King Open / Cambridge Street Schools & Community Complex Project

Cambridge, Massachusetts

PREPARED FOR

City of Cambridge
Cambridge Public Schools

PREPARED BY

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Introduction & Project Overview

On behalf of the City of Cambridge Public School (CPS) Department, Vanasse Hangen Brustlin, Inc. (VHB) has conducted a Traffic Study for the proposed construction of the King Open/Cambridge Street Upper Schools & Community Complex Project, which is intended to replace the existing school and be rebuilt at the school's current location at 850 Cambridge Street in Cambridge, Massachusetts.

The Traffic Study responds to the scope dated March 18, 2016 defined by the City of Cambridge Traffic, Parking and Transportation (TP&T) Department in response to VHB's Request for Scoping dated March 3, 2016. A copy of the City's scoping letter is included in the Appendix for reference. The Traffic Study has been prepared in conformance with the current City of Cambridge Guidelines for Traffic Studies.

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;
- Traffic Study, 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 Traffic Study Summary Sheets and Planning Board Criteria Performance Summary are included in this document. Supplementary data and analysis worksheets are provided in a supporting Technical Appendix. Electronic files for Automatic Traffic Recorder (ATR) counts, Turning Movement Counts (TMC), and Synchro analyses are included on an accompanying compact disk (CD).

Project Description & Overview

The King Open and Cambridge Upper Elementary Schools are public schools in the City of Cambridge that serve 566 students in Grades Pre-K though 8 and employ 140 staff, some of whom are part-time employees. The existing site includes approximately 120,000 square feet (SF) of facility space, providing academic, library, pool and community uses.

The City of Cambridge proposes to completely reconstruct the school into a new complex that will better serve the existing and future planned uses on this site. The new Project will include an expanded library layout, a reconstructed pool, more space for academic and human services activities and a new space dedicated to Cambridge Public School (CPS) Administration offices.

- Figure A presents a regional context map
- Figure B presents study area intersections
- Figure C presents the proposed Site Plan
- Figure D presents the proposed Vehicle Parking Plan
- Figure E presents the proposed Bicycle Parking Plan

The proposed Project, as currently envisioned, involves the demolition of all existing buildings (including the pool and library) and construction of a new school complex that will include the following redesigned components:

- King Open School
- Cambridge Upper School
- Human Services Programs (Pre-school and After-school)
- Valente Branch Library
- Gold Star Pool
- Cambridge Public School (CPS) Department Administration Offices
- Underground parking garage with 105 parking spaces for vehicles as well as 92 long-term and 118 short-term bicycle parking spaces

As shown in Figure A, the Project Site is bounded by Cambridge Street to the north, Willow Street to the west, Berkshire Street to the east and Donnelly Field to the south. The existing Project Site is registered for 55 vehicle parking spaces, however historically the school was using approximately 86 spaces in multiple surface lots. The old site provided short-term bicycle parking racks at both schools' entrances, along the east sidewalk of Willow Street, the west sidewalk of Berkshire Street and near the Gold Star Pool entrance. No long-term bicycle parking was provided at the existing site.

Existing student activity, including school bus drop-off/pick-up, parent drop-off/pick-up and bicycle parking, is administered from Cambridge Street, with some modest parent pick-up activity occurring along Berkshire Street for Upper School during the afternoon dismissal period only, and ASD bus activity occurring off Berkshire Street.

The proposed Project will include replacement of existing academic, human services, library and pool spaces as well as the construction of new CPS administrative space. Of the total 273,000 GFA (Gross Floor Area) of newly constructed space, only approximately 21,500 SF is considered a new trip generator to the site. Although the school is expanding with respect to gross floor area, most of the incremental increase in space is intended to improve and right-size existing uses. The school's total population will experience only a modest increase in staffing and student enrollment.

The student enrollment is projected to grow by only 2 percent, from 566 students to approximately 580 students (approximately only 14 new students). Similarly, the school staff is anticipated to increase modestly, from 140 to 143 staff.

The existing library, pool, and human services spaces are expanding in gross floor area, and are not expected to contribute to an increase in employee or resident use. The school will gain more square footage to better accommodate its existing operations and to benchmark uses to current academic facility space standards. The only new addition to the school site will be the Cambridge Public School Department Administrative Offices which are anticipated to be relocated from 159 Thorndike Street to this new Site. Approximately 80 CPS staff are expected to be transferred to this new facility when completed.

A summary of the proposed Project program is presented in Table 1.

TABLE 1: PROPOSED SITE USES (GROSS FLOOR AREA "GFA") AND PARKING PROGRAM

Land Use	Size/Quantity	Note:
King Open & Cambridge Upper Schools	193,185 GFA	Exiting users
Valente Library	10,077 GFA	Exiting users
Gold Star Pool Building	5,624 GFA	Exiting users
CPS Admin Offices	21,919 GFA	New use on site
Mechanical Space and Parking Garage	42,746 GFA	
Total	***273,114 GFA***	
Vehicle Parking	105 Spaces	
Bicycle Parking	92 Long-Term Spaces	
	118 Short-Term Spaces	

The proposed mix of tandem and single vehicular parking spaces and long-term bicycle parking spaces will be accommodated in a single-level, underground garage with access from Berkshire Street, as shown in Figure C. Short-term bicycle parking spaces will be located at multiple building entrances. Both long- and short-term bicycle parking will comply with the City's Bicycle Parking Guidelines.

Planning Board Criteria Summary

Based on the Traffic Study 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 Traffic Study, and the Planning Board Criteria Performance Summary is presented below.

Planning Board Permit Number: _____

PROJECT

Project Name:	King Open/Cambridge Street Upper Schools & Community Complex Project
Project Address:	850 Cambridge Street Cambridge, MA 02141
Owner/Developer Name:	City of Cambridge Public School Department
Contact Person:	Michael J. Black, Construction Program Manager
Contact Address:	795 Massachusetts Avenue Cambridge, MA 02139
Contact Phone Number:	(617)349-4251

SIZE

ITE sq. ft. :	21,482 GFA (CPS Admin Only)
Land Use Type:	LUC 710 - General Office

PARKING

Existing Parking Spaces*:	55	Use: School and Library
New Parking Spaces**:	105	Use: School, Library and Office
Net New Parking Spaces***:	50	

*Existing registered parking spaces for project site

**Proposed underground parking garage

***New parking spaces minus the existing parking spaces

TRIP GENERATION (for CPS Admin Only):

	Daily	AM Peak Hour	PM Peak Hour
Total Trips	266	37	37
Vehicle	198	28	26
Transit	22	3	4
Bicycle	0	0	0
Walk	24	3	4
Other	22	3	2

MODE SPLIT (Person Trips)

	CPS Administrative Offices
Auto	71% SOV / 4% HOV
Transit	8%
Walk	9%
Bike	0%
Other	8%

TRANSPORATION CONSULTANT

Company Name:	VHB, Inc.
Contact Name:	Sean Manning, PE / Selma Mandzo-Preldzic, PE
Contact Phone Number:	617-738-7777

Date of Building Permit Approval: _____

Total Data Entries = 61 **Total Number of Criteria Exceedances = 3**

Criteria A –Project Vehicle Trip Generation

Time Period	Criteria (trips)	Build	Exceeds Criteria?
Weekday Daily	2,000	198	No
Week AM Peak Hour	240	28	No
Week PM Peak Hour	240	26	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
Cambridge St at Windsor St	F	F	1.0%	No	F	F	1.1%	No
Cambridge St at Willow St	C	C	1.2%	No	C	C	1.3%	No
Cambridge St at Berkshire St	C	C	0.5%	No	D	D	1.7%	No
Cambridge St at Cardinal Medeiros Ave	F	F	0.8%	No	F	F	0.6%	No

Criteria C – Traffic on Residential Streets

			AM Peak Hour			PM Peak Hour		
Roadway	Reviewed Segment	Amount of Residential	Existing[1]	Project Trips	Exceeds Criteria?	Existing[1]	Project Trips	Exceeds Criteria?
Cambridge Street	Windsor St to Willow St	>1/3 but <1/2	803	10	No	867	12	No
	Willow St to Berkshire St	1/3 or less	803	3	No	868	11	No
	Berkshire St to Cardinal Medeiros Ave	1/3 or less	823	2	No	980	7	No
Willow Street	Cambridge St to Palermo St	1/2 or more	70	7	No	70	1	No
	Palermo St to Lincoln St	1/2 or more	70	7	No	70	1	No
	Lincoln St to York St	1/2 or more	70	7	No	70	1	No
Berkshire Street	York St to Hardwick St	1/2 or more	95	11	No	225	2	No
	Hardwick St to Marney St	1/2 or more	95	11	No	225	2	No
	Marney St to Marcella St	1/2 or more	95	23	Yes	225	4	No
	Marcella St to Cambridge St	1/2 or more	95	3	No	225	18	No
Cardinal Medeiros Ave	Cambridge St to Marcella St	1/2 or more	470	9	No	460	1	No
	Marcella St to Marney St	1/2 or more	470	9	No	460	4	No
	Marney St to Hardwick St	1/2 or more	470	3	No	460	4	No
	Hardwick St to Vandine St	1/2 or more	470	3	No	460	4	No
	Vandine St to Plymouth St	1/2 or more	470	3	No	460	4	No
	Plymouth St to Bristol St	1/2 or more	470	3	No	460	4	No

Criteria D – Lane Queue (for signalized intersections)

		AM Peak Hour			PM Peak Hour		
Intersection	**Movement**	**Existing**	**Build**	**Exceeds Criteria?**	**Existing**	**Build**	**Exceeds Criteria?**
Cambridge Street at Willow Street	EB – Left/Thru/Right	8	8	No	8	8	No
	WB – Left/Thru/Right	7	7	No	8	8	No

Criteria E – Pedestrian Delay

		AM Peak Hour			PM Peak Hour		
Intersection	**Crosswalk**	**Existing**	**Build**	**Exceeds Criteria?**	**Existing**	**Build**	**Exceeds Criteria?**
Cambridge Street at Willow Street	East	B	B	No	B	B	No
	West	B	B	No	B	B	No
	North	A	A	No	A	A	No
	South	A	A	No	A	A	No

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?**
Cambridge Street	Willow Street and Berkshire Street	Yes	No	Yes	No
Willow Street	Cambridge Street and York Street	Yes	No	No	Yes
Berkshire Street	Cambridge Street and York Street	Yes	No	No	Yes

Traffic Study

This Traffic Study for the proposed King Open/Cambridge Street Upper Schools & Community Complex Project (the Project) describes existing and future transportation conditions in the study area in accordance with the City of Cambridge Sixth Revision (November 28, 2011) Traffic Study Guidelines. The study area for the Traffic Study includes 1 signalized intersection and 3 unsignalized intersections as illustrated in Figure B, and listed below.

1. Cambridge Street at Windsor Street
2. Cambridge Street at Willow Street
3. Cambridge Street at Berkshire Street
4. Cambridge Street at Cardinal Medeiros Avenue

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.

1.0 Inventory of Existing Conditions

1.a Roadways

Roadway access to the Project site is provided by Cambridge Street, Windsor Street, Willow Street, Berkshire Street and Cardinal Medeiros Avenue.

Descriptions of these roadways and photographic views are presented below. Roadway layout and dimensions have been documented in Figure 1.a.1 through Figure 1.a.3.

Cambridge Street

Cambridge Street is a two-way, east-west roadway with one travel lane provided for each direction, in the vicinity of the Project. The roadway connects Monsignor O'Brien Highway in the east with Hampshire Street and Harvard area in the west. Bicycle lanes and regulated on-street parking are provided on each side of the street. Several MBTA bus routes run along Cambridge Street, with a stop adjacent to the Project site. Land uses along Cambridge Street are commercial and residential resulting in an active pedestrian environment. Sidewalks are provided on both sides of the street and are considered to be in good condition. Crosswalks are provided at major intersections. In front of the Project Site, in addition to regulated

parking, a school bus drop off zone is also available during school hours. Photos 1 and 2 show views of Cambridge Street.

