

Transportation Impact Study

Mixed-Use Redevelopment

256, 270, & 278 Elm Street,
& 7 Herbert Street
Somerville, MA

Prepared by
McMahon Associates, Inc.
120 Water Street, 4th Floor
Boston, MA 02109
617.556.0020

Prepared for
Asana Partners

August 2022

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INTRODUCTION

McMahon Associates has completed a review of the existing transportation operations and potential impacts associated with the proposed mixed-use redevelopment located at 256, 270, and 278 Elm Street, and 7 Herbert Street. The purpose of this impact study is to evaluate existing and projected transportation operations in the area surrounding the project site.

The assessment documented in this transportation impact study is based on a review of existing traffic volumes and the anticipated traffic generating characteristics of the proposed project. The study examines existing and projected traffic operations at key intersections in the vicinity of the project site. The study area was determined in coordination with and approved by the City of Somerville Mobility Division based on a review of the surrounding roadway network and estimated trip generating characteristics of the proposed project. This study provides a detailed analysis of traffic operations during the weekday morning, weekday afternoon, and Saturday midday peak hours when the combination of adjacent roadway volumes and project trips would be expected to be the greatest.

Based on the analysis presented in this study, the additional trips projected to be generated by the proposed redevelopment are not shown to have a significant impact to the study area roadways and intersections. The following report documents these findings.

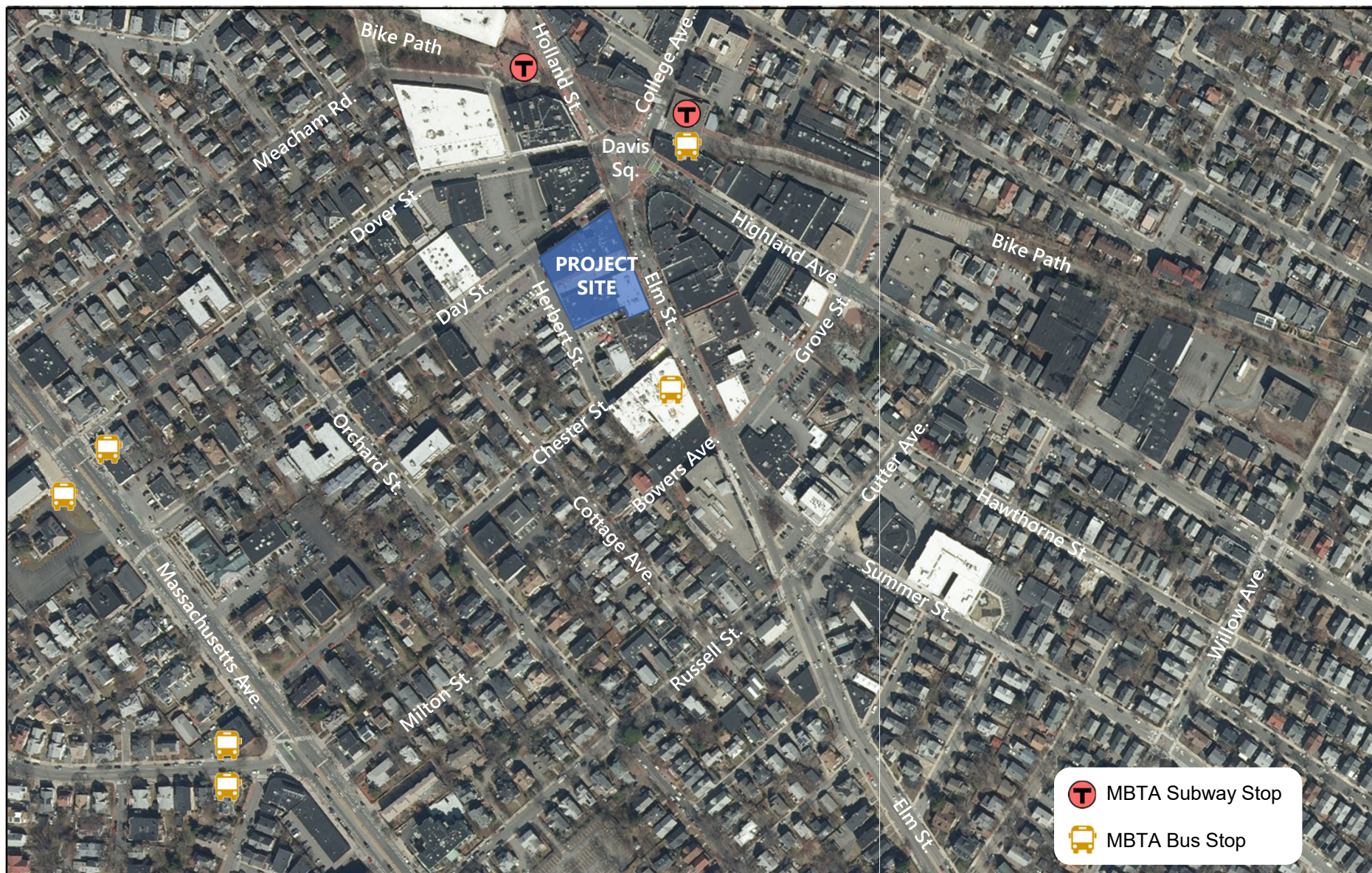
Project Description

The proposed mixed-use project involves the redevelopment of the existing Davis Square Plaza located between Elm Street, Day Street, and Herbert Street in Davis Square, as shown in Figure 1. The site is currently occupied by approximately 27,400 square feet (sf) of retail space and approximately 28,400 sf of office space split over three existing buildings. The first floors of each building primarily include the retail land uses and the existing upper floors house the office space. As part of the proposed project, the existing site would be redeveloped within its general existing footprint, to provide approximately 20,300 sf of retail space, approximately 39,600 sf of office space, and approximately 59,400 sf of laboratory space.

A large portion of the existing first floor retail space in the southern building would be renovated with a small expansion of the first-floor footprint which would be constructed at the location of the existing parking areas on the southwest corner of the site. The additional space on the first floor would primarily serve as back of house, storage, and loading space for the site. Full second, third, and fourth floors would be constructed on the southern site building, which would house the majority of the proposed additional office and lab space. The first-floor areas of the northwestern and northeastern site buildings are proposed to be largely unchanged as part of this redevelopment. The second, third, and fourth floors of the northwestern site buildings would be renovated to support the proposed office and lab uses. The existing second floor of the northeastern site building would be altered to accommodate proposed office and lab use.

The site is currently accessed via a pedestrian walkway connecting Elm Street and Herbert Street as well as via the sidewalks along Elm Street, Day Street, and Herbert Street. A small parking area currently exists at the southwestern corner of the site and provides a limited number of off-street parking spaces. With the proposed redevelopment in place, pedestrian and bicycle access would continue to be provided via the existing sidewalks and the pedestrian walkway between the northern and southern project site buildings. Under the proposed condition, no on-site parking would be

provided for customers or employees. Metered street parking is available along portions of Elm Street, Day Street, and Herbert Street in the vicinity of the project site, and a public parking lot is available just west of the project site at 44 Day Street. In addition, four exterior bicycle parking spaces and an indoor bicycle storage room providing storage for 15 bicycles would be constructed as part of the proposed redevelopment.



Study Methodology

This transportation impact study evaluates existing and projected transportation operations within the study area for the weekday morning, weekday afternoon, and Saturday midday peak hour conditions, when the combination of the adjacent roadway volumes and estimated project trips would be expected to be the greatest.

The study was conducted in three steps. The first step consisted of an inventory of existing transportation conditions within the project study area. As part of this inventory, turning movement counts and automatic traffic recorder (ATR) counts were collected at key locations, confirmed by the City of Somerville's Mobility Division. Field visits were completed to document intersection and roadway geometries, inventory existing pedestrian, bicycle, and public transportation infrastructure, and to conduct a parking study.

The second step of the study built upon the data collected in the first step of the study to establish the basis for evaluating potential impacts associated with the projected build conditions, under current and future year conditions. During this second step, the projected traffic demands associated with the proposed mixed-use redevelopment and other planned future developments that could influence traffic volumes at the study area intersections were assessed. Consistent with City of Somerville transportation impact study guidelines, the 2022 Build traffic volumes were forecasted to the future year 2027 to establish 2027 Design Year Build conditions.

The third step of this study determined if measures were necessary to improve future traffic operations and safety and minimize potential traffic impacts associated with the proposed redevelopment.

Study Area Intersections

In conjunction with the City of Somerville Mobility Department, the following study area intersections were selected for analysis:

- Elm Street/Holland Street at Highland Avenue/Dover Street & College Avenue & Day Street (Davis Square)
- Highland Avenue at Grove Street
- Highland Avenue at Cutter Avenue/Ellington Road
- Summer Street at Cutter Avenue/Russell Street
- Elm Street at Grove Street/Bowers Avenue
- Elm Street at Chester Street
- Chester Street at Herbert Street
- Day Street at Herbert Street
- Day Street at Orchard Street

This report documents existing and future traffic conditions for the study area intersections noted above. For the purposes of analysis within this report, the Davis Square intersection was split into two intersections:

- Elm Street/Holland Street at Highland Avenue/Dover Street & College Avenue (Davis Square)
- Elm Street at Day Street

EXISTING CONDITIONS

An accurate assessment of the potential transportation impacts associated with the proposed redevelopment requires a comprehensive understanding of the existing conditions within the project study area. The existing conditions assessment included in this study consists of an inventory of intersection and roadway geometries, pedestrian and bicycle infrastructure, public transportation infrastructure, and the collection of transportation volumes for each of these modes. The existing conditions of the roadways in the vicinity of the project site are summarized below. Additional information on the pedestrian and bicycle conditions is provided in the pedestrian and bicycle levels of traffic stress sections (PLTS and BLTS, respectively).

Roadway Network

Elm Street

Elm Street runs in a general northwest-southeast direction between Davis Square and Somerville Avenue in the City of Somerville. For the purposes of this assessment, Elm Street was considered to be a north-south roadway. In the vicinity of the study area, Elm Street is classified as an urban minor arterial under City of Somerville jurisdiction. Within the study area, Elm Street is a one-way roadway southbound and provides access to primarily commercial land uses. South of Davis Square, parking lanes are provided on both sides of the roadway, with sections of these lanes being used for outdoor dining between April and November. Elm Street provides a single travel lane measuring 13 feet wide in the southbound direction with a buffer measuring between five and six feet wide on either side of the travel lane. A parking lane measuring approximately eight feet wide extends along the buffer on both the east and west sides of the roadway. Brick sidewalks measuring approximately ten feet wide exist on both sides of the roadway. No speed limits are posted on Elm Street in the vicinity of the site. As such, the City of Somerville prevailing speed limit of 25 miles per hour (mph) would apply.

Highland Avenue

Highland Avenue runs in a general northwest-southeast direction through the City of Somerville. For the purposes of this assessment, Highland Avenue was considered to be an east-west roadway. In the vicinity of the study area, Highland Avenue is classified as an urban minor arterial under City of Somerville jurisdiction. Within the study area, Highland Avenue provides access to primarily commercial land uses and is a one-way roadway westbound. Highland Avenue provides two travel lanes measuring ten feet wide with a five-foot-wide bike lane provided adjacent to the northern travel lane. Parking lanes measuring approximately eight feet wide extend along the north and south sides of the roadway adjacent to the sidewalk. Sidewalks measuring approximately ten feet wide exist along both sides of the roadway. Approaching the study area, a speed limit of 20 mph is posted on Highland Avenue.

College Avenue

College Avenue runs in a general northeast-southwest direction through the City of Somerville and is classified as an urban minor arterial under City of Somerville jurisdiction. In the vicinity of the study area, College Avenue provides access to a combination of commercial and residential land uses. College Avenue generally provides one travel lane measuring approximately 11 feet wide in each direction with an adjacent parking lane measuring approximately eight feet wide on both sides of the roadway. Sidewalks measuring between 10 and 13 feet in width extend along both sides of College Avenue in the vicinity of the study area. A speed limit of 20 mph is posted on College Avenue in both directions in the vicinity of Davis Square.

Holland Street

Holland Street runs in a general north-south direction between Broadway and Davis Square in the City of Somerville. Holland Street is classified as an urban minor arterial under City of Somerville jurisdiction. In the vicinity of the study area, Holland Street provides access to a combination of commercial and residential land uses. Holland Street generally provides one travel lane measuring between 10 and 13 feet wide in each direction with an adjacent eight-foot-wide parking lane on each side of the roadway. A brick sidewalk measuring approximately 13 feet wide extends along the west side of the roadway, and a cement concrete sidewalk measuring ten feet wide extends along the east side of the roadway. A speed limit of 20 mph is posted on Holland Street in the vicinity of the study area.

Day Street

Day Street runs in a general northeast-southwest direction between Davis Square and Massachusetts Avenue (Route 2A) and is classified as an urban minor arterial under City of Somerville jurisdiction. For the purposes of this assessment, Day Street was considered to be an east-west roadway. In the vicinity of the project site, Day Street provides access to primarily commercial land uses and provides one-way travel in the eastbound direction. Day Street also provides access to the 44 Day Street public parking lot via a single driveway west of its intersection with Herbert Street. Day Street provides a single travel lane measuring 12 feet wide with adjacent parking lanes measuring between seven and eight feet wide on both sides of the roadway. A ten-foot-wide cement concrete sidewalk extends along the south side of the roadway, and a seven-foot-wide cement concrete sidewalk extends along the north side of the roadway. No speed limits are posted on Elm Street in the vicinity of the site. As such, the City of Somerville prevailing speed limit of 25 miles per hour (mph) would apply.

Dover Street

Dover Street runs in a general east-west direction between Davis Square and Massachusetts Avenue (Route 2A) and is classified as an urban minor arterial under City of Somerville jurisdiction. In the vicinity of the project site, Dover Street provides access to primarily commercial land uses and provides one-way travel in the westbound direction. Dover Street measures approximately 25 feet wide and accommodates a single travel lane with adjacent parking lanes on both sides of the roadway. No pavement markings exist to delineate the travel lane and parking lanes. Seven-foot-wide cement concrete sidewalks extend along both sides of the roadway. No speed limits are posted on Dover Street in the vicinity of the study area. As such, the City of Somerville prevailing speed limit of 25 miles per hour (mph) would apply.

Cutter Avenue

Cutter Avenue runs in a general north-south direction between Elm Street and Highland Avenue in the City of Somerville and is classified as a local roadway under City jurisdiction. Cutter Avenue is one-way northbound and provides access to primarily residential land uses. Cutter Avenue provides a single travel lane measuring approximately 12 feet wide. A five-foot-wide bicycle lane, separated from the travel lane by a two-foot-wide buffer, extends east of the travel lane. An eight-and-a-half-foot-wide parking lane extends east of the bike lane. Seven-foot-wide sidewalks are provided on both sides of Cutter Avenue.

Grove Street

Grove Street runs in a general north-south direction in the City of Somerville and is classified as a local roadway under City of Somerville jurisdiction. In the vicinity of the study area, Grove Street provides

access to primarily commercial land uses. Grove Street measures approximately 26 feet wide and accommodates two-way travel. On-street parking is not permitted on Grove Street. Sidewalks measuring approximately seven feet wide extend along both sides of the roadway. Grove Street has a posted speed limit of 20 mph.

Chester Street

Chester Street runs in a general east-west direction in the City of Somerville and is classified as a local roadway under City of Somerville jurisdiction. In the vicinity of the study area, Chester Street is a one-way roadway southbound and provides access to a combination of commercial and residential land uses. Chester Street measures approximately 26 feet wide and accommodates a single travel lane with adjacent parking lanes on both sides of the roadway. No pavement markings exist to delineate the travel lane and parking lanes. Seven-foot-wide cement concrete sidewalks extend along both sides of the roadway. No speed limits are posted on Chester Street in the vicinity of the study area. As such, the City of Somerville prevailing speed limit of 25 miles per hour (mph) would apply.

Herbert Street

Herbert Street runs in a general north-south direction between Day Street and Chester Street in the City of Somerville and provides access to a combination of residential and commercial land uses. Two driveways providing access to the 44 Day Street public parking lot are located at the northern end of Herbert Street near its intersection with Day Street. Herbert Street measures approximately 26 feet wide and accommodates two-way traffic with parking/loading on the east side of the roadway. No pavement markings exist to delineate the travel lanes and parking/loading lane. Seven-foot-wide cement concrete sidewalks extend along both sides of the roadway. No speed limits are posted on Herbert Street in the vicinity of the study area. As such, the City of Somerville prevailing speed limit of 25 miles per hour (mph) would apply.

Roadway Improvements

Based on guidance from the City of Somerville, the existing conditions capacity analysis contained within this report for the signalized Davis Square intersection is based on a traffic signal layout and timing plan prepared by Toole Design and dated May 2022. As of the date of the transportation volume counts and field visits for this report, the layout and timings contained within this plan had not been implemented. However, as they are planned to be implemented in the near future, they have been utilized as the basis for the existing year analysis. The proposed improvements as documented in the plans would implement a separated bicycle lane with signal separation at the Davis Square intersection. As part of the bicycle lane implementation, the Highland Avenue westbound approach to the signal would be reduced from three vehicle lanes to two: a dedicated right-turn lane onto College Avenue and a shared lane for traffic movements onto Dover Street and Holland Street. The changes would also include some minor restriping within the Davis Square signal to help communicate routes through the intersection for bicycles, buses, and drivers, as well as relocating the crosswalk at the Elm Street approach to the intersection to cross both Elm Street and Day Street. This configuration is used for the 2022 Existing and 2022 Build conditions capacity analysis described later in the report.

Public Transportation

The project is served by numerous Massachusetts Bay Transportation Authority (MBTA) bus routes as well as the MBTA Red Line subway. A summary of the public transportation within a half mile of the site is provided below, and a summary of the average frequencies for the bus routes serving the study area are provided in Table 2. The locations and average number of boardings and alightings (ons and offs) at the key bus stops in the vicinity of the site are shown in Figure 2.

