Mass + Main

Cambridge, Massachusetts

PREPARED FOR

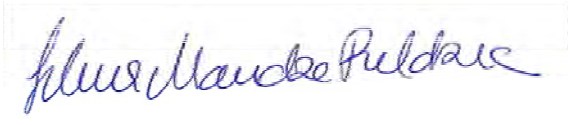
Watermark Central Venture LLC/Twining Properties
One Broadway
Cambridge, MA 02142

PREPARED BY

99 High Street
Boston, MA 02110
617.728.7777

August 1, 2016

UNDER THE DIRECTION OF



Selma Mandzo-Preldzic, P.E., LEED AP
Massachusetts Registration No. 49895

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Introduction & Project Overview

On behalf of Watermark Central Venture LLC (the Owner), VHB, Inc. has conducted a Transportation Impact Study (TIS) for the proposed Mass + Main residential development (the Project Site) for 295 residential units and approximately 17,000 GSF of retail in three buildings within the Central Square/Lafayette Square area (the Proposed Project).

The TIS responds to the scope dated May 4, 2016 defined by the City of Cambridge Traffic, Parking and Transportation (TP&T) Department in response to VHB's Request for Scoping dated April 4, 2016. Copies of the City's scoping letter and VHB's Request for Scoping are included in the Appendix. The TIS has been prepared in conformance with the current City of Cambridge Guidelines for Transportation Impact Studies, as required under the Article 19 Special Permit Project Review. This document is comprised of three components, as follows:

- Introduction and Project Overview – describing the framework in which the transportation component of this Project was evaluated;
- Transportation Impact Study (TIS) – presenting the technical information and analysis results as required under the guidelines; and,
- Planning Board Special Permit Criteria – summarizing the evaluation of the proposed Project as defined under the guidelines.

The required TIS Summary Sheets and Planning Board Criteria Performance Summary are included. Supplementary data and analysis worksheets are provided in the Appendix. Electronic files for Automatic Traffic Recorder (ATR) counts, Turning Movement Counts (TMC), and Synchro analyses are included on an accompanying CD.

Project Overview

The Proposed Project will include 295 residential units and approximately 17,000 GSF of ground floor retail space. Approximately 146 parking spaces will be provided in an underground garage and an off-site surface lot for the residents, as described below and illustrated in the relevant figures.

- **Figure A** presents a site location map.
- **Figure B** presents a regional context map.
- **Figure C** presents the existing conditions of the proposed sites.
- **Figure D** presents the proposed site plan.
- **Figure E** presents the TIS study area.

As shown in Figures A and B, the Project consists of 3 site locations centrally located southeast of Central Square. The main site is located at the corner of Massachusetts Avenue and Main Street at Lafayette Square. This site will contain two new residential buildings, B-1 and B-2, while a parcel at 47 Bishop Allen Drive will be redeveloped as a new residential building and 65 Bishop Allen Drive will remain a surface parking lot to be utilized by the residents of the new buildings.

As shown in Figure C, the main site currently contains multiple one to three story buildings fronting Columbia Street, Lafayette Square, and Massachusetts Avenue, with the City's Parking Lot 6 behind the existing buildings. The 47 Bishop Allen Drive site is currently an unused three level parking garage, while the 65 Bishop Allen Drive site is currently an unused surface parking lot.

In December 2012, Dr. J.R. Fennel sold his property to Twining Properties and Normandy Real Estate Partners. Formerly occupied by Quest Diagnostics, the commercial operation relocated to Marlborough by the end of 2015. Quest Diagnostic conducted lab testing at the site and housed a fleet of delivery vehicles in the parking garage located at 47 Bishop Allen Drive. Building 1 and the majority of Building 2 are located in the buildings previously occupied by Quest. Mark's Warehouse was located on the remaining portion of the Building 2 site on the corner of Bishop Allen Drive and Columbia Street. In November 2014, the development partners filed a zoning petition for a mixed-income residential community at Massachusetts Avenue and Main Street. The City Council voted to adopt the Mass + Main zoning Petition in May 2015.

While currently vacant, the site had been a very active lab and office site, for the past 20 years. Quest Diagnostics provided blood lab testing for many hospitals in the area generating frequent delivery vehicle trips. Additionally, Quest employees travelled to the facility for three work shifts resulting, in combination with the delivery services, in frequent site generated vehicular activity.

Figure D presents the proposed Mass + Main site plan for the Lafayette Square site location. The site will include approximately 270 apartment units in two buildings. The taller residential building, B-1, will be 19-stories fronting Massachusetts Avenue with approximately 215 residential units and the lower building, B-2, will be 6-stories fronting Columbia Street providing approximately 55 residential units. The two buildings will also provide approximately 17,000 square feet of ground floor retail space.

The Owner is also proposing to redevelop the existing parking garage at 47 Bishop Allen Drive into a residential building of approximately 25 units.

It is currently envisioned that 146 parking spaces will be provided as residential parking of which some will be car-sharing spaces, in a combination of underground parking below B-1 and surface parking at the 65 Bishop Allen Drive lot.

The Proposed Project program is summarized in Table A below.

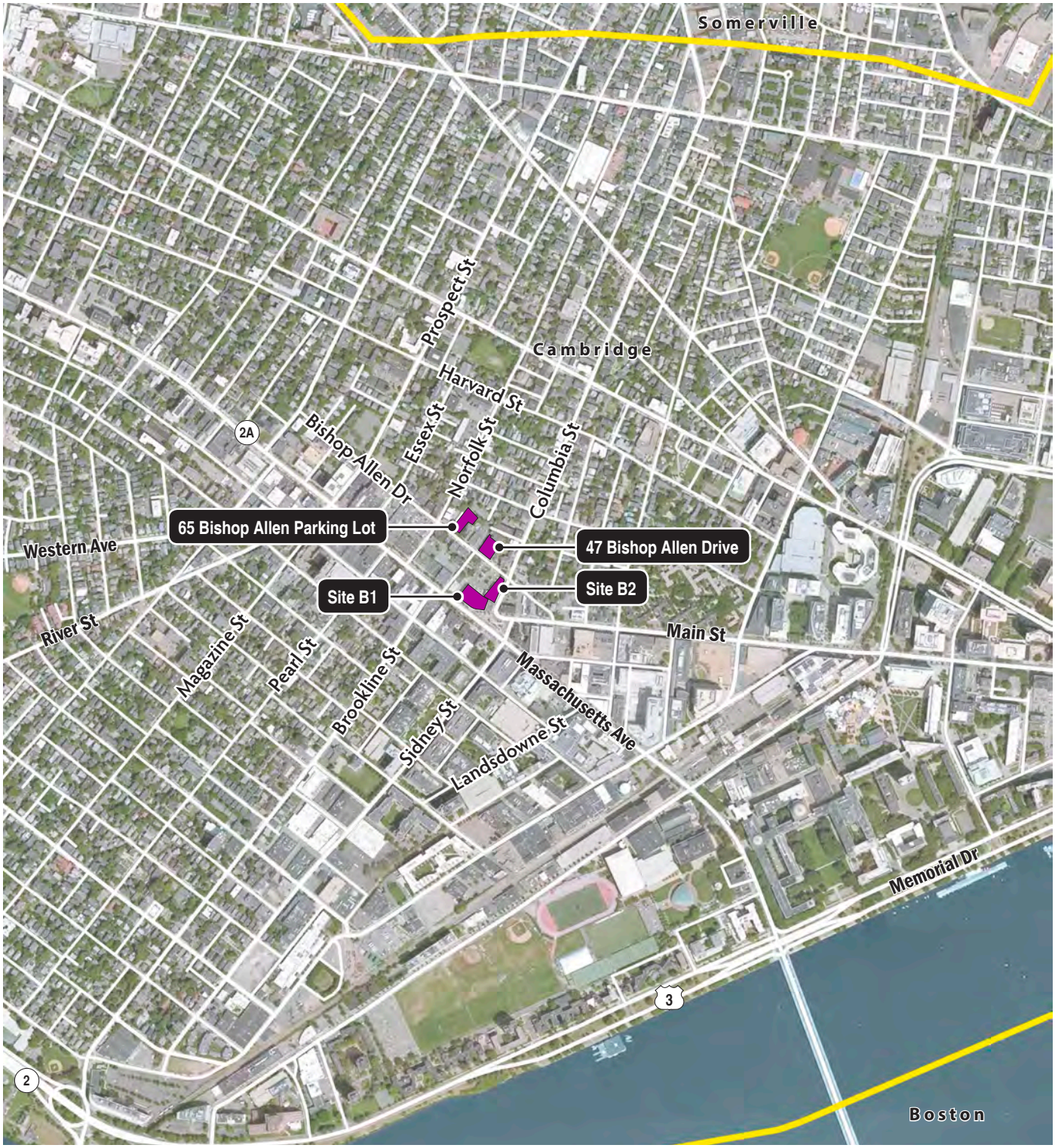
TABLE A PROPOSED DEVELOPMENT PROGRAM

Project Component	Size/Quantity
Residential	295 units
B-1	215 units
B-2	55 units
47 Bishop Allen	25 units
Retail	Approx. 17,000 GSF
Total SF	Approx. 325,529 GSF
Vehicle Parking	Approx. 146 spaces B-1 Garage – 95 spaces 65 Bishop Allen – 51 spaces
Bicycle Parking	41 short-term spaces 310 long-term spaces

GSF – Gross Square Feet

The TIS study area for the Proposed Project, as defined by the City of Cambridge, is shown in Figure E. The study intersection include the following:

1. Bishop Allen Drive at Douglass Street
2. Bishop Allen Drive at Columbia Street
3. Columbia Street at Main Street/Sidney Street
4. Massachusetts Avenue at Sidney Street
5. Crosswalk on Massachusetts Avenue at Lafayette Square
6. Massachusetts Avenue at Brookline Street/Douglass Street
7. Bishop Allen Drive at Norfolk Street
8. Bishop Allen Drive at Prospect Street
9. Massachusetts Avenue at Prospect Street/River Street/Western Avenue
10. Green Street at River Street/Western Avenue
11. Massachusetts Avenue at Essex Street

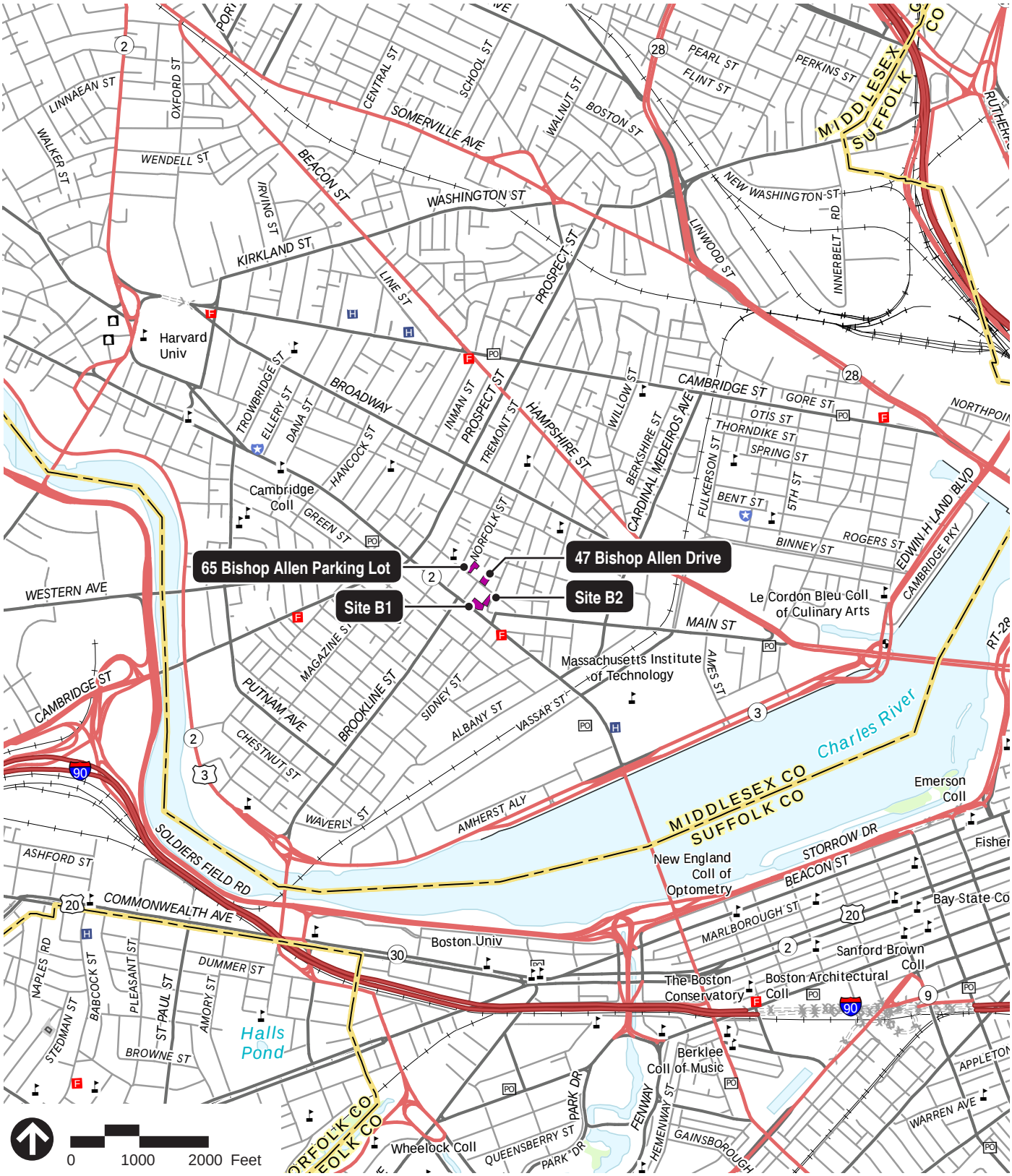


Source: ArcGIS Online Bing Aerial, MassGIS

Figure A

Site Location Map

Mass + Main
Cambridge, Massachusetts



Source: 2015 USGS

Figure B

Regional Context Map

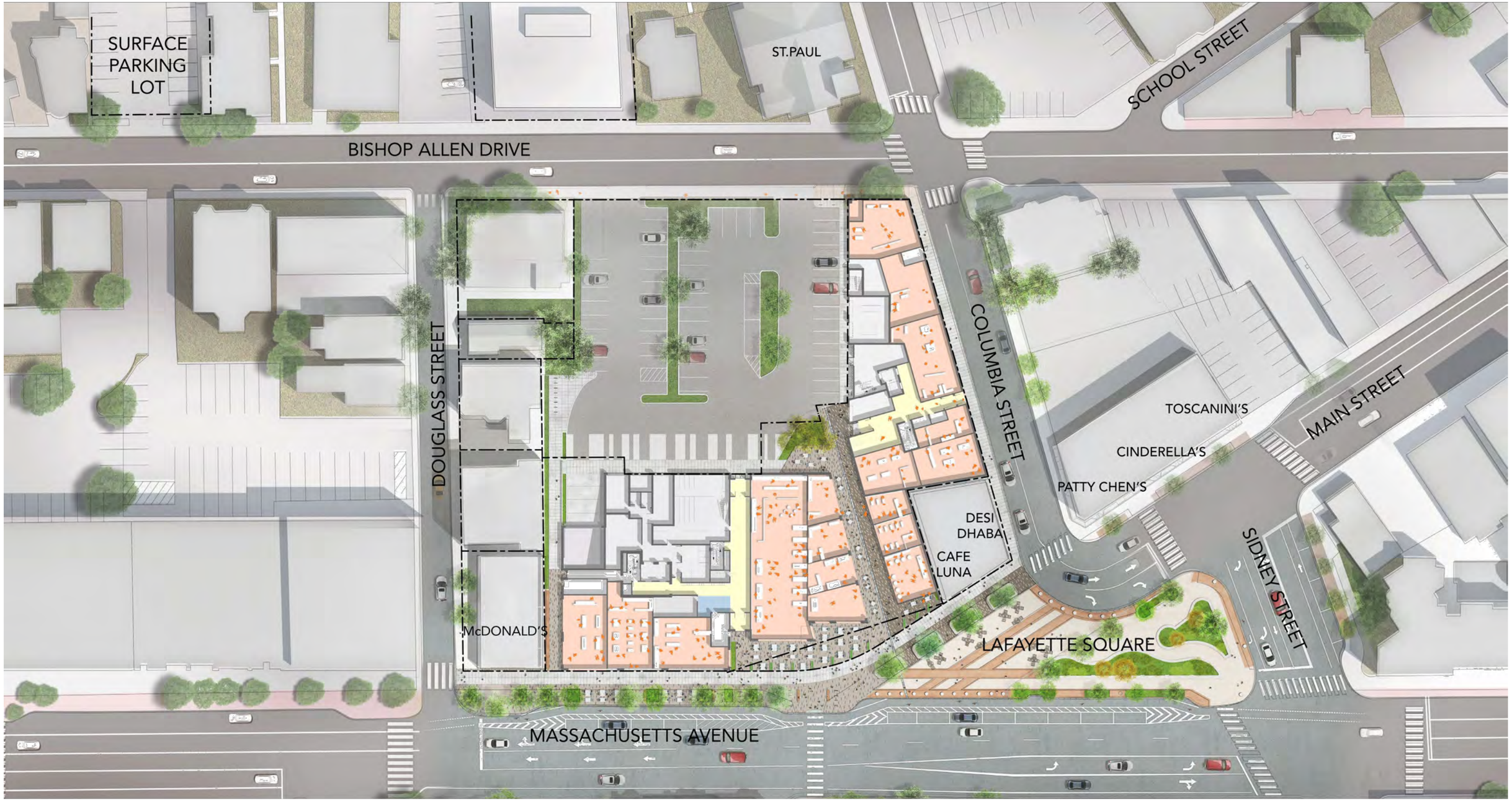
Mass + Main
Cambridge, Massachusetts

Source: ArcGIS Online Bing Aerial

Figure C

Existing Conditions

Mass + Main
Cambridge, Massachusetts



Source: Twining Properties

0 25 50 100 Feet

Figure D

Site Plan
Mass + Main
Cambridge, MA

Source: City of Cambridge GIS

Figure E

Site Plan and Study Area Intersections

Mass + Main
Cambridge, Massachusetts

Planning Board Criteria Summary

Based on the TIS analysis, the Project has been evaluated within the context of the Planning Board Criteria to determine if the Project has any potential adverse transportation impacts. Exceeding one or more of the Criteria is indicative of a potentially adverse impact on the City's transportation network. However, the Planning Board will consider mitigation efforts, their anticipated effectiveness, and other information that identifies a reduction in adverse transportation impacts.

The Planning Board Criteria consider the Project's vehicular trip generation, impact to intersection level of service and queuing, as well as increase of volume on residential streets. In addition, pedestrian and bicycle conditions are considered. A discussion of the Criteria set forth by the Planning Board is presented in the final section of the TIS, and the Planning Board Criteria Performance Summary is presented below.

PROJECT

Project Name:	Mass + Main
Project Address:	415 Massachusetts Avenue Cambridge, MA 02139
Owner/Developer Name:	Watermark Central Venture LLC
Contact Person:	Mark Barer
Contact Address:	Twining Properties One Broadway Cambridge, MA 02142
Contact Phone Number:	617-340-2411

SIZE

ITE sq. ft. :	325,529 GSF – 295 residential units; 17,000 GSF of retail
Land Use Type:	Residential; Retail

PARKING

Existing Parking Spaces*:	164	Use: Currently not used
Project Parking Spaces**:	146	Use: Residential, carshare
Net-New Parking Spaces***:	(-18)	

*Existing parking spaces on TIS Building sites: 51 on 65 Bishop Allen Drive surface lot and 113 in 47 Bishop Allen Drive garage.

TRIP GENERATION:

	Daily	AM Peak Hour	PM Peak Hour
Vehicle	898	53	82
Transit	1,106	64	102
Pedestrian	1,048	52	94
Bicycle	304	19	28
Other	138	9	13

MODE SPLIT (Person Trips)

	Residential	Retail
Drive Alone	25%	20%
Rideshare	5%	3%
Transit	31%	31%
Walk	24%	38%
Bike	10%	6%
Other	5%	2%

TRANSPORATION CONSULTANT

Company Name:	VHB
Contact Name:	Susan Sloan-Rossiter
Contact Phone Number:	617-607-2930

CITY OF CAMBRIDGE
Special Permit – Transportation Impact Study (TIS)
Planning Board Criteria Performance Summary
Mass + Main Planning Board Permit Number: _____
Date of Building Permit Approval: _____

Total Data Entries = 195 **Total Number of Criteria Exceedances = 8**

Criteria A –Project Vehicle Trip Generation

Time Period	Criteria (trips)	Build	Exceeds Criteria?
Weekday Daily	2,000	898	No
Week AM Peak Hour	240	53	No
Week PM Peak Hour	240	82	No

Criteria B – Vehicular LOS

	AM Peak Hour				PM Peak Hour			
Intersection	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?
Bishop Allen Dr at Douglass St	B	B	6.2%	No	C	C	4.7%	No
Bishop Allen Dr at Columbia St	B	B	4.6%	No	B	C	4.9%	No
Columbia St at Main St/Sidney St	C	D	3.3%	No	D	D	4.0%	No
Massachusetts Ave at Sidney St	C	C	0.6%	No	C	C	1.8%	No
Massachusetts Ave at Brookline St/Douglass St	B	B	0.1%	No	B	B	0.4%	No
Bishop Allen Dr at Norfolk St	B	B	3.7%	No	A	B	4.8%	No
Bishop Allen Dr at Prospect St	B	B	0.6%	No	C	C	0.9%	No
Massachusetts Ave at Prospect St/ River St/ Western Ave	C	C	0.7%	No	C	C	1.0%	No
Green St at River St/ Western Ave	B	B	0.2%	No	B	B	0.6%	No
Massachusetts Ave at Essex St	B	B	1.3%	No	A	B	1.8%	No

Criteria C – Traffic on Residential Streets

Roadway	Segment	Amount of Residential	AM Peak Hour			PM Peak Hour		
			Existing[1]	Project Trips	Exceeds Criteria?	Existing[1]	Project Trips	Exceeds Criteria?
Bishop Allen Drive	Prospect St to Essex St	1/3 or less	340	8	No	357	13	No
	Essex St to Norfolk St	1/3 or less	355	12	No	377	24	No
	Norfolk St to Douglass St	1/2 or more	300	23	No	331	37	**Yes**
	Douglass St to Columbia St	1/3 or less	365	31	No	409	45	No
	Columbia St to Main St	>1/3 but <1/2	230	8	No	243	12	No
Columbia Street	Bishop Allen Dr to Main St	1/3 or less	325	18	No	387	24	No
	Bishop Allen Dr to Washington St	1/2 or more	430	5	No	481	9	No
Sidney Street	Main St to Mass Ave	1/3 or less	530	18	No	709	24	No
	Mass Ave to Green St	1/3 or less	425	7	No	471	5	No
Mass Ave	Prospect St to Essex St	1/3 or less	785	11	No	970	16	No
	Essex St to Norfolk St	1/3 or less	765	7	No	946	5	No
	Norfolk St to Douglass St	1/3 or less	750	0	No	846	0	No
	Douglass St to Sidney St	1/3 or less	730	0	No	903	0	No
Douglass Street	Mass Ave to Bishop Allen Dr	1/2 or more	115	1	No	119	4	No

[1] Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added

Criteria D – Lane Queue (for signalized intersections)

Intersection	Movement	AM Peak Hour			PM Peak Hour		
		Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Columbia Street at Main Street/Sidney Street	Eastbound – Thru	0	0	No	0	0	No
	Eastbound – Right	6	6	No	4	4	No
	Westbound – Thru/Right	3	3	No	5	5	No
	Northbound – Left/Right	1	1	No	2	2	No
Massachusetts Avenue at Sidney Street	Eastbound – Left	2	2	No	3	3	No
	Eastbound – Thru/Right	8	8	No	5	5	No
	Westbound – Left	2	2	No	2	2	No
	Westbound – Thru/Right	6	6	No	9	9	No
	Northbound – Right	2	2	No	2	2	No
	Southbound – Left/Thru	3	3	No	4	4	No
	Southbound – Right	0	0	No	0	0	No
Massachusetts Avenue at Brookline Street/Douglass Street	Eastbound – Left/Thru	2	2	No	4	4	No
	Westbound – Thru/Right	3	3	No	1	1	No
	Northbound – Left	2	2	No	2	2	No
	Northbound – Thru/Right	3	3	No	6	6	No

Planning Board Permit Number: _____

Intersection	Movement	AM Peak Hour			PM Peak Hour		
		Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Bishop Allen Drive at Prospect Street	Westbound – Left/Thru/Right	5	5	No	8	~ 8	No
	Northbound – Left	0	0	No	0	0	No
	Northbound – Thru/Right	7	7	No	6	6	No
	Southbound – Left	0	0	No	1	1	No
	Southbound – Thru/Right	5	5	No	6	6	No
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	Eastbound – Thru	7	7	No	7	7	No
	Eastbound – Right	0	0	No	0	0	No
	Westbound – Thru	3	4	No	7	8	No
	Westbound – Right	1	1	No	2	2	No
	Northbound – Thru	6	6	No	4	4	No
	Northbound – Right	2	2	No	1	1	No
	Southbound – Thru/Right	11	11	No	12	12	No
Green Street at Western Avenue/River Street	Westbound – Left/Thru	3	3	No	6	6	No
	Westbound – Right	2	2	No	2	2	No
	Northbound – Left	1	1	No	3	3	No
	Northbound – Thru	5	5	No	4	4	No
	Southbound – Thru	13	13	No	11	11	No
Massachusetts Avenue at Essex Street	Eastbound – Left	1	1	No	1	1	No
	Eastbound – Thru	5	5	No	3	3	No
	Westbound – Thru/Right	3	3	No	3	4	No

Criteria E – Pedestrian Delay

Intersection	Crosswalk	AM Peak Hour			PM Peak Hour		
		Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Columbia Street at Main Street/Sidney Street	East	C	C	No	B	B	No
	West	C	C	No	B	B	No
Massachusetts Avenue at Sidney Street	East	C	C	No	B	B	No
	West	C	C	No	B	B	No
	North	C	C	No	B	B	No
	South	C	C	No	B	B	No
Massachusetts Avenue at Brookline Street/Douglass Street	East	C	C	No	C	C	No
	North	B	B	No	B	B	No
	South	B	B	No	B	B	No
Bishop Allen Drive at Prospect Street	East	A	A	No	A	A	No
	West	A	A	No	A	A	No
	North	C	C	No	C	C	No
	South	C	C	No	C	C	No
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	East	B	B	No	B	B	No
	West	B	B	No	B	B	No
	North	B	B	No	C	C	No
	South	B	B	No	C	C	No
	East	B	B	No	C	C	No

Intersection	Crosswalk	AM Peak Hour			PM Peak Hour		
		Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Green Street at Western Avenue/River Street	West	C	C	No	C	C	No
	North	D	D	No	D	D	No
	South	D	D	No	D	D	No
Massachusetts Avenue at Essex Street	West	C	C	No	C	C	No
	North	C	C	No	C	C	No
Bishop Allen Drive at Douglass Street	South	A	A	No	A	A	No
Bishop Allen Drive at Columbia Street	East	A	A	No	B	B	No
	West	C	C	No	E	E	**Yes**
	North	C	C	No	C	C	No
	South	B	B	No	B	B	No
Bishop Allen Drive at Norfolk Street	East	B	C	**Yes**	C	D	**Yes**
	West	C	C	No	D	D	No
	North	B	B	No	A	A	No
	South	A	A	No	A	A	No
Site Parking Lot Driveway at Bishop Allen Drive	South	A	A	No	A	A	No
Unsignalized Crosswalk at Massachusetts Avenue	N/A	F	F	**Yes**	F	F	**Yes**

Criteria E – Pedestrian and Bicycle Facilities

Adjacent Street	Link (between)	Sidewalk or Walkway Present	Exceeds Criteria?	Bicycle Facilities or Right of Ways Present	Exceeds Criteria?
Bishop Allen Drive	Norfolk Street and Columbia Street	Yes	No	No	**Yes**
Columbia Street	Bishop Allen Drive and Main Street	Yes	No	No	**Yes**
Massachusetts Avenue	Douglass Street and Sidney Street	Yes	No	Yes	No

Transportation Impact Study

This Transportation Impact Study for the proposed Mass + Main residential development (the Project) describes existing and future transportation conditions in the study area in accordance with the City of Cambridge Sixth Revision (November 28, 2011) of the Transportation Impact Study Guidelines. The study area for the TIS includes seven signalized intersections and four unsignalized intersections as previously shown in Figure E.

This section includes inventories of physical and operational conditions in the study area including roadways, intersections, crosswalks, sidewalks, on-street and off-street parking, transit facilities, and land uses in the study area. Transportation data that were collected and compiled are presented, including automatic traffic recorder counts, intersection turning movement counts, pedestrian and bicycle counts, vehicle crash data, and transit service data.

1 Inventory of Existing Conditions

1.a Roadways

The main Project site is located at the corner of Massachusetts Avenue and Columbia Street adjacent to Lafayette Square. The parcel is bordered by Bishop Allen Drive to the north, Columbia Street to the east, Massachusetts Avenue to the south and Douglass Street to the west. Figure C, preciously presented, shows the roadway network surrounding the Project site.

Massachusetts Avenue is an east-west roadway that extends from Uphams Corner in Dorchester to the east and Lexington to the west. Columbia Street is a north/south roadway that extends from Boston and through Central Square towards Harvard Square. Bishop Allen Drive is an east-west roadway that extends from Main Street in the east to Inman Street in the west. Figures 1.a.1 through 1.a.3 provided detailed plans of the main roadways surrounding the Project site.

1.b Intersections

The Project study area included the following eleven study intersections which were presented previously in Figure E and illustrated in Figures 1.b.1 through 1.b.12.

1.c Parking

The main Project site currently does not contain any vehicular parking. The City's Parking Lot 6, containing approximately 50 spaces abuts Project site with access off of Bishop Allen Drive.

The parking garage at 47 Bishop Allen Drive is an abandoned parking structure of approximately 113 spaces, which the Owner proposes to redevelop into 25 residential units. The surface parking lot at 65 Bishop Allen Drive, contains 51 parking spaces, which are currently unused. The Owner proposes to reopen the lot and provide some of the Project parking at this location. Figure 1.c.1 shows the existing parking locations at the Project sites.

Figure 1.c.2 presents existing on-street parking regulations within a quarter-mile (5 minute walk) of the Project site. The majority of on-street parking surrounding the study area is resident permit parking with areas of metered parking along Massachusetts Avenue, Bishop Allen Drive, and Columbia Street.

1.d Transit Services

Figure 1.d.1 illustrates existing Massachusetts Bay Transportation Authority (MBTA) services and the Charles River Transportation Management Association's (CRTMA) EZRide within the study area.

Public Transit Services

The Project area is accessible by several MBTA bus lines as well as the subway. Services are summarized below.

Red Line – Central Square

The Central Square MBTA Station is located approximately a quarter-mile northwest of the site along Massachusetts Avenue. The station provides access to the MBTA's Red Line providing service to Alewife to the northeast, downtown Boston and Braintree and Ashmont to the south. The Red Line connects with the Green Line at Park Street and the Orange and Silver Lines at Downtown Crossing. Connections to all southern commuter rail lines, the Red Line and Silver Line are made at South Station. In addition, the Fitchburg commuter rail line connects with the Red Line at Porter Square. The Red Line operates from 5:15AM to 12:30 AM on weekdays with approximately 9 minute headways during peak hours. Saturday service is from 5:15AM to 12:30AM, and Sunday service is from 6:00AM to 12:30AM.

MBTA Route #1 – Harvard/Holyoke Gate – Dudley Station via Mass Ave.

MBTA Route #1 connects Harvard Square and Central Square in Cambridge to Dudley Square via Massachusetts Avenue. The nearest bus stop to the Project site is located at the corner of Massachusetts Avenue and Sidney Street. Various stops along this route connect with other bus lines, the Red Line, Orange Line, and Green Line. The bus route runs on weekdays from 4:37 AM to 1:27 AM with 8 – 10 minute headways during peak hours. On Saturday, service runs from 4:40 AM to 1:40 AM, and Sunday services is from 6:00 AM to 1:32 AM.

MBTA Route #47 – Central Square, Cambridge – Broadway Station via B.U. Medical Center, Dudley Station & Longwood Medical Area

MBTA Route #47 connects Central Square in Cambridge to Broadway Station in South Boston via Fenway and the South End. The nearest bus stop to the Project site is located at the corner of Brookline Street and Green Street. Various stops along this route connect with other bus lines, the Red Line, Orange Line, and Green Line. The bus route runs on weekdays from 5:15 AM to 1:24 AM with 10 – 22 minute headways during peak hours. On Saturday, service runs from 5:00 AM to 1:40 AM, and Sunday services is from 7:30 AM to 1:04 AM.

MBTA Route #64 – Oak Square – University Park, Cambridge or Kendall/MIT via North Beacon St.

MBTA Route #64 connects Oak Square in Brighton and University Park and Kendall/MIT Station in Cambridge via North Beacon Street. The nearest bus stop to the Project site is located at the corner of Massachusetts Avenue and Sidney Street. Various stops along this route connect with other bus lines and the Red Line. The bus route runs on weekdays from 5:31 AM to 1:13 AM with 14 – 30 minute headways during peak hours. On Saturday, service runs from 5:20 AM to 1:15 AM, and Sunday services is from 8:18 AM to 6:59 PM.

MBTA Route #68 – Harvard/Holyoke Gate – Kendall/MIT via Broadway

MBTA Route #68 connects Harvard Square and Kendall Square in Cambridge via Massachusetts Avenue. The nearest bus stop to the Project site is located at the corner of Broadway and Columbia Street. Various stops along this route connect with other bus lines and the Red Line. The bus route runs on weekdays from 6:35 AM to 6:54 PM with 40 minute headways during peak hours. There is no service on the weekends.

MBTA Route #70/70A – Cedarwood, North Waltham or Watertown Square – University Park via Central Square, Cambridge, Arsenal St. & Western Ave.

MBTA Route #70/70A connects Waltham and Watertown to Central Square in Cambridge via Western Avenue Arsenal Street, and Main Street. The nearest bus stop to the Project site is located at the corner of Massachusetts Avenue and Sidney Street. Various stops along this route connect with other bus lines, the Red Line, and Fitchburg Commuter Rail. The bus route runs on weekdays from 4:50 AM to 1:04 AM with 10 – 15 minute headways during peak hours. On Saturday, service runs from 5:00 AM to 1:27 AM, and Sunday service is from 6:00 AM to 1:23 AM.

MBTA Route #83 – Rindge Ave. – Central Square, Cambridge via Porter Square Station

MBTA Route #83 connects Rindge Avenue near Alewife Station and Porter Square to Central Square via Massachusetts Avenue, Somerville Avenue, and Beacon Street. The nearest bus stop to the Project site is located at Magazine Street and Green Street. Various stops along this route connect with other bus lines, the Red Line, and Fitchburg Commuter Rail. The bus route runs on weekdays from 5:10 AM to 1:20 AM with 20 – 30 minute headways during peak hours. On Saturday, service runs from 5:10 AM to 1:29 AM, and Sunday service is from 7:25 AM to 1:22 AM.

MBTA Route #91 – Sullivan Square Station – Central Square, Cambridge via Washington Street

MBTA Route #91 connects Sullivan Square Station in Charlestown and Central Square in Cambridge via Washington Street and Union Square in Somerville. The nearest bus stop to the Project site is located at the corner of Magazine Street and Green Street. Various stops along this route connect with other bus lines, the Red Line, and Orange Line. The bus route runs on weekdays from 5:15 AM to 1:10 AM with 30 minute headways during peak hours. On Saturday, service runs from 5:00 AM to 1:05 AM, and Sunday service is from 6:30 AM to 12:54 AM.

MBTA Route CT1 – Central Square, Cambridge – B.U. Medical Center/Boston Medical Center via M.I.T.

MBTA Route CT1 connects Central Square in Cambridge to the Boston University Medical Center via Massachusetts Avenue and MIT Campus. The nearest bus stop to the Project site is located at the corner of Massachusetts Avenue and Sidney Street. Various stops along this route connect with other bus lines, the Red Line, Orange Line, Green Line, and Silver Line. The bus route runs on weekdays from 6:00 AM to 7:41 PM with 20 – 23 minute headways during peak hours. There is no service on weekends and most holidays.

Private Transit Services

In addition, the Charles River Transportation Management Association (CRTMA) operates the EZRide shuttle service between North Station, Lechmere, Kendall Square, University Park, and Cambridgeport. The shuttle thereby provides connections to the Green Line at Lechmere Station and the northern commuter rail services, as well as the Green and Orange lines at North Station. The shuttle operates every 8-10 minutes from North Station to Cambridgeport via Kendall Square during morning (6:20 AM to 10:50 AM) and evening (3:00 PM to 8:00 PM) commutes, and the midday (10:44 AM to 3:00 PM) shuttle operates every 20 minutes between Kendall Square and Northwest Campus. The shuttle runs Monday through Friday with no weekend and holiday service. EZRide stops closest to the Project area is Massachusetts Avenue at Landsdowne Street. The shuttle has a varying payment structure separate from the MBTA pass, as EZRide and the CRTMA are not affiliated with the MBTA. All EZRide Shuttle buses feature front-mounted bike racks for up to two standard bicycles. This service is open to the public with the fares as follows: $2 cash fare for adults, $1 for children/students age 12-17 years old, college students with ID, senior citizens (65+), and persons with disabilities, and EZRide is free for those with a member pass sticker, MIT ID, and children under 12 years old. Multi-ride ticket books may be purchased online or by mail order by the general public.

1.e Land Use

Figure 1.e.1 illustrates land uses in the area surrounding the Project sites. The neighborhood is largely characterized by residential and special district uses, while the immediate surrounding area incorporates ground floor retail and open public space.

2 Data Collection

2.a ATR Counts

Automatic Traffic Recorder (ATR) counts were conducted in May, 2016 to capture existing daily vehicle volumes inclusive of institutional traffic, within the Project study area. ATR counts were collected at the following locations:

- Massachusetts Avenue, adjacent to the Project site,
- Bishop Allen Drive between Columbia Street and Douglass Street,
- Bishop Allen Drive between Douglass Street and Norfolk Street, and
- Colombia Street, north of Bishop Allen Drive.

A traffic volume summary for the ATRs are presented in Tables 2.a.1 and 2.a.2. These data, representing the averages of data collected over two weekdays illustrate the daily variations of traffic demands and the directional flow of traffic over the course of an average weekday. Detailed count data sheets are induced in the Appendix.

TABLE 2.A.1 EXISTING TRAFFIC VOLUME SUMMARY (MAY 2016)

		AM Peak Hour			PM Peak Hour		
Location	**Daily[a]**	**Volume[b]**	**K[c]**	**Peak Direction**	**Volume[b]**	**K[c]**	**Peak Direction**
Massachusetts Avenue *adjacent to Project site*	12,879	698	5.4%	61% EB	754	5.9%	52% WB
Bishop Allen Drive *between Columbia Street and Douglass Street*	5,970	377	6.3%	73% EB	579	9.7%	58% EB
Bishop Allen Drive *between Douglass Street and Norfolk Street*	4,579	290	6.3%	58% EB	374	8.2%	68% WB
Columbia Street *north of Bishop Allen Drive*	6,943	506	7.3%	72% SB	582	8.4%	63% NB

a vehicles per day
b vehicles per peak hour
c percentage of daily traffic that occurs during the peak hour

TABLE 2.A.2 EXISTING AVERAGE DAILY TRAFFIC SUMMARY (MAY 2016)

Start Time	Massachusetts Avenue *adjacent to Project site*			Bishop Allen Drive *between Columbia Street and Douglass Street*			Bishop Allen Drive *between Douglass Street and Norfolk Street*			Columbia Street *north of Bishop Allen Drive*		
	EB	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**NB**	**SB**	**Total**
12:00 AM	156	128	284	45	25	70	21	34	55	45	41	86
1:00 AM	134	106	240	37	9	46	21	23	44	36	25	61
2:00 AM	66	36	102	11	6	17	5	10	15	14	13	27
3:00 AM	39	36	75	4	4	8	2	3	5	8	10	18
4:00 AM	42	32	74	11	6	17	6	5	11	9	14	23
5:00 AM	117	108	225	28	15	43	21	18	39	20	51	71
6:00 AM	218	196	414	76	39	115	51	45	96	35	146	181
7:00 AM	346	281	627	180	85	265	106	100	206	111	282	393
8:00 AM	434	267	701	289	98	387	188	109	297	137	379	516
9:00 AM	402	281	683	215	78	293	132	110	242	125	304	429
10:00 AM	341	318	659	195	73	268	116	97	213	143	209	352
11:00 AM	359	334	693	178	80	258	84	110	194	140	167	307
12:00 PM	352	346	698	202	110	312	104	152	256	147	179	326
1:00 PM	370	311	681	216	101	317	93	140	233	168	173	341
2:00 PM	378	371	749	254	115	369	102	163	265	233	177	410
3:00 PM	345	369	714	289	138	427	129	178	307	265	203	468
4:00 PM	328	382	710	300	201	501	117	243	360	301	192	493
5:00 PM	359	395	754	335	244	579	119	255	374	365	217	582
6:00 PM	342	370	712	304	186	490	148	260	408	273	197	470
7:00 PM	368	373	741	251	105	356	137	164	301	213	195	408
8:00 PM	356	345	701	183	93	276	95	142	237	151	169	320
9:00 PM	331	319	650	176	65	241	100	94	194	148	129	277
10:00 PM	304	264	568	137	56	193	70	74	144	124	107	231
11:00 PM	233	205	438	99	35	133	42	54	95	92	74	166
Total	**6,713**	**6,166**	**12,879**	**4,010**	**1,960**	**5,970**	**2,003**	**2,576**	**4,579**	**3,296**	**3,647**	**6,943**

2.b Pedestrian and Bicycle Counts

Twelve-hour bicycle counts were performed on May 18, 2016 between 7:00 AM and 7:00 PM at the driveway entrance to the City's Parking Lot 6 as well as at the ATR locations, listed above. Pedestrian counts were conducted as part of the vehicle turning movement counts. The twelve-hour bicycle counts are summarized in Table 2.b.1.