PHOTO 1: VIEW OF CAMBRIDGE ST EASTBOUND FROM INTERSECTION WITH WILLOW ST

PHOTO 2: VIEW OF CAMBRIDGE ST WESTBOUND, FROM SIDEWALK IN FRONT OF THE PROJECT SITE

Windsor Street

Windsor Street runs north-south to the west of the Project site, providing only one-way southbound access south of Cambridge Street and two-way access north of Cambridge Street. The roadway connects Massachusetts Avenue in the south to Cambridge Street in the north. Land uses along the northern portion of Windsor Street are mainly residential, and as the street approaches the MIT campus, the land use becomes institutional and industrial. Sidewalks are provided along both sides of the street with crosswalks provided at all intersections along Windsor Street. Cambridge resident parking is allowed on both sides of the street.

Willow Street

Willow Street runs one-way southbound in the vicinity of the Project site, providing one travel lane and on-street parking on both sides of the street. Parking is by resident permit only. Bike racks are available on the east sidewalk, adjacent to the Project site. Land uses along Willow Street are mainly residential with the east side abutting the Project site and Donnely Field. Sidewalks are provided along both sides of the street with crosswalks (some raised) provided at most intersections along Willow Street. Photo 3 shows a view of Willow Street.

PHOTO 3: VIEW OF WILLOW STREET SOUTHBOUND FROM CAMBRIDGE STREET

Berkshire Street

Berkshire Street runs one-way northbound in the vicinity of the Project, providing one travel lane and one parking lane for resident parking permit holders only. Bike racks are available on the west sidewalk, adjacent to the Project Site. The roadway connects Bristol Street to the south with Cambridge Street to the north. Land uses along the east side of Berkshire Street are residential, with the west side abutting the Project site and Donnely Field. Sidewalks are provided along both sides of the street with crosswalks (some raised) provided at most intersections along Berkshire Street. Photo 4 shows a view of Berkshire Street.

PHOTO 4: VIEW SOUTHBOUND FROM CAMBRIDGE STREET

Cardinal Medeiros Avenue

Cardinal Medeiros Avenue runs north-south, providing one lane of travel in each direction. Various sections of no parking and resident permit parking are available along the street. The roadway connects Hampshire Street to the south with Cambridge Street to the north. Land

uses along Cardinal Medeiros Avenue are primarily residential. Sidewalks are provided along both sides of the street with crosswalks provided at all intersections.

1.b Intersections

The Project study area includes the following 4 study intersections which are presented in Figure B and illustrated in more detail in sketches labeled Figure 1.b.1 through Figure 1.b.4.

1. Cambridge Street / Windsor Street

The intersection of Cambridge Street at Windsor Street is a four-legged unsignalized intersection. Windsor Street, south of Cambridge Street, is one-way southbound. Cambridge Street is free flowing, and Windsor Street, north of Cambridge Street, is stop-controlled. There is one lane of travel in each direction. Sidewalks and crosswalks are provided along all intersection legs. The wheelchair ramps at the crosswalks appear to not be fully ADA compliant. Cambridge Street eastbound has metered parking leading to the intersection and an MBTA bus stop just after the intersection. Cambridge Street westbound has permit parking along the street with an MBTA bus stop before the intersection. Windsor Street has no parking allowed along the north leg and no parking allowed with a loading zone on the east side of the street along the south leg of the intersection. See Figure 1.b.1 for an approximate layout and dimensions of this intersection.

2. **Cambridge Street / Willow Street**

The intersection of Cambridge Street at Willow Street is a four-legged signalized intersection. Willow Street runs one-way southbound and northbound away from the intersection. The signal was observed to control the Cambridge Street approaches only. Sidewalks are provided on all intersection legs and crosswalks are provided across Cambridge Street and Willow Street, with some corners not providing appropriate ADA compliant wheelchair ramps. Metered on-street parking is provided on the east and west approaches to the intersection. See Figure 1.b.2 for an approximate layout and dimensions of this intersection.

3. **Cambridge Street / Berkshire Street**

The intersection of Cambridge Street at Berkshire Street is a three-legged unsignalized intersection. Berkshire Street runs one-way northbound and is stop-controlled at intersection with Cambridge Street, while Cambridge Street is free flowing. MBTA bus stops are located near the southwest corner of the intersection and northeast corner of the intersection. Sidewalks are provided along all intersection legs and crosswalks are provided across Berkshire Street and across the western leg of Cambridge Street. Some crosswalks do not appear to

provide ADA compliant wheelchair ramps. See Figure 1.b.3 for an approximate layout and dimensions of this intersection.

4. Cambridge Street / Cardinal Medeiros Avenue / Warren Street

The intersection of Cambridge Street at Cardinal Medeiros Avenue / Warren Street is a four-legged unsignalized intersection with the north and south legs slightly offset from the intersection. Cardinal Medeiros Avenue is stop-controlled on the northbound approach while Warren Street is one-way northbound away from the intersection. Cambridge Street is free flow with one travel lane provided in each direction. The Cambridge Street eastbound approach has an MBTA bus stop adjacent to the intersection. The westbound approach at Cambridge Street has metered parking available before the street intersects with Warren Street to the north. Sidewalks are provided along all intersection legs and crosswalks are provided at all intersection approaches. Some crosswalks do not appear to provide ADA compliant wheelchair ramps. See Figure 1.b.4 for an approximate layout and dimensions of this intersection.

1.c Parking

Off-Street Vehicular Parking

The existing site is registered with 55 vehicle parking spaces, however the school has historically utilized as many as 86 parking spaces in multiple lots.

- Lot 1 has 5 parking spaces that are accessed from Willow Street
- Lot 2 is located near the secondary exit door and has 15 parking spaces. The lot is accessed from Berkshire Street as well.
- Lot 3 is located behind the pool and has approximately 25 parking spaces (faded pavement markings). The lot is accessed from Berkshire Street.
- Lot 4 is located in the back of the school building and has 24 parking spaces. The lot is accessed from Berkshire Street

The parking spaces are allocated to staff and faculty by CPS Administration and the Principal.

Parents and visitors are instructed to utilize existing on-street metered parking in the vicinity of the school.

On-Street Vehicular Parking

Figure 1.c.2 shows the existing on-street parking regulations surrounding the Project Site. The majority of on-street parking surrounding the study area is resident permit parking with

metered parking along Cambridge Street. A more detailed parking utilization analysis is presented in Section 2.f of this document.

Bicycle Parking

The existing site provided four bike racks at the school's front entrance. A large number of students bicycle to school, with existing bike racks used beyond their intended capacity. Once the bike racks near the main entrance are full utilized, bicyclists start using the front fence as an alternative means of bicycle parking. During observations on Wednesday, April 29, 2015, VHB staff counted 25 bicycles chained to the front fence at the start of school in the morning with the bike racks fully utilized.

Additional bike racks are provided along the east sidewalk of Willow Street, the west sidewalk of Berkshire Street and near the Gold Star pool entrance.

Long-term covered and secure bicycle parking was not provided on existing site in the past.

1.d Public Transit Services and School Buses

Public Bus Services

The Project area is accessible by several Massachusetts Bay Transportation Authority (MBTA) Bus lines. A graphical illustration of study area transit lines is presented in Figure 1.d.1 (Public Transit Services) and summarized in the following sections.

Route 69 – Harvard Square – Lechmere Station

MBTA Route #69 connects Harvard Square and Inman Square in Cambridge to Lechmere Station via Cambridge Street. The nearest bus stop to the Project Site is located at the corner of Cambridge Street at Berkshire Street. Various stops along this route connect with other bus lines, the Red Line, and the Green Line. The bus route runs on weekdays from 5:25 AM to 1:11 AM with 10 – 20 minute headways during peak hours. On Saturday, service runs from 5:15 AM to 1:25 AM, and Sunday services is from 6:05 AM to 1:11 AM.

Route 85 – Spring Hill – Kendall/MIT Station

MBTA Route #85 connects Spring Hill, Summer Street and Union Square in Somerville to the Kendall/MIT Station in Cambridge. The nearest bus stop to the Project Site is on Columbia Street, near Cambridge Street. Various stops along this route connect with other bus lines and the Red Line. The bus route runs on weekdays from 5:45 AM to 7:58 PM with 25 – 35 minute headways. There is no weekend service.

CT2 – Sullivan Station – Ruggles Station

MBTA Route CT2 is a limited stop, cross-town route that operates between Sullivan Square Station (Charlestown) and Ruggles Station (Orange Line in Roxbury). The nearest bus stop to the Project Site is on Columbia Street, near Cambridge Street. Various stops along this route

connect with other bus lines, the Red Line, the Orange Line, and the Green Line. The bus route runs on weekdays from 5:55 AM to 7:37 PM with 20 – 25 minute headways during peak hours. There is no weekend service.

School Bus Stops

The majority of school bus activity occurs along Cambridge Street. The southeast corner of Cambridge Street at Willow Street is used as a pick-up/drop-off location for school buses travelling eastbound that serve surrounding area schools. Similarly, the corner of Cambridge Street at Hunting Street is also used as a pick-up/drop-off location for school buses travelling westbound that serve surrounding area schools.

For school bus activity related to the King Open and Cambridge Upper School, two bus areas are available in front of the school along Cambridge Street for student pick-up and drop-off. Students that are transported in specialty vans or buses, access the site via Berkshire Street through the staff parking lot, and load/unload students at building's rear entrance.

Figure 1.d.2 illustrates existing school bus pick-up/drop-off locations.

1.e Land Use

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

2.0 Data Collection

2.a ATR Counts

Automatic traffic recorder (ATR) counts were conducted for 48-hours on Wednesday, March 2nd and Thursday, March 3rd, 2016, at the following three (3) locations:

- Cambridge Street between Harding and Berkshire Streets
- Willow Street between Cambridge and Palermo Street, and
- Berkshire Street between Marney and Marcella Streets

The summary data represents the weekday average and illustrates the daily variations of traffic demands and the directional flow of traffic over the course of an average weekday. It should be noted that these counts took place after the existing King Open/Cambridge Upper School was closed and students/staff were transferred to another location, and therefore, represent conditions without school traffic. In addition, construction activity on Berkshire Street during the day, also impacted the vehicular activity in this location. A traffic volume summary for the ATRs are presented in Tables 2.a.1 and 2.a.2 with detailed count sheets included in the Appendix.

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

Location	Daily[a]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		Volume[b]	K[c]	Peak Direction	Volume[b]	K[c]	Peak Direction
Cambridge Street, *west of Berkshire Street*	12,785	804	6.3%	57% EB	861	6.7%	54% WB
Willow Street, *south of Cambridge Street*	657	38	5.8%	100% SB (one-way)	65	9.9%	100% SB (one-way)
Berkshire Street, *south of Marcella Street*	1,432	86	6.0%	100% NB (one-way)	204	14.2%	100% NB (one-way)

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 (MARCH 2016)

	Cambridge Street, west of Berkshire Street	Willow Street, south of Cambridge Street		Berkshire Street, south of Marcella Street
Start Time	**EB**	**WB**	**SB**	**NB**
12:00 AM	67	64	7	20
1:00 AM	44	34	2	7
2:00 AM	24	22	1	3
3:00 AM	24	23	1	2
4:00 AM	44	38	4	6
5:00 AM	102	99	9	22
6:00 AM	232	247	17	47
7:00 AM	385	337	34	100
8:00 AM	465	337	39	63
9:00 AM	426	342	38	45
10:00 AM	394	375	29	39
11:00 AM	342	391	36	34
12:00 PM	388	379	44	39
1:00 PM	404	365	31	42
2:00 PM	385	408	33	68
3:00 PM	435	381	41	129
4:00 PM	395	408	59	172
5:00 PM	409	472	63	219
6:00 PM	360	390	37	135
7:00 PM	321	350	43	70
8:00 PM	282	284	29	68
9:00 PM	236	230	32	34
10:00 PM	198	188	17	39
11:00 PM	140	119	11	29
Total	**6,502**	**6,283**	**657**	**1,432**
Average Weekday Traffic Volume	**32,510**	**31,415**	**3,285**	**7,160**

2.b Pedestrian and Bicycle Counts

Peak hour pedestrian and bicycle movements at study-area intersections, collected during the vehicle turning movement counts are discussed below.

