6:00PM	5	5	2	17	8	0	0	8	1
	6:00PM-9:00PM	1	4	2	26	7	1	0	2	0
	9:00PM-6:00AM	0	1	0	17	4	0	1	0	1
	TOTAL	**14**	**25**	**9**	**100**	**33**	**3**	**1**	**19**	**5**

Crash Rate Worksheets

In addition to examining the number of crashes at the study area intersections, a crash rate was calculated to compare the occurrence of crashes to the volume of traffic passing through the intersection. The crash rate per million entering vehicles (MEV) was calculated using the evening peak hour volumes from the TMCs and a calculated K-factor obtained from the ATR counts to establish a daily intersection traffic volume. The crash rates at each of the study area intersections were compared to the statewide and district-wide averages published by MassDOT in June 2018 to determine the significance of the crash occurrence. The statewide average for signalized intersections is 0.78, and the District 4 average for signalized intersections is 0.73. The statewide average for unsignalized intersections is 0.57, and the District 4 average for unsignalized intersections is 0.57. A compilation of the MEV rate calculation worksheets and detailed crash data are provided in Appendix F.

Collision Diagrams

In conjunction with the RSA that was conducted for the Dascomb Road / Frontage Road and Dascomb Road / I-93 NB Ramps intersections, collision diagrams were prepared to determine crash patterns and highlight the need for additional safety improvements at the study area intersection. This collision diagram consists of MassDOT and Town of Andover Police Department crash data from 2011 to 2017. This collision diagram is presented in Appendix F.

Crash Data Summary

The intersection of Dascomb Road / East Street / Shawsheen Street experienced an average of approximately two (2.14) crashes per year over the seven-year study period. The crash rate for this intersection is significantly less than the statewide and district-wide averages for signalized intersections. An RSA had been conducted at this intersection in early 2011 prior to major intersection and signalization improvements that were design and constructed in 2014/2015. Six (6) of the crashes were rear-end crashes; however only one (1) crash of this manner have occurred following the intersection reconstruction. The lack of historical by-pass condition may be a cause of the three (3) sideswipe crashes that had occurred at the intersection as all crashes of this manner occurred before the intersection reconstruction. Since reconstruction, there have been five (5) reportable crashes; including three (3) angle crashes and one (1) head-on crash. Crash narratives indicate that two (2) of these involved vehicles turning left from Dascomb Road westbound and two (2) others involving vehicles turning left from Shawsheen Street northbound.

The intersection of Dascomb Road / HP Site Driveway experienced an average of more than three (3.71) crashes per year over the seven-year study period. The crash rate for this intersection is significantly less than the statewide and district-wide averages for unsignalized intersections. Ten (10) of the crashes were angled type crashes; which including five (5) crashes involving a vehicle turning left from Dascomb Road onto the HP Driveway and five (5) crashes involving a vehicle turning out of the HP Driveway. Thirteen (13) of the reported crashes occurred during the morning commuter peak period which is consistent with the commuter nature of the HP Site Driveway. This time period provides significant levels of traffic along the Dascomb Road corridor which may be a cause of rear-end and angled crashes; where

stop-and-go vehicles and a lack of by-pass capabilities develop the condition for these crash types.

The intersection of Dascomb Road / Smith Way experienced an average of just more than one (1.14) crash per year over the seven-year study period. The crash rate for this intersection is significantly less than the statewide and district-wide averages for unsignalized intersections. Half (4 of 8) of the crashes were rear-end crashes, which may be the result of vehicles stopping unexpectedly along Dascomb Road to allow vehicles to exit from Smith Way (courtesy gaps). With the low level of crashes noted at this intersection, there is no apparent crash trend. This intersection is expected to be a primary access/egress point for the proposed Dascomb Road Project.

The intersection of Dascomb Road / Frontage Road experienced an average of more than fourteen (14.43) crashes per year during the seven-year study period. The crash rate for this intersection is significantly greater than the statewide and district-wide averages for signalized intersections. The intersection currently holds an HSIP-eligible high crash location designation. Approximately half (51 of 101) of the reported crashes were designated as angle crashes, which are typical of signalized intersections and channelized right-turn movements under yield-control. Approximately one-third (37 of 101) of the reported crashes were designated as rear-end crashes, which are also typical at signalized intersections. The high rate of rear-end crashes may be a result of insufficient clearance time which is shorter than typical standards. The existing clearance interval for the eastbound-westbound approaches on Dascomb Road is currently five-seconds (three-seconds yellow and two-seconds all-red). Based on the existing geometry and the travel speeds at the intersection, the yellow time along Dascomb Road should be increased to 3.5-seconds. Forty percent of the intersection crashes occurred during the commuter peak periods where the volume through the intersection is at its peak. More than one-third (34%) of crashes at the intersection had resulted in a non-fatal injury. Further information related to crash trends at this intersection is described in the RSA provided in Appendix E.

The intersection of Dascomb Road / I-93 NB Ramps experienced an average of approximately five (4.71) crashes per year during the seven-year study period. The crash rate for this intersection is slightly less than the statewide and district-wide averages for unsignalized intersections. The intersection currently holds an HSIP-eligible high crash location designation. Two-thirds (22 of 33) of the crashes were designated as angle crashes, which are typical at unsignalized intersections and channelized right-turn movements. Many vehicles along this approach are dependent on smaller gaps in the Dascomb Road traffic stream as a result of excessive queuing during both commuter peak and off-peak hours. The high rate of angle crashes may be a result of drivers misjudging the gap in traffic when attempting to access Dascomb Road from the half-cloverleaf ramp intersection. Thirty percent of crashes at the intersection had resulted in a non-fatal injury. Further information related to crash trends at this intersection is described in the RSA provided in Appendix E. Additional crash reports for this intersection may become available from MassDOT and the Massachusetts State Police as part of the MEPA review process.

The intersection of Frontage Road / I-93 SB Ramps experienced an average of less than one (0.71) crash per year during the seven-year study period. The crash rate for this intersection is significantly less than the statewide and district-wide averages for unsignalized intersections.

Eighty (4 of 5) of the reported crashes were designated as angle crashes, which are typical at unsignalized intersections and channelized right-turn movements. With the low level of crashes noted at this intersection, there is no apparent crash trend. Additional crash reports for this intersection may become available from MassDOT and the Massachusetts State Police as part of the MEPA review process.

Crash data and reports for the intersection of Dascomb Road / Lovejoy Road / Acorn Drive were compiled for the years 2015 and 2017 only. The intersection of Dascomb Road / Lovejoy Road / Acorn Drive experienced an average of one (1.00) crash per year during the three-year study period. The crash rate for this intersection is significantly less than the statewide and district-wide averages for signalized intersections. Of the two (2) crashes where full crash reports were provided, both were related to snow and/or white out conditions at the intersection. The MassDOT Crash Portal indicates that up to two (2) additional crashes may have occurred at this intersection within the study period based on geocoded location; however the Town Police Department has not provided additional reports. Regardless of additional crash reports, the low level of crashes noted at this intersection depict no apparent crash trend.

Crash data and reports for the intersection of Dascomb Road / Clark Road / Bannister Road were compiled for the years 2015 and 2017 only. The intersection of Dascomb Road / Clark Road / Bannister Road experienced only one (1) reported crash during the three-year study period. The crash rate for this intersection is significantly less than the statewide and district-wide averages for signalized intersections. The MassDOT Crash Portal indicates that up to four (4) additional crashes may have occurred at this intersection within the study period based on geocoded location; however the Town Police Department has not provided additional reports. Regardless of additional crash reports, the low level of crashes noted at this intersection depict no apparent crash trend.

Crash data and reports for the intersection of Dascomb Road / Andover Street were compiled for the years 2015 and 2017 only. The intersection of Dascomb Road / Andover Street experienced more than six (6.66) crash per year during the three-year study period. The crash rate for this intersection is significantly higher than the statewide and district-wide averages for signalized intersections. Forty percent (8 of 20) of crashes at the intersection were angled crashes; including three (3) involving a vehicle exiting Dascomb Road and two (2) involving a vehicle turning left onto Dascomb Road. Two of these angled crashes involved a vehicle exiting the nursing home driveway opposite Dascomb Road. Sixty percent (12 of 20) crashes at the intersection occurred during the commuter peak periods. Three (3) crashes at this intersection were head-on crashes.

Sight Distance Measurements

TEC measured the available sight distances at the various stop-controlled approaches of the study area intersections. The available sight lines were compared to minimum requirements established by the American Association of State Highway and Transportation Officials (AASHTO).

Sight distance represents the length of roadway that is visible to a driver traveling within the roadway. Two types of sight distance are typically evaluated for driveways and intersections: stopping sight distance (SSD) and intersection sight distance (ISD). SSD is the minimum

distance required for a driver traveling along a roadway to perceive an object in the roadway and stop safely in advance of the object when traveling on a wet pavement surface. SSD is measured from an eye height of 3.5-feet to an object height of 2-feet above the ground, which is equivalent to a driver viewing the taillight of a vehicle ahead. SSD is measured along the centerline of the travel lane approaching the driveway or intersection.

ISD represents the length of the roadway visible to a driver waiting to exit a driveway or minor street. Minimum ISD requirements are based on the distance required for a driver to exit a minor street onto a major street without requiring an approaching vehicle to reduce its speed from the design speed to less than 70 percent of the design speed. ISD is measured from an eye height of 3.5-feet to an object height of 3.5-feet and is measured from a distance 14.5-feet beyond the edge of the travel-way of the major roadway to represent a driver waiting to exit a driveway or minor roadway.

SSD is typically considered the critical sight distance, as it represents the minimum distance required for safe stopping, while ISD represents an acceptable speed reduction for approaching vehicles. The ISD, however, must be at least equal to the minimum required SSD in order to prevent a driver from entering the roadway when an approaching vehicle is too close to safely stop. The guidance provided by AASHTO states:

> *"If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road."*

Tables 3 and 4 provide a summary of the available SSD and ISD at the existing intersection locations, respectively.

Table 3 – Existing Stopping Sight Distance Measurements

Approach / Direction	Operating Speed [a]	AASHTO Recommended Minimum	Measured Stopping Sight Distance
Dascomb Road at HP Driveway:			
Dascomb Road westbound	42 MPH	325 FT	> 500 FT
Dascomb Road eastbound	37 MPH	260 FT	> 500 FT
Dascomb Road at Smith Way:			
Dascomb Road westbound	42 MPH	325 FT	> 500 FT
Dascomb Road eastbound	37 MPH	260 FT	> 500 FT
Dascomb Road at I-93 NB Ramps:			
Dascomb Road westbound	41 MPH	305 FT	> 500 FT
Dascomb Road eastbound	38 MPH	270 FT	> 500 FT
Dascomb Road at Clark Road:			
Dascomb Road westbound	38 MPH	270 FT	> 500 FT
Dascomb Road eastbound	39 MPH	280 FT	> 500 FT

[a] Operating speeds calculated from ATR counts on September 12 through September 14, 2018
[b] Assumed operating speed calculated as speed limit plus 7 mph

Table 3 (Continued) – Existing Stopping Sight Distance Measurements

Approach / Direction	Operating Speed [a]	AASHTO Recommended Minimum	Measured Stopping Sight Distance
Andover Street at Dascomb Road:			
Andover Street southbound	37 MPH [b]	260 FT	> 500 FT
Andover Street northbound	37 MPH [b]	260 FT	475 FT
Frontage Road at I-93 SB Ramps:			
Frontage Road southbound	38 MPH	270 FT	> 500 FT
Frontage Road northbound	37 MPH	260 FT	> 500 FT

[a] Operating speeds calculated from ATR counts on September 12 through September 14, 2018
[b] Assumed operating speed calculated as speed limit plus 7 mph

Table 4 – Existing Intersection Sight Distance Measurements

Approach / Direction	Design Speed [a]	AASHTO Desired Minimum [b]	AASHTO Recommended Minimum [SSD]	Measured Intersection Sight Distance
Dascomb Road at HP Driveway:				
East of HP Driveway	42 MPH	465 FT	325 FT	> 500 FT
West of HP Driveway	37 MPH	410 FT	260 FT	300 FT
Dascomb Road at Smith Way:				
East of Smith Way	42 MPH	465 FT	325 FT	> 500 FT
West of Smith Way	37 MPH	410 FT	260 FT	390 FT [c]
Dascomb Road at I-93 NB Ramps:				
East of I-93 NB Ramps	41 MPH	455 FT	305 FT	> 500 FT
West of I-93 NB Ramps	38 MPH	420 FT	270 FT	> 500 FT
Dascomb Road at Clark Road:				
East of Clark Road	38 MPH	420 FT	270 FT	430 FT
West of Clark Road	39 MPH	430 FT	280 FT	> 500 FT
Andover Street at Dascomb Road:				
North of Dascomb Road	37 MPH [b]	410 FT	260 FT	> 500 FT
South of Dascomb Road	37 MPH [b]	410 FT	260 FT	475 FT
Frontage Road at I-93 SB Ramps:				
North of I-93 SB Ramps	38 MPH	420 FT	270 FT	> 500 FT
South of I-93 SB Ramps	37 MPH	410 FT	260 FT	> 500 FT

[a] Operating speeds calculated from ATR counts on September 12 through September 14, 2018
[b] ISD calculated using time gap (t_g) at design speed of 6.5 seconds for passenger car right-turn and 7.5 seconds for passenger car left-turn
[c] ISD may change based on vegetation level on southwest intersection corner

As shown in Table 3, the SSD at all study area unsignalized intersections are well in excess of AASHTO minimum recommendations. Similarly, ISD at all study area unsignalized intersections are well in excess of AASHTO minimum recommendations; however sight lines at multiple locations do not meet desired recommendations for the operating speeds along the mainline corridors. For those locations where ISD is below desired recommendations, sight lines are obstructed by vegetation for both the HP Driveway and Smith Way looking west along Dascomb Road.

III. FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2026, which reflects an 8-year planning horizon from the planned date of submission for permitting. The traffic conditions for the year 2026, under No-Build conditions, were developed to document the operating conditions independent of the proposed project; including all existing traffic and new traffic resulting from background growth. Anticipated site-generated traffic volumes for the proposed redevelopment were superimposed upon the No-Build traffic networks to reflect the Build conditions with the proposed project.

BACKGROUND TRAFFIC GROWTH

Traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. Traffic engineers frequently employ an annual percentage increase in traffic growth, which is applied to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a greater or a lesser rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, the potential growth in population and development external to the study area are not accounted for in the traffic projections.

To provide a conservative analysis framework, both procedures were considered.

General Background Growth

Traffic-volume data compiled from the adjacent MassDOT permanent count station[3] and from historic 2016 traffic counts along Frontage Road[4] were reviewed to determine traffic growth trends. Based on the traffic-volume data, traffic-volumes in the area have been increasing at a rate of 1.0 percent per year since 2008. To provide a conservative analysis scenario, a 1.0 percent per year compounded annual background traffic growth rate was used to account for

[3] MassDOT Permanent Count Station 5022 – Andover – I-93 North, north of Route 125
[4] ATR Counts – Andover – Frontage Road, south of I-93 SB Ramps (Oct 2016 to Sept 2018)

potential future traffic growth external to the study area and any presently unforeseen or unpermitted development. MassDOT historic count station data have been included in Appendix G. 2016 traffic volume counts along Frontage Road have been included in Appendix H.

