MarketStreet

Lynnfield, Massachusetts

PREPARED FOR

National Development

PREPARED BY

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Executive Summary

VHB, Inc. has prepared a Transportation Impact and Access Study (TIAS) to assess transportation impacts associated with the proposed modification to the remaining, approved, build-out of the MarketStreet Lynnfield development program to include a cinema. This Site is located at the Route 128/I-95 Interchange at Walnut Street in Lynnfield, Massachusetts. It is a first-class regional mixed-use destination, consisting of a vibrant collection of retail, restaurant, entertainment, residential, and office uses in a thoughtfully planned and carefully designed setting.

In 2008 the Town of Lynnfield approved the development of MarketStreet Lynnfield, which included 395,000 square feet (sf) of retail, restaurant, and entertainment uses, 180 units of rental apartments, 48 senior housing units, and 80,000 sf of office uses. Since then, most of the building areas have been built (357,826 sf of retail, restaurant, and entertainment uses, 180 apartments, 48 senior housing units, and 12,743 sf of office uses). The remaining approved development to be built includes 37,174 sf of retail, restaurant, and entertainment uses and 67,257 sf of office. It should be noted that 26,191 sf of medical office space (including 5,500 sf urgent care clinic and 20,691 sf medical office) and 14,500 sf of retail uses is currently being constructed.

The current proposal is to modify the remaining approved development to be built to essentially trade 40,000 sf of office use with a 40,000 sf (eight screens, 800 seats) of cinema use ("the proposed modification"). It should be understood that the trading out 40,000 sf of office space with 40,000 sf of cinema space represents a complimentary change in the site from a traffic generation perspective most days of the week. This TIAS evaluates the transportation changes associated with the proposed trade of space. The MarketStreet Lynnfield project will be built-out to its approved level regardless of whether the change in the final phase is approved or not.

This TIAS evaluates three conditions during the weekday evening and Saturday midday peak hour:

- 2018 Existing conditions – includes the existing built development. This condition does not include the portion of the development which is currently under construction.
- 2025 No-Build conditions – includes the 2018 Existing conditions with the addition of general traffic growth not associated with MarketStreet Lynnfield. This condition does not include the portion of the development which is currently under construction.

- 2025 Build conditions – includes the 2025 No-Build conditions with the addition of trips generated by the portion of the development which is currently under construction and the proposed modification.

This assessment considers the following nine intersections:

Lynnfield:

- I-95 Southbound Ramps at Walnut Street and Market Street
- I-95 Northbound Ramps at Walnut Street
- Walnut Street at Salem Street
- Market Street at King Rail Drive (roundabout)
- Audubon Road at King Rail Drive

Wakefield

- Audubon Road/Pleasure Island Road at Audubon Road
- I-95 Southbound Ramps at Audubon Road/Pleasure Island Road
- Audubon Road/Pleasure Island Road at Salem Street
- I-95 Northbound Ramps at Salem Street

Turning movement counts (TMC), collecting *peak hour* data, were conducted at each of the study area intersections during the weekday evening peak period from 4:00 PM to 6:00 PM and on a Saturday midday peak period from 11:00 AM to 2:00 PM in November 2017. Concurrent with the TMCs, 24-hour automatic traffic recorder (ATR) counts were conducted on a weekday and Saturday along Market Street to the west of Walnut Street.

The build-out of the development with the proposed modification is expected to result in a minimal increase of 15 total trips (6 entering/9 exiting) during the weekday evening peak hour and a minimal increase of 29 total trips (26 entering/3 exiting) during the Saturday midday peak hour when compared to the approved build-out of the development. With the two site access locations and multiple roadways surrounding the development, these trips will quickly dissipate into the roadway network and have a *minimal impact* to operations when compared to the approved build-out of the development without the proposed modification.

Capacity analyses were conducted for each of the study area intersections under 2018 Existing conditions, 2025 No-Build conditions (without the proposed development), and 2025 Build conditions (with the proposed development). Overall signalized intersection delays are only expected to increase by a maximum of 10 seconds (and many signalized intersections experiencing no increase in delay) with the addition of trips associated with the build-out of the development without the proposed Cinema modification. The results of the analysis indicate operational impacts associated with

the proposed build-out of the Site would be *imperceptible* to the average driver along Walnut Street, Salem Street, and Audubon Road/Pleasure Island Road.

Assuming the Cinema is approved, the Proponent is willing to fund an adaptive traffic signal system at the three signalized intersections located in close proximity to the site along Walnut Street to further reduce Project-related trip impacts, mitigate existing issues, and add corridor efficiency. The adaptive signal system will function similarly to the adaptive system to the west of the MarketStreet Site in Wakefield along Audubon Road, Pleasure Island Road and Salem Street. Adaptive signal systems are state of the art and allow traffic signals to respond more intelligently to fluctuations in traffic patterns (real-time) than standard time and phase base systems. The technology captures real-time traffic demand data to adjust traffic signal timing so that optimal flow in coordinated traffic signal systems can be achieved without manual changes being made to controllers. Adaptive systems are known to reduce traffic delay, increase average speeds, improve travel times, and decrease travel time variability. They also decrease emission, which helps the environment. In contrast to traditional timed systems, adaptive traffic signal control technologies can react to traffic accidents, special events, road construction, and other occurrences. The Proponent will implement these changes pending MassDOT's approval to do so and only if the cinema is approved.

1 Introduction

This transportation study documents the findings of the transportation evaluation conducted for the proposed modification including an assessment of existing conditions, projection of future traffic volumes without and with the proposed modification being contemplated, and analysis of impacts of the proposed modification.

Project Description

VHB, Inc. has prepared a Transportation Impact and Access Study (TIAS) to assess transportation impacts associated with the proposed modification to the remaining, approved, build-out of the MarketStreet Lynnfield development program to include a cinema. This Site is located at the Route 128/I-95 Interchange at Walnut Street in Lynnfield, Massachusetts. It is a first-class regional mixed-use destination, consisting of a vibrant collection of retail, restaurant, entertainment, residential, and office uses in a thoughtfully planned and carefully designed setting.

In 2008 the Town of Lynnfield approved the development of MarketStreet Lynnfield, which included 395,000 square feet (sf) of retail, restaurant, and entertainment uses, 180 units of rental apartments, 48 senior housing units, and 80,000 sf of office uses. Since then, most of the building areas have been built (357,826 sf of retail, restaurant, and entertainment uses, 180 apartments, 48 senior housing units, and 12,743 sf of office uses). The remaining approved development to be built includes 37,174 sf of retail, restaurant, and entertainment uses and 67,257 sf of office. It should be noted that 26,191 sf of medical office space (including 5,500 sf urgent care clinic and 20,691 sf medical office) and 14,500 sf of retail uses is currently being constructed.

The current proposal is to modify the remaining approved development to be built to essentially trade 40,000 sf of office use with a 40,000 sf (eight screens, 800 seats) of cinema use ("the proposed modification"). It should be understood that the trading

out 40,000 sf of office space with 40,000 sf of cinema space represents a complimentary change in the site from a traffic generation perspective most days of the week. This TIAS evaluates the transportation changes associated with the proposed trade of space. The MarketStreet Lynnfield project will be built-out to its approved level regardless of whether the change in the final phase is approved or not.

Study Methodology

This transportation assessment has been conducted in three stages. The first stage involved an assessment of existing transportation conditions within the Project area including an inventory of existing roadway geometry; observations of traffic flow, including daily and peak period traffic counts; and a review of vehicular accident data.

The second stage of the study established the framework for evaluating the transportation impacts of the proposed Project. Specific travel demand forecasts for the Project were assessed along with future traffic demands on the study area roadways due to projected background growth and other proposed area development that will occur, independent of the proposed development. The year 2025, a seven-year time horizon, was selected as the design year for analysis for the preparation of this Transportation Impact and Access Study (TIAS) to satisfy the Executive Office of Environmental Affairs/Executive Office of Transportation [EOEA/EOT] guidelines.

The third and final stage involved conducting operations analyses to identify both existing and projected future roadway capacities and demands. This analysis was used as the basis for determining potential Project impacts and potential mitigation measures.

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Existing Conditions

Evaluation of the transportation impacts associated with the proposed modification requires a thorough understanding of the existing transportation system in the Project study area. Existing transportation conditions in the study area include roadway geometry, traffic controls, daily and peak period traffic flow, and vehicular accident information data. Each of these elements is described in detail below.

Study Area

Based on a review of the anticipated trip generation and trip distribution for the proposed Project, a study area was established which includes the following nine intersections which are shown in Figure 1:

Lynnfield:

- I-95 Southbound Ramps at Walnut Street and Market Street
- I-95 Northbound Ramps at Walnut Street
- Walnut Street at Salem Street
- Market Street at King Rail Drive (roundabout)
- Audubon Road at King Rail Drive

Wakefield

- Audubon Road/Pleasure Island Road at Audubon Road
- I-95 Southbound Ramps at Audubon Road/Pleasure Island Road
- Audubon Road/Pleasure Island Road at Salem Street
- I-95 Northbound Ramps at Salem Street

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vhb

Site Location Map and
Study Area Intersections
MarketStreet
Lynnfield, Massachusetts

Figure 1

The existing conditions evaluation consisted of an inventory of the traffic control; roadway, driveway, and intersection geometry in the study area; the collection of daily and peak period traffic volumes; and a review of recent vehicular accident history.

Roadway Geometry

The major travel routes and intersections within the study area are described below. Figure 2 shows the observed existing intersection lane geometry and traffic control at each study-area intersection.

Roadways

Salem Street

Salem Street is an east/west running roadway that extends from Wakefield in the west to Peabody in the east. Within the study area, Salem Street is under local jurisdiction and classified as an urban collector between Audubon Road/Pleasure Island Road and Walnut Street and as an urban minor arterial west of Audubon Road/Pleasure Island Road and east of Walnut Street. Salem Street provides a single travel lane in each direction with turning lanes present at major intersections and the posted speed limit is 30 mph within the study area. Salem Street provides access to Route 1 and Interstate 95/ Route 128. Sidewalks are provided along the north side of Salem Street in the Town of Lynnfield and along the south side of Salem Street in the Town of Wakefield.

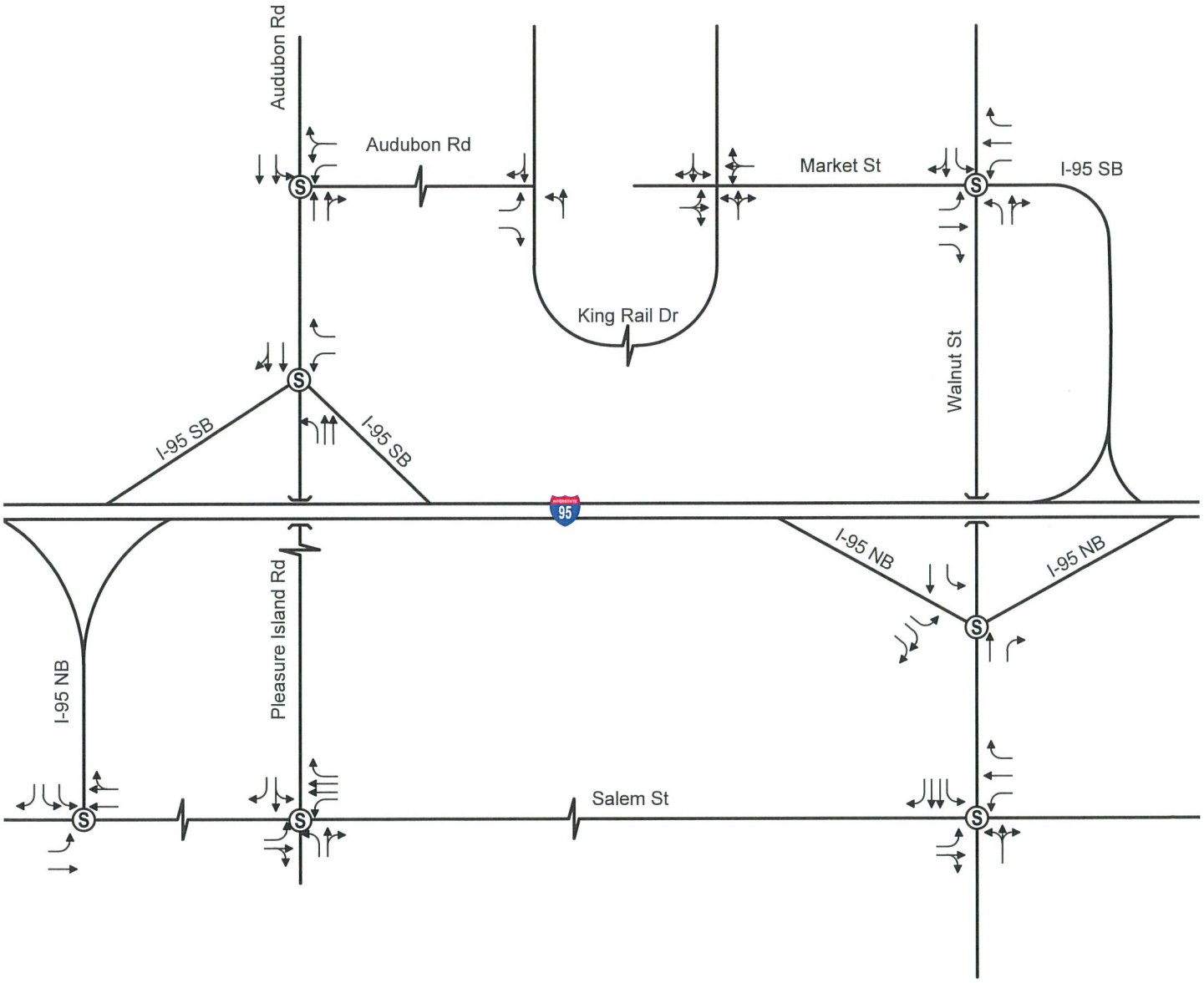
Walnut Street

Walnut Street is a north/south running, urban minor arterial roadway that extends from Summer Street in the north to the Saugus line in the south. The length of the roadway is under local jurisdiction, aside from the segment between Market Street/I-95 SB Ramps and Salem Street, which is under Massachusetts Department of Transportation (MassDOT) jurisdiction. Within the study area, Walnut Street provides a single travel lane in each direction, with a posted speed limit of 30 mph. Sidewalks are present on the east side of Walnut Street for the length of the roadway within the study area.

