Elementary School Feasibility Study

Baker School

Brookline, Massachusetts

DRAFT

Prepared for:

HMFH Architects
Cambridge, Massachusetts

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ELEMENTARY SCHOOL FEASIBILITY STUDY

BAKER SCHOOL
BROOKLINE, MASSACHUSETTS

Prepared for:

HMFH Architects
Cambridge, Massachusetts

March 2018

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CONTENTS

FIGURES

TABLES

BAKER SCHOOL INTRODUCTION

Vanasse & Associates, Inc. (VAI) has prepared this Transportation Impact Assessment (TIA) in order to identify the potential traffic impacts associated with the proposed expansion of the Baker School located on Beverly Road in Brookline, Massachusetts. The focus on this study is to assess the traffic impacts of the potential expansion to the Baker School. This report identifies and analyzes existing and future traffic conditions both with and without the project and reviews access requirements, potential off-site improvements, and safety considerations. As typical with school traffic, there is a relatively short peak of impacts less than 30 minutes as drop-off and pick-up occur at the school. Generally, the morning peak is more pronounced than the afternoon peak.

PROJECT DESCRIPTION

The Baker School consists of a 759 student elementary school, which under the current proposal will expand to a total of 1100 students. School hours are Monday – Thursday 8:00 AM to 2:30 PM and Friday 8:00 AM to 1:40 PM. The school will continue to be serviced by the existing Student Drop-Off/Pick-Up Loop and the Teacher's Parking Lot, in addition to the proposed lower Drop-Off/Pick-Up loop to the rear of the existing school, which is designed to better accommodate the drop-off and pick-up activity. A total of 150 parking spaces are proposed to accommodate staff parking. The school is primarily a walking school with up to 58 percent of the students walking to school.

STUDY METHODOLOGY

This study was prepared in general accordance with the state and town guidelines for Transportation Impact Assessments (TIA); and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics; observations of traffic flow; and collection of daily and peak period traffic counts.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the school were assessed along with future traffic demands due to expected traffic growth independent of the project. A seven-year time horizon was selected for analyses consistent with state guidelines for the preparation of TIA. The traffic analysis con-

ducted in stage two identifies existing or projected future roadway capacity, traffic safety, and site access issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

BAKER SCHOOL EXISTING CONDITIONS

A comprehensive field inventory of traffic conditions on the study area roadways was conducted. The field investigation consisted of an inventory of existing roadway geometrics, traffic volumes, and operating characteristics, as well as posted speed limits and land use information within the study area. The study area for the project was selected to contain the major roadway providing access to the project site, Beverly Road, as well as seven intersections located near the site:

- Beverly Road at Lagrange Street
- Beverly Road at Zanthus Road
- Zanthus Road at Wallis Road
- Beverly Road at Student Drop-Off/Pick-Up Circle North Drive
- Beverly Road at Student Drop-Off/Pick-Up Circle South Drive
- Beverly Road at Teacher Parking Lot
- Beverly Road at Independence Drive, Grove Street and Russett Road

The following describes the study area roadways and intersections. Figure 1 provides a Study Location Map.

GEOMETRY

Roadways

Beverly Road

Beverly Road traverses the study area in a general northwest-southeast direction and is under Town jurisdiction. Within the study area, Beverly Road generally provides one 15-foot wide travel lane in each direction, separated by a double-yellow centerline. Sidewalk is provided along both sides of Beverly Road, with illumination provided by way of street lamps mounted on wooden poles. Land use along Beverly Road within the study area consists of residential properties and the Baker School. During winter months, Beverly Road becomes a one-way road in the southbound direction at the morning and afternoon peak periods, at the beginning and end of the school day.

Intersections

Figure 2 depicts the Existing Lane Uses and Travel Lane Widths for the study area intersections.