Specific Developments by Others

TEC coordinated with the Town of Tewksbury Community Development Department and Town of Andover Planning Department to identify nearby private and public development projects in the vicinity of the study area that are either in the planning process or were recently approved by the municipal Planning Boards. After discussions with Town officials and a review of recently approved projects, there are no projects that are anticipated to contribute significant additional traffic volumes to the study area.

Although no specific developments were identified, the off-site improvements along the Dascomb Road and Frontage Road corridors have been designed to carry additional reserve capacity for potential future expansion of projects along the immediate Dascomb Road and Frontage Road area. The improvements have also been designed to not preclude additional transportation improvement measures should additional measures be warranted as mitigation for subsequent projects.

Reoccupancy of Previously Permitted Office / Industrial Space

The existing site currently consists of ±188,960 SF of mixed office and industrial uses with associated parking. The existing office and industrial space on-site are currently underutilized. At the time of the 2018 traffic-volume counts, the site was currently occupied by a single office tenant, utilizing 27,300 SF of office space on-site with no other significant traffic generating uses. Trips generated by this office space are included in the traffic volumes presented in this study.

The remainder of the existing development, ±161,660 SF of mixed office and industrial space, is currently not generating any significant traffic but could be reoccupied "by-right" by a similar land use without substantial permitting. The TIAPS will not include a credit for reoccupancy trip generation as part of the No-Build condition.

2026 NO-BUILD TRAFFIC VOLUMES

The 2026 No-Build weekday morning, weekday evening, and Saturday midday peak-hour traffic-volume networks were developed by applying the 1.0 percent per year compounded annual background traffic growth rate on the 2018 Existing Condition peak-hour traffic volumes over the 8-year design horizon. The resulting 2026 No-Build weekday morning, weekday evening, and Saturday midday peak-hour traffic-volume networks are illustrated in Figure 3.

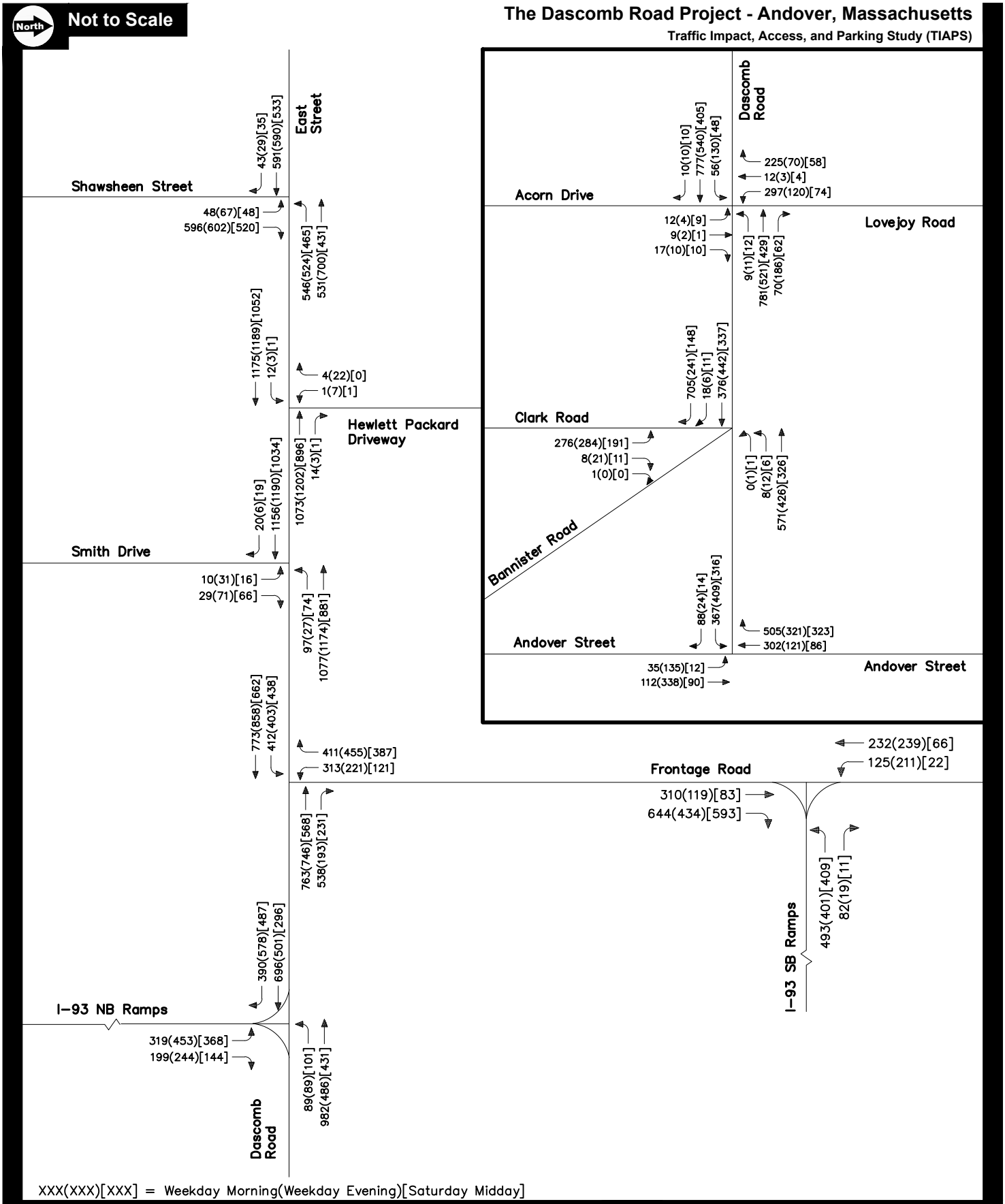

Figure 3

2026 No-Build Conditions
Weekday Morning, Weekday Evening and Saturday Midday
Peak Hour Traffic Volumes

The Engineering Corp

SITE GENERATED TRAFFIC

The Dascomb Road Project will consist of razing the existing ±180,640 SF of underutilized office and industrial space. The adjacent Restaurant Depot facility will remain in addition to the proposed redevelopment. For the purposes of this study no credit was taken for the underutilized industrial space on the existing site. The traffic volumes currently accessing/egressing Smith Way within the existing traffic counts are assumed to access/egress Smith Way under the proposed mixed-use redevelopment. Credit for the single office tenant is described in this section.

Upon razing the existing uses, the Dascomb Road Project proposed building program consists of constructing a 524,000 SF mixed-use development; comprised of a 100-room business-centric hotel; 293,000 SF of office space; 80,000 SF of general retail space; a 30,000 SF fitness center; a 35,000 SF neighborhood grocery store; and 20,000 SF of restaurant space (assumes 10,000 SF of quality restaurant and 10,000 SF of a high-turnover sit-down restaurant). TEC estimated the site-generated traffic based on industry standard trip rates published in the Institute of Transportation Engineers (ITE) publication, *Trip Generation, 10th Edition* for Land Use Code (LUC) 312 – Business Hotel, LUC 492 – Health/Fitness Club, LUC 710 – General Office Building, LUC 820 – Shopping Center, LUC 931 – Quality Restaurant, and LUC 932 – High-Turnover (Sit-Down) Restaurant.

Retail / Shopping Center Lane Use Code

Two land uses as defined in the proposed building program have been combined under LUC 820 – Shopping Center. This includes the 35,000 SF neighborhood grocery store and the 80,000 SF of general retail space. This has been completed based on the description of LUC 820 – Shopping Centers in the industry standard publication, ITE's *Trip Generation, 10h Edition*:

> *"Shopping centers; including neighborhood centers, community centers, regional centers, and super regional centers; were surveyed for this land use. Some of these centers contained non-merchandising facilities such as office buildings, movie theaters, restaurants, post offices, banks, health clubs, and recreational facilities (for example, ice skating rinks or indoor miniature golf courses)."*

As a result, the shopping center land use has been combined to include each of the above-mentioned land used to be comprised of 115,000 SF. As the separate land uses have been combined, no credit for internal capture rate has been assessed between these particular uses. Should the individual land uses be broken out separately, an internal capture rate applied to each of the land uses would generally be comparable to the combination of the land uses under LUC 820 – Shopping Center. Conservatively, TEC has not included the restaurant land uses in this combination as they are generally expected to generate a higher trip rate as compared to LUC 820 – Shopping Center.

Trip Generation Credits

Existing Office Space

The site currently houses a single office tenant within the existing #146 Dascomb Road building; occupying 27,300 SF of space on the buildings ground floor. The existing site-generated traffic for the office land use was estimated based on industry standard trip rates published in the ITE publication, *Trip Generation, 10th Edition* for LUC 710 – General Office Building. Trips associated with the existing office land use were credited from the overall proposed office space to be constructed as part of the Dascomb Road Project. As the existing trips do not share with other uses on-site and no dedicate transit options are generally available, the credit for these office trips was superimposed on the external primary trip for the entire proposed project. The total existing site generated traffic is depicted in Table 5.

Internal Capture

It is reasonable to expect that some site-generated trips to the site will be shared amongst multiple land uses. For example, someone traveling to the offices may choose to shop at the retail or eat at a restaurant within the Project site. Therefore, a reduction in the overall external trips experienced at the site driveways can be anticipated as a result of multi-use, or shared, trips that include stops at more than one use on the site. Based on information contained in the industry standard ITE publication *Trip Generation Handbook, 3rd Edition*, multi-use trips were assigned for trip sharing amongst the hotel, fitness center, office, retail, and restaurant land uses. Credit was not taken for internal capture between the proposed uses and the existing land uses along Smith Way (Restaurant Depot, California Paints, and Mayo Medical Laboratories). Therefore, it can be assumed that the internal capture rate is conservative as it is expected that some vehicle trips to and from the existing land uses may visit parts of the proposed redevelopment, most notably the restaurant and retail uses.

As previously noted, no credit for internal capture rate has been assessed between the several land uses combined as part of LUC 820 – Shopping Center; or between the two separate restaurant land uses. For example, there is no multi-use trips assessed between the 80,000 SF retail space to/from the 35,000 SF neighborhood grocery store; or between the high-turnover restaurant and the quality restaurant. The multi-use trip generation worksheets are included in Appendix I.

Transit Trips

Per the 2010-2014 American Community Survey 5-Year Estimates provided by the U.S. Census Bureau, five (5) percent of Andover residents utilize public transportation to commute to work. A Park-and-Ride facility for carpooling and bus service is located immediately across from the Project site along Frontage Road, the Ballardvale MBTA Commuter Rail Station along the MBTA Haverhill Commuter Rail Line is located only 1.6 miles east of the Project site, and the Andover MBTA Commuter Rail Station along the MBTA Haverhill Commuter Rail Line is located only 3.2 miles east of the Project site. Furthermore, the Applicant is actively seeking a bus route extension to provide both MVRTA and LRTA bus service for the Dascomb Road Project site, with connections to/from the Ballardvale MBTA Commuter Rail Station and the Andover MBTA Commuter Rail Station. Due to these factors, a five (5) percent transit trip credit was applied to

the hotel and general office land uses. The transit credit was not applied to the retail and restaurant uses as these uses generally do not experience the level of public transportation use in comparison.

Pass-by Traffic

Not all of the trips generated by the proposed mixed-use redevelopment will be new to the roadway network. Many of the trips generated by the proposed redevelopment are already present in the existing traffic flow passing by the site and may decide to visit the site on their way to another destination. For example, a driver travelling along Dascomb Road on the way home from work in Boston may stop at the on-site neighborhood grocery store and then continue his/her trip home. These vehicle trips are known as "pass-by" trips and are subtracted from the total trips to calculate the total primary (or "new") trips that affect the volume of traffic within the study area away from the site. Based on information contained in the industry standard ITE publication *Trip Generation Handbook, 3rd Edition*, approximately 26 to 34 percent of the general retail / shopping center site-generated traffic, 44 percent of quality restaurant site-generated traffic, and 43 percent of high-turnover (sit-down) restaurant site-generated traffic are expected to be pass-by traffic.

Table 5 provides a summary of the resulting trip generation estimate separated by LUC and the total trip generation separated by multi-use, transit, pass-by, and primary trips. The detailed trip generation calculation worksheets are provided in Appendix I.

As shown in Table 5, the proposed mixed-use redevelopment is anticipated to generate approximately 8,384 new vehicle trips (4,192 entering and 4,192 exiting) during the average weekday, with 410 new vehicle trips (324 entering and 86 exiting) during the weekday morning peak hour and 744 new vehicle trips (303 entering and 441 exiting) during the weekday evening peak hour. Approximately 8,846 new vehicle trips (4,423 entering and 4,423 exiting) are anticipated during the average Saturday, with 738 new vehicle trips (396 entering and 342 exiting) during the Saturday midday peak hour.

As this project is anticipated to generate more than 3,000 new VPD along the adjacent roadway network, will include the construction of more than 1,000 new parking spaces, directly abuts state-owned property, and provides direct access/egress to a state-owned roadway, the project will require review by the MEPA office in the form of an ENF and mandatory EIR.

Table 5 - Trip Generation Summary by Land Use Code

Time Period	Business Hotel (LUC 312)	Fitness Center (LUC 492)	General Office (LUC 710)	Shopping Center (LUC 820)	Quality Restaurant (LUC 931)	High-Turnover Restaurant (LUC 932)	Total Trips	Multi-Use Trips	Transit Trips	**External Pass-by Trips**	External Primary Trips	Credit for Existing Office Trips	**NEW External Primary Trips**
Weekday Daily													
IN	221	494	1,505	3,306	419	561	6,506	1,057	86	**1,038**	4,325	133	**4,192**
OUT	221	494	1,505	3,306	419	561	6,506	1,057	86	**1,038**	4,325	133	**4,192**
TOTAL	442	988	3,010	6,612	838	1,122	13,012	2,114	172	**2,076**	8,650	266	**8,384**
Weekday Morning													
IN	16	20	260	130	4	54	484	84	14	**34**	352	28	**324**
OUT	23	19	42	79	3	45	211	84	3	**34**	90	4	**86**
TOTAL	39	39	302	209	7	99	695	168	17	**68**	442	32	**410**
Weekday Evening													
IN	18	64	51	289	52	61	535	113	4	**110**	308	5	**303**
OUT	14	48	265	314	26	37	704	113	14	**110**	467	26	**441**
TOTAL	32	112	316	603	78	98	1,239	226	18	**220**	775	31	**744**
Saturday Daily													
IN	290	313	324	4,860	450	612	6,849	875	31	**1,490**	4,453	30	**4,423**
OUT	290	313	324	4,860	450	612	6,849	875	31	**1,490**	4,453	30	**4,423**
TOTAL	580	626	648	9,720	900	1,224	13,698	1,750	62	**2,980**	8,906	60	**8,846**
Saturday Midday													
IN	22	48	84	359	63	57	633	114	5	**110**	404	8	**396**
OUT	24	50	72	332	44	55	577	114	5	**110**	348	6	**342**
TOTAL	46	98	156	691	107	112	1,210	228	10	**220**	752	14	**738**

TRIP DISTRIBUTION

Site Access and Egress

The existing #146 Dascomb Road site is currently accessed via five (5) site driveways along the easterly side of Smith Way, south of Dascomb Road. The Project proposes to modify the access/egress to the property, providing two (2) full-access/egress driveways, a shared full-access/egress driveway with Restaurant Depot, and a loading dock driveway along the easterly side of Smith Way. All full-access/egress driveways for the Restaurant Depot facility along Smith Way will be retained. Additionally, a full-access/full-egress driveway for the proposed site will be provided immediately opposite Frontage Road at the signalized intersection on Dascomb Road.