Intersections

The following sections describe the study-area intersections in detail.

Ⓢ Signalized Intersection
neg = Negligible



Not to Scale

Intersection Lane Geometry and
Traffic Control
MarketStreet
Lynnfield, Massachusetts

Figure 2

I-95 Southbound Ramps at Walnut Street and Market Street

- Four-way signalized intersection.
- Walnut Street runs north/ south; Market Street intersects Walnut Street from the west; the I-95 southbound ramps intersect Walnut Street from the east.
- The Walnut Street Northbound approach consist of an exclusive left-turn lane, an exclusive through lane, and a channelized yield-controlled right-turn lane.
- The Walnut Street southbound approach consists of an exclusive left-turn lane and a shared through/ right-turn lane.
- The Market Street eastbound approach consists of exclusive left-turn, through, and right-turn lanes.
- The I-95 southbound off-ramp westbound approach consists of an exclusive left-turn lane, an exclusive through lane, and a channelized yield-controlled right-turn lane.
- Pedestrian facilities include sidewalks along the east side of Walnut Street and north side of Market Street and crosswalks located across the westbound approach of the I-95 southbound ramps and across the southbound approach of Walnut Street.
- Surrounding land use consists mainly of commercial uses, such as the MarketStreet Lynnfield Shopping Center, and residential uses.

I-95 Northbound Ramps at Walnut Street

- Four-way signalized intersection.
- Walnut Street runs north/ south; the I-95 northbound off-ramp intersects Walnut Street from the west; the I-95 northbound onramp intersects Walnut Street from the east.
- The northbound Walnut Street approach consists an exclusive through lane and a channelized yield-controlled right-turn lane.
- The southbound Walnut Street approach consists of an exclusive left-turn lane and an exclusive through lane.
- The I-95 northbound off-ramp eastbound approach consists of an exclusive left-turn lane and two exclusive right-turn lanes.
- The east/ west running Salem Street intersects Walnut Street approximately two-hundred feet south at a signalized intersection.

- Pedestrian facilities include sidewalks along the east side of Walnut Street and crosswalks located across the westbound approach of the I-95 northbound on-ramp.
- Surrounding land use consists mainly of residential land uses.

Walnut Street at Salem Street

- Four-way signalized intersection.
- Walnut Street runs north/ south; Salem Street runs east/ west.
- The Walnut Street northbound approach consists of a shared through/ left-turn lane and a channelized yield-controlled right-turn lane
- The Walnut Street southbound approach consists of an exclusive left-turn lane, two exclusive through lanes, and a channelized right-turn lane.
- The Salem Street eastbound approach consist of an exclusive left turn lane and a shared through/ right-turn lane
- The Salem Street westbound approach consists of exclusive left-turn, through, and right-turn lanes.
- Trucks over 2 ½ tons are not permitted to travel on Walnut Street south of Salem Street
- Pedestrian facilities include sidewalks along the east side of Walnut Street north of the intersection, along the west side of Walnut Street south of the intersection, along the north side of Salem Street to the west of the intersection, and both sides of Salem Street to the east; crosswalks are located across all approaches.
- Surrounding land use consists mainly of residential land uses.

Market Street at King Rail Drive (Roundabout)

- Four-way roundabout intersection.
- Market Street runs east/south; the Site driveway intersects from the west; King Rail Drive intersects from the north.
- Each approach consists of one shared entry lane to the roundabout.
- Pedestrian facilities include a sidewalk along the north side of Market Street and the Site driveway; a crosswalk is located across the southbound approach of King Rail Drive.

- Surrounding land use consists mainly of commercial uses, such as the MarketStreet Lynnfield Shopping Center.

Audubon Road at King Rail Drive

- Three-way unsignalized intersection.
- King Rail Drive runs north/ south; The stop-controlled Audubon Road intersects from the west.
- The King Rail Drive southbound and northbound approaches each consist of a single general purpose lane.
- The Audubon eastbound approach consists of exclusive left-turn and right-turn lanes.
- Pedestrian facilities include a sidewalk along the north side of Audubon Road and along the west side of King Rail Road north of the intersection.
- Surrounding land use consists mainly of commercial uses, such as the MarketStreet Lynnfield Shopping Center and Boston Sports Club.

Audubon Road/Pleasure Island Road at Audubon Road

- Three-way signalized intersection.
- Audubon Road/Pleasure Island Road runs north/ south; Audubon Road intersects from the east.
- The Audubon Road/Pleasure Island Road northbound approach consists of an exclusive through lane and a shared through/right-turn lane.
- The Audubon Road/Pleasure Island Road southbound approach consists of a shared through-left-turn lane and an exclusive through lane.
- The Audubon Road westbound approach consists of an exclusive left-turn lane and a shared left-turn/right-turn lane.
- Pedestrian facilities include sidewalks along both sides of Audubon Road/Pleasure Island Road north of the intersection, along the west side of Audubon Road/Pleasure Island Road south of the intersection, and along the south side of Audubon Road. Crosswalks are located across the southbound approach of Audubon Road/Pleasure Island Road and across the westbound approach of Audubon Road.
- Surrounding land use consists of commercial, residential, institutional, and hotel uses.

I-95 Southbound Ramps at Audubon Road/Pleasure Island Road

- Four-way signalized intersection.
- Audubon Road/Pleasure Island Road runs north/ south and is known as Pleasure Island Road south of the intersection; the I-95 southbound off-ramp intersects Audubon Road/Pleasure Island Road from the east; the I-95 southbound on-ramp intersects Audubon Road/Pleasure Island Road from the west.
- The Audubon Road/Pleasure Island Road northbound approach consists of an exclusive left-turn lane and two exclusive through lanes.
- The Audubon Road/Pleasure Island Road southbound approach consists of a channelized yield-controlled right-turn lane and two exclusive through lanes.
- The I-95 southbound off-ramp westbound approach consists of an exclusive left-turn lane and a channelized yield-controlled right-turn lane.
- Pedestrian facilities include sidewalks along the east side of Audubon Road/Pleasure Island Road and a crosswalk located across the westbound approach of the I-95 southbound off-ramp.
- Surrounding land use consists of institutional and hotel uses.

Audubon Road/Pleasure Island Road at Salem Street

- Four-way signalized intersection.
- Salem Street runs east/ west; Audubon Road/Pleasure Island Road intersects Salem Street from the north; a Dunkin Donuts Driveway intersects Salem Street from the south.
- The Dunkin Donuts Driveway northbound approach consist of an exclusive left-turn lane and a shared through/right-turn lane.
- The Audubon Road/Pleasure Island Road southbound approach consist of a shared through/left-turn lane and an exclusive right-turn lane.
- The Salem Street eastbound approach consists of an exclusive left-turn lane, two exclusive through lanes, and an exclusive right-turn lane.
- The Salem Street westbound approach consists of an exclusive left-turn lane and a shared through/right-turn lane.

- Pedestrian facilities include sidewalks along the south side of Salem Street and along the east side of Audubon Road/Pleasure Island Road; crosswalks are located across the Dunkin Donuts Driveway northbound approach and across the Salem Street westbound approach.
- Bicycle facilities include a bike lane on the Salem Street westbound approach.
- Surrounding land use includes office, scattered residential, and Dunkin Donuts.

I-95 Northbound Ramps at Salem

- Three-way signalized intersection.
- Salem Street runs east/ west; the I-95 northbound ramps intersect Salem Street from the north.
- The Salem Street eastbound approach consists of an exclusive through and a shared through/ left-turn lane.
- The Salem Street westbound approach consists of two exclusive through lanes and a channelized yield-controlled right-turn lane.
- The I-95 northbound off-ramp southbound approach consists of two exclusive left-turn lanes and a channelized yield-controlled right-turn lane.
- Pedestrian facilities include a sidewalk along the south side of Salem Street.
- Surrounding land use consists mainly of residential uses.

Traffic Volume Data

Turning movement counts (TMC), collecting *peak hour* data, were conducted at each of the study area intersections during the weekday evening peak period from 4:00 PM to 6:00 PM and on a Saturday midday peak period from 11:00 AM to 2:00 PM in November 2017. The counts were grown by a historic growth rate of one-percent per year to reflect the 2018 base year. Concurrent with the TMCs, 24-hour automatic traffic recorder (ATR) counts were conducted on a weekday and Saturday along Market Street to the west of Walnut Street. A summary of the ATR data is presented in Table 1. All count data is contained in the Appendix to this document.

Table 1 Existing Traffic Volume Summary

		Weekday Evening Peak Hour				Saturday Midday Peak Hour		
Location	Weekday ADT [a]	Volume	K Factor [b]	Dir. Dist. [c]	Saturday ADT [a]	Volume	K Factor	Dir. Dist.
Market Street west of Walnut Street	17,600	1,400	8.0%	51% EB	22,400	2,050	9.2%	52% EB

a. average daily traffic expressed in vehicles per day. Based on daily volumes collected in November 2017. Exact peak hours of the ATRs may not coincide with the peak hour of the TMCs.
b. peak period volumes expressed in vehicles per hour
c. percent of ADT that occurs during the peak period
d. directional distribution of peak period traffic volumes

As shown in Table 1, Market Street carries approximately 17,600 vehicles on a typical weekday with 8.0-percent during the evening peak hour and approximately 22,400 vehicles on a typical Saturday with 9.2-percent during the midday peak hour.

Seasonality of Count Data

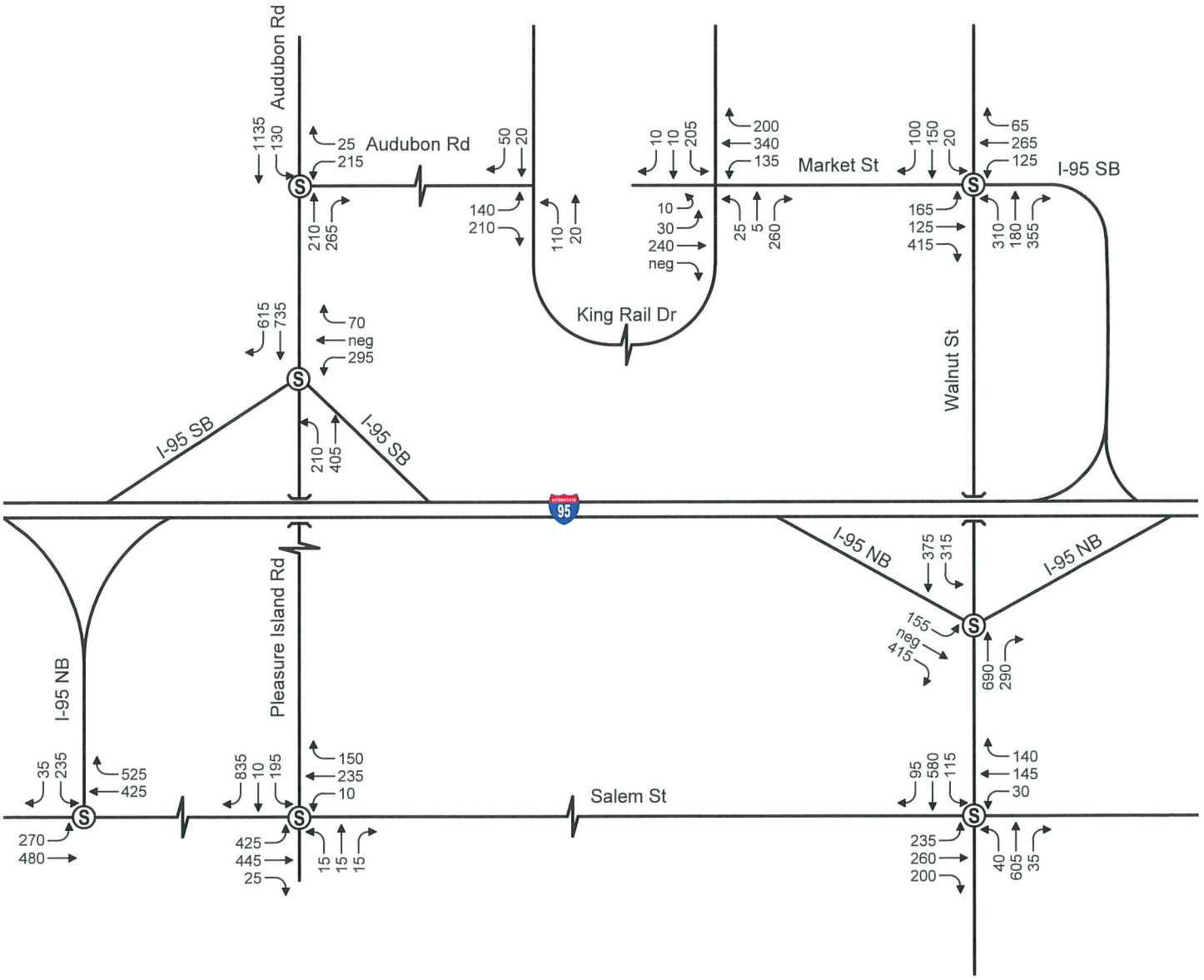
MassDOT historical traffic counts were reviewed to understand the seasonality of count data collected in the month of November. The statewide data for seasonal variation of traffic volumes indicate that counts in November are generally higher (by as much as three percent) than the average month. Since the November count data were found to be higher than annual average conditions, no further seasonal adjustment factors were applied to the data in order to provide a conservative analysis. The MassDOT seasonal factors are included in the Appendix to this document. Figures 3 and 4 illustrate the 2018 Existing weekday evening and Saturday midday peak hour traffic volumes.