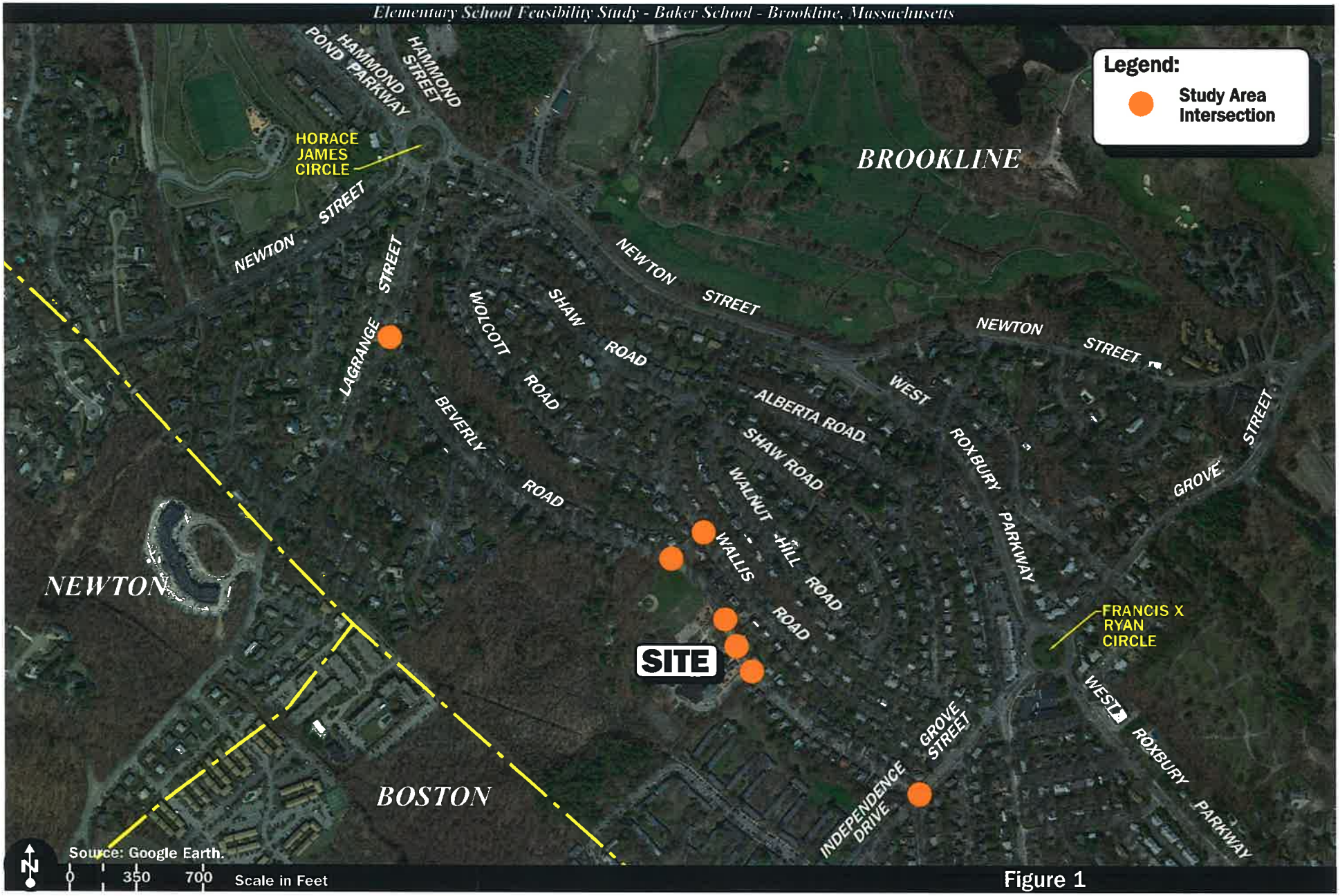

Figure 1

Site Location Map

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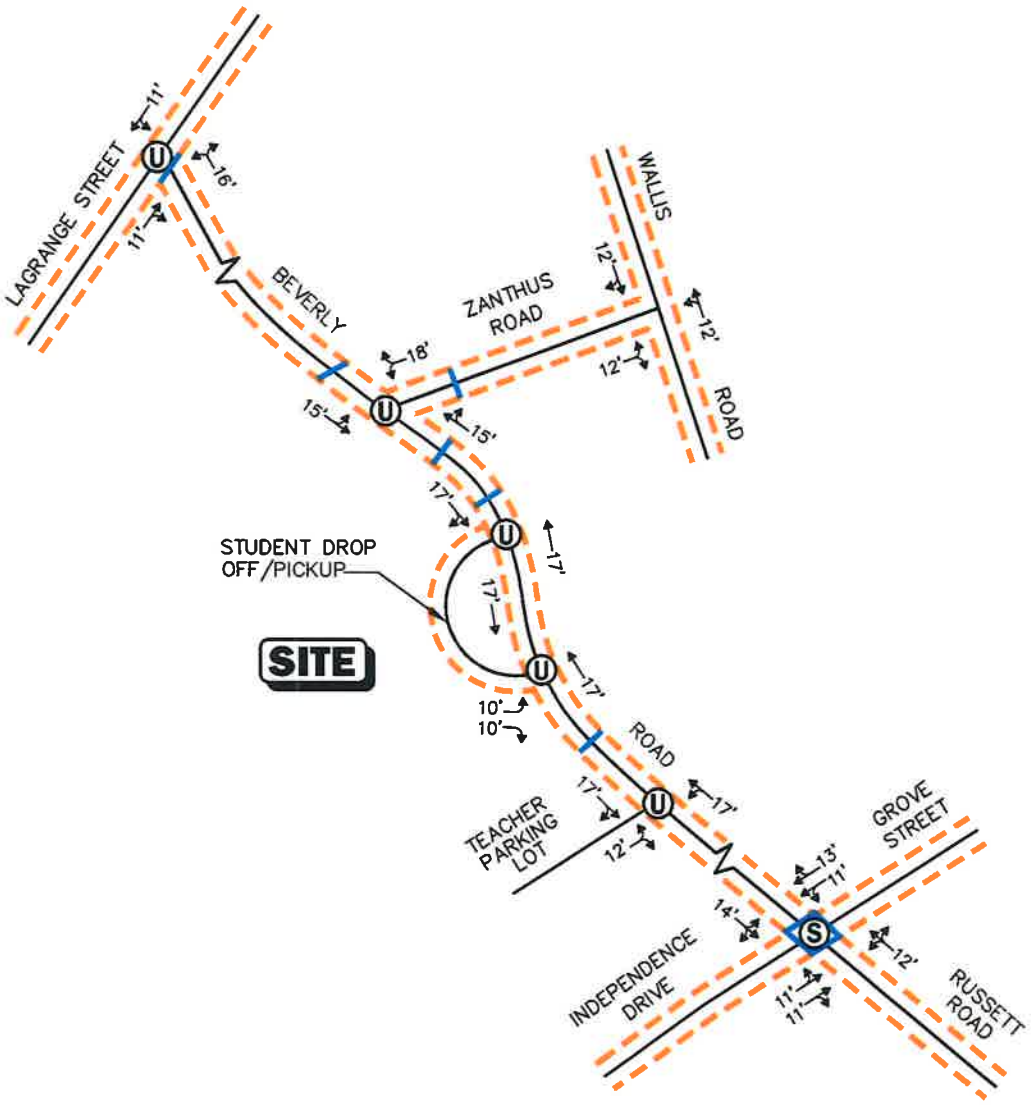

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Figure 2

Existing Lane Use and Travel Lane Widths

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EXISTING TRAFFIC VOLUMES

In order to determine existing traffic-volume demands and flow patterns within the study area, manual turning movement counts (TMCs) and vehicle classification counts were completed in January 2018, while school was in session. The traffic counts were conducted with weekday morning (7:00 to 9:00 AM) and weekday afternoon (2:00 to 5:00 PM) peak periods at the study intersections. These time periods were selected for analysis purposes as they are representative of the peak traffic volume hours for the school.

Traffic Volume Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, historical traffic data collected by MassDOT were examined. Based on a review of seasonal adjustment factors collected by MassDOT for urban arterials and collectors, January traffic volumes are typically 3 percent lower than average monthly conditions, and therefore were adjusted upwards in order to represent an average-month analysis condition. The morning peak hour is 7:15 to 8:15 AM, and the afternoon peak hour is after from 2:00 to 3:00 PM, which coincides with the school hours. The 2018 Existing traffic volumes are graphically depicted on Figure 3.