TABLE 2.B.1 EXISTING 12-HOUR BICYCLE VOLUMES (MAY 2016)

Start Time	Massachusetts Avenue *adjacent to Project site*			Bishop Allen Drive *between Columbia Street and Douglass Street*			Bishop Allen Drive *between Douglass Street and Norfolk Street*			Columbia Street *north of Bishop Allen Drive*		
	EB	**WB**	**Total**	**EB**	**WB**	**Total**	**EB**	**WB**	**Total**	**NB**	**SB**	**Total**
7:00 AM	10	9	19	10	3	13	5	3	8	5	49	54
8:00 AM	17	4	21	30	5	35	13	5	18	9	102	111
9:00 AM	14	7	21	22	5	27	7	4	11	6	82	88
10:00 AM	12	7	19	16	5	21	10	2	12	6	43	49
11:00 AM	11	5	16	15	2	17	5	3	8	6	25	31
12:00 PM	11	10	21	17	7	24	8	5	13	3	17	20
1:00 PM	9	10	19	21	3	24	6	5	11	12	17	29
2:00 PM	7	16	23	11	1	12	7	4	11	7	16	23
3:00 PM	7	18	25	18	8	26	6	4	10	13	22	35
4:00 PM	4	10	14	24	4	28	10	9	19	14	19	33
5:00 PM	14	30	44	45	13	58	11	15	26	23	27	50
6:00 PM	9	19	28	35	10	45	9	16	25	19	31	50
Total	**125**	**145**	**270**	**264**	**66**	**330**	**97**	**75**	**172**	**123**	**450**	**573**

Peak hour pedestrian and bicycle turning movement counts at study area intersection were conducted along with vehicle intersection turning movement counts, as discussed in the following section.

2.c Intersection Turning Movement Counts

Manual turning movement counts, including vehicles, pedestrians, and bicycles, were conducted at all study area intersection on Wednesday, May 18, 2016. The results of these counts indicated that the peak hours for vehicular traffic in the study area are:

- Morning Peak Hour – 7:45AM to 8:45AM
- Evening Peak Hour – 5:00PM to 6:00PM

The detailed turning movement counts are provided in the Appendix.

The morning and evening peak hour vehicle, pedestrian, and bicycle turning movement volumes are presented in Figures 2.c.1 through 2.c.6, respectively.

2.d Crash Analysis

Study area crash data was obtained from MassDOT records for the most recent three-year period available, January 2011 through December 2013. Analysis of the crash data is summarized in Table 2.d.1 and includes the calculated crash rates (number of reported crashes

per million entering vehicles) based on the evening peak traffic volumes. A detailed summary by crash type is presented in the Appendix.

TABLE 2.D.1 MASSDOT CRASH ANALYSIS (JANUARY 2011 – DECEMBER 2013)

Location	Total Crashes (3-year period)	Crashes Involving Pedestrians	Crashes Involving Bicycles	Calculated Crash Rate
Bishop Allen Drive at Douglass Street	4	0	0	0.51
Bishop Allen Drive at Columbia Street	11	1	1	1.02
Columbia Street at Main Street/Sidney Street	2	0	0	0.27
Massachusetts Avenue at Sidney Street	18	1	2	1.12
Crosswalk at Massachusetts Avenue at Lafayette Square	8	2	3	0.83
Massachusetts Avenue at Brookline Street/Douglass Street	19	1	1	1.47
Bishop Allen Drive at Norfolk Street	1	1	0	0.13
Bishop Allen Drive at Prospect Street	16	5	1	0.95
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	15	2	2	0.64
Green Street at River Street/Western Avenue	11	1	0	0.53
Massachusetts Avenue at Essex Street	14	4	2	1.33

Source: MassDOT data

MassDOT has 6 districts within Massachusetts, and Cambridge falls under the jurisdiction of District 6. The average crash rate per million entering vehicles for District 6 is 0.70 for signalized intersections and 0.53 for unsignalized intersections. Five of the study area intersections fall under the District 6 average for signalized/unsignalized intersections. Six of the study area intersections have a calculated crash rate greater than the District 6 average. The following signalized intersections have a calculated crash rate higher than the District 6 average of 0.70: Massachusetts Avenue at Sidney Street, Massachusetts Avenue at Brookline Street/Douglass Street, Bishop Allen Drive at Prospect Street, and Massachusetts Avenue at Essex Street. Bishop Allen Drive at Columbia Street is an unsignalized intersections with a higher calculated crash rate than the District 6 average of 0.53. The crosswalk at Massachusetts Avenue, while technically not an intersection, is an unsignalized crosswalk with a calculated crash rate of 0.83.

Massachusetts Avenue at Brookline Street/Douglass Street was well above the MassDOT crash rate for signalized intersections in District 6. The intersection experienced a high number of the following collision types: angle (5), rear-end (4), sideswipe same direction (3), and sideswipe opposite direction (2). The wide array of collision types may be due to the off-set configuration of Brookline Street and Douglass Street. The crosswalk at Douglass Street does not have a pedestrian crossing signal, and it functions as an unsignalized crosswalk. This may cause motorists to make unexpected stops in the intersection to allow for pedestrians to cross

Douglass Street. Approximately half of these crashes (10 out of 19) occurred during the weekday but not during the morning or evening peak. Five of the crashes occurred on the weekend, but not during Saturday midday peak. None of the crashes caused fatal injuries to the parties involved.

The intersection of Massachusetts Avenue at Essex Street was also well above the MassDOT crash rate for signalized intersections in District 6. The following collision types appeared most frequently: angle (4), single vehicle crash (3), rear-end (2). Although this intersection has an exclusive pedestrian phase for Massachusetts Avenue and Essex Street, pedestrians commonly cross Essex Street while the signal displays a solid hand. In a similar situation to the Douglass Street approach, vehicles turning left or right onto Essex Street may have to stop unexpectedly.

2.e Public Transit

Transit stops and stations closest to the site were shown previously in Figure 1.d.1. Operating hours, weekday daily ridership, and peak-hour headways for each service line are presented in Table 2.e.1.

TABLE 2.E.1 MBTA SERVICES

Route	Origin/Destination	Hours of Operation	Peak Hour Headways (minutes)	Weekday Ridership
Red Line	Alewife/Ashmont or Braintree	Weekday: 5:15AM-12:30AM Saturday: 5:15AM-12:30AM Sunday: 6:00AM-1:32AM	9	217,329[1]
MBTA Route #1	Harvard/Dudley Station	Weekday: 4:37AM-1:27AM Saturday: 4:40AM-1:40AM Sunday: 6:00AM-1:32AM	8 – 10	12,618
MBTA Route #47	Central Square/ Broadway Station	Weekday: 5:15AM-1:24AM Saturday: 5:00AM-1:40AM Sunday: 7:30AM-1:04AM	10 – 22	5,094
MBTA Route #64	Oak Square/ University Park or Kendall/MIT	Weekday: 5:31AM-1:13AM Saturday: 5:20AM-1:15AM Sunday: 8:18AM-6:59AM	14 – 30	1,904
MBTA Route #68	Harvard/Kendall/MIT	Weekday: 6:35AM-6:54PM Saturday: No Service Sunday: No Service	40	475
MBTA Route #70/70A	North Waltham or Watertown Square/University Park	Weekday: 4:50AM-1:04AM Saturday: 5:00AM-1:27AM Sunday: 6:00AM-1:23AM	10 – 15	7,553
MBTA Route #83	Rindge Ave/Central Square	Weekday: 5:10AM-1:20AM Saturday: 5:10AM-1:29AM Sunday: 7:25AM-1:22AM	20 – 30	2,047
MBTA Route #91	Sullivan Square Station/Central Square	Weekday: 5:15AM-1:10AM Saturday: 5:00AM-1:05AM Sunday: 6:30AM-12:54AM	30	1,651
MBTA Route CT1	Central Square/BU Medical Center or Boston Medical Center	Weekday: 6:00AM-7:41PM Saturday: No Service Sunday: No Service	20 – 23	2,203

Source: MBTA Official
[1] 2014 Blue Book

2.f Parking

The two existing parking locations on Bishop Allen Drive are both currently vacant, while the City's Parking Lot 6 behind the main site is an active, public city lot. The city surface lot is open to the public as 2-hour metered parking.

An occupancy study was conducted and the results are shown in Table 2.f.1. The lot reached its peak occupancy with all 51 spaces occupied from 12:30-1:00pm.

TABLE 2.F.1 PARKING OCCUPANCY FOR THE CITY'S PARKING LOT 6 (WEDNESDAY, MAY 18, 2016)

Time Period	Vehicles In	Vehicles Out	Occupied Spaces	% Occupied
7:00 – 7:30 AM	0	1	5	10%
7:30 – 8:00 AM	3	1	4	8%
8:00 – 8:30 AM	6	0	6	12%
8:30 – 9:00 AM	3	1	12	24%
9:00 – 9:30 AM	10	1	14	27%
9:30 – 10:00 AM	7	0	23	45%
10:00 – 10:30 AM	9	2	30	59%
10:30 – 11:00 AM	10	2	37	73%
11:00 – 11:30 AM	8	6	45	88%
11:30 – 12:00 PM	6	4	47	92%
12:00 – 12:30 PM	10	8	49	96%
12:30 – 1:00 PM	8	10	51	100%
1:00 – 1:30 PM	5	14	49	96%
1:30 – 2:00 PM	10	14	40	78%
2:00 – 2:30 PM	10	13	36	71%
2:30 – 3:00 PM	6	6	33	65%
3:00 – 3:30 PM	16	14	33	65%
3:30 – 4:00 PM	3	8	35	69%
4:00 – 4:30 PM	6	8	30	59%
4:30 – 5:00 PM	6	6	28	55%
5:00 – 5:30 PM	9	11	28	55%
5:30 – 6:00 PM	7	4	26	51%
6:00 – 6:30 PM	9	12	29	57%
6:30 – 7:00 PM	16	10	26	51%

2.g Unsignalized Crosswalk on Massachusetts Avenue at Lafayette Square

The unsignalized crosswalk on Massachusetts Avenue at Lafayette Square provides a crossing within the Central Square area adjacent to the proposed Project site. Extensive data was collected at this crosswalk including the following: pedestrian crossing volumes, a gap and yield study, and crash data for the past 3 most recent years available.

Peak Period Pedestrian Crossings

Morning and evening pedestrian crossings were collected simultaneously with the TMCs on Wednesday, May 18, 2016. As indicated in Table 2.g.1, a total of 308 pedestrians cross during the morning peak period, while 56 percent or 173 cross during the morning peak hour between 7:45 AM – 8:45 AM. During the evening peak period a total of 378 pedestrians cross, as shown in Table 2.g.2 with 57 percent or 217 cross during the evening peak hour, 5:00 PM to 6:00 PM.

TABLE 2.G.1 MORNING PEAK PERIOD PEDESTRIAN CROSSINGS

	Pedestrian Crossings		
Time Period	**Northbound**	**Southbound**	**Total**
7:30 – 7:45 AM	6	22	28
7:45 – 8:00 AM	17	16	33
8:00 – 8:15 AM	23	16	39
8:15 – 8:30 AM	12	35	47
8:30 – 8:45 AM	25	29	54
8:45 – 9:00 AM	19	21	40
9:00 – 9:15 AM	14	14	28
9:15 – 9:30 AM	23	16	39
Total	**139**	**169**	**308**

TABLE 2.G.2 EVENING PEAK PERIOD PEDESTRIAN CROSSINGS

	Pedestrian Crossings		
Time Period	**Northbound**	**Southbound**	**Total**
4:30 – 4:45 PM	13	10	23
4:45 – 5:00 PM	10	21	31
5:00 – 5:15 PM	36	22	58
5:15 – 5:30 PM	34	26	60
5:30 – 5:45 PM	27	27	54
5:45 – 6:00 PM	15	30	45
6:00 – 6:15 PM	17	28	45
6:15 – 6:30 PM	19	43	62
Total	**171**	**207**	**378**

Gap and Yield Study

Vehicle gap data was collected at the unsignalized crosswalk of Massachusetts Avenue at Lafayette Square in conjunction with the TMC and ATR counts on Wednesday, May 18, 2016, during the morning and evening peak hours. The gap study identifies the gap (or headway) in seconds, between vehicles passing through the crosswalk. The critical gap refers to the number of seconds between vehicles a pedestrian needs in order to feel safe to cross the unsignalized crosswalk. While much research has been conducted to try to identify the key critical gap time a pedestrian needs, it is also very subjective as each crossing pedestrian identifies with at different critical gap. A critical gap between four and eight seconds was the typical gap identified in the research, presented in the Appendix. Tables 2.g.3 and 2.g.4 summarizes the number of gaps of four seconds or greater, six seconds or greater, and eight seconds or greater during the morning and evening peak periods. The detailed gap analysis results are provided in the Appendix.

TABLE 2.G.3 MORNING PEAK VEHICLE GAP COUNTS AT CROSSING

	Critical Gap		
Time Period	**≥4.0 Sec**	**≥6.0 Sec**	**≥8.0 Sec**
7:30 – 7:45 AM	40	33	30
7:45 – 8:00 AM	50	31	25
8:00 – 8:15 AM	44	33	23
8:15 – 8:30 AM	45	33	28
8:30 – 8:45 AM	51	34	22
8:45 – 9:00 AM	54	36	24
9:00 – 9:15 AM	46	37	30
9:15 – 9:30 AM	47	37	28
Total	**377**	**274**	**210**

TABLE 2.G.4 EVENING PEAK VEHICLE GAPS AT CROSSING

	Critical Gap		
Time Period	**≥4.0 Sec**	**≥6.0 Sec**	**≥8.0 Sec**
4:30 – 4:45 PM	53	38	24
4:45 – 5:00 PM	39	25	19
5:00 – 5:15 PM	54	36	23
5:15 – 5:30 PM	46	34	17
5:30 – 5:45 PM	41	32	26
5:45 – 6:00 PM	32	25	15
6:00 – 6:15 PM	47	30	21
6:15 – 6:30 PM	51	36	28
Total	**363**	**256**	**173**

This data suggests that during the morning peak period there are an average of 2 gaps per minute of 8 seconds or greater for a pedestrian to cross Massachusetts Avenue. During the evening peak period an average of 1.5 gaps per minute of 8 seconds or more occurred.

It should be noted that based on the national standard walking speed of 3.5 feet per second, it takes approximately 15 seconds to cross Massachusetts Avenue at the unsignalized crosswalk.

A vehicle yield study was conducted by observing the number of vehicles that yield at the crosswalk when a pedestrian is present. The observations were from the same time periods and date as the Gap Study. Tables 2.g.5 and 2.g.6 summarized the number and percentage of yielding vehicles when a pedestrian was present at the crosswalk.

TABLE 2.G.5 MORNING PEAK PERIOD VEHICLE YIELD COUNTS AT CROSSING

	Vehicles Heading Eastbound			Vehicles Heading Westbound		
Time Period	**Yielding**	**Total**	**Percent Yield**	**Yielding**	**Total**	**Percent Yield**
4:30 – 4:45 PM	5	9	56%	5	5	100%
4:45 – 5:00 PM	8	8	100%	6	8	75%
5:00 – 5:15 PM	10	16	63%	10	14	71%
5:15 – 5:30 PM	15	19	79%	4	21	19%
5:30 – 5:45 PM	12	19	63%	11	23	48%
5:45 – 6:00 PM	19	21	90%	8	16	50%
6:00 – 6:15 PM	7	9	78%	6	7	86%
6:15 – 6:30 PM	11	18	61%	8	13	62%
Total	**87**	**119**	**74%**	**58**	**107**	**64%**

TABLE 2.G.6 EVENING PEAK PERIOD VEHICLE YIELD COUNTS AT CROSSING

	Vehicles Heading Eastbound			Vehicles Heading Westbound		
Time Period	**Yielding**	**Total**	**Percent Yield**	**Yielding**	**Total**	**Percent Yield**
4:30 – 4:45 PM	11	16	69%	8	16	50%
4:45 – 5:00 PM	10	12	83%	15	25	60%
5:00 – 5:15 PM	21	27	78%	16	20	80%
5:15 – 5:30 PM	17	24	71%	16	22	73%
5:30 – 5:45 PM	6	8	75%	12	31	39%
5:45 – 6:00 PM	9	12	75%	13	17	76%
6:00 – 6:15 PM	12	18	67%	6	9	67%
6:15 – 6:30 PM	13	16	81%	11	22	50%
Total	**99**	**133**	**75%**	**97**	**162**	**62%**

Crash Data

As presented previously there have been a total of eight crashes within the last three years of available data, January 2011 to December 2013. Of the eight crashes, two involved pedestrians, while three involved bicyclists. Both of the pedestrian crashes occurred during the fall (one in 2012 and one in 2013) at approximately noon with vehicles traveling straight ahead prior to the crash. All three bicycle crashes occurred with parked vehicles pulling out into the travel lane and hitting the passing bicyclist with a sideswipe in the same direction of travel. All pedestrian and bicycle crashes had non-fatal injuries and occurred during daylight.

Project Interaction with Crosswalk

The Project integrates the Massachusetts Avenue mid-block crosswalk with the public realm of the Project. The crosswalk aligns well with the various retail spaces within the Project and will

allow the pubic to easily access these proposed amenities. The residential lobbies will be small and integrated within the active, first-floor retail space.

3 Project Traffic

3.a Mode Share and Average Vehicle Occupancy

Mode share for residential and retail trips was based on the percentages outlined in the City's scoping letter and are presented in Table 3.a.1. The 2009 National Household Travel Survey specifies the national average vehicle occupancy (AVO) of 1.13 for residential (Apartment) land use and 1.78 for retail (Shopping Center) land use. Local AVO for residential land use was calculated to be 2.08 based on data from the 2010-2014 American Commuting Survey (ACS) 5-Year Estimates for the census tract 3531.01, Middlesex County, MA. Retail AVO was calculated, from the CTPP data from the 2006-2010 ACS 5-Year Estimates, to be 2.27.

TABLE 3.A.1 MODE SHARES BY LAND USE

Mode	Residential	Retail
Drive Alone Vehicle	25%	20%
Carpool/Rideshare Vehicle	5%	3%
Transit	31%	31%
Bike	10%	6%
Walk	24%	38%
Other	5%	2%

3.b Trip Generation

Trip generation estimates were based on the Institute of Transportation Engineers (ITE) Trip Generation Manual (9th Edition) rates for Apartment (LUC 220) and Shopping Center (LUC 820).

ITE vehicle trips were converted to person trips by application of the national AVO of 1.13 for residential and 1.78 for retail. While local AVOs were used to convert person trips back to vehicle trips once mode shares were applied.

The resulting Project trip generation by mode for the Proposed Project is summarized in Table 3.b.1.

TABLE 3.B.1 PROJECT TRIP GENERATION BY MODE

		Drive Alone Vehicle Trips			Carpool/Rideshare Vehicle Trips			Transit Trips			Bike			Walk			Other		
		Daily	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily	AM Peak	PM Peak	Daily	AM Peak	PM Peak
Residential	Entering	277	9	34	27	1	3	343	11	42	111	3	14	266	8	32	55	2	7
	Exiting	277	34	18	27	3	2	343	43	23	111	14	7	266	33	17	55	7	4
	Total	554	43	52	54	4	5	686	54	65	222	17	21	532	41	49	110	9	11
Retail	Entering	136	4	11	9	0	1	210	6	18	41	1	3	258	7	22	14	0	1
	Exiting	136	2	12	9	0	1	210	4	19	41	1	4	258	4	23	14	0	1
	Total	272	6	23	18	0	2	420	10	37	82	2	7	516	11	45	28	0	2
Total	Entering	413	13	45	36	1	4	553	17	60	152	4	17	524	15	54	69	2	8
	Exiting	413	36	30	36	3	3	553	47	42	152	15	11	524	37	40	69	7	5
	Total	826	49	75	72	4	7	1,106	64	102	304	19	28	1,048	52	94	138	9	13

Estimates based on ITE 9th Edition LUC 220 – Apartment and LUC 820 – Shopping Center
Daily trip generation in "trips per day"
Peak hour trip generation in "trips per hour"

Per the City's scoping letter, trip generation rates were compared between ITE and actual trips generated by comparable residential buildings in the area. Field observations were conducted at the Holmes residential building located at 632 Massachusetts Avenue providing 93 residential units with 80 vehicle parking spaces in a below grade garage off of Green Street. Data was collected on May 11, 2016 during the morning and evening peak hours, 7:30 AM – 9:30 AM and 4:30 PM – 6:30 PM, respectively, at the buildings main entrance and at the parking garage entrance. The data collected provides a breakdown of vehicle trips and non-vehicle trips (walk and bike) which can be used to calculate a trip rate per unit. These rates are listed in Table 3.b.2 along with other comparable residential buildings and the ITE trip generation rates for apartment units. Field observation sheets and detailed trip rate calculations are provided in the Appendix.

TABLE 3.B.2 COMPARABLE TRIP RATES

	Morning Peak Hour		Evening Peak Hour	
Trip Rate Description	Vehicle (In/Out)	Non-Vehicle (In/Out)	Vehicle (In/Out)	Non-Vehicle (In/Out)
Holmes Building[1]	0.01/0.01	0.16/0.58	0.03/0.02	0.39/0.25
303 Third Street[2]	0.03/0.13	N/A	0.09/0.04	N/A
ITE Apartment[3]	0.03/0.13	0.08/0.32	0.13/0.07	0.32/0.17

1 VHB observations Wednesday, May 11, 2016
2 VHB observations Tuesday, April 29, 2014, from the 88 Ames Street Residences TIS
3 ITE trip generation rates taking into account the mode shares discussed above

As shown in Table 3.b.2, the ITE trip generation rates, when mode shares are taken into account, are comparable to the 303 Third Street. The Holmes Building produces less vehicle trips and more non-vehicle trips (walk and bike trips) than the ITE trip generation rates. These findings were discussed with TP&T and it was concluded that the ITE Trip Generation methodology discussed above was the adequate way to estimate the Projects trip generation.

The Project will generate an estimated 49 drive alone vehicle trips (13 entering, 36 exiting) and an estimated 4 carpool/rideshare vehicle trips (1 entering, 3 exiting) in the morning peak hour. The evening peak hour will have 75 drive alone vehicle trips (45 entering, 30 exiting) and an estimated 7 carpool/rideshare vehicle trips (4 entering, 3 exiting).

While currently vacant, the site had been a very active lab and office site, for the past 20 years. Based on a 2012 47 Bishop Allen Drive PTDM mode share summary of Quest Diagnostics, between 42 and 70 percent of employees drove alone to work each day, depending on their work shift. The single-occupancy-vehicle rates for the three work shifts suggests that there was frequent vehicular activity over the course of an entire day.

3.c Site Access

The main sites of B-1 and B-2 will be accessed by vehicles through the City's Parking Lot 6 under an access agreement currently being discussed with the City. The Owner has been working with the City Traffic Parking and Transportation Department (TP& TD) and the Public

Works Department to develop this agreement that will provide access to the rear of B-1 where a loading dock and underground garage entrance/egress has been designed. The Owner has proposed a 20-foot, 2-way, drive aisle to the garage which would enable the City lot to continue as a surface parking lot and accommodate the City's future plans for housing or open space on a portion of Lot 6. Both B-1 and B-2 provide internal pedestrian walkways from their entrances on Massachusetts Avenue and Columbia Street respectively to the rear of the buildings adjacent to the City lot. Retail access is provided at various entrances along Massachusetts Avenue and Lafayette Square as well as along the new proposed pedestrian way between the two sites. This pedestrian way provides access from Lafayette Square to the back of the site and through the City's Parking Lot 6 all the way to Bishop Allen Drive.

The proposed 47 Bishop Allen Drive residential building provides pedestrian access off of Bishop Allen Drive with vehicle parking at the surface lot at 65 Bishop Allen Drive.

A loading dock at B-1, provides the loading and service facilities for B-1 and B-2. Figure 3.d.2 provides the location of the loading dock. The following section, 3.d Servicing and Deliveries, discusses the details of the servicing and delivery program related to the Project.

As requested in the TIS Scoping Letter, the team evaluated the feasibility of widening the street to accommodate bicycle lanes or improve the bicycle level of comfort. The findings indicated that the public right of way dimensions on Columbia Street have an insufficient cross-section width to accommodate full bicycle lane designs. The curb to curb dimension of Columbia Street is approximately 29 feet; assuming the removal of on-street parking and dedicating 20 feet for two travel lanes would not provide the 10 feet necessary for the two 5-foot bicycle lanes. Furthermore, the Cambridge Bicycle Vision Plan does not designate Columbia Street as a bike priority network street.

Widening the street by setting back the low-rise building from the existing property line severely compromises the viability for a marketable retail and residential program. The narrow triangular geometry of the existing parcel already creates challenging layouts for functional retail/back-of-house on the ground floor and for marketable units upstairs. Making the building skinnier would only exacerbate the existing condition.

Driver Sight Line Evaluation

As requested in the TIS Scoping Letter, an evaluation of driver sight lines at various locations was conducted, and no major impacts were identified. Figure 3.c.1 illustrates the resulting sight triangle projections, specifically:

- Columbia Street at Bishop Allen Drive – no Project impact. The drivers are able to see the stopped vehicles on the other three approaches without any obstructions within the sight triangle.
- 47 Bishop Allen Drive – no vehicular driveway proposed with the Project.
- 65 Bishop Allen Drive – no Project impact, the parking lot driveway currently exists and will continue to be utilized the same way.

- Lot 6 Driveways – no Project impact, the parking lot driveways currently exist and will continue to be utilized the same way. A sight triangle for both driveways is illustrated in Figure 3.c.1 to show existing conditions that are expected to remain.
- Loading Dock – it is anticipated that the trucks loading/servicing the building will do so by pulling up parallel to the building in the loading zone, without entering the loading dock. No sight line impacts are anticipated from this operation.
- Garage Access – There is a possible conflict between vehicles exiting the garage, and vehicles circulating in the lot in a clockwise direction during loading/servicing operations. The team will continue to study the possible conflict and will engage in discussions with the City on possible solutions, including the option of making the parking lot circulation into a one-way counterclockwise operation. The garage access will include all necessary pedestrian crossing warning signage or signalization, as required for safe operation of the garage.

Trip Distribution

Project generated traffic was distributed through the study area based on the K2C2 residential and employee arrival and departure distributions for Sub-Area 6 as well as discussions with TP&T. The distributions are presented in Table 3.c.1.

TABLE 3.C.1 VEHICULAR TRIP DISTRIBUTION

Route	Residential (Arrival/Departure)	Retail (Arrival/Departure)
Main Street	14%/14%	15%/15%
Mass Ave to/from east	19%/19%	31%/31%
Mass Ave to/from west	15%/16%	21%/18%
River/Western Street	26%/0%	13%/1%
Brookline Street	10%/0%	1%/0%
Columbia Street	12%/8%	15%/9%
Norfolk Street	4%/0%	4%/0%
Prospect Avenue	0%/15%	0%/16%
Sidney Street	0%/20%	0%/6%
Pearl Street	0%/7%	0%/5%

Source: K2C2 Study Residential/Employee Arrival & Departure Distribution for Sub-Area 6

Vehicles were distributed through the roadway network according to the corresponding residential or employee percentage. The vehicular trip distribution is shown in Figure 3.c.2 and the resulting Project generated trips are shown in Figures 3.c.3 and 3.c.4.

3.d Servicing and Deliveries

The Project will provide one loading dock at the back of B-1, accessed through the City Parking Lot 6. The loading dock will be used for early morning trash and recycle pick-up as

well as scheduled retail deliveries. Trash and recycling from B-2 will be wheeled over to the loading dock on trash pick-up days and then wheeled back to the trash room at the back of B-2 after pick-up. Retail deliveries will be through the back of the building at the loading dock.

Move-in/move-out activities will also be accommodated along the back of the building within the easement. These activities will be scheduled through the building management and occur during non-peak hour times as to minimize this impact to the residents and tenants of the buildings and to the City Lot.

Figures 3.d.1 through 3.d.2 illustrate vehicle access and turning movements at the site.

4 Background Traffic

In accordance with the City's Scope, background traffic growth reflecting regional growth was assumed to occur at 0.5 percent per year for five years to the 2021 Future Condition. In addition, trips associated with specific planned projects in the area of the Project site have been incorporated into the 2021 Future condition analysis. These specific projects include:

- 650 Main Street
- 10 Essex Street Residential Project – This project is covered in the 0.5 percent background traffic growth due to the small number of vehicle trips that will be generated from this transit oriented development.
- MIT Kendall Square Redevelopment Project
- 181 Massachusetts Avenue (Novartis)
- 300 Massachusetts Avenue project (Forest City) – This building is approximately 80% occupied and the traffic associated with the occupied space is captured in the TMC's. The small percentage of unoccupied space, 20%, is included in the general background growth.

5 Traffic Analysis

Traffic networks were developed, in accordance with the TIS Guidelines, for the following scenarios:

5.a 2016 Existing Condition

The 2016 Existing Condition analysis is based on existing vehicle, pedestrian, and bicycle counts at the study area intersections (see Section 2 –Data Collection). The Existing Condition traffic networks are shown in Figures 2.c.1 and 2.c.2.

5.b 2016 Build Condition

The Build Condition analysis assumes full occupancy of the 295 residential units and 17,000 GSF of ground-floor retail. The underground parking garage on B1 and surface lot on Bishop

Allen Drive will be open for residences' use. Project generated traffic (see Section 3 – Project Traffic) was added to the study area to create the 2016 Build Condition networks shown in Figures 5.b.1 and 5.b.2.

5.c 2021 Future Condition

The 2021 Future Condition builds upon the 2016 Build Condition volumes to include general background growth and other specific development projects as previously described (see Section 4 – Background Traffic). The Future Condition traffic networks are shown in Figures 5.c.1 and 5.c.2.

6 Vehicle Capacity Analysis

Synchro 8 software was used to determine the vehicle level of service (VLOS) for the 12 study intersection. Synchro software has the capability of performing LOS analysis based on the 2000 and 2010 Highway Capacity Manual. Given the limitations of the 2010 Highway Capacity Manual on signalized intersection, the LOS results are based on the 2000 Highway Capacity Manual.

Results for the 2016 Existing, 2016 Build, and 2021 Future Conditions for signalized intersections are shown in Tables 6.a.1 and 6.a.2 for the morning and evening peak hours, respectively. The results for unsignalized intersections are shown in Table 6.a.3 and 6.a.4 for the morning and evening peak hours, respectively. Visual representation of the changes in level of service are provided in Figures 6.a.1 and 6.a.2 for all conditions during the morning and evening peak hours. The tables also show the difference in delay between the Existing and Build delay and the Build and Future delay. Figures 6.a.3 and 6.a.4 show the incremental net change in vehicle delay at the study area intersections.

TABLE 6.A.1 SIGNALIZED INTERSECTION LOS – MORNING PEAK HOUR

Intersection	Approach	2016 Existing Condition			2016 Build Condition			Difference in Delay Existing to Build	2021 Future Condition			Difference in Delay Existing to Future
		V/C Ratio	Delay	VLOS	V/C Ratio	Delay	VLOS		V/C Ratio	Delay	VLOS	
Columbia Street at Main Street/Sidney Street	Columbia Street Eastbound	0.72	40.3	D	0.77	43.0	D	2.7	0.79	43.3	D	3.3
	Main Street Westbound	0.78	57.3	E	0.78	57.3	E	0.0	0.97	95.8	F	38.5
	Sidney Street Northbound	0.17	2.6	A	0.17	2.8	A	0.2	0.34	3.3	A	0.7
	OVERALL	**0.45**	**33.9**	**C**	**0.46**	**35.3**	**D**	**1.4**	**0.60**	**40.8**	**D**	**6.9**
Massachusetts Avenue at Sidney Street	Mass Ave Eastbound	0.64	30.7	C	0.64	30.7	C	0.0	0.77	34.4	C	3.7
	Mass Ave Westbound	0.61	31.3	C	0.61	31.5	C	0.2	0.71	34.6	C	3.3
	Sidney Street Northbound	0.50	39.1	D	0.50	39.1	D	0.0	0.49	38.4	D	-0.7
	Sidney Street Southbound	0.80	26.9	C	0.84	28.3	C	1.4	0.91	33.2	C	6.3
	OVERALL	**0.67**	**30.2**	**C**	**0.68**	**30.7**	**C**	**0.5**	**0.81**	**34.3**	**C**	**4.1**
Massachusetts Avenue at Brookline Street/Douglass Street	Mass Ave Eastbound	0.50	10.4	A	0.50	10.3	B	-0.1	0.70	11.9	B	1.5
	Mass Ave Westbound	0.25	11.0	B	0.25	10.8	B	-0.2	0.27	10.8	B	-0.2
	Brookline Street Northbound	0.33	24.4	C	0.33	24.4	C	0.0	0.24	23.6	C	-0.8
	OVERALL	**0.44**	**14.3**	**B**	**0.44**	**14.2**	**B**	**-0.1**	**0.57**	**14.4**	**B**	**0.1**
Bishop Allen Drive at Prospect Street	Bishop Allen Drive Westbound	0.74	49.3	D	0.77	51.3	D	2.0	0.79	52.9	D	3.6
	Prospect Street Northbound	0.64	13.2	B	0.64	13.3	B	0.1	0.66	13.7	B	0.5
	Prospect Street Southbound	0.45	8.8	A	0.45	8.8	A	0.0	0.46	8.9	A	0.1
	OVERALL	**0.67**	**17.0**	**B**	**0.67**	**17.5**	**B**	**0.5**	**0.69**	**18.0**	**B**	**1.0**
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	Mass Ave Eastbound	0.68	31.8	C	0.69	32.1	C	0.3	0.88	45.6	D	13.8
	Mass Ave Westbound	0.49	12.0	B	0.50	12.2	B	0.2	0.56	12.8	B	0.8
	River Street Northbound	0.91	28.5	D	0.91	28.8	C	0.3	0.93	30.4	C	1.9
	Prospect Street Southbound	0.80	30.9	C	0.80	30.8	C	-0.1	0.82	31.9	C	1.0
	OVERALL	**0.81**	**27.2**	**C**	**0.81**	**27.3**	**C**	**0.1**	**0.91**	**31.2**	**C**	**4.0**
Green Street at Western Avenue/River Street	Green Street Westbound	0.32	26.3	C	0.32	26.3	C	0.0	0.34	26.4	C	0.1
	River Street Northbound	0.55	13.7	B	0.55	13.7	B	0.0	0.61	14.6	B	0.9
	Western Avenue Southbound	0.75	17.5	B	0.75	17.5	B	0.0	0.77	17.9	B	0.4
	OVERALL	**0.58**	**17.1**	**B**	**0.58**	**17.1**	**B**	**0.0**	**0.60**	**17.5**	**B**	**0.4**
Massachusetts Avenue at Essex Street	Mass Ave Eastbound	0.50	11.9	B	0.50	12.0	B	0.1	0.68	15.8	B	3.9
	Mass Ave Westbound	0.53	10.9	B	0.54	11.2	B	0.3	0.58	12.1	B	1.2
	OVERALL	**0.36**	**11.5**	**B**	**0.37**	**11.6**	**B**	**0.1**	**0.49**	**14.3**	**B**	**2.8**

TABLE 6.A.2 SIGNALIZED INTERSECTION LOS – EVENING PEAK HOUR

Intersection	Approach	2016 Existing Condition			2016 Build Condition			Difference in Delay Existing to Build	2021 Future Condition			Difference in Delay Existing to Future
		V/C Ratio	Delay	VLOS	V/C Ratio	Delay	VLOS		V/C Ratio	Delay	VLOS	
Columbia Street at Main Street/Sidney Street	Columbia Street Eastbound	0.64	41.4	D	0.68	43.7	D	2.3	0.71	44.4	D	3.0
	Main Street Westbound	0.85	64.2	E	0.85	64.2	E	0.0	1.68	360.8	F	296.6
	Sidney Street Northbound	0.18	5.2	A	0.20	5.3	A	0.1	0.21	5.1	A	-0.1
	OVERALL	**0.43**	**36.2**	**D**	**0.45**	**36.5**	**D**	**0.3**	**0.63**	**180.5**	**F**	**144.3**
Massachusetts Avenue at Sidney Street	Mass Ave Eastbound	0.49	29.7	C	0.49	29.7	C	0.0	0.57	31.2	C	1.5
	Mass Ave Westbound	0.75	29.8	C	0.78	31.0	C	1.2	0.86	36.5	D	6.7
	Sidney Street Northbound	0.43	39.5	D	0.43	39.5	D	0.0	0.44	39.9	D	0.4
	Sidney Street Southbound	0.84	36.7	D	0.88	39.4	D	2.7	1.13	71.2	E	34.5
	OVERALL	**0.72**	**32.1**	**C**	**0.75**	**33.4**	**C**	**1.3**	**0.87**	**46.5**	**D**	**14.4**
Massachusetts Avenue at Brookline Street/Douglass Street	Mass Ave Eastbound	0.46	7.3	A	0.46	7.2	A	0.1	0.51	7.9	A	0.6
	Mass Ave Westbound	0.26	4.3	A	0.26	4.3	A	0.0	0.33	5.9	A	1.6
	Brookline Street Northbound	0.64	32.5	C	0.65	32.7	C	0.5	0.66	33.2	C	0.7
	OVERALL	**0.52**	**14.4**	**B**	**0.52**	**14.6**	**B**	**0.2**	**0.56**	**14.6**	**B**	**0.2**
Bishop Allen Drive at Prospect Street	Bishop Allen Drive Westbound	0.99	77.1	E	0.30	82.5	F	5.4	1.04	90.5	F	13.4
	Prospect Street Northbound	0.75	16.8	B	0.76	17.5	B	0.7	0.78	18.2	B	1.4
	Prospect Street Southbound	0.48	13.3	B	0.48	13.3	B	0.0	0.49	13.5	B	0.2
	OVERALL	**0.83**	**29.2**	**C**	**0.85**	**30.8**	**C**	**1.6**	**0.87**	**33.0**	**C**	**3.8**
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	Mass Ave Eastbound	0.76	40.8	D	0.78	42.3	D	1.5	0.84	47.7	D	6.9
	Mass Ave Westbound	0.94	53.9	D	0.94	53.8	D	-0.1	1.02	81.9	F	28.0
	River Street Northbound	0.69	14.9	B	0.70	15.1	B	0.2	0.72	15.4	B	0.5
	Prospect Street Southbound	0.75	26.9	C	0.75	26.8	C	-0.1	0.77	27.5	C	0.6
	OVERALL	**0.82**	**30.0**	**C**	**0.82**	**30.3**	**C**	**0.3**	**0.86**	**39.3**	**D**	**9.3**
Green Street at Western Avenue/River Street	Green Street Westbound	0.65	32.4	C	0.65	32.4	C	0.0	0.69	33.7	C	1.3
	River Street Northbound	0.56	15.9	B	0.56	15.8	B	-0.1	0.58	16.1	B	0.2
	Western Avenue Southbound	0.73	13.7	B	0.73	13.7	B	0.0	0.75	14.1	B	0.4
	OVERALL	**0.67**	**19.1**	**B**	**0.67**	**19.1**	**B**	**0.0**	**0.70**	**19.7**	**B**	**0.6**
Massachusetts Avenue at Essex Street	Mass Ave Eastbound	0.40	8.2	A	0.40	8.2	A	0.0	0.43	8.9	A	0.7
	Mass Ave Westbound	0.50	12.1	B	0.51	12.5	B	0.4	0.65	17.5	B	5.4
	OVERALL	**0.34**	**10.0**	**A**	**0.35**	**10.1**	**B**	**0.1**	**0.43**	**13.2**	**B**	**3.2**

TABLE 6.A.3 UNSIGNALIZED INTERSECTION LOS – MORNING PEAK HOUR

Intersection	Approach	2016 Existing Condition			2016 Build Condition			Difference in Delay Existing to Build	2021 Future Condition			Difference in Delay Existing to Future
		V/C Ratio	Delay	VLOS	V/C Ratio	Delay	VLOS		V/C Ratio	Delay	VLOS	
Bishop Allen Drive at Douglass Street	Douglass Street Northbound	0.20	11.7	B	0.20	11.8	B	0.1	0.21	11.9	B	0.2
Bishop Allen Drive at Columbia Street[1]	Bishop Allen Drive Eastbound	-	12.5	B	-	13.4	B	0.9	-	14.4	B	1.9
	Bishop Allen Drive Westbound	-	9.3	A	-	9.5	A	0.2	-	9.8	A	0.5
	Columbia Street Northbound	-	9.3	A	-	9.5	A	0.2	-	9.8	A	0.5
	Columbia Street Southbound	-	12.7	B	-	13.2	B	0.5	-	15.0	C	2.3
Bishop Allen Drive at Norfolk Street[1]	Bishop Allen Drive Eastbound	-	9.8	A	-	9.9	A	0.1	-	10.1	B	0.3
	Bishop Allen Drive Westbound	-	9.2	A	-	9.4	A	0.2	-	9.5	A	0.3
	Norfolk Street Southbound	-	10.4	B	-	10.6	B	0.2	-	10.8	B	0.4

TABLE 6.A.4 UNSIGNALIZED INTERSECTION LOS – EVENING PEAK HOUR

Intersection	Approach	2016 Existing Condition			2016 Build Condition			Difference in Delay Existing to Build	2021 Future Condition			Difference in Delay Existing to Future
		V/C Ratio	Delay	VLOS	V/C Ratio	Delay	VLOS		V/C Ratio	Delay	VLOS	
Bishop Allen Drive at Douglass Street	Douglass Street Northbound	0.53	19.5	C	0.56	21.3	C	1.8	0.58	22.2	C	2.7
Bishop Allen Drive at Columbia Street[1]	Bishop Allen Drive Eastbound	-	16.5	C	-	18.6	C	2.1	-	21.4	C	4.9
	Bishop Allen Drive Westbound	-	13.9	B	-	15.1	C	1.2	-	16.7	C	2.8
	Columbia Street Northbound	-	11.2	B	-	11.9	B	0.7	-	13.0	B	1.8
	Columbia Street Southbound	-	12.4	B	-	13.0	B	0.6	-	14.1	B	1.7
Bishop Allen Drive at Norfolk Street[1]	Bishop Allen Drive Eastbound	-	10.0	A	-	10.4	B	0.4	-	10.6	B	0.6
	Bishop Allen Drive Westbound	-	12.5	B	-	13.1	B	0.6	-	13.5	B	1.0
	Norfolk Street Southbound	-	10.7	B	-	10.9	B	0.2	-	11.1	B	0.4

V/C Ratio – Volume to Capacity Ratio
Delay – Average delay expressed in seconds per vehicle
VLOS – Vehicular level of service
[1] Synchro is unable to analyze V/C Ratio for all-way stop-controlled intersections

All intersections remain operating at the same level-of-service from 2016 Existing to 2016 Build except for Columbia Street at Main Street/Sidney Street and Main Street at Prospect and River Street/Western Avenue during the morning peak hour. Both intersections decrease from a level of service C to D, but the delay increase is only 1.3 seconds for the Columbia/Main Street intersection and 2.2 seconds at the Main/Prospect intersection. At these two intersections, the decrease in LOS is only due to slight increases in vehicle delay and the Project does not have a significant impact on these intersections.

