Nitsch Engineering

Zervas Elementary School
Newton, MA

Traffic Impact Study

October 2014

Prepared for:

Design Partnership of Cambridge
Hood Business Park
500 Rutherford Avenue
Charlestown, MA 02129

Submitted by:

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Nitsch Project #10023.1

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1 INTRODUCTION

Nitsch Engineering has been retained by Design Partnership of Cambridge to complete a Traffic Impact Study for the existing and proposed conditions relative to the redevelopment of the existing Zervas School, located at 30 Beethoven Avenue in the village of Waban in Newton, Massachusetts.

1.1 Initial Traffic Impact Study

Nitsch Engineering completed the existing conditions portion of the Traffic Impact Study in March 2014 and focused on evaluation of existing access/egress, traffic circulation, pick-up/drop-off, parking demand, crash data, traffic volumes and traffic operations.

To asses these conditions, Nitsch Engineering conducted a site reconnaissance in February 2014, conducted vehicle pick-up/drop-off counts in the site vicinity, collected peak hour traffic turning movement counts (TMC's) at the site adjacent intersection of Beacon Street at Beethoven Avenue and collected continuous automatic traffic recorder (ATR) counts along both Beacon Street and Beethoven Avenue to establish the average daily traffic (ADT) along both roadways. The TMC's and ATR's were collected in early March 2014 while school was in full session.

Based on the assessment of the existing conditions, Nitsch Engineering made several recommendations with regard to improving traffic flow and decreasing potential safety conflicts with regard to both vehicular and pedestrian flow for the planned redevelopment of the Zervas School.

1.2 Project Coordination

At the conclusion of the initial Traffic Impact Study, Nitsch Engineering worked with Design Partnership of Cambridge to offer guidance and planning on several site options with regards to future vehicle and pedestrian circulation, capacity and safety.

Design Partnership of Cambridge finalized a Site Plan with City approval and Nitsch Engineering received the Site Plan on October 15, 2014, which we used as basis for the evaluation of the proposed conditions in this Traffic Impact Study.

2 EXISTING CONDITIONS

2.1 Study Area

To examine the existing conditions, we studied and collected data at the following roadways and intersections:

Roadways

1. Beacon Street, east of Beethoven Avenue;
2. Beacon Street, west of Beethoven Avenue;
3. Beethoven Avenue, south of Beacon Street

Intersection

1. Beacon Street at Beethoven Avenue at Evelyn Road

Figure 1 shows the Locus Map of the study area and depicts the surrounding roadway network. Figure 2 depicts the School Site and Study Area.

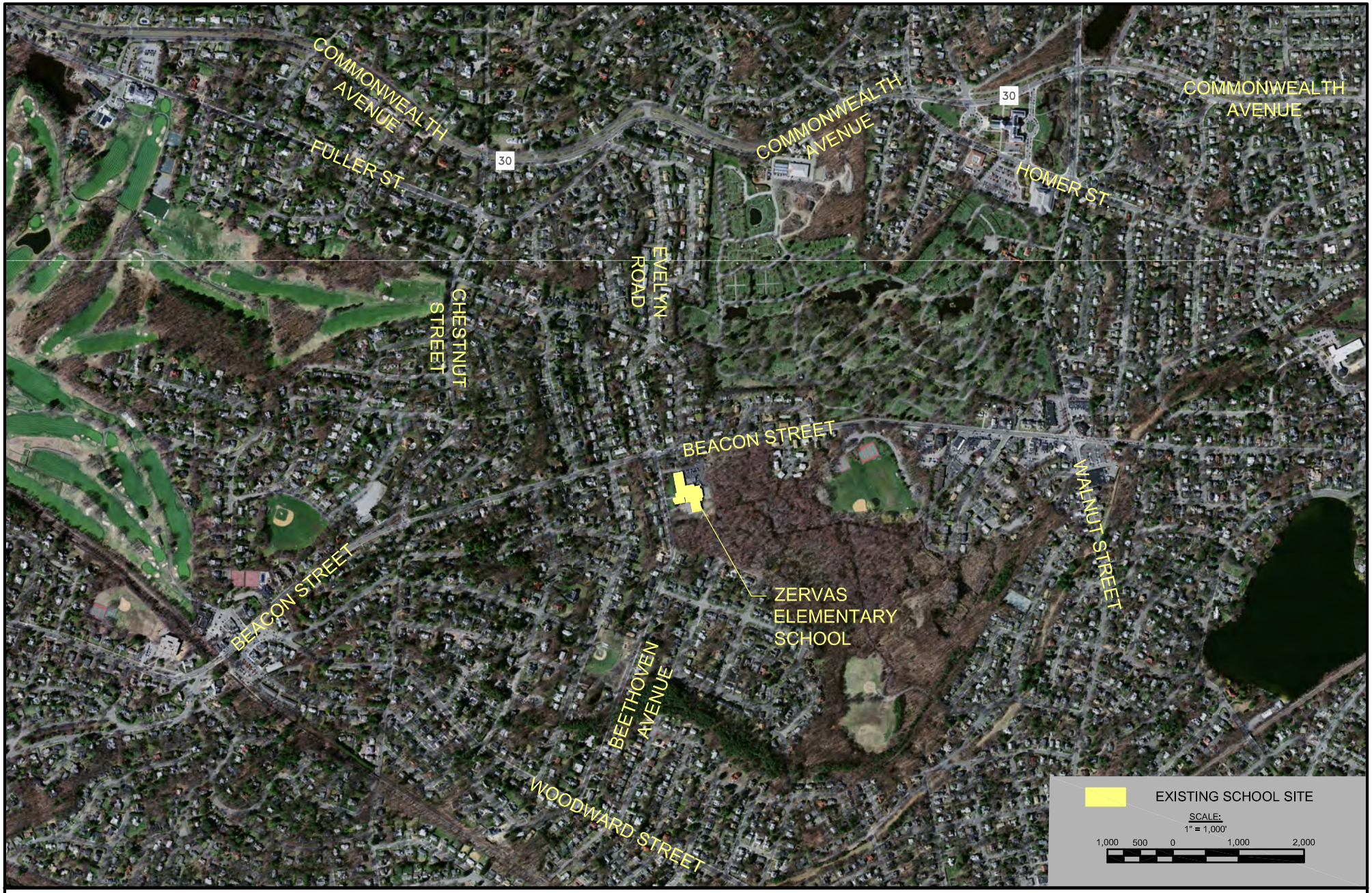
2.2 Site Visit

Nitsch Engineering conducted a Site Visit of the existing Zervas Elementary School located at 30 Beethoven Avenue in the Waban village of Newton, MA on Thursday February 27, 2014 and reviewed site access/egress, traffic circulation and pick-up/drop-off, and inventoried parking supply and demand. The site inspection was conducted in clear but cold weather conditions with temperature around 18 degrees. Due to previous snowy conditions, some parking spaces, sidewalks and driveways in the vicinity of the school property were covered with snow.

Roadways

Beacon Street near Beethoven Avenue

Beacon Street near Beethoven Avenue is classified as an urban minor arterial and runs in an east-west direction. Beacon Street contains one (1) travel lane in each direction and 4-foot wide shoulders on either side. The centerline is delineated by a double yellow centerline and the shoulders are delineated by solid white edge lines. Concrete sidewalks are present on either side of the roadway. A grass strip separates the sidewalks from the roadway on either side. The posted speed limit along the roadway is 30 mph. The land use is exclusively residential. The roadway is within the jurisdiction of the City of Newton, which oversees its operations and maintenance.



LOCUS MAP

ZERVAS SCHOOL
NEWTON, MA

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500 RUTHERFORD AVENUE, CHARLESTOWN, MA 02129

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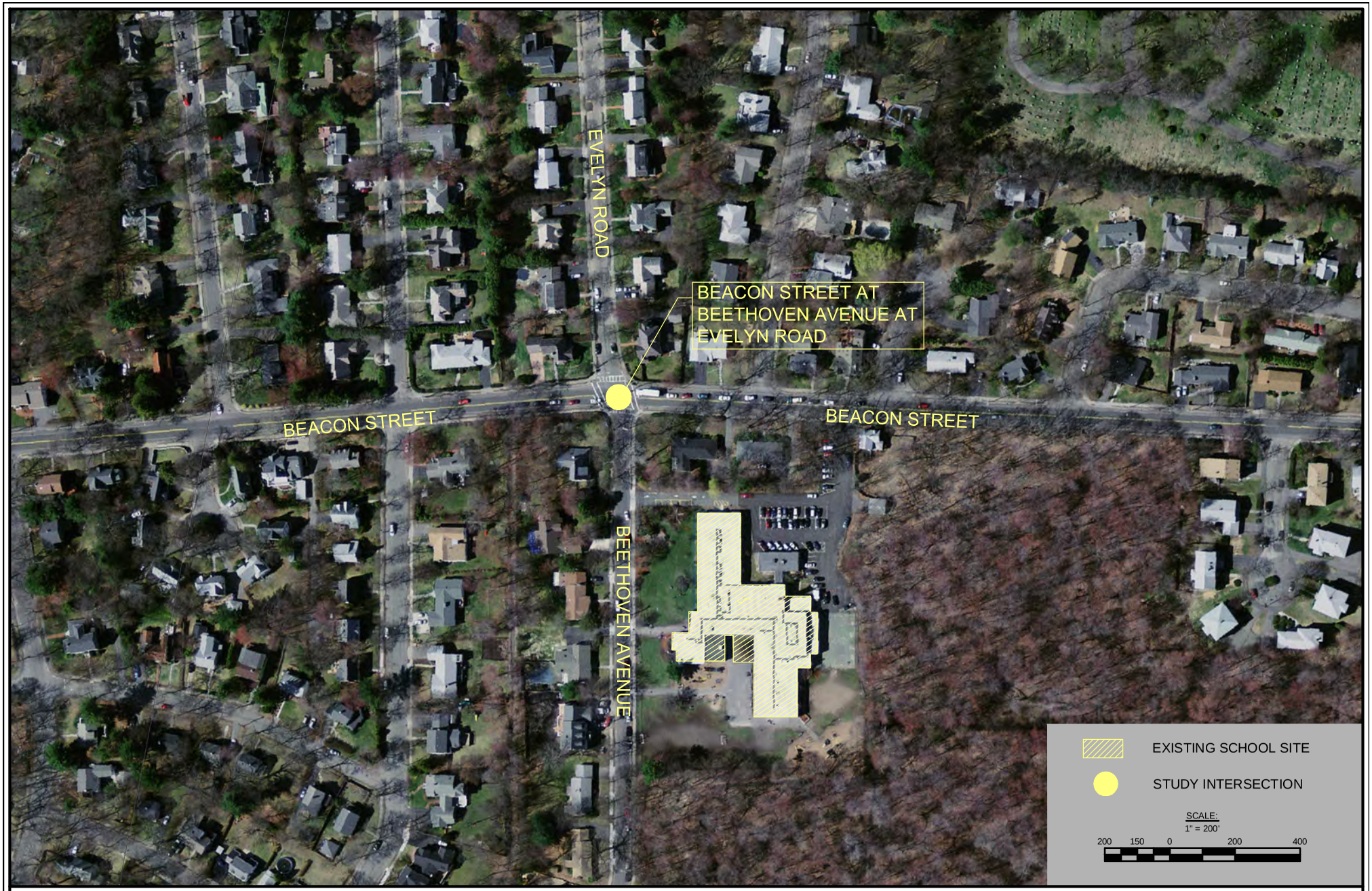
FIGURE 1



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SCHOOL SITE AND STUDY AREA

ZERVAS SCHOOL
NEWTON, MA

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FIGURE 2

Beacon Street, looking west

Beethoven Avenue

Beethoven Avenue is approximately 0.5 miles long and is classified as a local roadway running in a north-south direction from Woodward Street at its south end to Beacon Street at its north end. Beethoven Avenue operates with one (1) travel lane in each direction, however no striping is present. Concrete sidewalks are present on either side of the roadway. A grass strip separates the sidewalks from the roadway on either side. There is no posted speed limit along the roadway. The land use is exclusively residential. The roadway is maintained by the City of Newton.