Route 77

MBTA Route 77 operates between Harvard station and Arlington Heights. The closest stop pair to the project site is Massachusetts Avenue at Haskell Street in the inbound direction and Massachusetts Avenue at Dover Street in the outbound direction. Both stops have benches, and the inbound stop also has a shelter. The stop pair is a six-minute walk southwest of the project site.

Route 83

MBTA Route 83 operates between Central Square and Rindge Avenue. The closest stop pair to the site is Rindge Avenue at Pemberton Street in the inbound direction and Rindge Avenue at Massachusetts Avenue in the outbound direction. No benches, shelters, or other amenities are provided at either stop. The stop pair is a seven-minute walk southwest of the project site.

Routes 87, 88, 89, 90, 94, & 96

Within the immediate vicinity of the site, MBTA Routes 87, 88, 89, 90, 94, and 96 follow effectively the same routes. All of these routes operate on Elm Street immediately adjacent to the site. Their closest inbound stop is located on Elm Street at Chester Street, and their closest outbound stop is located at the Davis Red Line station. The inbound stop at Elm Street and Chester Street has benches and the outbound stop at Davis station has benches, a shelter, wayfinding signs, and other amenities. Both stops are a one-to-two-minute walk from the project site. The start and end points of each of these routes is shown in Table 1 below.

Table 1: Davis Square MBTA Bus Routes

Route	Operates Between
87	Arlington & Lechmere, via Holland Street & Elm Street
88	Arlington & Lechmere, via Holland Street & Highland Avenue
89	Davis Square & Sullivan Station, via College Avenue
90	Davis Square & Assembly Row, via Highland Avenue
94	Davis Square & Medford Square, via College Avenue
96	Harvard Station & Medford Square

Red Line

The MBTA Red Line services Davis Station, which has two headhouses, one on College Avenue just north of Highland Avenue, and the other located on Holland Street to the north of Dover Street. Both headhouses are a two-minute walk from the site. Table 2 presents the frequency of the nearby transit routes.

Table 2: Public Transportation Frequency

Period	Frequency by Route (Minutes)								
	Rt. 77	Rt. 83	Rt. 87	Rt. 88	Rt. 89	Rt. 90	Rt. 94	Rt. 96	Red Line
AM Peak (7-9am)	10	20-25	15-22	17-22	12-18	35	30	30	5.5
PM Peak (4-6:30pm)	9-10	25	20	20	17-26	35	28-32	30-33	5.5
Saturday (Daily)	12-17	28-45	25-35	25-35	21-50	50-70	45-60	45-62	6-8

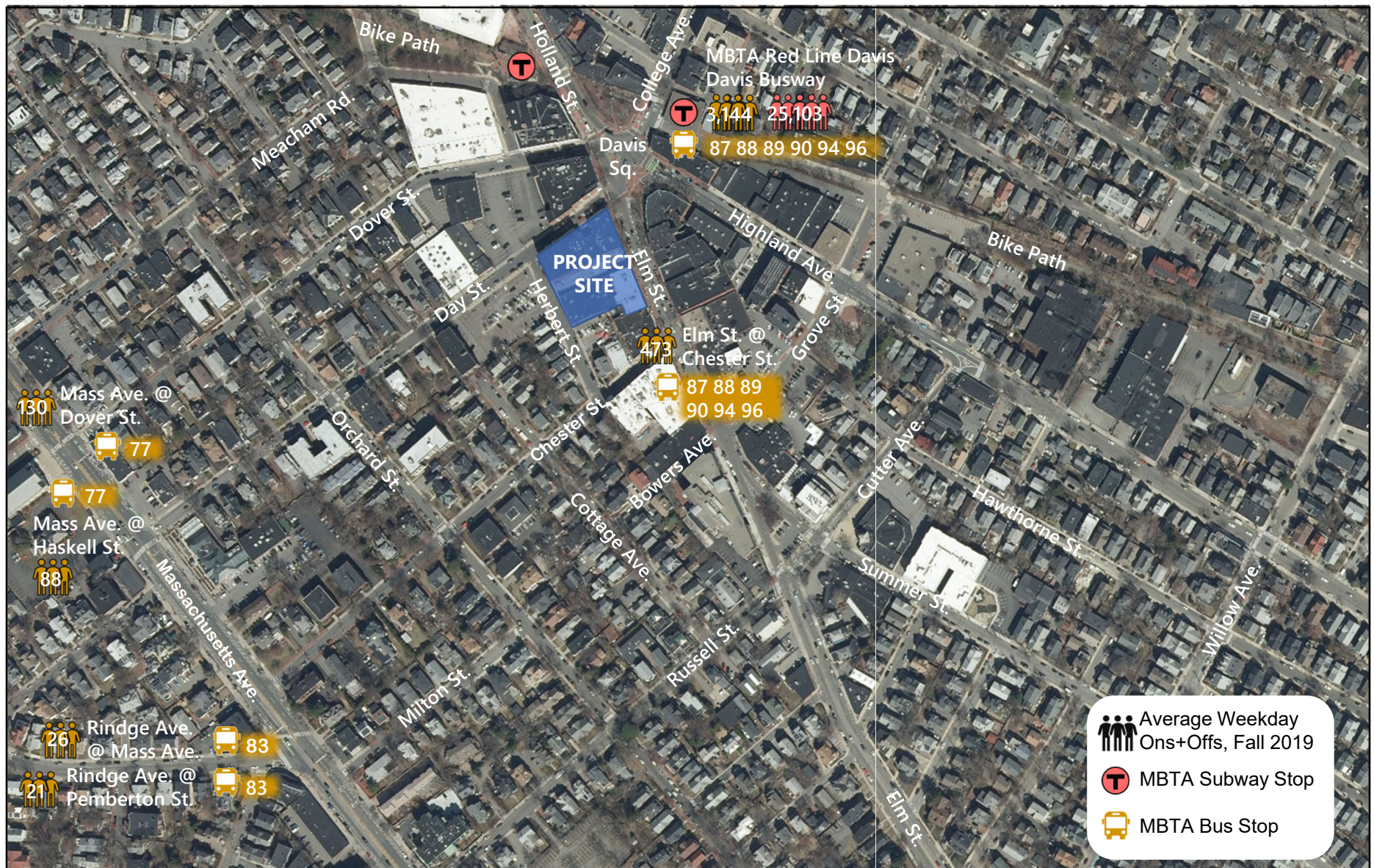
The Red Line currently has a weekday peak frequency of 11 minutes (with five-and-half-minute headways between Alewife and JFK stations including at Davis Station), and a weekday off-peak and weekend frequency of 12 to 16 minutes (six to eight minutes between Alewife and JFK including at Davis Station).

Field Review

A field review of the existing study area was conducted on Thursday, July 7, 2022. The review included the documentation of:

- Lane widths
- Traffic control devices
- Traffic signal timings
- Existing pedestrian and bicycle infrastructure
- Posted speed limits
- General traffic operations

Each of these elements from the field review have been incorporated into the vehicular capacity, pedestrian, bicycle, and transit analyses documented within this report.



Existing Condition Volumes

Existing Volume Data Collection

To assess peak hour traffic conditions, turning movement counts were conducted at the study area intersections between 6:00 AM and 8:00 PM on Thursday, July 14, 2022, and between 10:00 AM and 2:00 PM on Saturday, July 23, 2022. In addition, five 72-hour automatic traffic recorder (ATR) counts were conducted from Thursday, July 21, 2022, through Saturday, July 23, 2022, at the following locations:

- Elm Street north of Chester Street
- Day Street west of Elm Street
- Chester Street south of Elm Street
- Herbert Street between Chester Street and Day Street
- Dover Street west of Meacham Road

The results of the turning movement counts are tabulated by 15-minute periods and are provided in Appendix A of this report. The four highest consecutive 15-minute intervals during each of these count periods constitute the peak hours that are the basis of the traffic analysis provided in this report. Based on a review of the peak period traffic data, the weekday morning peak hour at the study area intersections occurs between 8:00 AM and 9:00 AM, the weekday afternoon peak hour occurs between 4:30 PM and 5:30 PM, and the Saturday midday peak hour occurs between 12:15 PM and 1:15 PM. The overall results of the ATR are summarized in Table 3 below and hourly details are provided in Appendix A.

Table 3: Automatic Traffic Recorder Data

Roadway	Weekday ¹	Saturday ²	HV% ³	85th % ⁴
	ADT	ADT		Speed
Elm Street	9,500	8,800	5%	19
Day Street	1,600	1,500	3%	19
Chester Street	1,300	1,200	2%	22
Herbert Street	940	830	2%	20
Northbound	420	370	3%	19
Southbound	520	460	2%	20
Dover Street	3,200	2,700	2%	26

1 Average daily traffic on Thursday, July 21, 2022

2 Average daily traffic on Saturday, July 23, 2022

3 Heavy vehicle percentage

4 85th percentile speed in miles per hour

Seasonal Variation

Based on correspondence with the City of Somerville, the traffic volumes collected were not adjusted for any seasonal variations in traffic volumes. Based on MassDOT Seasonal Adjustment factors, traffic

volumes during the month of July are generally considered to be greater than an average month of the year.

Existing Transportation Volumes

The 2022 Existing condition pedestrian, bicycle, and vehicle volumes are shown in Figures 3 through 5 for the weekday morning peak hour, Figures 6 through 8 for the weekday afternoon peak hour, and Figures 9 through 11 for the Saturday midday peak hour. The vehicle volumes are documented in the traffic projection model provided in Appendix B of this report.

U.S. Census Data

To assess the typical modes of transportation used for trips in the area of the site, data from the U.S. Census American Community Survey (ACS) was reviewed for Census tract 3509. The Census ACS provides information on demographic information including socioeconomic characteristics and housing characteristics, which include data on access to vehicles and vehicle use. Table 4 presents the resulting mode share for trips within the project's Census tract based on the 2015 to 2019 ACS data. The "work from home" and "other means" categories of the data were distributed proportionally between each of the modes displayed below as directed by the City of Somerville TIS Guidelines.

Table 4: Mode Share Summary

Mode	Share
Vehicle	40.2%
Public Transportation	49.6%
Bicycle	5.1%
Walked	5.0%

Additionally, the average vehicle occupancy for the Census tract containing the project site (Census tract 3509) was calculated based on single occupancy and carpooling data available from the ACS for the years 2015 to 2019. The resulting vehicle occupancy rate was identified as 1.09 persons per vehicle.

The calculated mode share and vehicle occupancy have been utilized to estimate the breakdown of estimated person trips associated with the proposed project and are discussed in more detail in the Site-Generated Traffic section of the report. The detailed Census data and vehicle occupancy calculations are included in Appendix C.

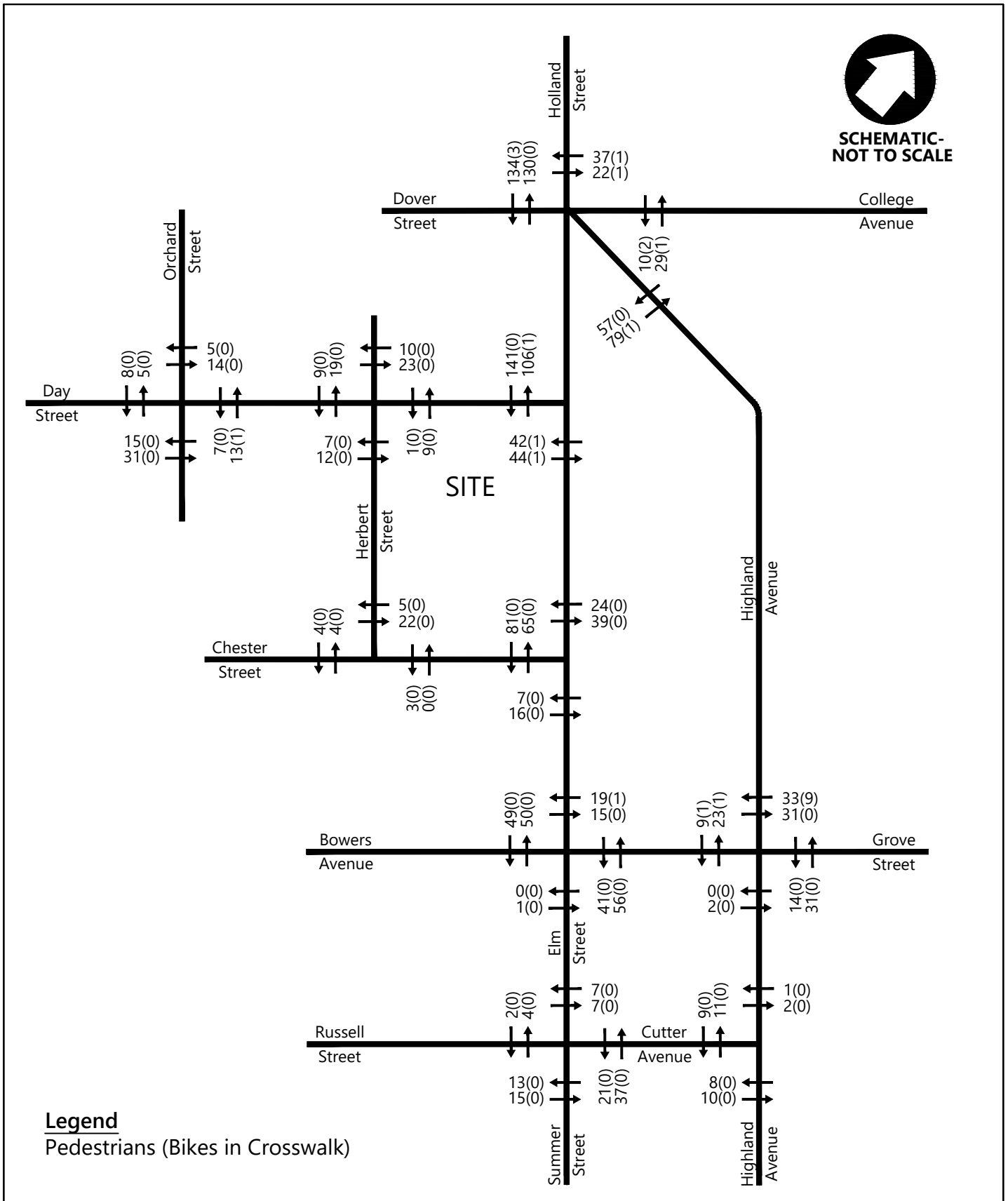


Figure 3
2022 Existing Weekday Morning
Peak Hour Pedestrian Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts



* Illegal or wrong-way movement

Figure 4
2022 Existing Weekday Morning
Peak Hour Bike Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts

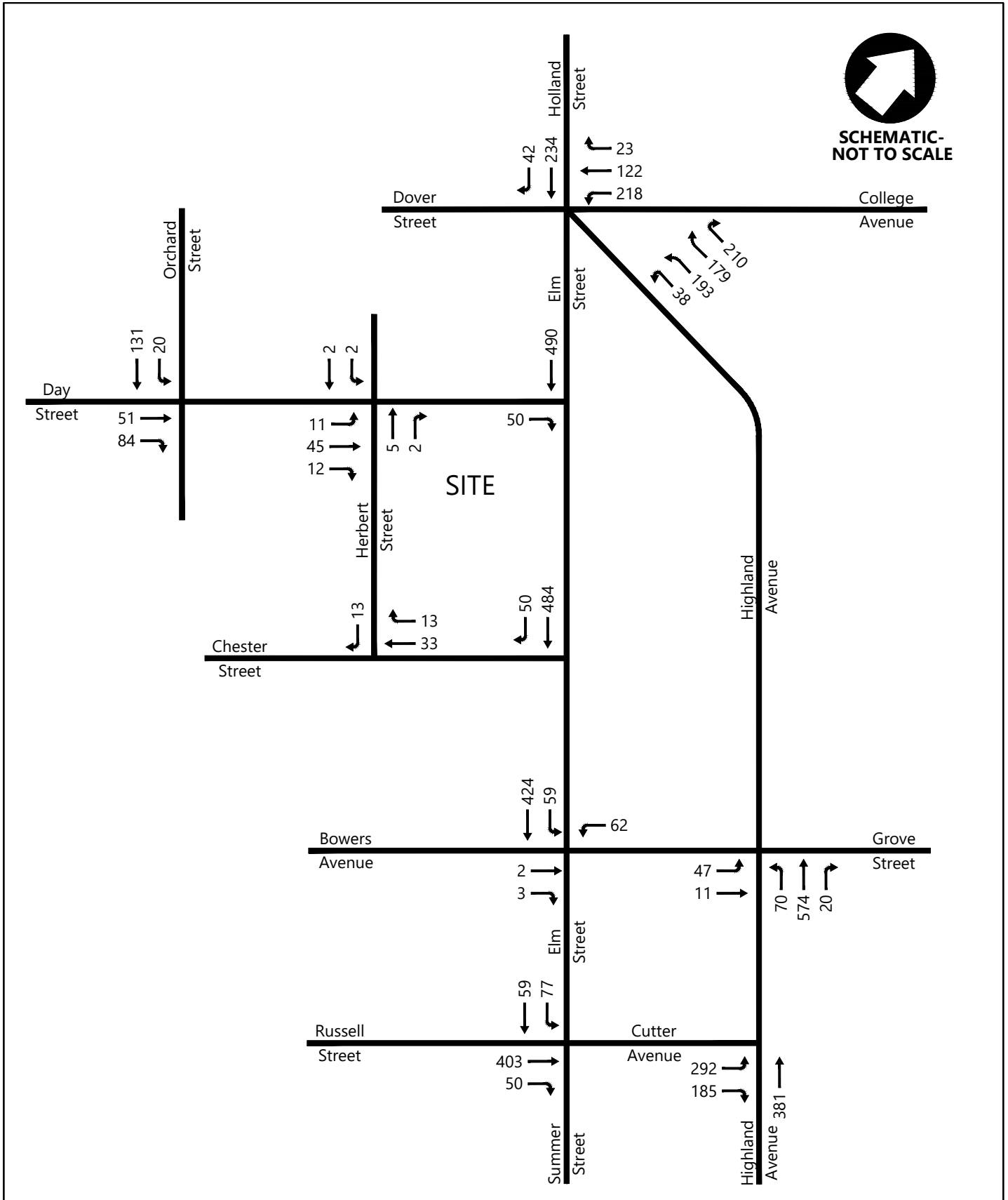
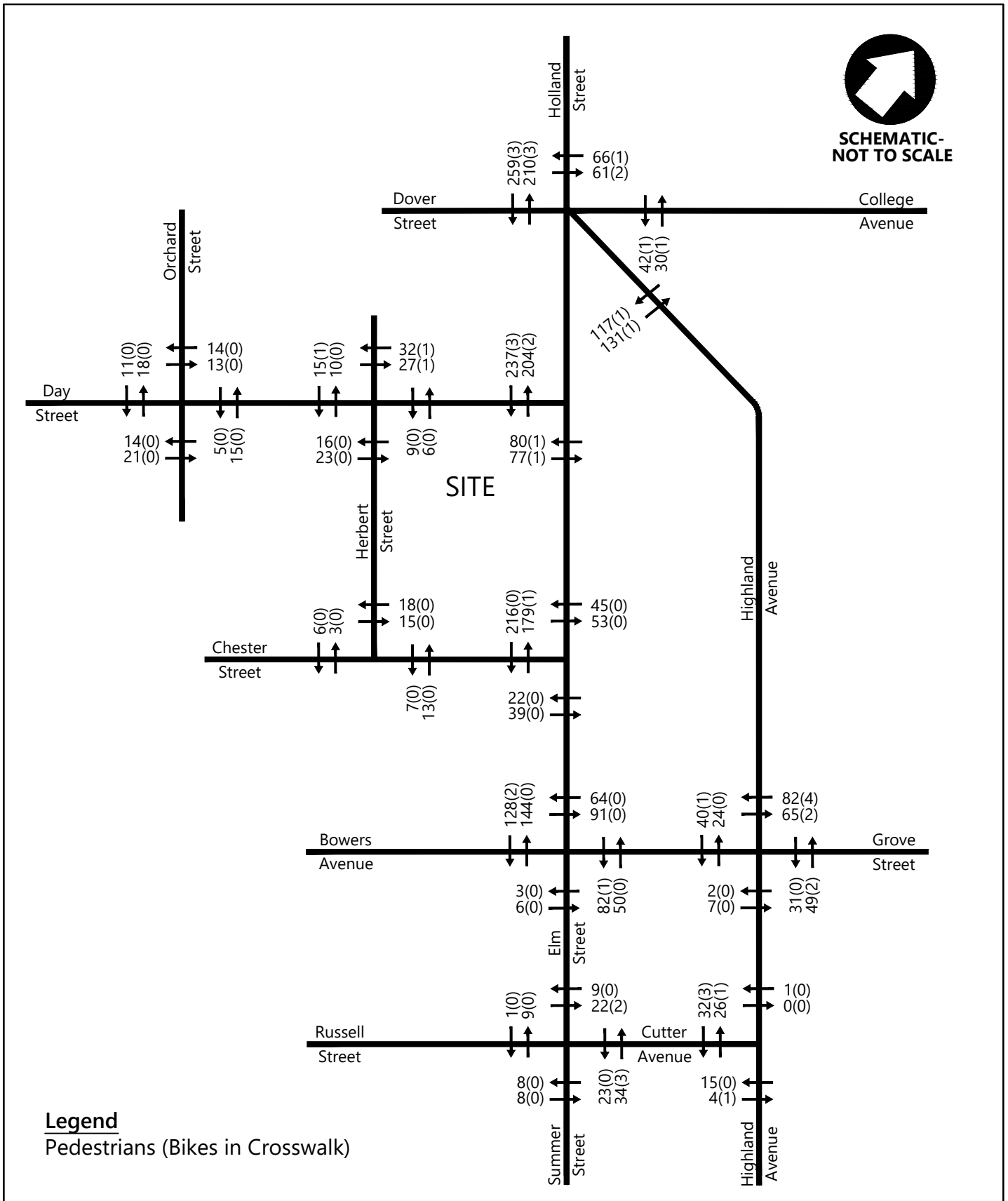
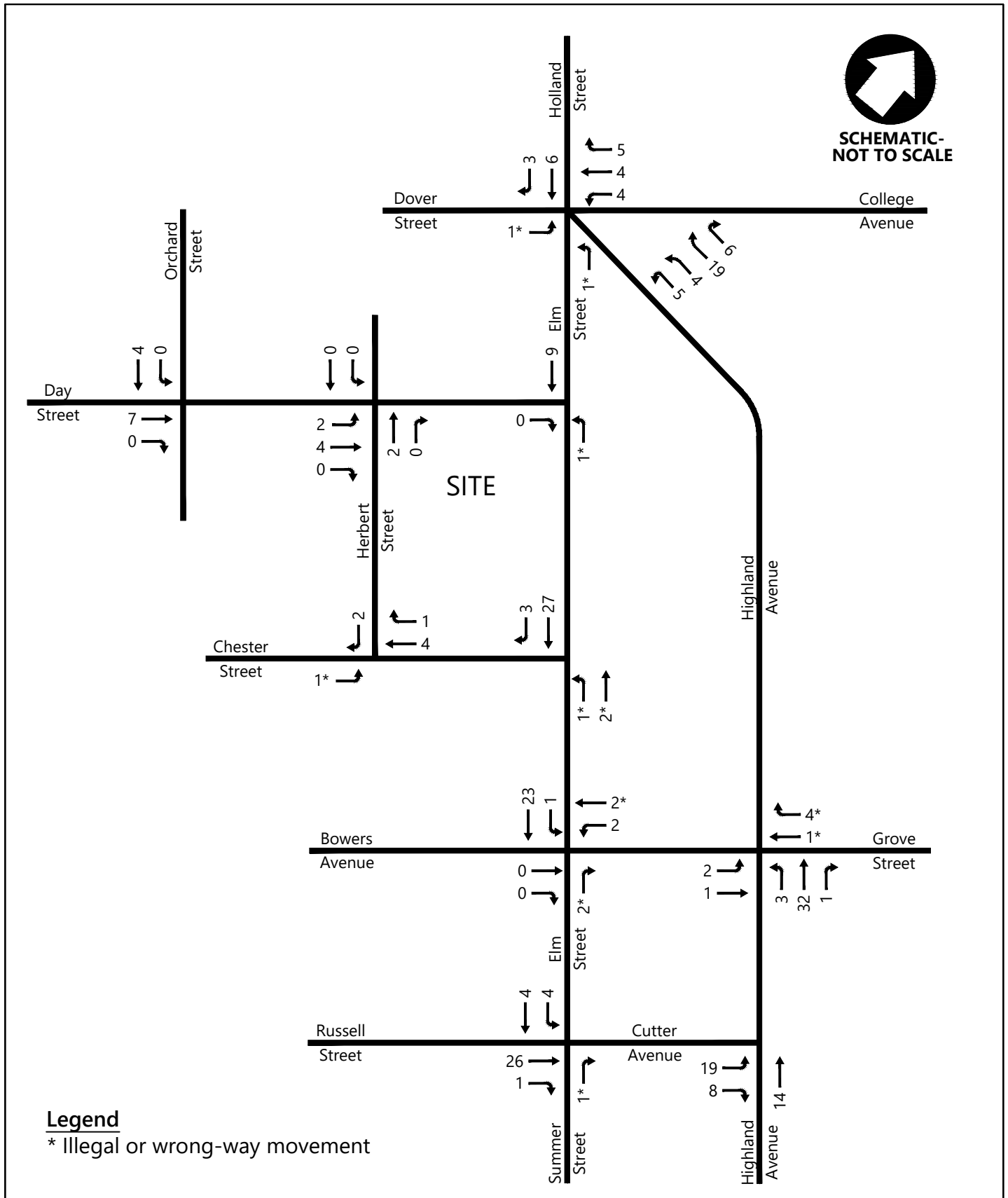


Figure 5
2022 Existing Weekday Morning
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts





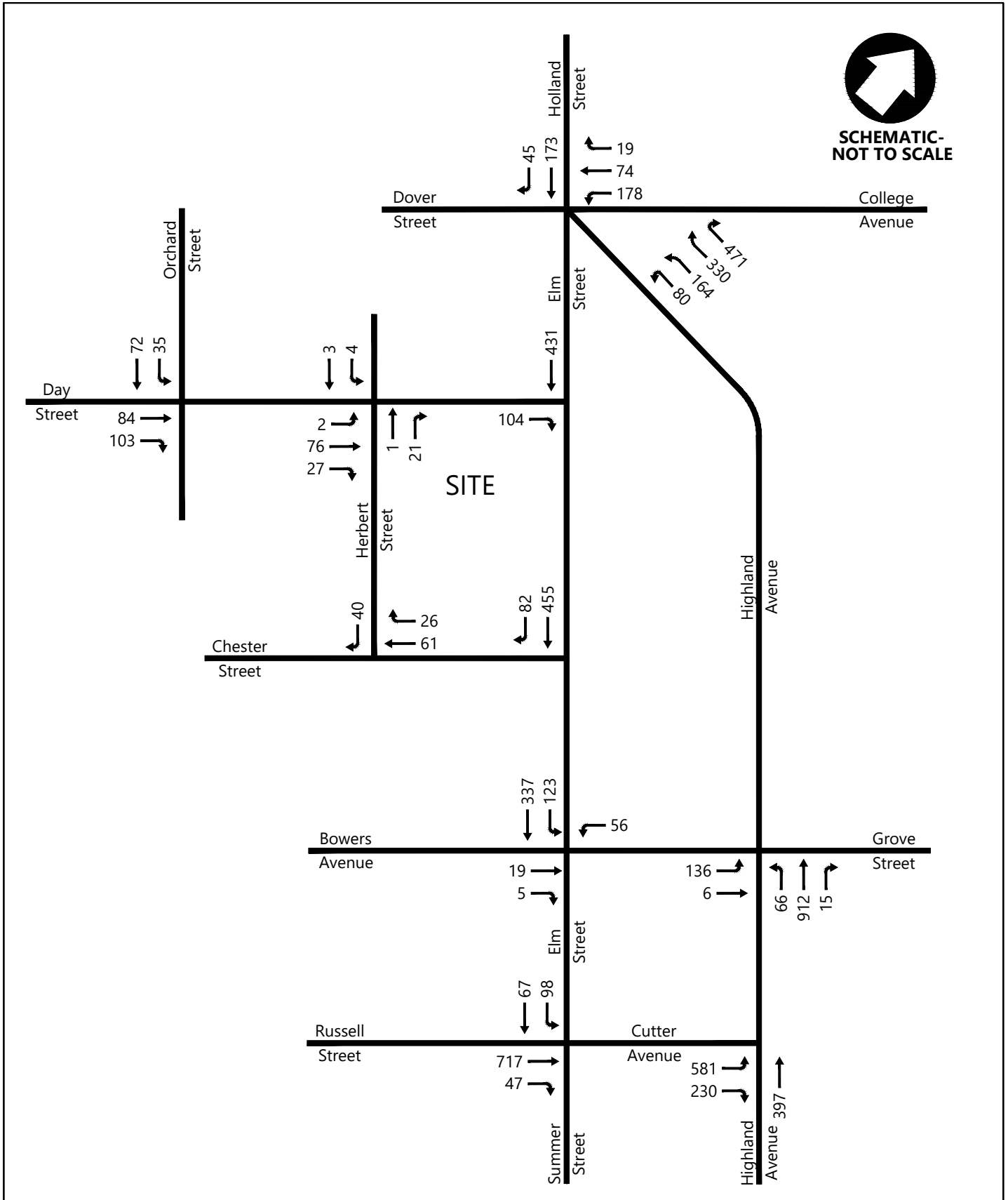
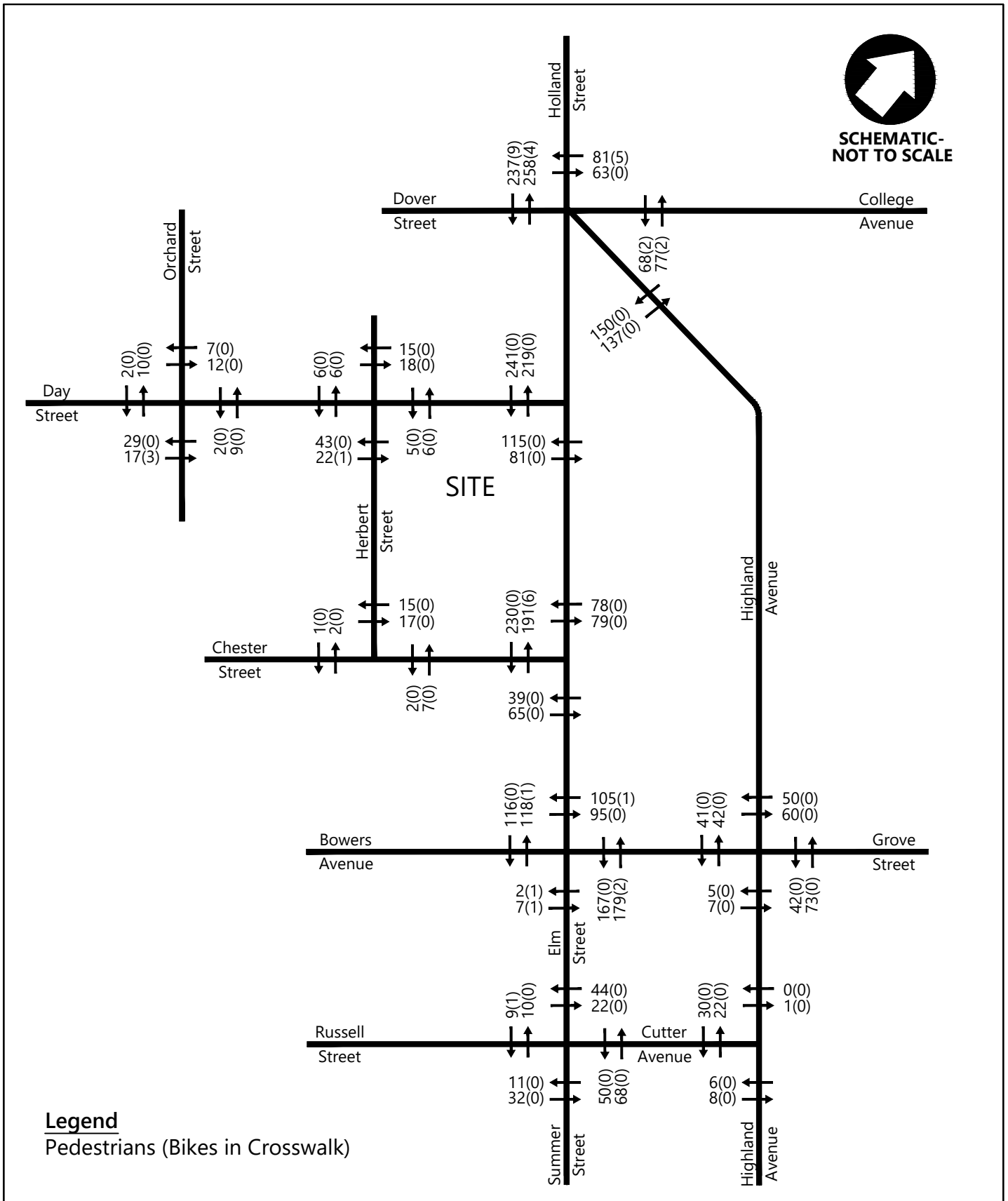


Figure 8
2022 Existing Weekday Afternoon
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts



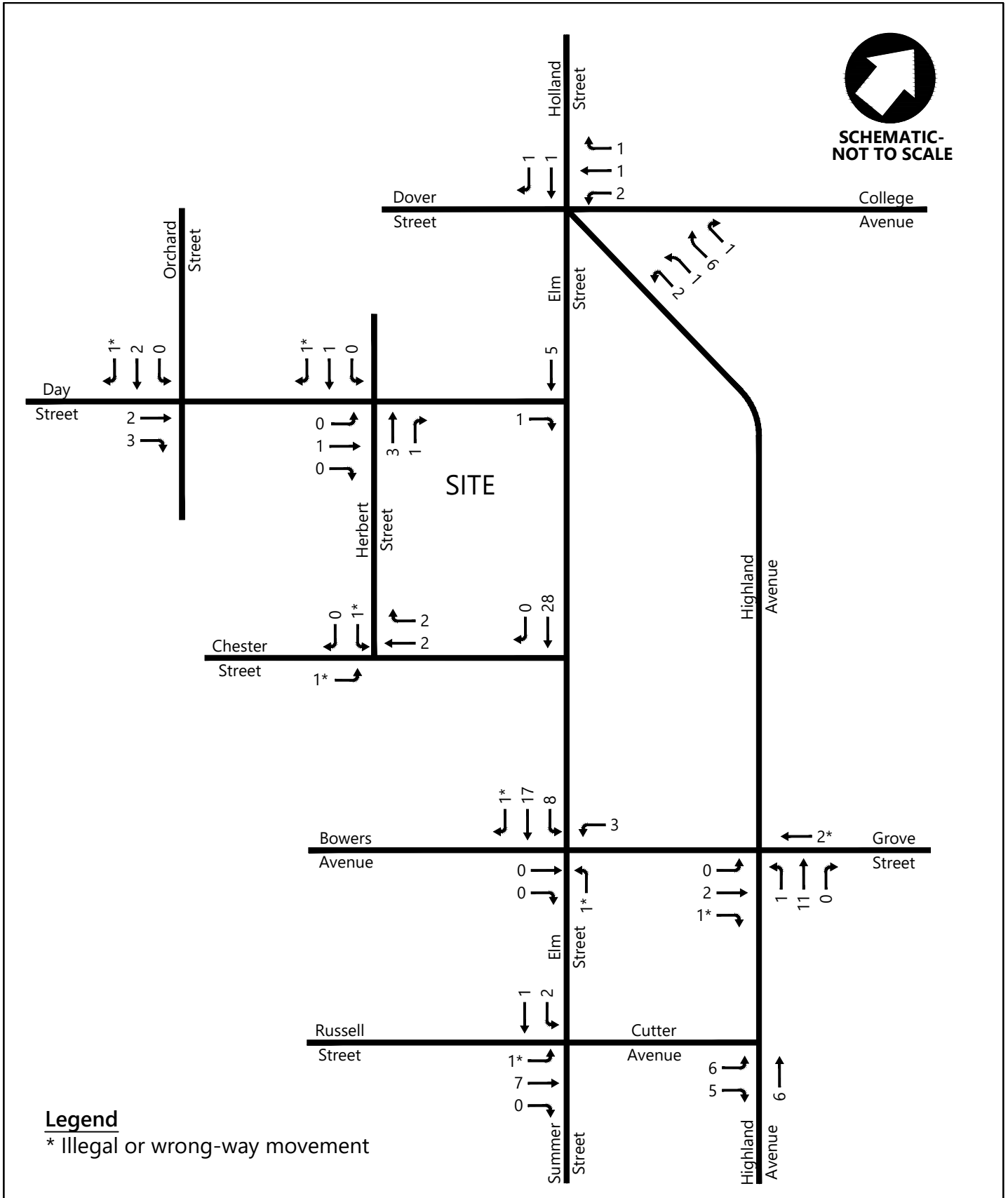


Figure 10
 2022 Existing Saturday Midday
 Peak Hour Bike Volumes
 Mixed-Use Redevelopment
 Somerville, Massachusetts