2.c Intersection Turning Movement Counts

VHB conducted morning and evening peak period Turning Movement Counts (TMCs) for vehicles, bicyclists and pedestrians at the intersection of Cambridge Street/Willow Street and Cambridge Street/Berkshire Street, on Thursday, February 4, 2016. The intersection of Cambridge Street/Cardinal Medeiros Avenue was counted on Wednesday, April 29, 2015, and the intersection of Cambridge Street/Windsor Street was counted on Thursday, March 3, 2016.

Three of the four study intersections were counted while the school was in operation, so the reported volumes include school generated traffic. The intersection of Cambridge Street at Windsor Street was counted after the school was closed, and the counts from this location will include an adjustment to accurately account for school traffic. The existing parking lot driveways were not counted.

The results of these counts indicate that the overall weekday traffic peak hour in the study area occur between 7:30AM - 8:30AM and 4:30PM – 5:30PM.

The morning peak hour occurs before school starts due to the gradual and continuous parent drop-offs. Although the afternoon volumes increase slightly after school dismissal, the true vehicular peak does not occur until 4:30PM. This evening peak hour also coincides with the hours of operation for many of the surrounding businesses and offices as well as the proposed addition of the Cambridge Public Schools administrative building – the one Project component that has been determined to generate new, incremental traffic to the site.

Vehicular volumes at study intersections are summarized in Figures 2.c.1 and 2.c.2 for the AM and PM peak hours. Pedestrian volumes are shown in Figures 2.c.3 and 2.c.4, and bicycle volumes are presented in Figures 2.c.5 and 2.c.6 for the AM and PM peak hours.

Detailed count sheets are included in the Appendix.

2.d Crash Analysis

To identify potential vehicle crash trends in the project study area, the most current vehicle crash data for the study area intersections were obtained from MassDOT for a 3-year period between 2011 through 2013. At the time of this study, data for 2014 and more recent years were not available.

An analysis of the crash data is summarized in Table 2.d.1.

TABLE 2.D.1 CRASH ANALYSIS SUMMARY (2011 – 2013)

	Cambridge Street/ Windsor Street	Cambridge Street/ Willow Street	Cambridge Street/ Berkshire Street	Cambridge Street/ Cardinal Medeiros Ave
Signalized?	No	Yes	No	No
District 6 Average Crash Rate	0.53	0.70	0.53	0.53
Calculated Crash Rate	1.55	0.27	0.16	0.71
Exceeds?	Yes	No	No	Yes
Year				
2011	8	0	0	4
2012	3	2	2	4
2013	10	1	0	2
Total	**21**	**3**	**2**	**10**
Collision Type				
Angle	13	1	2	5
Head-on	1	0	0	0
Rear-end	0	0	0	2
Sideswipe, opposite direction	0	0	0	0
Sideswipe, same direction	2	0	0	0
Single-vehicle crash	3	0	0	2
Unknown	2	2	0	1
Total	**21**	**3**	**2**	**10**
Severity				
Injury (non-fatal)	8	0	0	4
Property damage only	8	2	2	4
Not Reported	5	1	0	2
Total	**21**	**3**	**2**	**10**
Time of Day				
Weekday, 7:00 AM - 9:00 AM	2	1	1	4
Weekday, 4:00 PM - 6:00 PM	5	0	1	0
Saturday, 11:00 AM - 2:00 PM	0	0	0	0
Weekday, other time	12	2	0	2
Weekend, other time	2	0	0	4
Total	**21**	**3**	**2**	**10**
Pavement Conditions				
Dry	17	2	0	6
Wet	3	0	2	3
Snow	0	0	0	0
Other	1	1	0	1
Total	**21**	**3**	**2**	**10**
Non Motorist (Bike/Pedestrian)	**10**	**1**	**0**	**1**

Source: MassDOT vehicle crash data

Crash rates in Table 2.d.1 were calculated based on the number of crashes relative to the volume of traffic traveling through the intersections on a daily basis. These crash rates were then compared to the average MassDOT's District 6 rates. Rates that exceed MassDOT's average for crashes could indicate safety or geometric deficiencies at a particular intersection. The latest published average crash rates by MassDOT in District 6, as of February 2016, are 0.70 for signalized intersections and 0.53 for unsignalized intersections.

The intersections of Cambridge Street at Windsor Street, and Cambridge Street at Cardinal Medeiros Avenue were found to exceed the 2016 average crash rates for District 6.

Detailed crash data by location is provided in the Appendix.

2.e Public Transit

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

TABLE 2.E.1 EXISTING TRANSIT SERVICE SUMMARY

Transit Service	Origin – Destination	Weekday Hours of Operation[a]	Peak Hour Headways[a] (Minutes)	Weekday Daily Ridership[b] (Passengers)
MBTA Bus Route 69	Harvard Square – Lechmere Station	5:25AM – 1:11 AM	10-20 minutes	2,770
MBTA Bus Route 85	Spring Hill – Kendall/MIT Station	5:45AM – 7:58PM	25-35 minutes	577
MBTA Bus Route CT2	Sullivan Station – Ruggles Station	5:55AM – 7:37PM	20-25 minutes	2,674

a Source: MBTA Winter 2016
b Daily ridership compiled from MBTA Ridership Load Profile Fall 2014

2.f Parking

As requested in the Traffic Study Scoping Letter, a Neighborhood On-Street Parking Analysis was completed for this Project.

The purpose of the study was to quantify existing on-street parking supply by regulation type, determine existing typical weekday on-street parking demand and analyze future on-street parking supply conditions.

The occupancy study evaluated on-street parking availability on neighborhood streets within a ¼ mile radius (approx. 10 minute walk) of the Site. The study recorded the number of legal spaces (supply) and the number of occupied spaces (demand). Figure 2.f.1 indicates the extent of the on-street occupancy study area.

In partnership with the City of Cambridge TP&T Department, weekday counts were conducted during three periods:

- Early Morning Period
  Tuesday March 22, 2016 at 7:00 AM
- Mid-Morning Period
  Tuesday March 1, 2016 at 10:00 AM
- Late-Night Period
  Wednesday March 2, 2016 at 11:00 PM

Table 2.f.1 shows a summary of study area parking supply and Table 2.f.2 shows the detailed counts as recorded in the field for the morning, mid-morning and late-night count periods.

Charts 2.f.1 compare the availability of parking to the typical utilization, as observed during the study periods.

Figures 2.f.2, 2.f.3 and 2.f.4 visually illustrate the utilization of on-street parking in the study area, by study period.

TABLE 2.F.1 ON-STREET PARKING SUPPLY

Type	Approx. Number of Parking Spaces[1]
2-hr Metered Parking	41
Resident Permit Parking	518
Total Parking Spaces[2]	559

Source: City of Cambridge TP&T Parking Count March 1&2, 2016
1 – Number of parking spaces was estimated in the field, because parking spaces are not individually striped
2 - Note that 6 spaces were unavailable due to construction activity, and are therefore not included in this Total

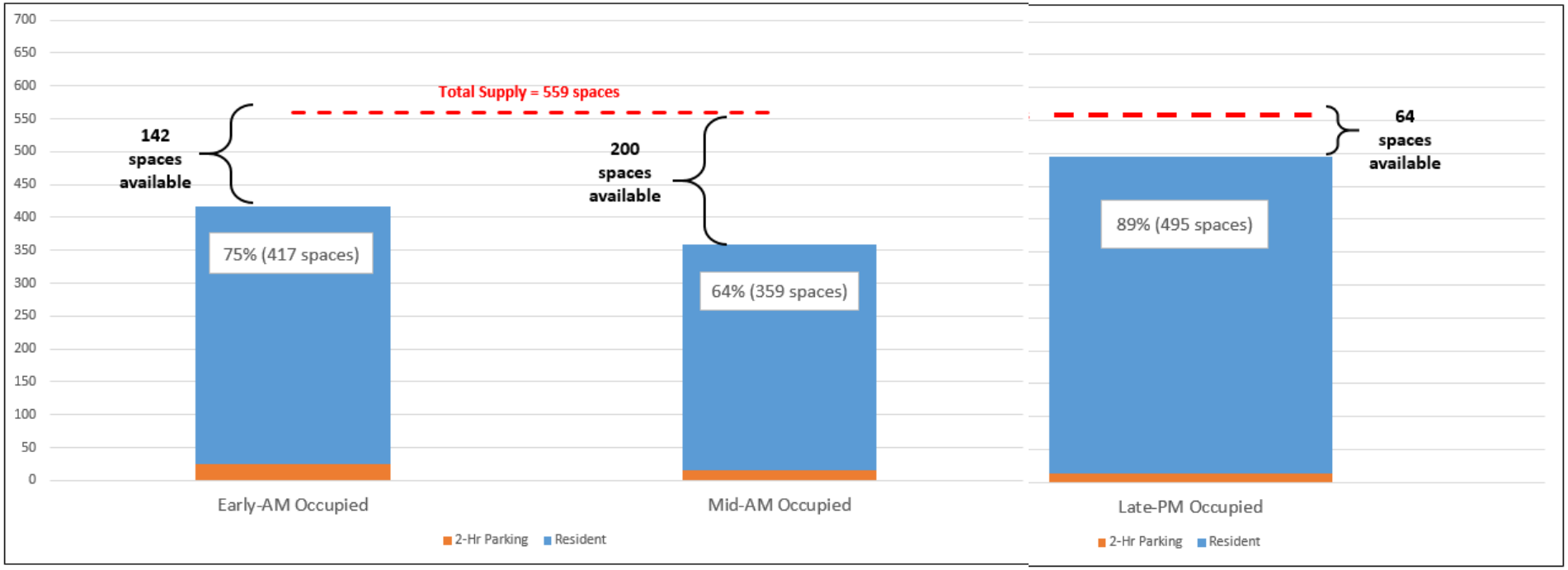
TABLE 2.F.2 ON-STREET PARKING OBSERVATIONS AND ANALYSIS (MARCH 2016)

					Early Morning (3/22/2016 7:00AM)	Mid-Morning (3/1/2016 10:00AM)	Late-Night (3/2/2016 11:00 PM)
Side	**Segment**			**# of Legal Spaces**	**# of Open Spaces**	**# of Open Spaces**	**# of Open Spaces**
Cambridge Street							
South	Windsor	to	Willow	10 (2-hr parking)	3	8	1
North	Willow St	to	Evereteze Way	7	1	2	0
North	Evereteze Way	to	Windsor St	6	0	1	0
South	Willow St	to	Hunting St	0	0	0	0
North	Hunting St	to	Willow St	5 (2-hr parking)	5	1	0
South	Hunting St	to	Berkshire St	0	0	0	0
North	Berkshire St	to	Harding St	7 (2-hr parking)	5	1	6
North	Harding St	to	Hunting St	3 (2-hr parking)	3	1	1
South	Berkshire St	to	Cardinal Medeiros	8 (2-hr parking)	4	3	1
North	Cardinal Medeiros	to	Marion St	4 (2-hr parking)	3	1	2
North	Marion St	to	Berkshire St	4 (2-hr parking)	1	1	2
Cardinal Medeiros Ave							
West	Cambridge St	to	Marcella St	9	0	4	0
West	Marcella St	to	Marney St	9	3	2	0
East	Michael Way	to	James Way	9	2	5	0
East	Cornelius Way	to	Michael Way	7	1	1	1
West	York Pl	to	Vandine St	4	0	0	0
West	Vandine St	to	Plymouth St	4	0	1	0
Plymouth St							
South	Cardinal Medeiros	to	Berkshire St	12	1	2	0
North	Cardinal Medeiros	to	Berkshire St	9	2	0	0
South	Berkshire St	to	Webster Ave	12	1	3	0
North	Berkshire St	to	Hamlin St	7	0	2	0
North	Hamlin St	to	Webster Ave	1	1	1	0