Beethoven Avenue is designated is a one-way northbound toward Beacon Street during school days between 8am – 9am and 2:30pm - 3:30pm. The east side of the roadway in front of the Zervas School is designated as the "Blue Zone", which is approximately 350 feet in length and it indicated by a blue painted curb. The "Blue Zone" is about 22 feet from the edge of the school entrance driveway that leads to the staff parking lot. The "Blue Zone" is subdivided into three zones - Zone 1, Zone 2 and Zone 3. Based on our conversation with the school's Principal, the three zones were initially designed to specify drop-off, pick up and visitor parking locations within the "Blue Zone", but due to the lack of adequate parking spaces coupled with their inability to enforce the policy, the entire "Blue Zone" is now designated for visitors, drop-off and pick-up. The "Blue Zone" has posted signs that specify when the area is strictly available for drop-off and pick-up parking only. The signs specify parking restriction during the following times; 8:05AM-8:35AM, 11:30AM-1PM, 2PM-3:30PM on Monday, Wednesday, Thursday and Friday, and 8:05AM-8:35AM and 11:30AM-1PM on Tuesdays.

Beethoven Avenue looking north, in front of Zervas School. Notesigns indicating the "Blue Zone"

Evelyn Road

Evelyn Road is approximately 0.5 miles long and is classified as a local roadway running in a north-south direction from Commonwealth Avenue at its north end to Beacon Street at its south end. Evelyn Road operates with one (1) travel lane in each direction, however no striping is present. Concrete sidewalks are present on either side of the roadway. A grass strip separates the sidewalks from the roadway on either side. There is no posted speed limit along the roadway. The land use is exclusively residential. The roadway is maintained by the City of Newton.

Evelyn Road, looking north

Intersection

Beacon Street at Beethoven Avenue at Evelyn Road

The signalized intersection of Beacon Street at Beethoven Avenue is located approximately 150 feet north of the Zervas School Access Driveway.

Beacon Street has a two-lane cross-section with one (1) approach lane and one (1) departure lane for bi-directional flow. Beethoven Avenue and Evelyn Road have a one-lane cross-section for bi-directional traffic flow. Approaching from the east and west, Beacon Street is 32 feet wide with one (1) 11.5-foot wide travel lane in each direction and 4-foot wide shoulders on either side. The centerline is delineated by a double yellow centerline and the shoulders are delineated by solid white edge lines. Concrete sidewalks are present on either side of the roadway. A grass strip separates the sidewalks from the roadway on either side. Crosswalks are present across Beacon Street at both approaches. The pedestrian ramps are compliant with the Americans with Disabilities (ADA) guidelines. There are "School" warning signs posted on the east and west approach to alert drivers to the approaching school in advance. There are no turns allowed from Beacon Street onto Beethoven Avenue from 8:00 AM – 9:00 AM and 2:30 – 3:30 PM on School Days, as Beethoven Avenue operates as one-way northbound (towards Beacon Street) during that time.

Approaching from the north, Evelyn Road is 24 feet wide and operates as one lane in each direction and there is no centerline striping. Concrete sidewalks are present on either side of the roadway. A grass strip separates the sidewalks from the roadway on either side.

Approaching from the south, Beethoven Avenue is 22 feet wide and operates as one lane in each direction, and there is no centerline striping. Concrete sidewalks are present on either side of the roadway. A grass strip separates the sidewalks from the roadway on either side. Entering the vicinity of the school along Beethoven Avenue from the north or the south, a speed limit of 20 mph sign with accompanying flashing

yellow beacons is posted to indicate a School Zone when activated during school hours. A "School" pavement marking is also present in both northbound and southbound direction approaching the school. A crossing guard is present at this intersection during drop-off and pick-up periods to help children and parents cross safely.

The intersection traffic signal operates in three (3) phases. The Beethoven Avenue northbound and Evelyn Road southbound approaches serve as the first phase. The Beacon Street east and westbound approaches serves as the second phase. The third phase operates as an exclusive pedestrian phase.

2.3 Site Access and Egress

During drop-off/pick-up periods when Beethoven Avenue is restricted to one-way northbound; primary access and egress points for the school are located on Beethoven Avenue. The school Access Driveway provides entrance to the parking area located behind the school building. A concrete walkway connects Beethoven Avenue to the main entrance of the school.

Beethoven Avenue can be accessed via Woodward Street which is on the south end of Beethoven Avenue. Woodward runs east-west and therefore can serve vehicles from both ends of the city to access the school via the south end of Beethoven Avenue. Vehicles from the north can access Woodward Street via Beacon Street and connect with either Allen Avenue, Upland Road, or Chestnut Street.

2.4 Recreational Facilities

Zervas School is proximate to Richardson Field, which is located approximately 0.25 miles south of the school on the west side of Beethoven Avenue. The field contains a Little League-sized baseball diamond and two play areas.

Zervas School is also proximate to Coldspring Park, a 67 acre park located approximately 0.25 miles east of the school along the south side of Beacon Street. The park contains a softball field, a soccer field and two basketball courts and three tennis courts, however recreation is not limited to these activities, as Lifecourse Trail winds through the wooded area adjacent to the Park.

2.5 Traffic Circulation and Pick-up/Drop-off

Beethoven Avenue is restricted to one-way northbound travel toward Beacon Street during school days between 8AM – 9AM and 2:30PM - 3:30PM. The Zervas School site provides no exclusive parking lot for visitors or parent drop-off and pick-up; these activities take place within the designated "Blue Zone" along the east side of Beethoven Avenue. Some neighborhood students walk to school accompanied by parents and others walk unaccompanied. Students that use the intersection of Beacon Street at Beethoven Avenue at Evelyn Road to access the school are aided by a crossing guard to cross the roads safely, even though an exclusive pedestrian phase is present at the intersection.

Nitsch Engineering observed high congestion along Beethoven Avenue during drop-off and pick-up periods. Vehicles frequently stopped and started again depending on the availability of spaces. Some vehicles stopped in the middle of Beethoven Avenue beside parked vehicles in the "Blue Zone" to drop off students. Vehicles had to stop to wait for vehicles to parallel park or to disembark from a parallel space. The constant stopping and maneuvering throughout Beethoven Avenue, particularly within the "Blue Zone", creates an

inefficient traffic flow that can increase driver frustration and delay and increase the likelihood of a safety incident during the drop-off/pick-up periods.

Existing Morning Drop-off Circulation

As shown in Figure 3, during the morning drop-off period, both bus and parent drop-off takes place along Beethoven Avenue within the "Blue Zone" within the travel way. The two morning buses drop-off within the "Blue Zone" in front of the main entrance of the school building, while parent drop-off take place along the entire length of the "Blue Zone". Several vehicles were observed travelling southbound on Beethoven Avenue prior to the one-way restriction time and executing a three-point turn prior to dropping off within the "Blue Zone".

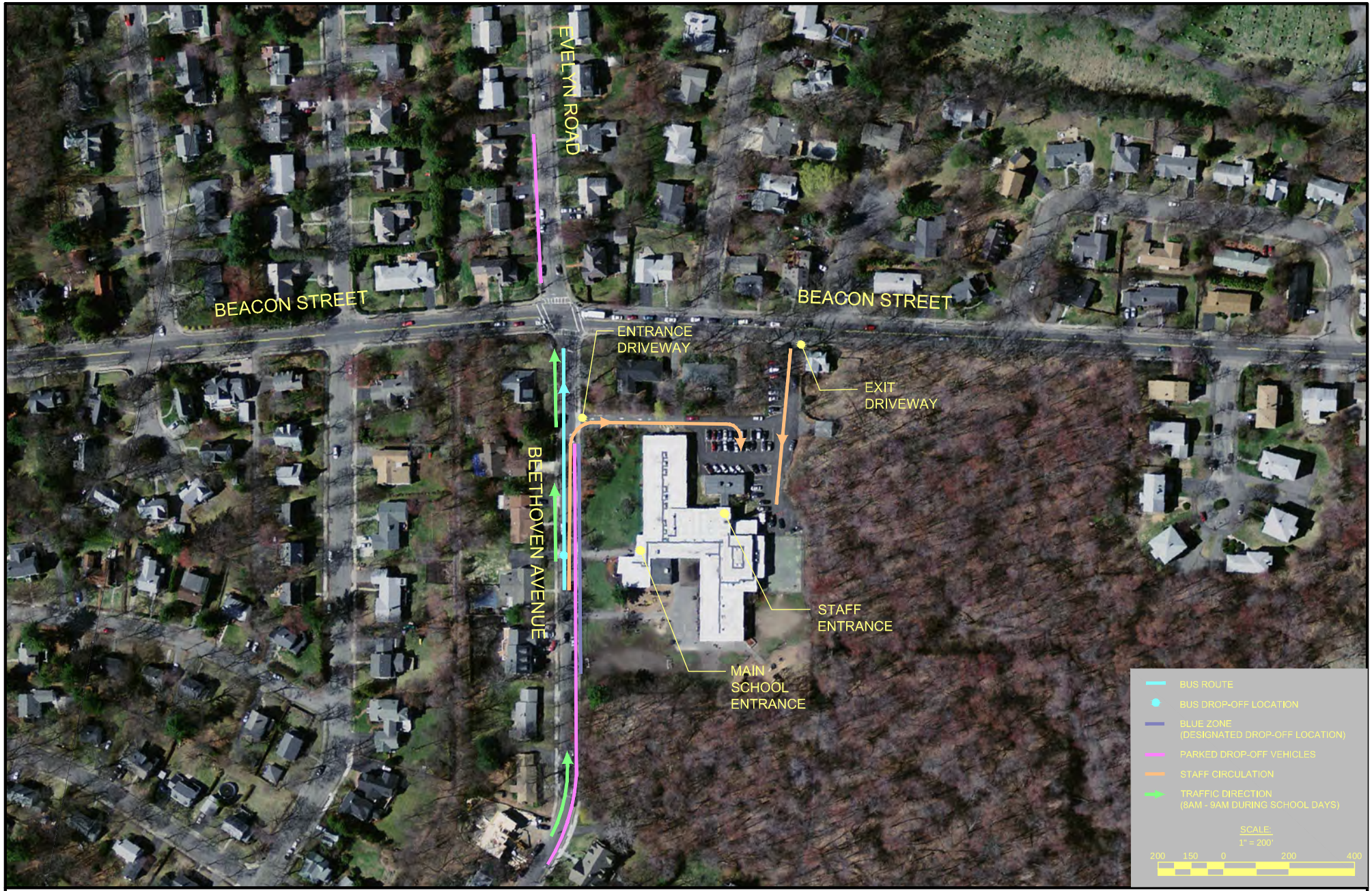
Parent drop-off at the Zervas School occurs as parents park their vehicles along the "Blue Zone" and walk their kids to the school building. This process takes approximately 5 to 10 minutes. Nitsch Engineering observed drop-off vehicles parking beyond the "Blue Zone" due to inadequate availability. Some drop-off vehicles approach the school from the south end of Beethoven Avenue with the intention of parking within the "Blue Zone", but when no spaces are available, they proceed to park on Evelyn Street prior to walking their kids to the School.

The school drop-off period overlaps with regular commuter trips, creating several conflict points along Beethoven Avenue due to vehicles merging and diverging at several locations. Because of this, some staff use the exit driveway on Beacon Street to access the school parking lot.

Existing Afternoon Pick-up Circulation

During the afternoon pick-up period, parents park their vehicles within the "Blue Zone" and wait until the children are released. Many parents will exit their vehicles and walk towards the main entrance and wait for school dismissal. Parent pick-up circulation is the same pattern as drop-off; the differences are the length of parked vehicles, and the timing and the rate at which vehicles exit Beethoven Avenue. Nitsch Engineering observed pick-up vehicles parking beyond the "Blue Zone" and extending onto Puritan Road and beyond as shown in Figures 4 and 5 due to the volume of vehicles arriving within the short time frame prior to dismissal. As noted in the morning drop-off, some pick-up vehicles parked on Evelyn Road in both directions of travel.

Upon school release, all staff exit the parking lot using the exit driveway on Beacon Street. One (1) bus was observed violating the Beethoven Avenue one-way northbound restriction and turned onto Beethoven Avenue from Beacon Street, then preceded to the School Access Driveway for pick up, after which they properly exited using the driveway on Beacon Street. The remaining two (2) buses picked up within the "Blue Zone" within the travel way in front of the main entrance to the school, after which they proceeded to Beacon Street. The practice of buses picking up within the travel way is not recommended because of driver delay and frustration attributed to vehicles merging and diverging at several locations within the "Blue Zone" at the same time and the potential danger due to the confluence of bus, vehicle and student traffic.