Study Area Trip Distribution Models

Commuter Office Land Uses

The distribution of office site-generated traffic volumes were based on gravity models using 2009-2013 U.S. Census Bureau Journey-to-Work/Home data (current complete data for public use) for the Town of Andover. The office distribution models the commutes of workers to Andover from the top 27 residential cities and towns, which represent approximately 70 percent of total Andover workforce. The top 70 percent of workforce communities generally allow for an approximation of overall distribution of traffic. Additional communities at this level each contribute less than 0.74% of the workforce each which is deemed to not change the distribution of traffic calculations significantly.

Retail, Fitness Center, and Restaurant Land Uses

The distribution of retail and restaurant site-generated traffic volumes was based on a gravity model using 2017 U.S. Census Bureau estimated population data for the surrounding communities within a 7.5-mile radius of the Project site. The retail, fitness center, and restaurant distribution models the commutes of residents from the Town of Andover and fourteen (14) adjacent communities to/from the Project site after weighting each community based on total population, travel-time to/from the Project site, and the presence of competing opportunities. Communities with competing opportunities within or adjacent to the 7.5-mile radius were noted as Woburn, Burlington, Lowell, Salem NH; as each of these communities provide heavy office, retail, and restaurant uses. The distribution of retail, fitness center, and restaurant pass-by trips was based on existing travel patterns along the streets immediately surrounding the site.

Hotel Land Use

The site-generated traffic for the hotel land use was anticipated to generate trips an overwhelming majority of its trip generation to/from I-93. This is based on the low level of nearby commercial land uses to generate hotel-type traffic in the immediate project vicinity as tourists and business travelers will primarily utilize I-93 to access the hotel. It is anticipated that 55 percent of hotel traffic will be generated to/from the north along I-93, 35 percent

to/from the south along I-93, with the remaining 10 percent to/from the secondary roadways leading towards the site.

Trip Distribution Summary

The resulting primary trip distributions for the business hotel, office, fitness center, retail, and restaurant are shown in Table 6. Trip distribution gravity models are included in Appendix J. The weekday morning, weekday evening, and Saturday midday site-generated traffic-volume networks are presented in Figure 4, Figure 5, and Figure 6, respectively.

Table 6 – Trip Distribution Summary

Direction	Business Hotel (LUC 312)	General Office Building (LUC 710)	Retail (LUC 820), Fitness (LUC 492), and Restaurant (LUC 931, 932)
Interstate 93 to/from North	55%	55%	32%
Interstate 93 to/from South	35%	15%	13%
Andover Street to/from East	3%	13%	15%
Clark Road to/from South	1%	6%	7%
Lovejoy Road to/from North	1%	4%	5%
Frontage Street to/from North	-	2%	3%
East Street to/from West	3%	3%	11%
Shawsheen Street to/from South	2%	2%	14%
Total	**100%**	**100%**	**100%**

Access to the site will be provided via multiple driveway locations along Smith Way and a fourth intersection leg at the Dascomb Road / Frontage Road intersection. Trip distribution to/from these driveway locations was estimated based on the most convenient entering and exiting maneuver for drivers along Dascomb Road and Frontage Road. Based on the location of the hotel building, all site-generated traffic to/from the hotel was projection to enter and exit the site via the Dascomb Road / Frontage Road intersection driveway. For the remainder of the site's land uses, parking is scattered between surface level parking and structured parking with access to these parking fields and structures off both Smith Way and Dascomb Road, opposite Frontage Road. TEC has therefore assumed that two-thirds of retail, fitness center, restaurant, and office related traffic will enter/exit the site at the first available access/egress point of Smith Way or the driveway opposite Frontage Road. The remaining one-third would enter/exit via the alternative access/egress point.

2026 BUILD TRAFFIC VOLUMES

The 2026 Build Condition traffic-volume networks consist of the 2026 No-Build traffic volumes with the addition of the site-generated traffic for the proposed redevelopment. The resulting 2026 Build weekday morning, weekday evening, and Saturday midday peak-hour traffic-volume networks are presented in Figure 7.