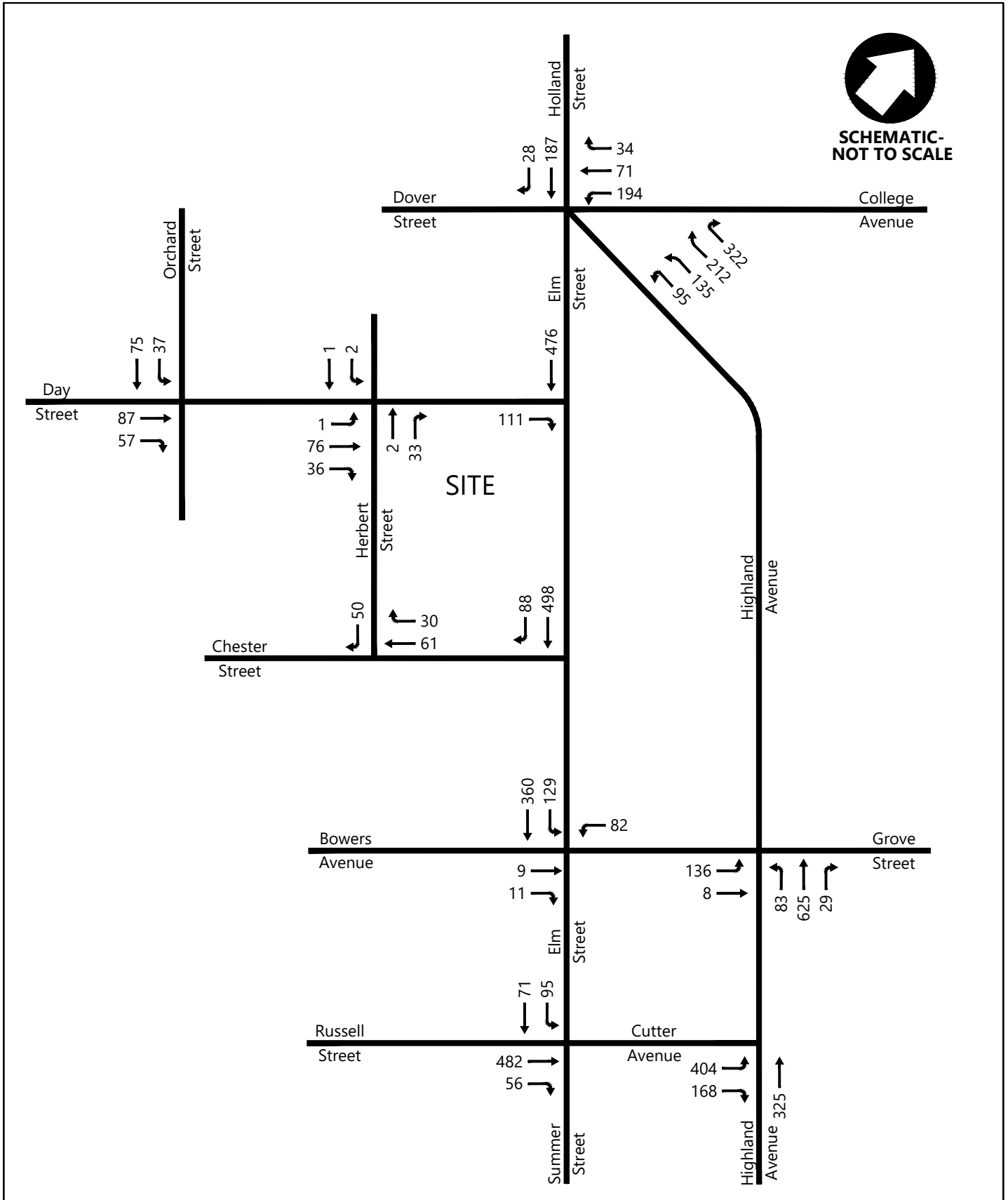


Figure 11
2022 Existing Saturday Midday
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts

Crash Summary

Crash data for the study area intersections was obtained from MassDOT for the most recent five-year period available. The MassDOT data include yearly crash summaries for 2015 through 2019. The results of the crash analysis are summarized below and are provided in Appendix D.

The MassDOT Crash Rate Worksheet calculations were used to determine whether the crash frequencies at the study area intersections were unusually high given the travel demands at each location. The MassDOT Crash Rate Worksheet calculates a crash rate expressed in crashes per million entering vehicles. The calculated rate is then compared to the average rate for signalized and unsignalized intersections statewide and within MassDOT District 4. For unsignalized intersections, the statewide and District 4 average crash rates are both 0.57 crashes per million entering vehicles. For signalized intersections the District 4 crash rate is 0.73 crashes per million entering vehicles, and the statewide average is 0.78 crashes per million entering vehicles.

During the five-year period reviewed, the signalized Davis Square intersection is reported to have experienced a total of 27 crashes resulting in a crash rate of 0.64 crashes per million entering vehicles, which is lower than the state- and district-wide averages. Of the 27 reported crashes, eight were sideswipe crashes, six were angle crashes, four were head-on crashes, two were single-vehicle crashes, one was a rear-end crash, and the type of one crash was unknown. Two of the reported crashes involved a bicyclist, and two crashes involved a pedestrian. Seven of the 27 total crashes resulted in personal injury, and the remaining 20 crashes resulted in property damage only.

Between 2015 and 2019, the intersection of Elm Street and Chester Street is reported to have experienced ten crashes, resulting in a crash rate of 0.58 crashes per million entering vehicles, approximately equivalent to the state- and district-wide average rate of 0.57 crashes per million entering vehicles. Of the ten reported crashes, two were angle crashes, three were rear-end crashes, and two were sideswipe crashes. One crash involved a pedestrian, and two crashes involved a bicyclist. Four of the reported crashes resulted in personal injury, and the remaining six crashes resulted in property damage only.

The unsignalized intersection of Elm Street and Grove Street is reported to have experienced nine crashes during the five-year period reviewed, resulting in a crash rate of 0.52 crashes per million entering vehicles, which is below the district- and state-wide averages. One of the reported crashes was an angle crash, two crashes were rear-end crashes, one was a sideswipe crash, and one was a single vehicle crash. Three crashes involved pedestrians, and one crash involved a bicyclist. Three of the reported crashes resulted in personal injury, five crashes resulted in property damage only, and the result of one crash was unknown.

The intersection of Summer Street at Cutter Avenue is reported to have experienced a total of five crashes between 2015 and 2019 resulting in a crash rate of 0.24 crashes per million entering vehicles. Of the five reported crashes, two were sideswipe crashes, one was a single vehicle crash, and two crashes involved a pedestrian. Two crashes resulted in personal injury and the remaining three crashes resulted in property damage only.

Between 2015 and 2019, the intersection of Highland Avenue and Cutter Avenue is reported to have experienced a total of 11 crashes resulting in a crash rate of 0.39 crashes per million entering vehicles.

Five of the reported crashes were angle crashes, and the remaining six crashes were sideswipe crashes. One crash resulted in personal injury, and ten crashes resulted in property damage only.

During the five-year period reviewed, the intersection of Highland Avenue at Grove Street is reported to have experienced a total of 21 crashes, resulting in a crash rate of 0.81 crashes per million entering vehicles. Five of the reported crashes were angle crashes, four crashes were rear-end crashes, six crashes were sideswipe crashes, and one crash was unknown. Three crashes involved a pedestrian, and the remaining two crashes involved a bicyclist. Eight crashes resulted in personal injury, 11 crashes resulted in property damage only, and the outcome of two crashes was unknown.

The intersection of Day Street and Herbert Street is reported to have experienced two crashes during the five-year period reviewed, resulting in a crash rate of 0.51 crashes per million entering vehicles. Both of the reported crashes were sideswipe crashes resulting in property damage only.

The intersection of Day Street at Orchard Street is reported to have experienced one crash between 2015 and 2019, resulting in a crash rate of 0.14 crashes per million entering vehicles, which is below the statewide and district-wide averages. The reported crash involved a bicyclist and resulted in personal injury.

Between 2015 and 2019, the intersection of Chester Street and Herbert Street is reported to have experienced a total of six crashes resulting in a crash rate of 1.72 crashes per million entering vehicles, which is higher than the statewide and district-wide crash rate averages. Half of these crashes appear to be collisions with parked cars, and all six resulted in property damage only. Two of the reported crashes were angle crashes, one crash was a rear-end crash, one crash was a single-vehicle crash, and two crashes were of unknown type.

All study area intersections, except Day Street at Orchard Street, are encompassed by larger Highway Safety Improvement Plan (HSIP) pedestrian and bicycle crash clusters from 2010-2019 within the Davis Square area. Traffic signal timing updates proposed by the City of Somerville as well as the proposed Elm Street pedestrian plaza, described in more detail later in this report, may improve bicycle and pedestrian safety within the study area. In addition, crosswalks throughout the study area have been restriped since 2019, and improved bike lanes were implemented between 2015 and 2019, which may help improve pedestrian and bicyclist visibility and safety at the study area intersections and may not be reflected in the available crash data for the area.

Parking Utilization

In order to assess the availability of parking in the areas around the site, parking utilization studies were conducted on Tuesday, July 19, 2022, and on Saturday, July 23, 2022, from 8:00 AM to 8:00 PM. Based on direction from the City of Somerville Mobility Division, the scope of the studies consisted of:

- The private parking lot at 55 Day Street
- The public parking lot at 44 Day Street
- On-street parking on Elm Street between Day Street and Chester Street
- On-street parking on Day Street between Elm Street and the entrance to the 44 Day Street parking lot
- On-street parking on Chester Street between Elm Street and Herbert Street
- On-street parking on Herbert Street

The study area was broken up into individual parking spaces. For on-street parking areas without demarcated spaces, approximate parking space limits were assumed based on approximately 20-foot spaces. Parking utilization was recorded every half hour beginning at 8:00 AM, with the final recording occurring between 7:30 PM and 8:00 PM. The data collected over the course of the study is attached to this report as Appendix E. The results of the study are summarized in Table 5 and illustrated on Figure 12 and Figure 13 below.

Table 5: Parking Utilization Summary

Location	Total Supply	Weekday Utilization			Saturday Utilization		
		Average	Maximum	Max. Time	Average	Maximum	Max. Time
Private 55 Day Lot	81	33%	46%	1:00 PM	12%	14%	9:30 AM
Public 44 Day Lot	61	57%	74%	1:00 PM	61%	92%	12:30 PM
Day Street	21	49%	76%	11:00 AM	51%	86%	12:30 PM
Elm Street	15	76%	93%	6:00 PM	76%	93%	2:00 PM
Herbert Street	5	68%	100%	12:00 PM	73%	100%	11:00 AM
Chester Street	8	59%	88%	10:30 AM	55%	100%	7:00 PM
Total Study Area	191	48%	63%	1:00 PM	41%	56%	12:30 PM

As shown in Table 5, the combined study area included a total of 191 usable parking spaces. In addition to these 191 spaces, approximately 15 parking spaces of on-street curb length were allocated to outdoor dining, approximately eight parking spaces of curb length were designated as loading zones, one parking space was allocated for bicycle parking, and six locations were identified where illegal parking was regularly observed. These locations are excluded from the analyses presented in the above table and below figures but are included in the detailed data attached in Appendix E. Additionally, two spaces in the 55 Day Street lot were observed to contain construction equipment for the majority of the study periods. These spaces are included in the analysis presented in this report, with the construction equipment treated as parked cars for the purposes of analysis.

Across the study area, an average parking utilization of about 48% was observed for the weekday study date, and an average utilization of approximately 40% was observed for the Saturday. The peak overall utilization of approximately 63% occurred during the weekday midday period. In general, utilization was shown to be higher for on-street parking than for the off-street lots. The private parking lot at 55 Day Street is permit parking only, which likely contributes to its lower utilization level, however the public lot at 44 Day Street still showed an average vacancy rate of approximately 40% on both study days.

Figure 12: Weekday Parking Utilization by Time



Figure 13: Saturday Parking Utilization by Time



CURRENT-YEAR BUILD CONDITIONS

Site-Generated Traffic

Projected Site Trips

In order to estimate the number of vehicle trips associated with the proposed mixed-use redevelopment, the Institute of Transportation Engineers (ITE) *Trip Generation Manual, 11th Edition*, was referenced. ITE is a national research organization of transportation professionals, and the *Trip Generation Manual, 11th Edition* provides traffic generation information for various land uses compiled from studies conducted by members nationwide. This reference establishes vehicle trip rates based on actual traffic counts conducted at similar types of existing land use. For the proposed redevelopment, Land Use Codes (LUCs) 822 (Strip Retail Plaza (<40k)), 710 (General Office Building), and 760 (Research and Development) were utilized. A summary of the unadjusted vehicle trips estimated for the site utilizing the ITE Trip Generation Manual is provided in Table 6.

Table 6: Proposed Condition ITE Trip Generation

Description	Size	Weekday AM			Weekday PM			Saturday Midday			Weekday Daily		
		Peak Hour			Peak Hour			Peak Hour					
		In	Out	Total	In	Out	Total	In	Out	Total	In	Out	Total
Proposed Retail ¹	20,300 sf	29	19	48	64	64	128	68	65	133	543	543	1,086
Proposed Office ²	39,600 sf	66	9	75	13	64	77	11	10	21	259	259	518
Proposed Lab ³	59,400 sf	63	14	77	12	63	75	11	11	22	412	412	824
Total Proposed ITE Trips		158	42	200	89	191	280	90	86	176	1,214	1,214	2,428

1 ITE Land Use Code 822 (Strip Retail Plaza (<40k)), based on 20,300 square feet.

2 ITE Land Use Code 710 (General Office Building), based on 39,600 square feet.

3 ITE Land Use Code 760 (Research and Development Center), based on 59,400 square feet.

In order to account for the significant portion of trips to the project site which are expected to utilize modes other than personal motor vehicles, the estimated total trip generation based on ITE data needed to be converted to person trips from vehicle trips. The vehicle trips summarized in Table 6 were multiplied by the average vehicle occupancy of 1.09 persons per vehicle to estimate the number of person trips. The resulting number of person trips was then distributed across the modes of personal vehicles, public transportation, biking, and walking based on the estimated mode share for the study area summarized in Table 4. The resulting person trips by mode and estimated vehicle trips associated with the proposed redevelopment are shown in Table 7 below.

Table 7: Proposed Condition Trips by Mode

Description	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour			Weekday Daily		
	In	Out	Total	In	Out	Total	In	Out	Total	In	Out	Total
Person Trips ¹	172	46	218	97	208	305	98	94	192	1,322	1,322	2,644
Vehicle Person Trips ²	69	19	88	39	84	123	39	38	77	532	532	1,064
Public Transportation	85	23	108	48	103	151	49	46	95	656	656	1,312
Bicycle	9	2	11	5	11	16	5	5	10	68	68	136
Walk	9	2	11	5	10	15	5	5	10	66	66	132
Vehicle Trips	63	17	80	36	77	113	36	35	71	489	489	978

1 Based on a vehicle occupancy rate of 1.09 persons/vehicle from Census Journey to Work data for Census Tract 3509.

2 Includes drive alone and carpool trips.

As shown in Table 7, the proposed redevelopment would be estimated to generate a total of approximately 80 vehicle trips (63 entering vehicles and 17 exiting vehicles) during the weekday morning peak hour, approximately 113 vehicle trips (36 entering vehicles and 77 exiting vehicles) during the weekday afternoon peak hour, and approximately 71 vehicle trips (36 entering vehicles and 35 exiting vehicles) during the Saturday midday peak hour. Over an average weekday, the proposed redevelopment is estimated to generate approximately 978 vehicle trips (489 entering vehicles and 489 exiting vehicles). However, because the site is currently occupied by existing retail and office land uses, a significant portion of the estimated trips entering and exiting the project site are already present on the adjacent transportation network. Therefore, the number of project site trips estimated under the proposed redevelopment program can be reduced by the number of trips to the existing site.

Existing Site Trips

The existing site does not have a traditional dedicated driveway and parking area intended for all the employees and customers accessing the site today. Therefore, conducting traffic counts at the existing parking area to determine the total number of trips to and from the existing site was not considered to be representative of the existing uses. To estimate the trip generation of the existing site, a review of ITE trip generation data for the existing land uses, utilizing LUCs 822 (Strip Retail Plaza (<40k)) and 710 (General Office Building), was conducted. A summary of the ITE trip generation estimates for the existing site is presented in Table 8 below.

Table 8: Existing ITE Trip Generation

Description	Size	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour			Weekday Daily		
		In	Out	Total	In	Out	Total	In	Out	Total	In	Out	Total
Existing Retail ¹	27,400 sf	39	26	65	80	80	160	92	88	180	693	693	1,386
Existing Office ²	28,400 sf	50	7	57	10	48	58	8	7	15	194	194	388
Total Existing ITE		89	33	122	90	128	218	100	95	195	887	887	1,774

1 ITE Land Use Code 822 (Strip Retail Plaza (<40k)), based on 27,400 square feet.

2 ITE Land Use Code 710 (General Office Building), based on 28,400 square feet.

The total estimated ITE trips for the existing project site were then removed from the total estimated trips with the proposed redevelopment in place, as shown in Table 9 below.