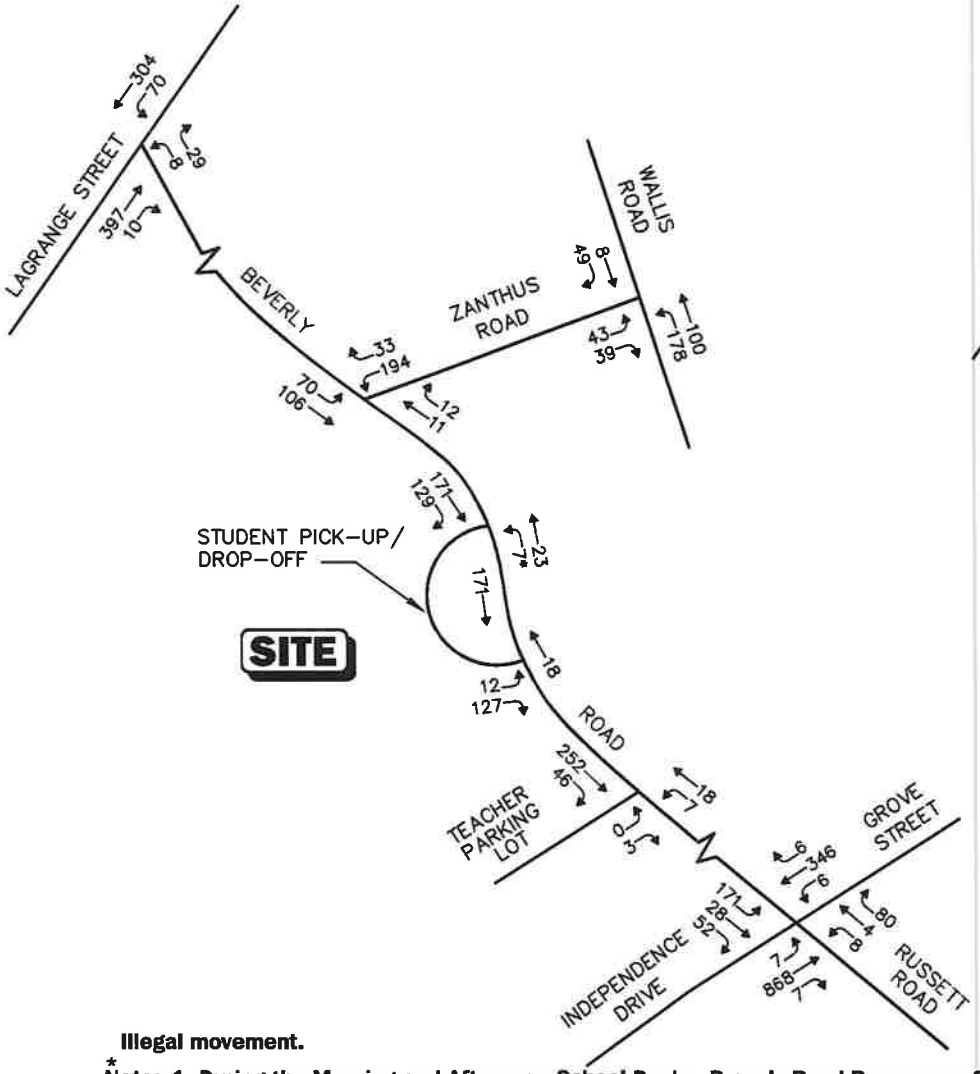
Existing Condition Observations

Observations were made in the area to obtain a better understanding of existing conditions. In the morning, drop-offs primarily occur at the loop, and in the afternoon the parents park on Beverly Road and walk to pick-up the students. A crossing guard is stationed on Beverly Road at the loop, and a traffic officer operates the signal at Beverly Road at Independence Drive, Grove Street and Russett Road. During winter months, Beverly Road becomes a one-way road in the southbound direction at the morning and afternoon peak periods, when school starts/releases.

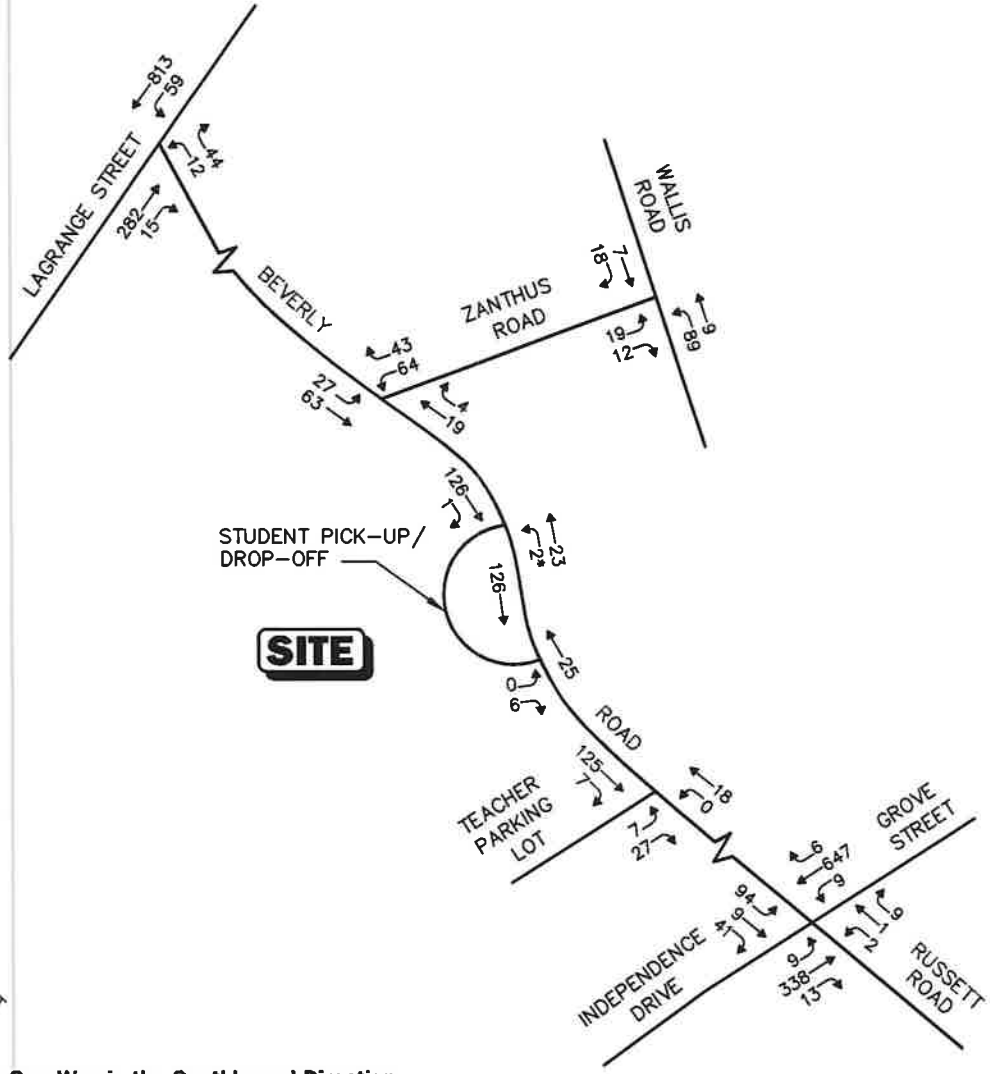
General observations included the following:

- During the morning period, traffic is observed to queue along Beverly Road, past Zanthus Road.
- Traffic also queues onto Zanthus Road and occasionally onto Wallis Road.
- On-street parking for staff and parents occurs on Beverly Road, Zanthus Road and occasionally onto Wallis Road.
- Existing morning on-street parking demand was 34 vehicles and 76 vehicles in the Teacher Lot.
- Traffic exiting onto Independence Drive can queue back to the school with over a 5 minute wait-time. These queues and delays quickly subside once the school traffic is processsed.
- During the afternoon period, parents park on-street for the pick-up time, with vehicles observed on Beverly Road, Zanthus Road and Wallis Road.
- At the school end-time, a total of 57 cars were counted on-street, which includes both staff and parent pick-up parking.

WEEKDAY MORNING PEAK HOUR



WEEKDAY AFTERNOON PEAK HOUR



Illegal movement.

* **Note: 1. During the Morning and Afternoon School Peaks, Beverly Road Becomes a One-Way in the Southbound Direction. During a Portion of the Peak Hour, Some Traffic does Flow Northbound.**
2. Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 3

2018 Existing Weekday Peak Hour Traffic Volumes

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- Observed queues along Beverly Road at Independence Drive were typically 10-15 vehicles, with wait times under 5 minutes.

Overall, during the peak morning and afternoon periods, delays and queues observed subside after 15-20 minutes.

PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in January 2018. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of existing and planned future bicycle facilities. Sidewalks are provided both sides of the study roadways with marked crosswalks and pedestrian traffic signal equipment provided at the signalized study intersection. No formal bicycle facilities were noted within the study area. A crossing guard is stationed on Beverly Road, just south of the loop, and a traffic officer operates the signal at Beverly Road at Independence Drive, Grove Street and Russett Road.

PUBLIC TRANSPORTATION

Public transportation services are provided within the study area by the Massachusetts Bay Transit Authority (MBTA) via the *Route 51 Bus*. Fixed Bus Route 51: *Reservoir (Cleveland Circle – Forest Hills Station* provides bus service Monday through Friday from approximately 5:55 AM to 10:30 PM, on Saturday from 6:15 AM to 10:09 PM, and no service on Sundays, with 25-minute headways on weekdays and 60-minute headways on Saturdays. The closest bus stop to the project site is located at the signalized intersection of Beverly Road at Independence Drive and Grove Street, at *Independence Dr. @ Beverly Rd* (southbound direction) and at *Grove Street @ Russet Rd* (northbound direction).

MOTOR VEHICLE CRASH DATA

Motor vehicle crash information for the study area intersections was provided by the MassDOT Safety Management/Traffic Operations Unit for the most recent five-year period available (2011 through 2015) in order to examine motor vehicle crash trends occurring within the study area. The data is summarized by intersection, type, pavement condition and severity in Table 1.

Table 1
MOTOR VEHICLE CRASH DATA SUMMARY[a]

Scenario	Beverly Road at LeGrange Street	Beverly Road at Drop-Off Circle	Beverly Road at Independence Drive & Grove Street
Year:			
2011	1	0	1
2012	0	1	0
2013	0	0	1
2014	1	0	1
2015	1	1	1
Total	3	2	4
Average[a]	0.6	0.4	0.8
Crash Rate[b]	0.12	0.30	0.17
Significant	No	No	No
Type:			
Angle	1	0	2
Rear-End	2	0	1
Head-On	0	0	0
Sideswipe	0	1	0
Fixed Object	0	0	1
Other	0	1	0
Total	3	2	4
Pavement Conditions:			
Dry	2	2	3
Wet	1	0	1
Snow/Ice	0	0	0
Unknown/ Other	0	0	0
Total	3	2	4
Severity:			
Property Damage Only	2	1	2
Personal Injury	1	0	1
Fatality	0	0	0
Unknown	0	1	1
Total	3	2	4

[a]Average crash over five-year period.
[b]Crash rate per million entering vehicles (mev).
Source: MassDOT Crash Data, 2011 through 2015.