The analysis indicates that the intersection at Massachusetts Avenue/Douglass Street/Brookline Street operates at LOS B under existing conditions for both peak hours. Through observations of the intersection, delays may be greater than the Synchro analysis indicates due to limitations of the software. Currently the northern crosswalk on Douglass Street is an unsignalized crosswalk. Vehicles receiving exclusive phases conflict this pedestrian crossing and vehicular flow is interrupted constantly by pedestrians in this crosswalk. The Brookline Street through movement onto Douglass Street is particularly affect. During the peak times, it was observed that only a few vehicles were able to pass through the intersection because of this conflict. Synchro cannot code a signalized intersection with this particular conflict and therefore the model controls the pedestrian crossing during conflicting vehicle movements.

7 Queue Analysis

Queue analysis was performed in conjunction with the LOS analysis. Table 7.a.1 and 7.a.2 present the results for the observed and modeled average queues for each scenario for the morning and evening peak hour, respectively, for signalized intersections. Table 7.a.3 and 7.a.4 provided queue analysis for unsignalized intersections at the stop-controlled approaches for morning and evening peak hour, respectively.

TABLE 7.A.1 SIGNALIZED INTERSECTION QUEUE ANALYSIS – MORNING PEAK HOUR

		Average Queue in Vehicles			
Intersection	**Lane**	**2016 Existing Observed**	**2016 Existing Modeled**	**2016 Build**	**2021 Future**
Columbia Street at Main Street/Sidney Street	Eastbound – Thru	1	0	0	1
	Eastbound – Right	6	6	6	6
	Westbound – Thru/Right	4	3	3	4
	Northbound – Left/Right	1	1	1	1
Massachusetts Avenue at Sidney Street	Eastbound – Left	3	2	2	5
	Eastbound – Thru/Right	6	8	8	10
	Westbound – Left	1	2	2	2
	Westbound – Thru/Right	5	6	6	7
	Northbound – Right	2	2	2	2
	Southbound – Left/Thru	1	3	3	4
	Southbound – Right	0	0	0	0
Massachusetts Avenue at Brookline Street/Douglass Street	Eastbound – Left/Thru	7	2	2	2
	Westbound – Thru/Right	3	3	3	4
	Northbound – Left	3	2	2	2
	Northbound – Thru/Right	3	3	3	3
Bishop Allen Drive at Prospect Street	Westbound – Left/Thru/Right	3	5	5	5
	Northbound – Left	0	0	0	0
	Northbound – Thru/Right	2	7	7	7
	Southbound – Left	1	0	0	0
	Southbound – Thru/Right	6	5	5	5
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	Eastbound – Thru	7	7	7	9
	Eastbound – Right	0	0	0	0
	Westbound – Thru	2	3	4	4
	Westbound – Right	1	1	1	1
	Northbound – Thru	4	6	6	6
	Northbound – Right	1	2	2	2
	Southbound – Thru/Right	6	11	11	12
Green Street at Western Avenue/River Street	Westbound – Left/Thru	2	3	3	3
	Westbound – Right	1	2	2	2
	Northbound – Left	2	1	1	2
	Northbound – Thru	3	5	5	6
	Southbound – Thru	2	13	13	13
Massachusetts Avenue at Essex Street	Eastbound – Left	1	1	1	1
	Eastbound – Thru	4	5	5	9
	Westbound – Thru/Right	4	3	3	3

Queue lengths are shown in number of vehicles. Synchro provides queue length in feet, which is converted to vehicles using a vehicle length of 25 feet.

Queue lengths were observed during the TMC count date, May 18, 2016

TABLE 7.A.2 SIGNALIZED INTERSECTION QUEUE ANALYSIS – EVENING PEAK HOUR

		Average Queue in Vehicles			
Intersection	**Lane**	**2016 Existing Observed**	**2016 Existing Modeled**	**2016 Build**	**2021 Future**
Columbia Street at Main Street/Sidney Street	Eastbound – Thru	0	0	0	0
	Eastbound – Right	5	4	4	4
	Westbound – Thru/Right	4	5	5	~ 15
	Northbound – Left/Right	1	2	2	2
Massachusetts Avenue at Sidney Street	Eastbound – Left	3	3	3	4
	Eastbound – Thru/Right	3	5	5	5
	Westbound – Left	2	2	2	2
	Westbound – Thru/Right	9	9	9	11
	Northbound – Right	3	2	2	2
	Southbound – Left/Thru	3	4	4	~ 10
	Southbound – Right	2	0	0	1
Massachusetts Avenue at Brookline Street/Douglass Street	Eastbound – Left/Thru	6	4	4	4
	Westbound – Thru/Right	5	1	1	2
	Northbound – Left	2	2	2	2
	Northbound – Thru/Right	10	6	6	6
Bishop Allen Drive at Prospect Street	Westbound – Left/Thru/Right	14	8	~ 8	~ 9
	Northbound – Left	0	0	0	0
	Northbound – Thru/Right	8	6	6	7
	Southbound – Left	1	1	1	1
	Southbound – Thru/Right	7	6	6	6
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	Eastbound – Thru	14	7	7	8
	Eastbound – Right	0	0	0	0
	Westbound – Thru	6	7	8	~ 11
	Westbound – Right	1	2	2	2
	Northbound – Thru	12	4	4	4
	Northbound – Right	3	1	1	1
	Southbound – Thru/Right	6	12	12	13
Green Street at Western Avenue/River Street	Westbound – Left/Thru	7	6	6	7
	Westbound – Right	2	2	2	2
	Northbound – Left	4	3	3	3
	Northbound – Thru	4	4	4	4
	Southbound – Thru	4	11	11	11
Massachusetts Avenue at Essex Street	Eastbound – Left	1	1	1	1
	Eastbound – Thru	3	3	3	3
	Westbound – Thru/Right	7	3	4	6

Queue lengths are shown in number of vehicles. Synchro provides queue length in feet, which is converted to vehicles using a vehicle length of 25 feet.

Queue lengths were observed during the TMC count date, May 18, 2016

~ Volume exceeds capacity, queue is theoretically infinite

TABLE 7.A.3 UNSIGNALIZED INTERSECTION QUEUE ANALYSIS – MORNING PEAK HOUR

		Average Vehicle Queues			
Intersection	**Approach**	**2016 Existing Observed**	**2016 Existing Modeled**	**2016 Build**	**2021 Future**
Bishop Allen Drive at Douglass Street	Northbound – Left/Thru/Right	1	1	1	1
Bishop Allen Drive at Columbia Street[1]	Eastbound – Left/Thru/Right	2	-	-	-
	Westbound – Left/Thru/Right	1	-	-	-
	Northbound – Left/Thru/Right	0	-	-	-
	Southbound – Left/Thru/Right	3	-	-	-
Bishop Allen Drive at Norfolk Street[1]	Eastbound – Thru/Right	1	-	-	-
	Westbound – Left/Thru	1	-	-	-
	Southbound – Left/Thru/Right	1	-	-	-

Queue lengths are shown in number of vehicles. Synchro provides queue length in feet, which is converted to vehicles using a vehicle length of 25 feet.
Queue lengths were observed during the TMC count date, May 18, 2016
[1] Synchro does not calculate queues for all-way stop-controlled intersections

TABLE 7.A.4 UNSIGNALIZED INTERSECTION QUEUE ANALYSIS – EVENING PEAK HOUR

		Average Vehicle Queues			
Intersection	**Approach**	**2016 Existing Observed**	**2016 Existing Modeled**	**2016 Build**	**2021 Future**
Bishop Allen Drive at Douglass Street	Northbound – Left/Thru/Right	3	3	3	4
Bishop Allen Drive at Columbia Street[1]	Eastbound – Left/Thru/Right	2	-	-	-
	Westbound – Left/Thru/Right	1	-	-	-
	Northbound – Left/Thru/Right	1	-	-	-
	Southbound – Left/Thru/Right	2	-	-	-
Bishop Allen Drive at Norfolk Street[1]	Eastbound – Thru/Right	1	-	-	-
	Westbound – Left/Thru	1	-	-	-
	Southbound – Left/Thru/Right	1	-	-	-

Queue lengths are shown in number of vehicles. Synchro provides queue length in feet, which is converted to vehicles using a vehicle length of 25 feet.
Queue lengths were observed during the TMC count date, May 18, 2016
[1] Synchro does not calculate queues for all-way stop-controlled intersections

The queue analysis results presented in the above tables correlate to the LOS analyses conducted of the study area intersections. The observed queue lengths were generally the same as the 2016 Existing Model Synchro results. Discrepancies occurred at approaches with nearby minor intersections that may cause an interrupt in flow or vehicle grouping, and Synchro is limited in its abilities to recreate actual vehicle arrival time at an approach. With the addition of Project trips in the 2016 Build Condition, there were minimal differences, if any, from the 2016 Existing Condition in both the morning and evening peak hours. Queues increase at various intersections in the 2021 Future Condition due to background traffic growth and area projects that generate additional vehicle trips.

8 Residential Street Volume Analysis

Roadway segments within the study area with residential street frontage were evaluated to understand Project impacts. The peak hour volumes (both directions) traveling the analyzed roadway segments are presented in Tables 8.a.1 and 8.a.2. For analyzed segments that are between study area intersections, the average volumes at these intersections were taken as the volume traveling along the segment. The analysis shows the percent increase in traffic along the residential roadway segments between Existing and Build volumes and Build and Future volumes.

Of all of the roadway segments in the study area, a total of four of the fourteen segments identified are streets which have more than 1/3 of residential frontage, as determined by the existing first floor use. These segments are evaluated in the Planning Board Criteria for increased volume on residential streets.

TABLE 8.A.1 TRAFFIC ON STUDY AREA ROADWAYS – MORNING PEAK HOUR

Roadway	Segment	Amount of Residential	Existing[1]	Build	Increase	Percent Increase	Future[2]	Increase	Percent Increase
Bishop Allen Drive	Prospect St to Essex St	1/3 or less	340	348	8	2.4%	357	17	5.0%
	Essex St to Norfolk St	1/3 or less	355	367	12	3.4%	377	22	6.2%
	Norfolk St to Douglass St	1/2 or more	300	323	23	7.7%	331	31	10.3%
	Douglass St to Columbia St	1/3 or less	365	396	31	8.5%	409	44	12.1%
	Columbia St to Main St	>1/3 but <1/2	230	238	8	3.5%	243	13	5.7%
Columbia Street	Bishop Allen Dr to Main St	1/3 or less	325	343	18	5.5%	387	62	19.1%
	Bishop Allen Dr to Washington St	1/2 or more	430	435	5	1.2%	481	51	11.9%
Sidney Street	Main St to Massachusetts Ave	1/3 or less	530	548	18	3.4%	709	179	33.8%
	Massachusetts Ave to Green St	1/3 or less	425	432	7	1.6%	471	46	10.8%
Massachusetts Avenue	Prospect St to Essex St	1/3 or less	785	796	11	1.4%	970	185	23.6%
	Essex St to Norfolk St	1/3 or less	765	772	7	0.9%	946	181	23.7%
	Norfolk St to Douglass St	1/3 or less	750	750	0	0%	846	96	12.8%
	Douglass St to Sidney St	1/3 or less	730	730	0	0%	903	173	23.7%
Douglass Street	Massachusetts Ave to Bishop Allen Dr	1/2 or more	115	116	1	0.9%	119	4	3.5%

[1] Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added

[2] Future accounts for area background project volumes, Project generated volumes, and a background growth rate of 0.5%

TABLE 8.A.2 TRAFFIC ON STUDY AREA ROADWAYS – EVENING PEAK HOUR

Roadway	Segment	Amount of Residential	Existing[1]	Build	Increase	Percent Increase	Future[2]	Increase	Percent Increase
Bishop Allen Drive	Prospect St to Essex St	1/3 or less	460	473	13	2.8%	485	25	5.4%
	Essex St to Norfolk St	1/3 or less	515	539	24	4.7%	552	37	7.2%
	Norfolk St to Douglass St	1/2 or more	470	507	37	7.9%	518	48	10.2%
	Douglass St to Columbia St	1/3 or less	585	630	45	7.7%	645	60	10.3%
	Columbia St to Main St	>1/3 but <1/2	380	392	12	3.2%	403	23	6.1%
Columbia Street	Bishop Allen Dr to Main St	1/3 or less	320	344	24	7.5%	384	64	20.0%
	Bishop Allen Dr to Washington St	1/2 or more	535	544	9	2.5%	590	55	10.3%
Sidney Street	Main St to Massachusetts Ave	1/3 or less	565	589	24	4.2%	774	209	37.0%
	Massachusetts Ave to Green St	1/3 or less	405	410	5	1.2%	473	68	16.8%
Massachusetts Avenue	Prospect St to Essex St	1/3 or less	825	841	16	1.9%	995	170	20.6%
	Essex St to Norfolk St	1/3 or less	760	765	5	0.7%	916	156	20.5%
	Norfolk St to Douglass St	1/3 or less	825	825	0	0%	979	154	18.7%
	Douglass St to Sidney St	1/3 or less	790	790	0	0%	940	150	19.0%
Douglass Street	Massachusetts Ave to Bishop Allen Dr	1/2 or more	230	234	4	1.7%	240	10	4.3%

[1] Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added
[2] Future accounts for area background project volumes, Project generated volumes, and a background growth rate of 0.5%

9 Parking Analysis

9.a Vehicle Parking

The parking requirements for the Project, as described in re-zoning *Ordinance Number 1368* dated April 30, 2015 and provided in the Appendix, state that the minimum required parking for the residential component is 0.5 parking spaces per residential units with a maximum parking ratio of 0.75 spaces per residential unit. In addition the "…Project shall provide, at a minimum, one (1) parking space for every 100 residential units that shall be dedicated for use by a carsharing organization…Each Carsharing Space within a Residential Mixed Income Project shall allow the required number of residential parking spaces to be reduced by five (5) spaces…" In addition, the ordinance states that "No separate off-street parking shall be required for ground-floor retail uses…"

The Project will provide 95 residential parking spaces in the B-1 underground garage and 51 residential parking spaces in the 65 Bishop Allen Drive surface parking lot for a total of 146 parking spaces. The Project is required to provide a minimum of 2 carshare spaces. Under re-soning each carshare space equates to providing 5 required parking spaces. Therefore, 154 "parking spaces" are being provided for the 295 units which equates to a .522 parking ratio.

The owner will work with the carsharing service to understand the demand for carsharing services within the area and provide at least 2 spaces with the initial opening of the building, and increase to a total of 5 carsharing spaces if demand exists.

Of the total 146 parking spaces provided, initially 144 will be leased to residential tenants and two will be used by carshare vehicles. In the future, up to five parking spaces may be used by carsharing vehicles and the remaining 141 spaces leased to residential tenants.

The Project estimated parking demand to be slightly lower than the provided parking supply. This is due to the information collected from American Commuter Survey 5-year estimates, in which car ownership within the area of the Project site is 49 percent and in particular, people who take public transportation as their main mode of transport, only 30 percent of these people own cars. It is expected, that due to the location of the site, the majority of residents will use public transportation as their main mode of transportation. The residents will also have the convenience of having carsharing options within the Project sites.

The proposed parking spaces will be managed through a key-card access gate system at the garage entrance and at the 65 Bishop Allen Drive surface lot. A transportation coordinator will be available to residents for parking and transportation information. To discourage car-ownership, residents will be required to pay market price for a Project parking space, this amount will be determined upon the opening and occupancy of the building. Visitors to the residential units will be able to park at the 65 Bishop Allen Drive lot with the use of a visitor pass, while retail patrons will use the various short-term parking options available along Massachusetts Avenue or within the City's Parking Lot 6.

9.b Bicycle Parking

The Project will provide bicycle parking in accordance with the City of Cambridge's Bicycle Parking Zoning Ordinance, as shown in Table 9.b.1.

TABLE 9.B.1 BICYCLE PARKING

	Long-Term			Short-Term		
Land Use	**Code**	**Rate**	**Spaces**	**Code**	**Rate**	**Spaces**
Residential	R2	1.05 spaces per dwelling[1]	308	R2	0.10 spaces per dwelling	30
Retail	N4	0.10 spaces per 1,000 sf[2]	2	N2	0.60 spaces per 1,000 sf	11
Total			**310**			**41**

Source: City of Cambridge Zoning Ordinance Article 6.0

1 per city guide – 1.00 spaces per unit for the first 20 units for a residential building

2 per city guide – up to 4 retail long-term spaces may be provided as short-term

B-1 will provide 230 long-term bicycle parking spaces in one large bike room with a mezzanine level accessed from an elevator.. B-2 will provide one 48 space, two-level bike room. The 47 Bishop Allen Drive residential building will provide its residents with their own long-term bicycle storage of approximately 32 spaces, for a total of 310 bicycle spaces for the whole Project. Forty-one short-term spaces are provided around the development to support the retail and residential patrons accessing the site. Figures 9.b.1 through 9.b.3 illustrate the long-term bicycle parking location and layout and Figure 9.b.4 highlights the short-term bicycle parking around and within the Project site, in accordance with City's Bicycle Parking Guidelines.

10 Transit Analysis

As requested by the City of Cambridge and in accordance with TIS Guidelines, a transit analysis has been conducted to support this Project. The analysis took an in-depth look at existing Red Line operations and assessed the impacts of project-generated transit trips to the Red Line, as requested in the Scoping Determination.

The following sections summarize existing transit service availability in the study area and provide an assessment of transit utilization and capacity for transit lines that are expected to be used by the proposed Project, specifically the Red Line accessed at Central Square Station, MBTA Bus Lines 1, 47, 64, 68, 70, 83, 91 and CT1.

This analysis follows methodology outlined in the Red Line analysis conducted in July 2015 as part of the MIT Kendall Square TIS, as instructed in the City's Scoping Letter, and includes the following 5 steps:

1. Quantify the existing transit system capacity
2. Quantify the existing transit system ridership
3. Report on existing transit system utilization
4. Develop and assign project-generated transit trips to the existing transit system
5. Report on project impacts to the transit system utilization

The V/C ratio (Volume to Capacity) is the resulting metric that, for the purposes of this study, is used to reflect the level of utilization for each transit service line. The V/C ratios (or utilization rates) are presented for both the Existing Condition (year 2016) and Build Condition (Existing + Project trips).

10.a Existing Transit System Capacity – STEP 1

The capacity of a transit line depends the number of trains (or buses) operating during a specified time period (frequency), the number of people that can be accommodated on a vehicle (a train car or bus), and the number of individual cars in each train.

The study period for this analysis includes the morning and evening transit peak hours, defined as 8:00 AM to 9:00 AM and 5:00 PM to 6:00 PM respectively.

Train and bus frequencies were compiled from latest published MBTA schedules[1] and MBTA Bus Ridecheck data from Fall 2015, and reported in Table 10.a.1.

For the purposes of this study the vehicle load standards (i.e. number of people safely and comfortably riding on a train car or bus) are based on MBTA's Service Delivery Policy[2] and

[1] MBTA schedules, January 2016
[2] MBTA Service Delivery Policy, approved by the Board of Directors in June 2010

MBTA Blue Book 14th edition data (Red Line policy capacity of 167 passengers per car, with a standard operation of 6-car trains; MBTA Bus policy capacity of 54 passengers per vehicle).

Similar to the MIT Kendall Square (MIT KS) transit analysis, the average Red Line on-time performance was adjusted based on the 2015 MBTA Scorecard (included on page 33 of the 2015 MBTA Annual Report, published in December 2015). The reported annual average on-time performance of the Red Line was at 84.8% for year 2015 (a reduction in performance from 86% reported in 2014), based on the passenger wait time metric. This number captures the percentage of passengers who wait on the platform no longer than the scheduled time between trains. For the purposes of this study, the on-time performance adjustment of 84.8% reduced the number of available trains during peak hour to account for schedule irregularities and resulting wait times experienced by the passengers. The MBTA Bus service capacity was not adjusted for on-time performance.

Table 10.a.1 below shows resulting system capacities for the Red Line and Bus Lines based on MBTA provided data.

TABLE 10.A.1 - SYSTEM PEAK HOUR CAPACITY (PER MBTA DATA)

Mode	Frequency[a]	OTP Factor[b]	# Passengers / Vehicle[c]	# Cars / Train	Resulting Capacity[d] (# Passengers / Peak Hour)
Red Line					
Inbound	13	0.848	167	6	11,046
Outbound	13	0.848	167	6	11,046
MBTA Bus					
Bus 1 Inbound	7.5	n/a	54	n/a	405
Bus 1 Outbound	7	n/a	54	n/a	378
Bus 47 Inbound	4.5	n/a	54	n/a	243
Bus 47 Outbound	3.5	n/a	54	n/a	189
Bus 64 Inbound	2.5	n/a	54	n/a	135
Bus 64 Outbound	3	n/a	54	n/a	162
Bus 68 Inbound	2	n/a	54	n/a	108
Bus 68 Outbound	2	n/a	54	n/a	108
Bus 70 Inbound	3.5	n/a	54	n/a	189
Bus 70 Outbound	3.5	n/a	54	n/a	189
Bus 83 Inbound	3	n/a	54	n/a	162
Bus 83 Outbound	3	n/a	54	n/a	162
Bus 91 Inbound	2	n/a	54	n/a	108
Bus 91 Outbound	2.5	n/a	54	n/a	135
Bus CT1 Inbound	3	n/a	54	n/a	162
Bus CT1 Outbound	3	n/a	54	n/a	162

Notes:

(a) Number of vehicles per hour, per MBTA published schedules (Red Line) and MBTA Ridecheck Fall 2015 (Buses); average number of buses assumed where not same during AM and PM period

(b) On Time Performance Factor from 2015 MBTA Annual Report
(c) Number of policy level capacity per MBTA Blue Book 14th Edition (Red Line and Buses) and EZ Ride Feasibility Study (March 2015)
(d) Calculated Capacity = #of Trains x OTP factor x # pax per vehicles x # cars – shown as number of passengers per peak hour

In addition to adjusting the MBTA Red Line capacity for on-time performance (OTP), this study also reviewed the MIT KS TIS Red Line Field Data from May 2015, which shows actual observed capacity numbers. A comparison of OTP adjusted capacity from Table 10.a.1 above and field observed capacity at MIT/Kendall Square Station, per MIT KS TIS document, is presented in Table 10.a.2 below.

All further utilization analyses will report results based on both the MBTA capacity and the MIT KS TIS field observed capacity.

TABLE 10.A.2 RED LINE PEAK HOUR CAPACITY (COMPARISON OF MBTA DATA AND FIELD DATA)

Mode	Frequency (# of vehicles / Peak Hour) [a]	Peak Hour Capacity (# Passengers / Peak Hour) [b]
Red Line (MBTA)		
Inbound AM&PM	13	11,046
Outbound AM&PM	13	11,046
Red Line (Field Observations)		
Inbound AM	14	14,028
Outbound AM	14	14,028
Inbound PM	12	12,024
Outbound PM	10	10,020

Notes:
(a) MBTA frequency from schedule assuming 9 min headway for two lines = 4.5min headway at Kendall (60/4.5=13 trains) – number of vehicles
(b) Field observed frequency at Kendall Station in May 2015 for MIT KS TIS

10.b Existing Transit System Ridership – STEP 2

The MBTA Ridership data from Fall 2015 was used to obtain peak hour passenger loads for bus routes that are expected to be utilized by the future Project employees and residents.

Red line ridership for this analysis was based on field observations, collected as part of the MIT KS TIS study in May 2015 as well as MBTA ridership data from October 2015.

The resulting adjusted ridership numbers, as used for analyzing the utilization of services, are presented in Table 10.b.1, below.

TABLE 10.B.1 ADJUSTED RIDERSHIP LEVELS (YEAR 2016)

	AM Peak Hour				PM Peak Hour			
Mode	Pax Load Entering Station	# Pax Boarding	# Pax Alighting	Pax Load Exiting Station	Pax Load Entering Station	# Pax Boarding	# Pax Alighting	Pax Load Exiting Station
Red Line (MBTA)								
Inbound	17,942	3,939	1,648	20,233	7,169	2,035	774	8,430
Outbound	6,704	587	1,757	5,534	18,320	1,506	3,749	16,077
Red Line (Field Observations)								
Inbound	11,752	3,939	1,648	14,043	7,072	2,035	774	8,333
Outbound	8,185	587	1,757	7,015	13,461	1,506	3,749	11,218
MBTA Bus (c)								
Bus 1 Inbound	287	22	8	301	222	36	10	248
Bus 1 Outbound	228	8	33	203	265	14	26	253
Bus 47 Inbound	0	192	0	192	0	44	0	44
Bus 47 Outbound	31	0	7	24	180	1	11	170
Bus 64 Inbound	127	55	83	99	44	1	31	14
Bus 64 Outbound	7	12	1	18	103	40	3	140
Bus 68 Inbound	25	2	1	26	8	0	1	7
Bus 68 Outbound	8	3	1	10	19	0	0	19
Bus 70 Inbound	23	0	13	10	14	0	2	12
Bus 70 Outbound	0	7	0	7	0	32	0	32
Bus 83 Inbound	18	0	18	0	27	0	27	0
Bus 83 Outbound	0	21	0	21	0	31	0	31
Bus 91 Inbound	13	0	13	0	16	0	16	0
Bus 91 Outbound	0	20	0	20	0	37	0	37
Bus CT1 Inbound	79	10	2	87	26	22	0	48
Bus CT1 Outbound	50	0	21	29	34	1	12	23

Notes:
(a) MBTA October 2015 Red Line ridership data
(b) MIT KS TIS red line field observations and estimates May 12&13, 2015 & pedestrian counts from MBTA October 2015 data
(c) MBTA 2015 bus ridership data was used

10.c Existing Transit System Utilization – STEP 3

By combining system capacity developed in Step 1 and system ridership from Step 2, we obtain system utilization rates.

Table 10.c.1 presents existing utilization levels in terms of V/C (Volume to capacity) ratios using MBTA data and Table 10.c.2 presents resulting utilization when calculated from MIT KS TIS Field Data.

TABLE 10.C.1 EXISTING TRANSIT SERVICE UTILIZATION (PER MBTA DATA)

Route and Direction	(a) Capacity Policy	(b) AM Peak Hour Ridership	(b) PM Peak Hour Ridership	(c) AM Peak Hour V/C	(c) PM Peak Hour V/C
Red Line					
Inbound Entering Central	11,046	17,942	7,169	1.62	0.65
Inbound Exiting Central	11,046	20,233	8,430	1.83	0.76
Outbound Entering Central	11,046	6,704	18,320	0.61	1.66
Outbound Exiting Central	11,046	5,534	16,077	0.50	1.46
Bus Routes					
1 Inbound Entering	405	287	222	0.71	0.55
1 Inbound Exiting	405	301	248	0.74	0.61
1 Outbound Entering	378	228	265	0.60	0.70
1 Outbound Exiting	378	203	253	0.54	0.67
47 Inbound Entering	243	0	0	0.00	0.00
47 Inbound Exiting	243	192	44	0.79	0.18
47 Outbound Entering	189	31	180	0.16	0.95
47 Outbound Exiting	189	24	170	0.13	0.90
64 Inbound Entering	135	127	44	0.94	0.33
64 Inbound Exiting	135	99	14	0.73	0.10
64 Outbound Entering	162	7	103	0.04	0.64
64 Outbound Exiting	162	18	140	0.11	0.86
68 Inbound Entering	108	25	8	0.23	0.07
68 Inbound Exiting	108	26	7	0.24	0.06
68 Outbound Entering	108	8	19	0.07	0.18
68 Outbound Exiting	108	10	19	0.09	0.18
70 Inbound Entering	189	23	14	0.12	0.07
70 Inbound Exiting	189	10	12	0.05	0.06
70 Outbound Entering	189	0	0	0.00	0.00
70 Outbound Exiting	189	7	32	0.04	0.17
83 Inbound Entering	162	18	27	0.11	0.17
83 Inbound Exiting	162	0	0	0.00	0.00
83 Outbound Entering	162	0	0	0.00	0.00
83 Outbound Exiting	162	21	31	0.13	0.19
91 Inbound Entering	108	13	16	0.12	0.15
91 Inbound Exiting	108	0	0	0.00	0.00
91 Outbound Entering	135	0	0	0.00	0.00
91 Outbound Exiting	135	20	37	0.15	0.27
CT1 Inbound Entering	162	79	26	0.49	0.16
CT1 Inbound Exiting	162	87	48	0.54	0.30
CT1 Outbound Entering	162	50	34	0.31	0.21
CT1 Outbound Exiting	162	29	23	0.18	0.14

Notes:
(a) Capacity from step 1, Table 10.a.1
(b) Peak hour ridership from step 2, Table 10.b.1
(c) Calculated V/C = ridership / capacity

As presented in Table 10.c.1, the existing Bus Routes are operating within MBTA policy capacity with V/C ratios below 1.0.

The existing Red Line utilization however, appears to be operating above system capacity in the morning inbound direction and evening outbound direction. A V/C ratio over 1.0 does not necessarily translate to passengers not able to board a train, instead the ratio indicates the number of passengers that are riding above MBTA's policy for a safe and comfortable ride.

A similar utilization analysis using MIT KS TIS observed field capacity data in combination with MBTA boardings and alightings at Central Square Station, results in the following V/C ratios.

TABLE 10.C.2 EXISTING TRANSIT SERVICE UTILIZATION (PER MIT FIELD CAPACITY & FIELD RIDERSHIP)

Route and Direction	AM Peak Hour Observed Capacity (a)	PM Peak Hour Observed Capacity (b)	AM Peak Hour Observed Ridership	PM Peak Hour Observed Ridership	AM Peak Hour V/C	PM Peak Hour V/C
Red Line						
Inbound Entering Central	14,028	12,024	11,752	7,072	0.84	0.59
Inbound Exiting Central	14,028	12,024	14,043	8,333	1.00	0.69
Outbound Entering Central	14,028	10,020	8,185	13,461	0.58	1.34
Outbound Exiting Central	14,028	10,020	13,461	11,218	0.50	1.12

Notes:
(a) VHB observed 14 trains serving the Inbound and Outbound platforms during the AM Peak Hour on May 12&13, 2015
(b) VHB observed 12 trains serving the Inbound platform and 10 trains serving the Outbound platform during the PM Peak Hour on May 12&13, 2015. Signal delays and disabled trains were observed on both platforms during the PM peak hour.

Most Red Line services indicate operational levels within MBTA Policy capacity, except for Outbound PM Peak Hour trains which come is slightly above MBTA policy capacity[3]. A V/C ratio of 1.34 for outbound trains entering the station translates to approximately 344 passengers per train (or 57 passengers per car) currently riding above MBTA Policy Capacity, during the PM Peak Hour. A V/C ratio of 1.12 for outbound trains leaving the station translates to approximately 120 passengers per train (or 20 passengers per car) currently riding above policy capacity, during the PM Peak Hour. As noted in the MIT KS TIS study, the field observation notes indicated service delays due to signal problems and disabled trains in the PM Peak Hour, which could have caused the overcapacity loads on the trains.

[3] Capacity benchmark used for all comparisons is MBTA's Service Delivery Policy (Red Line at 167 pass / car)

10.d Development of Transit Project Trips – STEP 4

As discussed previously in this study, the transit mode share for the Project is 31% for both Residential land uses and Retail land uses, therefore the Project is expected to generate 64 new transit trips (17 entering, 47 exiting) during the morning peak hour and 102 new transit trips (60 entering, 42 exiting) during the evening peak hour as shown in Table 10.d.1.

TABLE 10.D.1 PROJECT-GENERATED TRANSIT TRIPS

	AM Peak Hour			PM Peak Hour		
Use	**In**	**Out**	**Total**	**In**	**Out**	**Total**
Residential	11	43	54	42	23	65
Retail	6	4	10	18	19	37
Total	17	47	64	60	42	102

Project transit trip distribution, split between Red Line and Bus Lines, was established by compiling CTPP[4] data for the study area. The assignment to transit routes was done based on current ridership levels on each line near the Project Site, similar to the MIT KS TIS method. It is expected that new employees and residents in the area will follow similar trends. The studied data suggests that approximately 75 percent of retail employees who use transit will use the Red Line, and 25 percent will use buses to commute to work. The data also suggests that 60 percent of residents who use transit will ride the Red Line home and 40 percent will utilize the available bus services.

A detailed transit distribution by line, direction and peak hour is presented in Table 10.d.2.

TABLE 10.D.2 TRANSIT TRIP DISTRIBUTION

Route and Direction	AM Peak Hour		PM Peak Hour	
	% OUT	%IN	% OUT	%IN
Red Line				
Inbound	87.0%	48.4%	57.5%	17.1%
Outbound	13.0%	51.6%	42.5%	82.9%
	100%	100%	100%	100%
Bus Routes				
Bus 1 Inbound	6.3%	4.0%	13.9%	7.2%
Bus 1 Outbound	2.3%	16.4%	5.4%	18.7%
Bus 47 Inbound	54.5%	0.0%	17.0%	0.0%
Bus 47 Outbound	0.0%	3.5%	0.4%	7.9%
Bus 64 Inbound	15.6%	41.3%	0.4%	22.3%
Bus 64 Outbound	3.4%	0.5%	15.4%	2.2%
Bus 68 Inbound	0.6%	0.5%	0.0%	0.7%
Bus 68 Outbound	0.9%	0.5%	0.0%	0.0%

[4] AASHTO Census Transportation Planning Products, 2006-2010

Route and Direction	AM Peak Hour		PM Peak Hour	
	% OUT	%IN	% OUT	%IN
Bus 70 Inbound	0.0%	6.5%	0.0%	1.4%
Bus 70 Outbound	2.0%	0.0%	12.4%	0.0%
Bus 83 Inbound	0.0%	9.0%	0.0%	19.4%
Bus 83 Outbound	6.0%	0.0%	12.0%	0.0%
Bus 91 Inbound	0.0%	6.5%	0.0%	11.5%
Bus 91 Outbound	5.7%	0.0%	14.3%	0.0%
Bus CT1 Inbound	2.8%	1.0%	8.5%	0.0%
Bus CT1 Outbound	0.0%	10.4%	0.4%	8.6%
	100%	100%	100%	100%

Source: MBTA existing station ridership levels

Transit distribution is then applied to the Project generated transit trips presented previously in Table 10.d.1 in order to determine the Project-generated transit trips by line or route, as presented in Tables 10.d.3 and 10.d.4 below.

TABLE 10.D.3 AM PEAK HOUR PROJECT-GENERATED TRIPS BY LINE

Route and Direction	Trips OUT (Boardings)	Trips IN (Alightings)	Trips Total
Red Line			
Inbound	25	5	30
Outbound	4	6	10
Bus Routes			
Bus 1 Inbound	1	0	1
Bus 1 Outbound	0	1	1
Bus 47 Inbound	10	0	10
Bus 47 Outbound	0	0	0
Bus 64 Inbound	3	2	5
Bus 64 Outbound	1	0	1
Bus 68 Inbound	0	0	0
Bus 68 Outbound	0	0	0
Bus 70 Inbound	0	0	0
Bus 70 Outbound	0	0	0
Bus 83 Inbound	0	1	1
Bus 83 Outbound	1	0	1
Bus 91 Inbound	0	0	0
Bus 91 Outbound	1	0	1
Bus CT1 Inbound	1	0	1
Bus CT1 Outbound	0	1	1
Total	18	6	24

TABLE 10.D.4 PM PEAK HOUR PROJECT-GENERATED TRIPS BY LINE

Route and Direction	Trips OUT (Boardings)	Trips IN (Alightings)	Trips Total
Red Line			
Inbound	16	7	23
Outbound	12	32	44
Bus Routes			
Bus 1 Inbound	2	2	3
Bus 1 Outbound	1	4	5
Bus 47 Inbound	2	0	2
Bus 47 Outbound	0	2	2
Bus 64 Inbound	0	5	5
Bus 64 Outbound	2	0	3
Bus 68 Inbound	0	0	0
Bus 68 Outbound	0	0	0
Bus 70 Inbound	0	0	0
Bus 70 Outbound	2	0	2
Bus 83 Inbound	0	4	4
Bus 83 Outbound	2	0	2
Bus 91 Inbound	0	2	2
Bus 91 Outbound	2	0	2
Bus CT1 Inbound	1	0	1
Bus CT1 Outbound	0	2	2
Total	14	21	35

10.e Build Transit System Utilization – STEP 5

The Project-generated transit trips by line or route from Step 4 above are added to the existing route volumes to develop the "Build Condition" utilization scenario, where Existing+Project trips are assumed to be on the transit lines. Resulting v/c ratios are presented in Table 10.e.1.