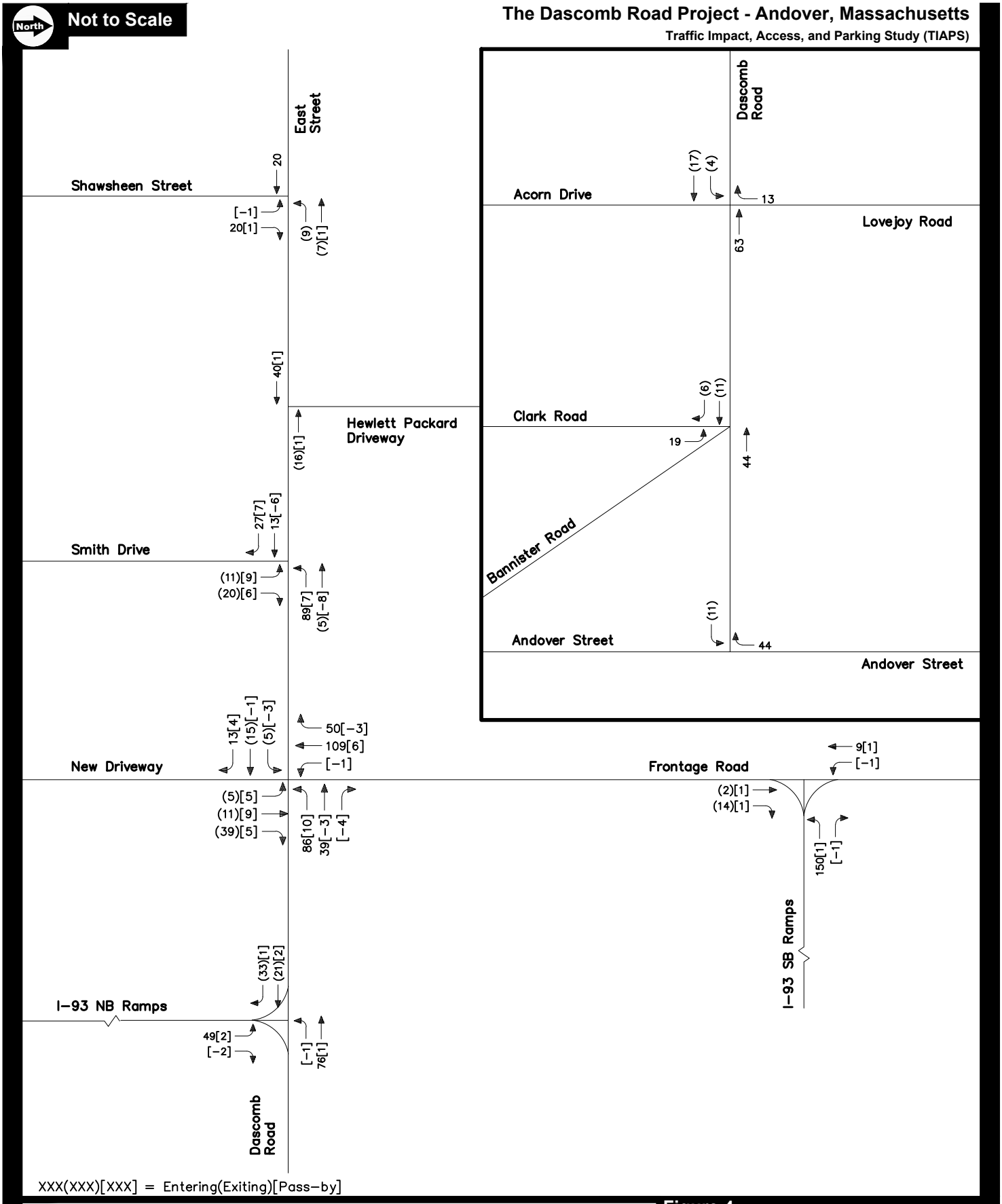

Figure 4

Site-Generated Traffic
Weekday Morning
Peak Hour Traffic Volumes

The Engineering Corp

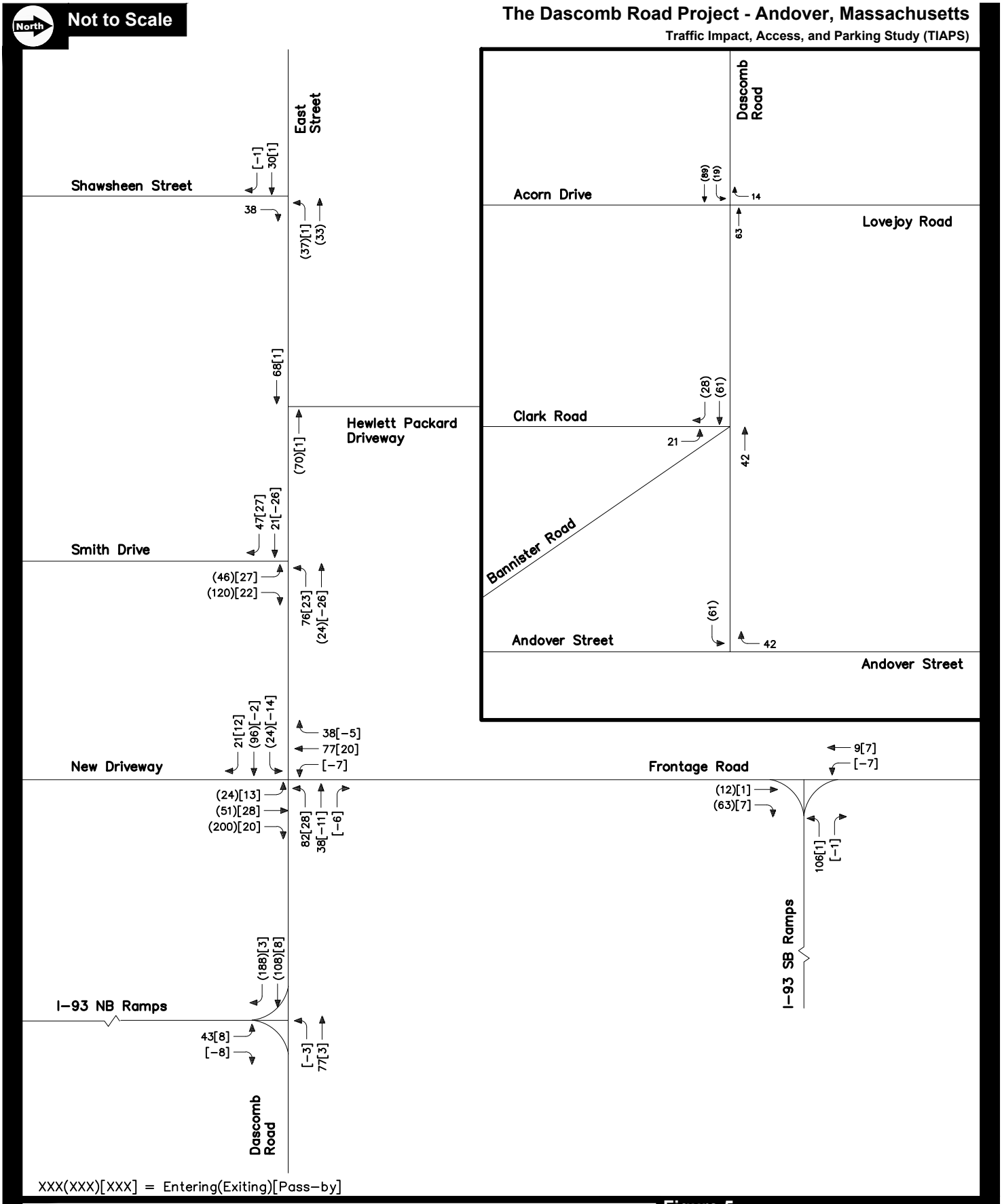

Figure 5

Site-Generated Traffic
Weekday Evening
Peak Hour Traffic Volumes

The Engineering Corp

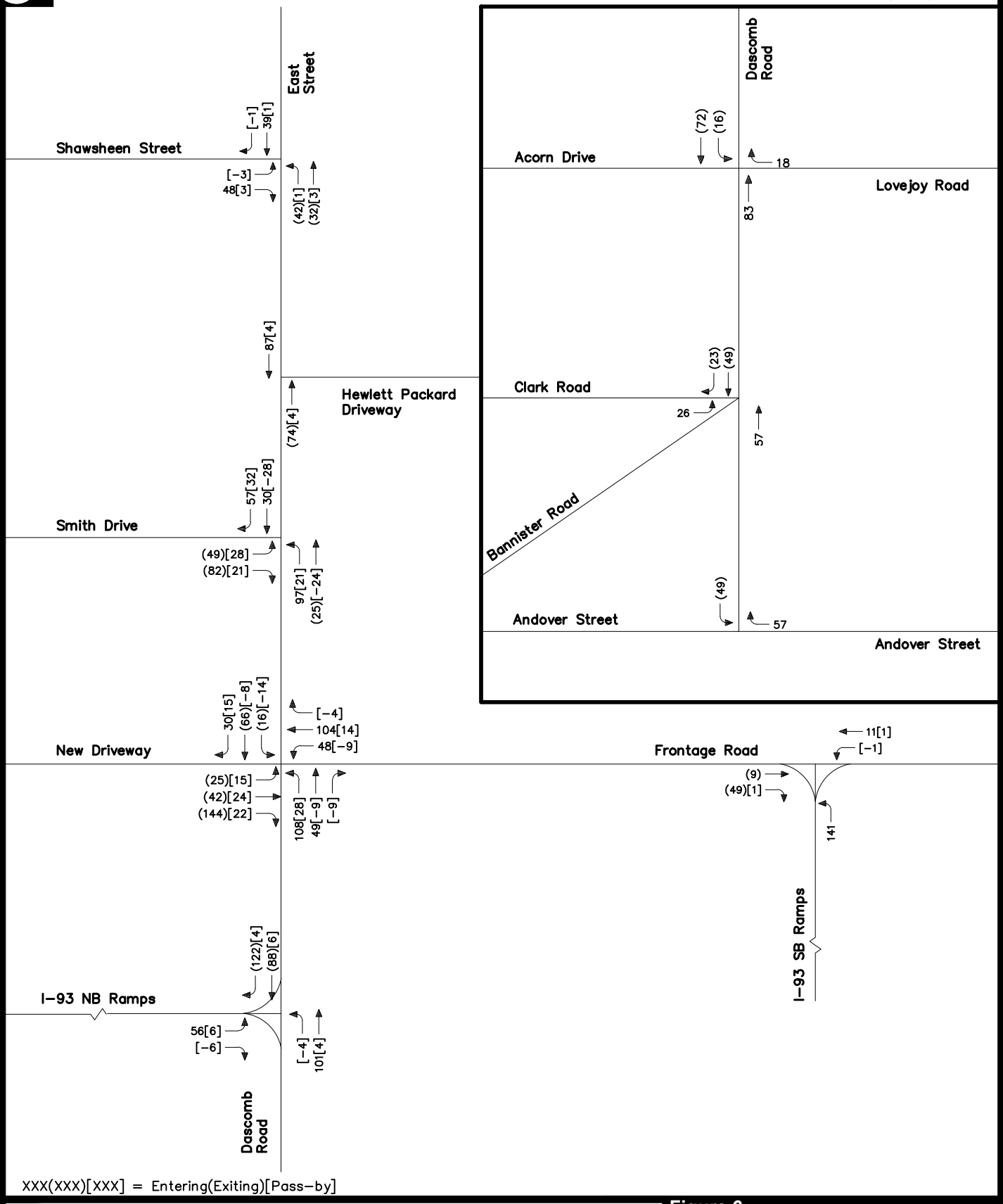

Figure 6

Site-Generated Traffic
Saturday Midday
Peak Hour Traffic Volumes

The Engineering Corp

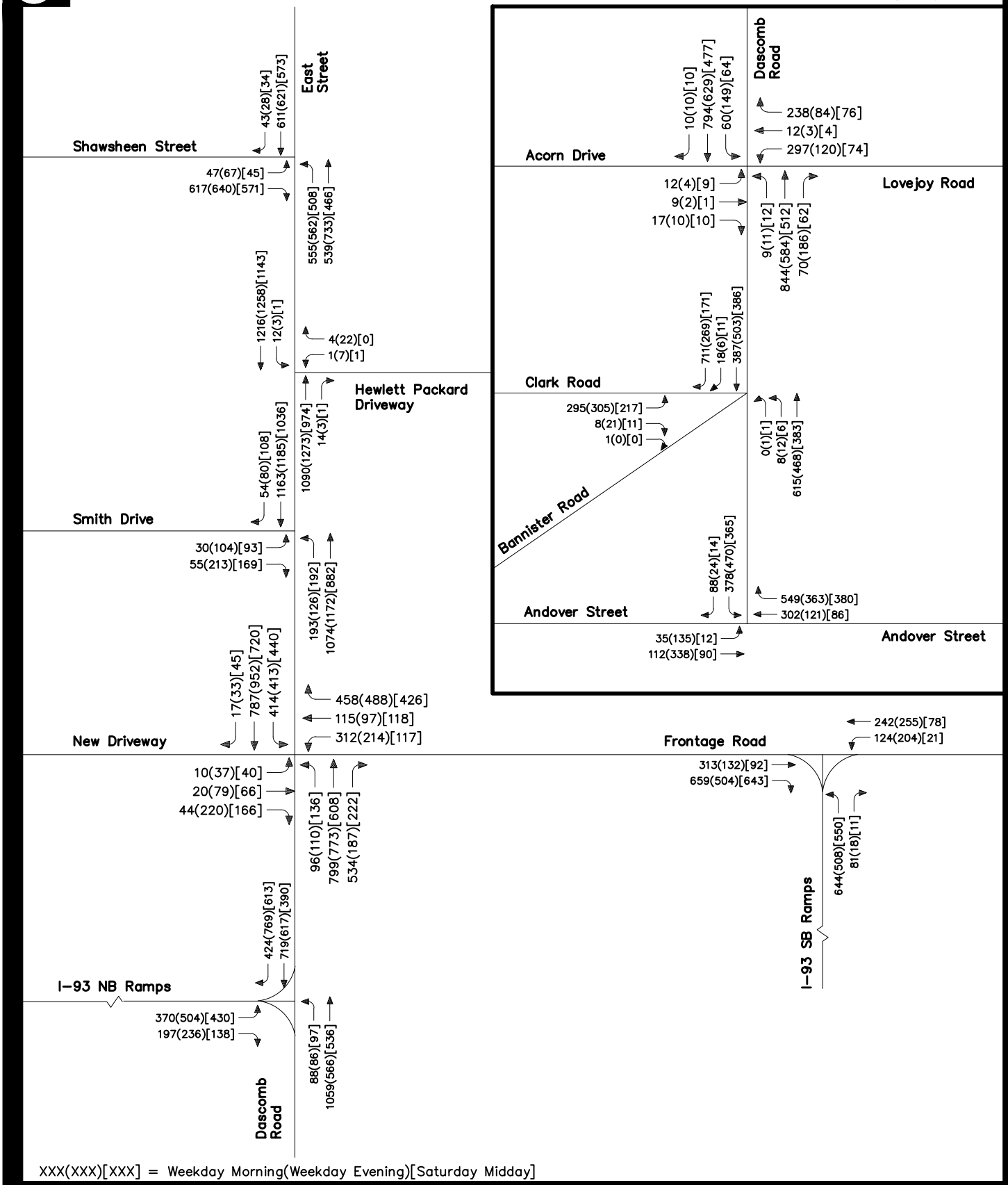

Figure 7

2026 Build Conditions
Weekday Morning, Weekday Evening and Saturday Midday
Peak Hour Traffic Volumes

The Engineering Corp

IV. TRAFFIC WARRANTS

TRAFFIC SIGNAL WARRANTS

Traffic signal warrant analyses were conducted for four intersections within the study area; including, Dascomb Road / Smith Way, Dascomb Road / I-93 NB Ramps, Frontage Road / I-93 SB Ramps, and Dascomb Road / Clark Road / Bannister Road to document the warranting condition should a traffic signal be recommended as mitigation for the project. TEC performed the traffic signal warrant analyses based on criteria contained within the *Manual on Uniform Traffic Control Devices* (*MUTCD*)[5]. The *MUTCD* contains eight warrants for evaluating the need for installation of a traffic signal. The two multi-hour volume-related warrants were evaluated to determine whether a traffic signal is warranted at the four intersections described above. These warrants include:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume

For the purposes of this analysis, TEC utilized 12-hour TMCs conducted at the subject intersections to assess the warranting condition over a typical weekday.

Site-generated traffic volumes to be utilized in the traffic signal warrant analyses were assessed based on trip generation rates obtained in the ITE publication, *Trip Generation, 10th Edition*. As many hours during the day are not represented based on the ITE trip generation data, TEC projected site generated traffic onto the non-peak hours based on engineering judgement for each land use. For example, the office land uses were projected to generate a small amount of traffic outside the commuter peak and lunch time periods. For retail land uses, the distribution was based upon LUC 820 – Shopping Center Table 1 (page 1558) of the previous ITE publication, *Trip Generation, 9th Edition.*

Dascomb Road / Smith Way

For the signal warrant analysis of the Dascomb Road / Smith Way intersection, the Smith Way northbound approach was considered the "minor street" volume, while the opposing Dascomb

[5] Manual on Uniform Traffic Control Devices (MUTCD) – Federal Highway Administration / U.S. DOT – 2009 Edition.

Road eastbound and westbound approaches were considered to be the "major street". Traffic volumes utilized in the traffic signal warrant were conducted during a 12-hour TMC on Thursday, September 13 and 20, 2018. Based on the existing traffic volumes and the addition of site-generated trips, the intersection of Dascomb Road / Smith Way meets the criteria for Warrant 1 (Conditions A and B) and Warrant 2. Therefore, installation of a traffic signal at this intersection is recommended as part of the overall improvements to the intersection. The signal warrant analysis worksheets are included in Appendix K.

Dascomb Road / Interstate 93 NB Ramps

For the traffic signal warrant analysis of the Dascomb Road / I-93 NB Ramps intersection, the I-93 NB Ramps northbound approach was considered the "minor street" volume, while the opposing Dascomb Road eastbound and westbound approaches were considered to be the "major street". Traffic volumes utilized in the traffic signal warrant were conducted during a 12-hour TMC on Thursday, September 13 and 20, 2018. For the purposes of this analysis, right-turns exiting the I-93 NB ramp and right-turns along Dascomb Road eastbound were removed from the traffic counts as they are able to travel relatively free-flowing during the projected signalized condition.

Based on the existing traffic volumes and the addition of site-generated trips, the intersection of Dascomb Road / I-93 NB Ramps meets the criteria for Warrant 1 (Conditions A and B) and Warrant 2. As a traffic signal is warranted and due to the operating and safety conditions of the intersection without a traffic signal in place, installation of a traffic signal at this intersection is recommended as part of the off-site corridor improvements along Dascomb Road. The signal warrant analysis worksheets are included in Appendix K.

Dascomb Road / Clark Road / Bannister Road

For the traffic signal warrant analysis of the Dascomb Road / Clark Road / Bannister Road intersection, the I Clark Road northbound approach was considered the "minor street" volume, while the opposing Dascomb Road eastbound and westbound approaches were considered to be the "major street". Traffic volumes utilized in the traffic signal warrant were conducted during a 12-hour TMC on Thursday, September 13 and 20, 2018. Based on the existing traffic volumes and the addition of site-generated trips, the intersection of Dascomb Road / Clark Road / Bannister Road meets the criteria for Warrant 1 (Conditions A and B) and Warrant 2. Warrants 1 and 2 are both satisfied under existing condition, prior to the additional traffic to be generated by the Project. Although warranted, a traffic signal is not proposed to be part of the off-site improvements for the project. Signalization for this location would be further evaluated by the Town based on public feedback and the desire to install additional signalization along the Dascomb Road corridor. The signal warrant analysis worksheets are included in Appendix K.

Frontage Road / Interstate 93 SB Ramps

For the signal warrant analysis of the Frontage Road / I-93 Southbound Ramps intersection, the I-93 Southbound Ramps westbound approach was considered the "minor street" volume, while the opposing Frontage Road northbound and southbound approaches were considered to be the "major street. Traffic volumes utilized in the traffic signal warrant were conducted during a 12-hour TMC on Thursday, September 13 and 20, 2018. For the purposes of this analysis,

right-turns exiting the I-93 SB ramp and right-turns along Frontage Road northbound were removed from the traffic counts as they are able to travel relatively free-flowing during the projected signalized condition.

As part of this traffic signal warrant analysis, the Frontage Road "major street" approaches to the intersection were designated as one-lane approaches. The MUTCD provides guidance that states:

> *"Engineering judgment should also be used in applying various traffic signal warrants to cases where approaches consist of one lane plus one left-turn or right-turn lane. The site-specific traffic characteristics should dictate whether an approach is considered as one lane or two lanes. For example, for an approach with one lane for through and right-turning traffic plus a left-turn lane, if engineering judgment indicates that it should be considered a one-lane approach because the traffic using the left-turn lane is minor, the total traffic volume approaching the intersection should be applied against the signal warrants as a one-lane approach. The approach should be considered two lanes if approximately half of the traffic on the approach turns left and the left-turn lane is of sufficient length to accommodate all left-turn vehicles." (MUTCD Section 4C.01(9))*

This paragraph generally states that engineering judgement shall be utilized in determination of number of travel lanes on the major and minor street. The Frontage Road northbound approach consists of one conflicting lane to the potential signalized location and the southbound approach consists of a through lane and a shared left-turn / through lane. Upon observation, the shared left-turn / through lane generally operates as a de facto left-turn lane due to the limited volume along this approach. Therefore, TEC has designated Frontage Road as one-lane on each approach.

Based on the existing traffic volumes and the addition of site-generated trips, the intersection of Dascomb Road / I-93 NB Ramps meets the criteria for Warrant 2. As a traffic signal is warranted, a queue extending onto I-93 SB exists, and due to the operating and safety conditions of the intersection without a traffic signal in place, installation of a traffic signal at this intersection is recommended as part of the off-site corridor improvements along Dascomb Road. The signal warrant analysis worksheets are included in Appendix K.

V. TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build, Build, and Build with Mitigation traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level-of-service to traffic facilities under various traffic-flow conditions.[6] The concept of level-of-service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing the worst. Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

Queue Length Analysis

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro 9.0™ intersection capacity analysis software which is also based upon the methodology and procedures presented in the *HCM 2010*.

[6] The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual 2010*; Transportation Research Board; Washington, DC; 2010

Synchro reports the 95th percentile queues for unsignalized intersections and both the 50th (average) and 95th percentile vehicle queues for signalized intersections, which are based on the number of vehicles that experience a delay of six (6) seconds or more at an intersection and is a function of the traffic signal timing; vehicle arrival patterns during the analysis period; and the saturation flow rate. The 50th percentile or average vehicle queue is the average number of vehicles that are projected to be delayed by six seconds or more at the intersection under study during the analysis period. The 95th percentile vehicle queue is the vehicle queue length that will be exceeded only five (5) percent of the time; or approximately three (3) minutes out of 60 minutes during the peak one hour of the day. During the remaining 57 minutes, the vehicle queue length will be less than the 95th percentile queue length.

PARAMETERS FOR TRAFFIC IMPACT ANALYSIS

Unsignalized Intersections

The levels of service of two-way stop-controlled unsignalized intersections are determined by application of a procedure described in the *HCM 2010*. Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and stop signs. Control delay includes the effects of initial deceleration delay approaching a stop sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the *HCM 2010*. Table 7 summarizes the relationship between level of service and average control delay.

Table 7 – Level-of-Service Criteria for Unsignalized Intersections [a]

Level of Service (v/c ≤ 1.0)	Level of Service (v/c > 1.0)	Average Control Delay (seconds per vehicle)	Description
A	F	≤10.0	LOS A represents a condition with little or no control delay to minor street traffic.
B	F	10.1 to 15.0	LOS B represents a condition with short control delays to minor street traffic.
C	F	15.1 to 25.0	LOS C represents a condition with average control delays to minor street traffic.
D	F	25.1 to 35.0	LOS D represents a condition with long control delays to minor street traffic.
E	F	35.1 to 50.0	LOS E represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
F	F	>50.0	LOS F represents a condition where minor street demand volume exceeds capacity of an approach lane, with excessive control delays resulting.

[a] Source: *Highway Capacity Manual 2010*; Transportation Research Board; Washington D.C.; 2010; page 17-2

Signalized Intersections

LOS for signalized intersections is calculated using the operational analysis methodology of the *HCM 2010*. This method assesses the effects of signal type, timing, phasing, progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of control or

signal delay per vehicle. Control or signal delay can be related to driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay.