Vehicular Accident History

To identify potential vehicle accident trends in the study area, vehicular accident data for the study area intersections were obtained from Massachusetts Department of Transportation (MassDOT) for the most recent five-year period (2011-2015) available. A summary of the MassDOT vehicle accident history is provided in Table 2 and the detailed accident data is provided in the Appendix to this document.

In addition to summarizing the accident history, accident rates were also calculated for the study area intersections. Intersection accident rates are calculated based on the number of accidents at an intersection and the volume of traffic traveling through that intersection on a daily basis. The MassDOT average intersection accident rate for District 4 (the MassDOT district designation for the Town of Lynnfield/Wakefield) is 0.73 for signalized intersections and 0.56 for unsignalized intersections. In other

Ⓢ Signalized Intersection
neg = Negligible

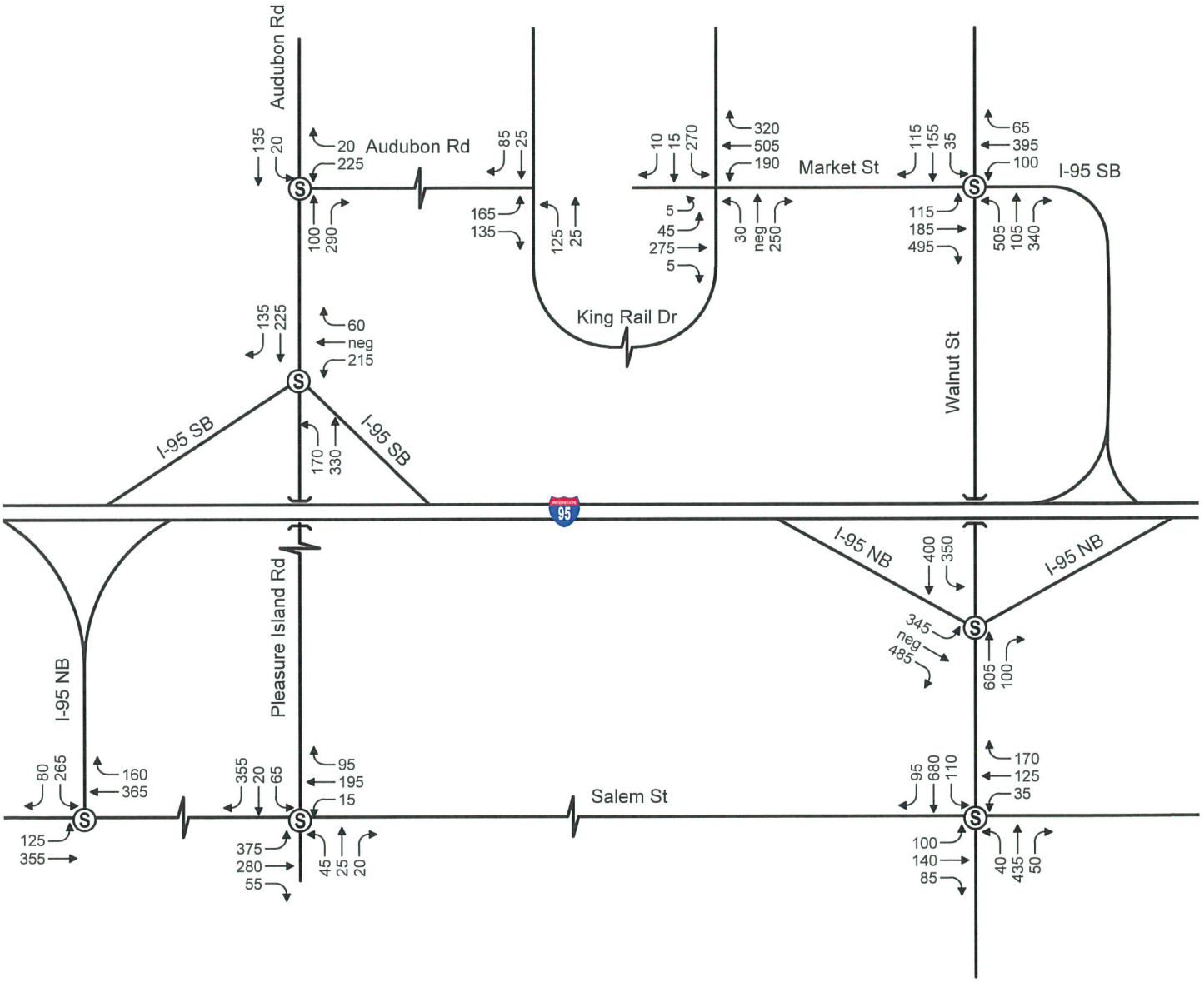


Not to Scale

2018 Existing Conditions
Weekday Evening Peak Hour Traffic Volumes
MarketStreet
Lynnfield, Massachusetts

Figure 3

Ⓢ Signalized Intersection
neg = Negligible



Not to Scale

2018 Existing Conditions
Saturday Midday Peak Hour Traffic Volumes
MarketStreet
Lynnfield, Massachusetts

Figure 4

words, on average, 0.73 accidents occurred per million vehicles entering signalized intersections and 0.56 accidents occurred per million vehicles entering unsignalized intersections throughout District 4. The accident rate worksheets for the study area intersections are included in the Appendix to this document.

As shown in Table 2, only one of the study area intersections had calculated accident rate over the district average, Walnut Street at Salem Street. The majority of accidents within the study area were angle, rear-end, and sideswipe accidents which resulted in property damage only. There were no reported accidents involving non-motorists, bicyclists or pedestrians.

Table 2 Intersection Vehicular Accident Summary (2011 – 2015)

	I-95 SB Ramps at Walnut Street and Market Street	I-95 NB Ramps at Walnut Street	Walnut Street at Salem Street	King Rail Drive at Market Street	King Rail Drive at Audubon Road	Audubon Road at Site Driveway	I-95 SB Ramps at Audubon Road	Audubon Road at Salem Street	I-95 NB Ramps at Salem Street
Signalized?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
MassDOT Average Accident Rate	0.73	0.73	0.73	0.56	0.56	0.73	0.73	0.73	0.56
Calculated Accident Rate	0.67	0.31	0.76	0.00	0.00	0.40	0.02	0.35	0.25
Exceeds Average?	No	No	Yes	No	No	No	No	No	No
Year									
2011	1	4	1	0	0	0	0	0	0
2012	1	2	6	0	0	3	0	2	2
2013	6	0	7	0	0	2	0	4	2
2014	9	6	10	0	0	3	0	4	5
2015	13	2	13	0	0	8	1	7	1
Total	30	14	37	0	0	16	1	17	10
Average	6.00	2.80	7.40	0.00	0.00	3.20	0.20	3.40	2.00
Accident Type									
Angle	8	6	10	0	0	4	0	3	5
Head-on	7	3	3	0	0	0	0	1	2
Rear-end	11	3	5	0	0	5	0	5	1
Rear-to-rear	0	0	0	0	0	0	0	1	0
Sideswipe, opposite direction	0	0	1	0	0	0	0	1	0
Sideswipe, same direction	4	1	12	0	0	2	0	5	0
Single vehicle accident	0	1	5	0	0	5	1	1	2
Not Reported/Unknown	0	0	1	0	0	0	0	0	0
Severity									
Fatal Injury	0	0	1	0	0	0	0	0	0
Non-Fatal Injury	6	4	4	0	0	5	1	3	4
Property Damage Only	24	10	32	0	0	11	0	14	6
Time of Day									
Weekday ,7:00 AM - 9:00 AM	2	0	6	0	0	3	0	5	1
Weekday, 4:00 – 6:00 PM	4	1	3	0	0	1	0	3	0
Saturday 11:00 AM – 2:00 PM	1	0	1	0	0	0	0	0	0
Weekday, other time	15	11	21	0	0	9	1	8	6
Weekend, other time	8	2	6	0	0	3	0	1	3
Pavement Conditions									
Dry	19	11	30	0	0	13	1	12	7
Wet	7	3	0	0	0	2	0	3	3
Snow	3	0	2	0	0	1	0	1	0
Ice	1	0	5	0	0	0	0	0	0
Slush	0	0	0	0	0	0	0	1	0
Not Reported/Unknown	0	0	0	0	0	0	0	1	0
Non-Motorist (bike, pedestrian)	0	0	0	0	0	0	0	0	0

Source: MassDOT crash portal, accessed November 2017.

Pedestrian and Bicycle Facilities

A field inventory was conducted to determine the current availability of pedestrian facilities in the vicinity of the Site. Currently, a fairly extensive pedestrian and bicycle infrastructure is available near the Site, including continuous sidewalks along the east side of Walnut Street, the north side of Salem Street in the Town of Lynnfield, the south side of Salem Street in the Town of Wakefield, and along the east side of Audubon Road/Pleasure Island Road, and the east side of Walnut Street within the vicinity of the study area. The Site includes an extensive pedestrian and bicycle network which connects to the off-Site facilities.

3

Future Conditions

Traffic volumes in the study area were projected to the year 2025, reflecting a typical seven-year planning horizon. Independent of the proposed modification, volumes on the roadway network under year 2025 No-Build conditions were assumed to include existing traffic and new traffic resulting from background development. Anticipated Site-generated traffic volumes were added to the year 2025 No-Build traffic volumes to reflect the year 2025 Build conditions in the study area.

Background Growth

Traffic growth on area roadways is a function of the expected land development, economic activity, and changes in demographics. A frequently used procedure is to estimate an annual percentage increase and apply that increase to study area traffic volumes. An alternative procedure is to identify estimated traffic generated by specific planned major developments that would be expected to affect the Project study area roadways. For the purpose of this assessment, *both* methods were utilized.

Historic Growth

To develop the 2025 No-Build conditions, historic count data were reviewed to establish a rate at which traffic volumes can be expected to grow. MassDOT historic traffic volumes at two permanent count stations along I-95 (station 5099 south of Walnut Street and station 595 south of Peabody town line) were reviewed to identify trends. Based on this review, traffic volumes have fluctuated both upward and downward over the past five years with no specific trend. Therefore, to provide a conservative analysis, a one-percent annual growth rate was assumed for the future conditions analysis.

Site-Specific Growth

In addition to the historic growth, VHB contacted the Town of Lynnfield and the Town of Wakefield to identify any other development projects planned within the vicinity of the Site. Based on these discussions, no projects were identified which would affect traffic volumes in the vicinity of the Site.

No-Build Traffic Volumes

The 2025 No-Build traffic volumes were developed by applying the one-percent per year growth rate to the 2018 Existing conditions traffic volumes. Figures 5 and 6 display the resulting 2025 No-Build peak hour traffic volumes.

Future Roadway Conditions

Another factor affecting background transportation conditions is the implementation of roadway improvements within the study area. No roadway improvement projects have been identified by the Town of Lynnfield or the Town of Wakefield within the study area.