Table 9: Additional ITE Trip Generation

Description	Weekday AM			Weekday PM			Saturday Midday			Weekday Daily		
	In	Out	Total	In	Out	Total	In	Out	Total	In	Out	Total
Proposed ITE Trips	158	42	200	89	191	280	90	86	176	1,214	1,214	2,428
Existing ITE Trips	89	33	122	90	128	218	100	95	195	887	887	1,774
Additional ITE Trips	69	9	78	-1	63	62	-10	-9	-19	327	327	654

Using the same methodology described for the proposed condition person trip estimation, the additional estimated trips to the site were converted to additional person trips based on the vehicle occupancy of 1.09 persons per vehicle for the study area Census tract. The resulting additional person trips were then distributed across modes by applying the mode share discussed above. The resulting estimates of the additional trips to the site by mode are summarized in Table 10 below.

Table 10: Additional Trip Generation by Mode

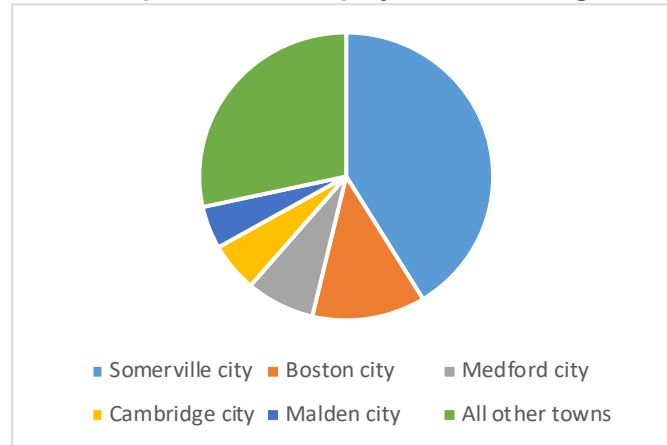
Description	Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour			Weekday Daily		
	In	Out	Total	In	Out	Total	In	Out	Total	In	Out	Total
Additional Person Trips	75	10	85	-1	69	68	-11	-9	-20	356	356	712
Vehicle Person Trips	30	5	35	0	28	28	-5	-4	-9	143	143	286
Public Transportation	37	5	42	-1	34	33	-5	-5	-10	177	177	354
Bicycle	4	0	4	0	4	4	-1	0	-1	18	18	36
Walk	4	0	4	0	3	3	0	0	0	18	18	36
Additional Vehicle Trips	27	4	31	0	26	26	-4	-4	-8	132	132	264

When compared to the estimated existing trip generation, the proposed redevelopment is projected to generate approximately 31 additional vehicle trips (27 entering vehicles and four exiting vehicles) during the weekday morning peak hour, approximately 26 additional vehicle trips (zero entering vehicles and 26 exiting vehicles) during the weekday afternoon peak hour, and approximately eight fewer vehicle trips (four fewer entering vehicles and four fewer exiting vehicles) during the Saturday midday peak hour. The proposed redevelopment is estimated to generate approximately 264 additional vehicle trips (132 entering vehicles and 132 exiting vehicles) over the course of an average weekday.

Project Trip Distribution and Assignment

Given the small change in retail space with the redevelopment, most of the new trips generated by the proposed redevelopment are considered to be office and laboratory trips. To determine the trip distribution for these trips, U.S. Census Journey-to-Work data for the City of Somerville was reviewed. Based on the results of the Journey-to-Work analysis, the top five municipalities with employees commuting to Somerville were determined to be Somerville, Boston, Medford, Cambridge, and Malden, as shown in Figure 14 below.

Figure 14: Municipalities with Employees Commuting to Somerville



Based on the locations of the cities shown above and 15 other municipalities comprising the top 20 municipalities with employees commuting to Somerville, trip distribution estimates were developed and are displayed below. Given the unique layout of roadways entering and exiting Davis Square, the overall trip distribution estimates were generated based on anticipated routes between the municipalities and the project site area.

Table 7: Trip Distribution Estimates

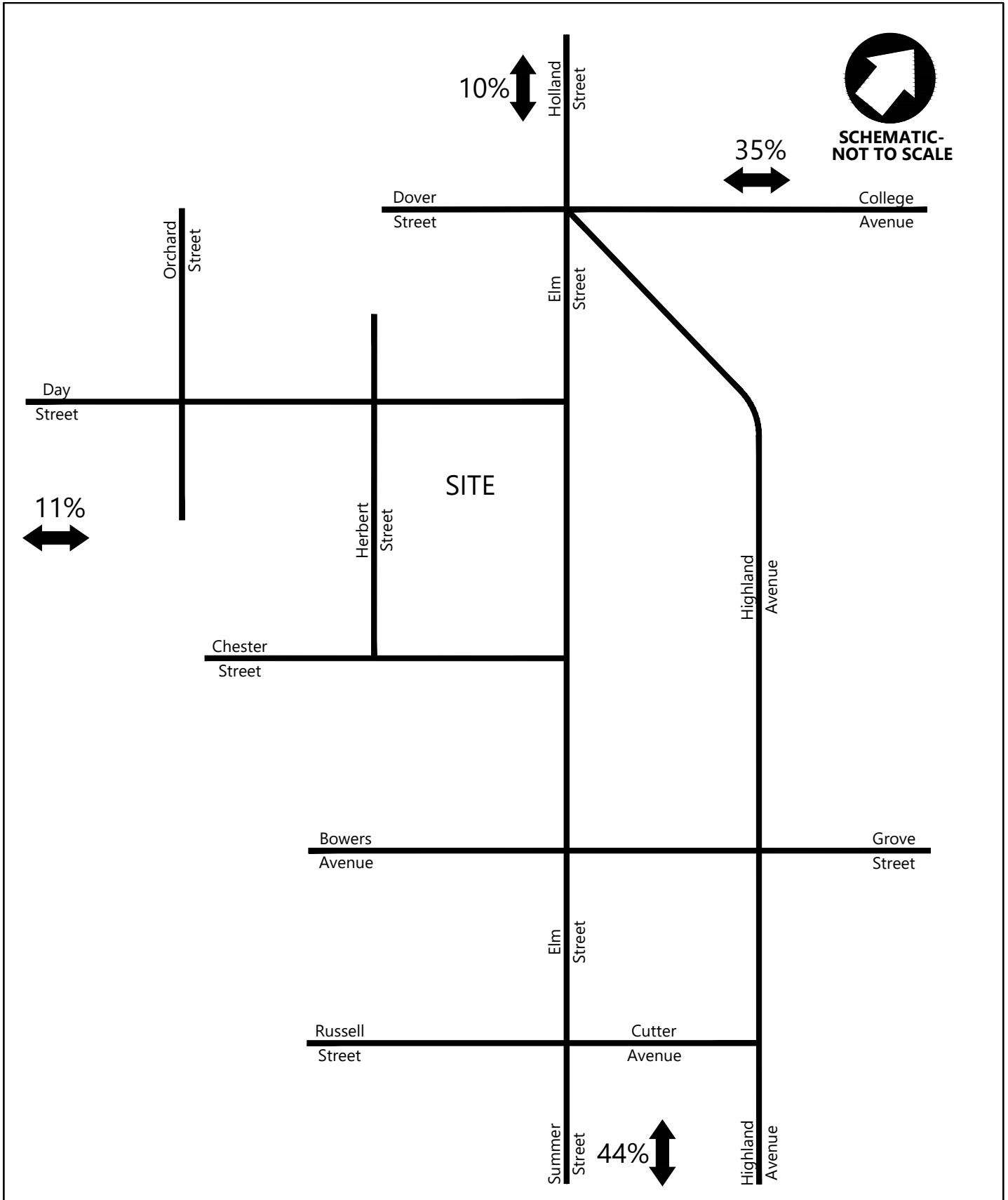
Holland Street	College Avenue	Day Street/ Chester Street	Highland Avenue/ Elm Street
10%	35%	11%	44%

As shown in Table 7, approximately 10 percent of new trips generated by the proposed redevelopment are estimated to arrive and depart via Holland Street, approximately 35 percent of new trips are estimated to arrive and depart via College Avenue, approximately 10 percent are estimated to arrive and depart via Day Street and Chester Street, and the remaining 45 percent are estimated to arrive and depart via Highland Avenue and Elm Street. Additional project site trips would be distributed onto the study area roadway based on the distribution patterns summarized in Table 7, as approved by the City of Somerville Mobility Division. The Journey-to-Work data is included in Appendix F of this report. The resulting arrival and departure patterns are presented in Figure 15 and the traffic projection model found in Appendix B.

The project-related vehicle traffic was then assigned to the surrounding roadway network based on the project trip distribution patterns presented in Figure 15. The resulting distributed additional project vehicle trips are shown in Figure 16 and Figure 17 for the weekday morning and weekday afternoon peak hours, respectively. No additional vehicle trips are estimated to occur during the Saturday midday peak hour.

2022 Build Volumes

To establish the 2022 Build peak hour traffic volumes, the distributed new project trips were added to the 2022 Existing peak hour traffic volumes to reflect the 2022 Build peak hour traffic volumes. The resulting 2022 Build weekday morning, weekday afternoon, and Saturday midday peak hour traffic volumes are presented in Figure 18, Figure 19, and Figure 20, respectively, and are documented in the traffic projection model presented in Appendix B of this report.



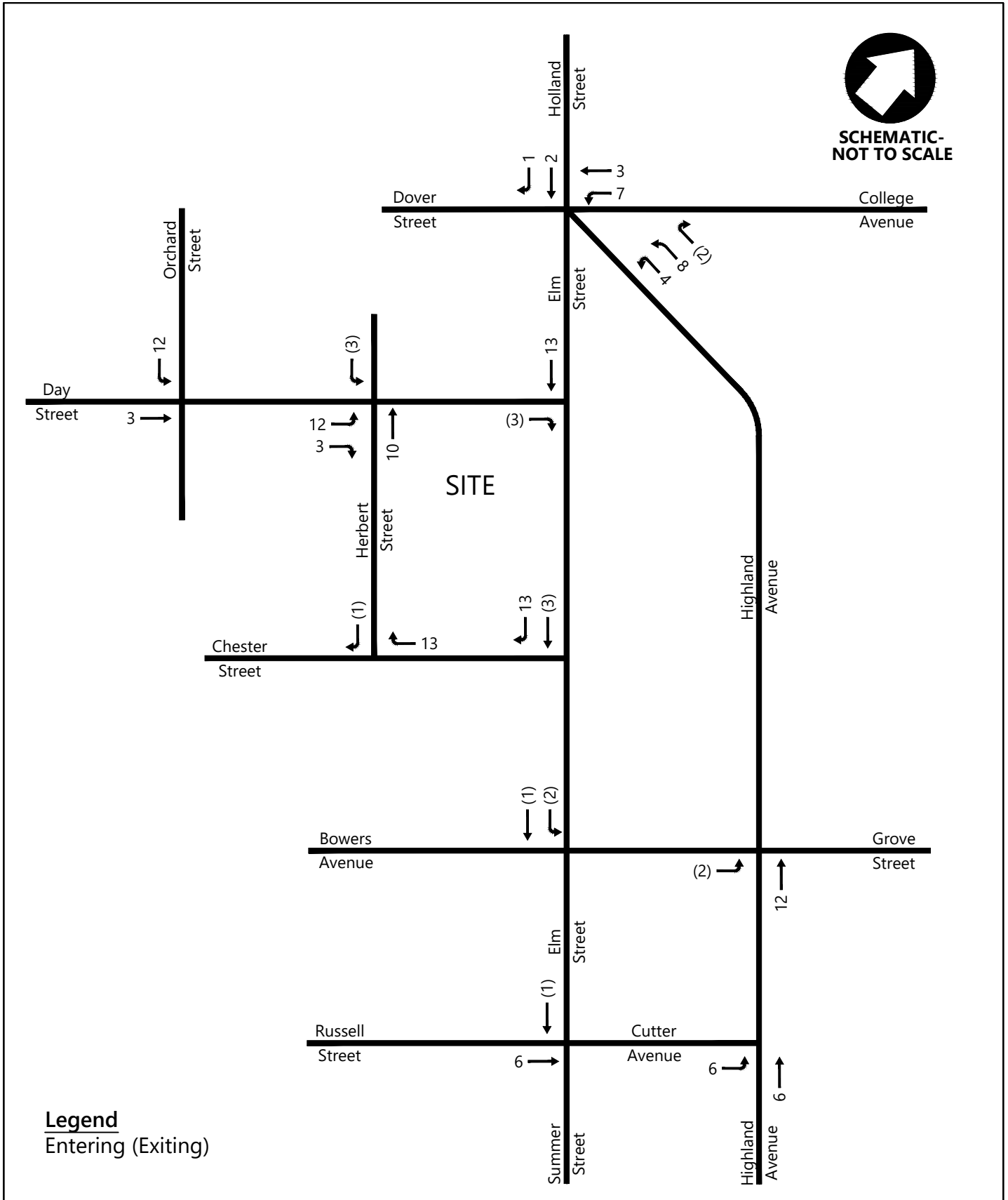


Figure 16
 Weekday Morning Peak Hour
 Additional Project Vehicle Trips
 Mixed-Use Redevelopment
 Somerville, Massachusetts

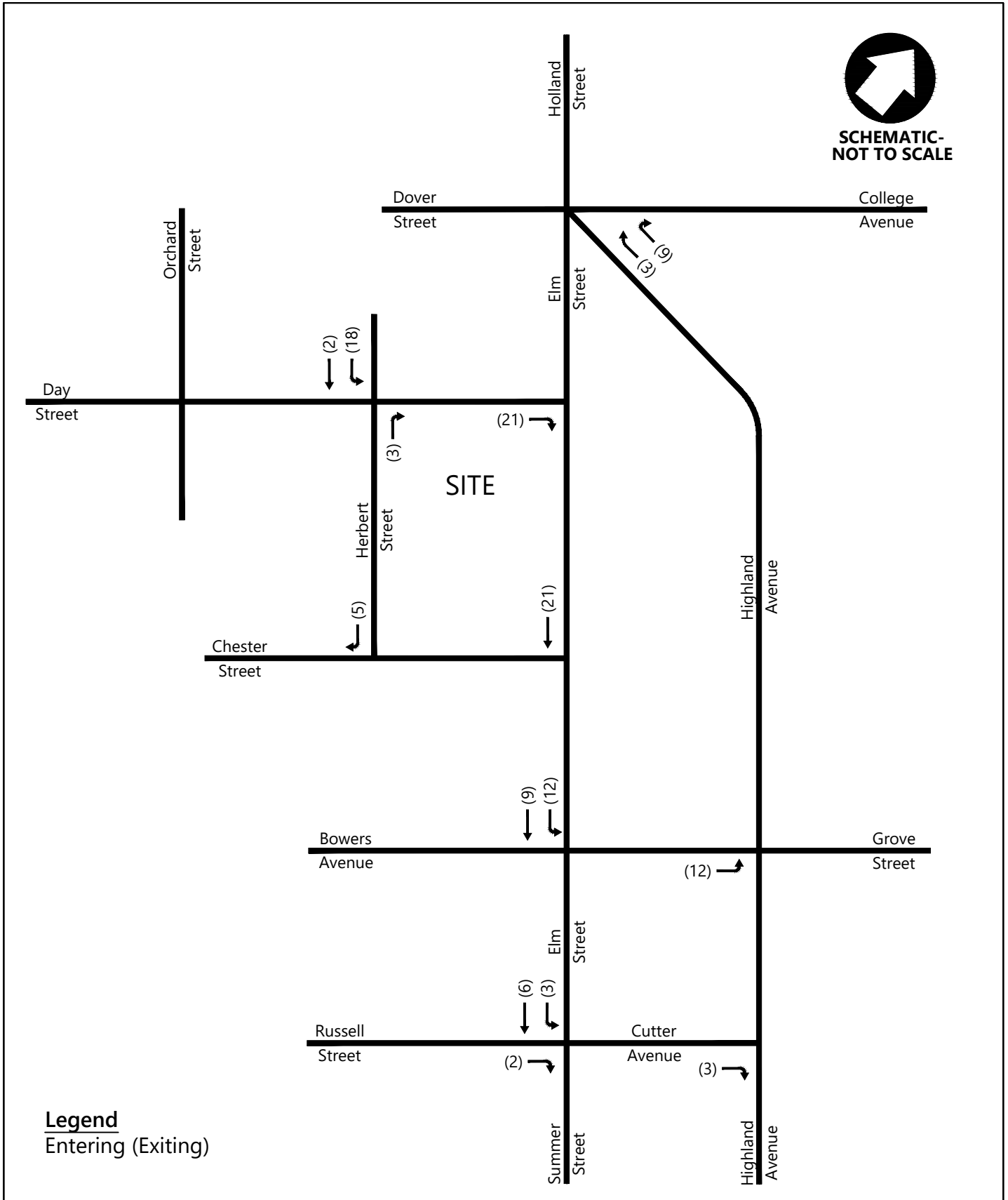


Figure 17
Weekday Afternoon Peak Hour
Additional Project Vehicle Trips
Mixed-Use Redevelopment
Somerville, Massachusetts