TABLE 10.E.1 BUILD CONDITION TRANSIT SERVICE UTILIZATION (PER MBTA DATA)

Route and Direction	Capacity Policy (from Step 1)	AM Peak Hour Ridership (Steps 2+3)	PM Peak Hour Ridership (Steps 2+3)	AM Peak Hour V/C (a)	PM Peak Hour V/C (a)
Red Line					
Inbound Entering Central	11,046	17,947	7,176	1.62	0.65
Inbound Exiting Central	11,046	20,258	8,446	1.83	0.76
Outbound Entering Central	11,046	6,710	18,352	0.61	1.66
Outbound Exiting Central	11,046	5,538	16,089	0.50	1.46
Bus Routes					
1 Inbound Entering	405	287	224	0.71	0.55
1 Inbound Exiting	405	302	250	0.75	0.62
1 Outbound Entering	378	229	269	0.61	0.71
1 Outbound Exiting	378	203	254	0.54	0.67
47 Inbound Entering	243	0	0	0.00	0.00
47 Inbound Exiting	243	202	46	0.83	0.19
47 Outbound Entering	189	31	182	0.16	0.96
47 Outbound Exiting	189	24	170	0.13	0.90
64 Inbound Entering	135	129	49	0.96	0.36
64 Inbound Exiting	135	102	14	0.76	0.10
64 Outbound Entering	162	7	103	0.04	0.64
64 Outbound Exiting	162	19	142	0.12	0.88
68 Inbound Entering	108	25	8	0.23	0.07
68 Inbound Exiting	108	26	7	0.24	0.06
68 Outbound Entering	108	8	19	0.07	0.18
68 Outbound Exiting	108	10	19	0.09	0.18
70 Inbound Entering	189	23	14	0.12	0.07
70 Inbound Exiting	189	10	12	0.05	0.06
70 Outbound Entering	189	0	0	0.00	0.00
70 Outbound Exiting	189	7	34	0.04	0.18
83 Inbound Entering	162	19	31	0.12	0.19
83 Inbound Exiting	162	0	0	0.00	0.00
83 Outbound Entering	162	0	0	0.00	0.00
83 Outbound Exiting	162	22	33	0.14	0.20
91 Inbound Entering	108	14	18	0.13	0.17
91 Inbound Exiting	108	0	0	0.00	0.00
91 Outbound Entering	135	0	0	0.00	0.00
91 Outbound Exiting	135	21	39	0.16	0.29
CT1 Inbound Entering	162	79	26	0.49	0.16
CT1 Inbound Exiting	162	88	49	0.54	0.30
CT1 Outbound Entering	162	51	36	0.31	0.22
CT1 Outbound Exiting	162	29	23	0.18	0.14

Notes:
(a) Calculated V/C = ridership / capacity

As presented in Table 10.e.1, all of the Bus Routes, are expected to operate within MBTA policy capacity (with V/C ratios below 1.0) in the Build Condition.

The table also indicates that the Red Line is expected to operate at similar levels in the Build Condition as under Existing Conditions. Most movements continue to show operating levels within MBTA policy capacity, except for Inbound trains in the morning and Outbound trains in the evening peak hour, which come is slightly above policy capacity[5].

A V/C ratio over 1.0 does not necessarily translate to passengers not able to board a train, instead the ratio indicates the number of passengers riding above MBTA's policy level of 167 passengers per car. Note that MBTA's crush capacity ranges between 260 and 277 passengers per car, depending on Red Line car model. This crush capacity definition (source MBTA Blue Book 14th edition) assumes a 1.5 square foot area per passenger.

A similar utilization analysis using the observed field data capacity levels from MIT KS TIS results in the following V/C ratios for the Build Condition.

TABLE 10.E.2 BUILD CONDITION TRANSIT SERVICE UTILIZATION (PER MIT FIELD CAPACITY & FIELD RIDERSHIP)

Route and Direction	AM Peak Hour Observed Capacity (a)	PM Peak Hour Observed Capacity (b)	AM Peak Hour Observed Ridership (Step 2+3)	PM Peak Hour Observed Ridership (Steps 2+3)	AM Peak Hour V/C	PM Peak Hour V/C
Red Line						
Inbound Entering Central	14,028	12,024	11,757	7,079	0.84	0.59
Inbound Exiting Central	14,028	12,024	14,068	8,349	1.00	0.69
Outbound Entering Central	14,028	10,020	8,191	13,493	0.58	1.34
Outbound Exiting Central	14,028	10,020	7,019	11,230	0.50	1.12

Notes:
(a) VHB observed 14 trains serving the Inbound and Outbound platforms during the AM Peak Hour on May 12&13, 2015
(b) VHB observed 12 trains serving the Inbound platform and 10 trains serving the Outbound platform during the PM Peak Hour on May 12&13, 2015. Signal delays and disabled trains were observed on both platforms during the PM peak hour.

Based on the MIT KS TIS Field Data, the Build Condition shows similar utilization rates as the Existing Condition.

[5] Capacity benchmark used for all comparisons is MBTA's Service Delivery Policy (Red Line at 167 pass / car), actual crush capacity is at 269 pass per car

10.f Staircase Analysis

As requested in the TIS Scoping Letter, the width and capacity of the stairways at the south end of the Central Square MBTA Red Line Station were evaluated. Two methods were used in the analysis— method 1 is based on passenger flows, as discussed in the Transit Capacity and Service Manual, 3rd Edition (Chapter 10 – Station Capacity, Page 10-48) and method 2 (v/c based) follows New York City Environmental Quality Review Manual, as referenced in the TIS Scoping Letter.

Method 1 determines the stairway level of service according to passenger flow (combined entering and exiting) during the peak 15 minutes and the effective stairway width. Method 2 separates the entering and exiting peak 15 minute pedestrian flows. A friction factor of 0.90 may be applied if there is flow in both directions of the stairway. A surging factor may also be used during the analysis if the passenger flow was concentrated in less time during the 15 minute interval. For this analysis, the friction factor was applied, but the surging factor was not applied due to consistent passenger flows.

Existing conditions were evaluated using current passenger inflow and outflow rates at the two south stairways. Passenger flow was developed from field counts from July 2016 (adjusted for season). The stairways are 3 feet wide from wall to wall for two-way travel up and down the staircase, therefore the effective stairway width per lane was determined to be 1.5 feet. The peak 15 minute flow of passengers for morning and evening was used for the volume calculations, as presented in table below.

TABLE 10.F.1 CENTRAL SQUARE STATION STAIRWAY EXISTING CONDITION

		National Method		New York Method	
Morning Peak Hour	**Peak 15 Min (Passengers)**	**Flow (passenger/ft/min)**	**LOS**	**V/C**	**LOS**
Inbound Stairway	267	11.87	D	1.22	D
Outbound Stairway	148	6.56	B	0.70	B
Evening Peak Hour					
Inbound Stairway	208	9.24	C	0.99	C
Outbound Stairway	296	13.17	E	1.41	E

Based on this limited staircase analysis, both methodologies indicate restricted passenger flow conditions on the inbound staircase during morning peak hour and on the outbound staircase during evening peak hour.

11 Pedestrian Analysis

Pedestrian crossing volumes at study area intersections are presented in Figures 2.c.3 and 2.c.4.

The results of pedestrian level-of-service (PLOS) analysis at intersection crosswalks are presented in Table 11.a.1 for signalized intersections and Table 11.a.2 for unsignalized intersections.

Pedestrian level-of-service at signalized intersections is dictated by the portion of the signal cycle dedicated to the pedestrian crossings. Accordingly, increasing pedestrian volumes does not alter pedestrian level of service at signalized intersections, and no changes in PLOS are projected under build or future conditions. It is assumed that the walk time and cycle length at this intersection will not change from existing conditions and therefore PLOS will remain consistent.

For unsignalized intersections, the PLOS is calculated using the crosswalk length and the conflicting vehicle flow rates for AM and PM peak hours.

The only intersection that shows a slight change in PLOS with the addition of Project trips is Bishop Allen Drive at Norfolk Street. The intersection's east crosswalk changes from PLOS B to PLOS C during the morning peak hour and from PLOS C to PLOS D during the evening peak hour. This change occurs due to the additional vehicles (21 during the morning peak hour and 33 during the evening peak hour) that will conflict with pedestrian movement as the vehicles pass through the crosswalk. The impact is minimal, with an additional one second added during the morning peak and two seconds during the evening peak hour which barely tips the LOS threshold at this crosswalk location. All other intersections show no change in PLOS with the addition of projected trips. Figures 11.a.1 and 11.a.2 show

TABLE 11.A.1 SIGNALIZED INTERSECTION – PEDESTRIAN LOS SUMMARY

		AM Peak Hour			PM Peak Hour		
Intersection	**Crosswalk**	**Existing 2016**	**Build 2016**	**Future 2021**	**Existing 2016**	**Build 2016**	**Future 2021**
Columbia Street at Main Street/Sidney Street	East	C	C	C	B	B	B
	West	C	C	C	B	B	B
Massachusetts Avenue at Sidney Street	East	C	C	C	B	B	B
	West	C	C	C	B	B	B
	North	C	C	C	B	B	B
	South	C	C	C	B	B	B
Massachusetts Avenue at Brookline Street/Douglass Street	East	C	C	C	C	C	C
	North	B	B	B	B	B	B
	South	B	B	B	B	B	B
Bishop Allen Drive at Prospect Street	East	A	A	A	A	A	A
	West	A	A	A	A	A	A
	North	C	C	C	C	C	C
	South	C	C	C	C	C	C
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	East	B	B	B	B	B	B
	West	B	B	B	B	B	B
	North	B	B	B	C	C	C
	South	B	B	B	C	C	C
	East	B	B	B	C	C	C
	West	C	C	C	C	C	C

Intersection	Crosswalk	AM Peak Hour			PM Peak Hour		
		Existing 2016	Build 2016	Future 2021	Existing 2016	Build 2016	Future 2021
Green Street at Western Avenue/River Street	North	D	D	D	D	D	D
	South	D	D	D	D	D	D
Massachusetts Avenue at Essex Street	West	C	C	C	C	C	C
	North	C	C	C	C	C	C

TABLE 11.A.2 UNSIGNALIZED INTERSECTION – PEDESTRIAN LOS SUMMARY

Intersection	Crosswalk	AM Peak Hour			PM Peak Hour		
		Existing 2016	Build 2016	Future 2021	Existing 2016	Build 2016	Future 2021
Bishop Allen Drive at Douglass Street	South	A	A	A	A	A	A
Bishop Allen Drive at Columbia Street	East	A	A	A	B	B	B
	West	C	C	C	E	E	E
	North	C	C	C	C	C	C
	South	B	B	B	B	B	B
Bishop Allen Drive at Norfolk Street	East	B	C	C	C	D	D
	West	C	C	C	D	D	D
	North	B	B	B	A	A	A
	South	A	A	A	A	A	A
Site Parking Lot Driveway at Bishop Allen Drive	South	A	A	A	A	A	A
Unsignalized Crosswalk at Massachusetts Avenue	N/A	F	F	F	F	F	F

12 Bicycle Analysis

12.a Conflicting Movements

Conflicting vehicle turning movements at the study area intersections are presented in Figure 2.c.5 and 2.c.6, and summarized in Table 12.a.1 for Existing 2016, Build 2016, and Future 2021 conditions.

TABLE 12.A.1 CONFLICTING BICYCLE/VEHICLE MOVEMENTS AT STUDY INTERSECTIONS

Intersection	Time Period	Bicycle Direction	Existing Peak Hour	Conflicting Vehicle Movements					
				Existing 2016		Build 2016		Future 2021	
			Bicycle Volume	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]
Bishop Allen Drive at Douglass Street	AM	EB	14	NA	NA	NA	NA	NA	NA
		WB	3	0	0	0	0	0	0
		NB	0	90	0	91	0	93	0
		SB	0	0	25	0	25	0	26

			Existing Peak Hour	Conflicting Vehicle Movements					
				Existing 2016		Build 2016		Future 2021	
Intersection	Time Period	Bicycle Direction	Bicycle Volume	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]
	PM	EB	9	NA	NA	NA	NA	NA	NA
		WB	21	0	0	0	0	0	0
		NB	0	175	5	179	5	183	5
		SB	0	5	55	5	55	5	56
Bishop Allen Drive at Columbia Street	AM	EB	13	30	5	45	5	46	5
		WB	2	10	85	10	88	10	90
		NB	9	0	15	0	15	0	15
		SB	78	40	10	42	13	43	13
	PM	EB	3	50	5	63	5	64	5
		WB	18	45	200	45	203	46	208
		NB	52	20	25	20	25	21	26
		SB	12	35	15	41	26	42	26
Columbia Street at Main Street/Sidney Street	AM	EB	20	270	110	285	110	295	144
		WB	5	NA	NA	NA	NA	NA	NA
		NB	0	115	NA	115	NA	231	NA
	PM	EB	6	175	165	188	165	193	316
		WB	15	NA	NA	NA	NA	NA	NA
		NB	0	110	NA	110	NA	136	NA
Massachusetts Avenue at Sidney Street	AM	EB	116	55	75	55	75	69	77
		WB	22	50	100	53	100	84	186
		NB	0	65	90	65	98	67	104
		SB	34	60	NA	60	NA	77	NA
	PM	EB	75	50	90	50	90	54	92
		WB	147	115	110	126	110	141	128
		NB	0	85	55	85	63	87	78
		SB	26	105	NA	105	NA	191	NA
Massachusetts Avenue at Brookline Street/Douglass Street	AM	EB	170	NA	NA	NA	NA	NA	NA
		WB	37	20	10	20	10	21	10
		NB	15	65	NA	65	NA	67	NA
	PM	EB	86	NA	NA	NA	NA	NA	NA
		WB	116	40	20	40	20	41	21
		NB	21	65	NA	65	NA	67	NA
Bishop Allen Drive at Norfolk Street	AM	EB	10	35	35	35	44	36	45
		WB	4	NA	NA	NA	NA	NA	NA
		SB	20	90	NA	90	NA	92	NA
	PM	EB	9	55	50	55	58	56	59
		WB	21	NA	NA	NA	NA	NA	NA
		SB	13	70	NA	70	NA	72	NA

				Conflicting Vehicle Movements					
			Existing Peak Hour	Existing 2016		Build 2016		Future 2021	
Intersection	Time Period	Bicycle Direction	Bicycle Volume	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]
Bishop Allen Drive at Prospect Street	AM	WB	4	60	NA	66	NA	68	NA
		NB	30	110	50	112	50	115	51
		SB	47	20	15	20	15	21	15
	PM	WB	8	105	NA	110	NA	113	NA
		NB	53	85	60	93	60	95	62
		SB	22	25	45	25	45	26	46
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	AM	EB	119	25	0	25	0	26	0
		WB	28	75	0	75	0	77	0
		NB	25	165	0	166	0	223	0
		SB	22	25	0	25	0	26	0
	PM	EB	74	20	0	20	0	21	0
		WB	125	75	0	75	0	78	0
		NB	23	180	0	182	0	196	0
		SB	15	50	0	50	0	51	0
Green Street at Western Ave/River Street	AM	WB	5	90	NA	90	NA	92	NA
		NB	54	NA	NA	NA	NA	NA	NA
		SB	30	15	65	15	65	15	67
	PM	WB	7	95	NA	95	NA	97	NA
		NB	23	NA	NA	NA	NA	NA	NA
		SB	46	20	145	20	145	21	149
Massachusetts Avenue at Essex Street	AM	EB	164	NA	NA	NA	NA	NA	NA
		WB	28	60	75	60	79	62	81
	PM	EB	94	NA	NA	NA	NA	NA	NA
		WB	138	50	110	50	121	51	124
Site Parking Lot Driveway at Bishop Allen Drive	AM	EB	29	5	5	11	10	11	10
		WB	2	NA	NA	NA	NA	NA	NA
		NB	0	0	NA	22	NA	22	NA
	PM	EB	37	10	10	31	30	31	30
		WB	27	NA	NA	NA	NA	NA	NA
		NB	0	5	NA	21	NA	21	NA

a Advancing volume
b Opposing volume
NA Movement not available

12.b Bicycle Facilities

As requested in the TIS Scoping Letter, an evaluation of the feasibility of providing a separated bicycle facility on Massachusetts Avenue, between Sidney Street and Douglass Street was conducted. A concept plan, included as Figure 12.b.1, was presented to the City in July. The

Owner will continue coordination with city staff in the development of an appropriate bicycle accommodation on Massachusetts Avenue in the vicinity of the project site.

Creating a vibrant and exciting ground floor plane has been a key priority for Mass + Main throughout the permitting process. Ownership has worked closely with the community and City to create a program that includes a diversified mix of retail uses that seamlessly blends with the public domain. The retail spaces are designed with porous storefronts that allow for a multitude of activities merging the indoor and outdoor spaces. Creating an uninterrupted area at the confluence of indoor and outdoor spaces immediately adjacent to the front façade encourages/enacts natural retail activity and flow were people will be shopping, eating and recreating. Therefore, the required number of short-term parking spaces are proposed to be provided on both private and public property as previously shown in Figure 9.b.4. For the same reasons mentioned above, the retail and public realm program proposed along Massachusetts Avenue does not have an area appropriate for locating a Hubway station. The current Hubway Station location (Massachusetts Avenue south sidewalk across the street from the Project) appears to work well for this area

The Project site is well serviced by an existing network of bicycle infrastructure as shown in Figure 12.b.2. Massachusetts Avenue provides bicycle lanes adjacent to the site and for the majority of the corridor. South of the Project the Massachusetts Avenue bicycle lane connects to the Paul Dudley White Bike Path along the Charles River. Main Street also provides bicycle lanes connecting Central Square to Kendall Square the over the Longfellow Bridge into Boston.

13 Transportation Demand Management

The Owner will support a program of transportation demand management (TDM) actions to reduce automobile trips generated by the Project. The goal of the Project's TDM plan is to reduce the use of single occupant vehicles (SOVs) by encouraging carpooling and vanpooling, bicycle commuting and walking, and increased use of the area's public transportation system by residents.

The Owner will consider the following TDM programs as part of the proposed Project to encourage residents to use alternatives to SOV travel:

- Make available up to 5 carshare parking spaces for a vehicle-sharing company.
- Offer a transit subsidy to residents
- Offer a Hubway membership subsidy to residents.
- Provide air pumps and other bike tools, such as a "fix-it" stand in the bicycle storage areas.
- Join the Charles River Transportation Management Association (TMA).
- Offer subsidized EZ Ride Shuttle stickers to residents
- Charge parking separately from the residential rent.

- Install a real-time multimodal transportation display screen providing transit, Hubway and other current transportation information.
- Designate a transportation coordinator (TC) for the site to manage the TDM program.
- Post information in a prominent location in the building and on the building's website, social media and property newsletters promoting the use of transportation options and service information.

Planning Board Special Permit Criteria

Criterion A – Project Vehicle Trip Generation

Table A-1 presents the Project vehicle trip generation criterion. Project vehicle trip generation is based on ITE trip rates, adjusted for local mode split and vehicle occupancy rates as discussed previously.

TABLE A-1 PROJECT VEHICLE TRIP GENERATION

Time Period	Criteria (trips)	Build	Exceeds Criteria?
Weekday Daily	2,000	898	No
Week AM Peak Hour	240	53	No
Week PM Peak Hour	240	82	No

The Project is not expected to exceed the Planning Board criteria for daily, morning peak and evening peak Project vehicle trip generation under the Full Build program.

Criterion B – Vehicle LOS

The criteria for a Project's impact to traffic operations at signalized intersections are summarized in Table B-1 below. These criteria are evaluated for each signalized study-area intersection and presented in Table B-2.

TABLE B-1 CRITERION - VEHICULAR LEVEL OF SERVICE

Existing	With Project
VLOS A	VLOS C
VLOS B, C	VLOS D
VLOS D	VLOS D or 7% roadway volume increase
VLOS E	7% roadway volume increase
VLOS F	5% roadway volume increase

TABLE B-2 VEHICULAR LEVEL OF SERVICE

Intersection	AM Peak Hour				PM Peak Hour			
	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?	Existing Condition	Build Condition	Traffic Increase	Exceeds Criterion?
Bishop Allen Dr at Douglass St	B	B	6.2%	No	C	C	4.7%	No
Bishop Allen Dr at Columbia St	B	B	4.6%	No	B	C	4.9%	No
Columbia St at Main St/Sidney St	C	D	3.3%	No	D	D	4.0%	No
Massachusetts Ave at Sidney St	C	C	0.6%	No	C	C	1.8%	No
Massachusetts Ave at Brookline St/Douglass St	B	B	0.1%	No	B	B	0.4%	No
Bishop Allen Dr at Norfolk St	B	B	3.7%	No	A	B	4.8%	No
Bishop Allen Dr at Prospect St	B	B	0.6%	No	C	C	0.9%	No
Massachusetts Ave at Prospect St/ River St/ Western Ave	C	C	0.7%	No	C	C	1.0%	No
Green St at River St/ Western Ave	B	B	0.2%	No	B	B	0.6%	No
Massachusetts Ave at Essex St	B	B	1.3%	No	A	B	1.8%	No

Criterion C – Traffic on Residential Streets

This criterion considers the magnitude of Project vehicle trip generation during any peak hour that may reasonably be expected to arrive and/or depart by traveling on a residential street. The criteria, based on a Project-induced traffic volume increase on any two-block residential street segment in the study area, are summarized in Table C-1.

TABLE C-1 CRITERION – TRAFFIC ON RESIDENTIAL STREETS

Parameter 1: Amount of Residential[1]	Parameter 2: Current Peak Hour Street Volume (two-way vehicles)		
	< 150 VPH	150-400 VPH	> 400 VPH
1/2 or more	20 VPH[2]	30 VPH[2]	40 VPH[2]
>1/3 but <1/2	30 VPH[2]	45 VPH[2]	60 VPH[2]
1/3 or less	No Max.	No Max.	No Max

1 - Amount of residential for a two block segment as determined by first floor frontage
2 - Additional Project vehicle trip generation in vehicles per lane, both directions
VPH - Vehicles per hour

4 of the 14 roadway segments in the study area identified as street segments which have more than 1/3 of residential frontage, and are therefore evaluated against the traffic volume criteria. The results are presented in Table C-2.

TABLE C-2 TRAFFIC ON RESIDENTIAL STREETS

Roadway	Segment	Amount of Residential	AM Peak Hour			PM Peak Hour		
			Existing[1]	Project Trips	Exceeds Criteria?	Existing[1]	Project Trips	Exceeds Criteria?
Bishop Allen Drive	Prospect St to Essex St	1/3 or less	340	8	No	357	13	No
	Essex St to Norfolk St	1/3 or less	355	12	No	377	24	No
	Norfolk St to Douglass St	1/2 or more	300	23	No	331	37	**Yes**
	Douglass St to Columbia St	1/3 or less	365	31	No	409	45	No
	Columbia St to Main St	>1/3 but <1/2	230	8	No	243	12	No
Columbia Street	Bishop Allen Dr to Main St	1/3 or less	325	18	No	387	24	No
	Bishop Allen Dr to Washington St	1/2 or more	430	5	No	481	9	No
Sidney Street	Main St to Mass Ave	1/3 or less	530	18	No	709	24	No
	Mass Ave to Green St	1/3 or less	425	7	No	471	5	No
Mass Ave	Prospect St to Essex St	1/3 or less	785	11	No	970	16	No
	Essex St to Norfolk St	1/3 or less	765	7	No	946	5	No
	Norfolk St to Douglass St	1/3 or less	750	0	No	846	0	No
	Douglass St to Sidney St	1/3 or less	730	0	No	903	0	No
Douglass Street	Mass Ave to Bishop Allen Dr	1/2 or more	115	1	No	119	4	No

[1] Where driveways/on-street parking created a segment inflow/outflow volume imbalance, an average was calculated per direction and added

Criterion D – Lane Queue

The criteria for a project's impact to queues at signalized intersections are summarized in Table D-1 below. These criteria are evaluated for each lane group at study-area signalized intersections and presented in Table D-2.

TABLE D-1 CRITERION – VEHICULAR QUEUES AT SIGNALIZED INTERSECTIONS

Existing	With Project
Under 15 vehicles	Under 15 vehicles, or 15+ vehicles with an increase of 6 vehicles
15 or more vehicles	Increase of 6 vehicles

TABLE D-2 LENGTH OF VEHICULAR QUEUES AT SIGNALIZED INTERSECTIONS

Intersection	Movement	AM Peak Hour			PM Peak Hour		
		Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Columbia Street at Main Street/Sidney Street	Eastbound – Thru	0	0	No	0	0	No
	Eastbound – Right	6	6	No	4	4	No
	Westbound – Thru/Right	3	3	No	5	5	No
	Northbound – Left/Right	1	1	No	2	2	No
Massachusetts Avenue at Sidney Street	Eastbound – Left	2	2	No	3	3	No
	Eastbound – Thru/Right	8	8	No	5	5	No
	Westbound – Left	2	2	No	2	2	No
	Westbound – Thru/Right	6	6	No	9	9	No
	Northbound – Right	2	2	No	2	2	No
	Southbound – Left/Thru	3	3	No	4	4	No
	Southbound – Right	0	0	No	0	0	No
Massachusetts Avenue at Brookline Street/Douglass Street	Eastbound – Left/Thru	2	2	No	4	4	No
	Westbound – Thru/Right	3	3	No	1	1	No
	Northbound – Left	2	2	No	2	2	No
	Northbound – Thru/Right	3	3	No	6	6	No
Bishop Allen Drive at Prospect Street	Westbound – Left/Thru/Right	5	5	No	8	~ 8	No
	Northbound – Left	0	0	No	0	0	No
	Northbound – Thru/Right	7	7	No	6	6	No
	Southbound – Left	0	0	No	1	1	No
	Southbound – Thru/Right	5	5	No	6	6	No
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	Eastbound – Thru	7	7	No	7	7	No
	Eastbound – Right	0	0	No	0	0	No
	Westbound – Thru	3	4	No	7	8	No
	Westbound – Right	1	1	No	2	2	No
	Northbound – Thru	6	6	No	4	4	No
	Northbound – Right	2	2	No	1	1	No
	Southbound – Thru/Right	11	11	No	12	12	No
Green Street at Western Avenue/River Street	Westbound – Left/Thru	3	3	No	6	6	No
	Westbound – Right	2	2	No	2	2	No
	Northbound – Left	1	1	No	3	3	No
	Northbound – Thru	5	5	No	4	4	No
	Southbound – Thru	13	13	No	11	11	No
Massachusetts Avenue at Essex Street	Eastbound – Left	1	1	No	1	1	No
	Eastbound – Thru	5	5	No	3	3	No
	Westbound – Thru/Right	3	3	No	3	4	No

Criterion E – Pedestrian and Bicycle Facilities

Criteria 1: Pedestrian Delay

Pedestrian delay is a measure of the pedestrian crossing delay on a crosswalk during the peak hour as determined by the pedestrian level of service analysis in the HCM 2000.

Table E-1 presents the indicators for this criterion. Tables E-2 present the evaluation of PLOS criteria for each crosswalk at study area intersections under existing and full build conditions.

TABLE E-1 CRITERION – PLOS INDICATORS

Existing	With Project
PLOS A	PLOS A
PLOS B	PLOS B
PLOS C	PLOS C
PLOS D	PLOS D or increase of 3 seconds
PLOS E, F	PLOS D

TABLE E-2 INTERSECTION PLOS SUMMARY

		AM Peak Hour			PM Peak Hour		
Intersection	**Crosswalk**	**Existing**	**Build**	**Exceeds Criteria?**	**Existing**	**Build**	**Exceeds Criteria?**
Columbia Street at Main Street/Sidney Street	East	C	C	No	B	B	No
	West	C	C	No	B	B	No
Massachusetts Avenue at Sidney Street	East	C	C	No	B	B	No
	West	C	C	No	B	B	No
	North	C	C	No	B	B	No
	South	C	C	No	B	B	No
Massachusetts Avenue at Brookline Street/Douglass Street	East	C	C	No	C	C	No
	North	B	B	No	B	B	No
	South	B	B	No	B	B	No
Bishop Allen Drive at Prospect Street	East	A	A	No	A	A	No
	West	A	A	No	A	A	No
	North	C	C	No	C	C	No
	South	C	C	No	C	C	No
Massachusetts Avenue at Prospect Street/River Street/Western Avenue	East	B	B	No	B	B	No
	West	B	B	No	B	B	No
	North	B	B	No	C	C	No
	South	B	B	No	C	C	No
Green Street at Western Avenue/River Street	East	B	B	No	C	C	No
	West	C	C	No	C	C	No
	North	D	D	No	D	D	No
	South	D	D	No	D	D	No
Massachusetts Avenue at Essex Street	West	C	C	No	C	C	No
	North	C	C	No	C	C	No
Bishop Allen Drive at Douglass Street	South	A	A	No	A	A	No
Bishop Allen Drive at Columbia Street	East	A	A	No	B	B	No
	West	C	C	No	E	E	**Yes**
	North	C	C	No	C	C	No
	South	B	B	No	B	B	No
	East	B	C	**Yes**	C	D	**Yes**
	West	C	C	No	D	D	No

Intersection	Crosswalk	AM Peak Hour			PM Peak Hour		
		Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Bishop Allen Drive at Norfolk Street	North	B	B	No	A	A	No
	South	A	A	No	A	A	No
Site Parking Lot Driveway at Bishop Allen Drive	South	A	A	No	A	A	No
Unsignalized Crosswalk at Massachusetts Avenue	N/A	F	F	**Yes**	F	F	**Yes**

Criteria 2 & 3: Safe Pedestrian and Bicycle Facilities

Safe pedestrian and bicycle facilities are off-road or on-street bicycle lanes and sidewalks that are along a publicly-accessible street.

Table E-3 presents the indicators for this criterion. The evaluation of sidewalks or walkways and bicycle facilities are displayed.

TABLE E-3 PEDESTRIAN AND BICYCLE FACILITIES

Adjacent Street	Link (between)	Sidewalk or Walkway Present	Exceeds Criteria?	Bicycle Facilities or Right of Ways Present	Exceeds Criteria?
Bishop Allen Drive	Norfolk Street and Columbia Street	Yes	No	No	**Yes**
Columbia Street	Bishop Allen Drive and Main Street	Yes	No	No	**Yes**
Massachusetts Avenue	Douglass Street and Sidney Street	Yes	No	Yes	No

TIS Figures

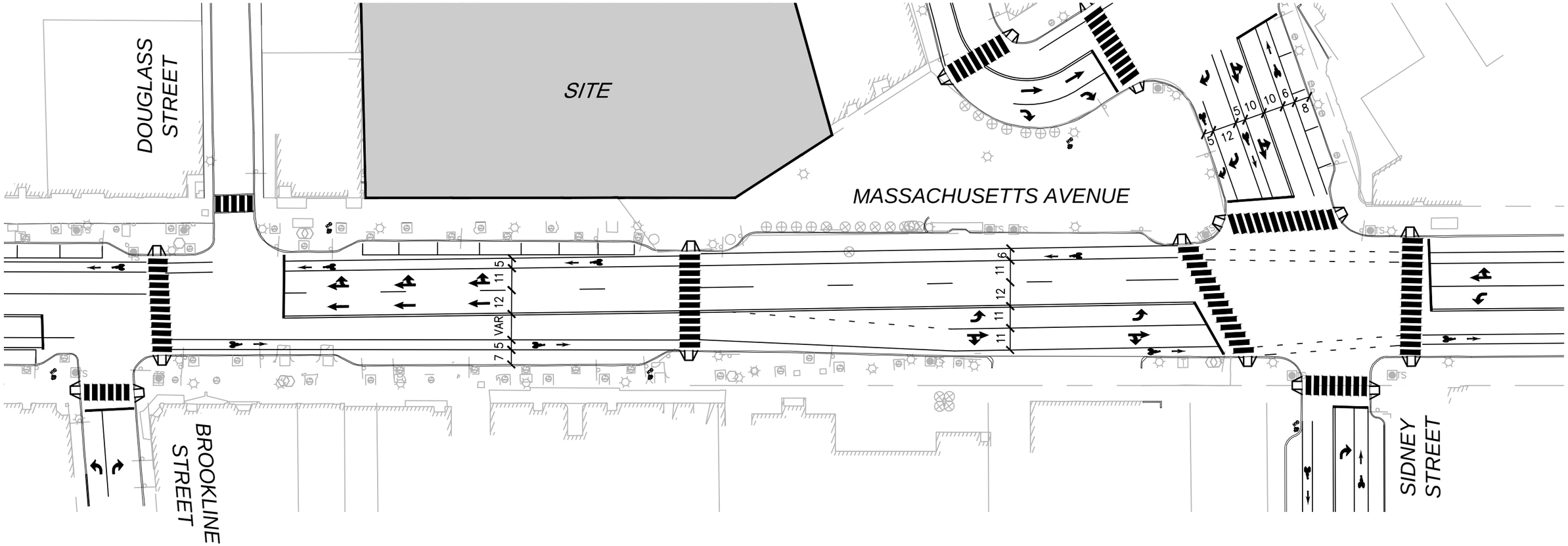
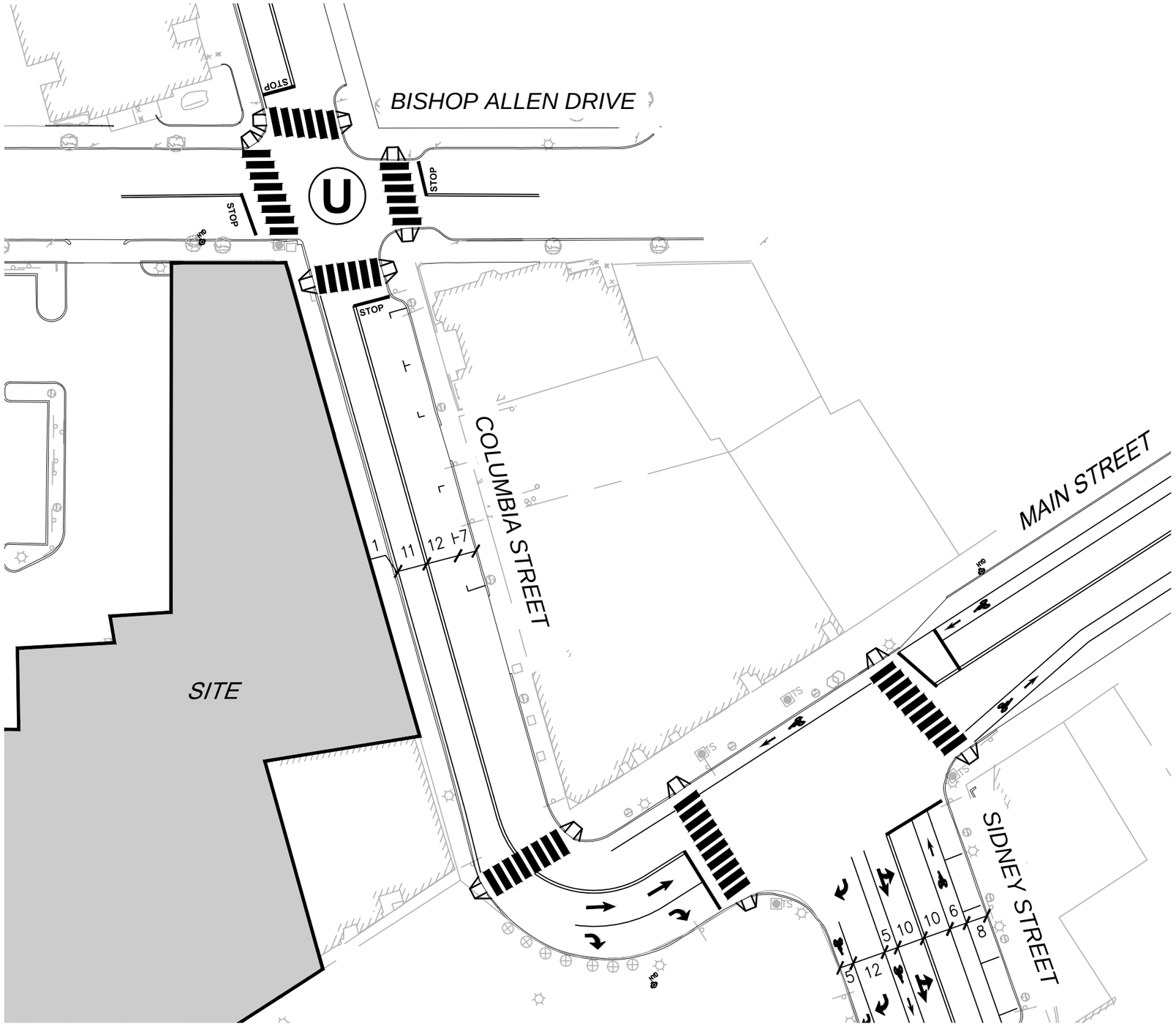
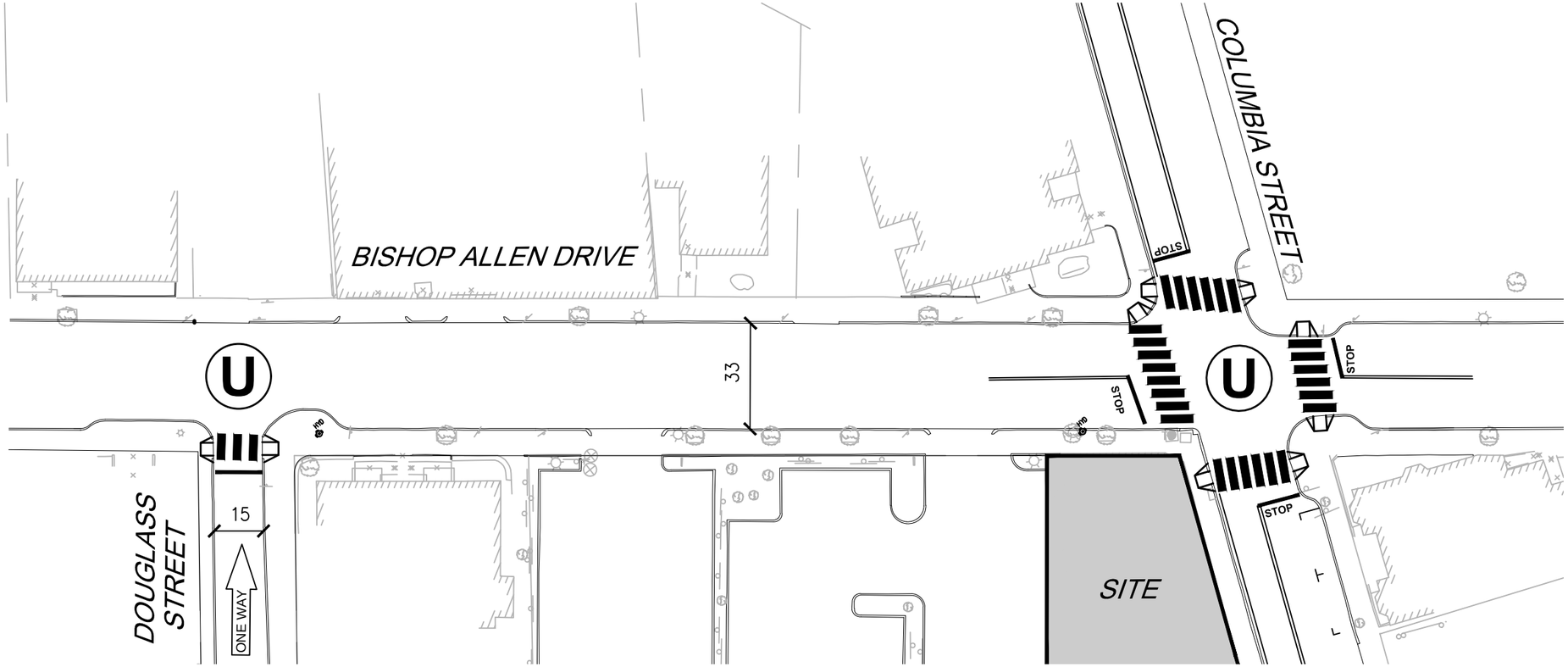


Figure 1.a.1
Existing Roadway Sketch
Massachusetts Ave between Douglass St and Sidney St
Mass + Main
Cambridge, MA