Webster Ave							
East	Plymouth St	to	York St	13	1	6	0
West	Seckel St	to	Plymouth St	9	2	2	2
East	York St	to	Lincoln St	6	0	3	2
West	Lincoln St	to	Seckel St	13	10	7	1
East	Windsor St	to	Lincoln St	5	0	1	3
West	Windsor St	to	Lincoln St	0	0	0	0
Lincoln St							
South	Webster Ave	to	Willow St	5	3	4	4
North	Webster Ave	to	Willow St	8	3	3	3
Willow St							
East	Cambridge St	to	Palermo St	9	0	N/A - Election Day Parking	1
West	Cambridge St	to	Palermo St	14	2	N/A - Election Day Parking	0
East	Palermo St	to	Lincoln St	27	8	9	6
West	Palermo St	to	Lincoln St	13	4	8	4
East	Lincoln St	to	York St	11	5	0	3
West	Lincoln St	to	York St	8	5	5	3
York St							
South	Willow St	to	Hamlin St	6	2	3	0
North	Willow St	to	Hamlin St	6	0	0	0
South	Hamlin St	to	Berkshire St	13	1	7	2
North	Hamlin St	to	Berkshire St	13	1	0	0
Hamlin St							
East	York St	to	Plymouth St	8	4	4	4
West	York St	to	Plymouth St	5	1	3	1
Berkshire St							
East	Plymouth St	to	Vandine St	5	1	0	0
West	Plymouth St	to	York St	7	0	0	0
East	Vandine St	to	York Pl	2	0	0	0

East	York Pl	to	Hardwick St	7	1	2	0
West	York St	to	Hardwick St	3	1	1	0
East	Hardwick St	to	Marney St	7	3	0	0
West	Hardwick St	to	Marney St	11	2	3	0
East	Marney St	to	Marcella St	14	2	3	0
West	Marney St	to	Marcella St	14	4	4	0
East	Marcella St	to	Cambridge St	7	0	2	0
West	Marcella St	to	Cambridge St	0	0	0	0
Vandine St							
South	Berkshire St	to	Cardinal Medeiros	11	2	2	2
Hardwick St							
South	Berkshire St	to	Cardinal Medeiros	14	2	7	0
North	Berkshire St	to	Cardinal Medeiros	11	4	6	0
Marney St							
South	Cardinal Medeiros	to	Berkshire St	12	4	2	0
North	Cardinal Medeiros	to	Berkshire St	12	5	5	0
Palermo St							
South	Windsor St	to	Willow St	10	1	6	0
North	Willow St	to	Windsor St	12	1	8	1
Windsor St							
East	Cambridge St	to	Palermo St	7	0	1	2
West	Cambridge St	to	Palermo St	6	3	2	1
East	Palermo St	to	Lincoln St	11	4	8	1
West	Palermo St	to	Hardwell Dr	10	4	4	1
West	Hardwell Dr	to	Lincoln St	7	5	2	3
Marcella St							
South	Berkshire St	to	Cardinal Medeiros	14	5	N/A Due to Construction	0
North	Berkshire St	to	Cardinal Medeiros	13	0	N/A Due to Construction	0

CHART 2.F.1 ON-STREET PARKING OBSERVATIONS AND ANALYSIS (MARCH 2016)



On-Street Parking Study Findings:

- The 2-hour parking spaces on Cambridge Street show general utilization of approximately 60% throughout the day. At night, the parking usage increased to 75% due to use by overnight resident parkers.
- Residential parking to the west of the site (Windsor and Willow Streets) shows utilization of approximately 60-70%, with a slight increase to 80% at night for overnight parking.
- Residential parking to the east of the site (Cardinal Medeiros Avenue and Berkshire Street) is fully utilized by residents for overnight parking, with spaces starting to free up early in the morning.

2.g School Activity Observations

In the spring and summer of 2015, VHB conducted observations of existing school activity at the site to assist the design team in understanding school operations, identify access challenges and opportunities, and to provide guidance and input regarding the framework of future transportation conditions and operations at the school.

School Year Observations

Regular school hours are from 8:55 AM to 2:55 PM Monday through Friday, however, various before- and after-school activities and programs result in slightly staggered dismissal times for some students.

The King Open Afterschool/Extended Day Program serves 130 children in grades K-5 that are also regular students at King Open. These programs run during the 10-month school year, from September until June, with no summer programming. After-school programs run from 2:55 PM to 6:00 PM every school day, 12:55 PM to 6:00 PM on early release days and 8:00 AM to 5:30 PM during school vacations (other than summer vacation and major holidays). Preschool Programs run Year Round for ages from 3 to 5. King Open Preschool is open on weekdays from 8:00 AM to 6:00 PM.

Arrival and dismissal observations were conducted from 8:00 AM to 9:30 AM on Wednesday, April 29, 2015 and from 2:30 PM to 4:00 PM on Tuesday, April 28, 2015.

The King Open School creates a significant amount of pedestrian traffic immediately before and after school. The majority of the students live in close proximity and walk to school. Those that do arrive by automobile are primarily dropped-off on Cambridge Street in the no-parking/bus only zone and picked-up on Berkshire Street. A smaller number of parents park at the metered spaces along Cambridge Street and on Berkshire Street for drop-off and pick-up.

Charts 2.g.1 and 2.g.2 illustrate the arrival and departure patterns, by mode of travel (excluding school buses).

CHART 2.G.1: MORNING STUDENT ARRIVAL

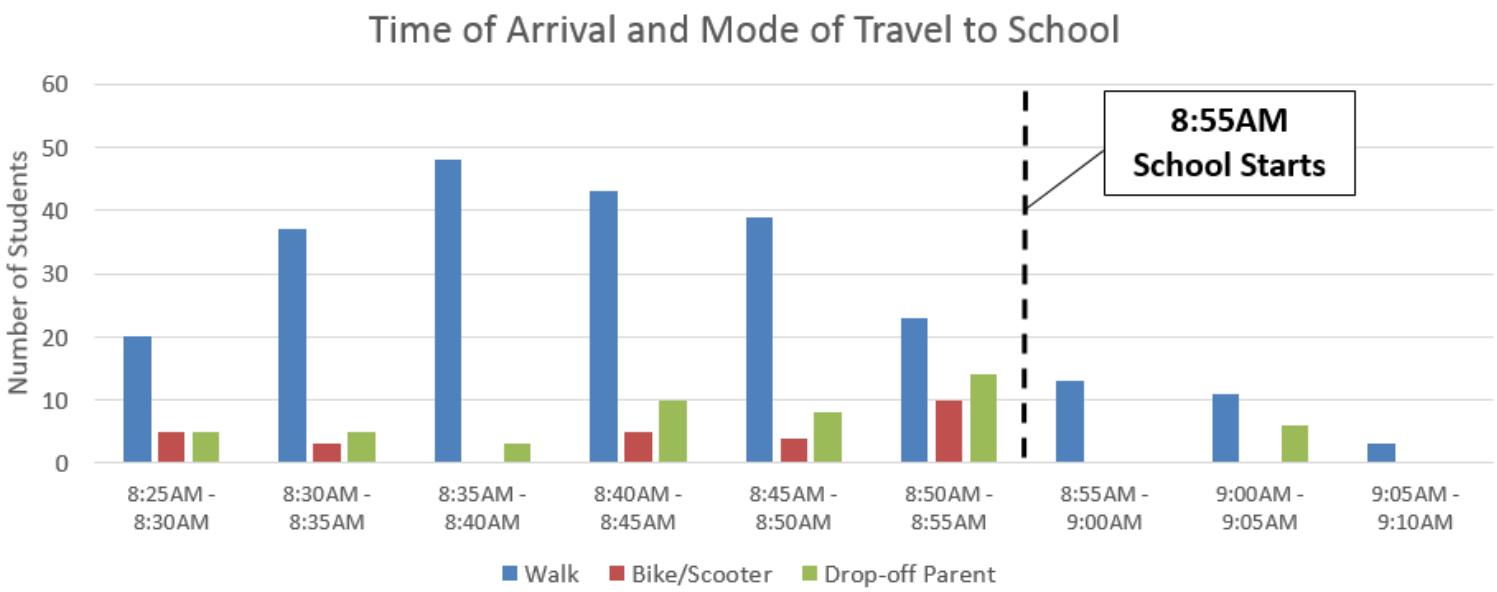
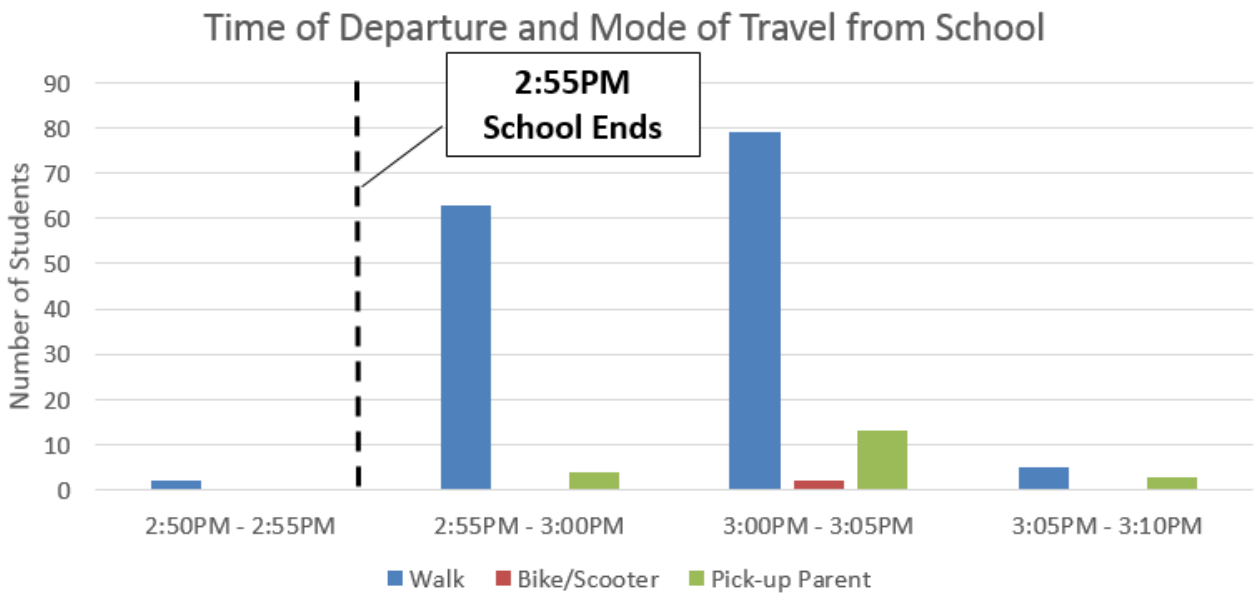


CHART 2.G.2: AFTERNOON STUDENT DISMISSAL



As indicated by both Chart 2.g.1 and 2.g.2, the prevalent mode of travel by students (not including school buses) is walking, followed by parent drop off and bike-scooter.

The observations indicate that drop-off activity occurs primarily along Cambridge Street, with most students arriving between 8:35 AM and 8:45 AM and school starting at 8:55 AM. In the afternoon most students leave between 2:55 PM an 3:05 PM.

Each travel mode is discussed in more detail in the sections below:

Pedestrian Activity

The King Open School creates a significant amount of pedestrian traffic immediately before and after school. The majority of students (approximately two-thirds) walk to school. Students enter through the main entrance but are allowed to exit through the main entrance or through the exit door on Berkshire Street. For students who walk or bike to and from school, three crossing guards are provided at the intersections of Cambridge Street at Willow Street, Cambridge Street at Hunting Street, and Cambridge Street at Berkshire Street.

Bicycle Activity

Four bike racks are provided at the school's front entrance. A large number of students bicycle to school, and the amount of bike racks was observed to be fully utilized on school days. Once the bike racks near main entrance fill up, bicyclists start using the front fence for parking. During observations on Wednesday, April 29, 2015, VHB staff counted 25 bicycles chained to the front fence at the start of school in the morning.