Table 8 summarizes the relationship between LOS and control delay. The tabulated control delay criterion may be applied in assigning LOS designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table 8 – Level-of-Service Criteria for Signalized Intersections[(a)]

Level of Service (v/c ≤ 1.0)	Average Control Delay (seconds per vehicle)	Description
A	≤10.0	LOS A describes operations with very low control delay; most vehicles do not stop at all.
B	10.1 to 20.0	LOS B describes operations with relatively low control delay. However, more vehicles stop than LOS A.
C	20.1 to 35.0	LOS C describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
D	35.1 to 55.0	LOS D describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable, whereby motorists are not able to get through the signal on one cycle.
E	55.1 to 80.0	LOS E describes operations with high control delay values. Individual cycle failures are frequent occurrences.
F	>80.0	LOS F describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

[a] Source: *Highway Capacity Manual 2010*; Transportation Research Board; Washington D.C.; 2010

TRAFFIC IMPACT ANALYSIS RESULTS

Level-of-service analyses were conducted for the 2018 Existing, 2026 No-Build, 2026 Build, and 2026 Build with Mitigation Conditions for the study area intersections. The results of the intersection capacity analysis are summarized in Table 9. The capacity analysis worksheets are provided in Appendix L.

Dascomb Road / East Street / Shawsheen Street

Improvements are recommended and proposed at this intersection as part of the Dascomb Road Project's off-site mitigation, which include re-timing the existing signal timings to accommodate the site-generated trips and coordinating the signal with the other proposed signals along the Dascomb Road corridor. With these improvements, this intersection is anticipated to continue operating at acceptable levels of service (LOS D) under 2026 Build with Mitigation conditions. All movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios.

Dascomb Road / HP Driveway

Specific traffic operational improvements are not proposed at the HP Driveway. Although the southbound left-turn movement is anticipated to operate primarily under LOS F during the commuter peak periods, the 95th percentile queue is not expected to exceed two (2) vehicles. Volume-to-capacity (V/C) ratios at the intersection are well below 1.00 which indicates that the intersection can accommodate the additional demand along the HP Site Driveway and Dascomb Road.

Dascomb Road / Smith Way

Without mitigation, the northbound left-turn movement at the intersection of Dascomb Road / Smith Way is anticipated to operate at LOS F under 2026 Build conditions during the peak commuter periods and during the Saturday midday peak. This is directly due to the consistent stream of traffic along Dascomb Road and the lack of available gaps in traffic.

Improvements are recommended and proposed at this intersection as part of the Dascomb Road Project's off-site mitigation, which include installation of a fully-actuated traffic signal coordinated with the other signals along the Dascomb Road corridor. Improvements also include the establishment of additional through lanes along Dascomb Road. With these improvements, this intersection is anticipated to operate at an acceptable level of service (LOS B or better) under 2026 Build with Mitigation conditions. All movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Although the vehicle delay along Dascomb Road approaches is expected to slightly increase with the installation of a traffic signal, mainline levels of service will remain LOS C or better with queues not extending past the upstream intersection.

Dascomb Road / Frontage Road

Without mitigation, the intersection of Dascomb Road / Frontage Road is anticipated to operate with specific movements at LOS F; specifically the Dascomb Road eastbound left-turn movement and the Frontage Road southbound left-turn movement. Improvements are recommended and proposed at this intersection as part of the Dascomb Road Project's off-site mitigation, which include re-timing the existing signal timings to accommodate the site-generated trips and coordinating the signal with the other signals along the Dascomb Road corridor. Additional travel lanes will also be added to multiple approaches. To improve access to the Project site, construction of a fourth intersection leg for direct project access/egress is also proposed.

With these improvements added, all movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Queues along the Dascomb Road mainline are anticipated to increase with the establishment of additional signal phase; however fine-tuning of the traffic signal post-occupancy should allow for additional green-time on the mainline in exchange for slightly decreased level of service along the Project's site driveway.

Dascomb Road / Interstate 93 Northbound Ramps

Without mitigation, the northbound left movement at the intersection of Dascomb Road / I-93 NB Ramps is anticipated to continue operating at LOS F under 2026 Build conditions during all three peak hour periods. This deficient operational condition under No-Build and Build conditions will continue to result in an extended queue, in excess of 1,000-feet, along the off-ramp approach which backs-up to the I-93 NB mainline. Improvements are recommended and proposed at this intersection as part of the Dascomb Road Project's off-site mitigation, which include installation of a fully-actuated traffic signal coordinated with the other signals along the Dascomb Road corridor and adding additional travel lanes to the I-93 NB Ramp approach.

With these improvements, this intersection is anticipated to operate at acceptable levels of service (LOS B or better) under 2026 Build with Mitigation conditions. All movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Vehicle delay and queues along the I-93 NB Ramp approach are expected to significantly decrease as the traffic signal provides scheduled gaps in the mainline green time. With the conflicted green-time along the I-93 NB Ramp approach, queues are anticipated to decrease by up to 85 percent.

Frontage Road / Interstate 93 Southbound Ramps

Without mitigation, the westbound left movement at the intersection of Frontage Road / I-93 SB Ramps is anticipated to operate at LOS F under 2026 Build conditions during the weekday commuter peak periods. This deficient operational condition under No-Build and Build conditions will continue to result in an extended queue along the off-ramp approach which backs-up along the breakdown lane of I-93 SB. Improvements are recommended and proposed at this intersection as part of the Dascomb Road Project's off-site mitigation, which include installation of a fully-actuated traffic signal coordinated with the other signals along the Dascomb Road corridor and adding an additional turn lane to the westbound approach.

With these improvements, this intersection is anticipated to operate at acceptable levels of service (LOS C or better) under 2026 Build with Mitigation conditions. All movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Vehicle delay and queues along the I-93 SB Ramp approach are expected to significantly decrease as the traffic signal provides scheduled gaps in the mainline green time along Frontage Road. With the conflicted green-time along the I-93 SB Ramp approach, queues are anticipated to decrease by up to 80 percent without significantly impacting mainline traffic flows along Frontage Road.

Dascomb Road / Lovejoy Road / Acorn Drive

Specific traffic operational improvements are not proposed at the intersection of Dascomb Road / Lovejoy Road / Acorn Drive; however the Applicant has committed to provide signal timing fine-tuning post-occupancy, if warranted. Under 2026 Build with Mitigation conditions, showing potential signal timing fine-tuning, the intersection of Dascomb Road / Lovejoy Road / Acorn Drive is expected to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios.

Dascomb Road / Clark Road / Bannister Road

Specific traffic operational improvements are not proposed at the intersection of Dascomb Road / Clark Road / Bannister Road. Under existing traffic conditions, the Clark Road northbound approach operates over capacity. The estimated additional traffic generated by the Dascomb Road Project is minimal along the Clark Road approach; including up to approximately 25 vehicles per hour (less than 1 new vehicle every 2 minutes). The approach is anticipated to continue operating at LOS F under both No-Build and Build conditions.

For the purposes of the capacity and queue analysis, TEC had presented a worst-case scenario in which all traffic from the Ballardvale Center area utilized the Clark Road cut-through as opposed to traversing Andover Street to Dascomb Road directly. As the Clark Road approach is over capacity, it is reasonable to assume that additional traffic along the approach will divert from the Ballardvale Center area along Andover Street and access Dascomb Road from its terminus instead of utilizing Clark Road as a cut-through roadway. Conflict and delay along the Andover Street northbound approach at Dascomb Road for this diversion is very limited under both existing and future conditions and can support a significant amount of new traffic-volumes prior to a exceeding a capacity threshold. Should the non-worst-case scenario be depicted at the intersection of Dascomb Road / Clark Road / Bannister Road, it is reasonably expected that the number of site-generated traffic accessing Clark Road would be substantially less than estimated in this TIAPS.

It is recommended that the Town of Andover further investigate transportation improvements at this intersection, isolated from the Dascomb Road Project.

Dascomb Road / Andover Street

Specific traffic operational improvements are not proposed at the intersection of Dascomb Road / Andover Street. Under existing traffic conditions, the Dascomb Road eastbound approach operated over capacity and under LOS F during the weekday evening peak hour under both No-Build and Build conditions. This condition is only expected to occur during the weekday evening peak hour. With or without the Dascomb Road Project, the Andover Street mainline approach will continue to operate at acceptable levels of service (LOS B or better). It is recommended that the Town of Andover further investigate transportation improvements at this intersection, isolated from the Dascomb Road Project.

Table 9 – Intersection Capacity and Queue Analysis Summary

Intersection / Lane Group	2018 Existing				2026 No-Build				2026 Build				2026 Build w/ Mitigation			
	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Dascomb Road / East Street / Shawsheen Street																
Weekday Morning Peak Period																
East Street EBT	0.76	22.3	C	241/363	0.94	50.3	D	348/610	1.00	65.5	E	370/636	0.92	47.6	D	394/627
East Street EBR	0.04	5.8	A	<25/<25	0.06	10.1	B	<25/<25	0.06	11.1	B	<25/<25	0.05	9.2	A	<25/<25
Dascomb Road WBL	1.00	55.6	E	212/443	0.95	41.6	D	210/424	0.95	46.4	D	233/455	1.00	54.9	D	256/501
Dascomb Road WBT	0.43	6.1	A	102/154	0.44	5.5	A	67/129	0.44	5.4	A	67/130	0.45	1.2	A	<25/54
Shawsheen Street NBL	0.15	26.6	C	<25/54	0.19	33.1	C	29/65	0.19	34.5	C	28/65	0.17	34.4	C	31/67
Shawsheen Street NBR	0.98	55.4	E	132/379	0.87	33.1	C	244/399	0.88	33.4	C	265/433	0.91	39.4	D	272/444
Overall Intersection	**0.53**	**34.5**	**C**	**-**	**0.57**	**32.7**	**C**	**-**	**0.58**	**37.9**	**D**	**-**	**0.57**	**35.9**	**D**	**-**
Weekday Evening Peak Period																
East Street EBT	0.69	19.0	B	223/333	0.77	24.1	C	271/507	0.83	30.2	C	322/553	0.81	34.5	C	351/650
East Street EBR	0.03	5.1	A	<25/<25	0.03	6.3	A	<25/<25	0.03	7.8	A	<25/<25	0.03	7.3	A	<25/<25
Dascomb Road WBL	0.89	26.1	C	131/355	0.93	25.8	C	152/314	0.94	36.3	D	211/431	0.97	35.1	D	176/331
Dascomb Road WBT	0.54	7.2	A	144/215	0.56	7.1	A	100/193	0.57	6.7	A	109/209	0.58	1.9	A	128/300
Shawsheen Street NBL	0.17	25.1	C	25/68	0.20	28.0	C	36/82	0.22	31.8	C	39/82	0.19	32.9	C	43/84
Shawsheen Street NBR	0.94	45.8	D	105/296	0.96	49.2	D	214/378	0.96	49.7	D	269/444	0.92	42.1	D	306/394
Overall Intersection	**0.52**	**23.6**	**C**	**-**	**0.56**	**25.6**	**C**	**-**	**0.59**	**29.5**	**C**	**-**	**0.57**	**27.1**	**C**	**-**
Saturday Midday Peak Period																
East Street EBT	0.70	19.3	B	183/310	0.75	18.6	B	195/410	0.80	22.8	C	249/457	0.79	28.4	C	262/528
East Street EBR	0.03	5.2	A	<25/<25	0.04	5.7	A	<25/<25	0.04	6.6	A	<25/<25	0.04	6.4	A	<25/<25
Dascomb Road WBL	0.84	20.1	C	81/267	0.88	14.4	B	90/224	0.92	24.3	C	145/340	0.93	32.0	C	92/287
Dascomb Road WBT	0.37	6.3	A	68/119	0.38	4.8	A	46/94	0.40	4.6	A	51/102	0.41	6.6	A	49/82
Shawsheen Street NBL	0.12	22.0	C	<25/52	0.17	22.2	C	<25/56	0.17	25.0	C	<25/53	0.14	26.8	C	<25/54
Shawsheen Street NBR	0.82	27.0	C	62/208	0.98	51.3	D	133/261	1.02	62.8	F	185/327	0.92	39.7	D	213/291
Overall Intersection	**0.45**	**18.5**	**B**	**-**	**0.50**	**23.0**	**C**	**-**	**0.53**	**29.5**	**C**	**-**	**0.51**	**27.2**	**C**	**-**
Dascomb Road / HP Driveway																
Weekday Morning Peak Period																
Dascomb Road EBL	0.02	10.5	B	<25	0.02	11.0	B	<25	0.02	11.1	B	<25	0.02	11.1	B	<25
HP Driveway SB approach	0.07	54.5	F	<25	0.09	70.8	F	<25	0.10	78.9	F	<25	0.15	118.2	F	<25
Weekday Evening Peak Period																
Dascomb Road EBL	0.01	10.9	B	<25	0.01	11.4	B	<25	0.01	11.8	B	<25	0.01	11.8	B	<25
HP Driveway SB approach	0.30	55.0	F	28	0.37	74.7	F	38	0.45	96.3	F	45	0.48	108.3	F	48
Saturday Midday Peak Period																
Dascomb Road EBL	0.00	9.5	A	<25	0.00	9.8	A	<25	0.00	10.2	B	<25	0.00	10.2	B	<25
HP Driveway SB approach	0.01	49.5	E	<25	0.02	60.4	F	<25	0.02	77.0	F	<25	0.02	86.9	F	<25