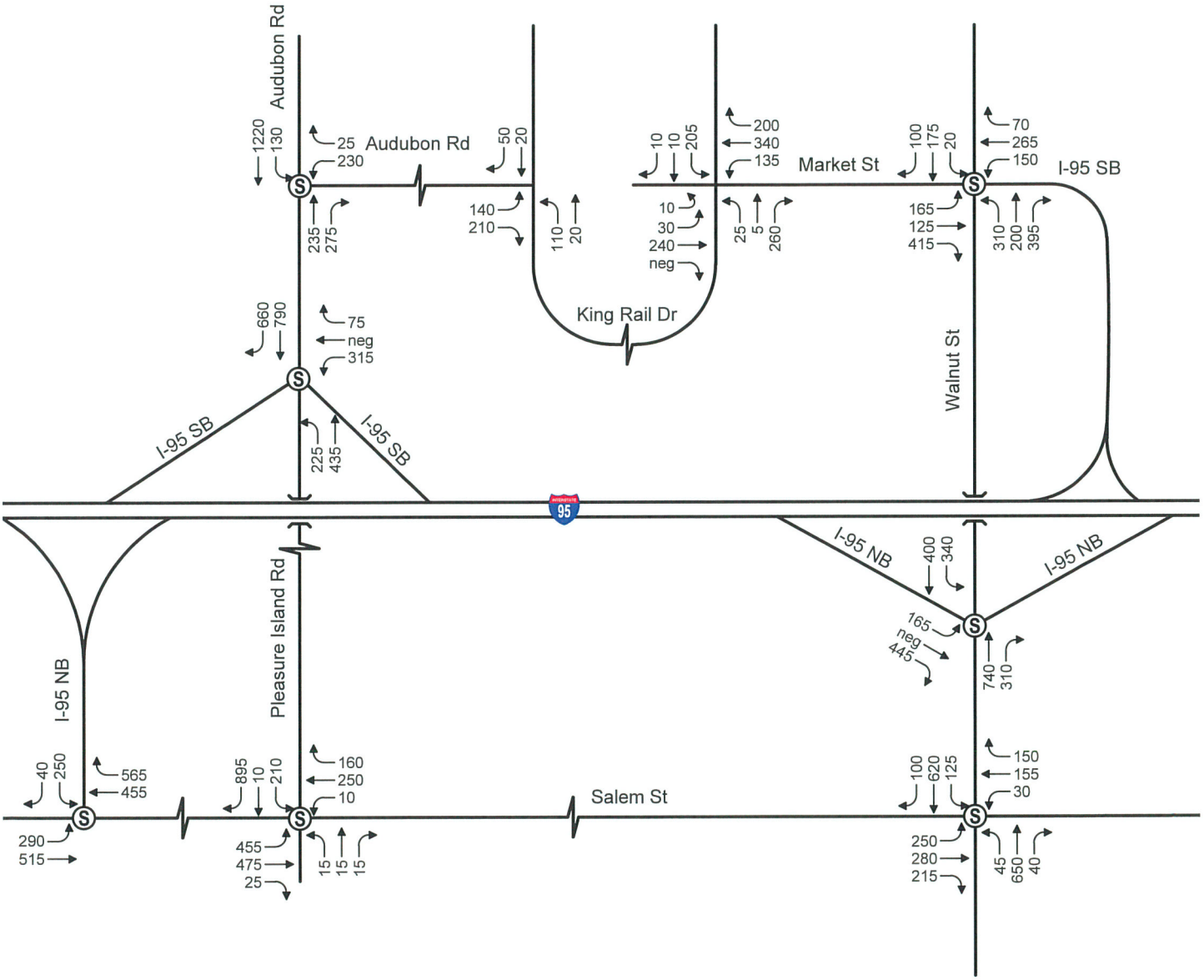
Trip Generation

The rate at which any development generates trips is dependent upon a number of factors such as size, location, and concentration of surrounding developments. As previously discussed, the proposed modification to the development plan consists of trade of 40,000 sf of office use with a 40,000 sf (eight screens, 800 seats) cinema. The remaining, approved, build-out of the development will include 26,191 sf of medical office space (including 5,500 sf urgent care clinic and 20,691 sf medical office) and 20,500 sf of retail space. Trip generation estimates for the build-out of the development including the proposed modification were projected using trip generation rates published by the Institute of Transportation Engineers (ITE) *Trip Generation, 10th Edition*[1]. The number of vehicle-trips generated by the proposed uses were estimated based on ITE LUC 445 (Multiplex Movie Theater), ITE LUC 720 (Medical-Dental Office), and ITE LUC 820 (Shopping Center). It should be noted that there is no ITE LUC for the new style of high-end theaters as is being proposed,

▼

[1] *Trip Generation, 10th Edition*, Institute of Transportation Engineers, Washington D.C., September 2017

Ⓢ Signalized Intersection
neg = Negligible

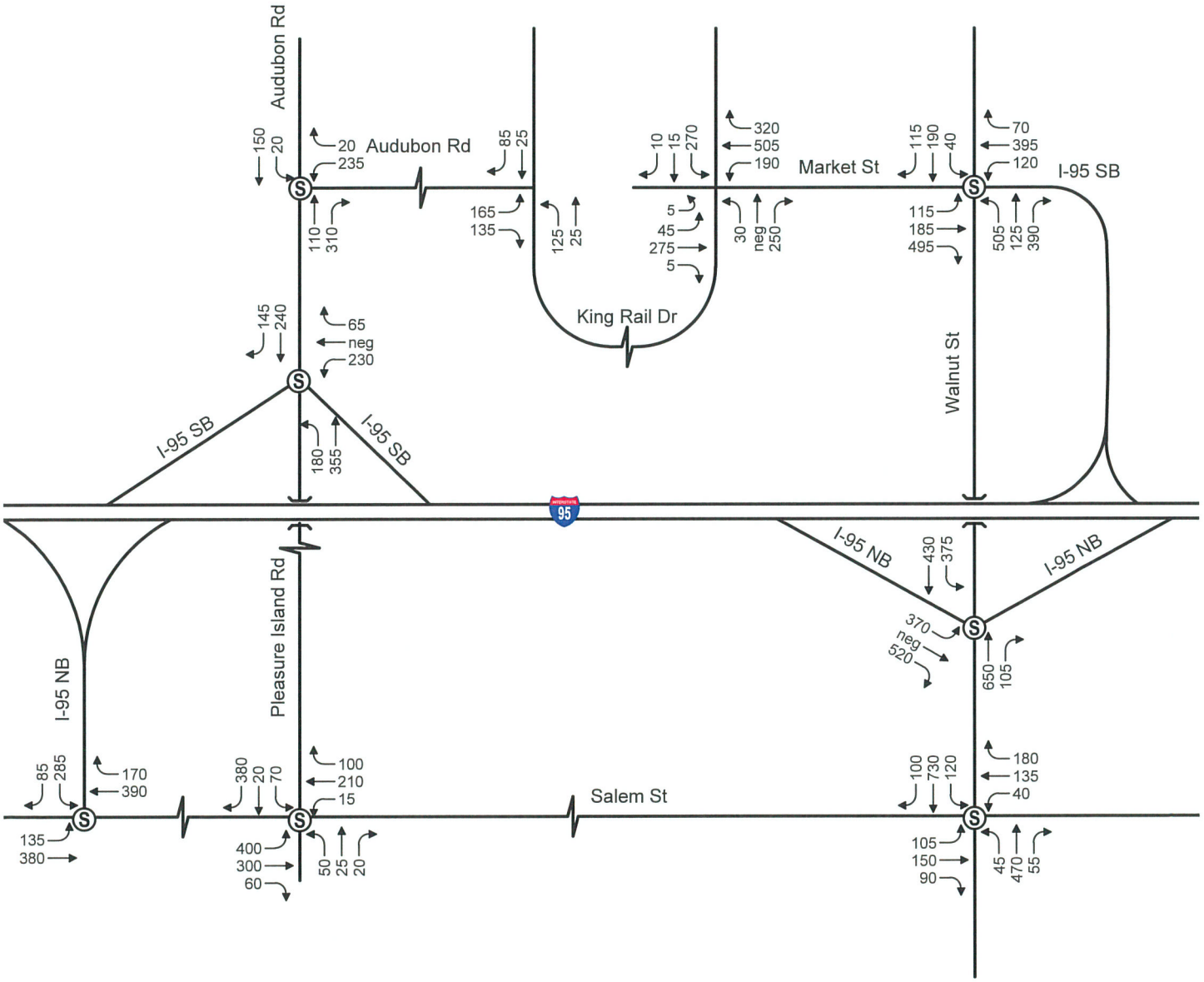


Not to Scale

2025 No-Build Conditions
Weekday Evening Peak Hour Traffic Volumes
MarketStreet
Lynnfield, Massachusetts

Figure 5

Ⓢ Signalized Intersection
neg = Negligible



Not to Scale

2025 No-Build Conditions
Saturday Midday Peak Hour Traffic Volumes
MarketStreet
Lynnfield, Massachusetts

Figure 6

therefore trip generation projections from ITE LUC 445 (Multiplex Movie Theater) are conservative.

Internal Capture

Given the mixed-use nature of the Project, it is expected that there will be shared business between the various components of the development. While these shared trips represent new trips to the individual uses, they do not represent new vehicle trips on the surrounding roadway network. Examples of this could be a customer of the proposed cinema using one of the commercial establishments on the Site. In such instances, the trips between the uses would be considered internal trips as they can be expected to have no impact to the adjacent roadway system. Guidelines provided by the National Cooperative Highway Research Program (NCHRP)[2] and the ITE *Trip Generation Handbook, 2nd Edition*[3] for the calculation of internal capture trips were used in the analysis.

Pass-by/Diverted-link Vehicle Trips

Based on an understanding of the operational characteristics of mixed-use facilities, it is expected the Project will draw a percentage of its trips from the vehicular traffic that is already on the area roadway network, particularly during peak periods. These trips, which are considered *pass-by* or *diverted-link* trips, are already on the roadway system traveling to and from locations other than the Site (such as home, work or shopping destinations).

Pass-by trips are attracted to the Site as they pass through the area, in close proximity to the Site, and do not require a noticeable detour to visit the Site. The rate at which pass-by trips are attracted to a Site is highly dependent on the type of land use, the proximity of the Site to major roadway corridors, and the location and type of nearby land uses.

Diverted-link trips are attracted from the traffic flow on roadways in proximity to the Site but require a diversion from another roadway to gain access to the Site.[4] The Site is located adjacent to major arterial roadways (I-95, Salem Street, and Walnut Street) that is anticipated to contribute vehicle trips, in the form of pass-by and diverted-link trips, to the proposed Site. An example of a multiple-stop diverted-link trip chain is

▼

[2] National Cooperative Highway Research Program Report 684: *Enhancing Internal Trip Capture Estimation for Mixed-Use Developments*, Washington D.C., Transportation Research Board

[3] Trip Generation Handbook, 2nd Edition, Institute of Transportation Engineers, Washington D.C., June 2004

[4] *Trip Generation Handbook, 3rd Edition*, Institute of Transportation Engineers, Washington D.C., August 2014

that of a restaurant patron leaving his/her place of work in the evening, traveling to the Site, and then leaving the Site to travel home.

For analysis purposes, a 34-percent and 26-percent pass-by/diverted-link trip rate was applied to the retail use (ITE pass-by data) during the weekday evening and Saturday midday peak periods, respectively, as allowed by MassDOT's updated guidelines. Pass-by adjustment was not applied to the cinema or medical office uses. Table 3 provides a summary of peak hour *net new* trip estimates for the build-out of the development with the proposed modification.

Table 3 Development Build-out Trip Generation Summary with the Proposed Modification

Peak Period	Gross Cinema Trips [1]	Gross Medical Office Trips [2]	Goss Retail Trips [3]	Gross Total	Shared Trips [4]	Pass-by Trips [5]	Net New Trips
Weekday Evening							
Enter	23	25	68	86	16	13	57
Exit	41	65	41	147	24	13	110
Total	64	90	79	233	40	26	167
Saturday Midday							
Enter	52	46	50	148	29	12	107
Exit	20	35	46	101	13	12	76
Total	72	81	96	249	42	24	183

1 Trip Generation estimate based on ITE LUC 445 (Multiplex Movie Theater) for 800 seats, using weekday PM peak of adjacent street rates and Saturday midday peak of generator rates.
2 Trip Generation estimate based on ITE LUC 720 (Medical/Dental Office) for 26,191 sf of space, using weekday PM peak of adjacent street regression equation and Saturday peak of generator rates.
3 Trip Generation estimate based on ITE LUC 820 (Shopping Center) for 20,500 sf of space weekday PM peak of adjacent street regression equation and Saturday peak of generator regression equation.
4 Internal capture rates based on NCHRP Report 684 for weekday evening and based on ITE Trip Generation Handbook, 2nd Edition for Weekday daily. Saturday daily rates assumed to be the same as weekday daily rates and Saturday midday rates assumed to be the same was weekday evening rates.
5 Pass-by rates based on ITE data.

As shown in Table 3, the build-out of the development with the proposed modification is expected to result in a total of 167 net new trips (57 entering/ 110 exiting) during the weekday evening peak hour and 183 net new trips (107 entering/76 exiting) during the Saturday midday peak hour.

It should be understood that the medical office was assumed to be open seven days a week, however the medical office portion (20,691 sf) may operate on reduced hours with reduced or no doctors/staff on weekends. Therefore, the trip generation projections during the Saturday Midday peak hour may be highly conservative.

Trip Generation Comparison – Proposed Modification

Trip generation estimates were also made for the proposed modification, the trade of 40,000 sf of office use with a 40,000 sf (eight screens, 800 seats) of cinema use. For this projection trip generation rates published by the Institute of Transportation Engineers [ITE] *Trip Generation, 10th Edition*[5] was utilized. The number of gross vehicle-trips generated by the approved uses were estimated based on ITE LUC 710 (General Office Building) and ITE LUC 445 (Multiplex Movie Theater).

Table 4 provides a gross trip generation comparison between 40,000 sf of office use with a 40,000 sf (eight screens, 800 seats) of cinema use. The trip generation estimates presented in Table 4 do not include any credits for shared trips.

Table 4 Proposed Modification Trip Generation Comparison

Peak Period	Gross Office Trips [1]	Gross Cinema Trips [2]	Net Increase
Weekday Evening			
Enter	8	23	15
Exit	40	41	1
Total	48	64	16
Saturday Midday			
Enter	11	52	41
Exit	10	20	10
Total	21	72	51

1 Trip Generation estimate based on ITE LUC 710 (General Office Building) for 40,000 sf of space.
2 From Table 3.

As shown in Table 4, when compared to the approved 40,000 sf of office use, the proposed modification of 40,000 sf (eight screens, 800 seats) of cinema use is expected to result in an increase of 16 total trips (15 entering/1 exiting) during the weekday evening peak hour and an increase of 51 total trips (41 entering/10 exiting) during the Saturday midday peak hour. It should be understood that the trading out 40,000 sf of office space with 40,000 sf of cinema space represents a complimentary change in the site from a traffic generation perspective most days of the week.