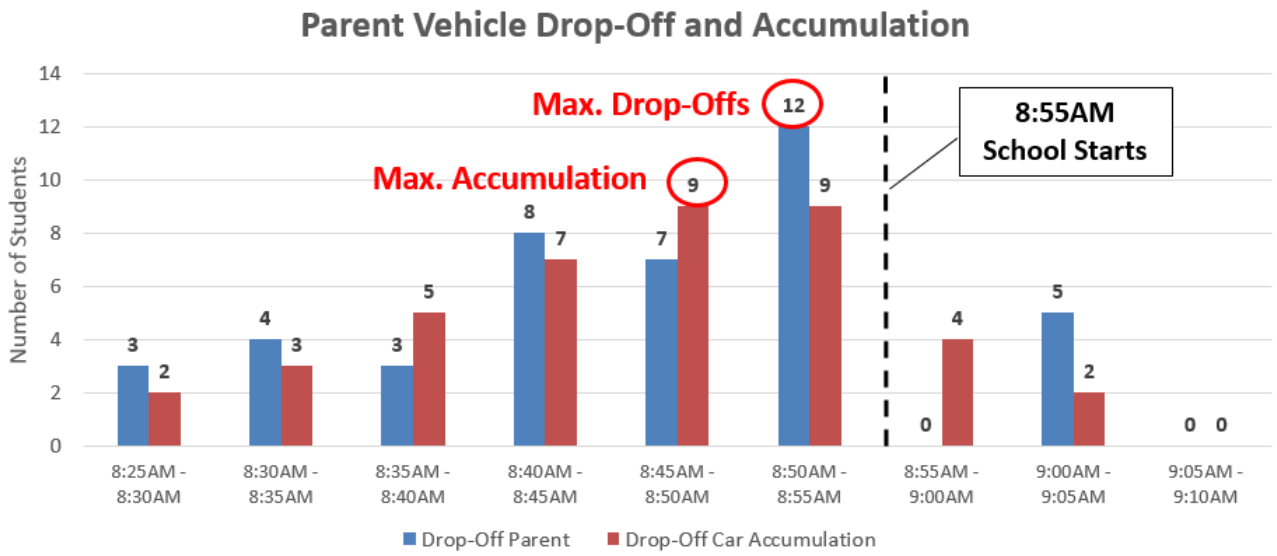
Additional bike racks are provided in the east sidewalk of Willow Street, the west sidewalk of Berkshire Street and near the Gold Star pool entrance, which tend to fill up as well.

Vehicular Activity

The King Open School has two "no parking"/school bus loading zones in front of the building for the primary use of bus pick-up and drop-off. Parents of young students were observed parking their cars in the "no parking"/school bus loading zone and walking their children into the school building. Some parents were parked in the "no parking"/school bus loading zone for up to twenty five minutes.

Chart 2.g.3 illustrates the parent vehicular activity in the morning and Chart 2.g.4 shows afternoon activity.

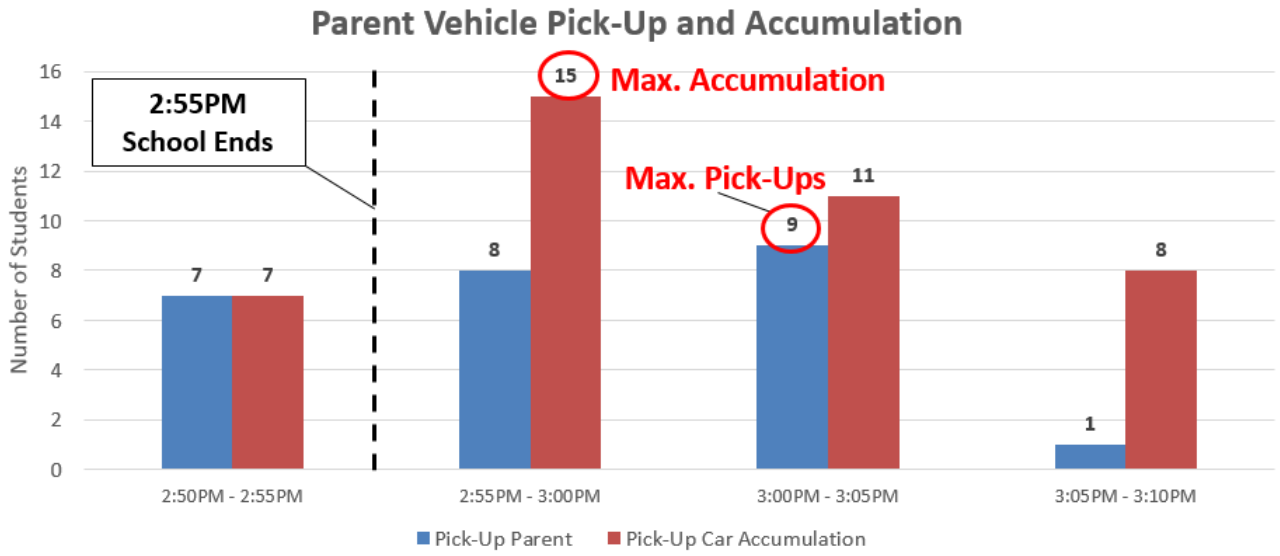
CHART 2.G.3: MORNING STUDENT ARRIVAL



As presented in Chart 2.g.3 from 8:45 to 8:55 AM, ten minutes before the start of school, there were approximately 19 observed parent drop-offs, and nine vehicles accumulated in the "no parking"/school bus loading zones along Cambridge Street.

This parent behavior blocks school buses from properly pulling into the drop-off zone, thereby causing buses to offload students into the street while stopped in the travel lane. Traffic is stopped on both sides of Cambridge Street, and vehicles start to queue up. In addition the busses were also observed to block the bicycle lane.

CHART 2.G.4: AFTERNOON STUDENT DISMISSAL



Student dismissal activity is presented in Chart 2.g.4. Dismissal activity observations at the secondary exit on Berkshire Street, showed up to fifteen vehicles waiting in the "no parking" zone on the west side of the street.

School Bus Activity

Five scheduled buses drop-off and pick-up students on Cambridge Street. The buses are numbered/labeled and staff members walk the children to and from the bus at arrival and dismissal.

Four buses and three vans were observed during the dismissal period at the school along Cambridge Street (two in the bus zone and two in the no parking zone) with approximately 20-24 students boarding each school bus. Staff members walk the children out to their respective bus in groups, and all buses leave by 3:05 PM.

Transportation Eligibility

The City of Cambridge provides bus transportation for the following students:

- Pre-k through 5th grade students who must walk one mile or more,
- 6th grade through 8th grade students who must walk 1.5 miles or more,
- Pre-k through 5th grade students who must cross Massachusetts Avenue,
- Pre-k through 8th grade students who must cross Fresh Pond Parkway, McGrath Highway, Alewife Brook Parkway, or the railroad tracks at Sherman Street.

If a student is not eligible for transportation to school, he or she must walk, bike, or get dropped-off at the school.

Summer Activities

VHB staff observed summer activities on Thursday, July 23, 2015, from 12:30 PM until 3:00 PM.

Summer School

Conversations with summer school staff indicate that King Open operates two summer camps out of the existing school building. The EEL Camp with an approximate student enrollment of 30 students grades K-4 and the Sun Splash camp with an approximate enrollment of 40 students. The EEL Camp runs through July 31 only between the hours of 8:00 AM and 2:30 PM. Most children attending camp take the school bus (approximately 75% of students) while the rest walks with only a few being dropped off/picked up by a car.

During a summer school day, typical activity will see two school buses and one school van on Cambridge Street. Most students that take the school bus are transported to an afterschool program at another location. A few kids attend an extended day program at King Open.

Pool Activity

The observations also covered activity at the Gold Star Pool. Pool staff explained that the pool is used by summer camps exclusively from 12:00 PM until 2:00 PM each weekday. Approximately 150 children attend swim camp class at the pool. Most camp children arrive by school bus from other locations in the city, the school bus then waits for children to finish swim class before driving them back to their original summer camp location. Only the SunSplash camp (with approximately 40 students) is located at King Open School and easily walks between the school building and the pool.

The Pool opens to the public after 2:00 PM on weekdays and is typically used by approximately 30-40 visitors in the afternoon. Busy weekends the pool tends to quickly fill to capacity, 150 people. Pool staff describe pool patrons as mostly local teenagers that that walk or bicycle to pool.

Pool visitors are not permitted to park in the school lots and are asked to find a space on-street. The parking lot behind the pool is signed as "no residential parking between 6:00 AM and 4:00 PM".

During the observation period, VHB counted 6 visitors and 5 staff/lifeguards at the pool at 2:00 PM. This count was conducted shortly after the summer camp children had left the pool. It was sunny and hot that day, and typically, a day that one would expect to see active summer pool use.

The Gold Star Pool is the only city-owned outdoor pool. The pool operates for nine weeks during the summer months and has an admission fee of $0.75 per person. The pool is unheated and has a depth range of 2.5 ft.-9ft. Residents of all ages are welcome; however, children ages eight and under must be accompanied by an adult and children ages five years or younger must have an adult in the pool with them at all times.[1]

3.0 Project Traffic

3.a Mode Share and Average Vehicle Occupancy (AVO)

Mode share characteristics for the Project were provided in the Traffic Study scoping letter per the 2014 DEP Ridesharing Survey for the CPS Administrative Staff. Table 3.a.1 presents the mode shares used as a basis for estimating Project trip generation by land use.

[1] City of Cambridge; http://www.cambridgema.gov/DHSP/Recreation/goldstarpool.aspx

TABLE 3.A.1 PROJECT MODE SHARES

Mode	Administrative Offices[1]
Drive Alone	71%
Carpool	4%
Transit	8%
Bike	0%
Walk	9%
Other	8%
Total	100%

Source: CPS Administrative Offices from DEP Ridesharing Survey 2014.

The 2009 National Household Travel Survey was consulted for appropriate Average Vehicle Occupancy (AVO) rates, and a rate of 1.13 was assumed for administrative space to convert ITE vehicle trips to person trips. A local AVO of 1.22 was calculated from the American Community Survey, and used to convert the adjusted person trips to vehicle trips for the trip generation analysis.

3.b Trip Generation

The trip generation estimate for the proposed new CPS Administrative Office space was calculated using the ITE Trip Generation Manual 9th Edition land use codes (LUC) 710 for General Office Building. The proposed academic space, library and pool are all uses that have historically existed on site and will be replaced with new construction. The only new trip generating aspect of the Project will be the Cambridge Public Schools Administrative Offices.

Table 3.b.1 presents the ITE Unadjusted Trips and conversion into person trips generated by the proposed Project.

TABLE 3.B.1 PROJECT PERSON TRIP GENERATION

Administrative Offices	ITE Trips	AVO National	Person Trips
Daily In	119	1.13	134
Daily Out	119	1.13	134
Total	**238**		**268**
AM In	30	1.13	33
AM Out	4	1.13	5
Total	**34**		**38**
PM In	5	1.13	6
PM Out	27	1.13	30
Total	**32**		**36**

Source: ITE Trip Generation 9th edition; LUC 710

The person trips are converted into walk trips, bike trips, transit trips, carpool trip and drive alone trips by applying the mode share splits. The estimated trips by mode are presented in Table 3.b.2 below.

TABLE 3.B.2 PROJECT TRIP GENERATION BY MODE

Administrative Offices	Person Trips	Transit Trips	Bike Trips	Walk Trips	Other Trips	Drive Alone Trips	Carpool Trips
Daily In	134	11	0	12	11	95	5
Daily Out	134	11	0	12	11	95	5
Total	**268**	**22**	**0**	**24**	**22**	**190**	**10**
AM In	33	3	0	3	3	24	1
AM Out	5	0	0	0	0	3	0
Total	**38**	**3**	**0**	**3**	**3**	**27**	**1**
PM In	6	1	0	1	1	4	0
PM Out	30	3	0	3	3	21	1
Total	**36**	**4**	**0**	**4**	**4**	**25**	**1**

Furthermore the drove alone (SOV) and carpool (HOV) trips are converted into number of vehicles by applying the relevant local AVO rate to the HOV trips. The estimated vehicle trips are presented in Table 3.b.3 below.