Table 9 (Continued) – Intersection Capacity and Queue Analysis Summary

	2018 Existing				2026 No-Build				2026 Build				2026 Build w/ Mitigation			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Dascomb Road / Smith Drive																
Weekday Morning Peak Period																
Dascomb Road EB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.58	19.1	B	205/455
Dascomb Road WBL	0.19	12.7	B	<25	0.20	13.6	B	<25	0.42	17.2	C	50	0.88	40.4	D	135/196
Dascomb Road WBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.41	0.4	A	63/31
Smith Drive NBL	0.46	247.0	F	35	0.61	367.6	F	40	>2.0	>999	F	133	0.36	46.4	D	<25/50
Smith Drive NBR	0.15	24.4	C	<25	0.17	27.6	D	<25	0.33	33.9	D	35	0.22	34.0	C	<25/33
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.49**	**13.5**	**B**	**-**
Weekday Evening Peak Period																
Dascomb Road EB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.58	6.3	A	221/283
Dascomb Road WBL	0.05	11.4	B	<25	0.05	12.0	B	<25	0.26	14.5	B	25	0.83	43.5	D	86/134
Dascomb Road WBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.46	0.5	A	58/88
Smith Drive NBL	0.88	274.0	F	80	1.17	433.1	F	95	>2.0	>999	F	363	0.42	39.1	D	67/117
Smith Drive NBR	0.31	26.8	D	33	0.36	31.3	D	38	1.12	147.2	F	268	0.58	34.1	C	101/149
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.52**	**8.8**	**A**	**-**
Saturday Midday Peak Period																
Dascomb Road EB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.57	25.5	C	178/235
Dascomb Road WBL	0.11	10.9	B	<25	0.12	11.4	B	<25	0.34	14.2	B	38	0.85	34.2	C	84/173
Dascomb Road WBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.35	0.3	A	93/188
Smith Drive NBL	0.28	88.5	F	25	0.36	118.9	F	30	>2.0	>999	F	308	0.40	32.9	C	42/83
Smith Drive NBR	0.23	20.7	C	<25	0.26	23.3	C	<25	0.71	48.1	E	120	0.44	25.5	C	51/82
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.46**	**17.4**	**B**	**-**
Dascomb Road / Frontage Road																
Weekday Morning Peak Period																
Dascomb Road EBL	0.74	11.8	B	88/307	0.82	17.2	B	119/392	1.02	88.5	F	337/533	0.88	39.4	D	101/207
Dascomb Road EBT/R	0.69	7.3	A	170/393	0.73	8.5	A	209/472	0.73	14.0	B	352/508	0.92	12.2	B	503/823
Dascomb Road WBL	-	-	-	-	-	-	-	-	0.83	40.3	D	-	0.80	46.4	D	65/77
Dascomb Road WBT [WBL/T]	0.62	15.2	B	135/226	0.65	16.8	B	154/253	0.88	44.6	D	344/488	0.55	15.2	B	240/288
Dascomb Road WBR	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25
Site Driveway NBL	-	-	-	-	-	-	-	-	0.03	30.5	C	<25/<25	0.09	44.9	D	<25/25
Site Driveway NBT	-	-	-	-	-	-	-	-	0.05	30.6	C	<25/32	0.19	45.0	D	<25/37
Site Driveway NBR	-	-	-	-	-	-	-	-	0.12	31.2	C	<25/25	0.22	39.0	D	<25/<25
Frontage Road SBL [SBL/T]	0.83	23.2	C	108/215	0.85	25.4	C	124/252	1.08	110.1	F	374/575	0.74	43.5	D	67/245
Frontage Road SBT	-	-	-	-	-	-	-	-	-	-	-	-	0.24	36.1	D	25/70
Frontage Road SBR	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.69	31.1	C	27/64
Overall Intersection	**0.54**	**13.0**	**B**	**-**	**0.57**	**15.2**	**B**	**-**	**0.51**	**51.8**	**D**	**-**	**0.55**	**25.3**	**C**	**-**
Weekday Evening Peak Period																
Dascomb Road EBL	0.61	7.8	A	55/203	0.69	9.3	A	79/280	1.08	95.6	F	213/376	0.86	38.5	D	111/201
Dascomb Road EBT/R	0.67	5.6	A	152/354	0.72	6.3	A	188/413	0.82	12.5	B	267/468	0.99	22.7	C	717/982
Dascomb Road WBL	-	-	-	-	-	-	-	-	0.78	27.9	C	-	0.80	54.6	D	75/135
Dascomb Road WBT [WBL/T]	0.56	13.1	B	106/190	0.58	13.4	B	130/207	0.87	31.0	C	206/335	0.46	30.5	C	82/186
Dascomb Road WBR	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25
Site Driveway NBL	-	-	-	-	-	-	-	-	0.11	23.9	C	<25/44	0.26	42.9	D	<25/57
Site Driveway NBT	-	-	-	-	-	-	-	-	0.24	24.3	C	30/67	0.44	43.0	D	51/98
Site Driveway NBR	-	-	-	-	-	-	-	-	0.78	38.2	D	27/90	0.80	52.7	D	66/137
Frontage Road SBL [SBL/T]	0.78	22.6	C	63/141	0.79	23.6	C	76/174	1.16	137.0	F	163/308	0.73	45.2	D	55/118
Frontage Road SBT	-	-	-	-	-	-	-	-	-	-	-	-	0.24	38.0	D	25/54
Frontage Road SBR	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.84	41.3	D	248/50
Overall Intersection	**0.51**	**10.2**	**B**	**-**	**0.53**	**11.0**	**B**	**-**	**0.62**	**45.0**	**D**	**-**	**0.57**	**34.5**	**C**	**-**

Table 9 (Continued) – Intersection Capacity and Queue Analysis Summary

	2018 Existing				2026 No-Build				2026 Build				2026 Build w/ Mitigation			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Dascomb Road / Frontage Road																
Saturday Midday Peak Period																
Dascomb Road EBL	0.57	6.2	A	44/118	0.63	6.7	A	50/185	1.00	66.4	E	217/383	0.83	35.2	D	94/148
Dascomb Road EBT/R	0.52	3.9	A	77/163	0.55	4.0	A	89/193	0.65	7.6	A	162/261	0.86	26.6	C	402/677
Dascomb Road WBL	-	-	-	-	-	-	-	-	0.71	22.9	C	-	0.82	34.2	C	73/116
Dascomb Road WBT [WBL/T]	0.50	12.2	B	65/123	0.51	12.2	B	80/136	0.77	24.1	C	157/258	0.41	3.9	A	88/196
Dascomb Road WBR	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25
Site Driveway NBL	-	-	-	-	-	-	-	-	0.14	23.1	C	<25/44	0.19	33.0	C	<25/46
Site Driveway NBT	-	-	-	-	-	-	-	-	0.19	23.0	C	25/58	0.39	33.3	C	40/90
Site Driveway NBR	-	-	-	-	-	-	-	-	0.57	26.4	C	<25/47	0.50	28.2	C	<25/41
Frontage Road SBL [SBL/T]	0.59	19.2	B	28/74	0.63	20.0	B	33/81	0.73	34.5	C	101/209	0.40	27.4	C	41/86
Frontage Road SBT	-	-	-	-	-	-	-	-	-	-	-	-	0.28	27.7	C	46/93
Frontage Road SBR	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.00	0.0	A	<25/<25	0.70	24.0	C	28/47
Overall Intersection	**0.44**	**8.1**	**A**	**-**	**0.46**	**8.4**	**A**	**-**	**0.52**	**27.5**	**C**	**-**	**0.50**	**23.6**	**C**	**-**
Dascomb Road / I-93 NB Ramps																
Weekday Morning Peak Period																
Dascomb Road EBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.55	0.6	A	66/<25
Dascomb Road EBR	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.00	0.0	A	<25/<25
Dascomb Road WBL	0.10	9.4	A	<25	0.11	9.7	A	<25	0.11	9.8	A	<25	0.16	3.6	A	<25/37
Dascomb Road WBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.79	9.7	A	425/689
NB Ramps NBL	>2.0	>999	F	840	>2.0	>999	F	955	>2.0	>999	F	1150	0.85	51.0	D	124/175
NB Ramps NBR	0.45	19.2	C	55	0.51	22.4	C	70	0.52	23.3	C	73	0.00	0.0	A	<25/<25
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.45**	**13.4**	**B**	**-**
Weekday Evening Peak Period																
Dascomb Road EBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.47	6.3	A	67/200
Dascomb Road EBR	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.00	0.0	A	<25/<25
Dascomb Road WBL	0.08	8.6	A	<25	0.09	8.8	A	<25	0.10	9.2	A	<25	0.17	10.7	B	<25/47
Dascomb Road WBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.44	6.5	A	150/263
NB Ramps NBL	>2.0	566.9	F	855	>2.0	804.8	F	1038	>2.0	>999	F	1330	0.86	41.7	D	166/210
NB Ramps NBR	0.41	15.3	C	50	0.46	17.0	C	60	0.53	20.7	C	75	0.00	0.0	A	<25/<25
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.35**	**16.6**	**B**	**-**
Saturday Midday Peak Period																
Dascomb Road EBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.30	0.3	A	<25/134
Dascomb Road EBR	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.00	0.0	A	<25/<25
Dascomb Road WBL	0.07	8.0	A	<25	0.08	8.1	A	<25	0.09	8.4	A	<25	0.12	3.9	A	<25/39
Dascomb Road WBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.41	5.4	A	105/199
NB Ramps NBL	1.20	156.9	F	395	1.45	257.8	F	533	>2.0	606.6	F	883	0.81	33.6	C	107/145
NB Ramps NBR	0.18	10.8	B	<25	0.20	11.1	B	<25	0.22	12.1	B	<25	0.00	0.0	A	<25/<25
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.27**	**12.3**	**B**	**-**

Table 9 (Continued) – Intersection Capacity and Queue Analysis Summary

	2018 Existing				2026 No-Build				2026 Build				2026 Build w/ Mitigation			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Frontage Road / I-93 SB Ramps																
Weekday Morning Peak Period																
SB Ramps WBL	1.26	167.2	F	510	1.49	266.1	F	690	1.97	472.1	F	1145	0.88	38.6	D	201/239
SB Ramps WBR	0.10	10.4	B	<25	0.12	10.6	B	<25	0.11	10.6	B	<25	0.00	0.0	A	<25/32
Frontage Road NBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.25	7.0	A	44/75
Frontage Road NBR	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.00	0.0	A	41/91
Frontage Road SB approach	0.09	8.1	A	<25	0.10	8.2	A	<25	0.10	8.2	A	<25	0.22	7.7	A	49/89
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.25**	**22.6**	**C**	**-**
Weekday Evening Peak Period																
SB Ramps WBL	1.10	113.3	F	365	1.31	193.3	F	508	1.68	346.4	F	825	0.86	41.0	D	166/208
SB Ramps WBR	0.02	9.0	A	<25	0.02	9.1	A	<25	0.02	9.2	A	<25	0.00	0.0	A	<25/<25
Frontage Road NBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.10	4.4	A	<25/<25
Frontage Road NBR	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.00	0.0	A	61/88
Frontage Road SB approach	0.14	7.8	A	<25	0.15	7.9	A	<25	0.15	7.9	A	<25	0.24	5.6	A	54/93
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.21**	**21.8**	**C**	**-**
Saturday Midday Peak Period																
SB Ramps WBL	0.52	14.2	B	75	0.57	15.5	C	93	0.78	24.3	C	198	0.84	31.4	C	143/179
SB Ramps WBR	0.01	8.7	A	<25	0.01	8.8	A	<25	0.01	8.8	A	<25	0.00	0.0	A	<25/<25
Frontage Road NBT	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.08	4.9	A	<25/<25
Frontage Road NBR	-	-	A	<25	-	-	A	<25	-	-	A	<25	0.00	0.0	A	104/176
Frontage Road SB approach	0.01	7.4	A	<25	0.02	7.4	A	<25	0.02	7.4	A	<25	0.05	4.8	A	<25/<25
Overall Intersection	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.14**	**24.5**	**C**	**-**
Dascomb Road / Lovejoy Road / Acorn Drive																
Weekday Morning Peak Period																
Dascomb Road EB approach	0.86	20.5	C	257/432	0.90	24.5	C	303/580	0.91	25.8	C	325/611	1.00	49.0	D	549/783
Dascomb Road WB approach	0.72	13.0	B	227/346	0.75	13.4	B	261/399	0.78	14.4	B	297/458	0.84	21.9	C	446/720
Acorn Drive NBL/T	0.06	17.1	B	<25/<25	0.07	18.8	B	<25/<25	0.07	20.0	B	<25/<25	0.06	19.7	B	<25/<25
Acorn Drive NBR	0.01	16.9	B	<25/<25	0.01	18.5	B	<25/<25	0.01	19.6	B	<25/<25	0.01	19.4	B	<25/<25
Lovejoy Road SBL/T	0.96	60.6	E	155/288	1.10	104.4	F	217/318	1.15	121.4	F	217/318	0.93	54.3	D	202/300
Lovejoy Road SBR	0.38	19.1	B	54/104	0.44	21.3	C	68/116	0.50	22.9	C	76/126	0.42	22.7	C	84/129
Overall Intersection	**0.98**	**23.8**	**C**	**-**	**1.05**	**32.5**	**C**	**-**	**1.07**	**35.4**	**D**	**-**	**1.04**	**36.2**	**D**	**-**
Weekday Evening Peak Period																
Dascomb Road EB approach	0.68	7.4	A	123/274	0.75	10.1	B	174/334	0.85	15.5	B	253/576	0.84	15.2	B	284/651
Dascomb Road WB approach	0.53	5.1	A	110/219	0.58	6.3	A	151/251	0.59	6.2	A	176/292	0.58	6.3	A	195/321
Acorn Drive NBL/T	0.04	19.8	B	<25/<25	0.03	22.0	C	<25/<25	0.04	26.4	C	<25/<25	0.04	30.0	C	<25/<25
Acorn Drive NBR	0.01	19.6	B	<25/<25	0.01	21.9	C	<25/<25	0.01	26.3	C	<25/<25	0.01	29.9	C	<25/<25
Lovejoy Road SBL/T	0.73	32.5	C	43/100	0.69	31.5	C	67/107	0.75	42.4	D	69/107	0.76	47.8	D	84/126
Lovejoy Road SBR	0.05	19.8	B	<25/<25	0.05	22.1	C	<25/<25	0.08	26.7	C	<25/29	0.13	30.6	C	<25/40
Overall Intersection	**0.78**	**9.4**	**A**	**-**	**0.81**	**11.1**	**B**	**-**	**0.90**	**14.4**	**B**	**-**	**0.89**	**14.9**	**B**	**-**