▼

[5] *Trip Generation, 10th Edition*, Institute of Transportation Engineers, Washington D.C., September 2017

Trip Generation Comparison – Development Build-out

Trip generation estimates were also made for the remaining approved build-out of the development which includes approximately 37,174 sf retail and approximately 67,257 sf office. For this projection trip generation rates published by the Institute of Transportation Engineers [ITE] *Trip Generation, 10th Edition*[6] was utilized. The number of vehicle-trips generated by the approved uses were estimated based on ITE LUC 710 (General Office Building) and ITE LUC 820 (Shopping Center).

Table 5 provides a comparison between the remaining approved build-out of the development and the build-out of the development with the proposed modification.

Table 5 Build-out Trip Generation Comparison

Peak Period	Approved Build-out [1]	Build-out with Proposed Modification [2]	Net Increase
Weekday Evening			
Enter	51	57	6
Exit	101	110	9
Total	152	167	15
Saturday Midday			
Enter	81	107	26
Exit	73	76	3
Total	154	183	29

1 Trip Generation estimate based on ITE LUC 710 (General Office Building) for 67,257 sf of space and ITE LUC 820 (Shopping Center) for 37,098 sf of space.
2 From Table 3.

As shown in Table 5, when compared to the remaining approved build-out of the development, the build-out of the development with the proposed modification is expected to result in an increase of 15 total trips (6 entering/9 exiting) during the weekday evening peak hour and an increase of 29 total trips (26 entering/3 exiting) during the Saturday midday peak hour.

▼

[6] *Trip Generation, 10th Edition*, Institute of Transportation Engineers, Washington D.C., September 2017

Trip Distribution and Assignment

The directional distribution of trips approaching and departing the development is a function of several variables. These include the population densities, shopping opportunities, competing uses, existing travel patterns, and the efficiency of the roadways leading to the Site.

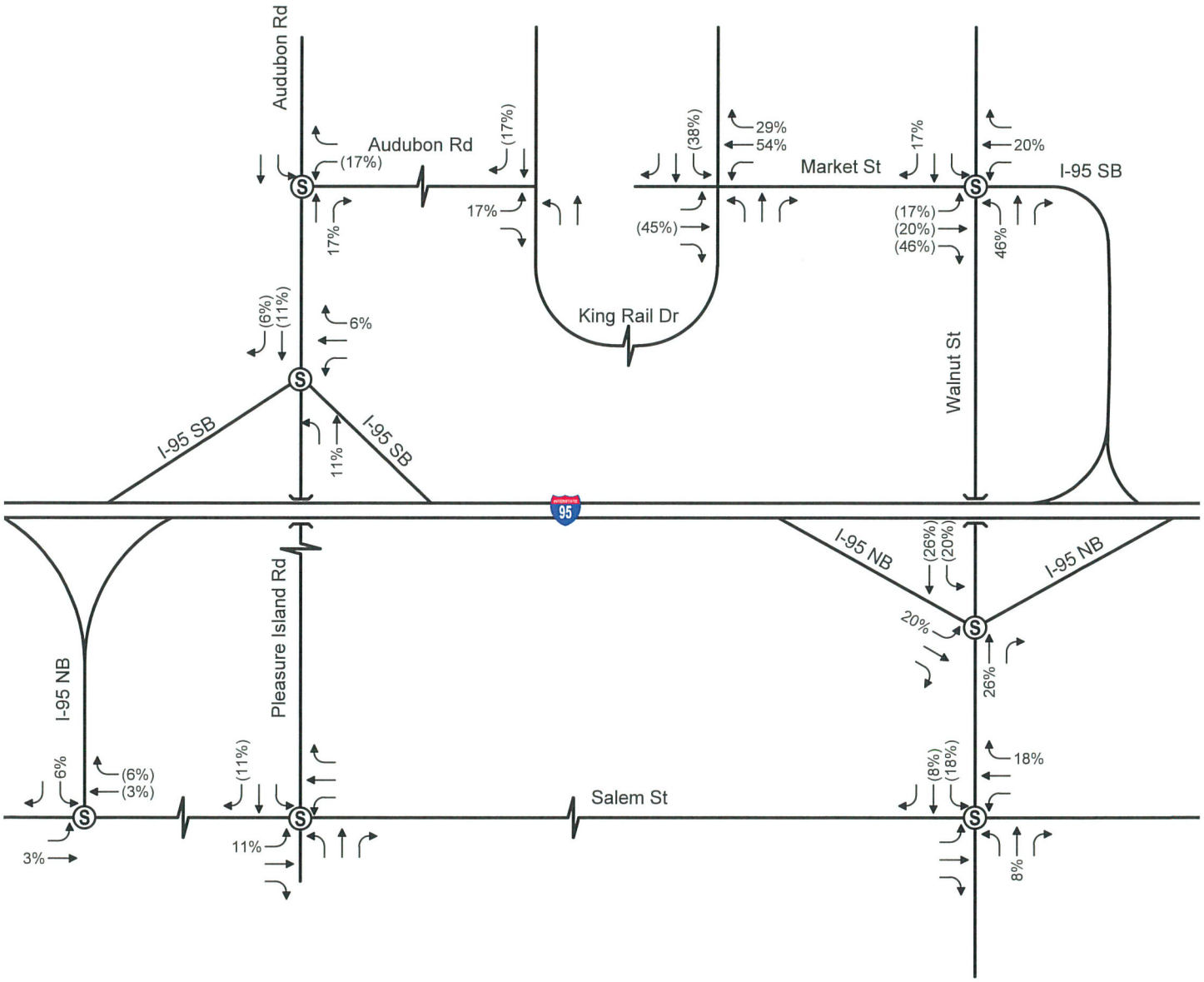
Due to the varying trip characteristics of the redevelopment uses – cinema, medical office, and retail – each use is expected to experience a different distribution pattern. Thus, regional trip distribution percentages were calculated separately for the medical office component and the cinema and retail components.

The medical office trip distribution patterns were determined using journey-to-work data derived from the 2010 US Census for the Town of Lynnfield. The trip distribution for the cinema and retail components were developed based on a gravity model utilizing the 2010 US Census data for communities included in the market trade area. Based on the distribution of population within the projected market trade area, arrival and departure patterns for Project-related trips were estimated and adjusted, if appropriate, based on known local factors such as locations of competing opportunities and efficiency of local roadways. The assignment of Site-generated trips to specific travel routes was based on observed traffic flow conditions on available routes, and the assumption that most motorists will seek the fastest and most direct routes to and from the Site. The trip distribution patterns are shown in Table 6 and the calculations are included in the Appendix to this document. Figures 7 and 8 illustrate the medical office, and cinema and retail trip distributions, respectively.

Table 6 Trip Distribution Summary

		Percent of New Site-Generated Trips Assigned to Route	
Travel Route	**Direction (to/from)**	**Medical Office**	**cinema/Retail**
Route 128/I-95	North	26%	15%
Route 128/I-95	South	26%	35%
Walnut Street	North	17%	14%
Walnut Street	South	8%	6%
Salem Street	East	18%	7%
Salem Street	West	3%	13%
Montrose Avenue	South	2%	10%
Total		100%	100%

The projected site-generated trips, summarized in Table 3, were distributed on the study area roadways using the trip distribution shown in Table 6 and added to the

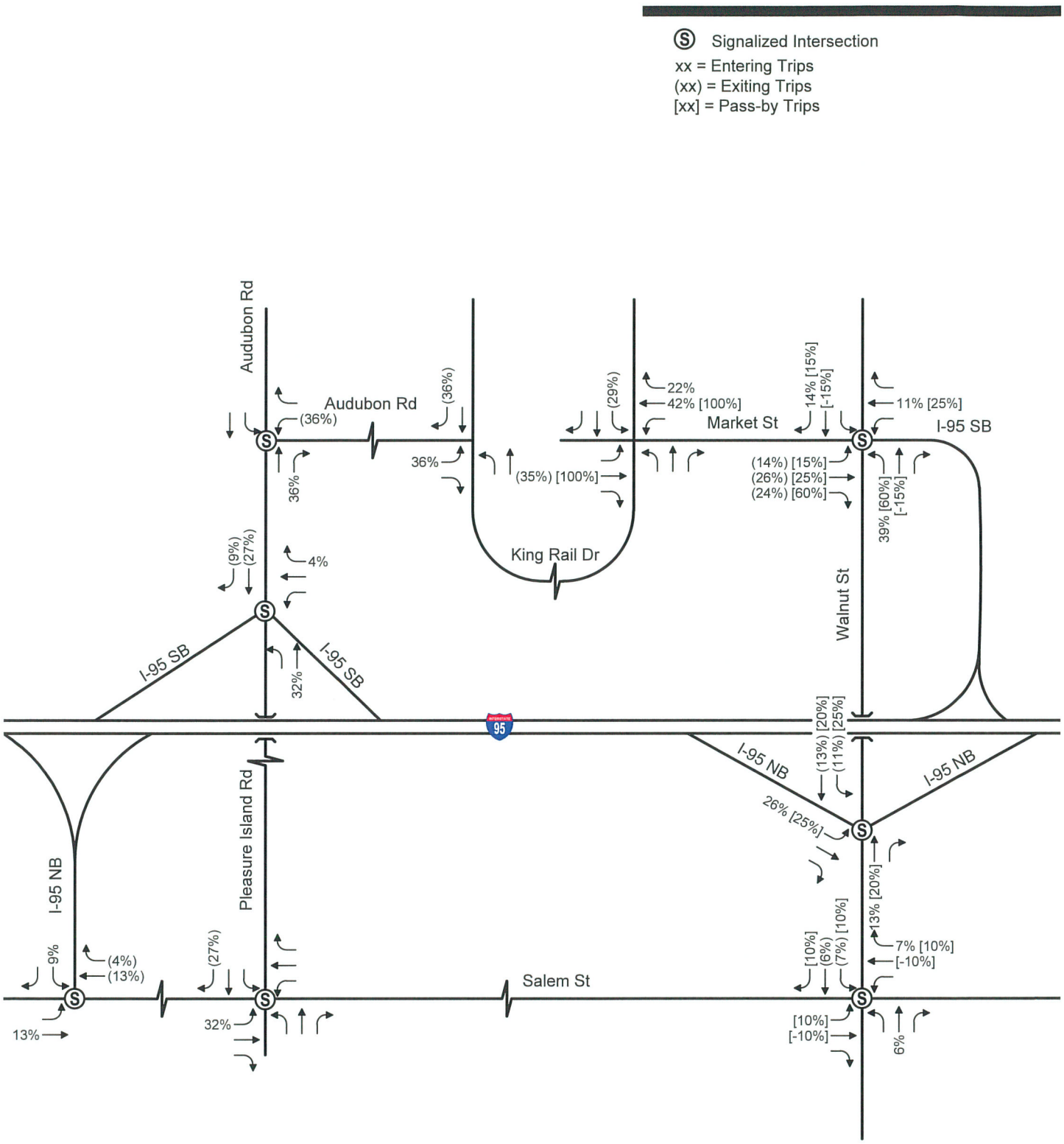


Not to Scale

Trip Distribution - Medical Office

Figure 7

MarketStreet
Lynnfield, Massachusetts



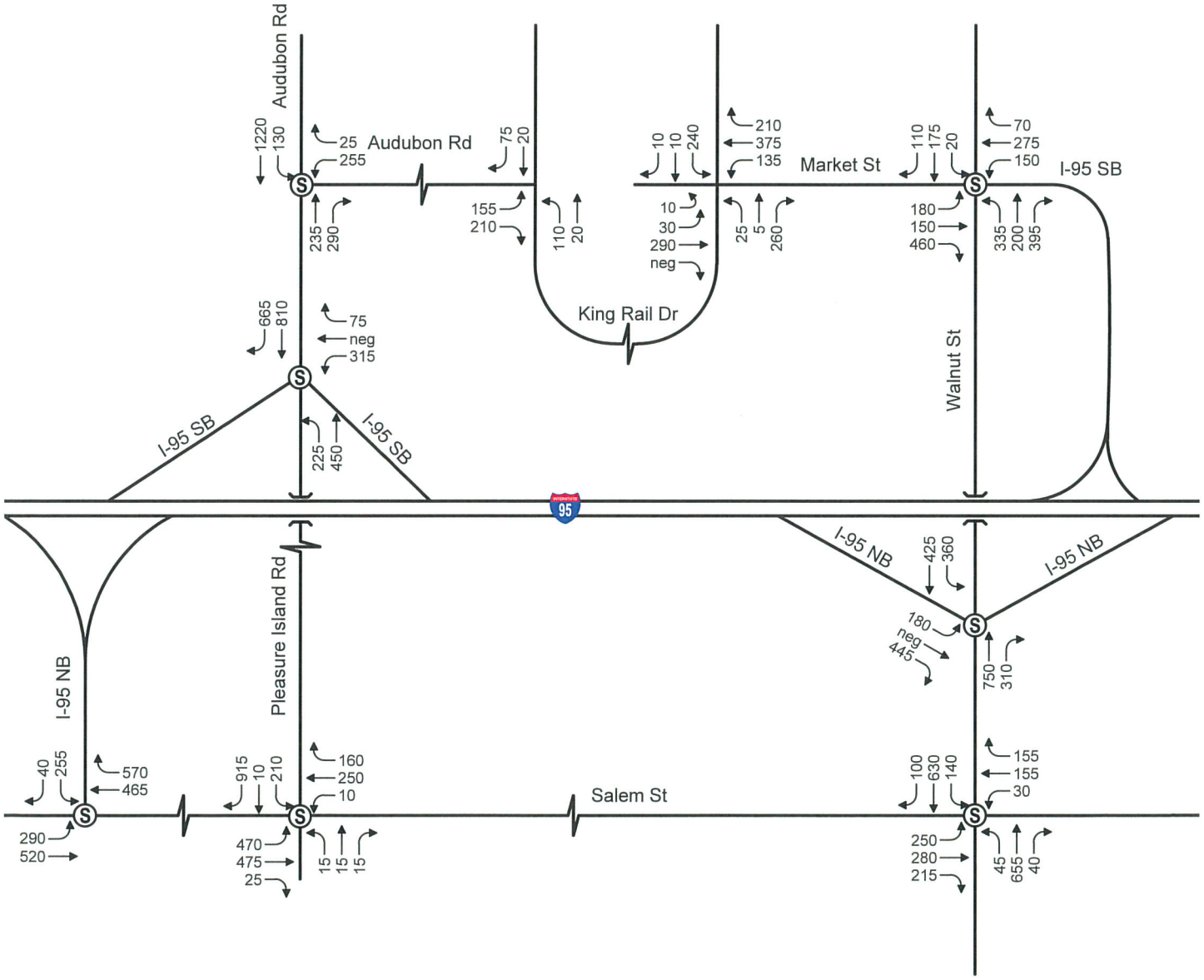
Not to Scale

Trip Distribution - Retail and Town Center Theater
MarketStreet
Lynnfield, Massachusetts

Figure 8

2025 No-Build peak hour traffic volumes to develop the 2025 Build peak hour traffic volumes. The 2025 Build traffic volumes are shown in Figures 9 and 10.