As can be seen in Table 1, the study area intersections were found to have experienced an average of less than one reported motor vehicle crashes over the five-year review period, with the intersection of Beverly Road, Independence Drive, Grove Street and Russett Road found to have experienced the largest number of reported crashes (4 total). Further review of the crash data indicates that the majority of the reported collisions resulted in property damage only, and involved angle collisions. All of the study intersections were found to have a motor vehicle crash rate below the MassDOT statewide and Highway Division District 6 (the MassDOT Highway Division District in which the intersections are located) average crash rates for a signalized or unsignalized intersection, as appropriate. In addition, no fatal motor vehicle crashes were reported within the study area over the five-year review period.

BAKER SCHOOL FUTURE CONDITIONS

To determine the impact of school traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to the year 2025. Traffic volumes on the roadway network at that time, in the absence of the project (that is, the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others expected to be completed by 2025. Inclusion of these factors resulted in the development of 2025 No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop the 2025 Build traffic-volume conditions.

FUTURE TRAFFIC GROWTH

Traffic growth on area roadways is a function of the expected land development in the immediate area, as well as the surrounding region. Several methods are used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This produces a more realistic estimate of growth for local traffic. However, the drawback of this procedure is that the potential growth in population and development external to the study area would not be accounted for in the traffic projections.

To provide a conservative analysis framework, both procedures were used.

General Background Growth

Traffic-volume data compiled by MassDOT from permanent count stations and historic traffic counts in the area were reviewed in order to determine general background traffic growth trends. Based on a review of this data and other area traffic studies, a 1.0 percent per year compounded annual background traffic growth rate was used in order to conservatively account for future traffic growth and presently unforeseen development within the study area. This is consistent with previous traffic studies conducted for the area.

Specific Development by Others

The Town of Brookline were contacted in order to determine if there are any planned or approved specific development projects within the area that would have an impact on future traffic volumes at the study intersections. Based on these discussions the following project was identified:

Hancock Village, Brookline. Residential development to be located off of Independence Drive in Brookline, Massachusetts.

No other background developments were identified within the study area.

Planned Roadway Improvements

The Town of Brookline was contacted in order to determine if there are any planned roadway improvement projects expected to be completed within the study area. Based on these discussions, no projects were identified.

No-Build Traffic Volumes

The 2025 No-Build peak-hour traffic-volume networks for weekday morning and weekday afternoon were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the Existing peak-hour traffic volumes, plus the indicated background development. The resulting 2025 No-Build weekday morning and weekday afternoon peak-hour traffic volume networks are shown on Figure 4.

PROJECT-GENERATED TRAFFIC

Design year (2025 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning these volumes on the study roadways. The following describes the methodology used to establish the traffic characteristics of the Project. As proposed, the Project will entail the expansion of a 759 student elementary school to a 1,100 student elementary school.