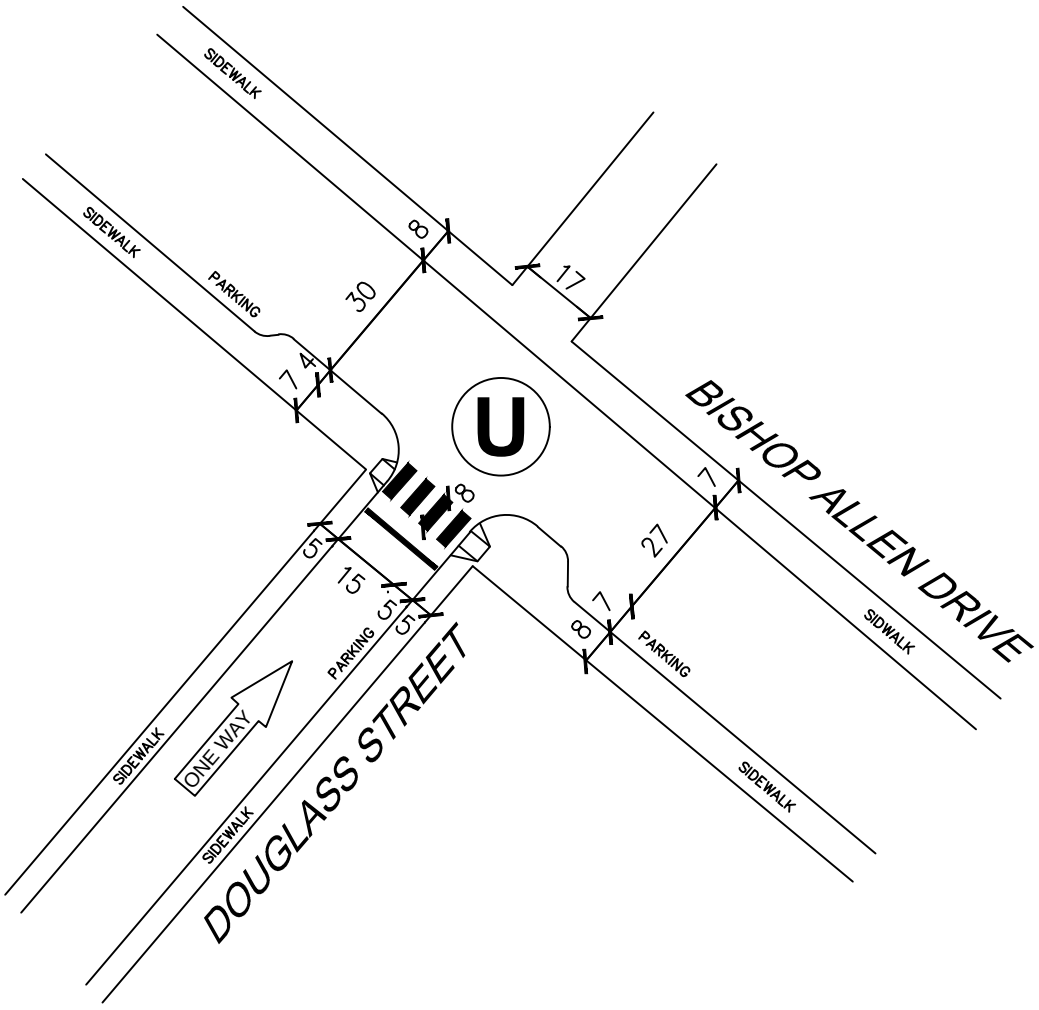
0 20 40 80 Feet

Figure 1.a.2
Existing Roadway Sketch
Columbia St between Main St and Bishop Allen Dr
Mass + Main
Cambridge, MA



0 20 40 80 Feet

Figure 1.a.3
Existing Roadway Sketch
Bishop Allen Dr between Douglass St and Columbia St
Mass + Main
Cambridge, MA

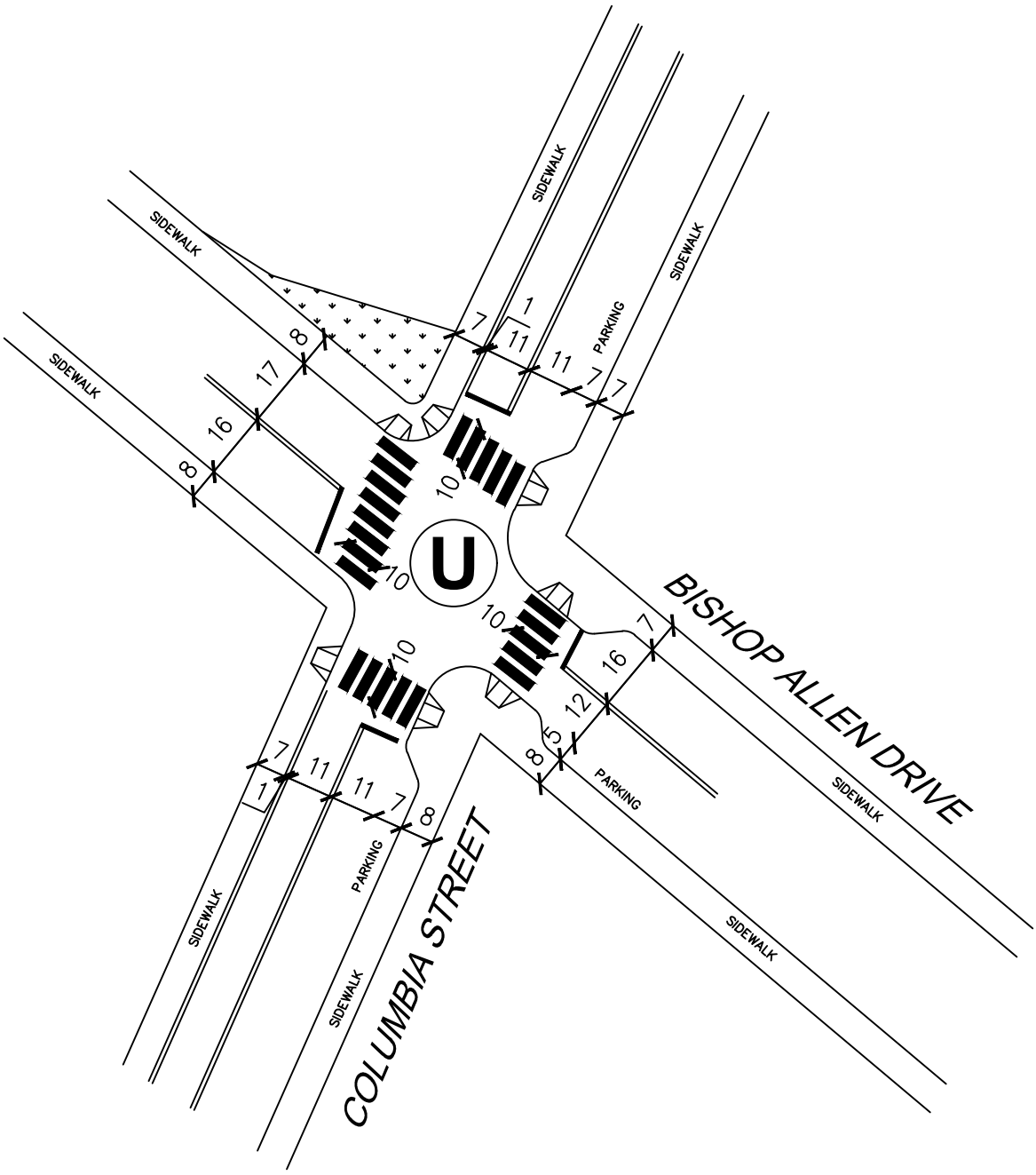


0 20 40 Feet

Figure 1.b.1
Existing Conditions Intersection Sketch
Bishop Allen Drive at Douglass Street

Mass + Main
Cambridge, MA

Date: June 2016

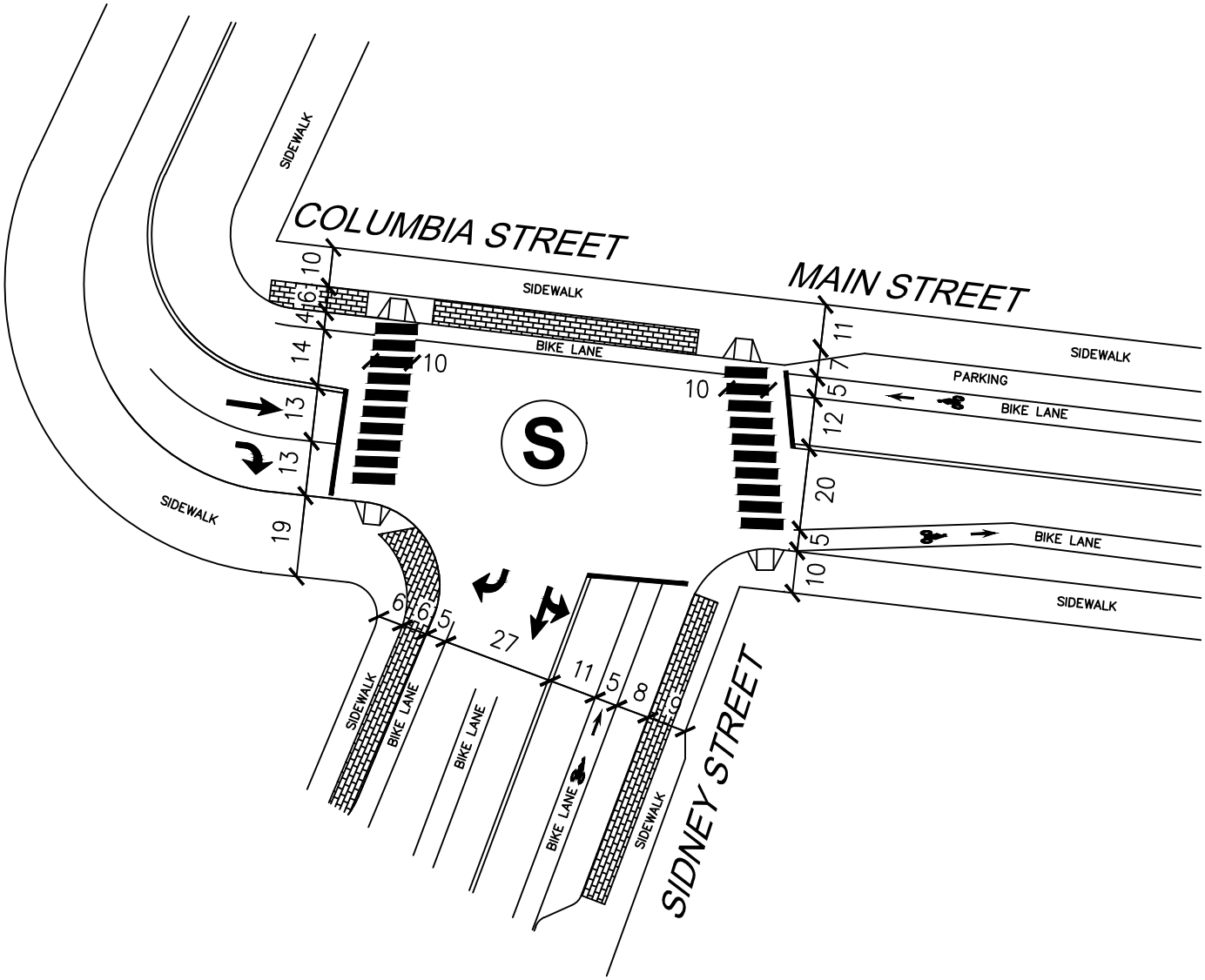


0 20 40 Feet

Figure 1.b.2
Existing Conditions Intersection Sketch
Bishop Allen Drive at Columbia Street

Mass + Main
Cambridge, MA

Date: June 2016



0 20 40 Feet

Figure 1.b.3
Existing Conditions Intersection Sketch
Columbia Street at Main Street/Sidney Street

Mass + Main
Cambridge, MA

Date: June 2016

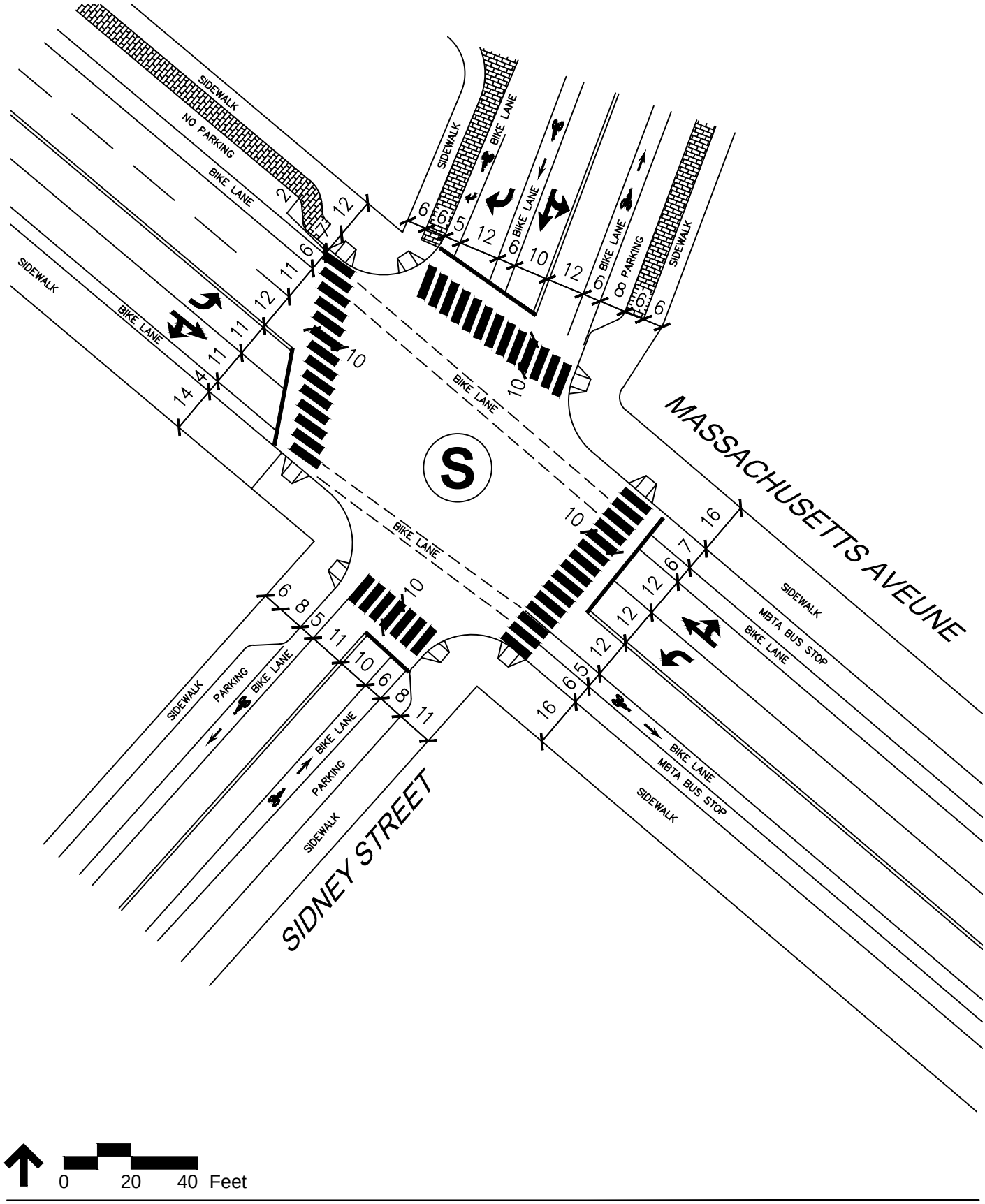
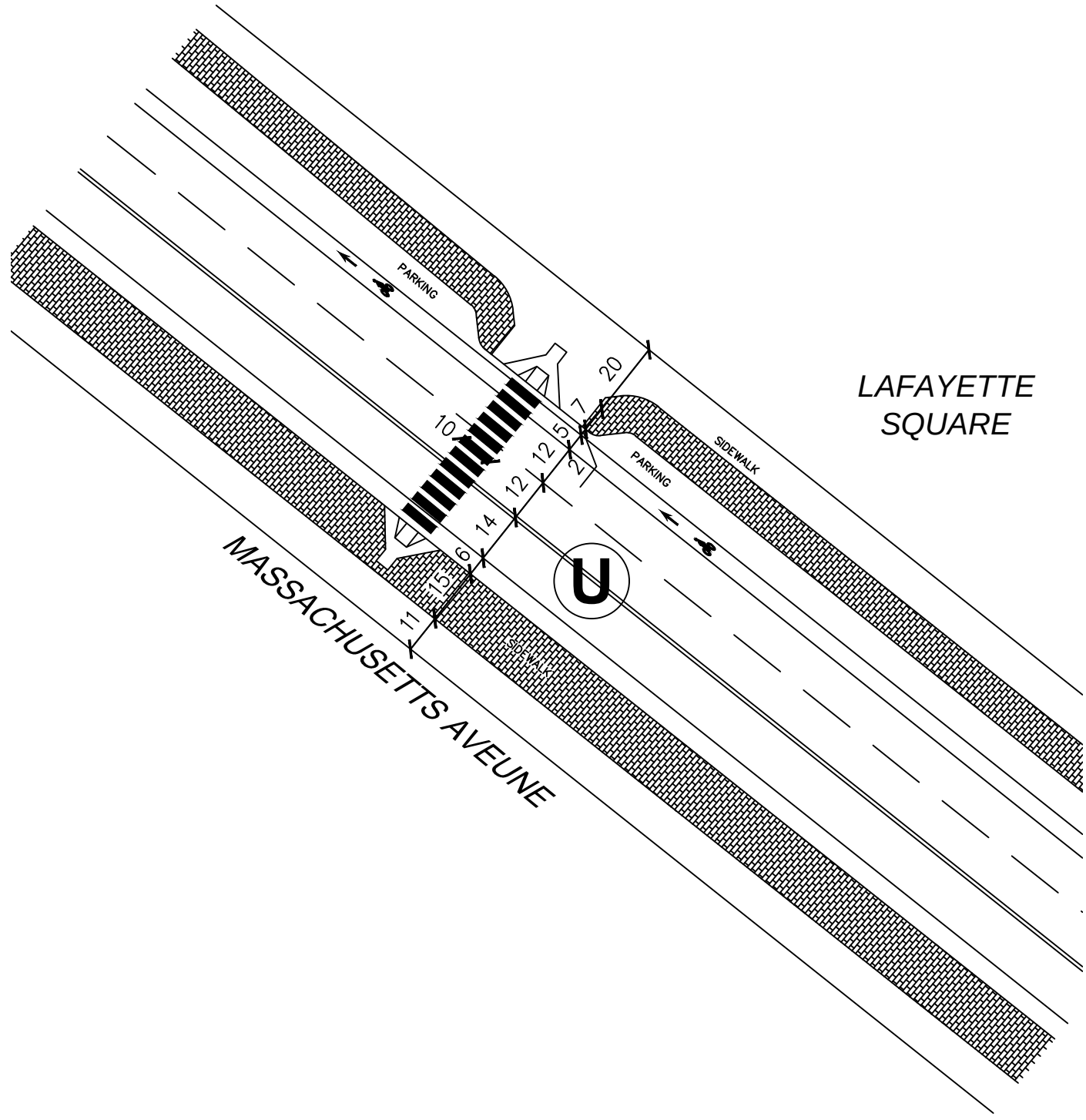


Figure 1.b.4
Existing Conditions Intersection Sketch
Massachusetts Avenue at Sidney Street

Mass + Main
Cambridge, MA

Date: June 2016



0 20 40 Feet

Figure 1.b.5
Existing Conditions Intersection Sketch
Crosswalk at Massachusetts Avenue/Layfette Square

Date: June 2016

Mass + Main
Cambridge, MA

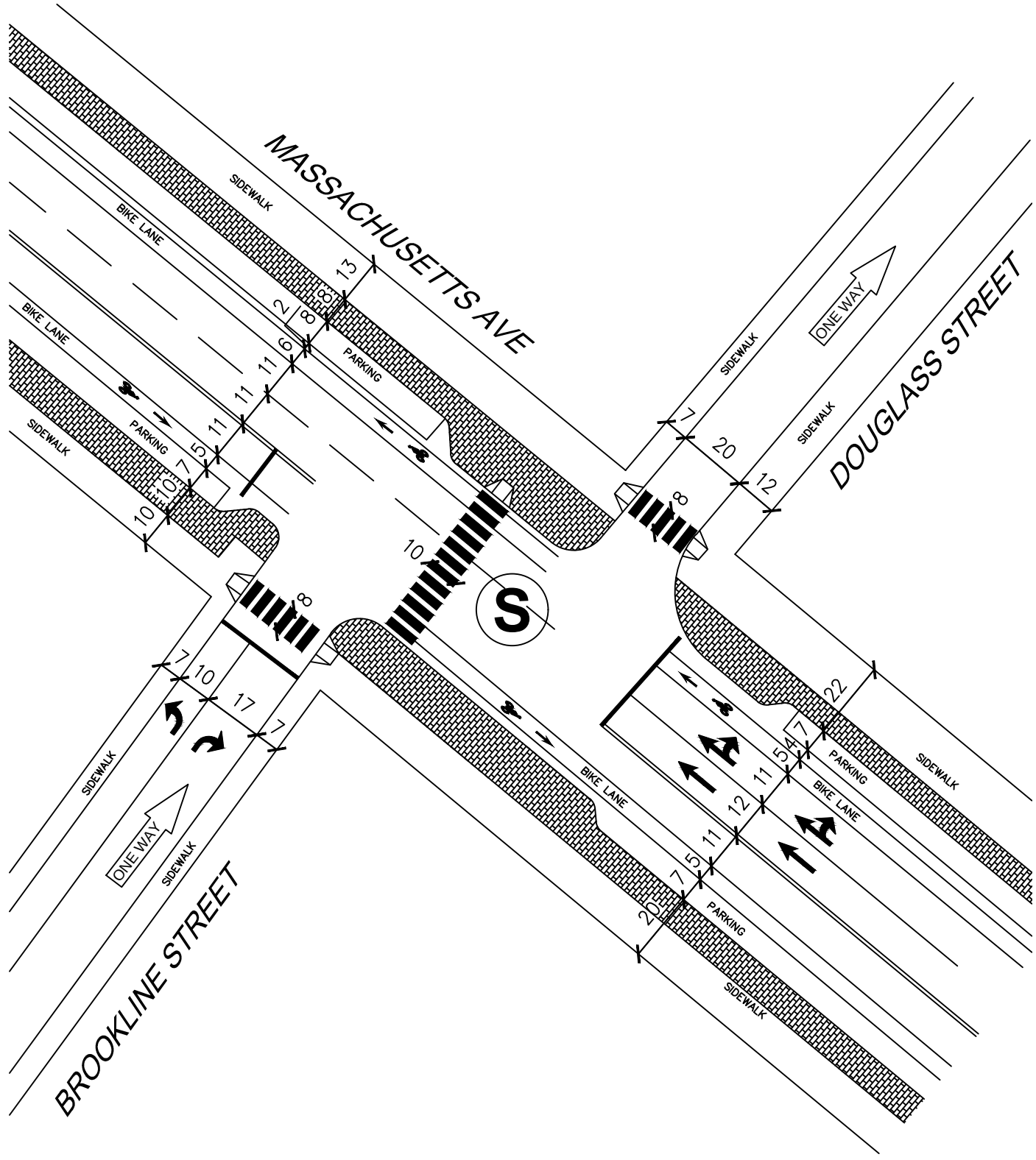


Figure 1.b.6
Existing Conditions Intersection Sketch
Massachusetts Avenue at Brookline Street/Douglass Street

Mass + Main
Cambridge, MA

Date: June 2016

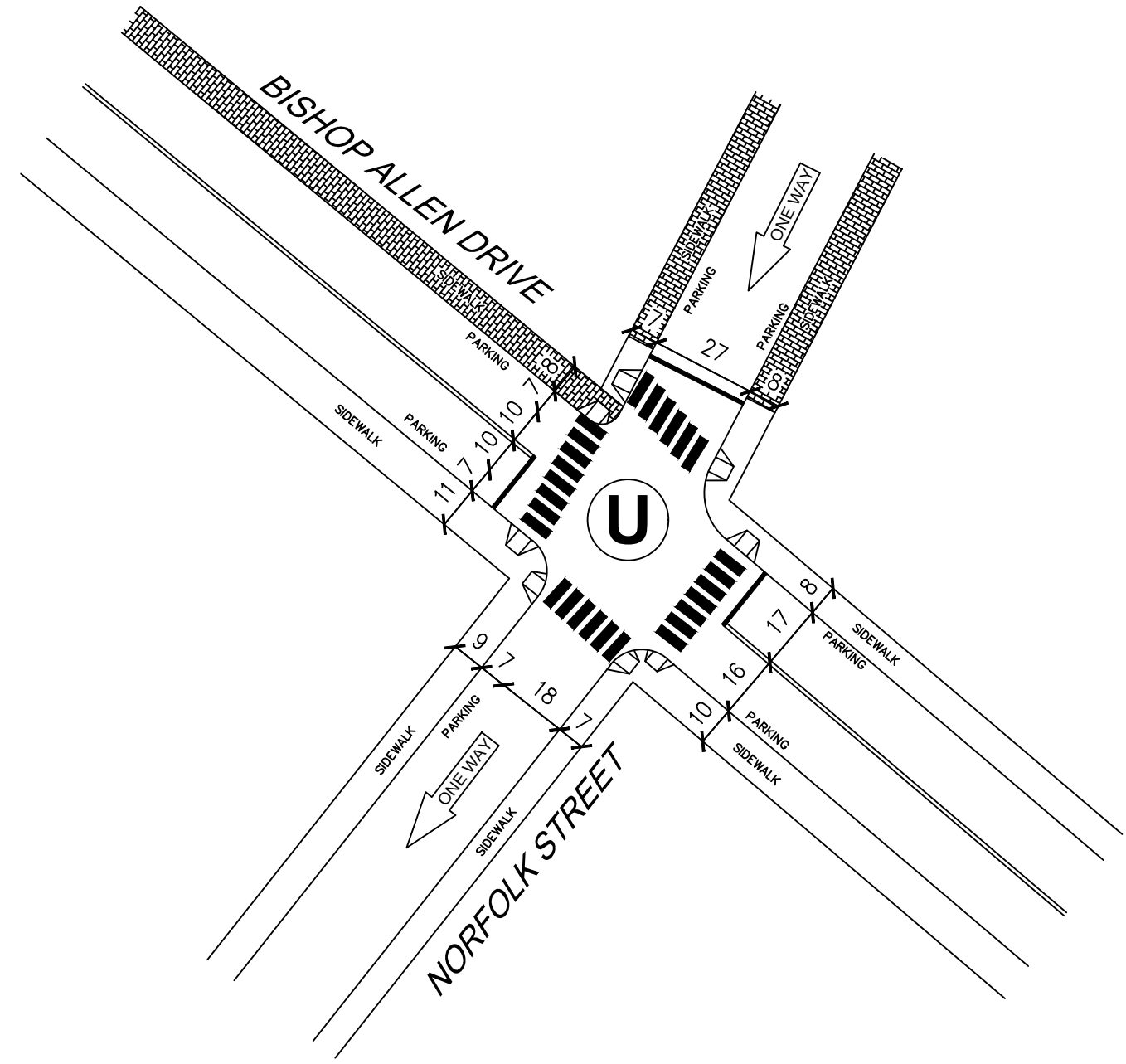
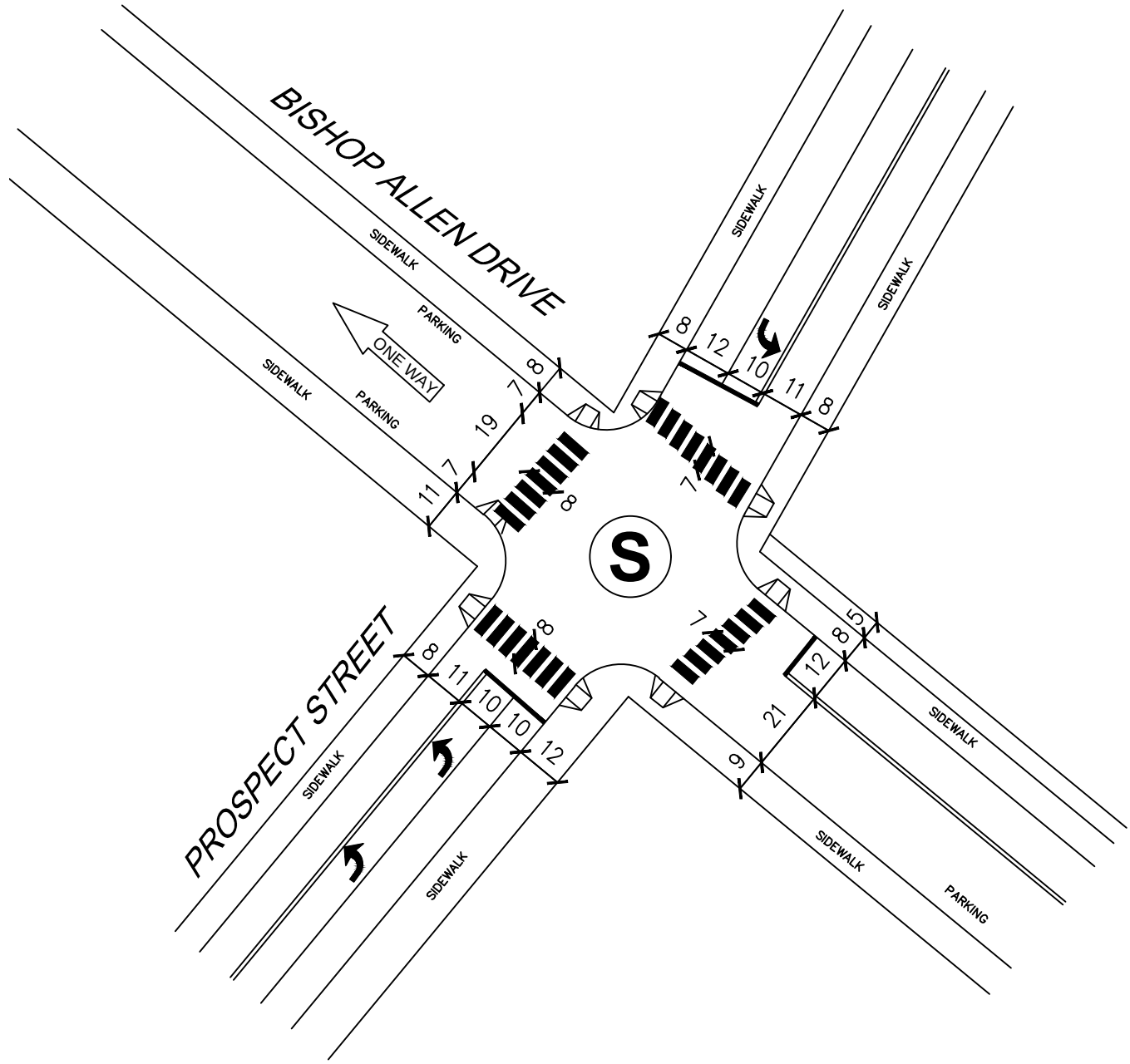


Figure 1.b.7
Existing Conditions Intersection Sketch
Bishop Allen Drive at Norfolk Street

Mass + Main
Cambridge, MA

Date: June 2016



0 20 40 Feet

Figure 1.b.8
Existing Conditions Intersection Sketch
Bishop Allen Drive at Prospect Street

Mass + Main
Cambridge, MA

Date: June 2016

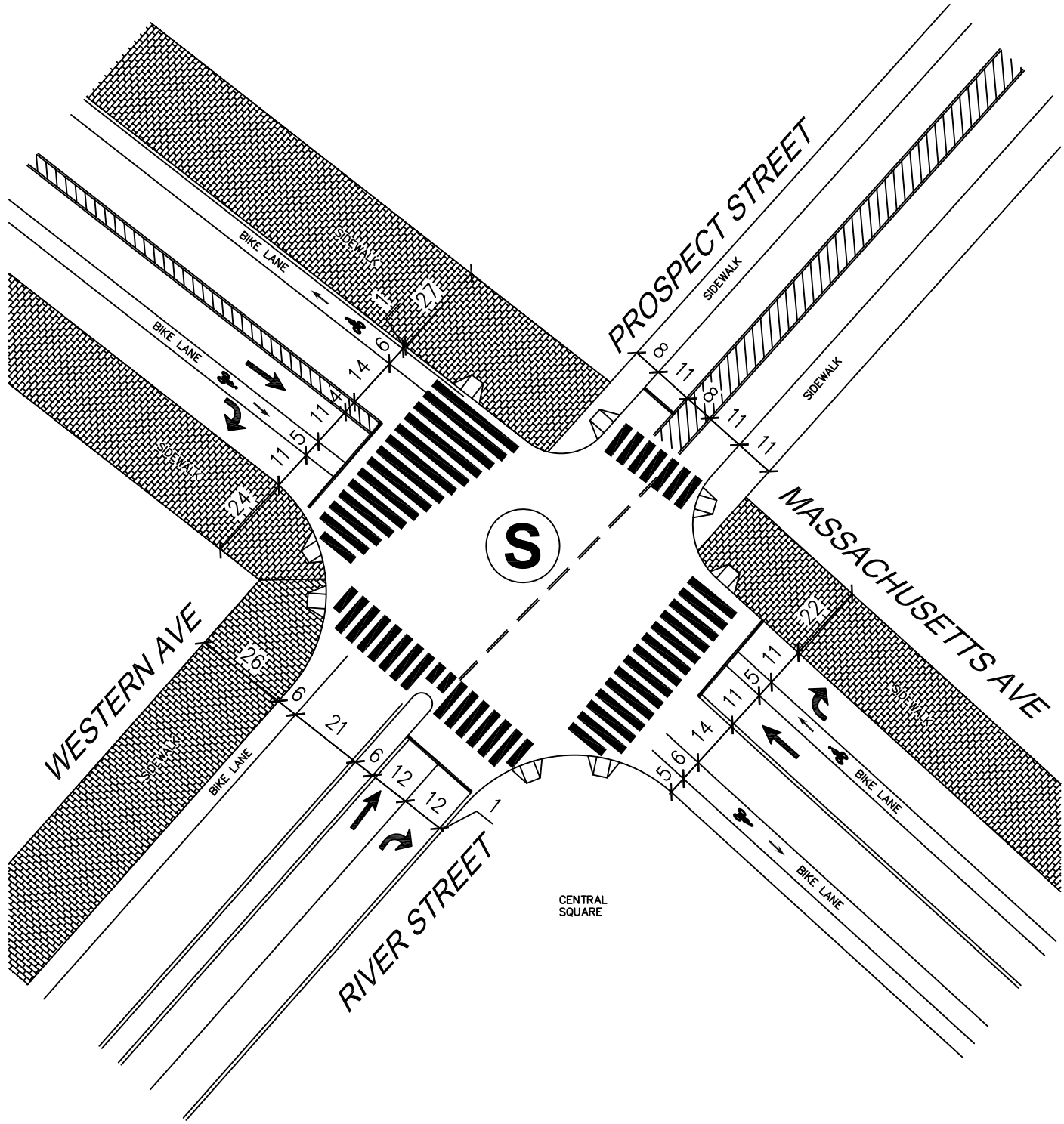
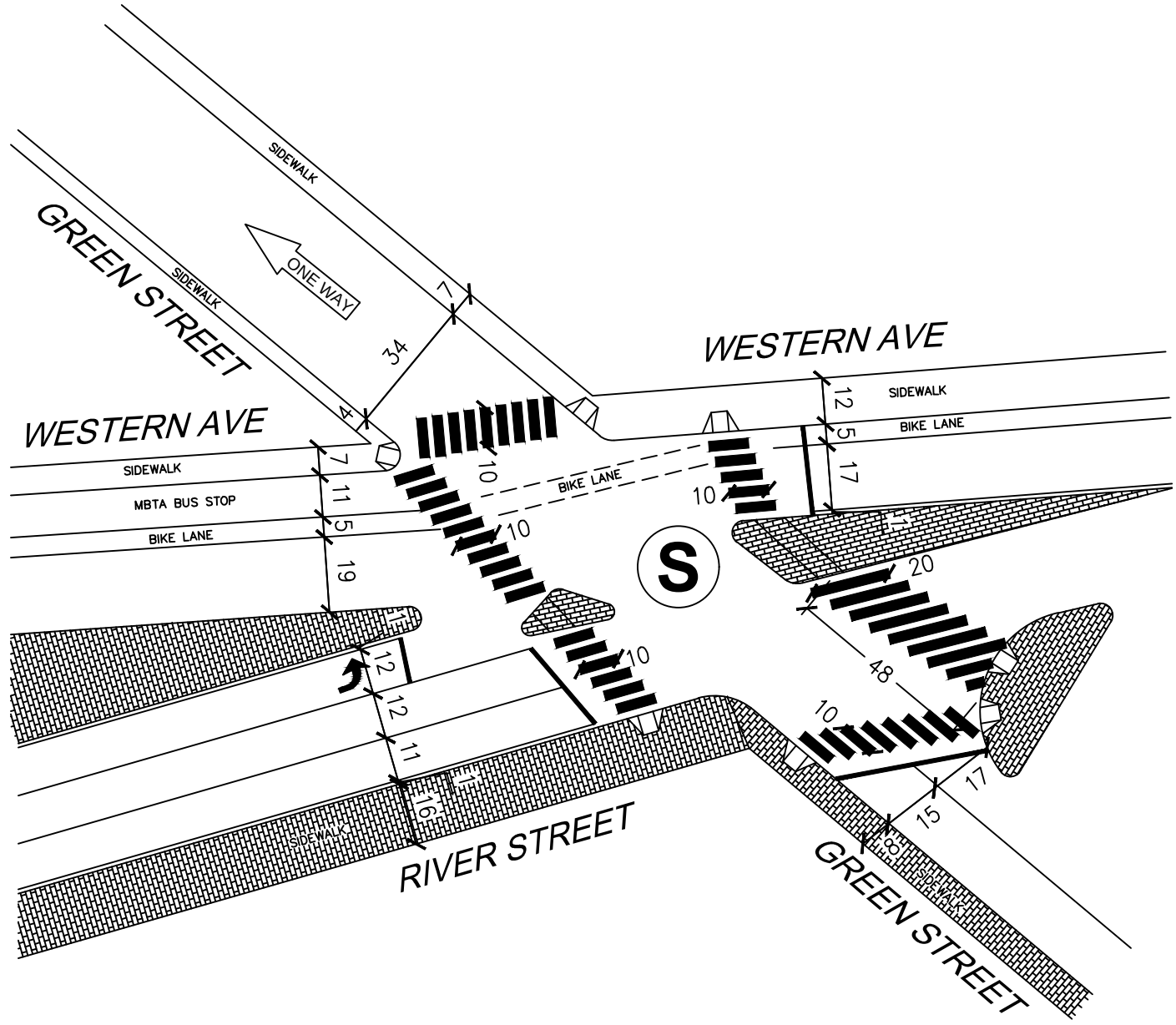


Figure 1.b.9
Existing Conditions Intersection Sketch
Massachusetts Avenue at Prospect St/River St/Western Ave

Mass + Main
Cambridge, MA

Date: June 2016



0 20 40 Feet

Figure 1.b.10
Existing Conditions Intersection Sketch
Green Street at Western Avenue/River Street