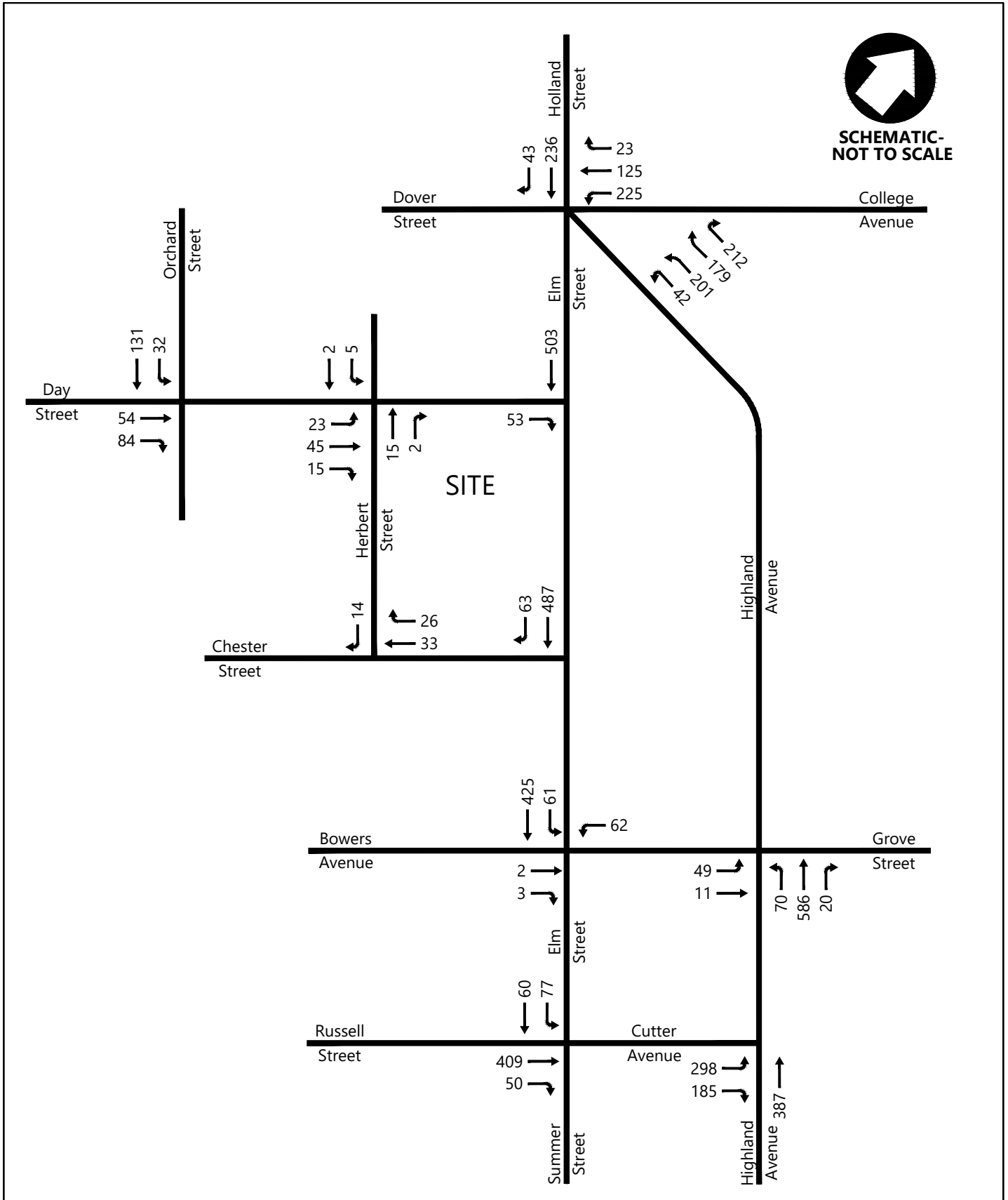


Figure 18
2022 Build Weekday Morning
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts

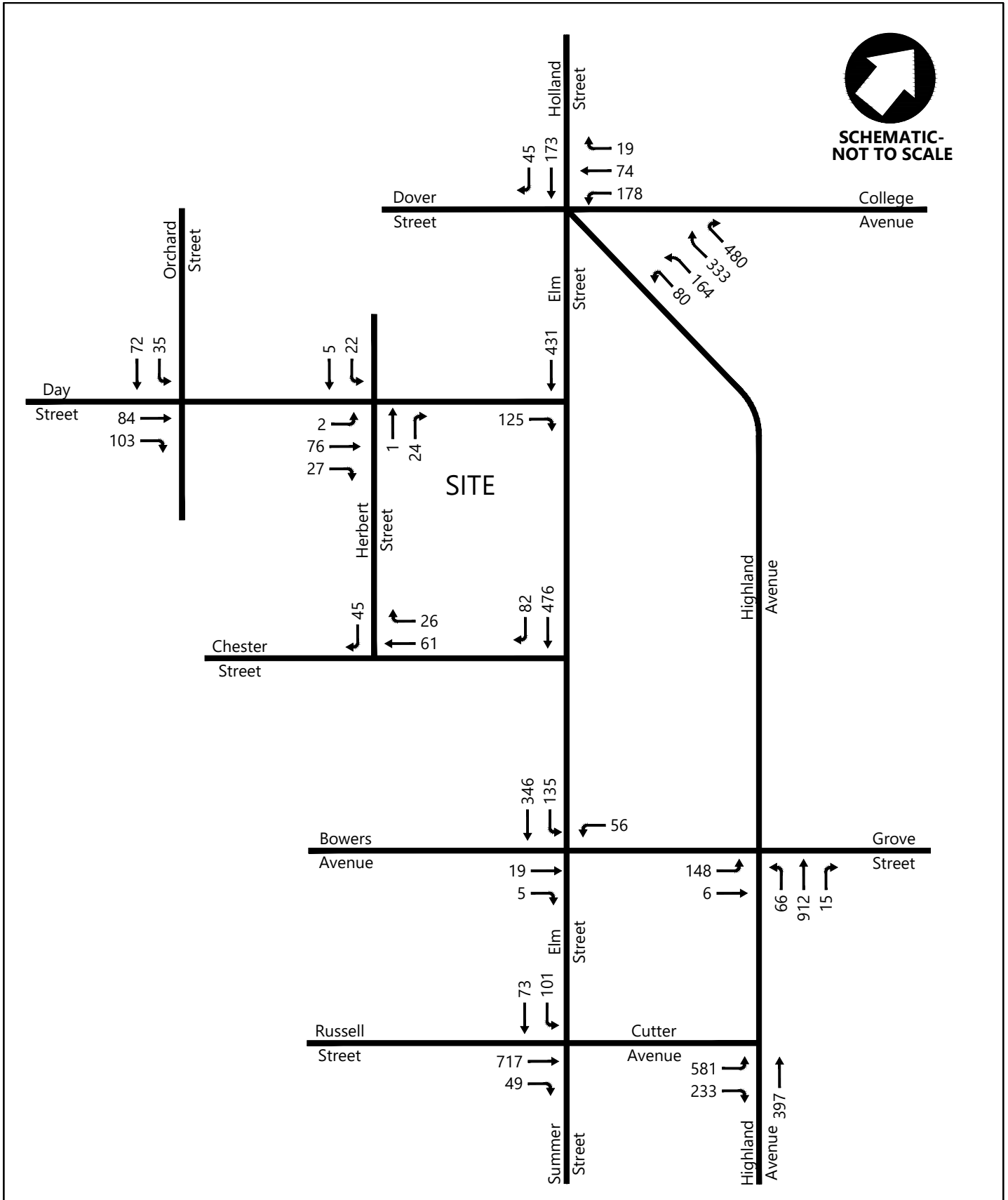
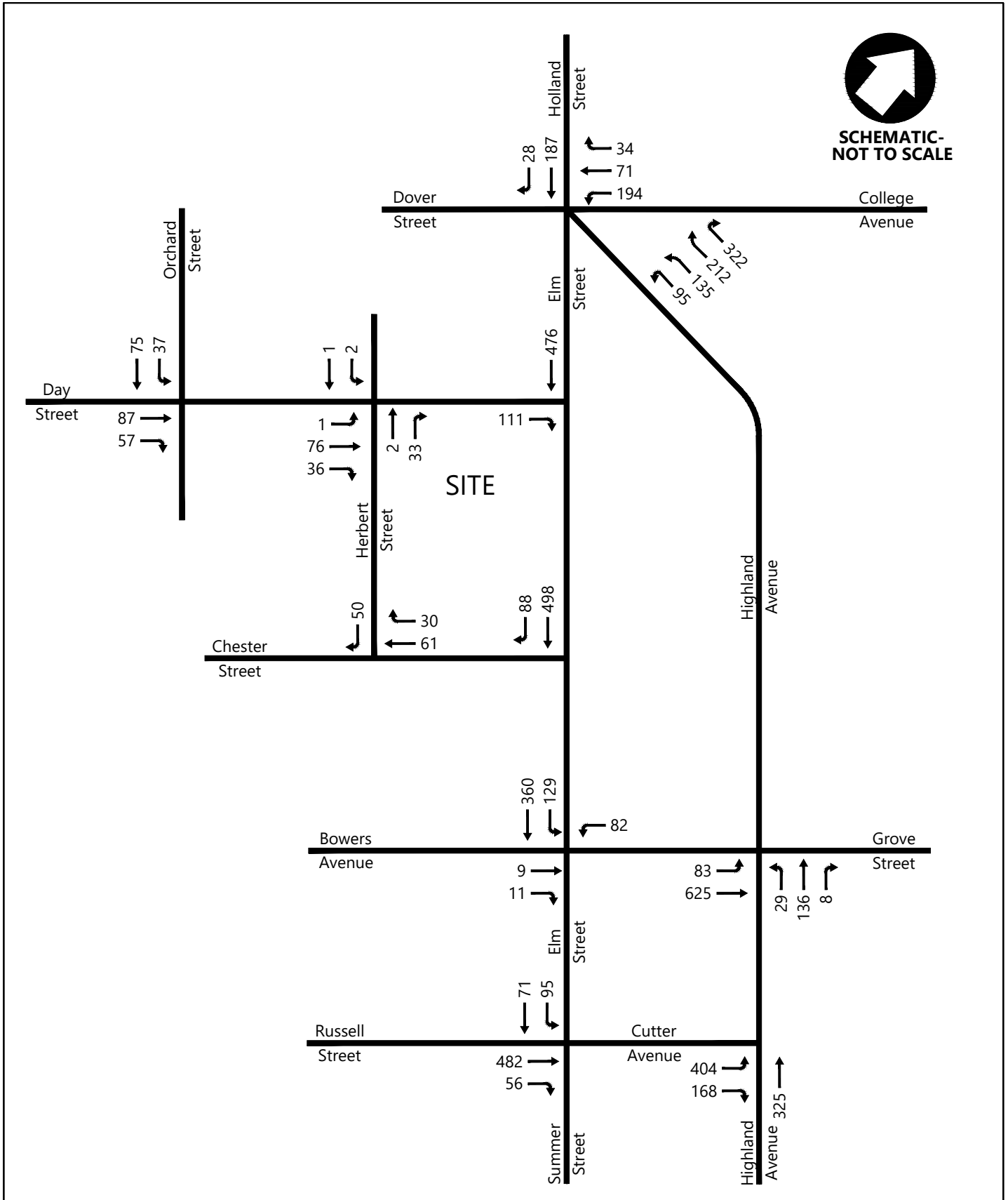


Figure 19
2022 Build Weekday Afternoon
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts



FUTURE YEAR CONDITIONS

To determine future traffic demands on the study area roadways, the 2022 Build traffic volumes were projected to the future year 2027. Traffic volumes on the roadways in 2027 are assumed to include the 2022 Build traffic volumes as well as new traffic resulting from general growth in the study area and from other planned development projects. The potential background traffic growth unrelated to the proposed project was considered in the development of the 2027 Design Year Build peak hour traffic volume networks. A more detailed description of the development of the 2027 Design Year Build traffic volume networks is presented below.

Future Roadway Improvements

Planned roadway improvement projects can affect area travel patterns and future traffic operations. Based on discussions with the City of Somerville, the City is planning on proposing that Elm Street be closed to traffic and transformed into a pedestrian plaza between Day Street and Grove Street. At the request of the City of Somerville, this proposed closure was incorporated into the 2027 Design Year Build traffic analysis. Based on the on a schematic plan from the City showing the general traffic patterns under the proposed condition, the proposed pedestrianization of Elm Street would include:

- The closure of Elm Street between Day Street and Grove Street
- The reversal of Elm Street between Day Street and the Davis Square signalized intersection, allowing vehicle traffic from Day Street to approach the signal from the south.
- The reconfiguration of the Davis Square intersection to allow this northbound traffic flow and remove the existing traffic flows onto Elm Street heading southbound.
- The conversion of Highland Avenue to two-way traffic between College Avenue and Grove Street.
- Estimated rerouting of existing and site-generated vehicle traffic based on the change in traffic patterns.

As the pedestrianization of Elm Street is in the preliminary planning stages, the final design of the project is not known at this time. As such, the conditions modeled for the 2027 Design Year were based on the City's schematic plan, the existing roadway network and signal timings, and engineering judgement. The resulting signal timing and lane configurations are depicted in the Synchro worksheets for the 2027 Design Year Build condition presented in Appendix I.

Vehicle traffic that currently travels along the proposed pedestrianized section of Elm Street was rerouted based on existing vehicle volumes and the proposed closures for vehicles. The volume changes were based solely on the existing vehicle volumes at the study area intersections and engineering judgment and do not account for changes in mode share, broader changes in travel patterns, or other effects that the pedestrianization of Elm Street and accompanying could result in. The rerouting of vehicle traffic is shown in the traffic projection model attached to this report as Appendix B.

Background Traffic Growth

Traffic growth is primarily a function of changes in motor vehicle use and expected land development in the region. To predict a rate at which traffic on the roadways in the vicinity of the site can be

expected to grow during the five-year forecast period (2022 to 2027), both planned area developments and historic traffic growth were examined.

Site-Specific Growth

Based on discussions with the City of Somerville, four developments which are currently planned for the area were identified to be included in the projections of future growth. The proposed projects consist of:

- A 184,000 square-foot laboratory development at 231-249 Elm Street and 6-8 and 12 Grove Street
- A 22-unit residential building with 1,940 square feet of first-floor retail space at 371 Highland Avenue
- A marijuana dispensary at 240 Elm Street
- A marijuana dispensary at 255 Elm Street

Vehicle trips associated with the above projects were added to the 2027 Design Year condition based on vehicle trip estimates contained within transportation impact studies for each project. The resulting vehicle trips at the study area intersections are shown in the traffic projection model provided in Appendix B.

Background Traffic Growth

Background traffic growth accounts for changes in traffic volumes associated with general changes in population and other developments that are not known at this time. Based on guidance provided by the City of Somerville, no background traffic growth was included in the development of the 2027 Design Year Build traffic volumes.

The projected traffic volumes at the study area intersections are documented in the traffic projection model located in Appendix B.

2027 Design Year Build Traffic Volumes

The estimated rerouting of vehicle traffic related to the proposed pedestrianization of Elm Street and the vehicle trips from the four background developments discussed above were added to the 2022 Build traffic volumes to establish the 2027 Design Year Build conditions. Vehicle volumes for the weekday morning, weekday afternoon, and Saturday midday peak hours, are illustrated in Figure 21, Figure 22, and Figure 23, respectively, and are documented in the traffic projection model presented in Appendix B of this report.