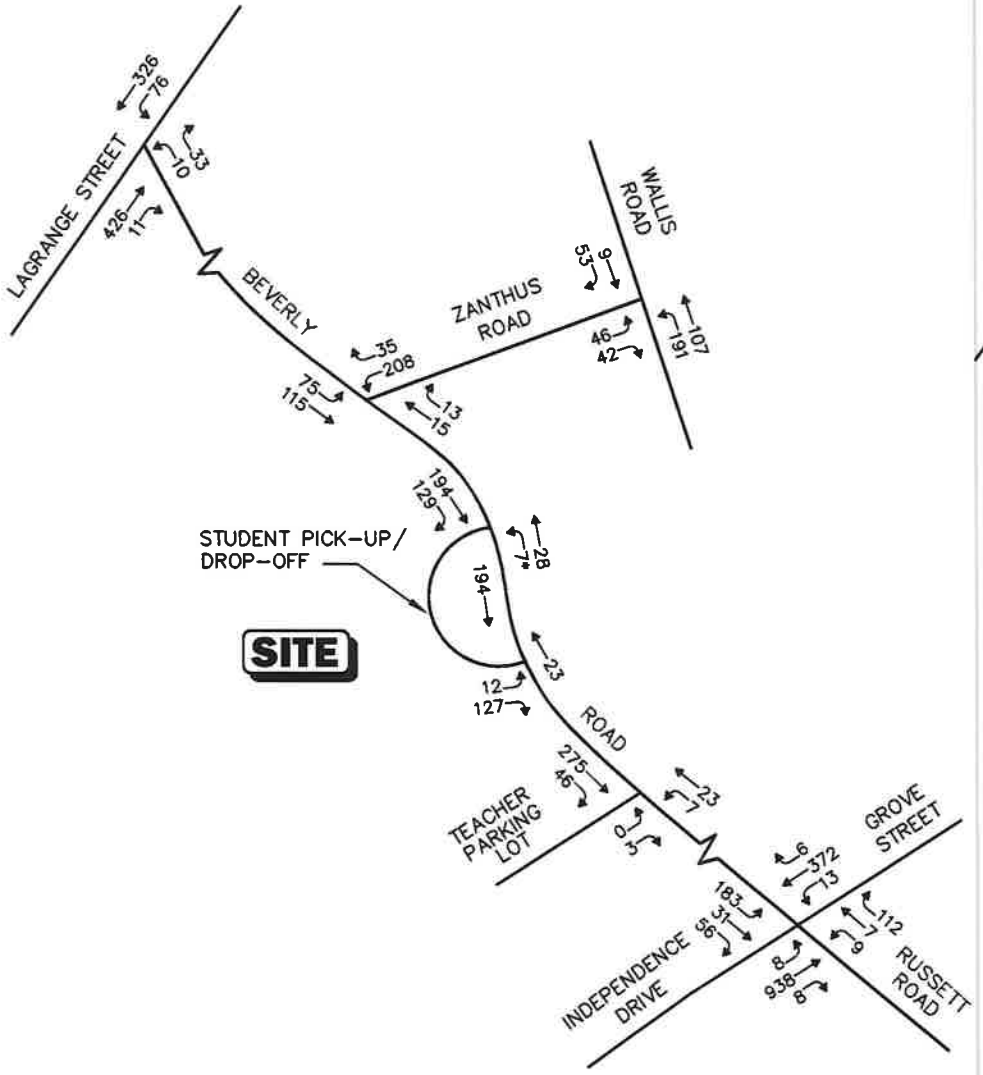
In order to develop the traffic characteristics of the Project, vehicles entering and exiting at the site access and egress points were counted, and a vehicle trip-rate per student was developed and applied to the increase of 341 students. Based upon survey data provided by the Public Schools of Brookline, approximately 450 students walk to the Baker School, which is approximately 58%.

Survey results of the existing student population of the Baker School include the following:

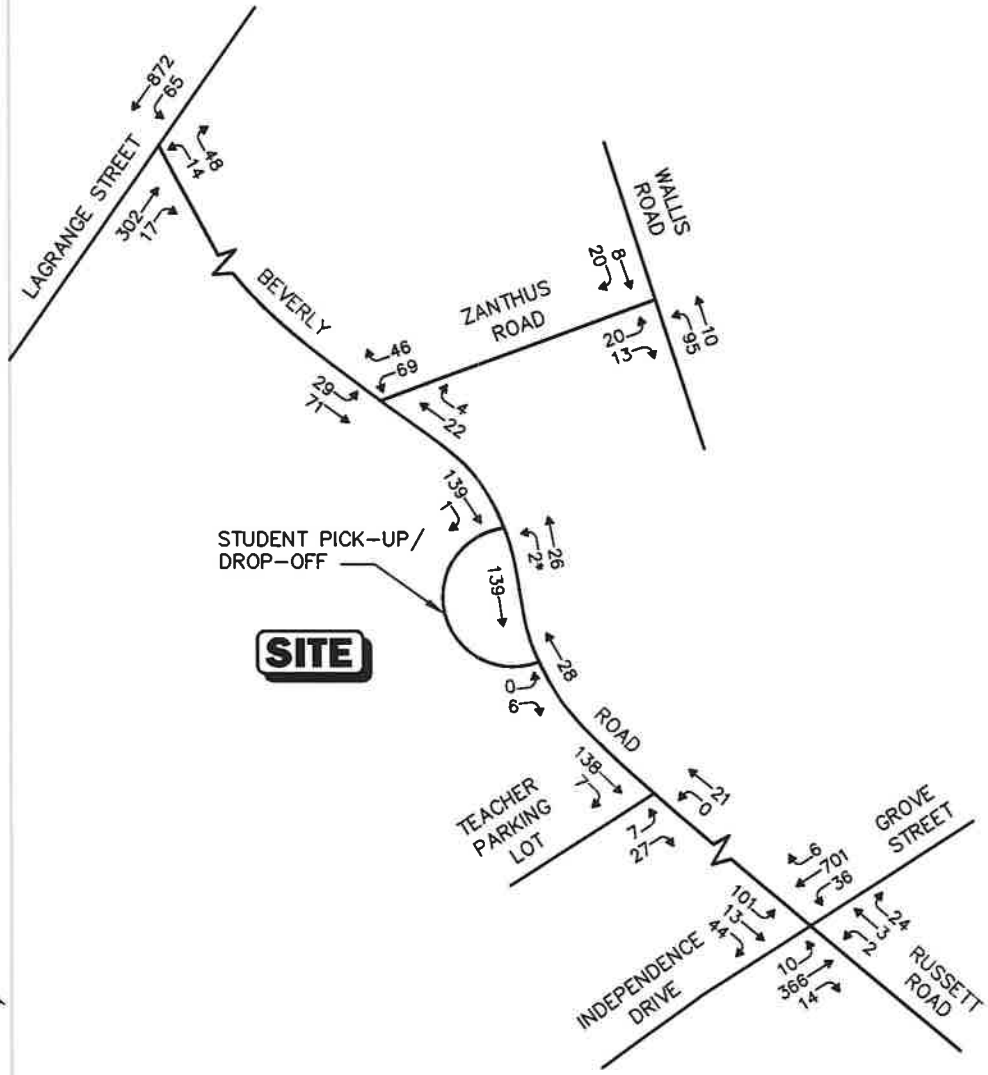
- 58% walk to/from Baker School
- 4% bus to/from Baker School
- 38% vehicle drop-off/pick-up