Mass + Main
Cambridge, MA

Date: June 2016

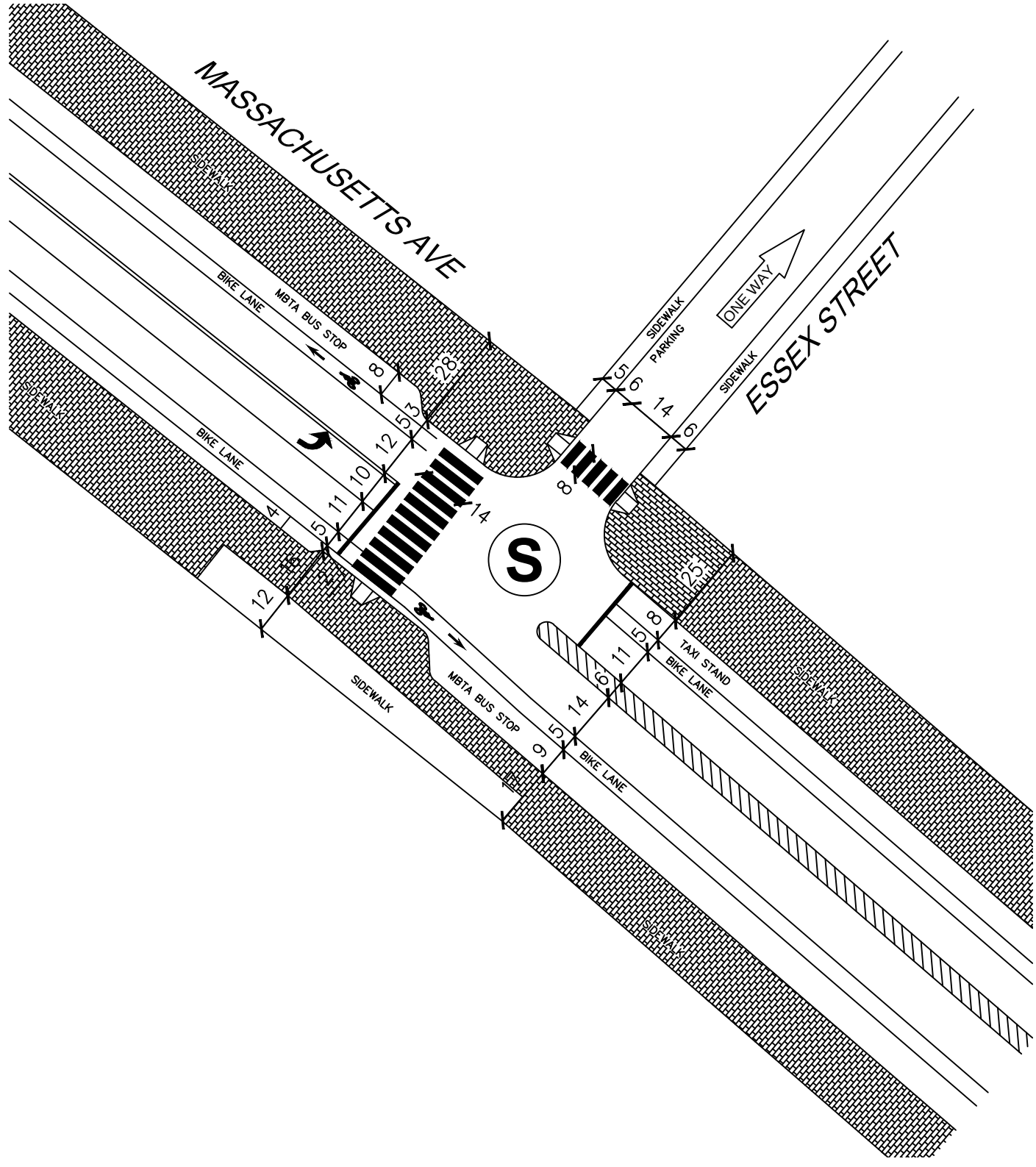
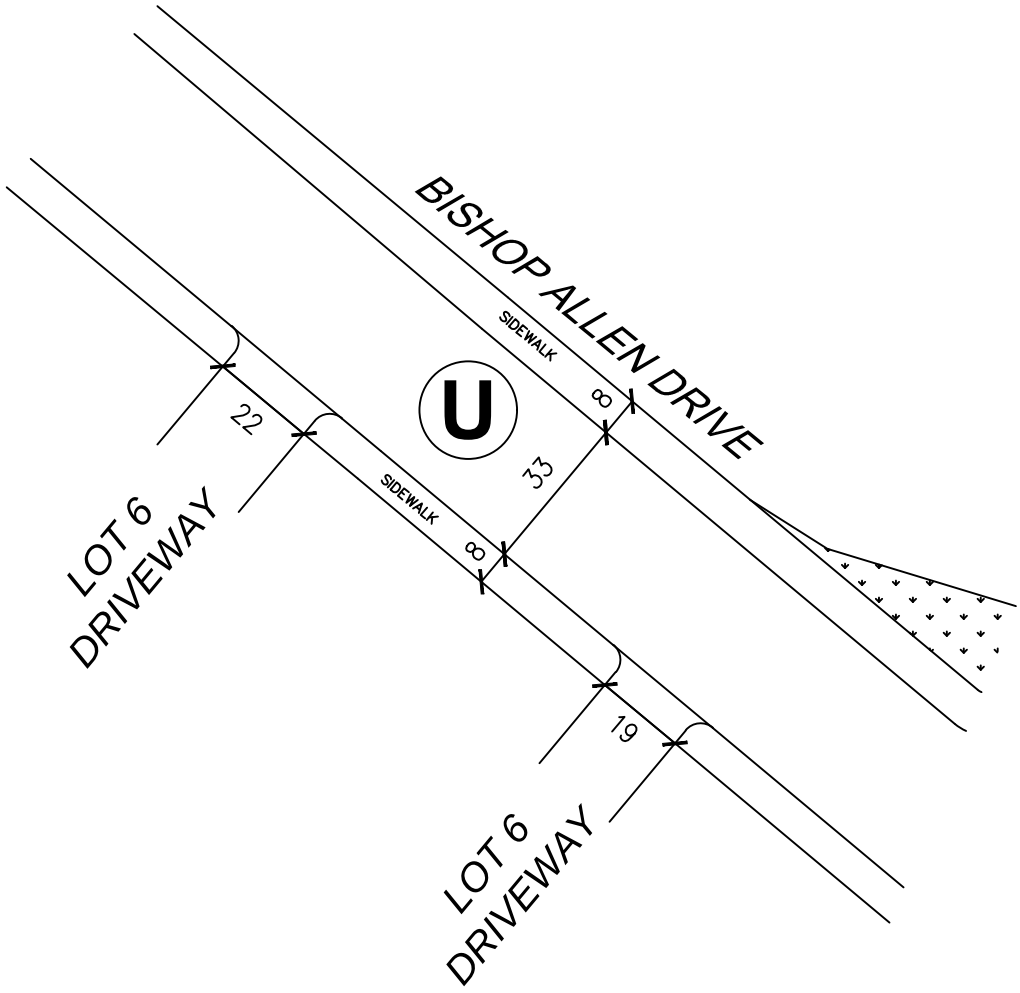


Figure 1.b.11
Existing Conditions Intersection Sketch
Massachusetts Avenue at Essex Street

Mass + Main
Cambridge, MA

Date: June 2016

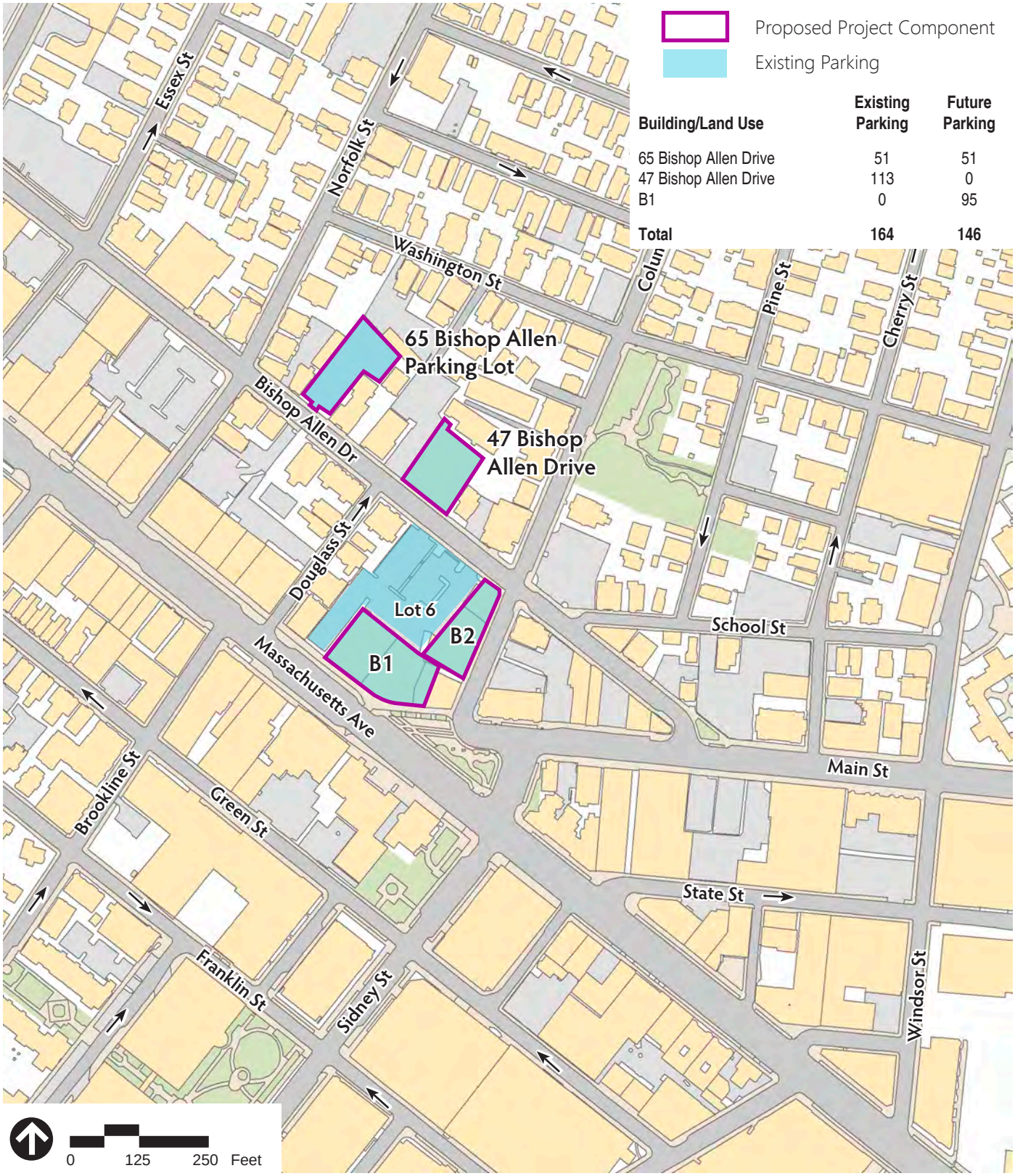


0 20 40 Feet

Figure 1.b.12
Existing Conditions Intersection Sketch
Driveway at Bishop Allen Drive

Mass + Main
Cambridge, MA

Date: June 2016

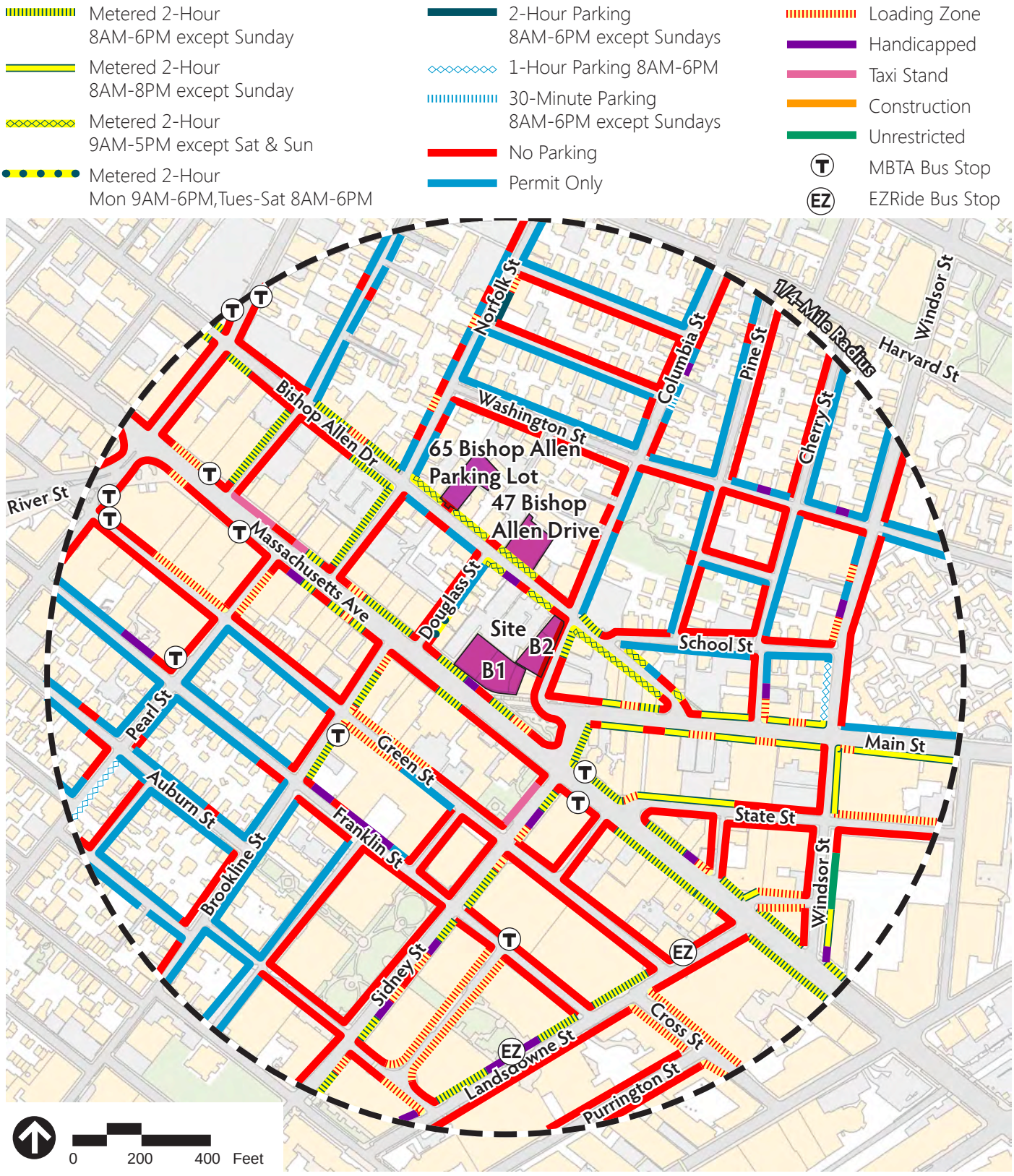


Source: City of Cambridge GIS

Figure 1.c.1

Off-Street Parking

Mass + Main
Cambridge, Massachusetts

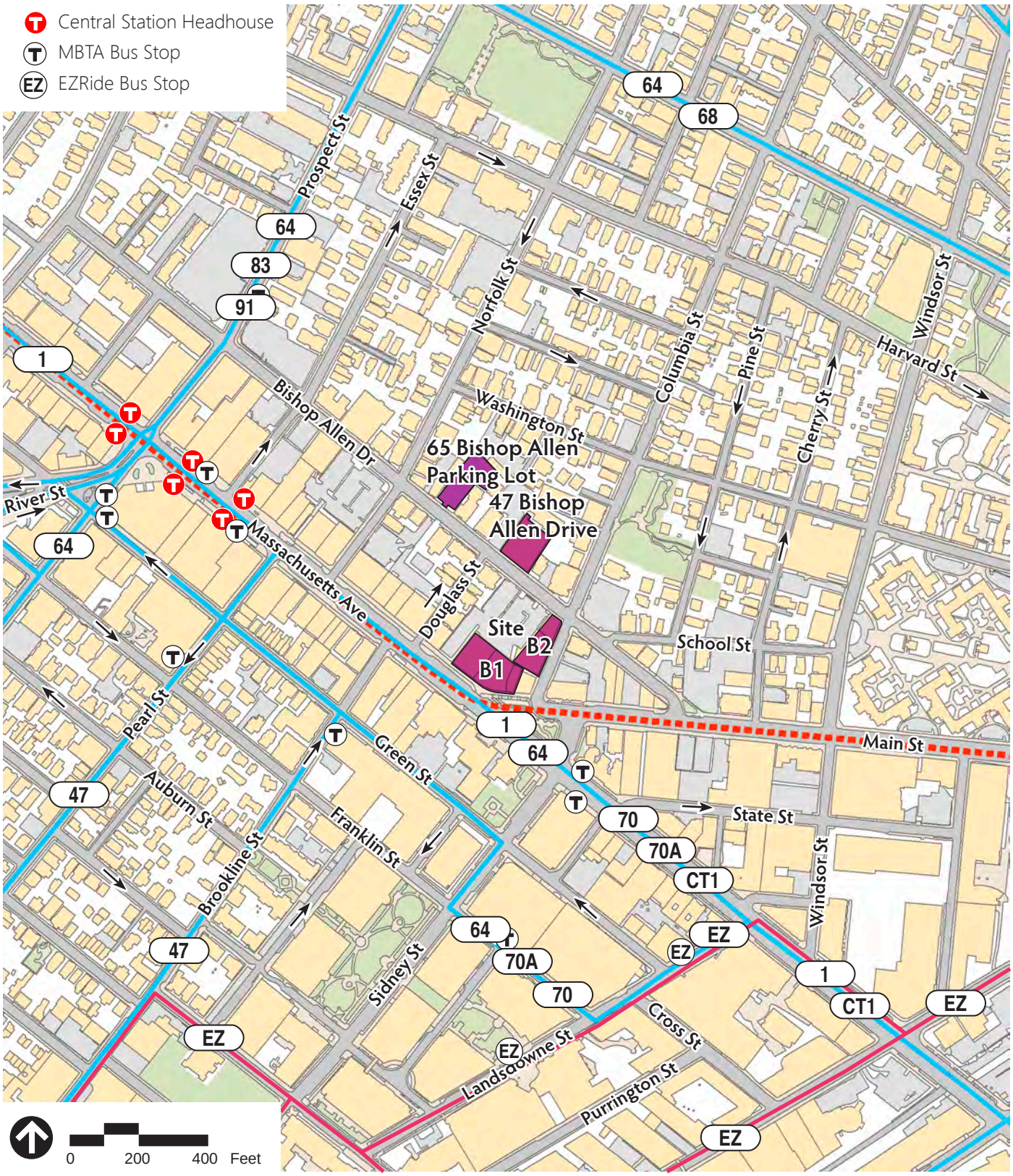


Source: City of Cambridge GIS

Figure 1.c.2

On-Street Parking Regulations

Mass + Main
Cambridge, Massachusetts

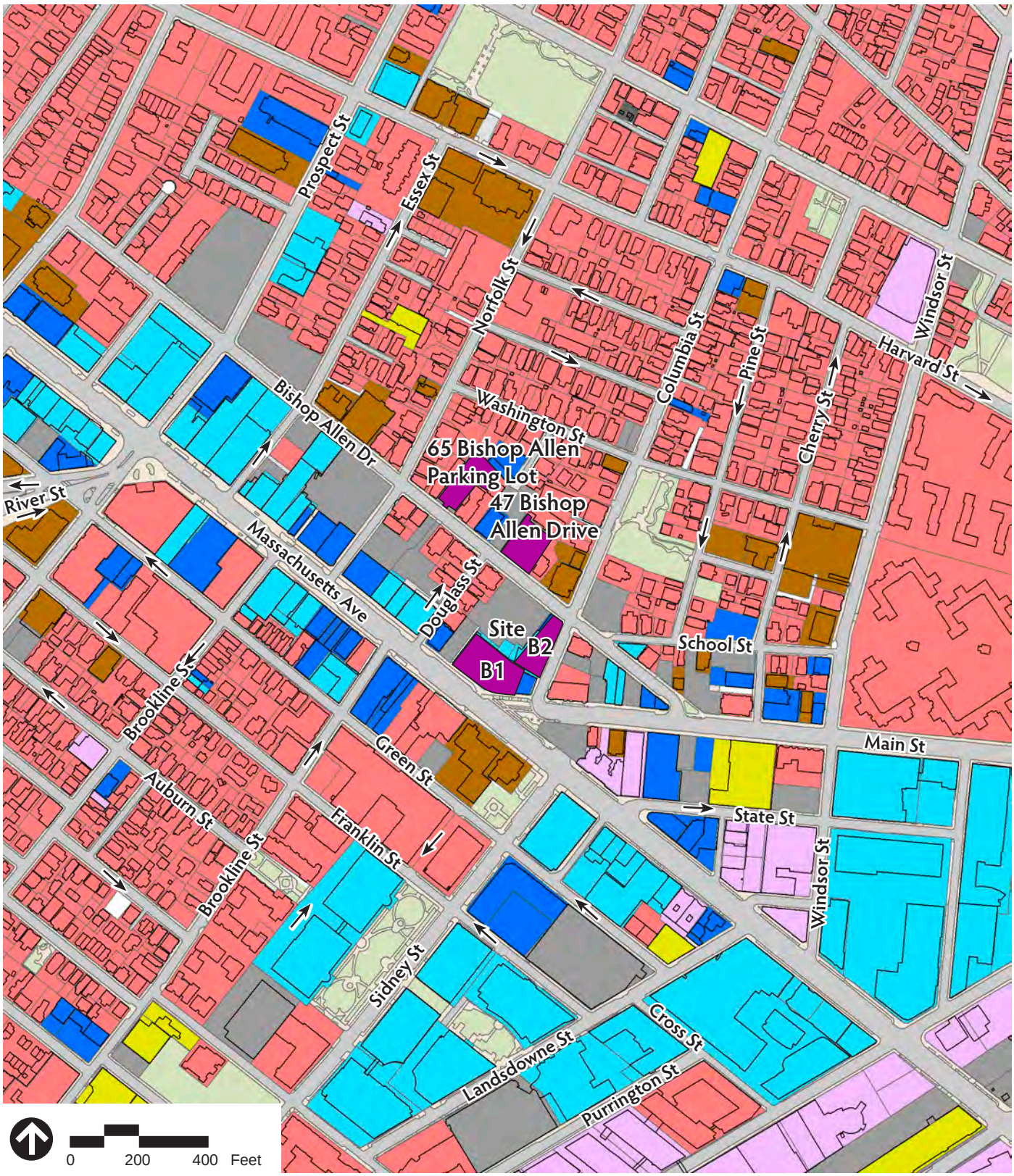


Source: City of Cambridge GIS

Figure 1.d.1

Public Transportation

Mass + Main
Cambridge, Massachusetts



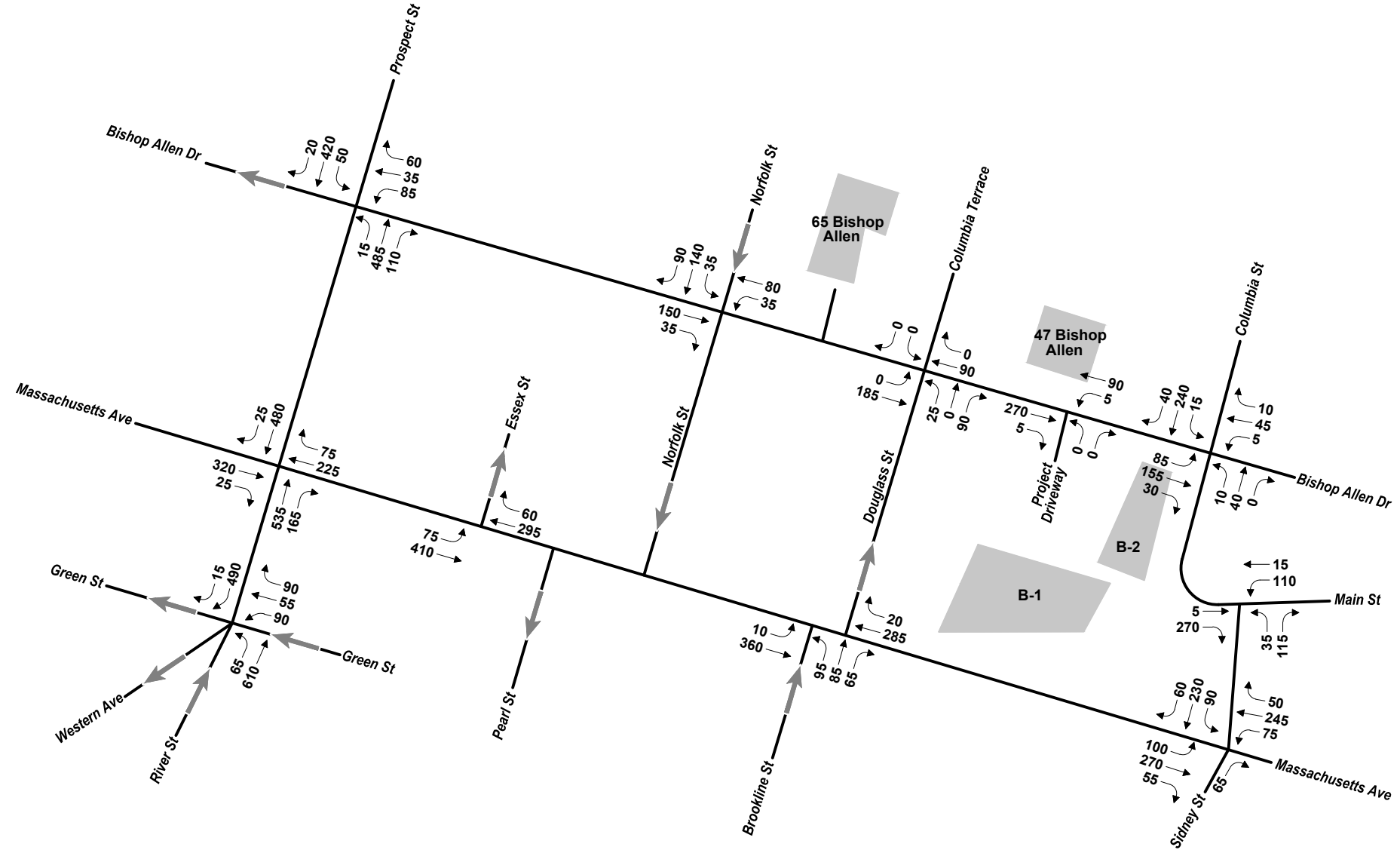
Source: City of Cambridge GIS

- Residential
- Commercial
- Industrial
- Office
- Education
- Government/Healthcare/ Religious

Figure 1.e.1

Land Use

Mass + Main
Cambridge, Massachusetts

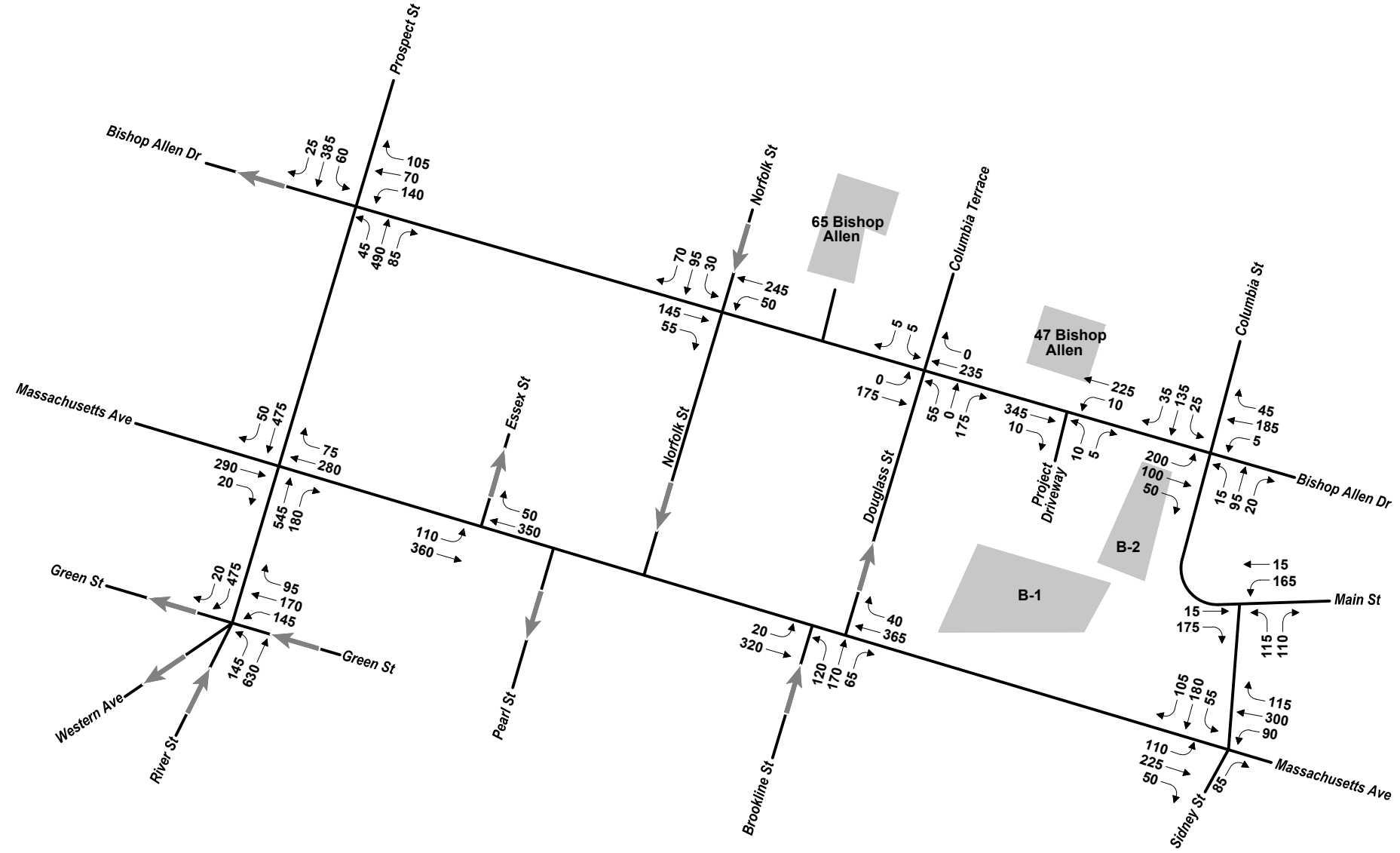


Not to Scale

NOTE: Existing volumes collected on Wednesday, May 18, 2016

Figure 2.c.1

2016 Existing Condition Vehicle Volume
Morning Peak Hour
Mass + Main
Cambridge, MA

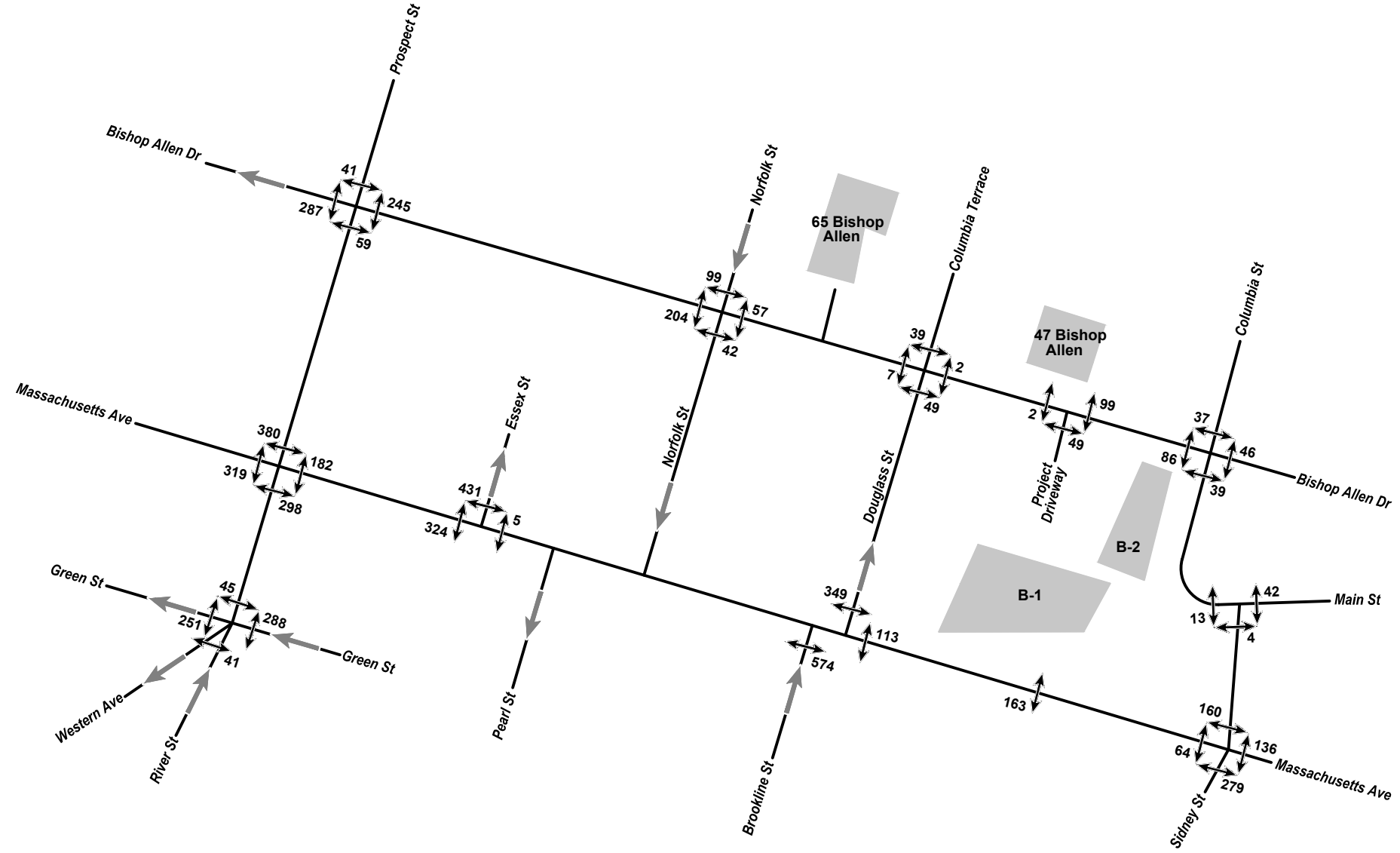


Not to Scale

NOTE: Existing volumes collected on Wednesday, May 18, 2016

Figure 2.c.2

2016 Existing Condition Vehicle Volume
Evening Peak Hour
Mass + Main
Cambridge, MA

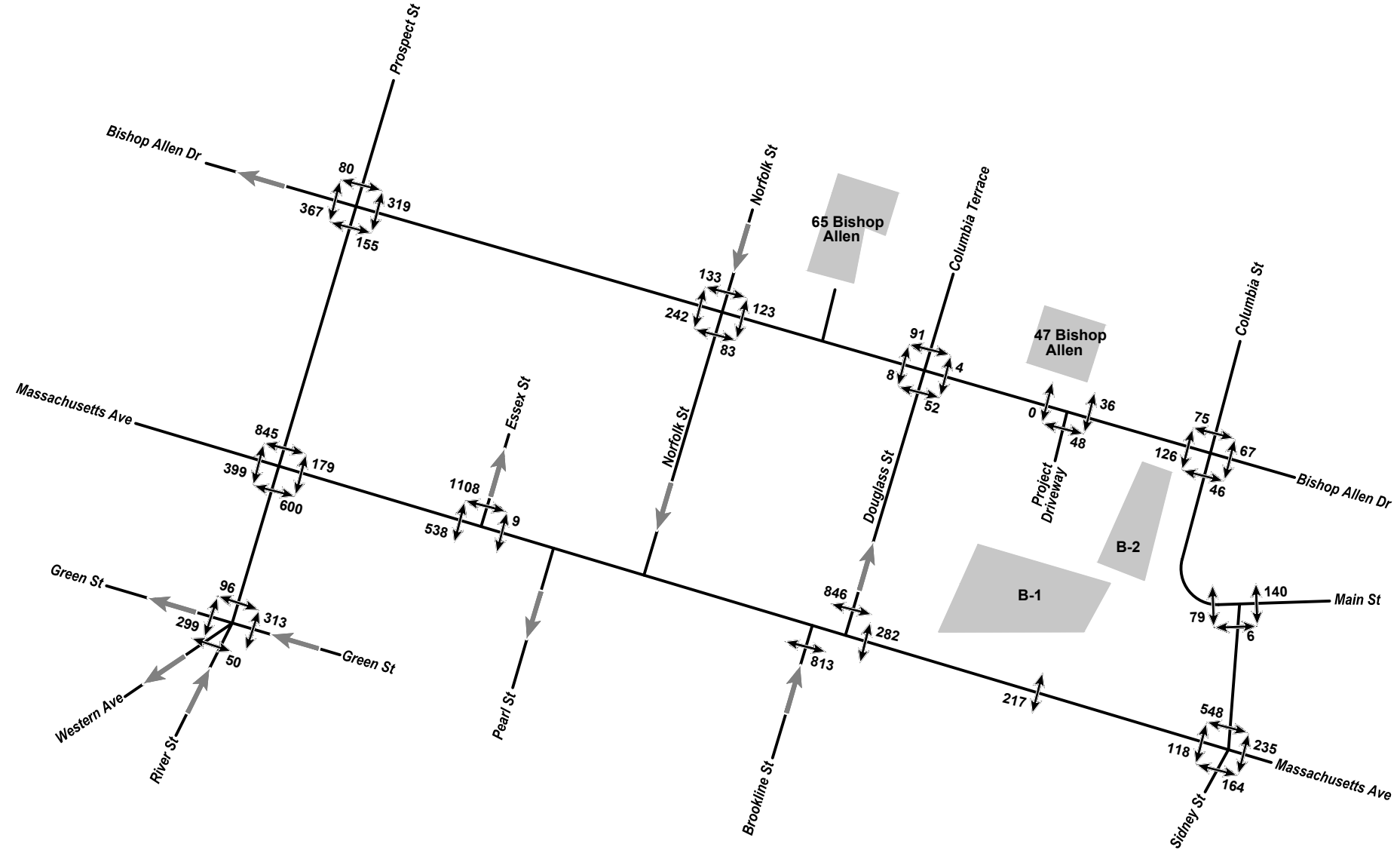


Not to Scale

NOTE: Existing volumes collected on Wednesday, May 18, 2016

Figure 2.c.3

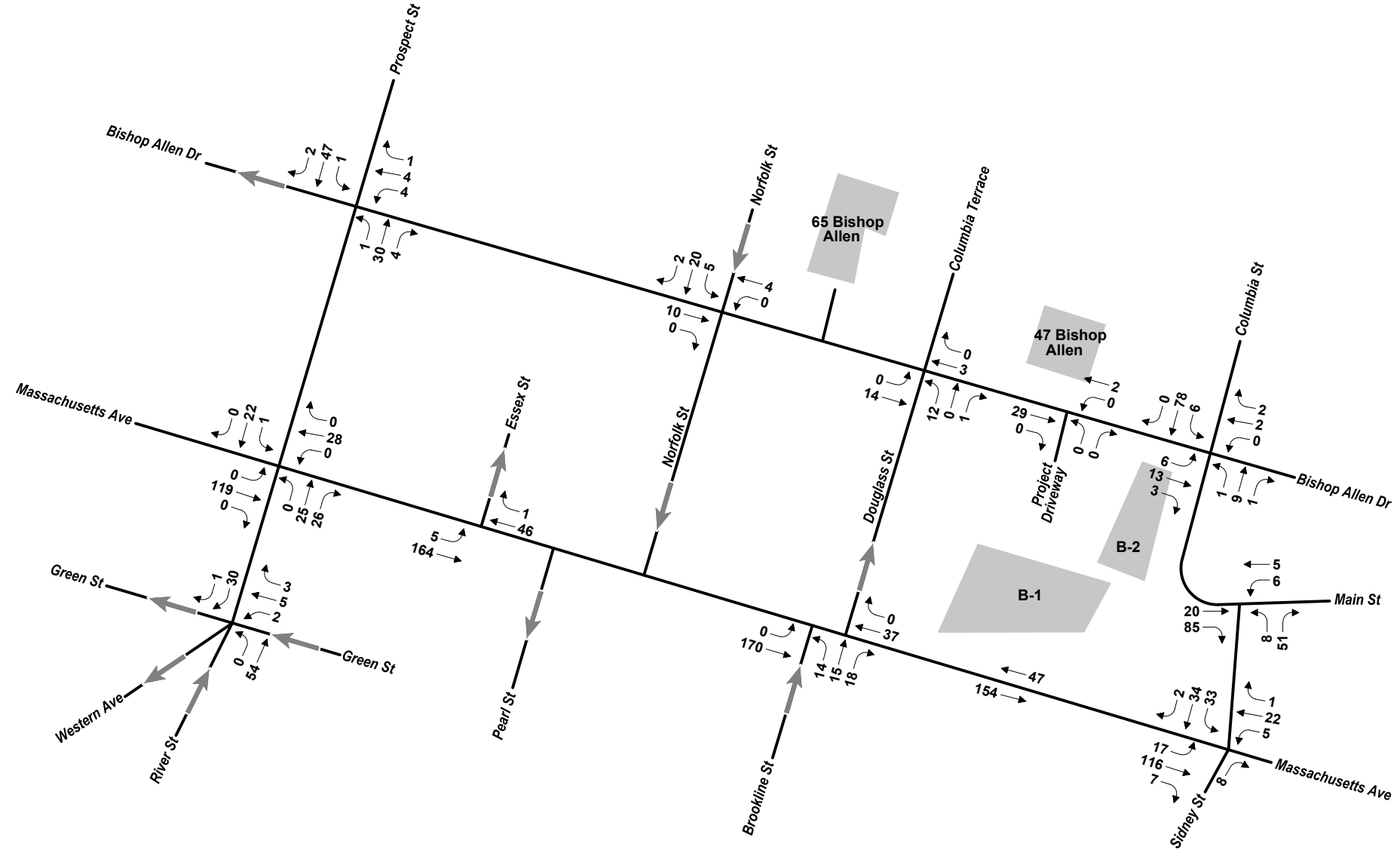
2016 Existing Condition Pedestrian Volume
Morning Peak Hour
Mass + Main
Cambridge, MA