WEEKDAY MORNING DROP-OFF TRAFFIC CIRCULATION

ZERVAS SCHOOL
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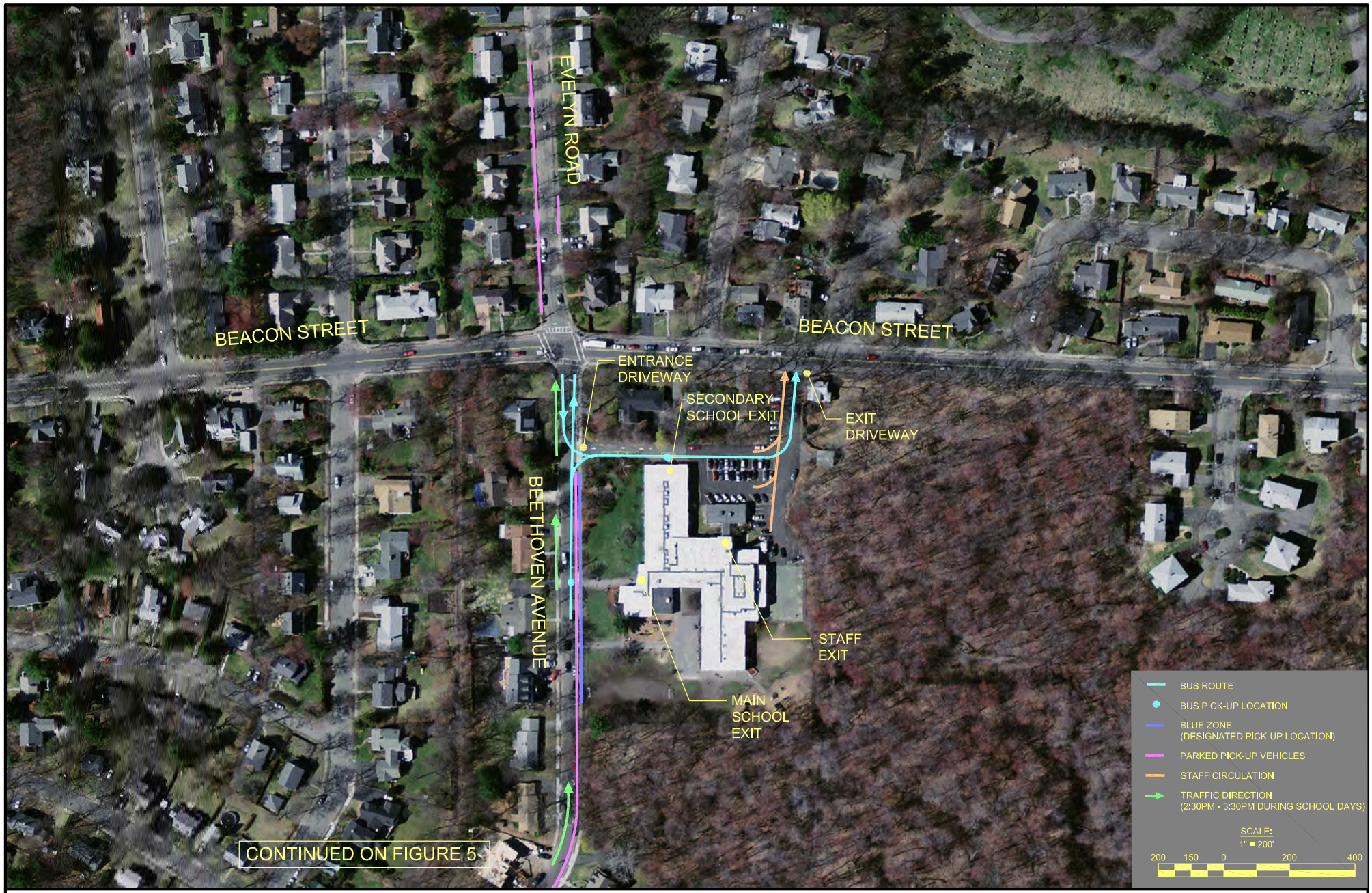
FIGURE 3



WEEKDAY AFTERNOON PICK-UP TRAFFIC CIRCULATION (1 OF 2)

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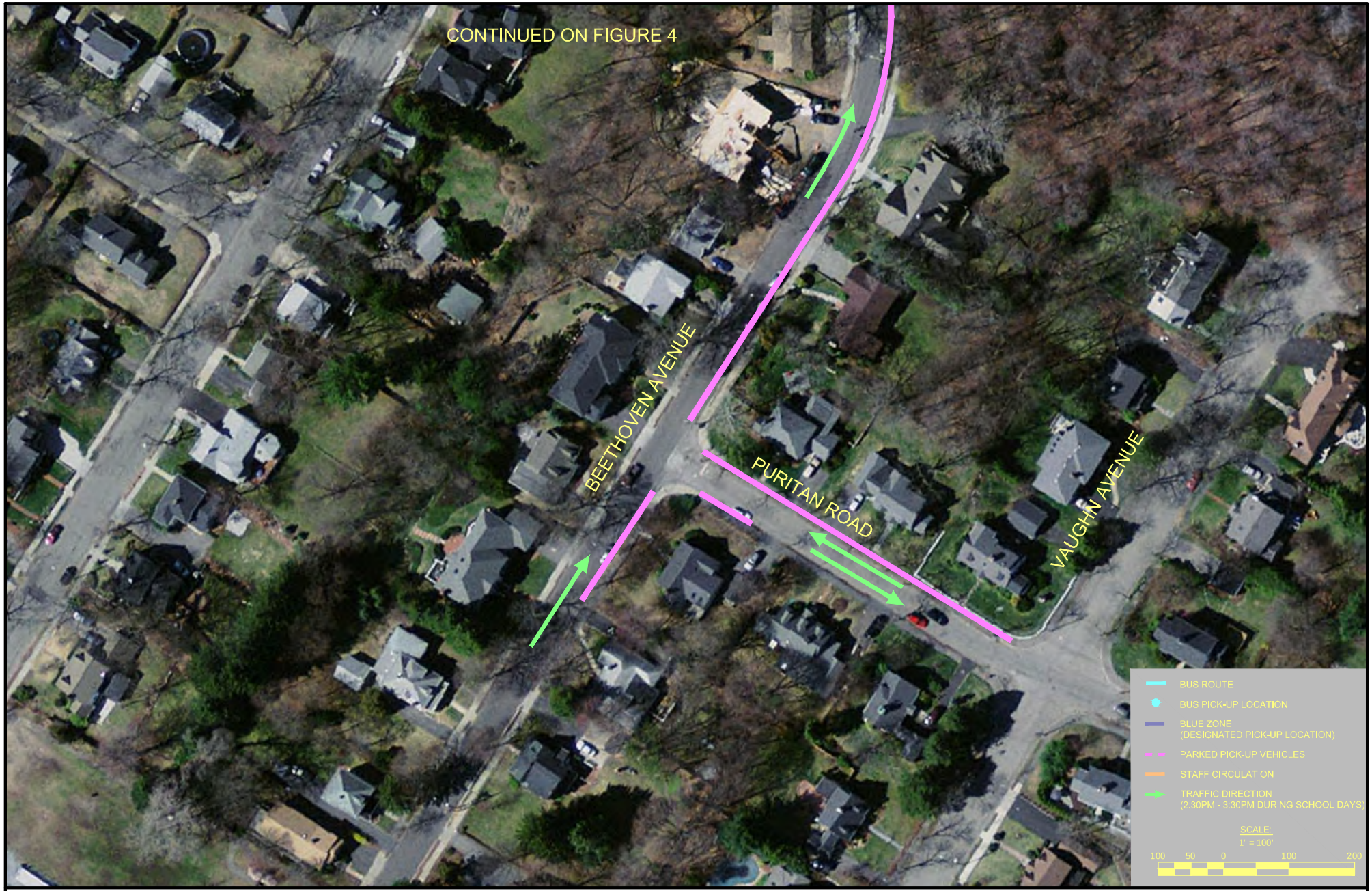
FIGURE 4



WEEKDAY AFTERNOON PICK-UP TRAFFIC CIRCULATION (2 OF 2)

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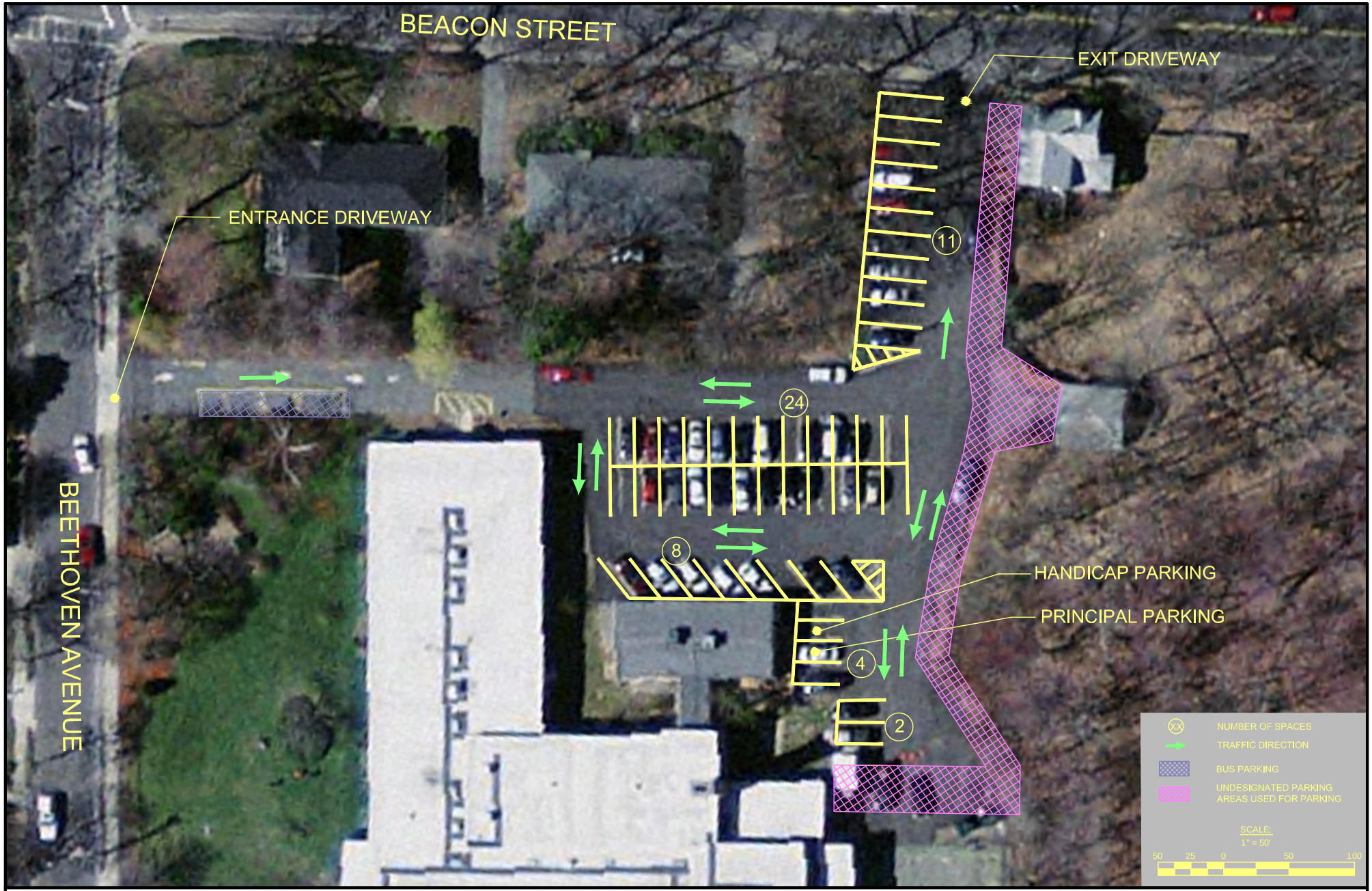
FIGURE 5

2.6 Parking Supply and Demand

Nitsch Engineering conducted a parking supply and demand assessment of both the school lot and adjacent on-street parking during the site visit. The existing school has one (1) parking lot, shown in Figure 6, which is used by staff only. The parking lot has 49 parking spaces, of which one (1) is reserved for the principal and one (1) handicap space. There is one (1) parking space at the entrance driveway reserved for buses and there is no allotted parking for visitors in the parking lot.