TABLE 3.B.3 PROJECT VEHICULAR TRIP GENERATION

Administrative Offices	Carpool Trips	AVO Local	Carpool Vehicles	Drive Alone Vehicles	Total Vehicle Trips
Daily In	5	1.22	4	95	99
Daily Out	5	1.22	4	95	99
Total	**10**		**8**	**190**	**198**
AM In	1	1.22	1	24	25
AM Out	0	1.22	0	3	3
Total	**1**		**1**	**27**	**28**
PM In	0	1.22	0	4	4
PM Out	1	1.22	1	21	22
Total	**1**		**1**	**25**	**26**

As shown in Table 3.b.3, the Project is expected to generate 26 vehicle trips during the morning peak hour and 25 vehicle trips in the evening peak hour.

3.c Site Access

As shown in Figure C, Proposed Site Plan, access to the new underground garage will be provided from Berkshire Street. The garage will provide a total of 105 parking spaces that will serve the school staff and faculty and relocated CPS employees.

Ground level access for bicyclists will be provided along the eastern side of the site, off Berkshire Street. An elevator will be located to provide access to the long-term bike parking in the garage.

Pedestrians will access the site from Cambridge Street, or via garage and internal lobby area.

Proposed School Arrival/Dismissal Activities

The proposed Project will include the replacement of existing academic, human services, library and pool spaces as well the construction of new CPS administrative space. Of the total approximately 273,000 square feet of newly constructed space, only approximately 21,500 square feet is considered a new trip generator to the site. Although the school is expanding with respect to gross floor area, most of the incremental increase in space is intended to improve and right-size existing uses. The school's total population will experience only a minimal change in staffing and student enrollment. When completed, the school will support approximately 580 students and 150 faculty and staff (total employee count includes school, library and pool employees). Parking to support the school will be provided in the proposed underground garage. Parent pick-up/drop-off will be provided on Willow Street and Berkshire Street, while school bus activity will be handled in the bus zones on Cambridge Street. Figures 3.c.1 and 3.c.2 illustrate areas that will be designated for arrival and dismissal activities.

School Operations

At full occupancy, 580 students will attend the School supported by 150 faculty/staff members. Primary pedestrian access to the building will be via main entrance doors on Cambridge Street.

Proposed school operations are as follows:

- The general school hours will be 8:55 am to 2:55 pm. The resulting morning drop-off periods will be 8:30 am to 9:00 am and pick-up in the afternoon will be generally occurring from 3:00 pm to 3:30 pm.
- Staff will include approximately 150 persons, which include full-time teachers, part-time teachers, administrators and support staff, as well as library and pool staff.
- It is anticipated that the majority of the faculty/staff will typically arrive at least 30 minutes prior to the start of school, and will leave only after the afternoon dismissal period has ended.
- A traffic management and operations plan will be implemented to manage pick-up/drop-off activity at the site. This will include all school bus and ASD van activity as well as parental drop-off/pick-up activities. Designated school staff will be responsible for all

activity, and serve as point of contact for all inquiries and parent, student and neighborhood coordination.

Pedestrian Access

Primary access to the building will be provided via the main entrances on Cambridge Street, to help facilitate drop-off/pick-up activities. Designated staff members will actively manage student pedestrian activity to and from the building.

School Bus Operations

Standard size (40 foot) school buses as well as mini buses (20 feet) and passenger vans will be used to transport students to the School. They are expected to arrive between 8:30am and 9:00am to drop students off and between 2:45pm and 3:00pm to pick students up. The bus zone on Cambridge Street will be used as the loading/staging area for school buses. The west drop off area on Cambridge Street will accommodate ASD vans. An appropriate striping and signage plan will be executed to ensure proper space is allocated to bus operations in the bus zones.

Parking

The Project will provide parking for faculty/staff and CPS admin employees in an underground garage. Parents dropping-off/picking-up their children will utilize a designated loading zone on Willow Street and Berkshire Street to park their cars while escorting students into the building. Parents will be directed to arrive between 3:00 pm and 3:15 pm to pick students up. It is anticipated that most parent drop-off/pick-up activity will be accommodated on Willow Street, with some early/late arrivals utilizing additional loading zones on Berkshire Street.

3.d Vehicular Trip Distribution and Assignment to Roadway Network.

Project generated vehicle trips were distributed and assigned to roadways based City provided zip code data for staff. The distribution of Project trips to roadway network, as approved by TP&T Department, is presented in Figures 3.d.1 and 3.d.2. Resulting Project generated trip networks are presented in Figures 3.d.3 and 3.d.4.

3.e Servicing and Deliveries

Truck Access and Egress

As shown in Figure C, the loading and service for the Project will be accommodated in an off-street loading dock accessed from Berkshire Street. The dock will provide a service bay and a dedicated location for a dumpster. Providing loading and service off-street will enhance the public realm in and around the Project site.

Truck Routes

Service and Delivery trucks will access the site using only designated truck routes as outlined by the City of Cambridge. Regionally, trucks will use O'Brien Highway (Route 28), Massachusetts Avenue and the Longfellow Bridge while avoiding Memorial Drive (Route 3). Locally, trucks will use Cambridge Street, Cardinal Medeiros and Berkshire Street to access the proposed loading dock.

Daily Deliveries

The servicing and deliveries are not expected to change with the construction of the new buildings. The new site will allow the servicing to take place inside a loading dock, which will enhance the public realm in and around the Project site. Table 3.e.1 summarizes existing deliveries accommodated at the school, which are expected to remain in the future.

TABLE 3.E.1 EXISTING DELIVERIES

Use	Type of Delivery	Size of Truck	Frequency of Delivery	Timing of Delivery	Daily Trip Rate
King Open School	Milk	16' - 24' truck	3 per week (M,W,F)	Early AM	0.6
	FNS	n/a	Daily (every weekday)	Morning	1.0
	FNS	n/a	Daily (every weekday)	Afternoon	1.0
	Produce	16' truck	Daily (every weekday)	Early AM	1.0
	Paper	20' - 26' truck	1 per week (Tuesdays)	Late AM/Early	0.2
	Grocery	20' - 26' truck	1 per week (Thursdays)	Late AM/Early	0.2
Extended Day	US Foods	Large box truck	1 per month	Morning	0.05
	Vendors	Small and large	2-3 per month	Daytime	0.15
Preschool	US Foods	Large box truck	1 per month	Morning	0.05
	Vendors	Small and large	2-3 per month	Daytime	0.15
Pool	Chemicals	n/a	2-3 per season	seasonal	-
	CO2 tanks	n/a	5-7 deliveries per season	seasonal	-
Library	Books	Panel truck	Daily (every weekday)	Morning	1.0
	Books	Small van	Intermittent	Daytime	0.5

As can be seen from the Table 3.e.1, most of the existing servicing and deliveries are completed with small to medium sized trucks. The new building is expected to have the same number of deliveries, however the School will likely have a delivery manager that will help schedule and reduce the number of trucks being generated by the project.

4.0 Background Traffic

A background growth of 0.5 percent per year, for five years, has been applied to the existing traffic volumes, as specified in the Traffic Study Scoping Letter. This growth rate accounts for area projects such as Alexandria at Kendal Square/Binney Street Project, MIT *at Kendal Square* Project and NorthPoint Developments.

Furthermore, as requested in the Traffic Study Scoping Letter, the 399 Binney Street Project and the Courthouse Building Project have been incorporated separately into the 2021 Future Condition analysis, in addition to the 0.5 percent general growth rate as described previously.

5.0 Traffic Analysis

Traffic networks were developed for the following scenarios:

5.a 2016 Existing Condition

The 2016 Existing Condition analysis is based on exiting vehicle, bicycle, and pedestrian counts at the study area intersections as previously presented in Section 2.

The 2016 Existing Condition uses TMC data from three different count periods. Cambridge Street at Cardinal Medeiros Avenue TMCs were conducted on April 29, 2015, while the school was in session. Cambridge Street at Willow Street and Cambridge Street at Berkshire Street TMCs were conducted on February 4, 2016, while school was in session. Cambridge Street at Windsor Street TMCs were conducted on March 2, 2016, while the school was closed and relocated due to construction. VHB developed a balanced existing volume network, to account for a scenario with all school traffic still on the roadway network.

5.b 2016 Build Condition

Project-generated traffic is added to the 2016 Existing Condition network to create the 2016 Build networks, presented in Figures 5.b.1 and 5.b.2 for the AM and PM peak hours, respectively.

5.c 2021 Future Condition

The 2021 Future Condition includes future background growth rate, trips from other developments (as described above) as well as Project trips all overlaid on the Existing Condition network. The resulting Future volume networks are presented in Figures 5.c.1 and 5.c.2.

As noted in the Traffic Study Scoping Letter, the number of school population trips is not expected to change by much in the future, and therefore this analysis assumes no changes to the distribution of existing parent pickup or drop off trips. Due to the small number of vehicular trips from parents accessing the site in the morning study peak hour, any proposed

shifting of traffic patterns to Willow and Berkshire Streets is negligible for the purposes of this analysis.

6.0 Vehicle Capacity Analysis

Synchro 8 software was used to determine the vehicle level of service (VLOS) for signalized and unsignalized study intersections. Synchro software is based on the 2000 Highway Capacity Manual. Results for the 2016 Existing, 2016 Build, and 2021 Future conditions are presented in Table 6.a.1 and Table 6.a.2 for signalized intersections and Table 6.a.3 and Table 6.a.4 for unsignalized intersections. Figures 6.a.1 and 6.a.2 illustrate the overall VLOS for each intersection for the morning and evening peak hour respectively. A summary of the analysis results follows.

TABLE 6.A.1 SIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – AM PEAK HOUR

		Existing (2016)			Build (2016)			Future (2021)		
Intersection	**Approach**	v/c	Delay	VLOS	v/c	Delay	VLOS	v/c	Delay	VLOS
Cambridge Street at Willow Street	Cambridge Street Eastbound	0.80	30.6	C	0.82	31.8	C	0.85	34.3	C
	Cambridge Street Westbound	0.77	29.0	C	0.77	29.3	C	0.79	30.8	C
	OVERALL	0.39	29.9	C	0.39	30.6	C	0.41	32.7	C

TABLE 6.A.2 SIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – PM PEAK HOUR

		Existing (2016)			Build (2016)			Future (2021)		
Intersection	**Approach**	v/c	Delay	VLOS	v/c	Delay	VLOS	v/c	Delay	VLOS
Cambridge Street at Willow Street	Cambridge Street Eastbound	0.80	30.3	C	0.80	30.3	C	0.82	31.7	C
	Cambridge Street Westbound	0.84	33.5	C	0.86	35.3	D	0.89	38.4	D
	OVERALL	0.41	31.9	C	0.41	32.9	C	0.43	35.2	D

TABLE 6.A.3 UNSIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – AM PEAK HOUR

		Existing (2016)			Build (2016)			Future (2021)		
Intersection	**Approach**	v/c	Delay	VLOS	v/c	Delay	VLOS	v/c	Delay	VLOS
Cambridge Street at Windsor Street	Windsor Street Southbound	1.12	150.0	F	1.14	158.1	F	1.23	193.3	F
Cambridge Street at Berkshire Street	Berkshire Street Northbound	0.30	19.0	C	0.31	19.4	C	0.34	20.4	C
Cambridge Street at Cardinal Medeiros Avenue	Cardinal Medeiros Avenue Northbound	2.10	601.6	F	2.20	647.7	F	2.79	926.6	F

TABLE 6.A.4 UNSIGNALIZED INTERSECTION LEVEL OF SERVICE RESULTS – PM PEAK HOUR

		Existing (2016)			Build (2016)			Future (2021)		
Intersection	**Approach**	v/c	Delay	VLOS	v/c	Delay	VLOS	v/c	Delay	VLOS
Cambridge Street at Windsor Street	Windsor Street Southbound	1.59	354.9	F	1.65	380.0	F	1.81	453.3	F
Cambridge Street at Berkshire Street	Berkshire Street Northbound	0.63	27.7	D	0.71	32.8	D	0.74	36.5	E
Cambridge Street at Cardinal Medeiros Avenue	Cardinal Medeiros Avenue Northbound	4.18	ERR	F	4.30	ERR	F	5.05	ERR	F

Under 2016 Existing and 2016 Build Conditions, the signalized intersection of Cambridge Street/Willow Street operates at an overall VLOS C during the AM and PM peak hours. With the addition of the proposed project trips traveling through the intersection (10 morning trips and 12 evening trips), the intersection maintains an overall VLOS C during the morning and evening peak hours. The westbound approach however, does show a drop in VLOS from C to D in the evening peak hour, due to an increase in delay of 1.8 seconds which is enough to trigger the LOS threshold.