Ⓢ Signalized Intersection
neg = Negligible

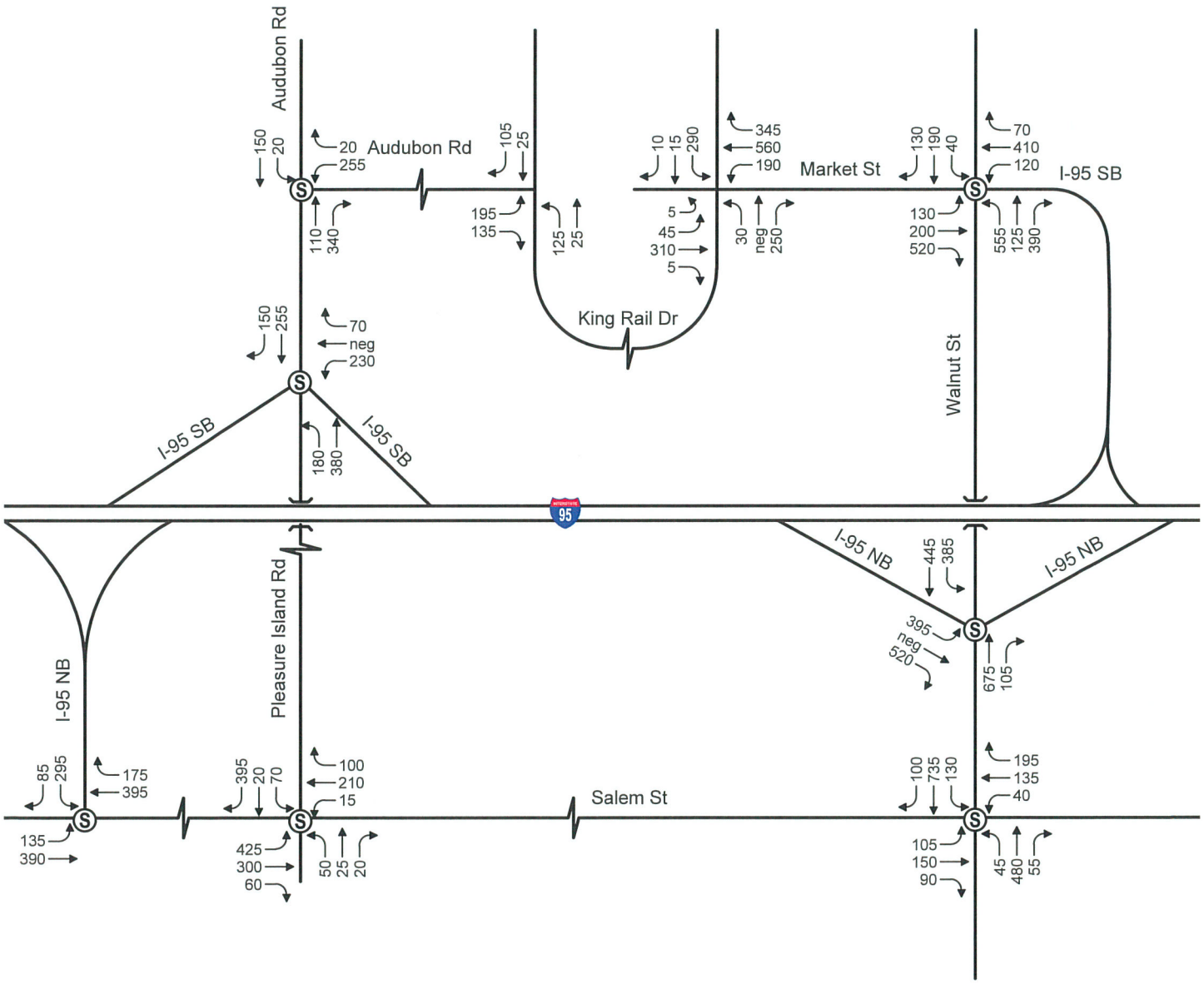


Not to Scale

2025 Build Conditions
Weekday Evening Peak Hour Traffic Volumes
MarketStreet
Lynnfield, Massachusetts

Figure 9

Ⓢ Signalized Intersection
neg = Negligible



Not to Scale

2025 Build Conditions
Saturday Midday Peak Hour Traffic Volumes
MarketStreet
Lynnfield, Massachusetts

Figure 10

4

Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic within the study area. To assess quality of flow, roadway capacity analyses were conducted with respect to the 2018 Existing conditions and projected 2025 No-Build and 2025 Build traffic volume conditions. Capacity analyses provide an indication of the adequacy of the roadway facilities to serve the anticipated traffic demands.

Level-of-Service and Delay Criteria

Level-of-service (LOS) is the term used to denote the different operating conditions that occur on a given roadway segment under various traffic volume loads. It is a qualitative measure of the effect of a number of factors including roadway geometrics, speed, travel delay, freedom to maneuver, and safety. Level-of-service provides an index to the operational qualities of a roadway segment or an intersection. Level-of-service designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. Level-of-service at intersections is a function of average vehicle control delay and has different ranges for signalized and unsignalized intersections. Therefore, a minor increase in vehicle delay may result in a change in level-of-service if the intersection is operating close to the upper range for a particular level-of-service designation. Table 7 summarizes the level-of-service criteria.

Table 7 Level-of-service Criteria

Level-of-service	Signalized Intersection Control Delay (sec/veh)	Unsignalized Intersection Control Delay (sec/veh)
A	0 – 10	0 – 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

As shown in Table 7, an increase in intersection control delay from 80 seconds to 81 seconds would result in a change in level-of-service from LOS E to LOS F, however the increase in intersection control delay is only one second.

For this study, capacity analyses were completed for the signalized and unsignalized study area intersections. Level-of-service (LOS) designation is reported differently for signalized intersections and unsignalized intersections. For signalized intersections, the analysis considers the operation of each lane or lane group entering the intersection and assigns a LOS designation to each. Overall intersection data is then calculated in order to represent the overall conditions at the intersection. The evaluation criteria used to analyze the signalized study area intersections is based on the percentile-delay method (Synchro results). For unsignalized intersections, the analysis assumes that traffic on the mainline is not affected by traffic on the side streets. The LOS is determined primarily for left-turns from the main street and all movements from the minor street. The evaluation criteria used to analyze the unsignalized study area intersections is based on the 2010 Highway Capacity Manual (HCM)[7].

Level-of-Service Analysis

Levels-of-service analyses were conducted for the 2018 Existing, 2025 No-Build, and 2025 Build conditions for the signalized and unsignalized study-area intersections.

7 Transportation Research Board, Highway Capacity Manual, Washington, D.C., 2010.

Signalized Intersection Capacity Analyses

Table 8 presents an overall intersection summary of the capacity analyses for the signalized intersections in the study area and Table 9 presents a detailed summary of the capacity analyses for the signalized intersections in the study area. The capacity analyses worksheets are included in the Appendix to this document.

As shown in the Tables 8 and 9, the majority of the signalized study area intersections are expected to experience minimal operational impacts (an increase in overall intersection delay of two seconds or less) with the addition of the proposed Project trips. Two of the signalized study area intersections are expected to experience minor operational impacts during the Saturday midday peak hour only; I-95 Southbound Ramps at Walnut Street and Market Street (an increase in overall intersection delay of ten seconds) and I-95 Northbound Ramps at Walnut Street (a change in overall intersection delay of eight seconds). It should be noted that the Saturday midday peak hour analysis is highly conservative as it considers the medical office, which accounts for up to approximately 33-percent of the gross trip generation for the build-out of the development with the proposed modification, is open and fully operational on a Saturday. The operational impacts at the signalized study area intersections would be imperceptible to the average driver along Walnut Street, Salem Street, and Audubon Road/Pleasure Island Road.

It should be noted that the analysis results presented in Tables 8 and 9 do not include the potential adaptive signal system improvement discussed in Chapter 5.

Table 8 Overall Signalized Intersection Capacity Analysis Summary

Location	Overall Delay [a] 2018 Existing Conditions	2025 No-Build Conditions	2025 Build Conditions	Increase (No Build to Build)
I-95 Southbound Ramps at Walnut Street and Market Street				
Weekday Evening	20	20	21	1
Saturday Midday	48	39	49	10
I-95 Northbound Ramps at Walnut Street				
Weekday Evening	42	48	50	2
Saturday Midday	49	64	72	8
Walnut Street at Salem Street				
Weekday Evening	44	44	45	1
Saturday Midday	26	27	27	0
Audubon Road/Pleasure Island Road at Audubon Road				
Weekday Evening	10	11	12	1
Saturday Midday	6	6	6	0
I-95 Southbound Ramps at Audubon Road/Pleasure Island Road				
Weekday Evening	13	14	14	0
Saturday Midday	9	9	9	0
Audubon Road/Pleasure Island Road at Salem Street				
Weekday Evening	17	18	19	1
Saturday Midday	10	10	10	0
I-95 Northbound Ramps at Salem Street				
Weekday Evening	9	10	10	0
Saturday Midday	8	8	9	1

a. Average total delay, in seconds per vehicle.

Table 9 Signalized Intersection Capacity Analysis

		2018 Existing Conditions					2025 No-Build Conditions					2025 Build Conditions				
Location	Movement	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q	v/c	Del	LOS	50 Q	95 Q
I-95 Southbound Ramps at Walnut Street and Market Street																
Weekday	EB L	0.78	56	E	112	166	0.77	56	E	107	165	0.80	58	E	117	181
Evening	EB T	0.33	32	C	75	111	0.32	32	C	73	111	0.36	32	C	86	128
	EB R	0.51	4	A	25	58	0.49	4	A	26	63	0.52	5	A	43	90
	WB L	0.31	22	C	58	85	0.37	23	C	71	101	0.38	22	C	69	99
	WB T/R	0.54	26	C	170	216	0.55	27	C	174	222	0.55	26	C	176	226
	NB L	0.56	12	B	46	m71	0.56	11	B	47	m68	0.64	15	B	56	m82
	NB T/R	0.59	9	A	37	m105	0.68	10	B	78	m112	0.69	12	B	86	m116
	SB L	0.09	31	C	11	33	0.09	32	C	10	34	0.09	34	C	11	34
	SB T/R	0.52	32	C	147	#264	0.51	33	C	141	#313	0.57	36	D	157	#328
	Overall		**20**	**B**				**20**	**B**				**21**	**C**		
Saturday	EB L	>1.20	>120	F	~123	#236	>1.20	>120	F	~113	#229	>1.20	>120	F	~139	#260
Midday	EB T	0.60	46	D	123	197	0.58	45	D	119	194	0.63	47	D	129	208
	EB R	0.55	5	A	32	97	0.55	6	A	46	123	0.56	7	A	57	147
	WB L	0.41	29	C	60	90	0.41	29	C	60	107	0.42	30	C	60	107
	WB T/R	1.03	79	E	~404	#469	0.87	49	D	298	#482	0.90	53	D	312	#508
	NB L	0.81	26	C	248	m396	0.83	27	C	240	m361	0.92	35	C	308	m#464
	NB T/R	0.46	9	A	92	m146	0.53	11	B	119	m203	0.53	11	B	119	m185
	SB L	0.15	30	C	19	47	0.18	31	C	21	52	0.20	32	C	22	52
	SB T/R	0.55	32	C	144	236	0.62	35	C	174	274	0.69	39	D	184	288
	Overall		**48**	**D**				**39**	**D**				**49**	**D**		
I-95 Northbound Ramps at Walnut Street																
Weekday	EB L	0.45	37	D	96	151	0.45	37	D	98	157	0.50	38	D	109	171
Evening	EB R	0.76	45	D	157	205	0.77	45	D	163	217	0.77	45	D	163	217
	NB T	0.85	79	E	490	m507	0.93	81	F	535	m506	0.94	81	F	544	m509
	NB R	0.20	0	A	0	m0	0.21	0	A	0	m0	0.21	0	A	0	m0
	SB L	0.85	38	D	112	#335	1.00	73	E	~206	#429	1.06	89	F	~237	#460
	SB T	0.32	8	A	98	192	0.35	9	A	106	213	0.37	9	A	117	211
	Overall		**42**	**D**				**48**	**D**				**50**	**D**		
Saturday	EB L	0.90	65	E	222	#381	0.98	79	E	256	#446	1.04	95	F	~298	#486
Midday	EB R	0.81	50	D	172	#242	0.87	72	E	198	#300	0.87	71	E	198	#300
	NB T	0.69	72	E	184	321	0.74	73	E	194	345	0.77	73	E	203	365
	NB R	0.07	0	A	0	m0	0.07	0	A	0	m0	0.07	0	A	0	m0
	SB L	0.96	51	D	133	#291	1.12	100	F	~142	#343	>1.20	>120	F	~174	#382
	SB T	0.37	12	B	137	217	0.39	12	B	143	224	0.40	12	B	154	238
	Overall		**49**	**D**				**64**	**E**				**72**	**E**		

a. Volume to capacity ratio.
b. Average total delay, in seconds per vehicle.
c. Level-of-service.
d. 50th percentile queue, in feet.
e. 95th percentile queue, in feet.
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
m Volume for 95th percentile queue is metered by upstream signal.