The parking inventory and count was conducted roughly one hour after the morning drop-off, around 10:00 AM. We observed that the quantity of parking spaces in the school parking lot was insufficient for demand, as some vehicles were parked in landscaped areas and other undesignated parking spaces. At the time of the site visit, approximately ten (10) designated parking spaces had been covered with snow and were not able to be utilized, but the number of vehicles that were parked in undesignated parking areas exceeded the number of designated spaces that were covered with snow. Within the lot, one space that contained a vehicle was outlined with several inches of snow, unlike adjacent parking spaces. We assumed that this vehicle is not parked for school business, and is most likely a nearby resident that utilizes the school lot for long-term parking. It is possible that this practice is widespread, though this cannot be verified because no parking count was done prior to staff arrival. The school currently has no parking permit program. The parking allotment is shown in Figure 6 and the Parking Utilization is shown in Table 1.

Long-term parking in the Zervas School lot may be a problem



PARKING ALLOCATION

ZERVAS SCHOOL
NEWTON, MA

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FIGURE 6

Vehicles parked along the parking lot egress driveway

Table 1 - Zervas Elementary School Parking Utilization

Parking Type		Main Parking Area	Overall
General Parking	Utilized	49	49
	Capacity	47	47
	Percent Used	104.3%	104.3%
Principal	Utilized	1	1
	Capacity	1	1
	Percent Used	100.0%	100.0%
Handicapped	Utilized	0	0
	Capacity	1	1
	Percent Used	0.0%	0.0%
Total	**Utilized**	**50**	**50**
	Capacity	**49**	**49**
	Percent Used	**102.0%**	**102.0%**

On-street parking is heavily restricted in front of the Zervas School on school days and during the weekday morning and weekday afternoon peak hours. Parking on the west side of Beethoven Avenue in front of the school is prohibited on School Days from 8AM-4PM. Parking within the "Blue Zone" is restricted from 8:05AM-8:35AM, 11:30AM-1PM, 2PM-3:30PM on Monday, Wednesday, Thursday and Friday, and 8:05AM-8:35AM and 11:30AM-1PM on Tuesdays, as shown in the photo below. Parking is prohibited on the east side of Beethoven Avenue between the "Blue Zone" and Beacon Street. Due to the heavy restriction, no on-street parking was observed outside of the peak periods.

Several signs are located along the east side of Beethoven Avenue south of the "Blue Zone", since this area is heavily utilized during both the weekday morning and weekday afternoon peak hours. The signs include warnings of 'No Parking Here to Corner' near the Beethoven Avenue intersection with Puritan Road and 'No Parking within 5 Feet of Driveway' near a private residential property between Puritan Road and the "Blue Zone".

Parking along the east side of Beethoven Avenue

Looking north from Beethoven Avenue toward Beacon Street

2.7 Parent Drop-Off/Pick-up Totals

Drop-off vehicles start arriving around 7:45 AM and the vehicles park and wait outside along the “Blue Zone” and other available spaces until the bell rings. School bell rings at 8:20 AM and school begins at 8:35 AM. When outside temperature is below 20 degrees, students are allowed to wait inside until after the bell rings and before school begins.

School dismissal time is at 12:30 PM on Tuesdays and 3:00 PM on all other days. For kindergarten, dismissal is 12:30 PM on Tuesdays and half of the class alternate dismissal on Mondays, Wednesdays, Thursdays and Fridays. There is one bus pick-up for all kindergarten students and another bus for Boston students only.

We compiled the total quantity of parent drop-off/pick-up totals and are shown in Table 2. The quantities do not include buses or van buses or drop-off/pick-ups that occurred outside the peak periods, as these are assumed late arrivals or early dismissals. We observed parent drop-off on Evelyn Road, but were unable to quantify the total because we were previously unaware of this occurrence. We were able to note the quantities for the afternoon pick-up period.

Table 2 - Zervas Elementary School Pick-Up/Drop-Off Quantity

Time	Parent Drop-Off*		Bus Drop-Off	
	Northbound (Beethoven Ave.)	Southbound (Beethoven Ave.)	Northbound (Beethoven Ave.)	Southbound (Beethoven Ave.)
7:45 - 8:00	17	2	1	0
8:00 - 8:15	58	0	1	0
8:15 - 8:30	9	0	0	0
Total	84	2	2	0
Time	**Parent Pick-Up**		**Bus Pick-Up**	
	Northbound	**Evelyn Road**	**Northbound**	**Evelyn Road**
12:15 - 2:30	8	0	1	0
2:30 - 2:45	34	4	0	0
2:45 - 3:00	15	12	1	1
3:00 - 3:15	6	1	2	0
Total	63	17	4	1

*Parent Drop-Off was observed on Evelyn Road, but was unable to be quantified

2.8 Existing Roadways and Intersection Deficiencies

The following deficiencies are noted for the study intersection and roadways.

Beacon Street

- There is no posted speed limit on the Beacon Street eastbound approach.

Evelyn Road

- There is no posted speed limit on the Evelyn Road southbound approach.

Beethoven Avenue

- The flashing beacons located in advance of the school in both the northbound and the southbound directions as are non-operational. Consider removing the sign facing southbound traffic because the roadway is one-way during the school pick-up/drop-off time, and may cause confusion with vehicles attempting to enter the roadway via Beacon Street or Evelyn Road.

Looking south on Beethoven Avenue. Flashing beacon is non-operational and may cause confusion due to the one-way northbound operation during peak school periods.

Beacon Street at Beethoven Avenue at Evelyn Road

- The pedestrian phase does not have a steady “DONT WALK” interval at the conclusion of the “FLASHING DON’T WALK” interval, which does not provide the proper pedestrian clearance time.
- The pedestrian push-buttons are non-compliant with the latest Manual on Uniform Traffic Control Devices (MUTCD) and Americans with Disability Act (ADA) standards.
- Traffic signal heads are missing backplates, which improve the visibility of the illuminated signal faces.

Traffic signal heads have no backplates, which would enhance signal visibility

Pedestrian push-button and signage is non-compliant with the latest MUTCD and ADA standards

3 SAFETY ANALYSIS

The following summarizes the crash data for Beacon Street at Beethoven Avenue at Evelyn Road.

3.1 Crash Data

Nitsch Engineering reviewed the crash data available from MassDOT for the three (3) most recent years available – 2010 to 2012 – for the study area intersection. A summary of the crashes, including the severity, and the manner of collision are shown in Table 3.

Table 3 - Crash Summary

Location	Number of Crashes			Severity				Manner of Collision					Percent During	
	Year	Total Crashes	Average	PD[a]	PI[b]	NR[c]	F[d]	A[e]	RE[f]	HO[g]	Other[h]	Incl. Ped-Bike[j]	Peak Hours[k]	Wet/Icy Conditions
Beacon Street at Evelyn Road/ Beethoven Avenue	2010	1	2	1	0	0	0	0	1	0	0	0	0%	0%
	2011	2		1	0	1	0	0	1	0	1	0	0%	0%
	2012	3		2	1	0	0	2	1	0	0	0	33%	33%
Total	ALL	**6**	**2**	**4**	**1**	**1**	**0**	**2**	**3**	**0**	**1**	**0**	17%	17%

[a]Property Damage Only; [b]Personal Injury Only (non-Fatal Injury); [c]Not Reported; [d]Fatality; [e]Angle; [f]Rear end; [g]Head on; [h]Sideswipe, opposite direction; sideswipe, same direction, single vehicle crash, rear-to-rear, not reported, unknown, etc.; [j]Includes pedestrian or cyclist; [k]Occurred between 7-9am or 4-6pm

As seen from Table 3, a total of six (6) crashes were reported at the intersection of Beacon Street at Beethoven Avenue at Evelyn Road from 2010 to 2012. Two-thirds of the crashes involved property damage, while one (1) crash involved personal injury and one (1) was not reported in terms of severity. No fatalities were reported. One-third were angle collisions and one-half were rear-end collisions. Only one of the six crashes occurred during peak hours and only one occurred during wet/icy conditions.

The most likely cause for a majority of the collisions were driver inattention, since a majority did not involve turning vehicles and weather was not a factor.

3.2 Intersection Crash Rate

The intersection crash rate is recognized as an effective tool to measure the safety of intersections. Crash rates are expressed by the number of crashes per million entering vehicles (MEV) at an intersection. The average statewide crash rate for signalized intersections is 0.80 per MEV and for District 6, which includes the City of Boston, the rate is 0.76 crashes per MEV.

From Table 3 and using the traffic count data presented in Section 4, the intersection experienced a crash rate of 0.19, which is below both the state and District 6 averages for signalized intersections.

4 EXISTING TRAFFIC CONDITIONS

4.1 2014 Traffic Count Data

Automatic Traffic Recorder (ATR) Data

Nitsch Engineering retained Precision Data Industries, LLC (PDI) of Berlin, MA to conduct 48-hour ATR vehicle traffic counts along Beacon Street and Beethoven Avenue from Wednesday, March 5 to Thursday, March 6, 2014. Table 4 provides a summary of the ATR data and peak hour volumes are shown in Figure 7. A copy of the traffic count data is included in the Appendix.

Table 4 - Automatic Traffic Recorder (ATR) Summary

LOCATION	PERIOD	ADT[a]		PEAK HOUR ROADWAY TRAFFIC			K factor[d]
		VOLUMES (vpd)[b]	DIRECTIONAL DISTRIBUTION	PERIOD	VOLUMES (vph)[c]	DIRECTIONAL DISTRIBUTION	
Beacon Street, east of Paulson Road	Weekday	10,324	50% EB	Morning	907	52% EB	0.09
				Evening	959	52% EB	0.09
Beacon Street west of Evelyn Road	Weekday	9,371	50% WB	Morning	829	52% EB	0.09
				Evening	857	54% EB	0.09
Beethoven Avenue south of Beacon Street	Weekday	1,460	60% NB	Morning	187	93% NB	0.13
				Evening	151	58% SB	0.10

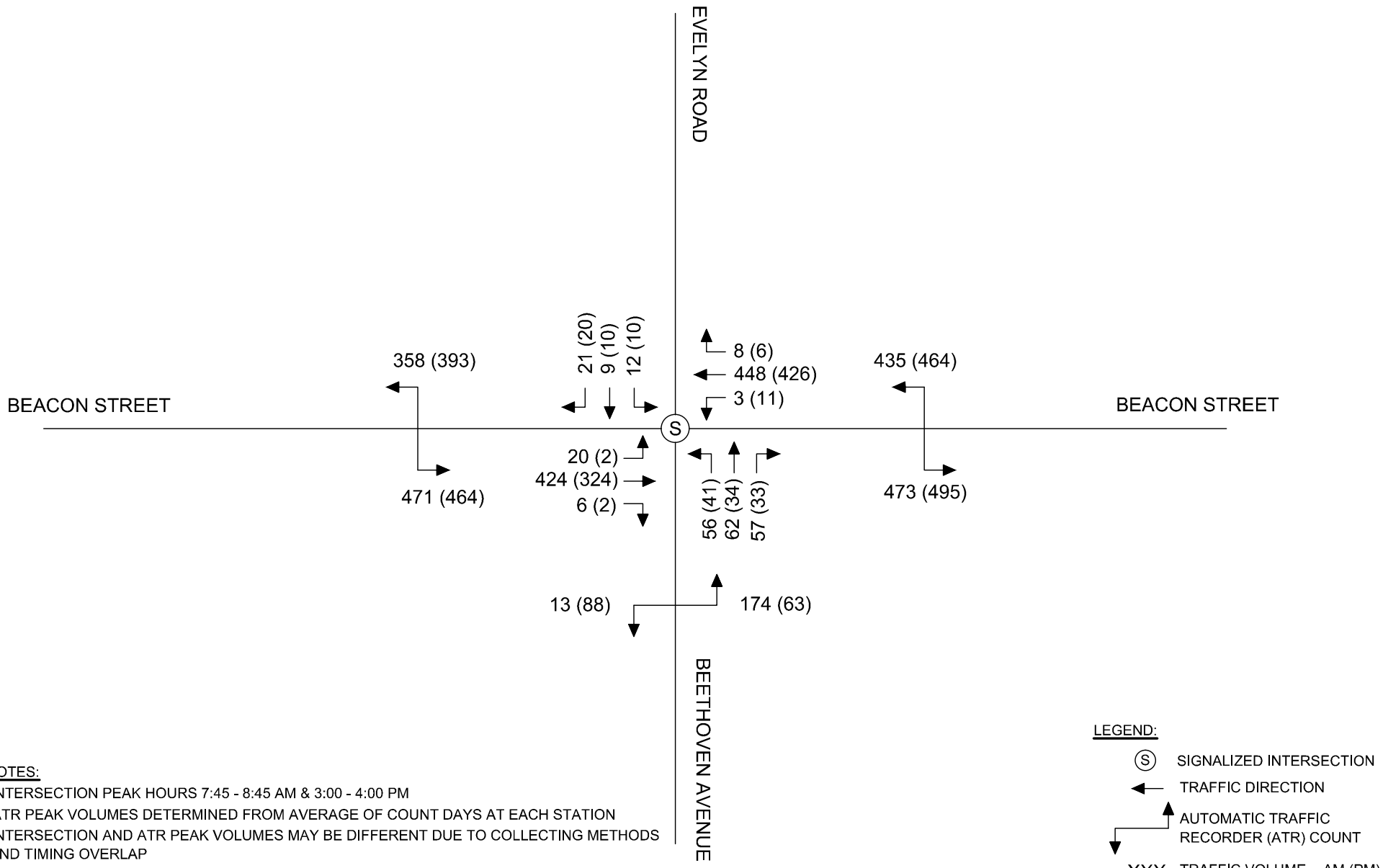
[a] Average Daily Traffic; [b] Vehicles per day; [c] Vehicles per hour; [d] Percent of daily traffic