Not to Scale
NOTE: Existing volumes collected on Wednesday, May 18, 2016

Figure 2.c.4

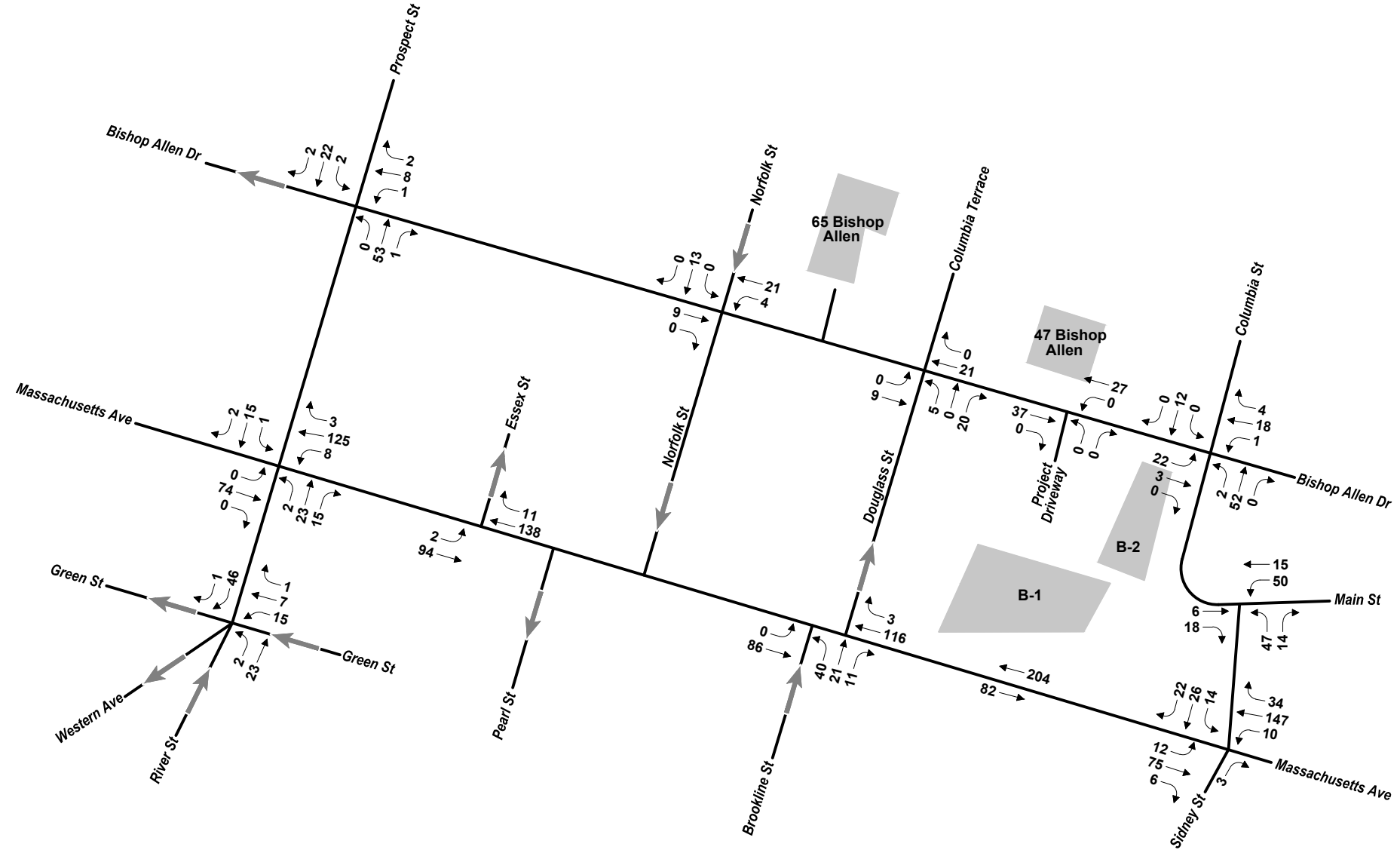
2016 Existing Condition Pedestrian Volume
Evening Peak Hour
Mass + Main
Cambridge, MA



Not to Scale
NOTE: Existing volumes collected on Wednesday, May 18, 2016

Figure 2.c.5

2016 Existing Condition Bicycle Volume
Morning Peak Hour
Mass + Main
Cambridge, MA

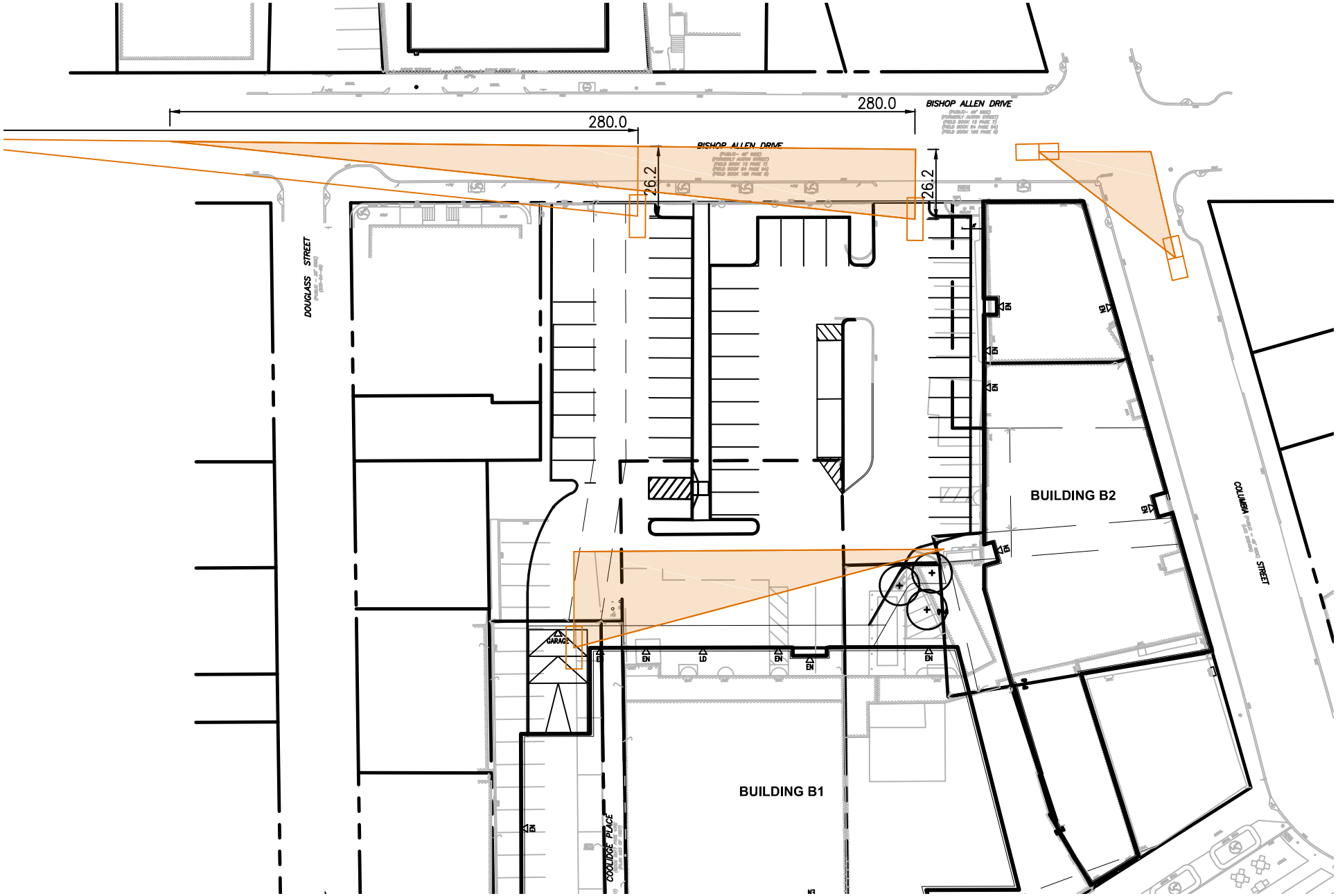


Not to Scale

NOTE: Existing volumes collected on Wednesday, May 18, 2016

Figure 2.c.6

2016 Existing Condition Bicycle Volume
Evening Peak Hour
Mass + Main
Cambridge, MA



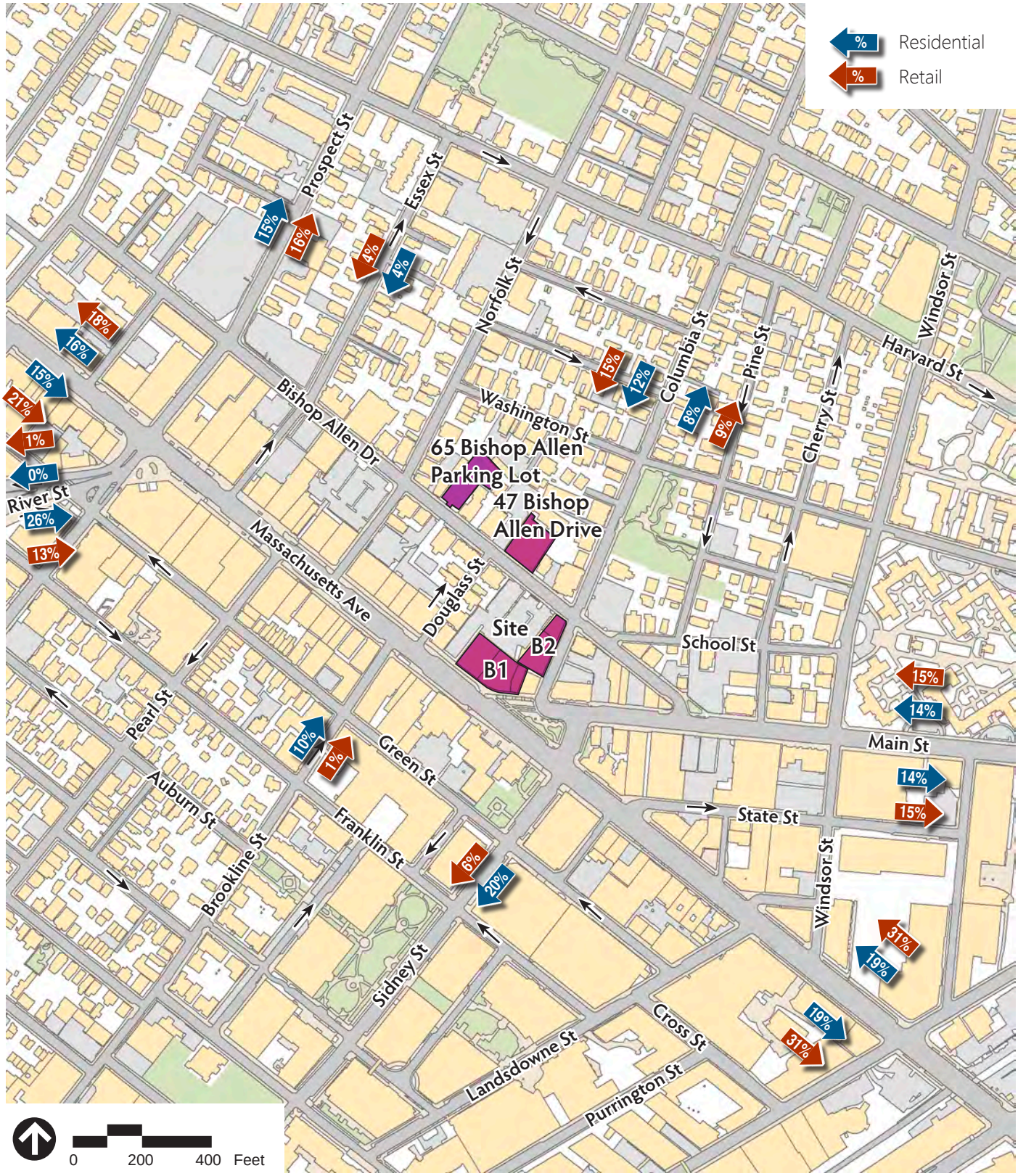
0 25 50 100 Feet

Driver Sight Line Evaluation

Mass + Main
Cambridge, MA

Figure 3.c.1

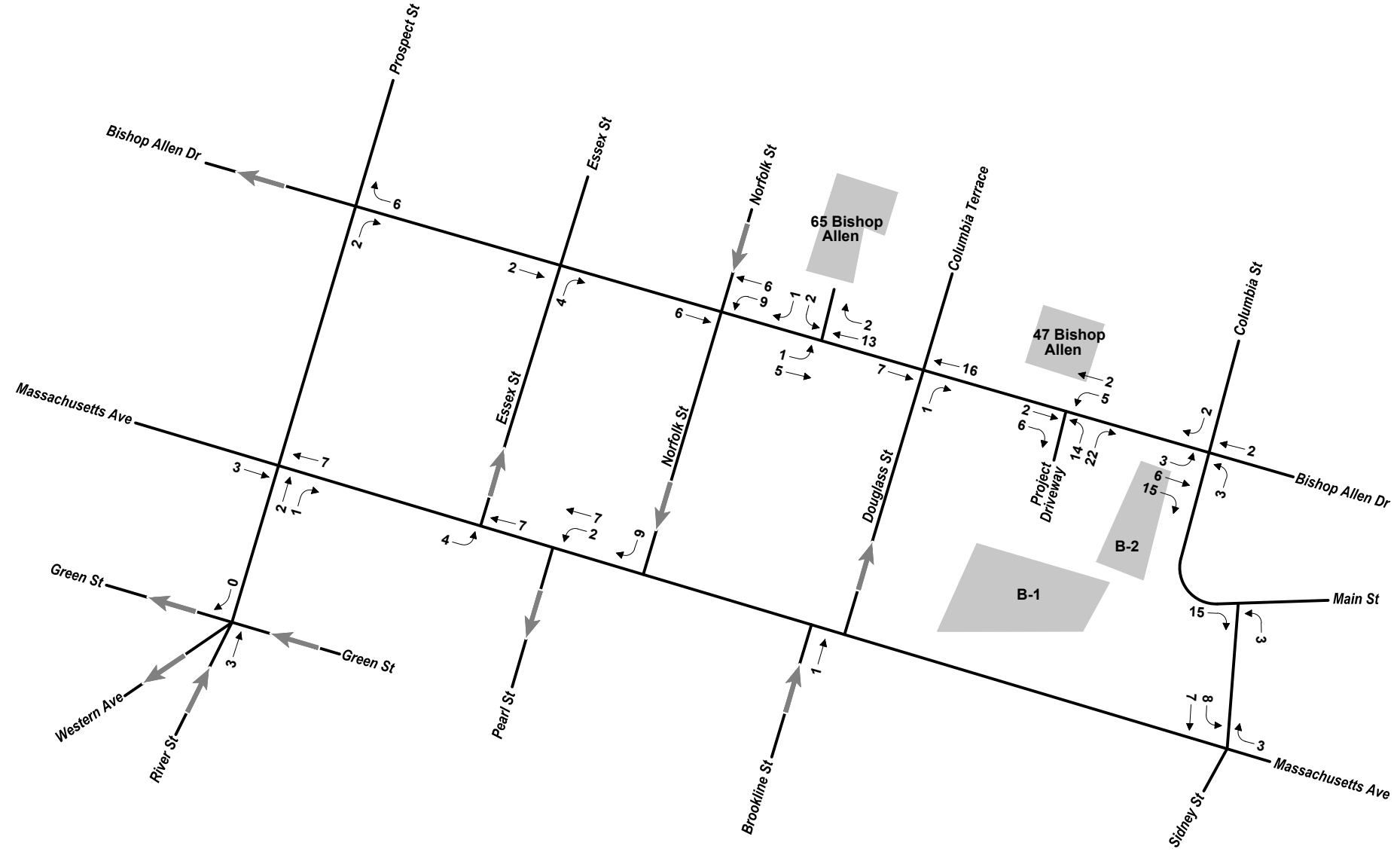
July 2016



Source: City of Cambridge GIS

Figure 3.c.2
Trip Distribution

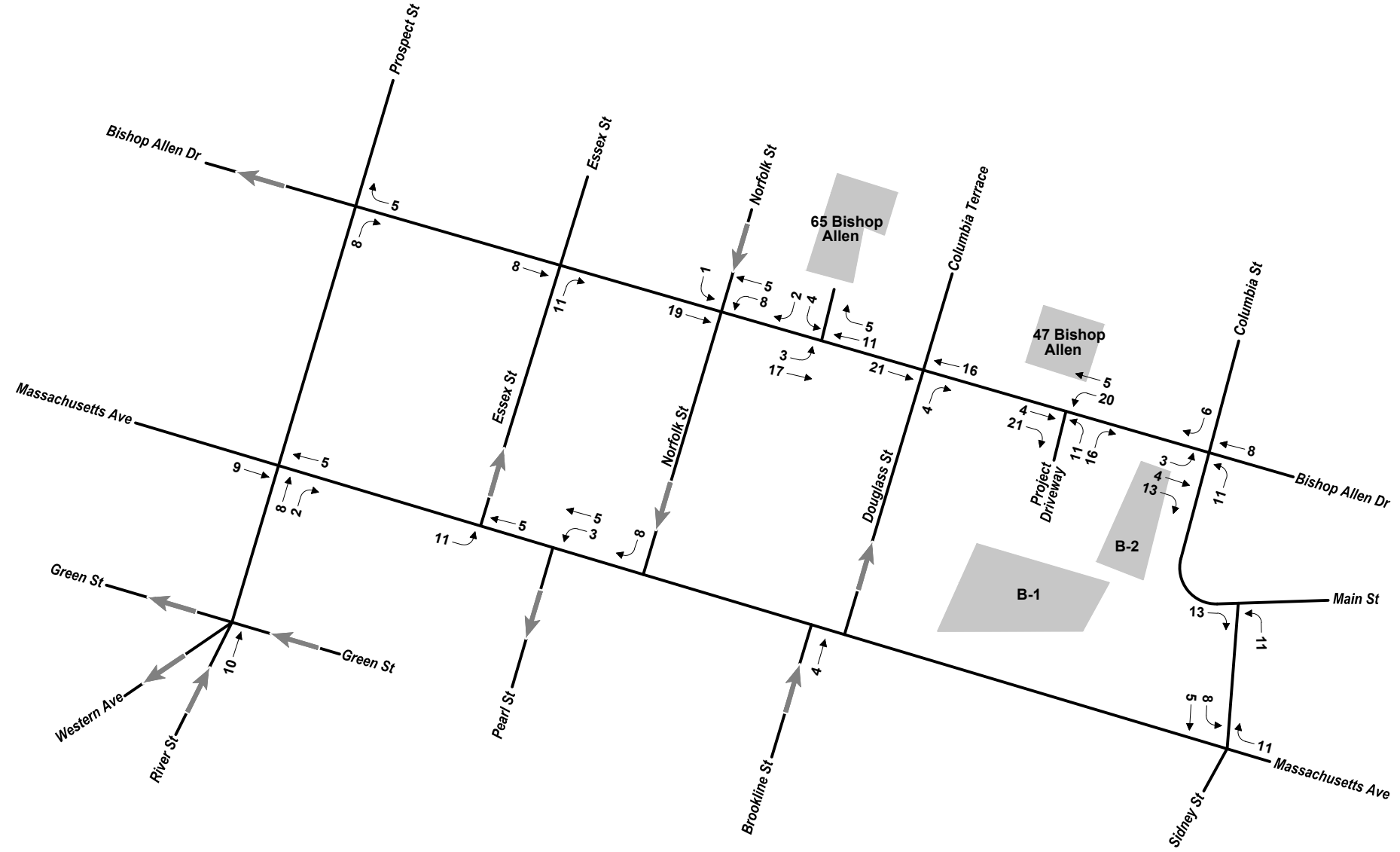
Mass + Main
Cambridge, Massachusetts



Not to Scale

Figure 3.c.3

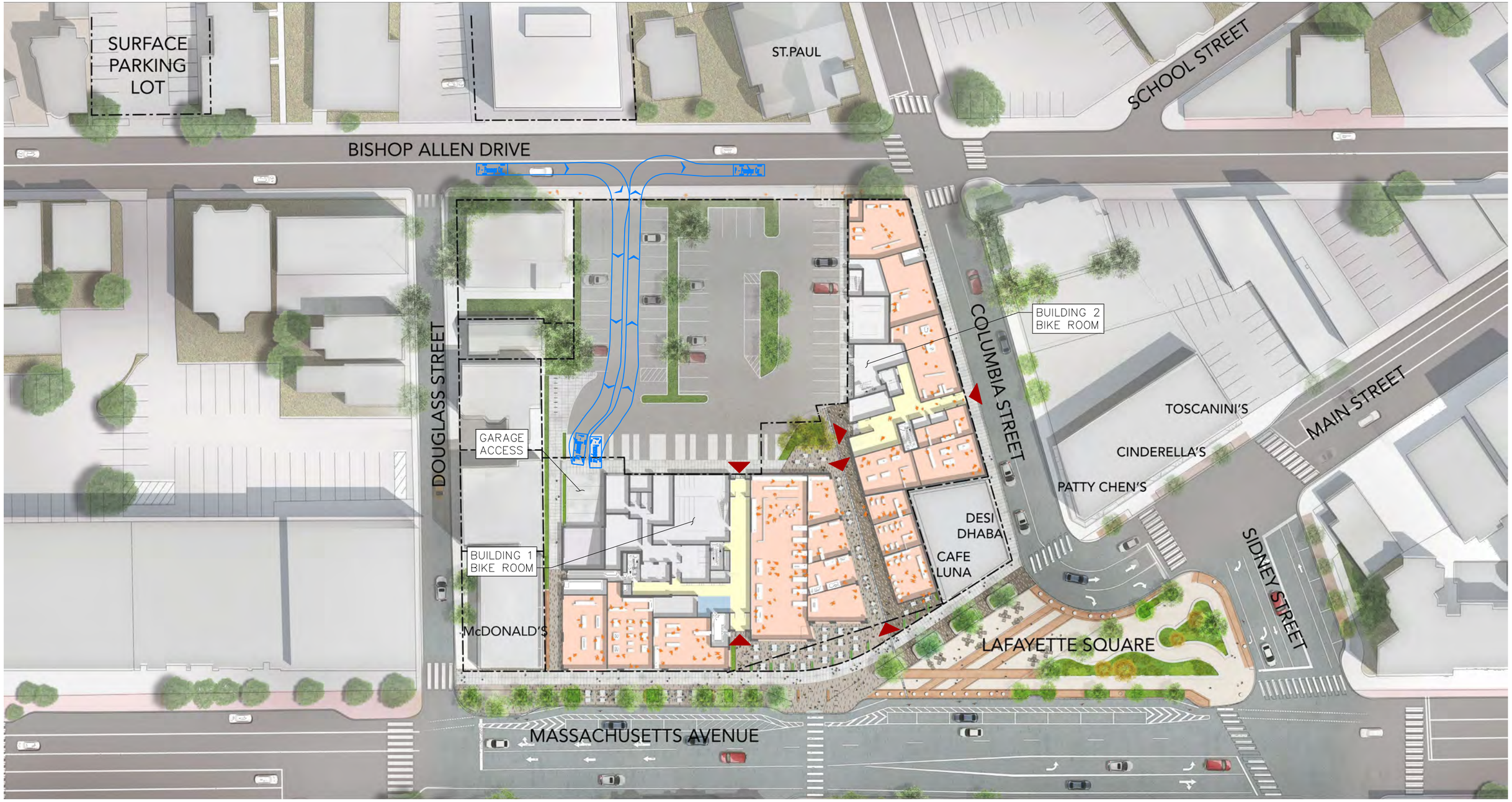
Project Generated Trips
Morning Peak Hour
Mass + Main
Cambridge, MA



Not to Scale

Figure 3.c.4

Project Generated Trips
Evening Peak Hour
Mass + Main
Cambridge, MA



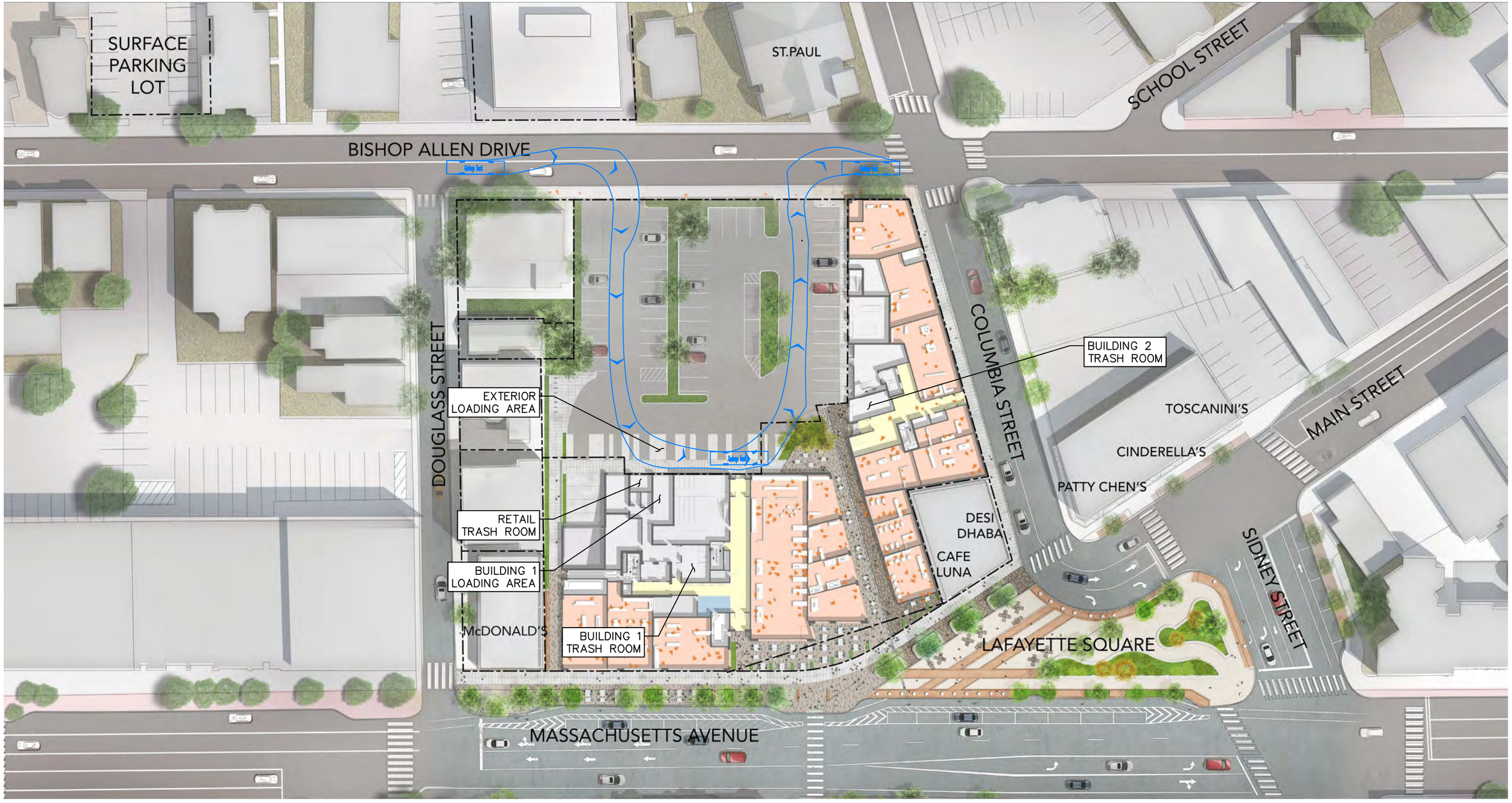
Source: Twining Properties

Major Pedestrian Access Points

0 25 50 100 Feet

Figure 3.d.1
Site Access
Passenger Car - IN and OUT
Mass + Main
Cambridge, MA

July 2016

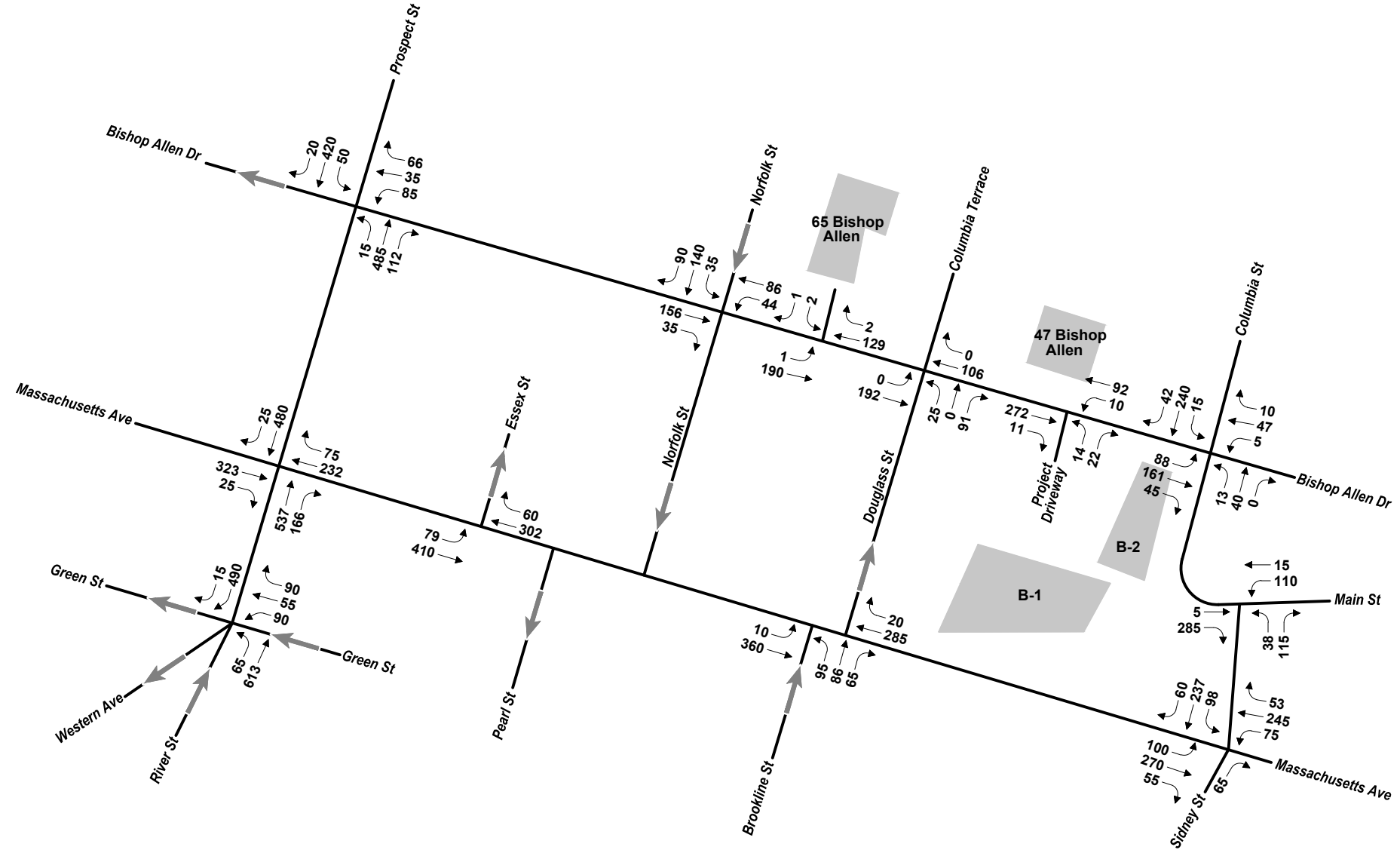


Source: Twining Properties

0 25 50 100 Feet

Figure 3.d.2
Loading Vehicle Access
"U" Access within City Lot
Mass + Main
Cambridge, MA

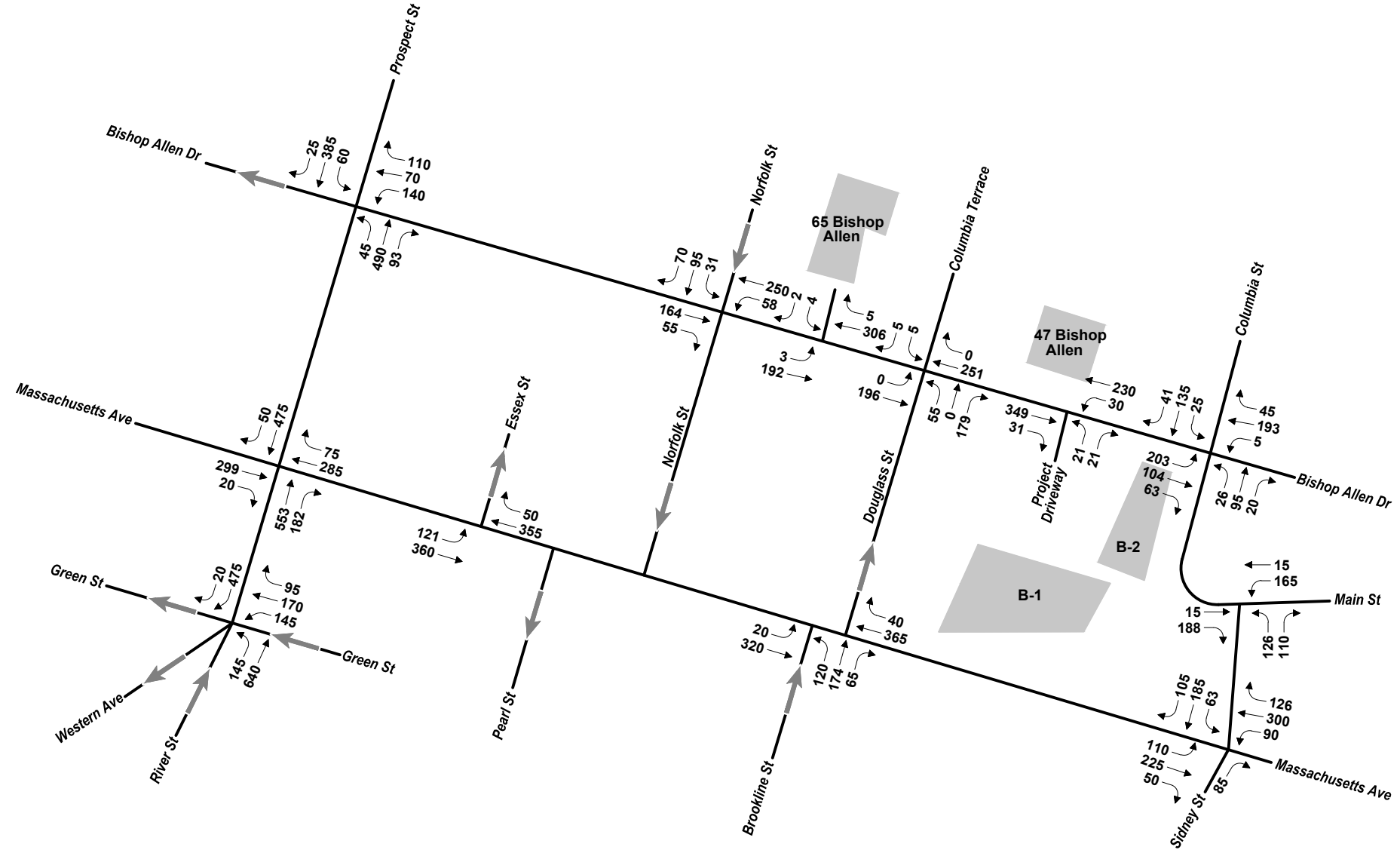
July 2016



Not to Scale

Figure 5.b.1

2016 Build Condition Vehicle Volume
Morning Peak Hour
Mass + Main
Cambridge, MA



Not to Scale

Figure 5.b.2

2016 Build Condition Vehicle Volume
Evening Peak Hour
Mass + Main
Cambridge, MA

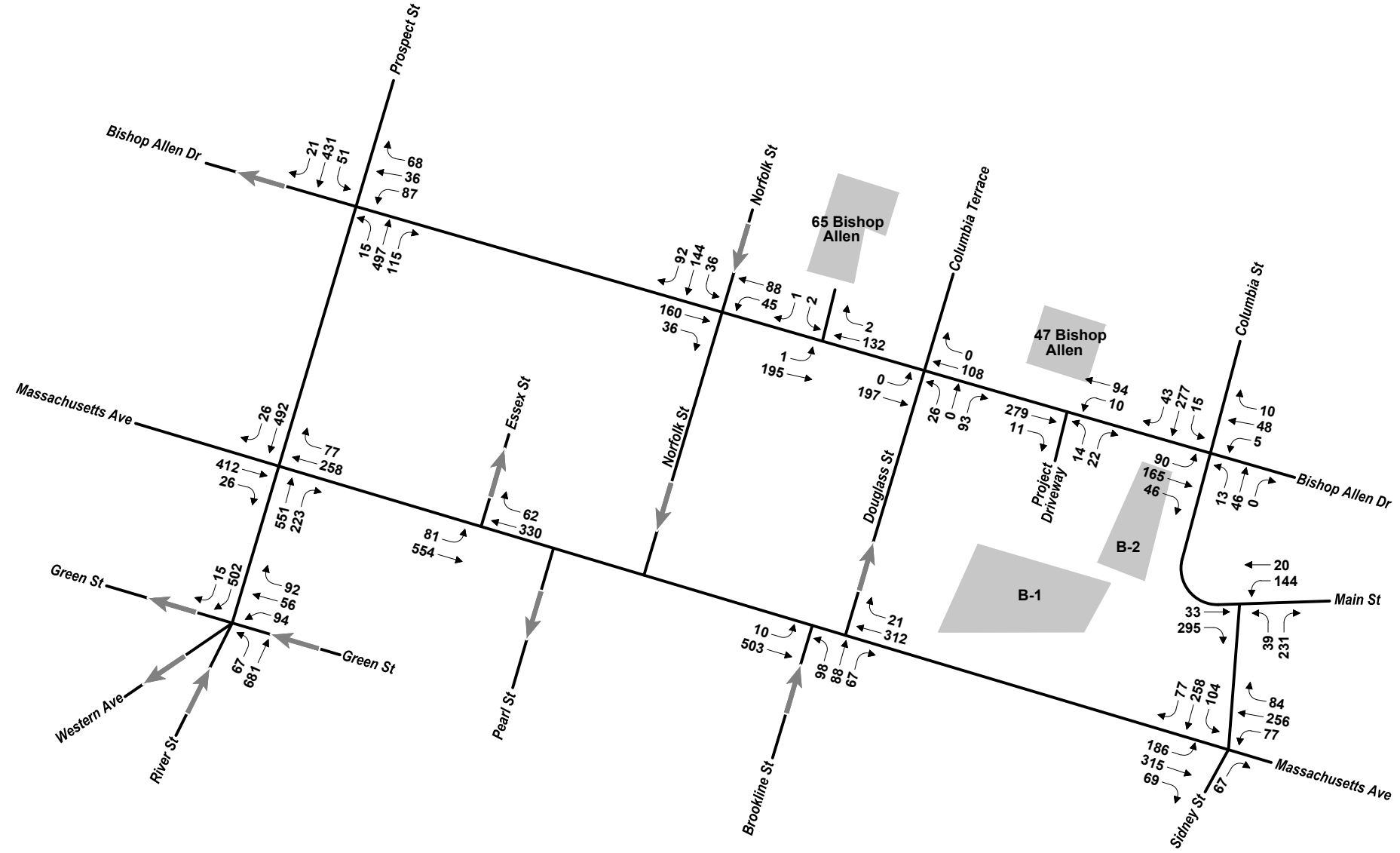
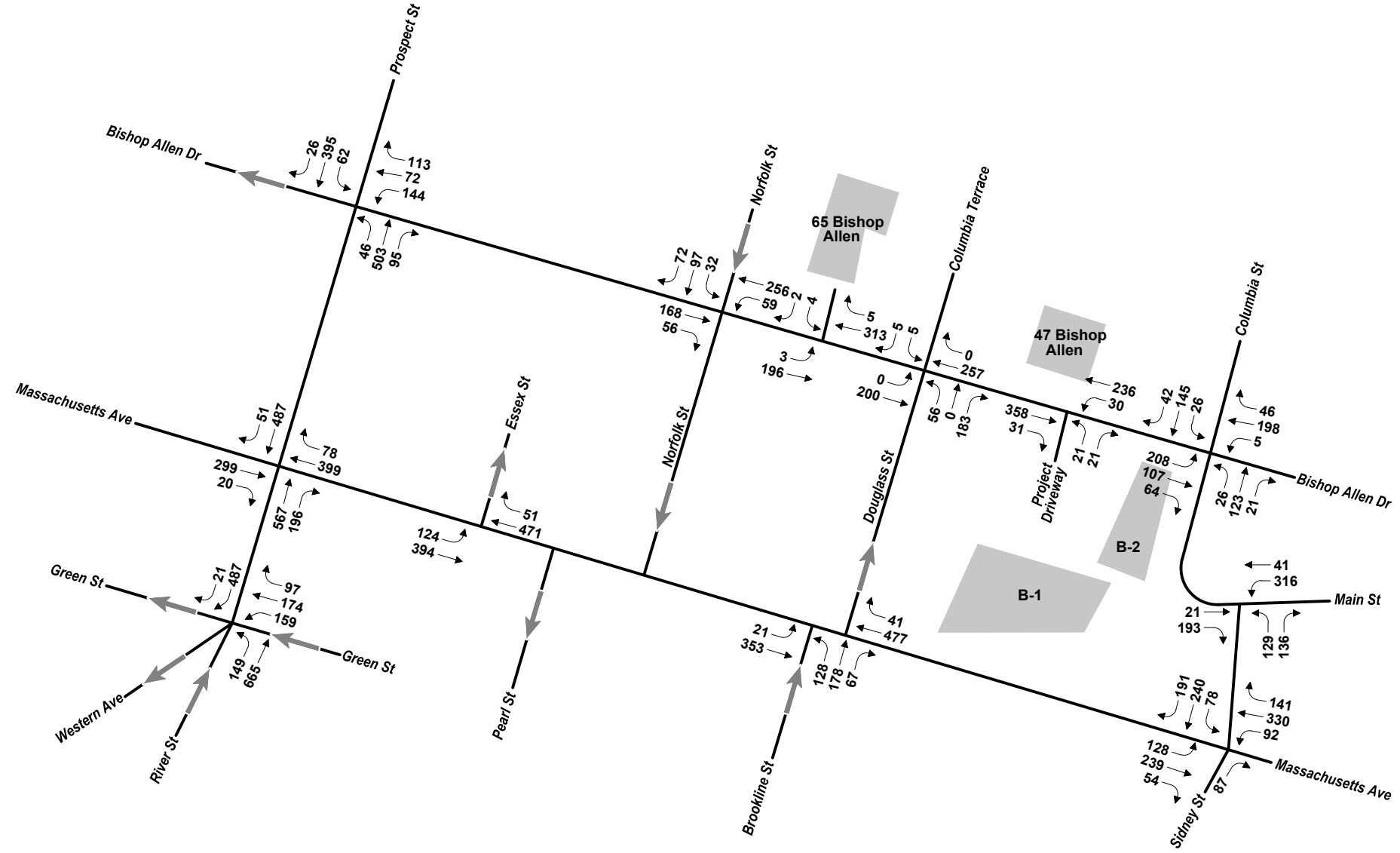