Table 9 (Continued) – Intersection Capacity and Queue Analysis Summary

	2018 Existing				2026 No-Build				2026 Build				2026 Build w/ Mitigation			
Intersection / Lane Group	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Dascomb Road / Lovejoy Road / Acorn Drive																
Saturday Midday Peak Period																
Dascomb Road EB approach	0.51	5.6	A	49/131	0.55	6.0	A	57/149	0.62	6.6	A	79/206	0.62	6.6	A	82/214
Dascomb Road WB approach	0.47	5.4	A	52/133	0.51	5.6	A	61/151	0.54	5.6	A	80/195	0.54	5.6	A	82/203
Acorn Drive NBL/T	0.07	11.5	B	<25/<25	0.08	11.9	B	<25/<25	0.08	14.2	B	<25/<25	0.08	14.4	B	<25/<25
Acorn Drive NBR	0.01	11.3	B	<25/<25	0.01	11.7	B	<25/<25	0.01	13.9	B	<25/<25	0.01	14.2	B	<25/<25
Lovejoy Road SBL/T	0.42	12.7	B	<25/37	0.46	13.3	B	<25/43	0.49	15.8	B	<25/55	0.48	16.1	B	<25/56
Lovejoy Road SBR	0.05	11.4	B	<25/<25	0.05	11.8	B	<25/<25	0.06	14.1	B	<25/<25	0.06	14.4	B	<25/<25
Overall Intersection	**0.61**	**6.7**	**A**	**-**	**0.65**	**7.0**	**A**	**-**	**0.70**	**7.5**	**A**	**-**	**0.69**	**7.7**	**A**	**-**
Dascomb Road / Clark Road / Bannister Road																
Weekday Morning Peak Period																
Dascomb Road EB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25				
Dascomb Road WB approach	0.01	10.7	B	<25	0.02	11.2	B	<25	0.02	11.3	B	<25				
Clark Road NB approach	1.67	373.9	F	495	>2.0	577.4	F	628	>2.0	734.0	F	723				
Weekday Evening Peak Period																
Dascomb Road EB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25				
Dascomb Road WB approach	0.01	9.0	A	<25	0.02	9.2	A	<25	0.02	9.5	A	<25		NO CHANGE		
Clark Road NB approach	1.11	128.3	F	318	1.35	221.7	F	440	1.73	387.6	F	598				
Saturday Midday Peak Period																
Dascomb Road EB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25				
Dascomb Road WB approach	0.01	8.4	A	<25	0.01	8.5	A	<25	0.01	8.7	A	<25				
Clark Road NB approach	0.52	24.0	C	73	0.61	30.0	D	98	0.82	54.5	F	170				
Dascomb Road / Andover Street																
Weekday Morning Peak Period																
Dascomb Road EBL	0.65	23.1	C	115	0.74	29.7	D	155	0.76	31.4	D	168				
Dascomb Road EBR	0.11	10.4	B	<25	0.12	10.6	B	<25	0.12	10.6	B	<25				
Andover Street NB approach	0.03	8.1	A	<25	0.03	8.2	A	<25	0.03	8.2	A	<25				
Andover Street SB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25				
Weekday Evening Peak Period																
Dascomb Road EBL	1.19	143.3	F	428	1.42	236.7	F	585	1.63	325.7	F	770				
Dascomb Road EBR	0.03	9.1	B	<25	0.03	9.1	A	<25	0.03	9.1	A	<25				
Andover Street NB approach	0.09	7.7	A	<25	0.10	7.8	A	<25	0.10	7.8	A	<25		NO CHANGE		
Andover Street SB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25				
Saturday Midday Peak Period																
Dascomb Road EBL	0.40	12.6	B	50	0.45	13.4	B	58	0.52	14.6	B	75				
Dascomb Road EBR	0.02	8.8	A	<25	0.02	8.9	A	<25	0.02	8.9	A	<25				
Andover Street NB approach	0.01	7.6	A	<25	0.01	7.6	A	<25	0.01	7.6	A	<25				
Andover Street SB approach	-	-	A	<25	-	-	A	<25	-	-	A	<25				

[a] Volume-to-capacity ratio,
[b] Delay expressed in seconds per vehicle (average)
[c] Level of service,
[d] 50th/95th Percentile Queue [95th Percentile Queue only for unsignalized intersections]

VI. PARKING

The Dascomb Road Project as depicted in the conceptual site plans provided a parking supply of 1,760 on-site parking spaces (1,728 standard spaces and 32 accessible spaces) to service the proposed redevelopment, which is divided into several separate parking fields. A large quantity of the on-site parking, 1,256 spaces, will be structured in order to maximize the amount of green space within the project while still maintaining opportunities for patrons, employees, and visitors to park efficiently without overflow. Access/egress to/from the structured parking will be provided at multiple locations within the site so to disperse traffic volumes throughout the site and the site driveways. The parking supply have been appropriately designed to provide adequate parking to meet the peak parking demand of the future tenant in-line with both Town of Andover By-Laws and ITE demand estimates.

TOWN OF ANDOVER ZONING BY-LAWS

The Town of Andover Zoning By-Laws and Regulations contains off-street parking supply requirements for various land uses within the Town of Andover. Based on zoning regulations for the ID2 district, a total of 1,747 parking spaces are required to serve the 524,000 SF (Per Section §5.1.4 – Appendix A Table 3) as noted in Table 10 below.

Table 10 – Town of Andover Zoning Parking Requirements

Land Use	Parking Requirements	Size	Required Parking Spaces
Business Office	1 space / 300 SF GFA	293,000 SF	977
Restaurant	1 space / 2 seats & 1.5 space / 2 employees	20,000 SF + 60 Employees	145
Grocery Store	1 space / 300 SF GFA	35,000 SF	117
Retail	1 space / 250 SF GFA	80,000 SF	320
Hotel	1 space / Room & 1 space / 4 PPL maximum occupancy	100 Rooms + 200 PPL Function	150
Fitness Center	1 space / 4 PPL maximum occupancy	150 PPL	38
	Total Parking		**1,747**

Based on a parking supply of 1,760 spaces throughout the site, the proposed parking supply on-site is in general conformance with the Town of Andover Zoning By-Laws and Regulations.

INSTITUTE OF TRANSPORTATION ENGINEERS PARKING DEMAND ESTIMATE

The peak parking demand generated by the proposed land uses was estimated based on the 85th percentile parking demand generation rates obtained from the ITE publication *Parking Generation, 4th Edition* for LUC 310 – Hotel, LUC 492 – Health/Fitness Club, LUC 701 – General Office, LUC 820 – Shopping Center, LUC 931 – Quality Restaurant, and LUC 932 – High-Turnover (Sit-Down) Restaurant. Detailed parking demand generation worksheets are included in Appendix M.

The peak non-December parking demand for the entire Dascomb Road Project was estimated at 1,603 parking spaces. Drivers typically perceive a parking lot to be full when approximately 90 percent of the spaces are occupied. As a result, it is recommended that the parking supply exceed the peak parking demand by at least 10 percent to minimize excessive recirculation of vehicles searching for empty spaces. Based on this assumption, a minimum of 1,781 parking spaces is recommended to accommodate the peak parking demand during the non-December period. Based on the provision of 1,760 on-site parking spaces, the available parking supply will be comparably adequate (at 9.8 percent recirculation projection) to accommodate the anticipated peak parking demand.

As the site will experience an increased parking demand during the month of December for both the weekday and Saturday conditions, the peak parking demand for the month of December was also estimated. While only a select number of days annually experience this additional holiday period demand, the number of parking spaces available on the site should be sufficient to maintain an adequate parking supply to eliminate parking demand on-street or at alternative locations. The peak December parking demand was estimated at 1,728 vehicles. Based on the provision of 1,760 on-site parking spaces, the available parking supply will be adequate to accommodate the anticipated peak parking demand in December.

VII. MITIGATION MEASURES

After evaluating the operations and safety of the study area roadways and intersections, the next step is to identify measures to improve the roadways and intersections based on existing and future deficiencies. The Project has impacts in the area immediately adjacent to the site and requires mitigation. The following section provides a summary of measures that are recommended to improve the existing and future operations and safety of the study area intersections. These recommended measures where noted in the previous capacity and queue analysis.

The Applicant has proposed a robust and comprehensive transportation mitigation program along Dascomb Road, Frontage Road, and Smith Way to improve vehicular, bicycle, and pedestrian operations and safety. The primary improvements include the installation of three new traffic signals within the study area to provide a coordinate network of signals; improving driver progression in the vicinity of the I-93 Interchange 42. In addition, the Applicant seeks to significantly improve multi-modal accommodations for bicycles and pedestrians along Dascomb Road to service not only the Dascomb Road Project; but other existing developments and residences along the corridor. Finally, the Applicant has proposed improvements along the Dascomb Road corridor have been designed to carry additional reserve capacity for potential future expansion of projects along the immediate Dascomb Road and Frontage Road area.

SITE ACCESS

As part of the Project, a fourth leg will be added to the intersection of Dascomb Road / Frontage Road. Primary access/egress to the site is proposed via a series of internal driveways along Smith Way; however, the addition of a driveway at the intersection of Dascomb Road / Frontage Road would improve access and egress along Dascomb Road for users of the site. The distribution of site-generated traffic to these driveways is identified in the prior chapters. The proposed site driveway will be designed to accommodate safe travel speeds and in accordance with *MUTCD* standards for pavement markings and signage and AASHTO standards for sight lines and geometry.

Although operations at the intersection are expected to improve as a result of the proposed fourth leg, the safety characteristics of the intersection will be improved significantly. Without the proposed fourth intersection leg, all site-generated traffic entering the site via the Frontage Road southbound approach will be required to traverse two lanes of traffic along Dascomb Road westbound immediately after exiting the channelized right-turn from Frontage Road. Where the channelized right-turn operates under yield-control, vehicles entering the site from that

movement will need to accurately judge the gaps in Dascomb Road westbound traffic before cutting across two lanes of traffic to access the two exclusive left-turn lanes into the Project site. After construction of the proposed fourth leg, site-generated trips entering the site via the Frontage Road southbound approach can access the site directly under signalized protection without the need to use Dascomb Road or the channelized right-turn, significantly improving vehicular safety.

OFF-SITE IMPROVEMENTS

Intersection Improvements

Dascomb Road / East Street / Shawsheen Street

To improve traffic operations at the intersection of Dascomb Road / East Street / Shawsheen Street, the Applicant will extend the exclusive left-turn lane along the Dascomb Road westbound approach to provide adequate storage capacity for the increased westbound traffic volumes. In addition, the existing traffic signal timings will be modified to run in coordination with the new traffic signals proposed along the Dascomb Road corridor. The master controller unit currently housed at the intersection of Dascomb Road / East Street / Shawsheen Street will be transferred to the reconstructed intersection of Dascomb Road / Frontage Road / Site Driveway.

Dascomb Road / Smith Way

To mitigate the impacts of the Project and to provide additional reserve capacity along the corridor, the Applicant has committed to the following improvements at the intersection of Dascomb Road / Smith Way:

- Install a fully-actuated traffic signal with coordination to/from other traffic signals located along the Dascomb Road corridor. Provide demand-based vehicular and bicycle detection as part of the new traffic signal, as well as providing accommodations for emergency-vehicle pre-emption;
- Slightly widen Smith Way to accommodate a consistent cross-section which includes an exclusive left-turn lane and an exclusive right-turn lane;
- Widen Dascomb Road to include a through lane and a shared through / right-turn lane on the eastbound approach; and an exclusive left-turn lane and two through lanes on the westbound approach; and
- Add Americans with Disabilities Act (ADA) / Architectural Access Board (AAB) compliant pedestrian accommodations; including crosswalks across Dascomb Road and Smith Way, accessible ramps, and audio/vibratory pedestrian signal equipment.

Dascomb Road / Frontage Road

To improve traffic operations at the intersection of Dascomb Road / Frontage Road, the Applicant has committed to the following intersection improvements:

- Implement various short-term to long-term safety improvements as noted in the December 2016 RSA as coordinated with the Town of Andover and MassDOT;
- Reconstruct the fully-actuated traffic signal with coordination to/from other traffic signals located along the Dascomb Road corridor. Provide new demand-based vehicular and bicycle detection as part of the new traffic signal, as well as providing accommodations for emergency-vehicle pre-emption;
- Construct a fourth intersection leg with an exclusive left-turn lane, a through lane, and an exclusive right-turn lane;
- Widen Frontage Road to accommodate an exclusive left-turn lane, a through lane and a channelized right-turn lane;
- Widen Dascomb Road to include two exclusive left-turn lanes and a shared through / right-turn lane on the eastbound approach; and a left-turn lane, two through lanes and a channelized right-turn lane on the westbound approach; and
- Add ADA/AAB-compliant pedestrian accommodations; including crosswalks across fourth intersection leg, accessible ramps, and audio/vibratory pedestrian signal equipment.

Dascomb Road / Interstate 93 NB Ramps

The additional traffic generated by the proposed Dascomb Road Project is anticipated to degrade the overall intersection level of service at the Dascomb Road / I-93 NB Ramps unsignalized intersection. To mitigate this issue, the Applicant has committed to the following intersection improvements:

- Various short-term to long-term improvements as noted in the December 2016 RSA as coordinated with the Town of Andover and MassDOT;
- Install a fully-actuated traffic signal with coordination to/from other traffic signals located along the Dascomb Road corridor. Provide demand-based vehicular and bicycle detection as part of the new traffic signal, as well as providing accommodations for emergency-vehicle pre-emption. The proposed traffic signal is projected to significantly reduce queuing along the I-93 NB Off-Ramp;
- Widen Dascomb Road to include a consistent cross-section with a through lane and a channelized right-turn lane on the eastbound approach; and an exclusive left-turn lane and a through lane on the westbound approach;
- Re-stripe (with minor geometric modifications) the I-93 Northbound Ramps northbound approach to include two exclusive left-turn lanes and a channelized right-turn lane; and
- Add ADA/AAB-compliant pedestrian accommodations; including crosswalks across the I-93 Northbound Ramps, accessible ramps, countdown signal housings, and audio/vibratory pedestrian push buttons.

Dascomb Road / Lovejoy Road / Acorn Drive

The additional traffic generated by the proposed Dascomb Road Project is not anticipated to impact the overall intersection level of service or approach-by-approach level of service at the Dascomb Road / Lovejoy Road / Acorn Drive intersection. Although no specific mitigation is warranted, the Applicant has committed to the following intersection improvements:

- Fine-tune traffic signal timings at the intersection post-occupancy, if warranted. The capacity and queue analysis described in the previous chapter does not reflect any change in traffic signal timings beyond general maintenance that may be performed by the Town of Andover Department of Public Works (DPW) in the interim;
- Reconstruct ADA/AAB-compliant accessible ramps on the intersection corners; and
- Retrofit the existing traffic signal updated ADA/AAB-compliant pedestrian signal equipment; including countdown signal housings and audio/vibratory push buttons.

Dascomb Road / Clark Road / Bannister Road

The additional traffic generated by the proposed Dascomb Road Project is anticipated to slightly degrade the overall intersection level of service at the Dascomb Road / Clark Road / Bannister Road unsignalized intersection. The Applicant has committed to the following intersection improvements:

- Reconstruct ADA/AAB-compliant accessible ramps on the intersection corners; and
- Install a Rectangular Rapid Flashing Beacon (RRFB) on the westerly leg of the intersection to improve pedestrian crossing opportunities for pedestrians at the intersection.

Frontage Road / Interstate 93 SB Ramps

The additional traffic generated by the proposed Dascomb Road Project is anticipated to degrade the overall intersection level of service at the Frontage Road / I-93 SB Ramps unsignalized intersection. To mitigate this issue, the Applicant has committed to the following intersection improvements:

- Install a fully-actuated traffic signal with coordination to/from the traffic signal located at the Dascomb Road / Frontage Road intersection. Provide demand-based vehicular and bicycle detection as part of the new traffic signal, as well as providing accommodations for emergency-vehicle pre-emption. The proposed traffic signal is projected to significantly reduce queuing along the I-93 SB Off-Ramp;
- Re-stripe the I-93 Southbound Ramps westbound approach to include two exclusive left-turn lanes and a channelized right-turn lane.

Corridor Improvements

To improve pedestrian and bicycle access along Dascomb Road, as well as provide measures to calm traffic along the corridors, new amenities and multi-modal accommodations are proposed to be implemented by the Applicant.