Turning Movement Count (TMC) Data

PDI conducted Turning Movement Counts (TMC) for the study area intersection on Thursday, March 6, 2014 from 7:00 AM to 9:00 AM to capture the school morning peak hour volumes and from 2:00 PM to 4:00 PM to capture the afternoon school peak hour volumes. The peak hour of the intersection was determined to be 7:45 AM to 8:45 AM in the morning and 3:00 PM to 4:00 PM in the afternoon. The collected volumes are shown in Figure 7.

Vehicle Travel Speeds

PDI measured vehicle travel speeds at the ATR locations at the time of the traffic count. The 85th percentile speed, meaning the speed at which 85% of the vehicles are at or below, is noted because of its importance in determining appropriate roadway speed limits and for calculating required sight distance. For each ATR location, the 85th percentile speed was averaged between the two (2) 24-hour periods in which counts were taken. For the Beacon Street location, the 85th percentile speed was 33 mph westbound and 29 mph eastbound compared to a posted speed limit of 30 mph. For the Beethoven Avenue location, the 85th percentile speed was 28 mph northbound.



NOTES:
-INTERSECTION PEAK HOURS 7:45 - 8:45 AM & 3:00 - 4:00 PM
-ATR PEAK VOLUMES DETERMINED FROM AVERAGE OF COUNT DAYS AT EACH STATION
-INTERSECTION AND ATR PEAK VOLUMES MAY BE DIFFERENT DUE TO COLLECTING METHODS AND TIMING OVERLAP

LEGEND:
- (S) SIGNALIZED INTERSECTION
- ← TRAFFIC DIRECTION
- ↑ AUTOMATIC TRAFFIC RECORDER (ATR) COUNT
- XXX TRAFFIC VOLUME - AM (PM)

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2014 EXISTING PEAK HOUR TRAFFIC VOLUMES

ZERVAS SCHOOL
NEWTON, MA

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500 RUTHERFORD AVENUE, CHARLESTOWN, MA 02129

NOT TO SCALE

FIGURE 7

4.2 Seasonal Adjustment

Nitsch Engineering used the MassDOT's 2007 Weekday Seasonal Adjustment Factors to determine if any seasonal adjustment was necessary. Traffic volumes collected during the month of March on urban arterials and collectors are approximately 3% higher than an "average" month. Additionally, the counts were performed while school was in full session, so the counts represent the average condition. In order to present a conservative approach, Nitsch Engineering made no reduction to the counted volumes. The Weekday Seasonal Adjustment Factors are included in the Appendix.

5 FUTURE NO-BUILD TRAFFIC CONDITIONS

Nitsch Engineering used the 2014 existing traffic volumes as the baseline for projecting traffic volumes to the future 2024 condition. To determine the future 2024 condition, the following steps are included:

- Project existing 2014 traffic volumes ten years in the future to the horizon year (2024) using an annual background traffic growth factor;
- Add traffic volumes associated with any planned developments that may impact the study area;
- Include any planned roadway improvements that may affect traffic volumes; and
- Analyze the study area location to determine future operational statistics

5.1 Background Growth

MassDOT records traffic volumes at various stations throughout the Commonwealth over multiple years to identify regional shifts in traffic. Nitsch Engineering researched MassDOT count stations in the vicinity of the study area to determine a traffic volume trend throughout the years of volume data available. The only station with counts for multiple years in the in the vicinity of Zervas School is Route 16, west of Interstate 95 in Newton. Route 16 is located approximately 2 miles west of the Zervas School. Table 5 depicts the traffic volumes per year and the calculated growth rate.

Table 5 - Annual Average Daily Traffic (AADT) Comparison

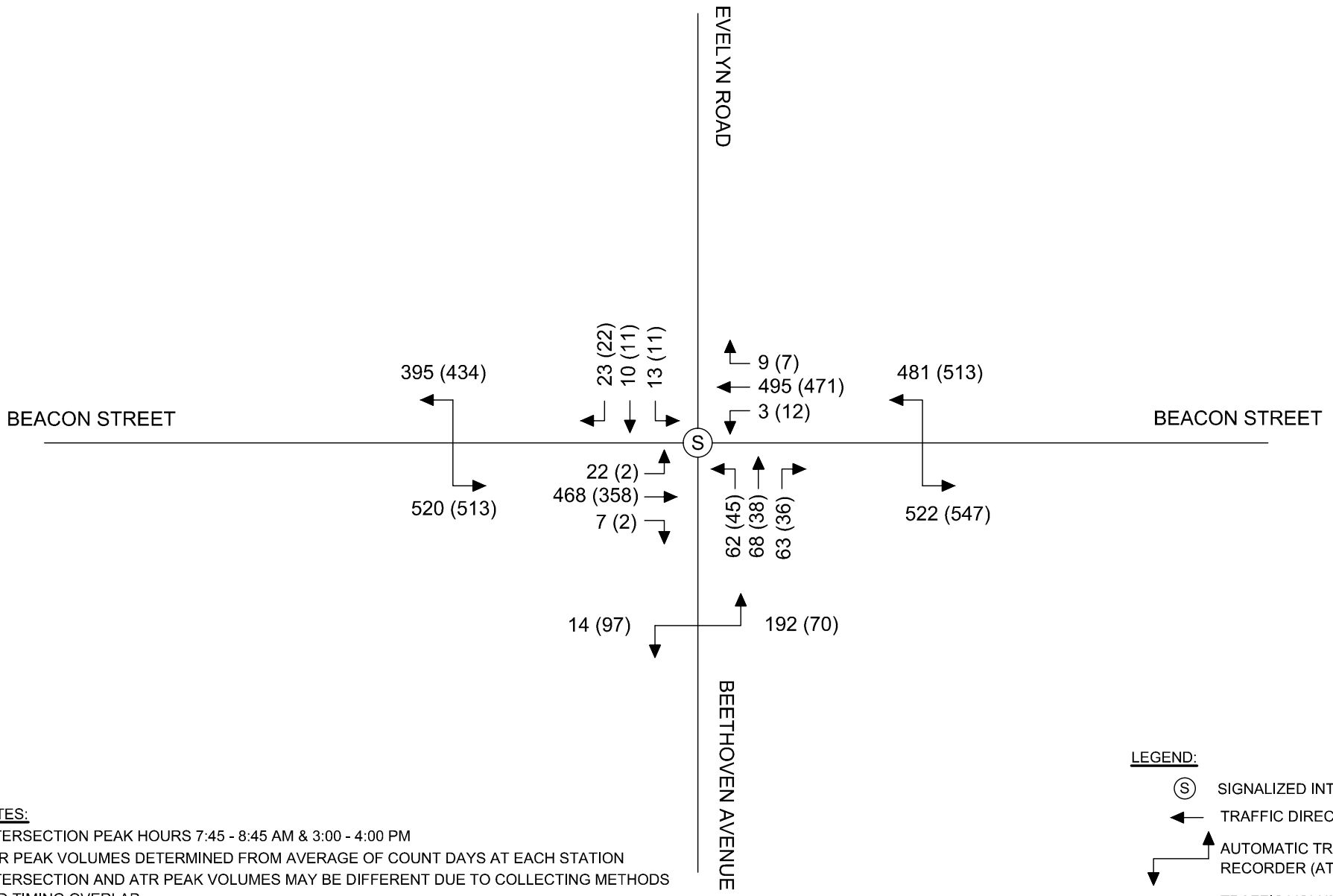
STATION ID	COUNT LOCATION	YEAR				ANNUAL GROWTH RATE
		2000	2003	2006	2009	
6726	Newton Route 16, West of I-95	21,000	18,700	21,400	22,400	2000 - 2009 0.72%
Note: Numbers presented are Annual Average Daily Traffic (AADT), which presents the average traffic volume for the entire given calendar year.						

5.2 Additional Development

Nitsch Engineering contacted the City of Newton to establish if there are any planned projects in the vicinity of the school that would add additional trips to the study area in the near future. According to the City of Newton, there are no new planned developments in the vicinity of Zervas School.

5.3 No-Build Traffic Volumes

The 2024 No-Build Traffic Volumes are shown in Figure 8 and are derived by applying the traffic growth rate of 1% per year over the ten-year design horizon to the 2014 traffic counts.



NOTES:

-INTERSECTION PEAK HOURS 7:45 - 8:45 AM & 3:00 - 4:00 PM

-ATR PEAK VOLUMES DETERMINED FROM AVERAGE OF COUNT DAYS AT EACH STATION

-INTERSECTION AND ATR PEAK VOLUMES MAY BE DIFFERENT DUE TO COLLECTING METHODS AND TIMING OVERLAP

LEGEND:

- (S) SIGNALIZED INTERSECTION
- ← TRAFFIC DIRECTION
- AUTOMATIC TRAFFIC RECORDER (ATR) COUNT
- XXX TRAFFIC VOLUME - AM (PM)

Nitsch Engineering

2024 NO-BUILD PEAK HOUR TRAFFIC VOLUMES

ZERVAS SCHOOL
NEWTON, MA

PREPARED FOR:
DESIGN PARTNERSHIP OF CAMBRIDGE
500 RUTHERFORD AVENUE, CHARLESTOWN, MA 02129

NOT TO SCALE

FIGURE 8

6 FUTURE CONDITIONS

6.1 Proposed Project Design

At the conclusion of the initial Traffic Impact Study, Nitsch Engineering worked with Design Partnership of Cambridge to offer guidance and planning on several site options with regards to future vehicle and pedestrian circulation, capacity and safety. Several of the site options were submitted to The City of Newton ("the City") for review and comment.

Design Partnership of Cambridge finalized a Site Plan with City approval and Nitsch Engineering received the Site Plan on October 15, 2014, which we used as basis for the evaluation of the proposed conditions in this Traffic Impact Study. The Site Plan is included as Figure 9.

6.2 Proposed Site Plan

Redevelopment of the Zervas School involves several alterations to the site layout, vehicle access/egress, parking, traffic circulation, pick-up/drop-off, generated traffic volumes and traffic operations.

Site Layout, Vehicle Access/Egress and Parking

The proposed new Zervas School layout will be a "Reverse-L" shape with one building face in a north-south direction on the east side of the site and the other to bisect the site in an east-west orientation. An emergency access/hard surface will be located in an east-west orientation to the south of the school building.

A one-way counterclockwise semicircular roadway will provide access to parking and an exclusive bus loop located off of Beacon Street opposite Paulson Road and Amy Circle. Two "one-way" driveways are proposed rather than a single "two-way" entrance as this reduces the driveway width for pedestrians to cross and makes it easier for pedestrians to identify oncoming traffic as vehicles approach from only one direction. Upon entry opposite Paulson Road, vehicles desiring to park can turn into a 33-space lot located to the left or a 32-space lot to the right. Buses will continue straight and align parallel to the sidewalk adjacent to the north side of the school.