Table 9 Signalized Intersection Capacity Analysis (continued)

		2018 Existing Conditions					2025 No-Build Conditions					2025 Build Conditions				
Location	Movement	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q	v/c	Del	LOS	50 Q	95 Q
Walnut Street at Salem Street																
Weekday	EB L	0.70	35	D	131	182	0.69	34	C	130	192	0.69	34	C	130	192
Evening	EB T/R	0.87	44	D	289	379	0.88	45	D	291	411	0.88	45	D	291	411
	WB L	0.39	49	D	21	47	0.37	48	D	19	48	0.37	48	D	19	48
	WB T	0.64	50	D	108	150	0.59	47	D	99	160	0.59	47	D	99	160
	WB R	0.44	9	A	0	39	0.43	9	A	0	53	0.43	9	A	0	54
	NB L/T/R	0.97	100	F	439	#786	1.09	98	F	~592	#900	1.11	100	F	~605	#908
	SB L	0.34	7	A	11	m21	0.39	8	A	12	m24	0.44	9	A	14	m30
	SB T	0.32	6	A	30	47	0.34	6	A	34	57	0.35	6	A	36	65
	SB R	0.06	0	A	0	m0	0.06	0	A	0	m0	0.06	0	A	0	m0
	Overall		**44**	**D**				**44**	**D**				**45**	**D**		
Saturday	EB L	0.41	43	D	58	97	0.40	43	D	56	101	0.40	44	D	56	101
Midday	EB T/R	0.58	34	C	129	193	0.57	34	C	126	204	0.57	34	C	126	204
	WB L	0.32	47	D	23	55	0.34	47	D	25	60	0.34	47	D	25	60
	WB T	0.64	56	E	85	146	0.67	57	E	90	154	0.67	57	E	90	154
	WB R	0.54	17	B	0	59	0.54	17	B	0	63	0.56	18	B	0	64
	NB L/T/R	0.68	24	C	277	415	0.73	26	C	304	467	0.74	27	C	314	481
	SB L	0.22	16	B	47	m73	0.25	17	B	55	m75	0.28	17	B	60	m81
	SB T	0.32	22	C	176	239	0.35	24	C	201	m253	0.35	24	C	204	m256
	SB R	0.05	0	A	0	m0	0.06	0	A	0	m0	0.06	0	A	0	m0
	Overall		**26**	**C**				**27**	**C**				**27**	**C**		
Audubon Road/Pleasure Island Road at Audubon Road																
Weekday	WB L	0.50	24	C	35	80	0.53	26	C	40	85	0.57	27	C	45	93
Evening	NB T	0.25	2	A	12	27	0.27	2	A	14	29	0.28	2	A	15	29
	SB T	0.78	11	B	137	213	0.80	11	B	154	234	0.81	12	B	160	235
	Overall		**10**	**B**				**11**	**B**				**12**	**B**		
Saturday	WB L	0.34	10	B	15	29	0.35	10	B	16	31	0.37	10	B	18	33
Midday	NB T	0.37	3	A	6	15	0.35	3	A	5	22	0.37	3	A	5	22
	SB T	0.19	7	A	10	18	0.17	7	A	8	20	0.17	7	A	8	21
	Overall		**6**	**A**				**6**	**A**				**6**	**A**		

a. Volume to capacity ratio.
b. Average total delay, in seconds per vehicle.
c. Level-of-service.
d. 50th percentile queue, in feet.
e. 95th percentile queue, in feet.
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
m Volume for 95th percentile queue is metered by upstream signal.

Table 9 Signalized Intersection Capacity Analysis (continued)

		2018 Existing Conditions					2025 No-Build Conditions					2025 Build Conditions				
Location	Movement	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q	v/c	Del	LOS	50 Q	95 Q
I-95 Southbound Ramps at Audubon Road/Pleasure Island Road																
Weekday	WB L/T	0.73	29	C	101	188	0.72	29	C	100	199	0.72	29	C	101	199
Evening	WB R	0.04	0	A	0	0	0.04	0	A	0	0	0.04	0	A	0	0
	NB L	0.64	18	B	32	#109	0.70	22	C	36	#137	0.71	22	C	37	#139
	NB T	0.22	7	A	32	60	0.24	7	A	36	66	0.25	7	A	37	68
	SB T	0.73	21	C	121	185	0.74	21	C	125	198	0.75	21	C	130	204
	SB R	0.45	1	A	0	0	0.46	1	A	0	0	0.46	1	A	0	0
	Overall		**13**	**B**				**14**	**B**				**14**	**B**		
Saturday	WB R/T	0.54	19	B	50	102	0.54	19	B	50	108	0.54	19	B	50	108
Midday	WB R	0.04	0	A	0	0	0.04	0	A	0	0	0.04	0	A	0	0
	NB L	0.42	8	A	23	45	0.39	8	A	21	48	0.39	8	A	21	48
	NB T	0.24	6	A	23	37	0.22	6	A	21	40	0.24	6	A	23	43
	SB T	0.25	13	B	24	46	0.26	13	B	25	48	0.27	13	B	27	51
	SB R	0.10	0	A	0	0	0.10	0	A	0	0	0.11	0	A	0	0
	Overall		**9**	**A**				**9**	**A**				**9**	**A**		
Audubon Road/Pleasure Island Road at Salem Street																
Weekday	EB L	0.63	12	B	87	145	0.67	13	B	99	164	0.69	14	B	103	176
Evening	EB T/R	0.50	10	A	97	162	0.53	10	B	110	181	0.53	10	B	110	181
	WB L	0.07	25	C	4	16	0.08	25	C	4	17	0.08	25	C	4	17
	WB T	0.43	27	C	51	81	0.45	27	C	52	85	0.45	27	C	52	85
	WB R	0.20	3	A	0	25	0.21	3	A	0	27	0.21	3	A	0	27
	NB L	0.08	20	C	7	18	0.06	20	B	5	19	0..06	20	B	5	19
	NB T/R	0.10	13	B	7	20	0.07	14	B	5	24	0.07	14	B	5	24
	SB L/T	0.73	39	D	84	#190	0.77	43	D	88	#199	0.77	43	D	88	#199
	SB R	0.85	17	B	189	#505	0.88	20	B	216	#550	0.90	22	C	230	#570
	Overall		**17**	**B**				**18**	**B**				**19**	**B**		
Saturday	EB L	0.56	9	A	48	112	0.60	9	A	53	123	0.63	10	B	57	133
Midday	EB T/R	0.33	6	A	37	89	0.36	6	A	41	98	0.36	6	A	41	98
	WB L	0.08	20	C	4	19	0.08	21	C	4	19	0.08	21	C	4	19
	WB T	0.30	20	C	31	61	0.30	20	C	32	64	0.31	21	C	32	64
	WB R	0.14	3	A	0	18	0.14	3	A	0	20	0.14	3	A	0	20
	NB L	0.26	22	C	17	36	0.23	22	C	15	41	0.23	22	C	15	41
	NB T/R	0.18	14	B	9	26	0.15	14	B	7	30	0.15	14	B	7	30
	SB L/T	0.41	25	C	28	63	0.41	25	C	28	65	0.40	25	C	29	65
	SB R	0.39	3	A	16	41	0.39	3	A	17	47	0.41	3	A	19	50
	Overall		**10**	**A**				**10**	**A**				**10**	**A**		

a. Volume to capacity ratio.
b. Average total delay, in seconds per vehicle.
c. Level-of-service.
d. 50th percentile queue, in feet.
e. 95th percentile queue, in feet.
95th percentile volume exceeds capacity, queue may be longer.

Table 9 Signalized Intersection Capacity Analysis (continued)

		2018 Existing Conditions					2025 No-Build Conditions					2025 Build Conditions				
Location	Movement	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q	v/c	Del	LOS	50 Q	95 Q
I-95 Northbound Ramps at Salem Street																
Weekday	EB L/T	1.11dl	13	B	65	129	>1.20dl	15	B	77	147	1.38dl	15	B	80	160
Evening	WB T/R	0.50	3	A	23	49	0.53	3	A	28	54	0.53	3	A	28	56
	SB L	0.42	20	C	27	72	0.45	22	C	32	86	0.46	23	C	34	86
	SB R	0.02	0	A	0	0	0.02	0	A	0	0	0.02	0	A	0	0
	Overall		**9**	**A**				**10**	**A**				**10**	**A**		
Saturday	EB L/T	0.52	9	A	29	62	0.56	10	A	32	71	0.57	10	A	34	73
Midday	WB T/R	0.39	6	A	21	46	0.42	6	A	24	54	0.43	6	A	25	56
	SB L	0.36	12	B	18	47	0.38	13	B	21	54	0.39	13	B	22	59
	SB R	0.05	0	A	0	0	0.06	0	A	0	0	0.06	0	A	0	0
	Overall		**8**	**A**				**8**	**A**				**9**	**A**		

a. Volume to capacity ratio.
b. Average total delay, in seconds per vehicle.
c. Level-of-service.
d. 50th percentile queue, in feet.
e. 95th percentile queue, in feet.
dl Defacto left-lane.

Unsignalized Intersection Capacity Analyses

The analytical methodologies typically used for the analysis of unsignalized intersections use conservative analysis parameters, such as high critical gaps[8]. Actual field observations indicate that drivers on minor streets generally accept smaller gaps in traffic than those used in the analysis procedures and therefore experience less delay than reported by the analysis software. Consequently, the analysis results tend to overstate the actual delays experienced in the field. For this reason, the results of the unsignalized intersection analyses should be considered highly conservative.

Table 10 presents a summary of the capacity analyses for the unsignalized intersections in the study area. The capacity analyses worksheets are included in the Appendix to this document.

As shown in the Table 10, the unsignalized study area intersections of King Rail Drive at Audubon Road (during both peak hours) and King Rail Drive at Market Street Driveway (during the weekday evening peak hour) are expected to experience minimal operational impacts (an increase in intersection delay of two seconds or less) with the addition of the proposed Project trips. The operational impacts at these locations

▼

8 'Critical gap' is defined as the minimum time, in seconds, between successive major-stream vehicles, in which a minor-street vehicle can make a maneuver

during the peak hours specified would be imperceptible to the average driver. The unsignalized study area intersection of King Rail Drive at Market Street Driveway (during the Saturday midday peak hour) is expected to experience moderate operational impacts (an increase in intersection delay of 31 seconds or less). However, this intersection is internal to the Site and the impacts associated would only be experienced by customers of the Site and not by traffic traveling adjacent to the Site. It should be noted that the Saturday midday peak hour analysis is highly conservative as it considers the medical office, which accounts for up to approximately 33-percent of the gross trip generation for the build-out of the development with the proposed modification, is open and fully operational on a Saturday.

Table 10 Unsignalized Intersection Capacity Analysis

		2018 Existing Conditions					2025 No-Build Conditions					2025 Build Conditions				
Location	Movement	D [a]	v/c [b]	Del [c]	LOS [d]	95 Q [e]	D	v/c	Del	LOS	95 Q	D	v/c	Del	LOS	95 Q
Audubon Road at King Rail Drive																
Weekday	EB L	140	0.31	14	B	33	140	0.24	13	B	23	155	0.27	13	B	28
Evening	EB R	210	0.27	10	A	28	210	0.22	10	A	23	210	0.23	10	A	23
	NB L	110	0.09	8	A	8	110	0.08	8	A	8	110	0.08	8	A	8
Saturday	EB L	165	0.34	15	B	38	165	0.31	14	B	33	195	0.38	15	C	43
Midday	EB R	135	0.16	9	A	15	135	0.15	9	A	13	135	0.15	9	A	13
	NB L	125	0.10	8	A	8	125	0.09	8	A	8	125	0.09	8	A	8
Market Street at King Rail Drive (roundabout)																
Weekday	EB L/T/R	280	0.39	10	A	50	280	0.40	10	A	50	330	0.49	12	B	75
Evening	WB L/T/R	675	0.69	14	B	150	675	0.70	15	B	150	720	0.75	17	C	175
	NB L/T/R	290	0.51	14	B	75	290	0.47	13	B	75	290	0.52	15	B	75
	SB L/T/R	225	0.45	12	B	50	225	0.38	11	B	50	260	0.45	13	B	50
Saturday	EB L/T/R	330	0.54	14	B	75	330	0.54	14	B	75	365	0.61	17	C	100
Midday	WB L/T/R	1015	1.03	56	F	550	1015	1.07	69	F	650	1095	1.16	100	F	850
	NB L/T/R	280	0.57	17	C	100	280	0.52	15	C	75	280	0.55	17	C	75
	SB L/T/R	295	0.66	22	C	125	295	0.63	22	C	100	315	0.72	28	D	150

a. Demand of critical movement.
b. Volume to capacity ratio.
c. Average total delay, in seconds per vehicle.
d. Level-of-service.
e. 95th percentile queue, in feet.