The unsignalized intersections experience no operational changes from the 2016 Existing to 2016 Build Conditions for both the morning and evening peak hours. The southbound stop-controlled approach at Cambridge Street/Windsor Street operates at a VLOS F, the northbound stop-controlled approach at Cambridge Street/Berkshire Street operates at a VLOS C during the morning peak and VLOS D during the evening peak, and the northbound approach at Cambridge Street/Cardinal Medeiros Avenue operates at a VLOS F.

Under the 2021 Future Condition, all of the intersections maintain their VLOS except for the intersections of Cambridge Street/Willow Street and Cambridge Street/Berkshire Street during the PM peak hour. The VLOS at Cambridge Street/Willow Street decreases from a VLOS C to a VLOS D, and Cambridge Street/Berkshire Street decreases from a VLOS D to a VLOS E. These decreases are due to the traffic generated by surrounding background projects and the 5 year vehicular volume growth. The overall intersection delay only increases by approximately 5 seconds from the 2016 Build Condition to the 2021 Future Condition during the PM peak hour for each intersection.

Due to the high v/c ratio projected by Synchro during the evening peak hour, delays for the unsignalized intersection of Cambridge Street and Cardinal Medeiros Avenue (in the northbound approach) cannot be calculated by the software.

7.0 Queue Analysis

Queue analysis was performed in conjunction with the VLOS analysis. Tables 7.a.1 and 7.a.2 present results for observed and modeled average queues for each scenario for AM and PM peak hours, respectively. The observed queues were recorded the week of March 7th, 2016, after the school was closed and relocated, which may have resulted in lower observed queue numbers in comparison to the modeled queues.

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

		Average Queue in Vehicles			
Intersection	**Lane**	**2016 Observed[1]**	**2016 Modeled**	**2016 Build**	**2021 Future**
Cambridge Street at Willow Street	Eastbound – Left/Thru/Right	3	8	8	8
	Westbound – Left/Thru/Right	1	7	7	7

[1] Observations occurred after the school was closed and relocated

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

		Average Queue in Vehicles			
Intersection	**Lane**	**2016 Observed[1]**	**2016 Modeled**	**2016 Build**	**2021 Future**
Cambridge Street at Willow Street	Eastbound – Left/Thru/Right	3	8	8	8
	Westbound – Left/Thru/Right	1	8	8	9

[1] Observations occurred after the school was closed and relocated

8.0 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 14 of the 16 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 ROADWAY – AM PEAK

Roadway	Segment	Amount of Residential	Existing[1]	Build	Increase	Percent Increase	Future[2]	Increase	Percent Increase
Cambridge Street	Windsor St to Willow St	>1/3 but <1/2	803	813	10	1.2%	839	36	4.5%
	Willow St to Berkshire St	1/3 or less	803	806	3	0.4%	832	29	3.6%
	Berkshire St to Cardinal Medeiros Ave	1/3 or less	823	825	2	0.2%	852	29	3.5%
Willow Street	Cambridge St to Palermo St	1/2 or more	70	77	7	10%	79	9	12.9%
	Palermo St to Lincoln St	1/2 or more	70	77	7	10%	79	9	12.9%
	Lincoln St to York St	1/2 or more	70	77	7	10%	79	9	12.9%
Berkshire Street	York St to Hardwick St	1/2 or more	95	106	11	11.6%	112	17	17.9%
	Hardwick St to Marney St	1/2 or more	95	106	11	11.6%	112	17	17.9%
	Marney St to Marcella St	1/2 or more	95	118	23	24.2%	124	29	30.5%
	Marcella St to Cambridge St	1/2 or more	95	98	3	3.2%	101	6	6.3%
Cardinal Medeiros Ave	Cambridge St to Marcella St	1/2 or more	470	479	9	1.9%	520	50	10.6%
	Marcella St to Marney St	1/2 or more	470	479	9	1.9%	520	50	10.6%
	Marney St to Hardwick St	1/2 or more	470	473	3	0.6%	514	44	9.4%
	Hardwick St to Vandine St	1/2 or more	470	473	3	0.6%	514	44	9.4%
	Vandine St to Plymouth St	1/2 or more	470	473	3	0.6%	514	44	9.4%
	Plymouth St to Bristol St	1/2 or more	470	473	3	0.6%	514	44	9.4%

[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 ROADWAY – PM PEAK

Roadway	Segment	Amount of Residential	Existing[1]	Build	Increase	Percent Increase	Future[2]	Increase	Percent Increase
Cambridge Street	Windsor St to Willow St	>1/3 but <1/2	867	879	12	1.4%	904	37	4.3%
	Willow St to Berkshire St	1/3 or less	868	879	11	1.3%	906	38	4.4%
	Berkshire St to Cardinal Medeiros Ave	1/3 or less	980	987	7	0.7%	1016	36	3.7%
Willow Street	Cambridge St to Palermo St	1/2 or more	70	71	1	1.4%	73	3	4.3%
	Palermo St to Lincoln St	1/2 or more	70	71	1	1.4%	73	3	4.3%
	Lincoln St to York St	1/2 or more	70	71	1	1.4%	73	3	4.3%
Berkshire Street	York St to Hardwick St	1/2 or more	225	227	2	0.9%	232	7	3.1%
	Hardwick St to Marney St	1/2 or more	225	227	2	0.9%	232	7	3.1%
	Marney St to Marcella St	1/2 or more	225	229	4	1.8%	234	9	4.0%
	Marcella St to Cambridge St	1/2 or more	225	243	18	8.0%	248	23	10.2%
Cardinal Medeiros Ave	Cambridge St to Marcella St	1/2 or more	460	461	1	0.2%	510	50	10.9%
	Marcella St to Marney St	1/2 or more	460	464	4	0.9%	513	53	11.5%
	Marney St to Hardwick St	1/2 or more	460	464	4	0.9%	513	53	11.5%
	Hardwick St to Vandine St	1/2 or more	460	464	4	0.9%	513	53	11.5%
	Vandine St to Plymouth St	1/2 or more	460	464	4	0.9%	513	53	11.5%
	Plymouth St to Bristol St	1/2 or more	460	464	4	0.9%	513	53	11.5%

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

9.0 Vehicle Parking Analysis

To better understand the parking needs of the Project a vehicle parking analysis has been conducted, and is described in the following sections.

9.a Projected Parking Supply and Demand

Parking Supply Per Zoning

The school, library and pool Project components are governed by City of Cambridge's Article 5.54 parking definition, while the office component falls within the Article 6.0 ordinance. To develop parking supply requirements per zoning, a review of Article 6 parking ratios was conducted, as documented in Tables 9.a.1 and 9.a.2, and later supplemented with Article 5.54 applicability provisions for the school components of the Project only.

TABLE 9.A.1 PROJECT PARKING RATIOS, ZONING (PER ARTICLE 6.0)

Land Use	Minimum Parking Ratio	Maximum Parking Ratio
School	1 space per 5 seats in the main auditorium	3 spaces per 2 instructional rooms
Library	N/A	1 space per 600 square feet
Pool	N/A	1 space per 600 square feet
Office	1 space per 800 square feet	1 space per 400 square feet

Parking ratios are calculated based on GFA

In order to estimate the Project parking supply per zoning, the parking ratios for each land use were applied to the relevant parameter (number of instructional classrooms for the school land use and square footage for the library, pool and office land use). Table 9.a.2 presents the resulting number of parking spaces calculated.

TABLE 9.A.2 PROJECT PARKING SUPPLY, ZONING

Land Use	GFA (SF)	Unit[1]	Minimum Parking Supply	Maximum Parking Supply
School	193,185	60 classrooms and 400 seat auditorium	80	90
Library	10,077		17	17
Pool	5,624		9	9
Sub-Total (School Use Only)			**106**	**116**
Office	21,482		27	55
Mechanical Space/Parking Garage	42,746		n/a	n/a
GRAND TOTAL	**273,114**		**133**	**171**

1 –Classrooms with 5 or more students included for this count

Per Article 6.0 Zoning, a minimum of 133 parking spaces and maximum of 171 parking spaces are to be provided for the proposed site. However, since Article 5.54 governs the school uses on the site (school, library and pool) the applicable definition for parking supply for those components states that "The minimum required number of off-street motor vehicle parking spaces shall be the number of legally existing off-street parking spaces on the lot or the minimum number of off-street parking spaces required by Article 6.000, whichever is fewer." Because the minimum number of legal spaces for the lot is 55, and minimum number of parking spaces per Article 6.000 is 105, the site is required to provide a minimum of 55 parking spaces for school uses only.

The final parking supply numbers are summarized in Table 9.a.3.

TABLE 9.A.2 PROJECT PARKING SUPPLY, ZONING

Land Use	Minimum Parking Supply	Maximum Parking Supply
School, Library and Pool	55[(a)]	116[(b)]
Office	27[(b)]	55[(b)]
TOTAL	**82**	**171**

a- Per Article 5.54, City of Cambridge Zoning Ordinance
b- Per Article 6.00, City of Cambridge Zoning Ordinance

As indicated in Table 9.a.3, the total minimum required parking supply by the project is 82 spaces and maximum parking supply is 171 spaces.

The Project proposes to construct 105 parking spaces, which is in compliance with Zoning, as presented above.

Parking Demand Per Employee Density

The calculated parking supply provides a range for number of vehicular parking spaces that are required to be provided by site, however a calculation of parking demand indicates the demand for parking that is anticipated for the Project. In order to estimate parking demand for the Project, the future employee numbers were multiplied by the vehicle mode share (drive alone and carpool). A 10 percent vacancy rate was then applied to the calculated numbers for the school/library/pool, to account for absentees due to vacations, sick time, and flexible working arrangements... etc. A higher reduction/vacancy rate of 25 percent was applied to CPS Admin/Office parking numbers, to account for absenteeism and the nature of the staff's employment (off-site assignments).

The resulting parking demand per employee density is presented in Table 9.a.3.

TABLE 9.A.3 PROJECT PARKING DEMAND

Land Use	Estimated # of Future Employees	% Drive Alone[2]	% Carpool[2]	Full[3] Parking Demand	Reduced[4] Parking Demand
Building Staff[1]	150	57%	4%	88	80
CPS Admin	80	71%	4%	60	45
TOTAL	**230**			**148**	**125**

1 – building staff includes king open/upper school, as well as library and pool staff
2 – mode shares from City of Cambridge 2014 DEP Survey data; 56% drive alone for King and 57% drive alone for Upper, use 57% for analysis; 0% carpool for King and 4% Carpool for upper, use 4% for analysis; Assume 1.22 local AVO to change Carpool trips into number of vehicles
3 – Full parking demand stands for calculated demand based on number of employees and auto mode share
4 – Reduced parking demand stands for parking spaces reduced for absenteeism; 10% school and 25% office

Parking Supply vs. Demand

The following Table 9.a.4 compares the projected parking demand based on employee numbers and mode shares with the proposed parking supply based on Zoning parking ratios assumed for the site.