A service driveway and 9-space parking area is located on the east side of the school building that can be accessed by turning right from the exit to the 33-space lot. Service vehicles are not anticipated to access the driveway during pick-up or drop-off hours and therefore should not affect traffic operations.. Emergency vehicles will be able to access the entire perimeter of the school via the access or egress driveways. The bus loop and parking lot roadway exit onto Beacon Street opposite Amy Circle.

The total parking area contains a total of 74 spaces, which represents an increase of approximately 50% when compared to existing conditions.

Traffic Circulation and Pick-Up/Drop-Off

The traffic circulation for pick-up and drop-off will remain the same, in that vehicles will travel northbound on Beethoven Avenue and pick-up or drop-off within the "Blue Zone", a designated area located on the east side of Beethoven Avenue in front of the Zervas School. Beethoven Avenue is one-way northbound during the drop-off period between 8AM – 9AM and for the pick-up period between 2:30PM - 3:30PM. The proposed improvement will widen Beethoven Avenue on its east side such that the "Blue Zone" will be a widened portion of the roadway. This modification is planned to separate the pick-up/drop-off vehicles from the

remainder of Beethoven Avenue northbound traffic, which may include vehicles that have already picked up or dropped off and wish to exit to Beacon Street. Currently, since the Blue Zone is merely an inclusive zone located within the existing roadway, vehicles frequently double-park and block through traffic, which contributes to excess delay and contributes to driver frustration. During the afternoon pick-up period, it is not expected that the "Blue Zone" will be able to process the increase in vehicle trips due to student enrollment expansion and queuing will increase in the adjacent neighborhood, however, we believe that shifting the "Blue Zone" east into a widened roadway will increase visibility, allow for safer access to parked vehicles, and improve the overall operation of the Blue Zone.

Bus traffic will utilize the driveway into the site located on Beacon Street opposite Paulson Road. After buses pick-up or drop-off students, the buses can exit via the driveway onto Beacon Street opposite Amy Circle. While Beacon Street has significant traffic volume (especially in the AM peak which corresponds with the peak school hour) the proposed driveway entrance and exit are far enough separated from the existing signal at Beacon and Beethoven to allow the buses to negotiate a left turn into or out from the school site without significant impact to Beacon Street traffic.

The existing bus operation requires buses to travel down Beethoven Avenue and turn right into the site. Nitsch observed that some buses did not use the site drive but instead stopped within Beethoven Avenue and discharged students while blocking traffic. The proposed design intends to completely separate bus traffic from vehicle pick-up/drop-off traffic, which we believe increases safety for students and vehicles and will minimize delay.

Pedestrian Safety

The site design incorporates the placement of pedestrian paths to minimize the number of conflicts between pedestrians and vehicles. The existing crossing of the main site entrance driveway on the east side of Beethoven Avenue, north of the "Blue Zone" has been eliminated. A new sidewalk will connect the new "Blue Zone" directly to the main school entrance with no vehicle conflicts. The bus drop-off and pick-up will occur directly in front of school entrance with no conflicts from pick-up/drop-off vehicles or vehicles desiring to park on-site.

Crosswalks have been added across the two proposed site driveways to align with the sidewalk on the south side of Beacon Street. Nitsch expects that the conflicts between pedestrians and vehicles at the driveway entrance and exit will be minimal as; 1) most pedestrians from the east travel down the north side of Beacon Street and cross at the intersection, 2) The proposed sidewalk to the school on the south side of Beacon Street continues around the outside of the bus loop avoiding the driveways entirely, and 3)most staff arrival happens well in advance of school opening and there are only four buses expected to service the school.

The existing signal at Beacon Street and Beethoven Avenue has a pedestrian actuated phase. Nitsch has previously recommended minor equipment improvements to the intersection and signal timing adjustments. While the crossing distance is proposed to be increased across Beethoven Avenue with the addition of a proposed right turn lane at this approach (discussed below), Nitsch believes that retiming the pedestrian phase along with the continued presence of a crossing guard at this location will provide pedestrians with the same level of safety that exists today.

6.3 Proposed Traffic Volume Generation

The City has indicated the student enrollment is expected to increase from 320 students to 490 students. Because the increase in enrollment will be comprised of students located further away from the school than the current student population, we expect that most of the new students will be transported to the school via private vehicle. To be conservative, Nitsch Engineering estimates that for every increase in one student, there will be an increase in one vehicle. This does not account for students that will carpool, ride the bus or bicycle, therefore we expect this number in actuality to be less, however we want to present the most conservative analysis possible.

Weekday Morning Drop-Off

During the weekday morning drop-off period, using the methodology described above, we estimate an additional 170 drop-off trips during the peak hour and most to occur along Beethoven Avenue. We estimate that some of these additional drop-offs will occur near adjacent neighborhoods, however to be conservative in our estimate of Beethoven Avenue traffic, we assigned all of the new parent drop-off trips to the roadway.

The staff parking area holds a total of 74 spaces, 33 located in the interior of the bus loop, located to the left upon entry to the site, 32 spaces located to the right upon entry to the site and 9 spaces in an area to the east of the service driveway. The 9-space lot would ideally be used for overflow or guest parking, or vehicles arriving during non-peak times. To be conservative, we estimated 100% parking utilization and 100% of the vehicles would arrive during the same single peak hour as the morning drop-off vehicles along Beethoven Avenue. We added five (5) staff vehicles that would exit the site after entering and re-enter within the peak hour, which could be contributed to those who leave for errands, appointments, etc. The City estimates that four (4) buses will be used, and all four were estimated to arrive and depart within the same single peak hour as the staff and the drop-off vehicles along Beethoven Avenue. In total, we estimate 83 vehicle arrivals to the Zervas School staff parking area and bus loop during the weekday morning peak hour.

Weekday Afternoon Pick-Up

During the weekday afternoon pick-up period, using the methodology described above, we estimate an additional 170 pick-up trips during the peak hour and most to occur along Beethoven Avenue. We believe this is a highly-conservative estimate since some students remain at school past the peak PM hour for after school activities, or leave the school via bus or carpool. We estimate that some of these additional pick-ups will occur near adjacent neighborhoods, however to be conservative in our estimate of Beethoven Avenue traffic, we assigned all of the new parent pick-up trips to the roadway. We anticipate the pick-up vehicle queue to continue to extend into the adjacent neighborhoods, as experienced under existing conditions and illustrated in Figure 5, however, the operations of Beethoven Avenue should improve based on the improvements illustrated in Section 6.5.

During the weekday afternoon pick-up period, we used the same conservative methodology as the weekday morning drop-off period for vehicles exiting the staff parking area and bus loop. We estimate that 100% of the 74 projected parked vehicles and 4 buses on-site will exit during the same peak hour. We added five (5) additional vehicles that will enter and then exit the site sometime in the peak hour, which could be comprised of parents that park within the lot to visit with School staff and/or administrators. In total, we estimate 83 vehicle departures from the Zervas School staff parking area and bus loop during the weekday afternoon peak hour.

6.4 Proposed Traffic Volume Distribution

Because of the modified staff parking access from its existing location we anticipate the travel patterns to and from the site for staff will likely change. Staff will no longer be able to access the site via Beethoven Avenue andwill need to use Beacon Street exclusively. We assumed an increase in eastbound through vehicles at the Beacon Street / Beethoven Avenue intersection and an increase in westbound-traveling vehicles as they approach the staff parking entrance on the south side of Beacon Street. To remain conservative, these increases were applied during the same peak hour as the morning drop-off period, though it is likely the staff will arrive prior to the peak morning drop-off time frame.

Because of the modified bus access from its existing location, the travel patterns to and from the site for buses will likely change. Buses will no longer be able to access the site directly from Beethoven Avenue. We assumed an increase in eastbound through buses at the Beacon Street at Beethoven Avenue intersection and an increase in westbound-traveling buses as they approach the parking/bus loop entrance on the south side of Beacon Street. These increases were applied during the same peak hour as the morning drop-off period since the two arrival periods will overlap.

At the time of the publication of this report, the geographical limits of the new Zervas School district were unknown. To estimate the distribution of new trips, we utilized the existing distribution of vehicles exiting Beethoven Avenue towards Beacon Street and Evelyn Road during both the morning drop-off and afternoon pick-up, along with predicting logical travel patterns to access well-traveled routes in the area. Departing Beethoven Avenue during both the weekday morning and weekday afternoon peak hours, the distribution is roughly one-third in each direction towards the north, east and west.

The Site-Generated Volumes attributed to the Zervas School Expansion is shown in Figure 10. These volumes were added to the 2024 No-Build Traffic Volumes to present the 2024 Build Traffic Volumes and are shown in Figure 11.

6.5 Proposed Beethoven Avenue Traffic Operations

While we expect the number of pick-up and drop-off vehicles to the Zervas School Site along Beethoven Avenue to increase, we believe that the delay at the Beethoven Avenue approach to the Beacon Street at Beethoven Avenue at Evelyn Road intersection to only moderately increase when compared to 2014 Existing and 2024 No-Build Conditions. This can be attributed to the following:

Addition of Right-Turn Lane along Beethoven Avenue approaching Beacon Street

Beethoven Avenue is proposed to be widened approaching the intersection with Beacon Street to provide an exclusive “Right-turn” only lane. The addition of the right-turn only lane at the Beethoven Avenue approach to the Beacon Street intersection provides an increase to the amount of vehicles that can travel through the intersection from Beethoven Avenue.

Widening the “Blue Zone”

We believe the widening of Beethoven Avenue at the “Blue Zone” will allow for more efficient processing of pick-up/drop-off vehicles when compared to existing conditions, as these vehicles should not conflict with through movements along Beethoven Avenue. To limit potential vehicle conflicts between the “Blue Zone”

and the addition of the right-turn lane on the Beethoven Avenue approach to the Beacon Street a “bump out” of the curb is proposed to keep these areas distinct and seperate.

Modifying Bus Pick-Up/Drop-Off Location

Removing the bus pick-up/drop-off from Beethoven Avenue will eliminate the interaction between buses and vehicles and should reduce delay along Beethoven Avenue.
In addition to the modifications to Beethoven Avenue for the right-turn lane and Blue Zone, we recommend that the traffic signal timing at the intersection be modified to address the inclusion of the right-turn only lane and the increase in pick-up/drop-off vehicles due to the increase in student enrollment. In our previous report we also noted that, at the time of our site visit it appeared that vehicle detection at the intersection was not operating properly which was contributing to an increase in delay at the intersection. We recently learned that the City has completed fixing this issue.

Beacon Street at Beethoven Avenue at Evelyn Road Actuation

The City of Newton recently indicated that signal loops have been installed along the Beacon Street at Beethoven Avenue approaches and the intersection is fully-actuated. At the site visit in February 2014, we had noted that the intersection was operating with pre-timed control, where the Beethoven Avenue queue was not able to be properly processed which led to long delays.

Beacon Street at Beethoven Avenue at Evelyn Road Signal Timing & Optimization

The additional vehicle traffic on Beethoven Avenue will likely cause additional significant delay at the approach if the existing traffic signal timing is used. Nitsch Engineering recommends that the traffic signal timing be updated and optimized to reflect the increase in vehicular traffic.

The addition of the right-turn only lane at the Beethoven Avenue approach to the Beacon Street at Beethoven Avenue at Evelyn Road will necessitate increasing the pedestrian “flashing don’t walk” time, which is the time necessary for a pedestrian to reach the sidewalk once in the crosswalk.

Nitsch Engineering recommends that traffic signal timing and pedestrian “flashing don’t walk” time be recalculated and reevaluated as part of the Zervas School reconstruction.

6.6 Proposed Beacon Street Traffic Operations

As stated above, the proposed Zervas School site drive entrance will be located on the south side of Beacon Street opposite Paulson Road and the site exit will be located on the south side of Beacon Street opposite Amy Circle.

The weekday morning peak period of parent drop-off, staff and bus arrival is likely to overlap with the peak hour of Beacon Street. However, most vehicles will be turning into the site; the only contribution to delay along Beacon Street will be the vehicles that need to turn left into the site from the east. It is possible some delay may be occur when vehicles wish to enter the site simultaneously from opposite direcitons and one driver must yield to the other(s). Our analysis of the left turn into the site from Beacon Street westbound has concluded that there will be sufficient gaps in opposing traffic such that turning vehicle delay will be minimal.