Figure 5.c.1

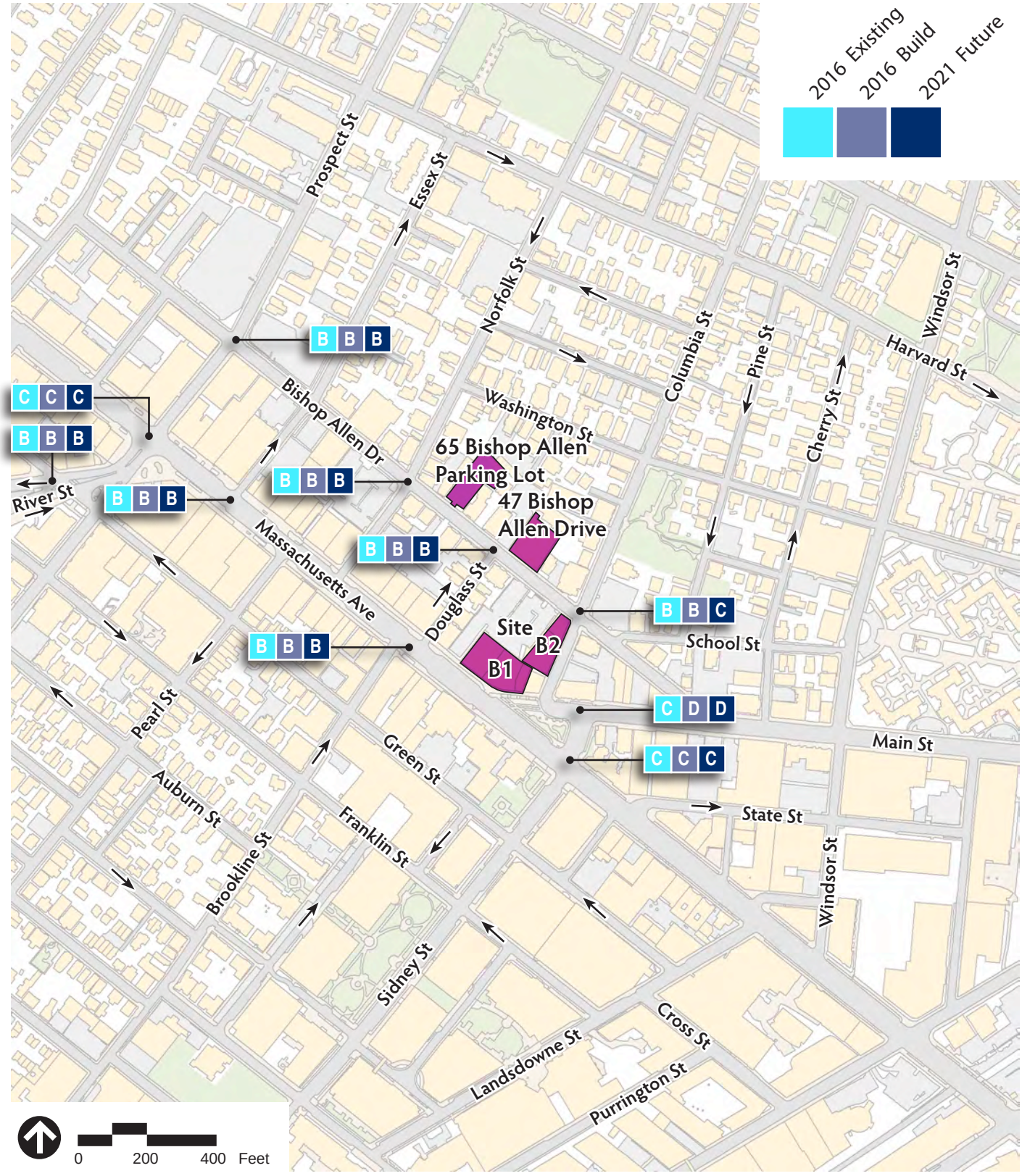
2021 Future Condition Vehicle Volume
Morning Peak Hour
Mass + Main
Cambridge, MA



Not to Scale

Figure 5.c.2

2021 Future Condition Vehicle Volume
Evening Peak Hour
Mass + Main
Cambridge, MA

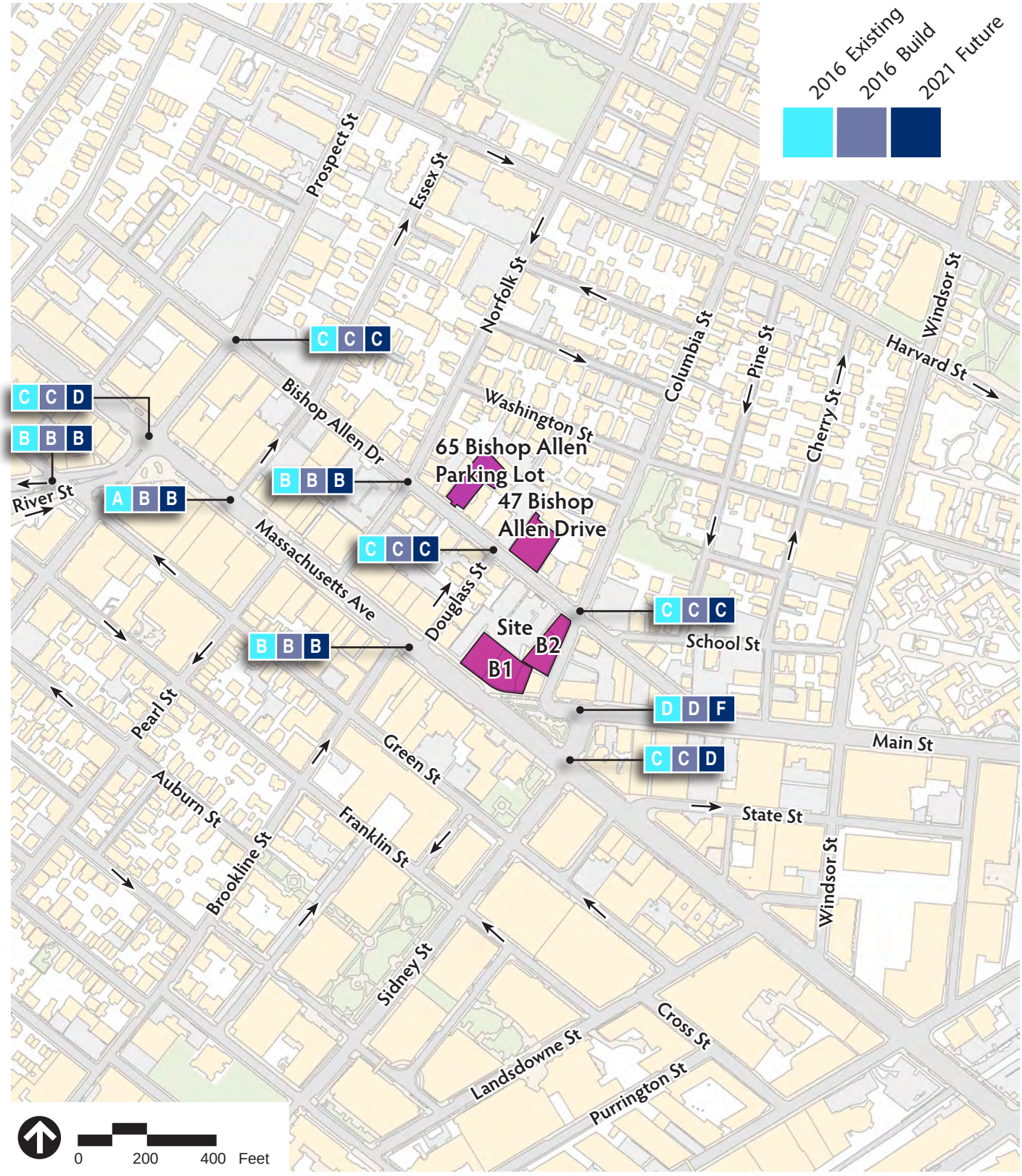


Source: City of Cambridge GIS

Figure 6.a.1

AM Peak Hour Vehicular Level of Service Comparison

Mass + Main
Cambridge, Massachusetts

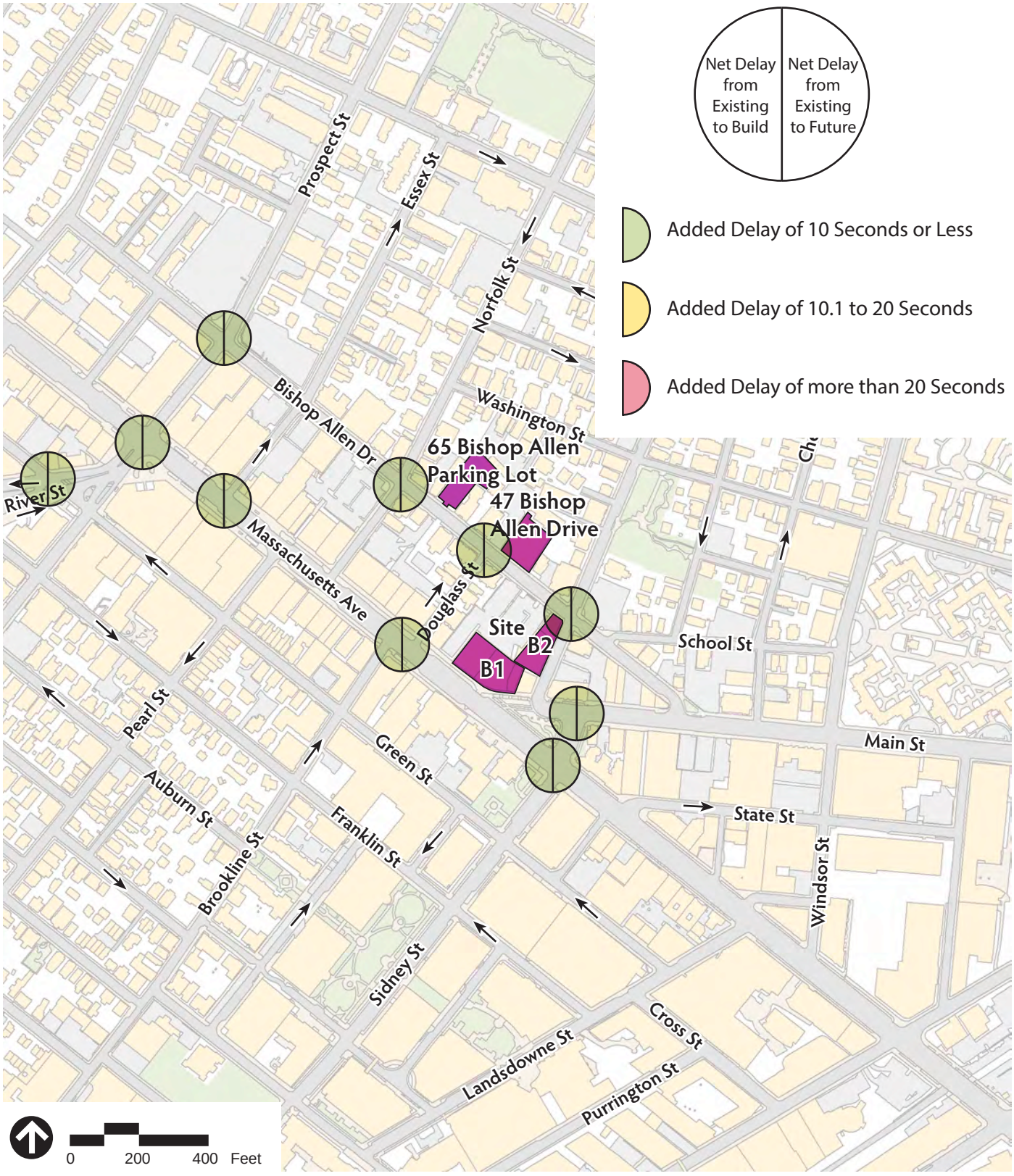


Source: City of Cambridge GIS

Figure 6.a.2

PM Peak Hour Vehicular Level of Service Comparison

Mass + Main
Cambridge, Massachusetts

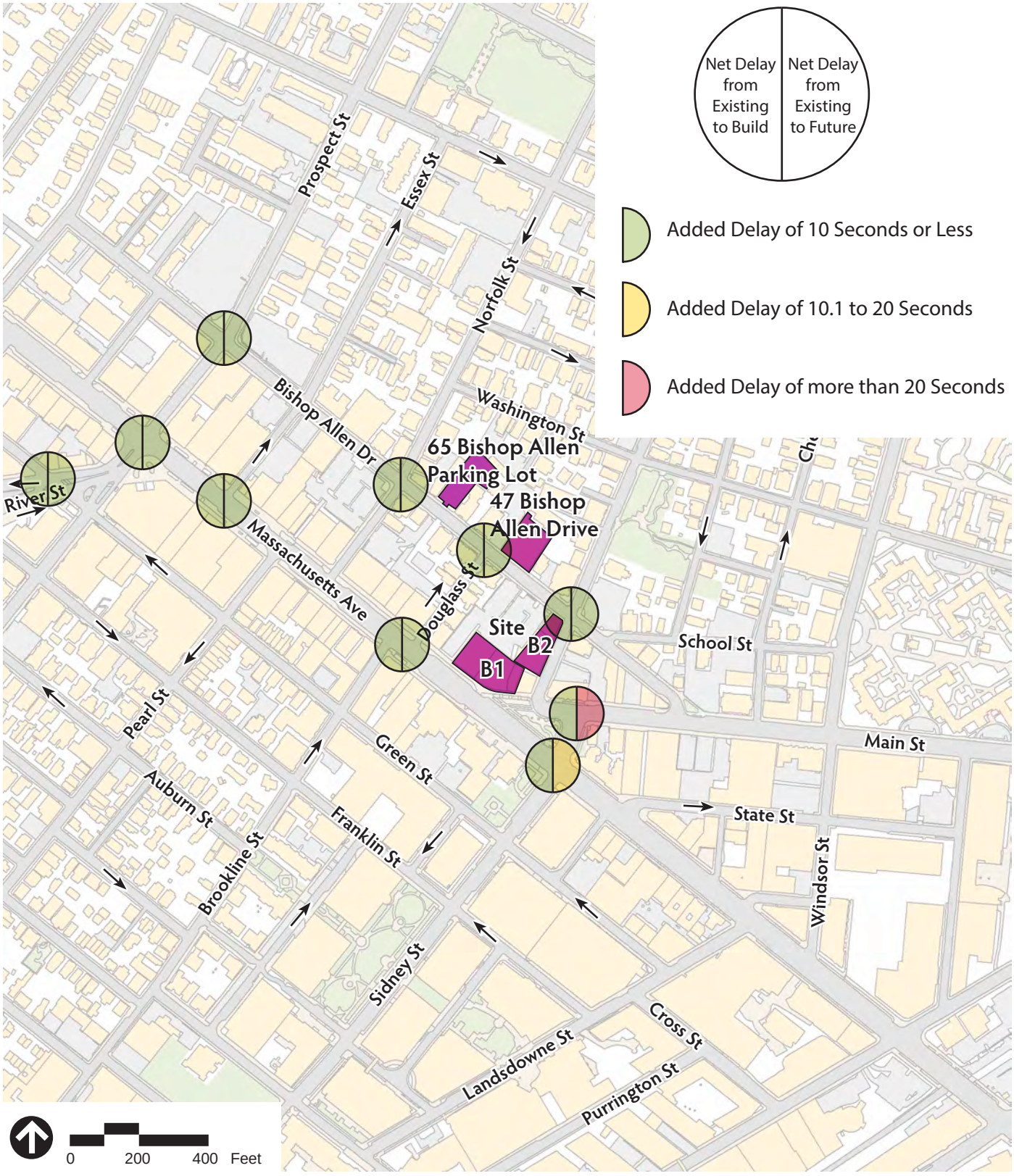


Source: City of Cambridge GIS

Figure 6.a.3

Net Change in Vehicular Delay
AM Peak Hour

Mass + Main
Cambridge, Massachusetts

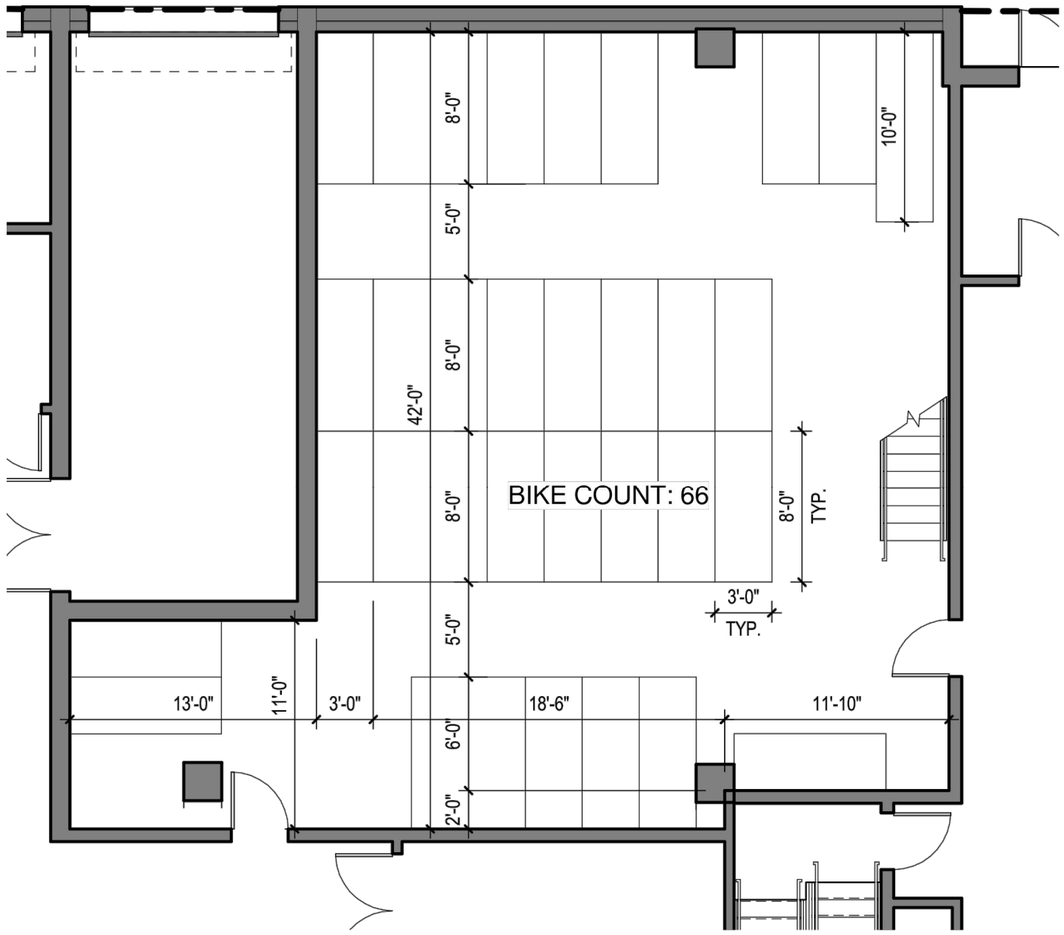


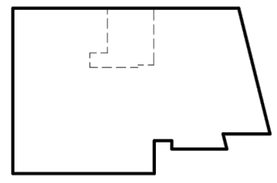
Source: City of Cambridge GIS

Figure 6.a.4

Net Change in Vehicular Delay
PM Peak Hour

Mass + Main
Cambridge, Massachusetts





Source: CBT

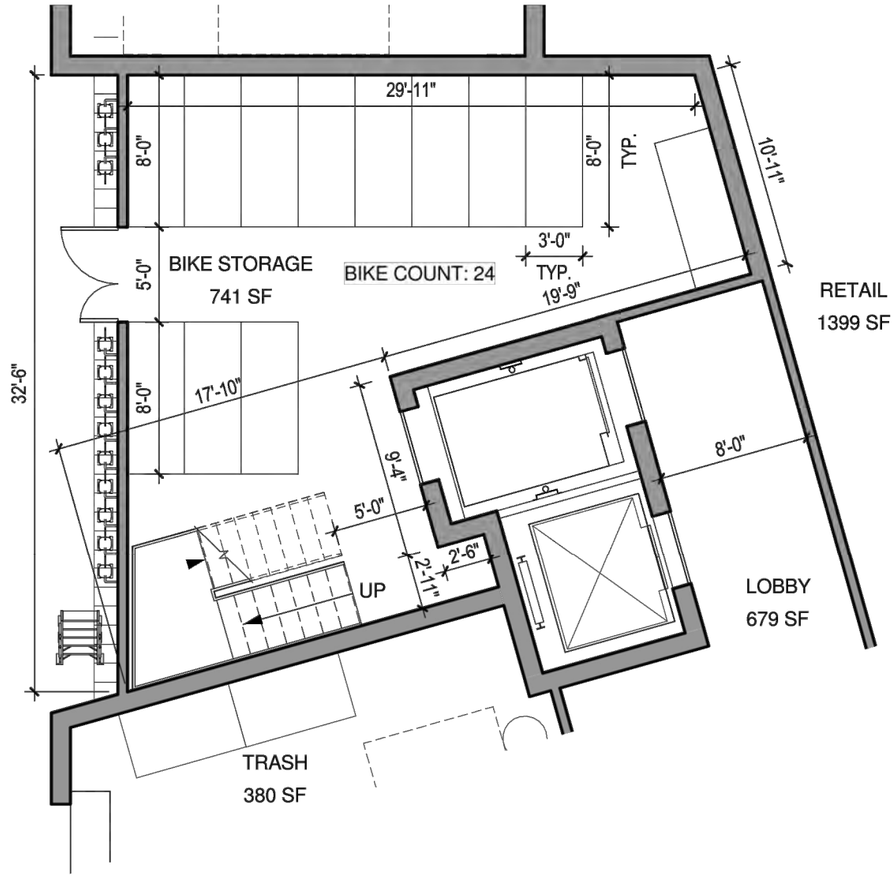
0 4 8 16 Feet

Figure 9.b.1
Long-Term Bicycle Parking - B-1
Level 1
Mass + Main
Cambridge, MA

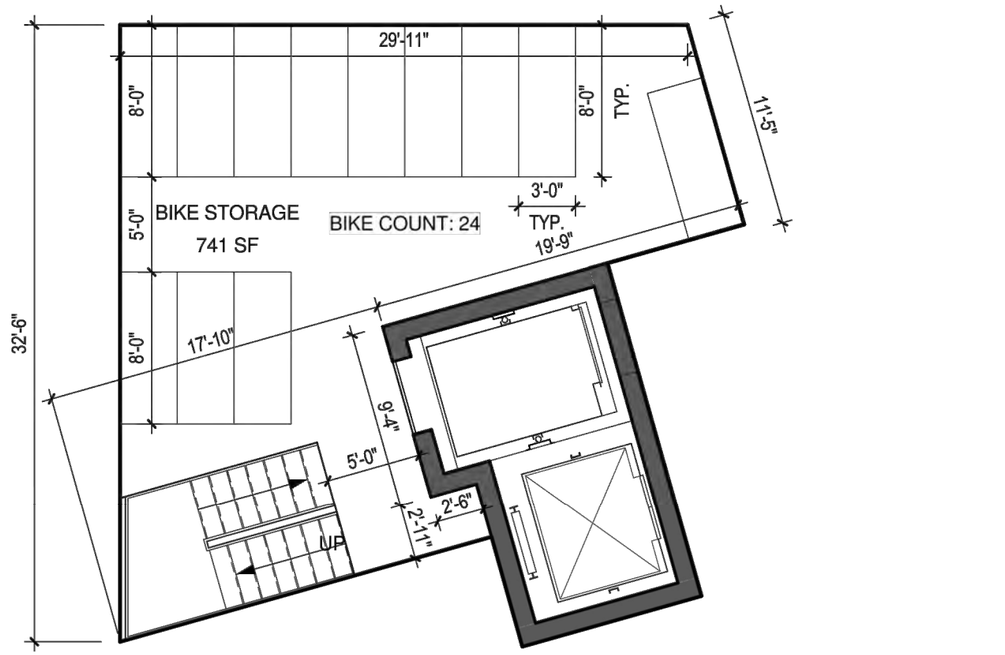
Source: CBT

0 4 8 16 Feet

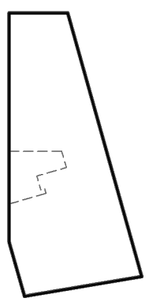
Figure 9.b.2
Long-Term Bicycle Parking - B-1
Mezzanine Level
Mass + Main
Cambridge, MA



1 First Floor Plan
1/8" = 1'-0"



2 Mezzanine Plan
1/8" = 1'-0"



Source: CBT

0 4 8 16 Feet

Figure 9.b.3
Long-Term Bicycle Parking - B-2

Mass + Main
Cambridge, MA

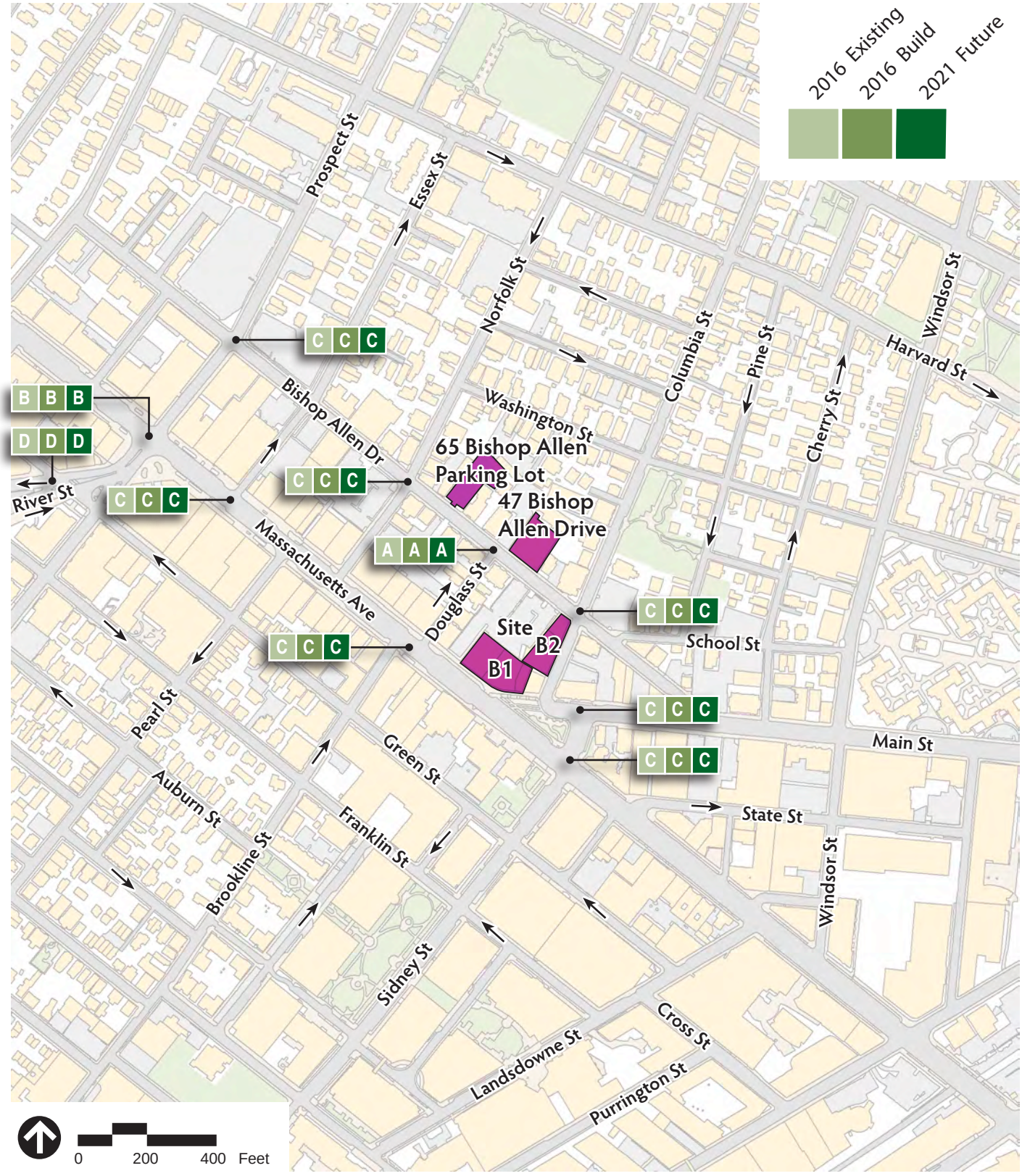
Source: Twining Properties and cbt Architects

BICYCLE RACKS (2 BIKES / RACK)
21 RACKS, TOTAL OF 42 SPACES

0 25 50 100 Feet

Figure 9.b.4

Short-Term Bicycle Parking
Mass + Main
Cambridge, MA



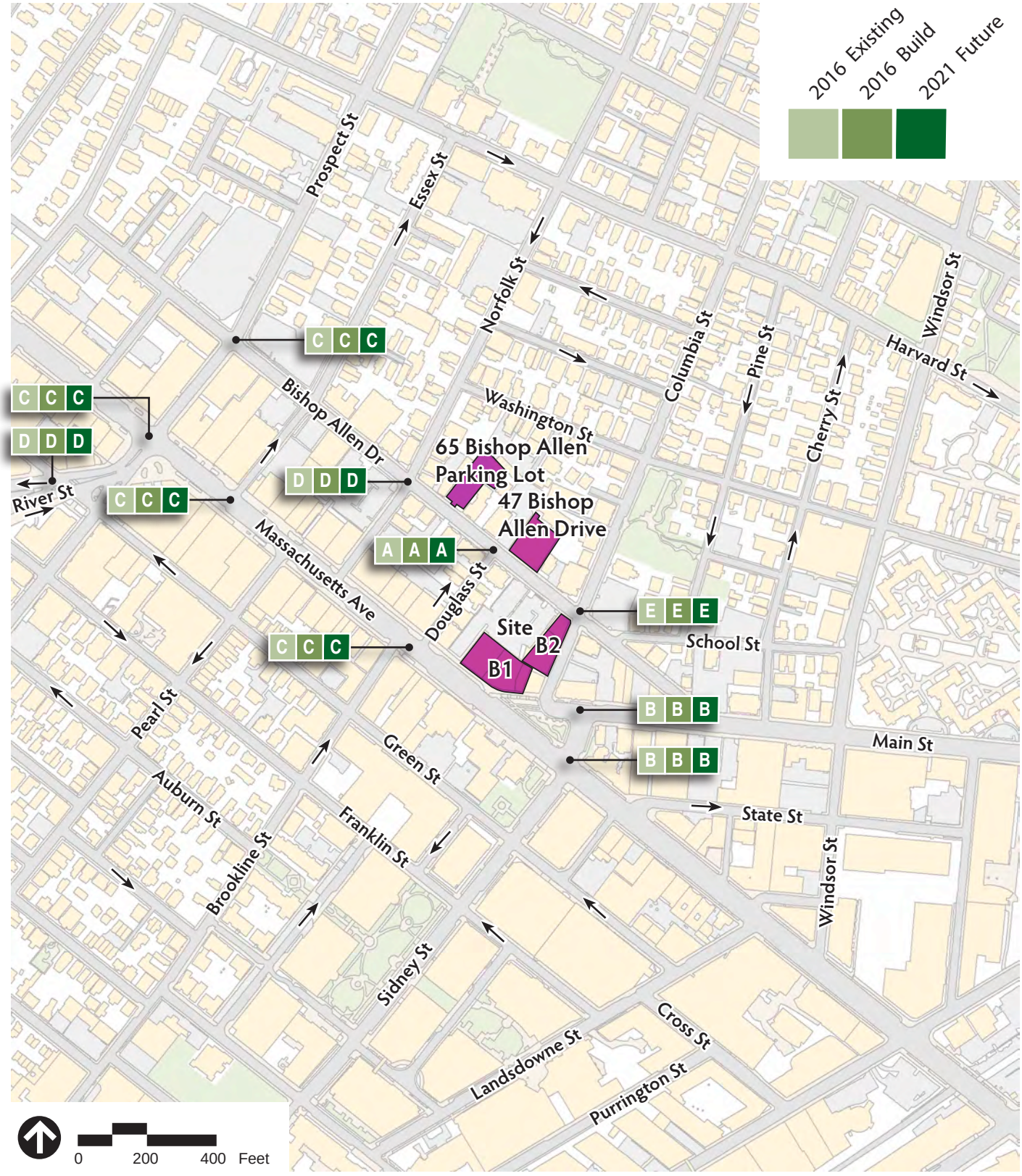
Source: City of Cambridge GIS

Note: When multiple crossings are present, the crossing with the lowest LOS is shown

Figure 11.a.1

AM Peak Hour Pedestrian Level of Service Comparison

Mass + Main
Cambridge, Massachusetts



Source: City of Cambridge GIS

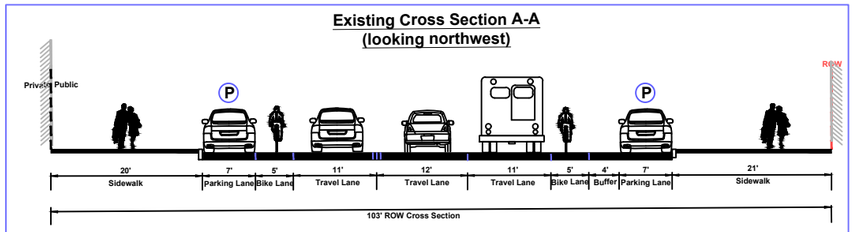
Note: When multiple crossings are present, the crossing with the lowest LOS is shown

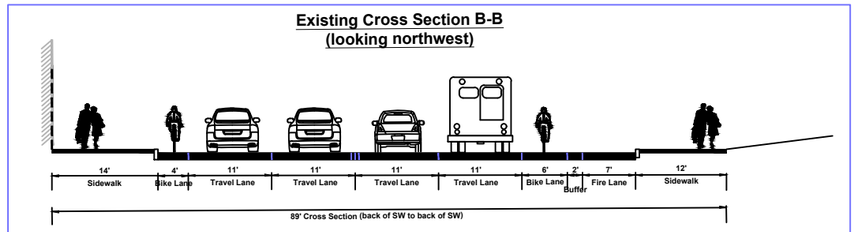
Figure 11.a.2

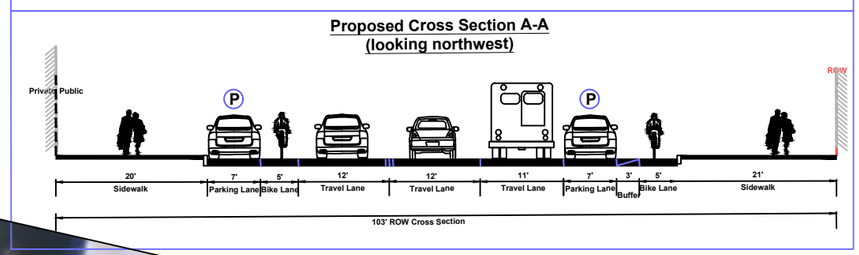
PM Peak Hour Pedestrian Level of Service Comparison

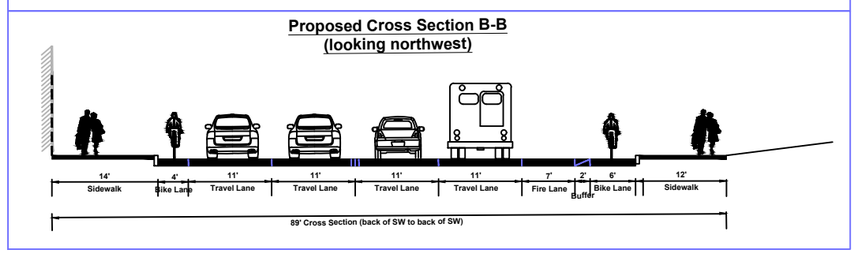
Mass + Main
Cambridge, Massachusetts

\\vhb\proj\Boston\13471.00\cad\ld\Traffic\Separated Bike Lane - Sketches.dwg





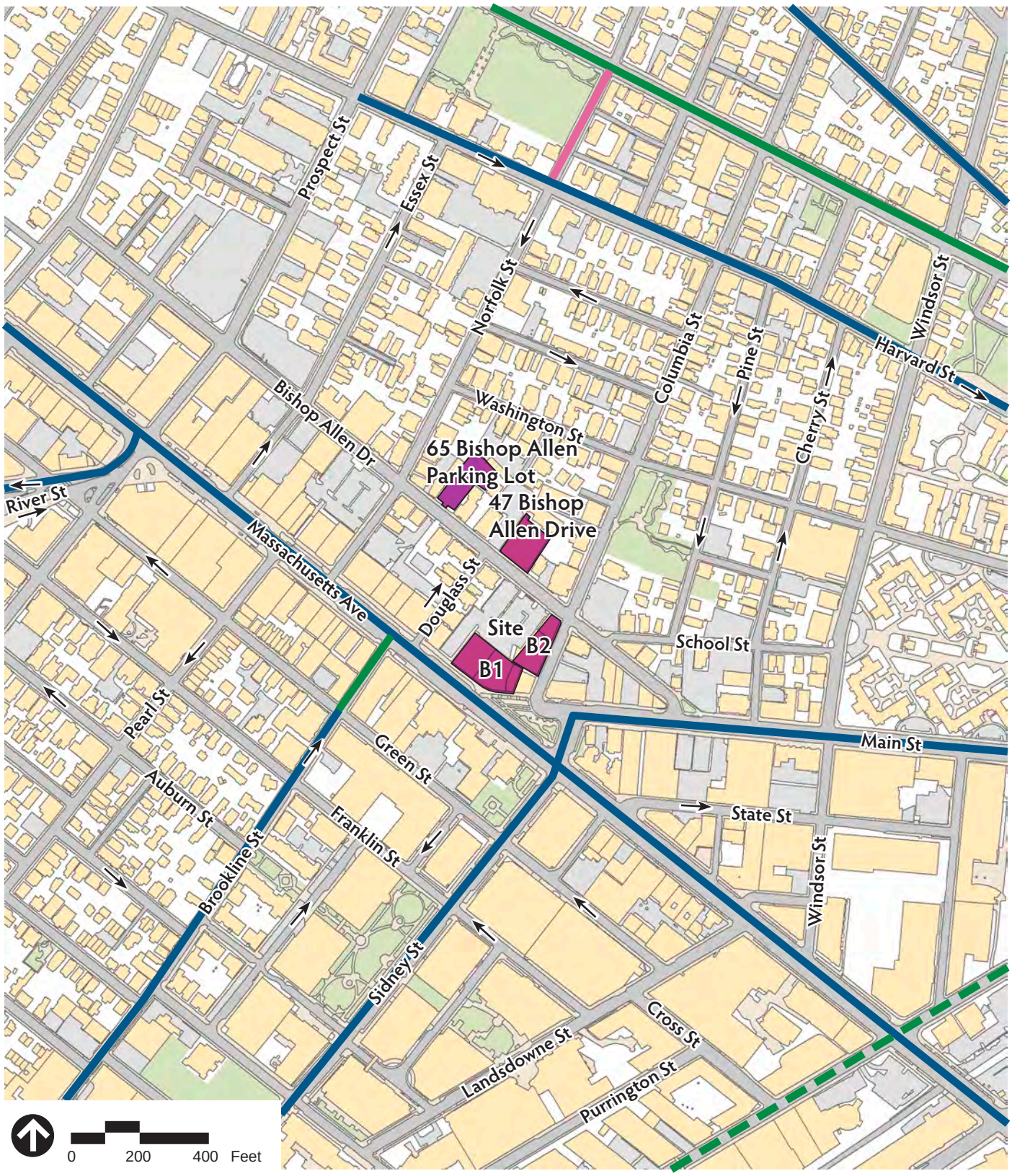




Separated Bicycle Lane Concept
Massachusetts Avenue at Project
Mass + Main
Cambridge, MA

Figure 12.b.1

July 2016



Source: City of Cambridge GIS

Bike Lane

Contra-Flow

Shared Lane Pavement Marking

Planned Shared Lane Pavement Marking

Figure 12.b.2

Bicycle Facilities

Mass + Main
Cambridge, Massachusetts