TABLE 9.A.4 PROJECT PARKING SUPPLY VS. DEMAND (# OF PARKING SPACES)

Land Use	Parking Supply per Zoning (range min – max)	Parking Demand[3]	Parking Provided by Project	Estimated On-Street Parking (overflow)
Building Staff[1]	55 - 116	80	80	0
CPS Admin	27 - 55	45	25	20
TOTAL	**82 - 171**	**125**	**105**	**20**

1 – building staff includes king open/upper school, as well as library and pool staff
2 – parking supply per zoning ratios
3 – parking demand from employee numbers and mode share rates and vacancy rate

Based on the analysis presented in previous paragraphs, the Project is providing sufficient parking to meet zoning. On the demand side, a parking shortfall of approximately 20 parking spaces is estimated. The shortfall will be addressed by allowing a certain number of employees to utilize on-street parking as well as implementing generous PTDM programs. It should be noted that historically, up to 15 KOCUS staff have parked on-street because of existing off-street parking shortfalls on-site.

Parking Provided by Project

The project is providing 105 parking spaces in an underground garage accessed from Berkshire Street. The parking spaces are a combination of single and tandem spaces, for most

efficient space usage within the garage footprint. The garage will have controlled access, and be used by employees only.

10.0 Transit Analysis

In accordance with Traffic Study Guidelines, a transit analysis has been conducted to support this project.

The Project is expected to generate 3 new transit trips (3 entering) during the AM peak hour and 2 new transit trips (2 exiting) during the PM peak hour. For a conservative analysis, all transit trips were assigned to CT2 bus route, the busiest bus line that services the Project Site. The impact of project trips to the MBTA CT2 during the peak hours are presented in Table 10.a.1.

TABLE 10.A.1 TRANSIT CAPACITY ANALYSIS – PEAK LOAD/PEAK DIRECTION

		AM Peak					PM Peak				
MBTA Bus Route	**Capacity (MBTA)**	**Existing Ridership**	**Existing V/C**	**Project Trips**	**Build Ridership**	**Build V/C**	**Existing Ridership**	**Existing V/C**	**Project Trips**	**Build Ridership**	**Build V/C**
CT2 Inbound	54	44	0.27	3	47	0.29	15	0.09	0	15	0.09
CT2 Outbound	54	5	0.03	0	5	0.03	60	0.37	2	62	0.38

Source: MBTA Ridership Data Fall 2014

11.0 Pedestrian Analysis

Pedestrian crossing volumes at study 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 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.

All intersection show no change in PLOS with the addition of project trips.

TABLE 11.A.1 SIGNALIZED INTERSECTION - PEDESTRIAN LEVEL OF SERVICE SUMMARY

		AM Peak Hour			PM Peak Hour		
Intersection	**Crosswalk**	**Existing 2016**	**Build 2016**	**Future 2021**	**Existing 2016**	**Build 2016**	**Future 2021**
Cambridge Street at Willow Street	East	B	B	B	B	B	B
	West	B	B	B	B	B	B
	North	A	A	A	A	A	A
	South	A	A	A	A	A	A

TABLE 11.A.2 UNSIGNALIZED INTERSECTIONS – PEDESTRIAN LEVEL OF SERVICE SUMMARY

		AM Peak Hour			PM Peak Hour		
Intersection	**Crosswalk**	**Existing 2016**	**Build 2016**	**Future 2021**	**Existing 2016**	**Build 2016**	**Future 2021**
Cambridge Street at Windsor Street	East	F	F	F	F	F	F
	West	F	F	F	F	F	F
	North	A	A	A	A	A	A
	South	B	B	B	B	B	B
Cambridge Street at Berkshire Street	West	F	F	F	F	F	F
	South	A	A	A	A	A	A
Cambridge Street at Cardinal Medeiros Ave	East	F	F	F	F	F	F
	West	F	F	F	F	F	F
	North	A	A	A	B	B	B
	South	D	D	D	D	D	D

12.0 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 Bicycle Volume	Conflicting Vehicle Movements					
				Existing 2016		Build 2016		Future 2021	
				Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]	Right Turn[a]	Left Turn[b]
Cambridge Street at	AM	EB	34	40	40	40	40	41	41
Windsor Street		WB	10	5	15	5	15	5	15
		SB	0	70	NA	70	NA	72	NA
	PM	EB	16	45	45	45	45	46	46
		WB	22	5	10	5	10	5	10
		SB	0	55	NA	55	NA	56	NA
Cambridge Street at	AM	EB	35	30	40	37	40	38	41
Willow Street		WB	24	5	10	5	10	5	10
	PM	EB	15	35	35	36	35	37	36
		WB	45	15	10	15	10	15	10
Cambridge Street at	AM	EB	36	NA	NA	NA	NA	NA	NA
Berkshire Street		WB	14	NA	NA	NA	NA	NA	NA
	PM	EB	13	NA	NA	NA	NA	NA	NA
		WB	42	NA	NA	NA	NA	NA	NA
Cambridge Street at	AM	EB	81	60	240	61	248	65	275
Cardinal Medeiros Ave		WB	24	25	70	25	70	26	72
		NB	0	30	NA	30	NA	37	NA
	PM	EB	21	40	130	40	131	41	138
		WB	66	25	200	25	203	26	208
		NB	10	55	NA	55	NA	88	NA

a Advancing volume
b Opposing volume
NA Movement not available

12.b Bicycle Access

The Project team is working with the City of Cambridge TP&T and CDD staff to evaluate options for improving the bicycle accommodations on Cambridge Street, while preserving a safe environment for students and staff. The bicycle lane concepts are being developed and evaluated separately from this Traffic Study submission process. The City has instructed the design team to include a separated bike lane on the south side of Cambridge Street, in front of the project site. The preferred concept, illustrated in Figure 12.b.1, is a raised bike lane at +3 inches from vehicular traffic, and separated by another 6 inch curb from pedestrians/sidewalk. The elevated bike lane is 5 feet wide with a horizontal buffer of 2 feet for an effective width of 7 feet.

The City is also planning to install a 19-dock Hubway Bikeshare station on the Berkshire Street sidewalk close to the intersection with Cambridge Street.

12.c Bicycle Parking

The proposed Project will provide short-term and long term bicycle parking per the City of Cambridge Bicycle Parking Guidelines, as calculated in Table 12.c.1. Short-term bicycle parking will be located close to building entrances, and long-term bicycle parking will be provided in the parking garage, as illustrated in Figure E. An elevator sized to accommodate bicycles will be provided on-site.

TABLE 12.C.1: BICYCLE PARKING SUPPLY (PER ZONING)

Land Use	GFA (SF)	Number of Rooms*	Long-Term Parking Ratio	Long-Term Spaces	Short-Term Parking Ratio	Short-Term Spaces
King Open & Cambridge Upper Schools	193,185	60	0.3/room	18	1.7/room	102
Valente Library	10,077	-	0.08/1,000 SF	1	0.5/1,000 SF	6
Gold Star Pool Building	5,624	-	0.08/1,000 SF	1	0.5/1,000 SF	3
CPS Admin Offices	21,482	-	0.3/1,000 SF	7	0.06/1,000 SF	2
Mechanical Space/Parking Garage	42,746	-	-	-	-	-
Total	***273,114***		***Min. Required:***	***27***	***Min. Required:***	***113***
			Provided by Project:	***92***	***Provided by Project:***	***118***

*Number of instructional classrooms and square footage per latest architectural program dated 1/29/2016

Per zoning, the project is required to provide a minimum of 27 long-term bicycle parking spaces and 113 short-term, however the project is able to allocate 92 long-term bicycle parking spaces in the underground garage and 113 short-term bicycle parking spaces near building entrances. The long-term and short-term spaces are above and beyond the minimum requirements set by zoning.

13.0 Transportation Demand Management

The Proposed Site 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 (SOV's) by encouraging carpooling and vanpooling, bicycling, walking, and increased use of the area's public transportation system by employees and visitors.

Furthermore, the Project will become subject to the City's PTDM Ordinance (Parking, Transportation Demand Management) and require a large project PTDM Plan submission, as indicated in the City's Traffic Study Scoping Letter. The PTDM Ordinance is applicable because the existing site is only registered for 55 parking spaces and the project proposes to build 105 spaces, any addition of 20 or more new parking spaces triggers a Large Project PTDM Plan.

The Cambridge Public School Department will work with the City's PTDM Officer to develop and put in place an appropriate set of TDM measures for this Site.

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 188is 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	198	No
Week AM Peak Hour	240	28	No
Week PM Peak Hour	240	26	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 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
Cambridge St at Windsor St	F	F	1.0%	No	F	F	1.1%	No
Cambridge St at Willow St	C	C	1.2%	No	C	C	1.3%	No
Cambridge St at Berkshire St	C	C	0.5%	No	D	D	1.7%	No
Cambridge St at Cardinal Medeiros Ave	F	F	0.8%	No	F	F	0.6%	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

14 of the 16 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	Reviewed Segment	Amount of Residential	AM Peak Hour			PM Peak Hour		
			Existing[1]	Project Trips	Exceeds Criteria?	Existing[1]	Project Trips	Exceeds Criteria?
Cambridge Street	Windsor St to Willow St	>1/3 but <1/2	803	10	No	867	12	No
	Willow St to Berkshire St	1/3 or less	803	3	No	868	11	No
	Berkshire St to Cardinal Medeiros Ave	1/3 or less	823	2	No	980	7	No
Willow Street	Cambridge St to Palermo St	1/2 or more	70	7	No	70	1	No
	Palermo St to Lincoln St	1/2 or more	70	7	No	70	1	No
	Lincoln St to York St	1/2 or more	70	7	No	70	1	No
Berkshire Street	York St to Hardwick St	1/2 or more	95	11	No	225	2	No
	Hardwick St to Marney St	1/2 or more	95	11	No	225	2	No
	Marney St to Marcella St	1/2 or more	95	23	Yes	225	4	No
	Marcella St to Cambridge St	1/2 or more	95	3	No	225	18	No
Cardinal Medeiros Ave	Cambridge St to Marcella St	1/2 or more	470	9	No	460	1	No
	Marcella St to Marney St	1/2 or more	470	9	No	460	4	No
	Marney St to Hardwick St	1/2 or more	470	3	No	460	4	No
	Hardwick St to Vandine St	1/2 or more	470	3	No	460	4	No
	Vandine St to Plymouth St	1/2 or more	470	3	No	460	4	No
	Plymouth St to Bristol St	1/2 or more	470	3	No	460	4	No

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

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?
Cambridge Street at Willow Street	EB – Left/Thru/Right	8	8	No	8	8	No
	WB – Left/Thru/Right	7	7	No	8	8	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 SIGNALIZED INTERSECTION PLOS SUMMARY

		AM Peak Hour			PM Peak Hour		
Intersection	Crosswalk	Existing	Build	Exceeds Criteria?	Existing	Build	Exceeds Criteria?
Cambridge Street at Willow Street	East	B	B	No	B	B	No
	West	B	B	No	B	B	No
	North	A	A	No	A	A	No
	South	A	A	No	A	A	No

Criteria 2 & 3: Safe Pedestrian and Bicycle Facilities

Safe pedestrian facilities must exist on any adjacent publicly-accessible street or ROW; and they must connect to site entrances, interior walkways, and adjoining pedestrian facilities.

Safe Bicycle Facilities are on-street bicycle lanes or off-road paths along a publicly-accessible street or right-of-way which meet City design standards.

Where sufficient ROW currently exists, safe bicycle facilities must exist or sufficient ROW must be preserved on any adjacent publicly-accessible street or ROW; and they must connect to site entrances, interior pathways, and adjoining bicycle facilities.

Table E-3 presents the evaluation of the pedestrian and bicycle facilities for the streets adjacent to the Project.

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?
Cambridge Street	Willow Street and Berkshire Street	Yes	No	Yes	No
Willow Street	Cambridge Street and York Street	Yes	No	No	Yes
Berkshire Street	Cambridge Street and York Street	Yes	No	No	Yes