The weekday afternoon peak period of parent pick-up, staff and bus departure is predicted to be more pronounced than the weekday morning period, as vehicles access the adjacent roadway from the site under "STOP" control. Contributing further to delay is that vehicles will wish to depart the site in a condensed fashion over a relatively short period of time. This will occur, however, during the time of day where through traffic along Beacon Street is less than other hours of the day. Therefore, we do not believe this delay will be problematic to the operations of exiting the site or along the adjacent roadway.

6.7 Traffic Signal Warrants

To quantify if additional mitigation that would be necessary along Beacon Street at Zervas School Exit/Amy Circle, we performed a Traffic Signal Warrant Analysis at the location.

We performed the warrants based on the procedures outlined in the *Manual on Uniform Traffic Control Devices*[1] (MUTCD), 2009 edition. The MUTCD indicates nine (9) separate conditions under which a traffic signal warrant can be met, and they are shown below.

1. Warrant 1: Eight-Hour Vehicular Volume;
2. Warrant 2: Four-Hour Vehicular Volume;
3. Warrant 3: Peak Hour;
4. Warrant 4: Pedestrian Volume;
5. Warrant 5: School Crossing;
6. Warrant 6: Coordinated Signal System;
7. Warrant 7: Crash Experience;
8. Warrant 8: Roadway Network; and
9. Warrant 9: Intersection Near a Grade Crossing.

Given the information available, we performed the warrant analysis for Warrant 1, Warrant 2 and Warrant 3. To complete the data needed to complete the warrant, we made a few assumptions:

- The volumes at the Beacon Street approaches were used from the ATR data
- The same growth rate (1% per year over ten years) was applied to calculate hourly volumes as was used to establish the 2023 Peak Hour Traffic Volumes (as shown from Figure 8).
- No data was available for Amy Circle, located across form the Zervas School Exit, so we assumed 30 vehicles during the peak hours and token amounts during non-peak times to aid in calculating the four and eight-hour warrants.
- We established traffic departing the Zervas School Exit during both the weekday morning and weekday afternoon peak hours (as shown in Figure 9), however we assumed token amounts during non-peak times to aid in calculating the four and eight-hour warrants.

Given the criteria set forth in the MUTCD and the assumptions above, none of the three (3) traffic signal warrants were met. The Traffic Signal Warrant Analysis is included in the Appendix.

[1] Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition, Federal Highway Administration

6.8 Potential Additional Mitigation

While a traffic signal is not warranted along the Beacon Street at Zervas School Exit/Amy Circle intersection, we paid careful attention to queuing and delay at the intersection under 2024 Build Conditions to examine if additional turning lanes along Beacon Street would be necessary. The Operations Analysis is included in Section 7.

SITE PLAN

ZERVAS SCHOOL
NEWTON, MA

PREPARED BY:

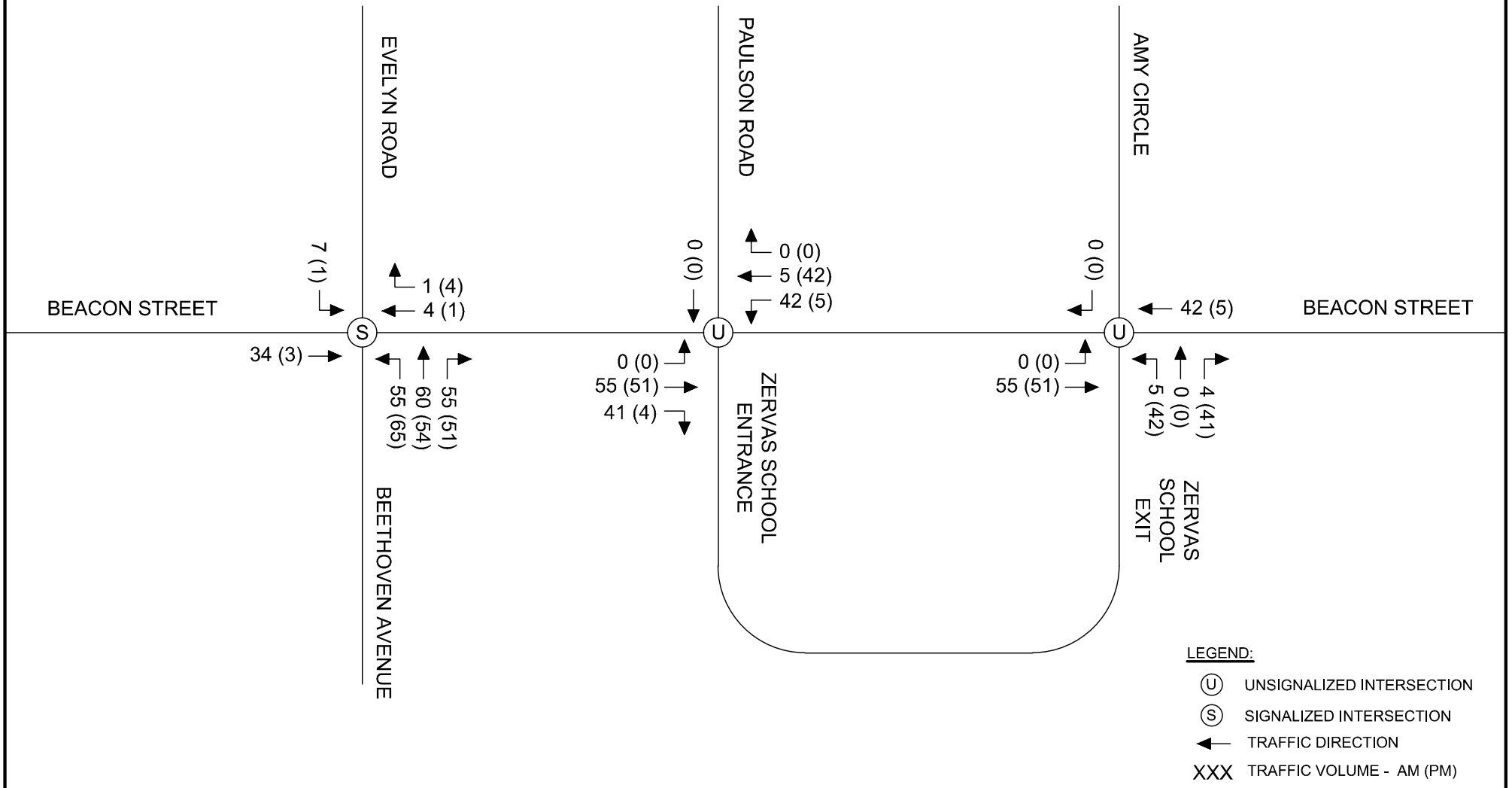
DESIGN PARTNERSHIP OF CAMBRIDGE
500 RUTHERFORD AVENUE, CHARLESTOWN, MA 02129

Nitsch Engineering

NOT TO SCALE

APPX. NORTH

FIGURE 9



Nitsch Engineering

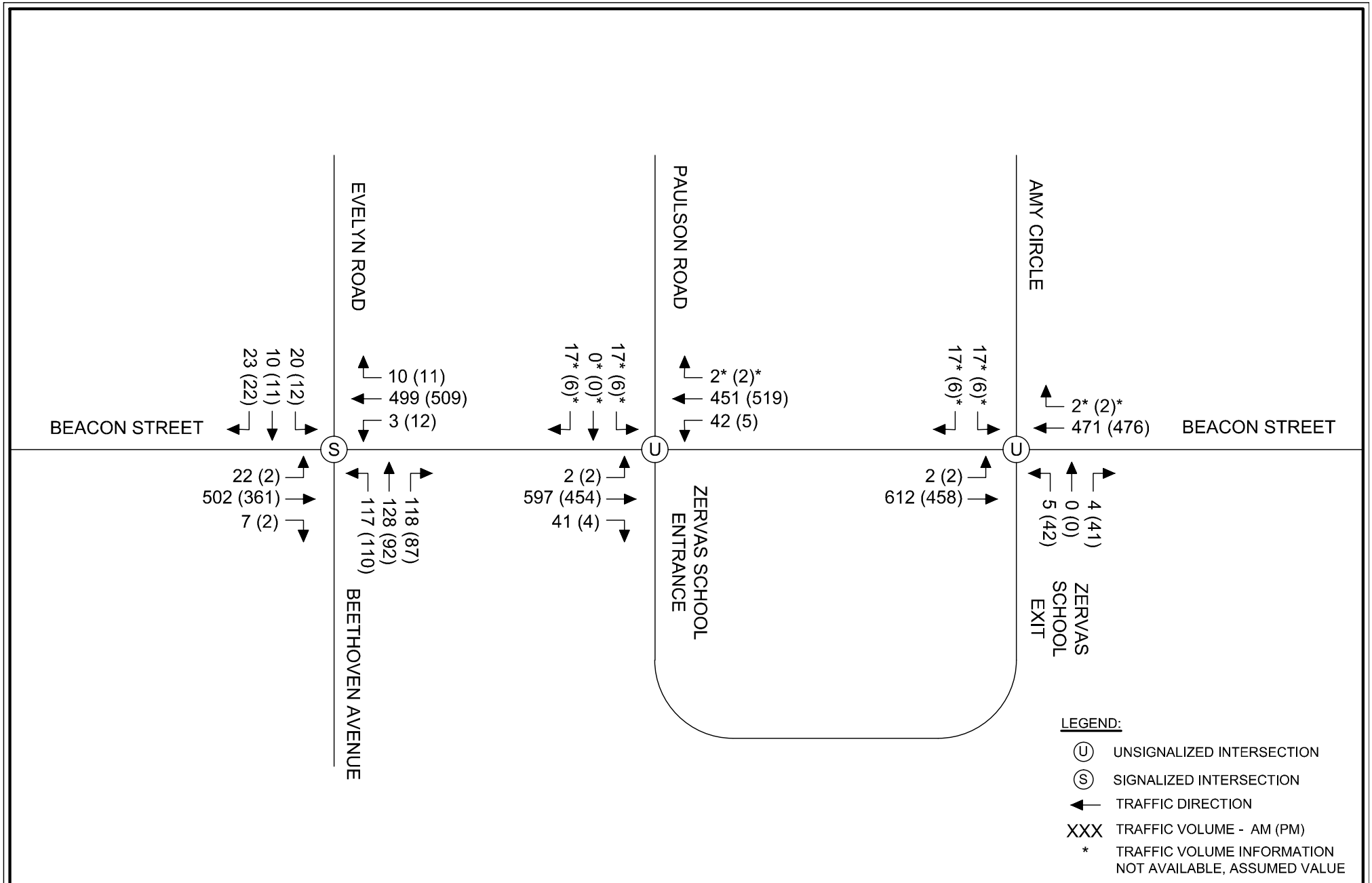
SITE-GENERATED VEHICLE VOLUMES

ZERVAS SCHOOL
NEWTON, MA

PREPARED FOR:
DESIGN PARTNERSHIP OF CAMBRIDGE
500 RUTHERFORD AVENUE, CHARLESTOWN, MA 02129

NOT TO SCALE

FIGURE 10



Nitsch Engineering

2024 BUILD PEAK HOUR TRAFFIC VOLUMES

ZERVAS SCHOOL
NEWTON, MA

PREPARED FOR:
DESIGN PARTNERSHIP OF CAMBRIDGE
500 RUTHERFORD AVENUE, CHARLESTOWN, MA 02129

NOT TO SCALE

FIGURE 11

7 OPERATIONS ANALYSIS

7.1 Level of Service Criteria

Level of Service (LOS) is a qualitative measure describing operational conditions within a traffic stream. Six (6) LOS criteria are used to describe the quality of traffic flow for any type of facility controls. LOS A represents the best operating conditions, and LOS-F represents the worst operating conditions. Nitsch Engineering analyzed the levels of service for signalized intersections using Synchro 8 software, which is based the traffic operational analysis methodology of the Highway Capacity Manual[2] (HCM). The methodology for signalized intersections assesses the effects of signal type, timing, phasing, progression, vehicle mix, and geometrics on control delay. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Table 6 summarizes the relationship between LOS and average control delay for signalized and unsignalized intersections.