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Potential Improvements

As outlined in Chapter 4, the proposed modification to the development plan is expected to have minor impacts on transportation conditions in the study area. However, the Proponent proposes to provide the following improvements within the study area to further minimize the potential for Project-related trip impacts.

Walnut Street Adaptive Signal System

Assuming that the cinema is approved, the Proponent is willing to fund an adaptive traffic control system along Walnut Street at the following three intersections to further reduce Project-related trip impacts, mitigate existing issues, and add corridor efficiency:

- I-95 Southbound Ramps at Walnut Street and Market Street
- I-95 Northbound Ramps at Walnut Street
- Walnut Street at Salem Street

The adaptive signal system will function similarly to the adaptive system to the west of the MarketStreet Site in Wakefield along Audubon Road, Pleasure Island Road and Salem Street. Adaptive signal systems are state of the art and allow traffic signals to respond more intelligently to fluctuations in traffic patterns (real-time) than standard time and phase base systems. The technology captures real-time traffic demand data to adjust traffic signal timing so that optimal flow in coordinated traffic signal systems can be achieved without manual changes being made to controllers. Adaptive systems are known to reduce traffic delay, increase average speeds, improve travel times, and decrease travel time variability. They also decrease emission, which helps the environment. In contrast to traditional timed systems, adaptive traffic signal control technologies can react to traffic accidents, special events, road construction, and other occurrences. The Proponent is willing to fund these changes pending MassDOT's approval to do so and only if the cinema is approved. A preliminary

meeting with MassDOT to discuss the possibility of these changes occurred in December 2017 and MassDOT was receptive to the potential modifications which are similar to those recently implemented on Salem Street and Pleasure Island Road.

Table 11 presents a summary of the capacity analyses with the potential adaptive traffic signal system in place. The capacity analyses worksheets are included in the Appendix to this document. It should be noted that due to the limitations of the Synchro program, adaptive signal systems cannot be modeled to their full potential. Therefore, the capacity results do not reflect the full benefit that the adaptive system will provide.

As shown in Table 11, the intersections along Walnut Street are expected to experience the same or improved operations and queues as the 2025 Build conditions. It should be reiterated that adaptive signal systems respond to traffic demands in a real-time basis, which is not reflected in the capacity analysis results due to limitations of the Synchro software. The operational benefits of an adaptive signal system are not just limited to the peak hours, traffic flow along Walnut Street will be improved during all times of day and night.

Table 11 Signalized Intersection Capacity Analysis with Adaptive Signal System

		2025 No-Build Conditions					2025 Build Conditions					2025 Build Conditions with Mitigation				
Location	Movement	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q	v/c	Del	LOS	50 Q	95 Q
I-95 Southbound Ramps at Walnut Street and Market Street																
Weekday	EB L	0.77	56	E	107	165	0.80	58	E	117	181	0.81	55	D	86	#198
Evening	EB T	0.32	32	C	73	111	0.36	32	C	86	128	0.37	27	C	63	121
	EB R	0.49	4	A	26	63	0.52	5	A	43	90	0.49	4	A	18	72
	WB L	0.37	23	C	71	101	0.38	22	C	69	99	0.36	19	B	50	97
	WB T/R	0.55	27	C	174	222	0.55	26	C	176	226	0.53	21	C	127	219
	NB L	0.56	11	B	47	m68	0.64	15	B	56	m82	0.70	20	C	105	167
	NB T/R	0.68	10	B	78	m112	0.69	12	B	86	m116	0.73	17	B	175	304
	SB L	0.09	32	C	10	34	0.09	34	C	11	34	0.13	26	C	9	27
	SB T/R	0.51	33	C	141	#313	0.57	36	D	157	#328	0.75	36	D	122	208
	Overall		**20**	**B**				**21**	**C**				**21**	**C**		
Saturday	EB L	>1.20	>120	F	~113	#229	>1.20	>120	F	~139	#260	>1.20	>120	F	~103	#220
Midday	EB T	0.58	45	D	119	194	0.63	47	D	129	208	0.51	36	D	109	180
	EB R	0.55	6	A	46	123	0.56	7	A	57	147	0.54	6	A	58	138
	WB L	0.41	29	C	60	107	0.42	30	C	60	107	0.38	25	C	52	94
	WB T/R	0.87	49	D	298	#482	0.90	53	D	312	#508	0.82	39	D	266	#441
	NB L	0.83	27	C	240	m361	0.92	35	C	308	m#464	1.00	59	E	~276	#503
	NB T/R	0.53	11	B	119	m203	0.53	11	B	119	m185	0.56	9	A	88	176
	SB L	0.18	31	C	21	52	0.20	32	C	22	52	0.25	33	C	20	51
	SB T/R	0.62	35	C	174	274	0.69	39	D	184	288	0.88	54	D	172	#318
	Overall		**39**	**D**				**49**	**D**				**40**	**D**		
I-95 Northbound Ramps at Walnut Streets																
Weekday	EB L	0.45	37	D	98	157	0.50	38	D	109	171	0.47	30	C	81	141
Evening	EB R	0.77	45	D	163	217	0.77	45	D	163	217	0.74	35	C	122	177
	NB T	0.93	81	F	535	m506	0.94	81	F	544	m509	1.04	95	F	~443	#677
	NB R	0.21	0	A	0	m0	0.21	0	A	0	m0	0.21	0	A	0	0
	SB L	1.00	73	E	~206	#429	1.06	89	F	~237	#460	1.04	80	F	~163	#343
	SB T	0.35	9	A	106	213	0.37	9	A	117	211	0.39	8	A	95	161
	Overall		**48**	**D**				**50**	**D**				**50**	**D**		
Saturday	EB L	0.98	79	E	256	#446	1.04	95	F	~298	#486	1.02	85	F	~264	#444
Midday	EB R	0.87	72	E	198	#300	0.87	71	E	198	#300	0.85	47	D	175	#273
	NB T	0.74	73	E	194	345	0.77	73	E	203	365	0.96	100	F	393	#630
	NB R	0.07	0	A	0	m0	0.07	0	A	0	m0	0.07	0	A	0	0
	SB L	1.12	100	F	~142	#343	>1.20	>120	F	~174	#382	1.04	83	F	~209	#392
	SB T	0.39	12	B	143	224	0.40	12	B	154	238	0.41	9	A	119	178
	Overall		**64**	**E**				**72**	**E**				**64**	**E**		

a. Volume to capacity ratio.
b. Average total delay, in seconds per vehicle.
c. Level-of-service.
d. 50th percentile queue, in feet.
e. 95th percentile queue, in feet.
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
m Volume for 95th percentile queue is metered by upstream signal.

Table 11 (continued) Signalized Intersection Capacity Analysis with Adaptive Signal System

		2025 No-Build Conditions					2025 Build Conditions					2025 Build Conditions with Mitigation				
Location	Movement	v/c [a]	Del [b]	LOS [c]	50 Q [d]	95 Q [e]	v/c	Del	LOS	50 Q	95 Q	v/c	Del	LOS	50 Q	95 Q
Walnut Street at Salem Street																
Weekday	EB L	0.69	34	C	130	192	0.69	34	C	130	192	0.77	39	D	106	#211
Evening	EB T/R	0.88	45	D	291	411	0.88	45	D	291	411	0.94	53	D	237	#433
	WB L	0.37	48	D	19	48	0.37	48	D	19	48	0.37	42	D	15	43
	WB T	0.59	47	D	99	160	0.59	47	D	99	160	0.55	38	D	77	138
	WB R	0.43	9	A	0	53	0.43	9	A	0	54	0.42	9	A	0	50
	NB L/T/R	1.09	98	F	~592	#900	1.11	100	F	~605	#908	1.09	83	F	~461	#679
	SB L	0.39	8	A	12	m24	0.44	9	A	14	m30	0.47	16	B	34	61
	SB T	0.34	6	A	34	57	0.35	6	A	36	65	0.35	23	C	95	132
	SB R	0.06	0	A	0	m0	0.06	0	A	0	m0	0.06	0	A	0	0
	Overall		**44**	**D**				**45**	**D**				**45**	**D**		
Saturday	EB L	0.40	43	D	56	101	0.40	44	D	56	101	0.35	27	C	43	96
Midday	EB T/R	0.57	34	C	126	204	0.57	34	C	126	204	0.55	28	C	96	193
	WB L	0.34	47	D	25	60	0.34	47	D	25	60	0.28	40	D	20	56
	WB T	0.67	57	E	90	154	0.67	57	E	90	154	0.55	44	D	71	#161
	WB R	0.54	17	B	0	63	0.56	18	B	0	64	0.52	11	B	0	63
	NB L/T/R	0.73	26	C	304	467	0.74	27	C	314	481	0.83	30	C	273	418
	SB L	0.25	17	B	55	m75	0.28	17	B	60	m81	0.30	8	B	28	50
	SB T	0.35	24	C	201	m253	0.35	24	C	204	m256	0.40	9	A	105	138
	SB R	0.06	0	A	0	m0	0.06	0	A	0	m0	0.06	0	A	0	0
	Overall		**27**	**C**				**27**	**C**				**20**	**B**		

a. Volume to capacity ratio.
b. Average total delay, in seconds per vehicle.
c. Level-of-service.
d. 50th percentile queue, in feet.
e. 95th percentile queue, in feet.
~ Volume exceeds capacity, queue is theoretically infinite.
# 95th percentile volume exceeds capacity, queue may be longer.
m Volume for 95th percentile queue is metered by upstream signal.

6

Conclusion

VHB, Inc. has prepared a Transportation Impact and Access Study (TIAS) to assess transportation impacts associated with the proposed modification to the remaining, approved, build-out of the MarketStreet Lynnfield development program to include a cinema. This Site is located at the Route 128/I-95 Interchange at Walnut Street in Lynnfield, Massachusetts. It is a first-class regional mixed-use destination, consisting of a vibrant collection of retail, restaurant, entertainment, residential, and office uses in a thoughtfully planned and carefully designed setting.

The current proposal is to modify the remaining approved development to be built to essentially trade 40,000 sf of office use with a 40,000 sf (eight screens, 800 seats) of cinema use ("the proposed modification"). It should be understood that the trading out 40,000 sf of office space with 40,000 sf of cinema space represents a complimentary change in the site from a traffic generation perspective most days of the week. This TIAS evaluates the transportation changes associated with the proposed trade of space. The MarketStreet Lynnfield project will be built-out to its approved level regardless of whether the change in the final phase is approved or not.

The build-out of the development with the proposed modification is expected to result in a minimal increase of 15 total trips (6 entering/9 exiting) during the weekday evening peak hour and a minimal increase of 29 total trips (26 entering/3 exiting) during the Saturday midday peak hour when compared to the approved build-out of the development. With the two site access locations and multiple roadways surrounding the development, these trips will quickly dissipate into the roadway network and have a *minimal impact* to operations when compared to the approved build-out of the development without the proposed modification.

Capacity analyses were conducted for each of the study area intersections under 2018 Existing conditions, 2025 No-Build conditions (without the proposed development), and 2025 Build conditions (with the proposed development). Overall signalized intersection delays are only expected to increase by a maximum of 10 seconds (and

many signalized intersections experiencing no increase in delay) with the addition of trips associated with the build-out of the development without the proposed Cinema modification. The results of the analysis indicate operational impacts associated with the proposed build-out of the Site would be *imperceptible* to the average driver along Walnut Street, Salem Street, and Audubon Road/Pleasure Island Road.

Assuming the Cinema is approved, the Proponent is willing to fund an adaptive traffic signal system at the three signalized intersections located in close proximity to the site along Walnut Street to further reduce Project-related trip impacts, mitigate existing issues, and add corridor efficiency. The adaptive signal system will function similarly to the adaptive system to the west of the MarketStreet Site in Wakefield along Audubon Road, Pleasure Island Road and Salem Street. Adaptive signal systems are state of the art and allow traffic signals to respond more intelligently to fluctuations in traffic patterns (real-time) than standard time and phase base systems. The technology captures real-time traffic demand data to adjust traffic signal timing so that optimal flow in coordinated traffic signal systems can be achieved without manual changes being made to controllers. Adaptive systems are known to reduce traffic delay, increase average speeds, improve travel times, and decrease travel time variability. They also decrease emission, which helps the environment. In contrast to traditional timed systems, adaptive traffic signal control technologies can react to traffic accidents, special events, road construction, and other occurrences. The Proponent will implement these changes pending MassDOT's approval to do so and only if the cinema is approved.