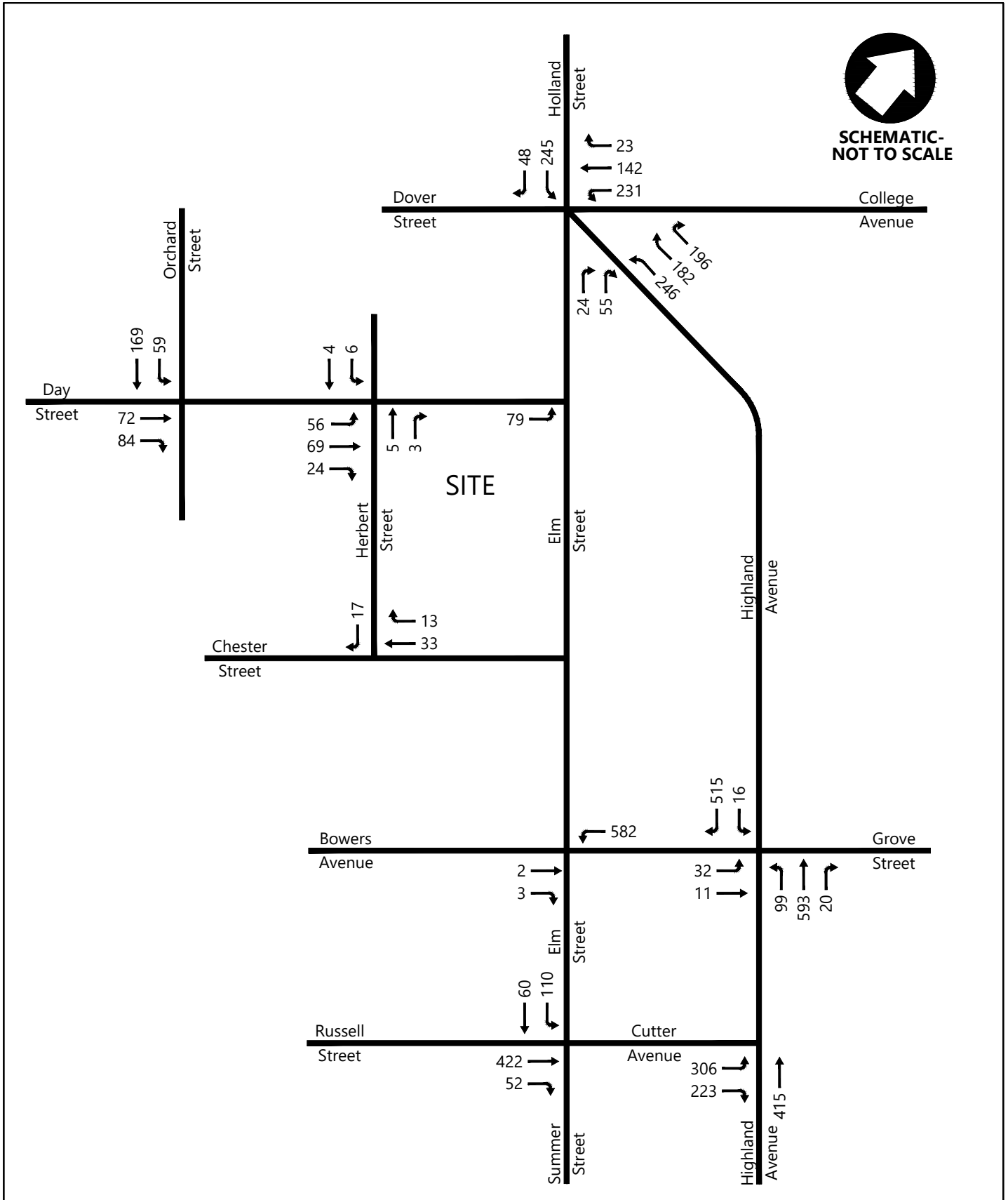
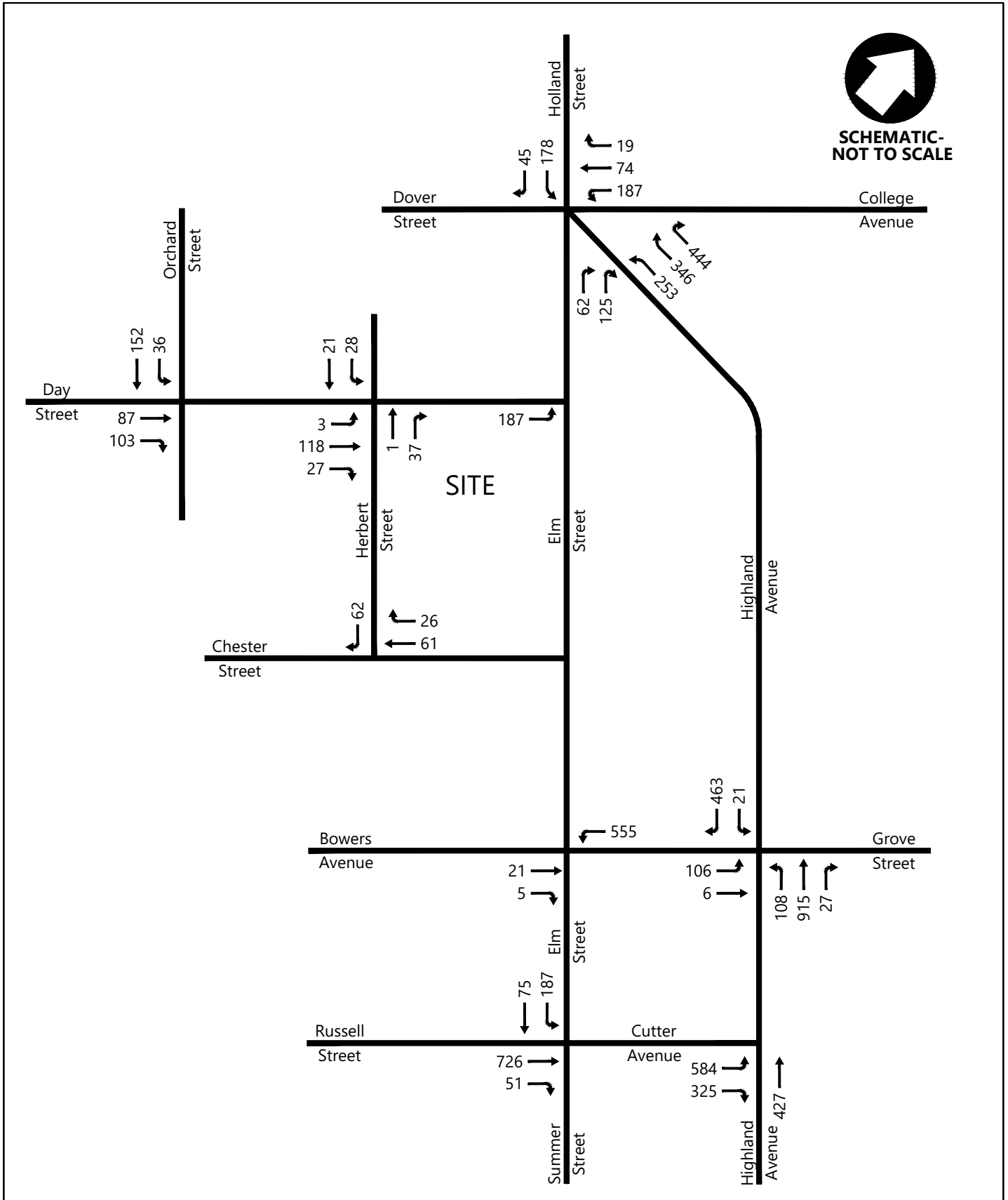


Figure 21
2027 Design Year Build Weekday Morning
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment
Somerville, Massachusetts



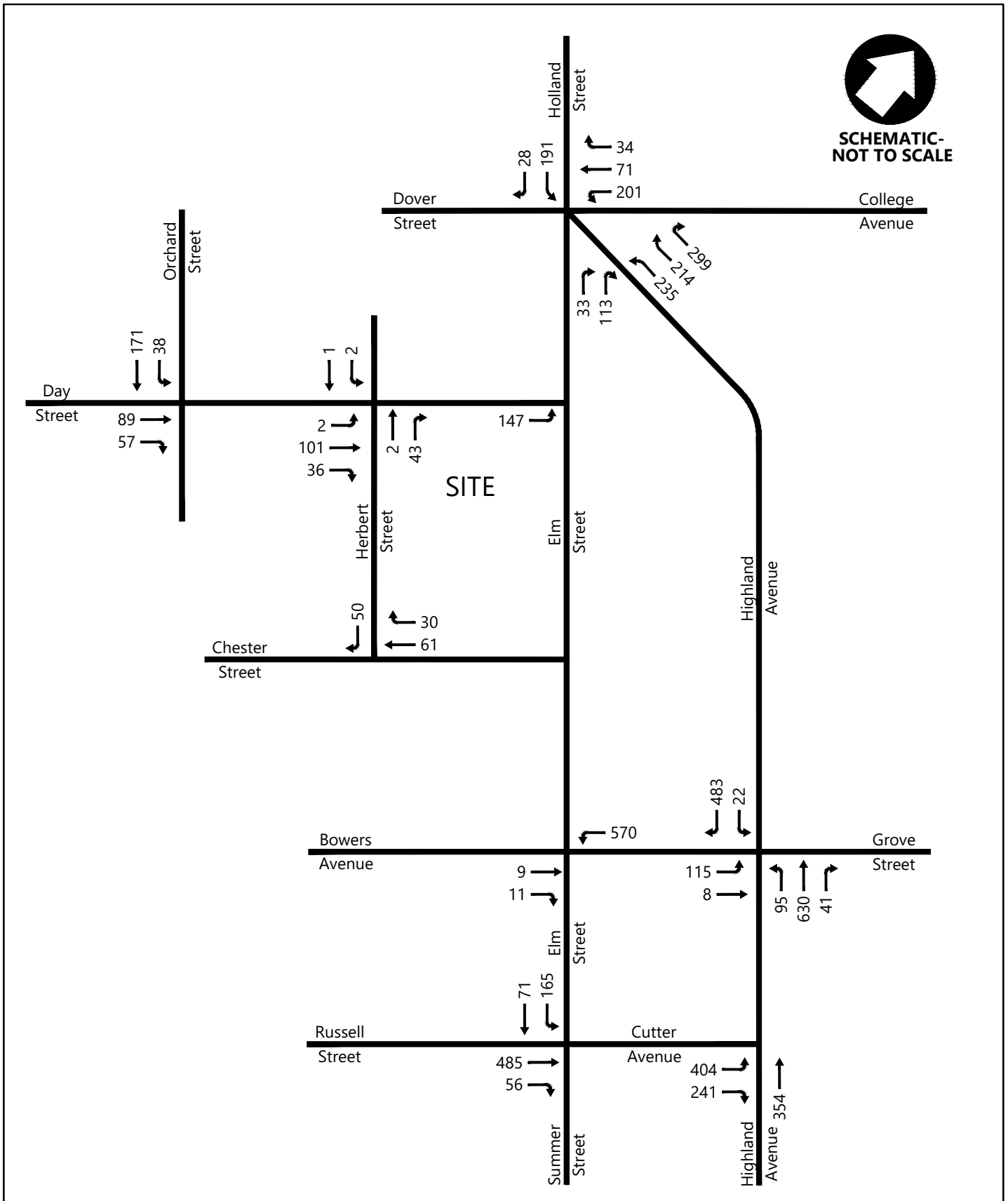


Figure 23
2027 Design Year Build Saturday Midday
Peak Hour Vehicle Volumes
Mixed-Use Redevelopment Somerville,
Massachusetts

TRANSPORTATION OPERATIONS ANALYSIS

In previous sections of this report, the quantity of pedestrians, vehicles, and bicycles at the study area intersections has been discussed. The following sections describe the overall quality of flow and experiences for the various modes through study area intersections during the weekday morning, weekday afternoon, and Saturday midday peak hours. The following section presents capacity analysis for vehicular operations, pedestrian level of traffic stress, bicycle level of traffic stress, and an evaluation of potential impacts to public transit.

Vehicular Capacity Analysis

As a basis for this assessment, intersection capacity analysis was conducted using the Synchro capacity analysis software at the study area intersections under the 2022 Existing, 2022 Build, and 2027 Design Year Build peak hour traffic conditions. The analysis is based on Synchro capacity analysis methodologies and procedures contained in the *Highway Capacity Manual* (HCM). In accordance with City of Somerville guidelines, the capacity analysis for the unsignalized study area intersections was generally performed using HCM2000 methodology, rather than the current HCM6 methodology with vehicle queues for the signalized study area intersections. Due to limitations of the HCM2000 reports provided by Synchro, the Synchro reports were used for estimates of queueing at signalized intersections.

Average total vehicle delay is reported as level-of-service (LOS) on a scale of A to F. LOS A represents delays of ten seconds or less and LOS F represents delays in excess of 50 seconds for unsignalized intersections and greater than 80 seconds for signalized intersections.

The detailed Synchro capacity analysis worksheets for the 2022 Existing, 2022 Build, and 2027 Design Year Build traffic conditions are presented in Appendix G, Appendix H, and Appendix I, respectively. A detailed summary of the capacity analysis for each study area intersection is provided in Appendix J. The results of the specific capacity analysis at the study area intersections are discussed below.

Capacity Analysis Results

Table 11 presents the overall capacity analysis results for the signalized study area intersections under 2022 Existing, 2022 Build, and 2027 Design Year Build conditions.

Table 11: Signalized Intersection Capacity Analysis

Intersection	Peak Period	2022 Existing			2022 Build			2027 Design Year Build		
		LOS ¹	Delay ²	V/C ³	LOS	Delay	V/C	LOS	Delay	V/C
Davis Square	AM	D	51.3	0.77	D	53.6	0.79	E	68.2	0.84
	PM	F	84.2	0.88	F	85.8	0.88	F	176.6	1.27
	SAT	D	49.7	0.76	D	49.7	0.76	E	78.4	0.94
Elm Street at Day Street	AM	A	7.2	0.41	A	7.7	0.42	n/a	n/a	n/a
	PM	B	12.3	0.36	B	12.8	0.37	n/a	n/a	n/a
	SAT	B	13.5	0.42	B	13.5	0.42	n/a	n/a	n/a
Summer Street at Cutter Avenue	AM	A	9.1	0.31	A	9.1	0.31	B	10.1	0.32
	PM	B	10.1	0.51	B	10.3	0.52	B	12.1	0.52
	SAT	A	9.6	0.36	A	9.6	0.36	B	11.4	0.36
Highland Avenue at Cutter Avenue	AM	A	2.1	0.34	A	2.1	0.35	A	2.1	0.37
	PM	A	2.7	0.44	A	2.7	0.44	A	3.1	0.44
	SAT	A	2.3	0.31	A	2.3	0.31	A	2.4	0.32

1 Level-of-Service

2 Average vehicle delay, in seconds

3 Volume to capacity ratio

n/a Not applicable

As shown in Table 11, the Davis Square signalized intersection is shown to currently operate at overall LOS D during the weekday morning and Saturday midday peak hours, and at overall LOS F but under capacity during the weekday afternoon peak hour. For the purposes of this analysis, the overall results for the Davis Square intersection exclude vehicle delay at the Elm Street at Day Street intersection, which is reported separately in the table. Under 2022 Build conditions, the proposed project is projected to have a minimal impact on vehicle operations, with the signalized Davis Square intersection shown to continue to operate at the same overall LOS during each peak period, and with less than 2.5 seconds of additional average vehicle delay. With no additional vehicles traveling to or from the site under the proposed project during the Saturday midday peak hour, the 2022 Existing and 2022 Build conditions modeled for the Saturday midday peak hour are effectively identical.

The signalized intersections of Elm Street at Day Street, Summer Street at Cutter Avenue, and Highland Avenue at Cutter Avenue are all projected to operate at overall LOS B or better during the weekday morning, weekday afternoon, and Saturday midday peak hours, both without and with the proposed project in place under 2022 conditions.

With the proposed pedestrianization of Elm Street in place, the Davis Square signal is projected to operate at overall LOS E during the weekday morning and Saturday midday peak hours, and at overall LOS F during the weekday afternoon peak hours. The other signalized study area intersections are projected to experience marginal increases in overall vehicle delay under 2027 Design Year Build conditions. Based on the minimal impact of the proposed redevelopment shown in the 2022 conditions, the project would not be expected to have a significant impact on the study area roadways with the proposed Elm Street pedestrianization in place.

A summary of traffic operations for the stop-controlled approaches at the unsignalized study area intersections is provided in Table 12 below.

Table 12: Unsignalized Intersection Capacity Analysis

Intersection	Movement	Peak Period	2022 Existing			2022 Build			2027 Design Year Build		
			LOS ¹	Delay ²	V/C ³	LOS	Delay	V/C	LOS	Delay	V/C
Elm Street at Grove Street/ Bowers Avenue	WB L	AM	C	21.2	0.24	C	21.3	0.25	E	41.7	0.93
		PM	D	30.3	0.37	D	33.6	0.40	F	189.8	1.35
		SAT	F	230.5	1.13	F	230.5	1.13	F	627.1	2.30
Highland Avenue at Grove Street	NB LT	AM	C	20.5	0.27	C	20.9	0.28	E	48.6	0.28
		PM	F	67.5	0.79	F	77.3	0.85	F	381.8	1.54
		SAT	E	46.5	0.71	E	46.5	0.71	F	232.0	1.26
Day Street at Herbert Street	NB TR	AM	B	10.0	0.02	B	10.5	0.04	B	10.9	0.02
		PM	A	9.4	0.04	A	9.5	0.04	A	9.9	0.07
		SAT	A	9.9	0.06	A	9.9	0.06	B	10.2	0.08
	SB LT	AM	B	10.0	0.02	B	10.4	0.03	B	11.8	0.05
		PM	B	10.9	0.02	B	11.3	0.08	B	12.8	0.15
		SAT	B	10.8	0.01	B	10.8	0.01	B	11.3	0.01
Day Street at Orchard Street	EB TR	AM	A	8.0	n/a	A	8.1	n/a	A	8.6	n/a
		PM	A	8.0	n/a	A	8.0	n/a	A	8.4	n/a
		SAT	A	7.9	n/a	A	7.9	n/a	A	8.3	n/a
	SB LT	AM	A	8.7	n/a	A	9.0	n/a	B	10.2	n/a
		PM	A	8.3	n/a	A	8.3	n/a	A	9.1	n/a
		SAT	A	8.1	n/a	A	8.1	n/a	A	9.0	n/a
Herbert Street at Chester Street	SB R	AM	A	8.6	0.02	A	8.6	0.02	A	8.6	0.03
		PM	A	9.2	0.06	A	9.3	0.06	A	9.4	0.09
		SAT	A	9.3	0.07	A	9.3	0.07	A	9.3	0.07

1 Level-of-Service

2 Average vehicle delay, in seconds

3 Volume to capacity ratio; intersection capacity utilization reported

n/a Not applicable

As shown in Table 12, the westbound Grove Street left-turn movement at the intersection of Elm Street at Grove Street/Bowers Avenue is shown to currently operate at LOS C during the weekday morning peak hour, at LOS D during the weekday afternoon peak hour, and at LOS F during the Saturday midday peak hour. With the proposed project in place, the movement is projected to experience minimal additional vehicle delay and to continue operating at the same LOS during the three peak hours analyzed as under 2022 Existing conditions.

The northbound Grove Street approach to Highland Avenue is shown to currently operate at LOS C during the weekday morning peak hour, at LOS F and under capacity during the weekday afternoon

peak hour, and at LOS E during the Saturday midday peak hour. The proposed redevelopment is projected to result in less than one second of additional average vehicle delay during the weekday morning peak hour and less than ten seconds of additional average vehicle delay for this movement during the weekday afternoon peak hour, with the movement operating at the same LOS for each peak hour as under 2022 Existing conditions.

The stop-controlled movements at the intersections of Day Street at Herbert Street, Day Street at Orchard Street, and Herbert Street at Chester Street are all projected to operate at LOS B or better during the three peak hours analyzed without and with the proposed project in place. No movement is projected to experience more than half a second of additional average vehicle delay with the proposed redevelopment project in place.

As noted previously in this study, the pedestrianization of Elm Street is projected to result in a significant number of rerouted vehicles utilizing Grove Street to travel between Elm Street and Highland Avenue. Under 2027 Design Year Build conditions, the westbound left-turn movement from Grove Street to Elm Street and the northbound left-turn/through movement at the intersection of Highland Avenue at Grove Street are projected to operate at LOS E during the weekday morning peak hour and at LOS F during the weekday afternoon and Saturday midday peak hours due to the projected change in travel patterns with the Elm Street changes in place.

Overall, the additional trips associated with the proposed redevelopment are not projected to have a significant impact on vehicular operations at the study area intersections.

Pedestrian Analysis

Pedestrian Level of Traffic Stress

Pedestrian Level of Traffic Stress (PLTS) is a measurement that analyzes segments of sidewalk based on the overall level of comfort that it provides pedestrians. PLTS is based on sidewalk widths and conditions, and the separation provided from vehicle traffic, and assigns a score from PLTS1 to PLTS4. PLTS1 represents high-quality, accessible conditions which are comfortable to walk on and provide separation from vehicles. PLTS4 represents conditions which do not provide separated infrastructure for pedestrians or are inaccessible due to the condition, width, or some other characteristic of the sidewalks. The PLTS for the nearby roadway segments serving the project site, including on the routes to critical transit stops, are presented in Figure 23.