Table 6 - Level of Service Criteria

SIGNALIZED INTERSECTIONS		UNSIGNALIZED INTERSECTIONS		
Level of Service	Control Delay (seconds/vehicle)	Level of Service by Volume-to-Capacity (v/c) Ratio		Control Delay (seconds/vehicle)
		v/c ≤ 1.0	v/c > 1.0	
A	0 to 10	A	F	0 to 10
B	>10 to 20	B	F	>10 to 15
C	>20 to 35	C	F	>15 to 25
D	>35 to 55	D	F	>25 to 35
E	>55 to 80	E	F	>35 to 50
F	>80	F	F	>50
Source: 2010 Highway Capacity Manual, Transportation Research Board, Washington D.C. 2010				

7.2 2014 Existing Capacity Analysis

Nitsch Engineering performed traffic analyses to evaluate traffic operations for the 2014 Existing Conditions during the weekday morning and weekday afternoon peak hours at the study area intersection. The analyses depict the volume-to-capacity (v/c) ratio, vehicle delay, LOS, and the 50th/95th percentile vehicle queues. Table 7 summarizes the analyses results. The analysis worksheets are provided in the Appendix.

[2] Highway Capacity Manual, 2010 Edition, Transportation Research Board (TRB), Washington, D.C.

Table 7 - Level of Service Summary – 2014 Existing Conditions

INTERSECTION	MOVEMENT	WEEKDAY MORNING PEAK HOUR					WEEKDAY AFTERNOON PEAK HOUR				
		V/C[1]	DELAY[2]	LOS[3]	50th Q[4]	95th Q[5]	V/C[1]	DELAY[2]	LOS[3]	50th Q[4]	95th Q[5]
Beacon Street at Evelyn Road/ Beethoven Avenue	Beacon St. EB - LTR	0.53	14.9	B	149	233	0.34	12.0	B	88	141
	Beacon St. WB - LTR	0.54	14.9	B	154	234	0.54	14.9	B	154	222
	Beethoven Ave. NB - LTR	1.09	117.7	F	~123	#179	0.80	56.1	E	72	84
	Evelyn Rd. SB - LTR	0.31	23.1	C	13	33	0.22	21.2	C	10	36
	Overall	1.09	34.4	C	-	-	0.80	21.1	C	-	-

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 50th Percentile Queue (in feet); [5] 95th Percentile Queue (in feet) based upon 22 feet per vehicle; * = Defacto Left Lane; # = volume exceeds capacity, queue may be longer; m = 95th percentile queue is metered by upstream signal; ~ = Volume exceeds capacity, queue is theoretically infinite

As shown in Table 7, the Beethoven Avenue northbound movements operate at LOS F during the morning peak hours and LOS E during afternoon peak hours. This is attributed to the traffic related to the Zervas School combined with regular commuter traffic.

7.3 2024 No-Build Capacity Analysis

Nitsch Engineering analyzed the 2024 No-Build Conditions traffic operations at the study intersection. The 2024 No-Build Condition represents the 2014 Existing Conditions and projecting a traffic increase at the rate of 1% per year between 2014 and 2024. Figure 8 shows the 2024 No-Build traffic volumes used in the analyses. Table 8 summarizes the 2024 No-Build Condition traffic operations.

Table 8 - Level of Service Summary – 2024 No-Build Conditions

INTERSECTION	MOVEMENT	WEEKDAY MORNING PEAK HOUR					WEEKDAY AFTERNOON PEAK HOUR				
		V/C[1]	DELAY[2]	LOS[3]	50th Q[4]	95th Q[5]	V/C[1]	DELAY[2]	LOS[3]	50th Q[4]	95th Q[5]
Beacon Street at Evelyn Road/ Beethoven Avenue	Beacon St. EB - LTR	0.59	16.1	B	171	267	0.38	12.5	B	99	158
	Beacon St. WB - LTR	0.60	16.1	B	177	269	0.60	16.1	B	178	256
	Beethoven Ave. NB - LTR	1.19	105.4	F	~148	#204	0.89	69.3	E	82	93
	Evelyn Rd. SB - LTR	0.35	23.8	C	14	35	0.24	21.2	C	11	38
	Overall	1.19	41.5	D	-	-	0.89	24.0	C	-	-

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 50th Percentile Queue (in feet); [5] 95th Percentile Queue (in feet) based upon 22 feet per vehicle; * = Defacto Left Lane; # = volume exceeds capacity, queue may be longer; m = 95th percentile queue is metered by upstream signal; ~ = Volume exceeds capacity, queue is theoretically infinite

As seen in Table 8, the traffic operations under the 2024 No-Build Conditions would remain similar to, or would be slightly worse than, the 2014 Existing Conditions. The Beethoven northbound movements operate at LOS F during the morning peak hours and LOS E during afternoon. The entire intersection will operate at LOS D during morning peak hours compared to LOS C during 2014 Existing Condition.

Given the limited right-of-way and densely developed nature of this location, physical improvements such as adding turning lanes or widening the roadway to improve the level of service are not recommended. Nitsch Engineering offers the following conclusions and recommendations to improve circulation in the vicinity of Zervas School.

7.4 2024 Build Capacity Analysis

Nitsch Engineering analyzed the 2024 Build Conditions traffic operations at the study intersection. The 2024 No-Build Condition represents the 2024 No-Build Conditions traffic volumes and adding the Site-Generated Traffic Volumes, for which the methodology and improvements are outlined Section 6 and shown in Figure 9. Because the pedestrian "flashing don't walk" time would need to be extended due to the increase in curb width along Beethoven Avenue, this change was incorporated with in the Build Conditions. Nitsch Engineering also recommends that the traffic signal timing be rebalanced to reflect the increase in vehicle volumes to the Beethoven Avenue approach to Beacon Street and Evelyn Road. These improvements are incorporated in Table 9, which summarizes the 2024 Build Condition traffic operations.

Table 9 - Level of Service Summary – 2024 Build Conditions

INTERSECTION	MOVEMENT	WEEKDAY MORNING PEAK HOUR					WEEKDAY AFTERNOON PEAK HOUR				
		V/C[1]	DELAY[2]	LOS[3]	50th Q[4]	95th Q[5]	V/C[1]	DELAY[2]	LOS[3]	50th Q[4]	95th Q[5]
Beacon Street at Evelyn Road/ Beethoven Avenue	Beacon St. EB - LTR	0.85	35.0	C	261	#454	0.56	22.3	C	171	257
	Beacon St. WB - LTR	0.82	31.9	C	250	#422	0.86	36.4	D	305	#459
	Beethoven Ave. NB - LT	0.75	38.0	D	163	#210	0.60	34.5	C	172	164
	Beethoven Ave. NB - R	0.35	24.8	C	67	93	0.28	25.4	C	64	74
	Evelyn Rd. SB - LTR	0.16	15.5	B	16	34	0.10	15.2	B	11	35
	Overall	0.85	32.8	C	-	-	0.86	30.6	C	-	-
Beacon Street at Zervas School Entrance at Paulson Road	Beacon St. EB - LTR	0.00	0.1	A	-	0	0.00	0.1	A	-	0
	Beacon St. WB - LTR	0.06	1.5	A	-	4	0.01	0.2	A	-	0
	Paulson Rd. SB[6] - LTR	0.25	30.9	D	-	23	0.06	20.2	C	-	5
Beacon Street at Zervas School Exit at Amy Circle	Beacon St. EB - LTR	0.00	0.1	A	-	0	0.00	0.1	A	-	0
	Beacon St. WB - LTR	0.00	0.0	A	-	0	0.00	0.0	A	-	0
	Zervas Exit NB - L	0.07	38.4	E	-	6	0.41	39.5	E	-	45
	Zervas Exit NB - TR	0.01	12.9	B	-	1	0.12	12.2	B	-	10
	Amy Circle SB[7] - LTR	0.22	27.8	D	-	21	0.07	22.7	C	-	6

[1] Volume to Capacity Ratio; [2] Vehicle Delay, measured in seconds; [3] Level Of Service; [4] 50th Percentile Queue (in feet), calculation unavailable for unsignalized intersections; [5] 95th Percentile Queue (in feet) based upon 22 feet per vehicle; [6] Count data for Paulson Road was unavailable as part of this report. Analysis reflects assumed traffic volumes; [7] Count data for Amy Circle was unavailable as part of this report. Analysis reflects assumed traffic volumes; * = Defacto Left Lane; # = volume exceeds capacity, queue may be longer; m = 95th percentile queue is metered by upstream signal; ~ = Volume exceeds capacity, queue is theoretically infinite

As seen in Table 9, the traffic operations under the 2024 Build Conditions for the Beacon Street at Beethoven Avenue at Evelyn Road intersection would be slightly worse than the 2024 No-Build Conditions, which can be attributed to the additional traffic volume from the increase in student enrollment, and therefore vehicles, to the Zervas School site. We believe that the improvements outlined in Section 6 along with the recommended modifications to the signal timing, as incorporated in Table 9, are sufficient mitigation for the intersection.

From Table 9, the delay for vehicles entering the Zervas School Entrance during the weekday morning peak hour will be minimal. As explained in Section 6.8, we examined the delay and queuing at this location and both will be minimal. There should be significant gaps in traffic for vehicles to turn left into the site from Beacon Street westbound.

The delay for vehicles exiting the Zervas School Exit during the weekday afternoon peak hour will be moderate, operating with an average delay of 35.5 seconds per vehicle over the course of the entire peak hour. Inherently, the delay will be highest soon after the school release and the staff aims to depart the site simultaneously. Given the methodology in Section 6.7 and Table 9 and based on the Site Plan in Figure 9, we do not recommend any additional mitigation is warranted at this time.

8 CONCLUSIONS & RECOMMENDATIONS

8.1 Conclusions

Nitsch Engineering was retained by Design Partnership of Cambridge to complete a Traffic Impact Study for the existing and proposed conditions relative to the redevelopment of the existing Zervas School, located at 30 Beethoven Avenue in the village of Waban in Newton, Massachusetts.

Nitsch Engineering completed the existing conditions portion of the Traffic Impact Study in March 2014 and focused on evaluation of existing access/egress, traffic circulation, pick-up/drop-off, parking demand, crash data, traffic volumes and traffic operations.

To asses these conditions, Nitsch Engineering conducted a site reconnaissance in February 2014, conducted vehicle pick-up/drop-off counts in the site vicinity, collected peak hour traffic turning movement counts (TMC's) at the site adjacent intersection of Beacon Street at Beethoven Avenue and collected continuous automatic traffic recorder (ATR) counts along both Beacon Street and Beethoven Avenue to establish the average daily traffic (ADT) along both roadways. The TMC's and ATR's were collected in early March 2014 while school was in full session.

Based on the assessment of the existing conditions, Nitsch Engineering made several recommendations with regard to improving traffic flow and decreasing potential safety conflicts with regard to both vehicular and pedestrian flow for the planned redevelopment of the Zervas School.

At the conclusion of the initial Traffic Impact Study, Nitsch Engineering worked with Design Partnership of Cambridge to offer guidance and planning on several site options with regards to future vehicle and pedestrian circulation, capacity and safety. Several of the site options were submitted to The City of Newton for review and comment.

Design Partnership of Cambridge finalized a Site Plan with City approval and Nitsch Engineering received the Site Plan on October 15, 2014, which we used as basis for the evaluation of the proposed conditions in this Traffic Impact Study.

Nitsch Engineering evaluated the access/egress, traffic circulation, pick-up/drop-off, parking and traffic operations relative to expansion of the Zervas School from 320 to 490 students. Nitsch Engineering was conservative in the estimate of additional vehicle trips to the site, assuming one vehicle per additional student. These traffic volumes were added to the roadway network using the changes and mitigation measures outlined in the Site Plan.

8.2 Recommendations

Beyond what is shown in the Site Plan, Nitsch Engineering recommends the following upgrades and adjustments to the Beacon Street at Beethoven Street at Evelyn Road intersection:

- The traffic signal timing should be rebalanced to incorporate the predicted addition and shift and traffic volumes due to the student expansion to yield the delay values shown in the 2024 Build Conditions in Table 9.

- The pedestrian signal timing should be extended to account for the roadway widening at Beethoven Street, and therefore would require a longer time to cross the roadway. These changes are also incorporated in Table 9.
- The pedestrian push-buttons should be replaced to comply with the latest MUTCD and ADA standards
- Backplates on the signal heads should be installed to enhance driver visibility
- Regarding site restrictions, Nitsch Engineering recommends that the 9-space parking area located on the east of the site be used primarily for overflow and/or guest parking, as accessing this area during the weekday morning peak hour when many staff will arrive may be difficult given the one-way bus operation adjacent to the parking area.