Pedestrian Accommodations

Five-foot sidewalk will be constructed along the southerly side of Dascomb Road between the existing sidewalk at the intersection of East Street / Dascomb Road / Shawsheen Street to Frontage Road. A crossing will be provided at the intersection to join a newly constructed sidewalk along the northerly side of Dascomb Road between Frontage Road and Osgood Street. Additional 5-foot sidewalk will be constructed along the southerly side of Dascomb Road between Cardinal lane and Partridge Hill Road. The Applicant is also committed to reconstruct segments of the existing sidewalk along the southerly side of Dascomb Road between Acorn Drive and Clark Road, as needed. With the improvement of sidewalk facilities, the proposed sidewalk network will provide full connectivity from the Project site to the Ballardvale MBTA Commuter Rail Station. Sidewalk will be constructed with 6-inch granite curbing to provide vertical separation between pedestrian and vehicular traffic. ADA/AAB-compliant accessible ramps and crosswalks will be constructed / reconstructed at all cross-street and other crossing locations, as well as provisions for audible/vibratory pedestrian push buttons, pedestrian signal phasing, and pedestrian countdown signal housings at the various traffic signal locations, where applicable.

To promote traffic calming along Dascomb Road, the Applicant is committed to install a series of solar-powered RRFB assemblies at defined crosswalk locations. The RRFB assemblies will be installed across Dascomb road west of Partridge Hill Road, across Dascomb Road west of Osgood Street, and across Dascomb Road west of Clark Road. The RRFB's will be activated by audible/vibratory pedestrian push buttons and be programmed to limit the light and noise pollution to the adjacent residences. RRFBs are a lower-cost improvement alternative to traffic signals and hybrid beacons (High-Intensity Activated Crosswalks or HAWKs) that are shown to increase driver/vehicle yielding behavior at crosswalks significantly when supplementing standard pedestrian warning signs and pavement markings.

Sidewalk will also be constructed along Smith Way, the Site Driveway opposite Frontage Road, and internally within the site. Finally, new sidewalk will be constructed along the easterly side of Frontage Road, between Dascomb Road and the MassDOT Park-n-Ride facility, to facilitate walking trips to/from the site and those users of the Park-n-Ride facility.

Bicycle Accommodations

The Applicant is committed to construct new 5-foot bicycle lanes between the intersection of East Street / Dascomb Road / Shawsheen Street to Frontage Road. The Applicant will continue the bicycle accommodations as shared-use lane markings (sharrows) along the Dascomb Road corridor between Frontage Road and Osgood Street as a result of the narrow cross-section below the I-93 overpass. All bicycle-related pavement markings will be supplemented with MUTCD-compliant bicycle signage. The final provisions for sharrows and/or bicycle lanes will be determined based on the availability of Right-of-Way along the corridor, the cross-sectional

elements below the I-93 overpass, and further discussions with MassDOT and the Town of Andover.

To provide connectivity from the Dascomb Road corridor and the project site, the Applicant is seeking to construct a shared-use path which parallels the proposed site driveway opposite Frontage Road. This shared-use path will take place of traditional bicycle lanes along the site's driveway in order to reduce potential conflict approaching the traffic signal. The shared-use path will connect into the sites bicycle and pedestrian amenities. Bicycle accommodations will also be programmed into the each of the signalized intersection within the limits of improvements in the form of bicycle detection. Additional bike accommodations along Dascomb Road and/or within the project site will be noted in the following TDM section.

TRANSPORTATION DEMAND MANAGEMENT MEASURES

The Applicant has commitment to research and provide a dynamic Transportation Demand Management (TDM) program in order to reduce single-occupancy vehicle (SOV) trips to/from the site. A full compilation of TDM measures have not been identified to-date; but will be further evaluated by the Applicant during the state's MEPA review. At this time, the Applicant is committed to provide the following TDM measures:

Individual Measures

Transit Measures

- Locate development close to transit services, including the MassDOT Park-n-Ride facility, MBTA Commuter Rail, MVRTA bus services, and LRTA bus services;
- Promote the use of public transportation and coordinate with MBTA, MVRTA, and LRTA to provide information on the availability of service to employees and patrons;
- Coordinate with both MVRTA and LRTA to actively seek a bus route extension to provide both MVRTA and LRTA bus service for the Dascomb Road Project site. Providing both the nearby regional transit authorities service will designate the Dascomb Road site as a potential major transit hub for the region;
- Provide an on-site bus / shuttle stop with passenger amenities such as weather protection, seating, and other customer information;
- Provide transit schedules and information about program services at various locations throughout the redevelopment;
- Coordinate with tenants to provide preferential shift selection to employees using transit services, and align shifts to the extent possible with MBTA, MVRTA, and LRTA transit service;
- Provide on-site transit pass sales and offer reduced-cost transit pass sales for employees; and
- Provide a forum for employees to give customer feedback on transit service for Transportation Coordinator to share with MBTA, MVRTA, and LRTA to target improvements in service.

Parking Measures

- Provide preferential parking for rideshare, carpool, and hybrid vehicles;
- Provide charging stations for electric vehicles;
- Implement an intelligent parking system to direct drivers to open parking spaces and parking levels in the structured parking areas on-site; and
- Employee parking "buy out" program, which will provide a financial incentive for employees to use public transportation or other modes rather than using a single-occupancy vehicle and parking at, or near, the Project.

Bicycle and Pedestrian Measures

- Update and retrofit pedestrian signal equipment at study area intersections surrounding the site along Dascomb Road and Frontage Road;
- Provide connectivity to existing sidewalk infrastructure and along the site frontage from the intersection of East Street / Dascomb Road / Shawsheen Street intersection to Clark Road;
- Install three (3) RRFB crossing locations across Dascomb Road at Partridge Hill Road, Osgood Street, and Clark Road;
- Provide connectivity from the public corridors to the site via sidewalks along the site driveway and Smith Way; as well as a shared-use path to promote bicycle travel from Dascomb Road into the site;
- Provide striping improvements for sharrows and/or bicycle lanes along Dascomb Road and Frontage Road with complementary bike signs;
- Provide ADA/AAB improvements at curb ramps near the site;
- Provide secure, weather protected, long-term bicycle parking for employees at designated locations within the site;
- Provide bicycle racks for short-term users at several locations on-site; and
- Coordinate with tenants to provide showers for employees who commute by walking or biking.

Other Measures

- Appoint a Transportation Coordinator (TC) on-site to oversee, implement, monitor, and evaluate TDM measures, employed or funded by the Applicant;
- Partner with the Merrimack Valley Transportation Management Association (TMA) to implement and monitor TDM measures;
- Register employees with NuRide to encourage ride-sharing and "green" trips;
- Encourage vanpool and carpooling participation through marketing, events and vanpool formation meetings;

- Offer employees a guaranteed ride home program through participation with NuRide;
- Electronic sign-up for TDM programs provides Transportation Coordinator with information for a database of participants to track program effectiveness and costs;
- Facilitate events through coordination with Merrimack Valley TMA, MBTA, MVRTA, and LRTA; and
- Provide a transportation monitoring program to evaluate TDM goals.

Transportation Monitoring Program

The Proponent is committed to implementing a Transportation Monitoring Program (TMP), which is intended to monitor traffic operations, parking occupancy, public transportation utilization, and pedestrian / bicycle use for a period following completion of the Project. The TMP will include providing traffic count information to the MassDOT District 4 office, the Town of Andover, and the Merrimack Valley TMA for use of tracking site-generated trips. The intent of the monitoring program is to ensure that the Project impacts are consistent with those predicted in the Project's permitting process, evaluate the effectiveness of the TDM measures in meeting the mode share targets, and assess the need for additional off-site improvements or TDM measures.

The MassDOT / Merrimack Valley TMA monitoring program will include evaluation of the following:

- Traffic operations at key study area intersections and roadways surrounding the development;
- Adequacy of the constructed parking supply; and
- Effectiveness of TDM measures.
- As part of the MassDOT monitoring program, the Proponent will complete the following tasks beginning six months after issuance of an occupancy permit, continuing annually for a period of five years following occupancy of the Project

Additional details related to the TMP will be documented with MassDOT and the Town of Andover as part of the upcoming MEPA state review process.

VIII. CONCLUSION

TEC has examined the potential traffic impacts associated with the proposed Dascomb Road Project, located at #146 Dascomb Road in Andover, Massachusetts on the study area roadways and intersections. The following is a summary of the results and conclusions of this effort:

- The existing site currently consists of ±188,960 SF of mixed office and industrial uses with associated parking. The existing office and industrial space on-site is currently underutilized. A ±90,000 SF Restaurant Depot facility, who partially shared driveways connections with the site, operates on the property located adjacent to and south of the site at #148 Dascomb Road.
- The Project consists of razing the existing ±188,960 SF of underutilized office and industrial space and constructing a 524,000 SF mixed-use development; comprised of a 100-room business-centric hotel; 293,000 SF of office space; 80,000 SF of general retail space; a 30,000 SF fitness center; a 35,000 SF neighborhood grocery store; and 20,000 SF of restaurant space.
- The Project proposes to modify the access/egress to the property, providing two full-access/egress driveways, a shared full-access/egress driveway with Restaurant Depot, and a loading dock driveway along the easterly side of Smith Way. All full-access/egress driveways for the Restaurant Depot facility along Smith Way will be retained. Additionally, a full-access/full-egress driveway for the proposed site will be provided immediately opposite Frontage Road at the signalized intersection on Dascomb Road.
- As the Project is anticipated to generate more than 3,000 new vehicle trips per day, the project is subject to EIR review by the MEPA office. In addition, as the project provides direct frontage to SHLO and the interstate highway system, the project is subject to a Permit to Access State Highway, direct review by the MassDOT, and review by the FHWA;
- TEC conducted an RSA, in coordination with MassDOT, at two high-crash designated intersections within the study area; including the intersections of Dascomb Road / Frontage Road and Dascomb Road / I-93 NB Ramps. Various improvements as identified in the RSA will be incorporated into the off-site mitigation to be implemented by the Applicant;

- The Project is anticipated to generate approximately 8,384 new vehicle trips (4,192 entering and 4,192 exiting) during the average weekday, with 410 new vehicle trips (324 entering and 86 exiting) during the weekday morning peak hour and 744 new vehicle trips (303 entering and 441 exiting) during the weekday evening peak hour. Approximately 8,846 new vehicle trips (4,423 entering and 4,423 exiting) are anticipated during the average Saturday, with 738 new vehicle trips (396 entering and 342 exiting) during the Saturday midday peak hour.
- Operational improvements are recommended and proposed at this intersection of Dascomb Road / East Street / Shawsheen Street including re-timing the existing signal timings to accommodate the site-generated trips and coordinating the signal with the other proposed signals along the Dascomb Road corridor. With these improvements, all movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios;
- Specific traffic operational improvements are not proposed at the HP Driveway. Although the southbound left-turn movement is anticipated to operate primarily under LOS F during the commuter peak periods, the 95th percentile queue is not expected to exceed two (2) vehicles. Volume-to-capacity (V/C) ratios at the intersection are well below 1.00 which indicates that the intersection can accommodate the additional demand along the HP Site Driveway and Dascomb Road;
- Improvements are recommended and proposed at the intersection of Dascomb Road / Smith Way, which include cross-sectional widening and installation of a fully-actuated traffic signal coordinated with the other signals along the Dascomb Road corridor. With these improvements, all movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios.
- Improvements are recommended and proposed at the intersection of Dascomb Road / Frontage Road. With these improvements added, all movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Queues along the Dascomb Road mainline are anticipated to increase with the establishment of additional signal phase; however fine-tuning of the traffic signal post-occupancy should allow for additional green-time on the mainline in exchange for slightly decreased level of service along the Project's site driveway.
- Improvements are recommended and proposed at the intersection of Dascomb Road / I-93 NB Ramps; which includes the installation of a fully-actuated traffic signal coordinated with the other signals along the Dascomb Road corridor. With these improvements, all movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Vehicle delay and queues along the I-93 NB Ramp approach are expected to significantly decrease as the traffic signal provides scheduled gaps in the mainline green time. With the conflicted green-time along the I-93 NB Ramp approach, queues are anticipated to decrease by up to 85 percent.

- Improvements are recommended and proposed at the intersection of Frontage Road / I-93 SB Ramps; which includes the installation of a fully-actuated traffic signal coordinated with the other signals along the Dascomb Road corridor. With these improvements, all movements at the intersection are anticipated to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios. Vehicle delay and queues along the I-93 SB Ramp approach are expected to significantly decrease as the traffic signal provides scheduled gaps in the mainline green time. With the conflicted green-time along the I-93 SB Ramp approach, queues are anticipated to decrease by up to 80 percent.
- Specific traffic operational improvements are not proposed at the intersection of Dascomb Road / Lovejoy Road / Acorn Drive; however the Applicant has committed to provide signal timing fine-tuning post-occupancy, if warranted. Under 2026 Build with Mitigation conditions, showing potential signal timing fine-tuning, the intersection of Dascomb Road / Lovejoy Road / Acorn Drive is expected to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios with individual movements operating at LOS E or better.
- Specific traffic operational improvements are not proposed at the intersection of Dascomb Road / Clark Road / Bannister Road. Under a worst-case cut-through traffic scenario, the additional traffic generated by the Dascomb Road Project is still minimal along the Clark Road approach; including up to approximately 25 vehicles per hour (1 new vehicle every 2 minutes). The approach is anticipated to continue operating over capacity under both No-Build and Build conditions. It is recommended that the Town of Andover further investigate transportation improvements at this intersection, isolated from the Dascomb Road Project.
- Specific traffic operational improvements are not proposed at the intersection of Dascomb Road / Andover Street. Under existing traffic conditions, the Dascomb Road eastbound approach operated over capacity at LOS F during the weekday evening peak hour under both No-Build and Build conditions. With or without the Dascomb Road Project, the Andover Street mainline approach will continue to operate at acceptable levels of service (LOS B or better). It is recommended that the Town of Andover further investigate transportation improvements at this intersection, isolated from the Dascomb Road Project.
- The Applicant has proposed a robust off-site transportation mitigation program along Dascomb Road, Frontage Road, and Smith Way to improve vehicular, transit, bicycle, and pedestrian operations and safety. The primary improvements include the installation of three new traffic signals within the study area to both reduce queuing along the I-93 Off-Ramps and provide a coordinate network of signals; improving driver progression along Dascomb Road and Frontage Road in the vicinity of the I-93 Interchange 42. In addition, the Applicant seeks to significantly improve accommodations for bicycles and pedestrians along Dascomb Road to service not only the Dascomb Road Project; but other existing developments along the corridor. Finally, the Applicant has proposed improvements along the Dascomb Road corridor have been designed to carry additional reserve capacity for potential future expansion of projects along the immediate Dascomb Road and Frontage Road area; and

- The Applicant has commitment to research and provide a dynamic and extensive TDM program in order to reduce SOV trips to/from the site and promote multi-modal travel. A full compilation of TDM measures have been identified and include provisions to reduce on-site parking, increase pedestrian and bicycle travel, promote transit use to/from the site, and decrease the impacts of vehicle emissions.

In conclusion, with implementation of the proposed improvements, the anticipated traffic generated by the Dascomb Road Project can be safely and efficiently accommodated within the study area corridors and intersections. The Applicant has committed to work hand-and-hand with the Town of Andover and MassDOT to implement the robust transportation mitigation program.