As shown in Figure 23, the sidewalks on both sides of Holland Street just north of the Davis Square signalized intersection, as well as the western sidewalk on College Avenue just north of the intersection, are shown to provide PLTS3 conditions. All other sidewalks in the surrounding area and adjacent to the project site are shown to provide PLTS2 conditions or better. With these conditions, the site would be accessible by foot, as well as by nearby transit. The proposed project would not significantly change pedestrian access to the site except within the pedestrian plaza between the buildings. The proposed changes to the pedestrian plaza have been identified in coordination with the City and would be expected to improve the pedestrian experience through this area and connecting to the off-site pedestrian network. The pedestrianization of Elm Street also presents an opportunity for improved connection between the project site and adjacent sidewalk network. Based on the estimated trip generation for the project, approximately 46 additional person trips during the weekday morning peak hour and approximately 36 additional person trips during the weekday afternoon peak hour would be accessing the project site by walking from nearby areas or transit. The limited increase in

pedestrian activity associated with the proposed redevelopment is not expected to result in a significant impact to the adjacent pedestrian network.

Pedestrian Delay Analysis

As part of the evaluation of the pedestrian operations within the study area, the widths, crossing distances, Walk and pedestrian clearance timings, and maximum pedestrian delay for the crosswalks at the signalized intersections within the study area are presented in Table 13 below. Additionally, the approximate pedestrian clearance time which would be required for the crossing distances based on the Manual on Uniform Traffic Control Devices (MUTCD) is included for comparison to the pedestrian clearance times provided.

Table 13: Signalized Crosswalk Pedestrian Delay

Intersection	Crossing Street	Crosswalk		Cycle		MUTCD ¹		Max. Ped. Delay (s)
		Width (ft)	Length (ft)	Length (s)	Walk (s)	Pedestrian Clearance (s)	Pedestrian Clearance (s)	
Davis Square	Dover St	11	26	114	7	10	8	103
	Highland Ave	11	34	114	27	10	10	83
	Elm St ²	10	46	114	10	13	14	100
	Holland St ³	14	56	114	7	10	16	103
	Day St	11	27	114	8	17	8	102
	College Ave	10	54	114	16	17	16	94
Highland Avenue at Cutter Avenue	Highland Ave (E)	10	35	90	7	10	10	79
	Cutter Ave	10	30	90	7	7	9	79
Summer Street at Cutter Avenue	Cutter Ave	10	29	86	8	12	9	74
	Summer St (S)	10	29	86	8	12	9	74
	Summer St (N)	10	24	86	8	12	7	74

1 Based on a walking speed of 3.5 feet per second.

2 Crossing distance based on relocated crosswalk from May 2022 Toole Design signal plan.

3 Pedestrian refuge island provided. Crossing length and times reported for full length of crossing.

As shown in Table 13, the majority of the pedestrian clearance times provided at the signalized intersections meet or exceed the required time based on the MUTCD. At the Davis Square signal, the relocated Elm Street crosswalk is shown to have 13 seconds of pedestrian clearance time, where based on the crossing distance it's estimated that approximately 14 seconds would be required. The Holland Street crossing is shown to require 16 seconds of pedestrian clearance, where only ten is provided. However, this approach includes an approximately seven-foot-wide pedestrian refuge island, which would be considered sufficient for a pedestrian to wait and would reduce the required clearance time to well below the ten seconds provided.

At the intersection of Highland Avenue at Cutter Avenue, the crosswalk across Cutter Avenue is shown to provide approximately seven seconds of pedestrian clearance time, where nine seconds would be required by the MUTCD. However, the pedestrian clearance time contained within Table 13 for this location is based on the field-measured Flashing Don't Walk time. As a portion of the pedestrian

clearance time is generally assigned to the Don't Walk portion of the pedestrian signal (MassDOT recommends approximately three seconds), it is possible that the apparent two-second discrepancy is related to a portion of the pedestrian clearance time occurring during Don't Walk, and the crossing overall is provided with sufficient pedestrian clearance time.

All other signalized crossings within the study area are shown to meet or exceed the required pedestrian clearance time based on the MUTCD.

Bicycle Analysis

Bicycle Level of Traffic Stress

Similar to Pedestrian Level of Traffic Stress, Bicycle Level of Traffic Stress (BLTS) is a measurement that summarizes and groups the quality of different types of bicycle infrastructure based on the overall experience of cyclists who use it. BLTS combines inputs such as the type and width of bicycle infrastructure and the nature of vehicle traffic on a given roadway segment and assigns that segment a score from BLTS1 to BLTS4. BLTS1 represents conditions that are comfortable for a wide variety of cyclists including children and senior citizens, and BLTS4 represents conditions that are only comfortable for a small segment of experienced, confident cyclists. The BLTS for the nearby roadway segments serving the project site are presented in Figure 24.

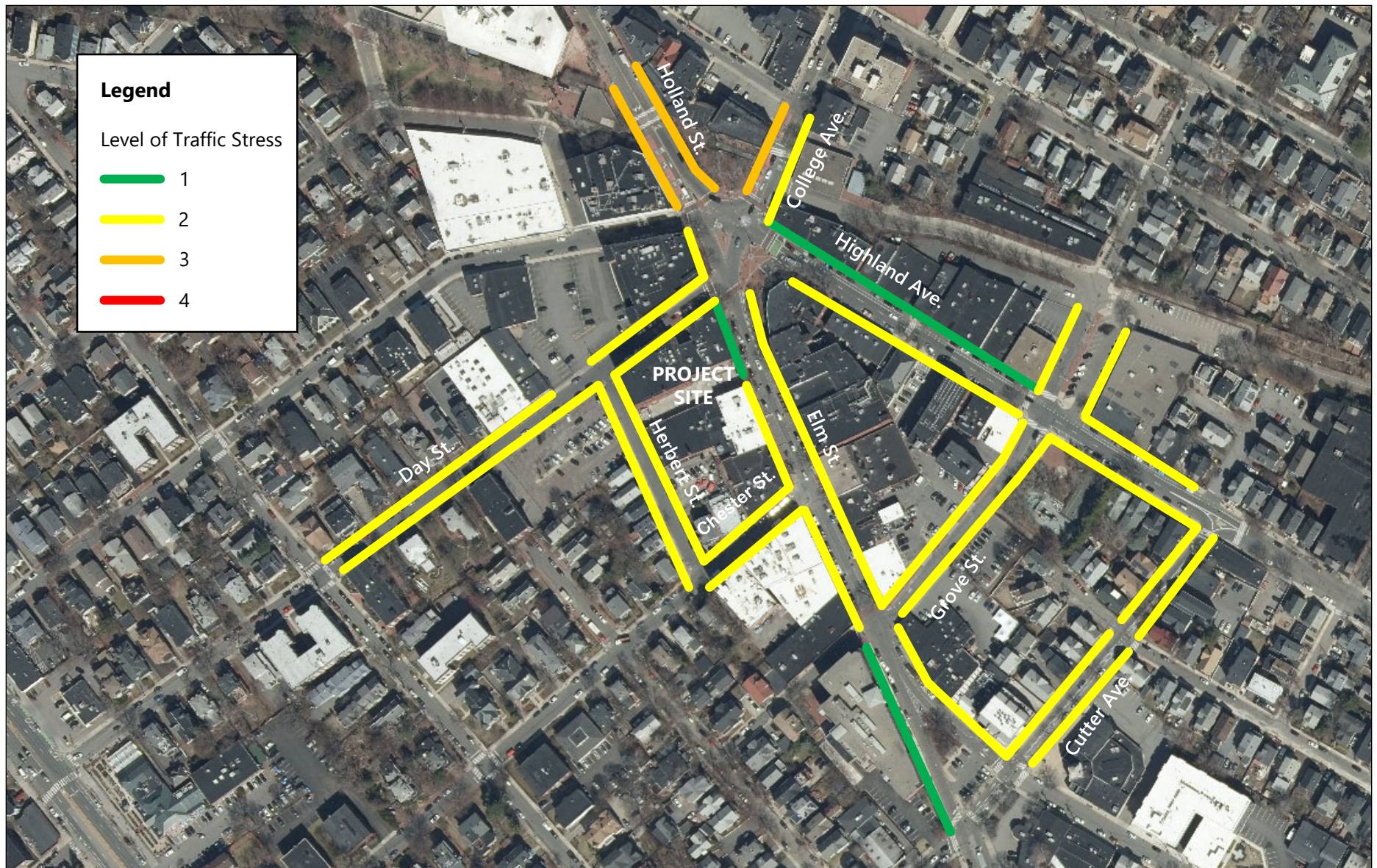
As shown, the roadways surrounding the site vary from BLTS1 to BLTS3. Highland Avenue is shown to provide BLTS3 conditions, while Elm Street, Holland Avenue, College Avenue, and Grove Street are shown to provide BLTS2 conditions. All other roadways analyzed are shown to provide BLTS1 conditions. The impact of the estimated increase in bicycle trips associated with the project (less than five during each peak hour analyzed) is expected to be negligible. The bicycle level of traffic stress analysis was conducted based on the conditions that currently exist. With the striping and signal updates proposed and incorporated into the Existing vehicular capacity analysis, the resulting BLTS values for the study area may improve.

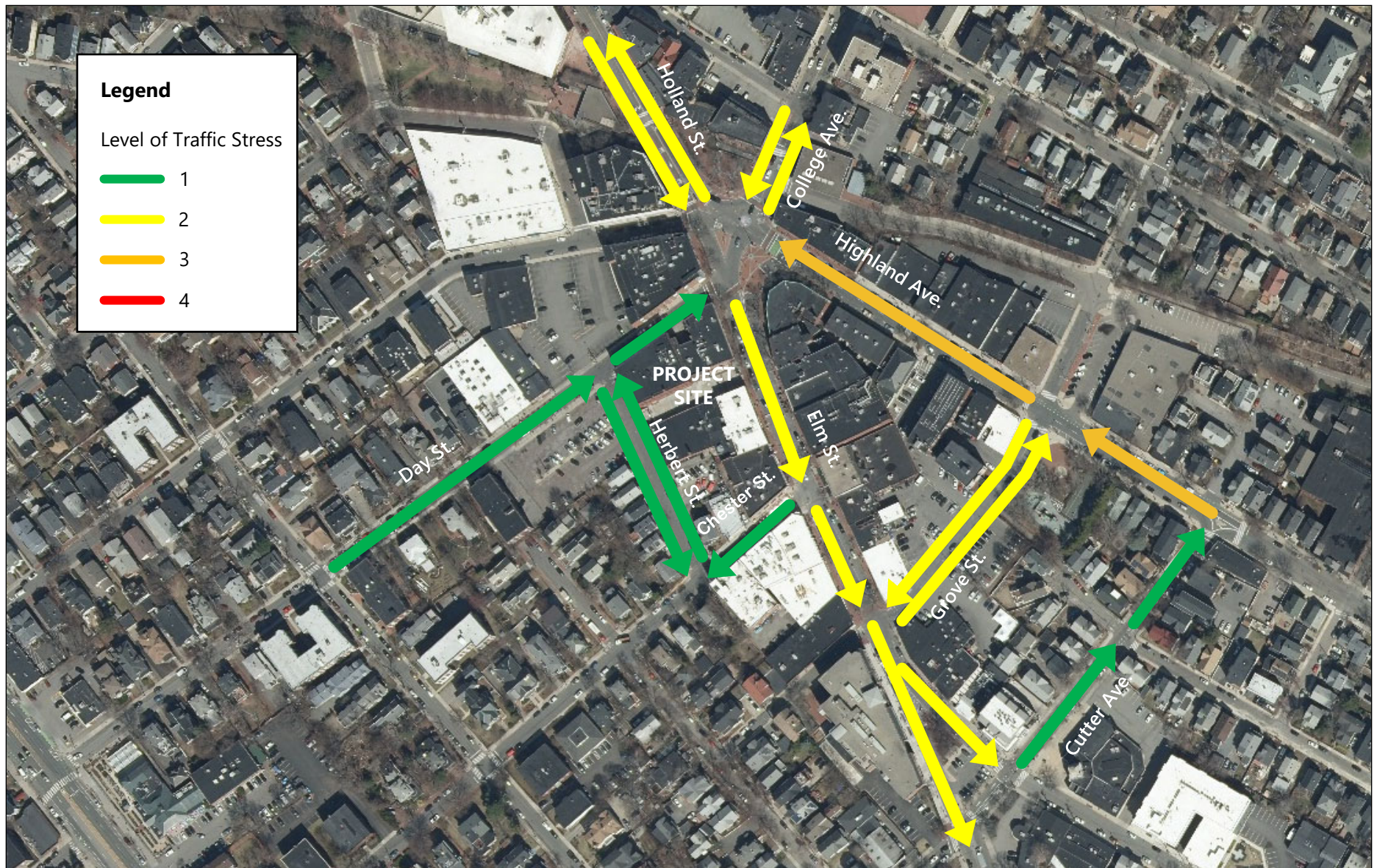
Transit Analysis

The project site is well-served by a number of MBTA rail and bus transit options, which are expected to result in a minimal increase in additional public transit trips associated with the proposed redevelopment. The proposed redevelopment is estimated to generate approximately 42 additional transit trips (37 entering trips and 5 existing trips during the weekday morning peak hour, approximately 33 total additional transit trips (one fewer entering trips and 34 additional exiting trips) during the weekday afternoon peak hour, and no additional transit trips during the Saturday midday peak hour.

By comparison, the existing number of total boardings and alightings on the MBTA Red Line at Davis station is approximately 2,500 during the weekday morning peak hour and approximately 3,500 during the weekday afternoon peak hour. Therefore, even if all transit trips to the site came via the Red Line, the total number of estimated additional trips would therefore represent an increase in boardings and alights of less than two percent during the weekday morning peak hour and less than one percent during the weekday afternoon peak hour.

Overall, the proposed redevelopment is not anticipated to have a significant impact on overall transit operations or ridership in the area of the site.





Site Access and Circulation

Existing vehicular access to the site is limited to a small parking lot located on Herbert Street in the southwestern portion of the site. This parking lot would be removed as part of the proposed project and replaced with additional building footprint and a loading dock driveway. Pedestrian access to the site would be provided via doors on Elm Street, Day Street, and the improved plaza between the buildings which connects Elm Street to Herbert Street. Approximately four short-term bicycle parking spaces would be provided within the pedestrian walkway, outside one of the main entrances to the northern building. An additional 15 spaces for secure bicycle parking would be provided within the site to allow employees to park their bicycle.

As part of the proposed project, the existing pedestrian plaza between the buildings would be improved. The proposed changes to the pedestrian plaza have been identified in coordination with the City and would be expected to improve the user experience and accessibility through this area and the connections to the off-site pedestrian network. The pedestrianization of Elm Street also presents an opportunity for an improved connection between the project site and adjacent pedestrian network.

TRANSPORTATION DEMAND MANAGEMENT

As part of the proposed project, the Proponent will implement a Transportation Demand Management (TDM) program to encourage the use of alternative modes of transportation and reduce single occupancy vehicles trips to the site. This TDM program would include elements such as those listed below:

- **Employee Commuter incentives/Guaranteed Ride Home Program**
These include programs that make non-vehicle travel easier or more appealing to commuters and can include carpool matching services, guaranteed ride home service, flexible work hours or telecommunication-friendly policies. Tenants could also offer bike share memberships to employees, encouraging use of the Bluebikes station at Davis Square.
- **Informational strategies**
Tenants would be encouraged to post commuter information in key areas, provide relevant commute information to new employees, and participate in annual meetings related to transportation.
- **On-site transportation coordinators**
Tenants would be encouraged to hire an on-site transportation coordinator, someone who would organize TDM programs at large, liaise between the employer and the City, and distribute information to employees.
- **Transportation Management Association (TMA) membership**
Although at present no TMA expressly serves Davis Square, the Proponent would be interested in joining such an organization, should one become available in the neighborhood. TMAs work under the broader umbrella of MassCommute to keep members informed on transportation, provide them with TDM resources and ideas, and connect employers to public officials and other decision makers

CONCLUSIONS

The proposed project includes the redevelopment of the Davis Square Plaza located at 256-260 Elm Street, and 274-280 Elm Street in Somerville. The existing site would be redeveloped, primarily within its existing footprint, to provide approximately 20,300 square feet (sf) of retail space, approximately 39,600 sf of office space, and approximately 59,400 sf of laboratory space. With the proposed redevelopment, the existing plaza between the buildings would be updated to improve the user experience and accessibility within the site and improve connections to the adjacent transportation network.

Based on the analysis presented in this transportation impact study, the proposed project is estimated to generate approximately 31 additional vehicle trips (27 entering vehicles and four exiting vehicles) during the weekday morning peak hour, approximately 26 additional vehicle trips (zero entering vehicles and 26 exiting vehicles) during the weekday afternoon peak hour, and approximately eight fewer vehicle trips (four fewer entering vehicles and four fewer exiting vehicles) during the Saturday midday peak hour. The proposed redevelopment is estimated to generate approximately 264 additional vehicle trips (132 entering vehicles and 132 exiting vehicles) over the course of an average weekday.

The capacity analysis indicates that the proposed mixed-use development is projected to have a limited impact on the operations of the study area intersections. At the Davis Square intersection, overall intersection operations are shown to be maintained for all peak hours analyzed under 2022 Existing and 2022 Build conditions. The key movements at all other study area intersections are projected to continue operating at the same LOS as under 2022 Existing conditions for the 2022 Build conditions for all peak hours analyzed.

The site is well served by the existing pedestrian, bicycle, and public transit infrastructure of Davis Square. The small number of trips anticipated to travel via each of these modes are anticipated to have a negligible impact on the transportation network within the study area.

Based on a review of the analysis contained within this transportation impact study, the proposed site redevelopment is not shown to have a significant impact on the overall transportation operations of the study area intersections and roadways.