Table 2 summarizes the anticipated characteristics of the school based upon vehicle counts conducted at key school access and egress locations.

WEEKDAY MORNING PEAK HOUR



WEEKDAY AFTERNOON PEAK HOUR



Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 4

2025 No-Build
Weekday
Peak Hour Traffic Volumes

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Table 2
EXISTING BAKER SCHOOL VEHICLE TRIPS[a]

Time Period/Direction	Drop-Offs/ Pick-Ups (Loop)	Teacher Parking Lot	On-Street Drop-Offs/ Pick-Ups	On-Street Parked Vehicles	Gerry Road Drop-Offs/ Pick Ups	**Total Elementary School Trips** (759 Students)
Weekday Morning Peak Hour:						
Entering	136	64	39	44	14	**297**
Exiting	139	3	39	0	14	**195**
Total	275	67	78	44	28	**492**
Weekday Afternoon Peak Hour:						
Entering	3	7	37	0	12	**59**
Exiting	6	34	37	27	12	**116**
Total	9	41	74	27	24	**175**

[a]Based on TMCs conducted January 2018.

As can be seen in Table 2, the existing 759-student Baker School generates approximately 492 vehicle trips during the weekday morning peak hour (297 entering and 195 exiting), with 175 vehicle trips during the weekday afternoon peak hour (59 entering and 116 exiting). A summary of expected vehicle trip generation for the expansion of the Baker School is summarized in Table 3, and is based upon a trip-rate developed from Table 2. The trip rate was calculated only using trips on Beverly Road, excluding trips on Gerry Road.

Table 3
TRIP GENERATION SUMMARY

Time Period	Existing Vehicle Trips Beverly Road (759 students)	Trip-Rate Per Student	New Vehicle Trips (341 students)	Beverly Road Total Trips (1100 students)	Total Baker School Trips (1100 students)
Weekday Morning Peak Hour:					
Entering	283	0.37	126	409	423
Exiting	181	0.24	82	263	277
Total	464	0.61	208	672	700
Weekday Afternoon Peak Hour:					
Entering	47	0.06	20	67	79
Exiting	104	0.14	48	152	164
Total	151	0.20	68	219	243

Note: an additional 11-13 trips expected at Gerry Road

As can be seen in Table 3, the Project is expected to generate approximately 208 new vehicle trips (126 vehicles entering and 82 exiting) expected during the weekday morning peak-hour. During the weekday afternoon peak hour the Project is expected to generate approximately 68 new vehicle trips (20 vehicles entering and 48 exiting). The above estimates were utilized for analysis purposes in assessing the overall impacts.

TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of the site-generated trips to the proposed school was determined based on a review of existing traffic patterns at the study area intersections. The trip distribution on Figure 5 and summarized in Table 4, and is reflective of the one-way flow pattern on Beverly Road. It should be noted that the exiting part of the new loop roadway is west of Zanthus Road, and as such, traffic can also exit to the west. The site generated traffic as a result of the expansion is graphically depicted on Figure 6.

Table 4
TRIP-DISTRIBUTION SUMMARY

Roadway	Direction (To/From)	Entering	Exiting
Independence Drive	South	0	20
Grove Street	North	0	15
Russett Road	East	0	10
Wallis Road	South	50	5
Wallis Road	North	15	15
Lagrange Street	North	30	30
Lagrange Street	Southwest	5	5
TOTAL		100	100

FUTURE TRAFFIC VOLUMES – BUILD CONDITION

The 2025 Build condition networks consist of the 2025 No-Build traffic volumes with the anticipated site-generated traffic added to them. The 2025 Build weekday morning and weekday afternoon traffic-volume networks are graphically depicted on Figure 7.

A summary of peak-hour projected traffic-volume increases external to the study area that is the subject of this assessment is shown in Table 5. These volumes are based on the expected increases from the project.

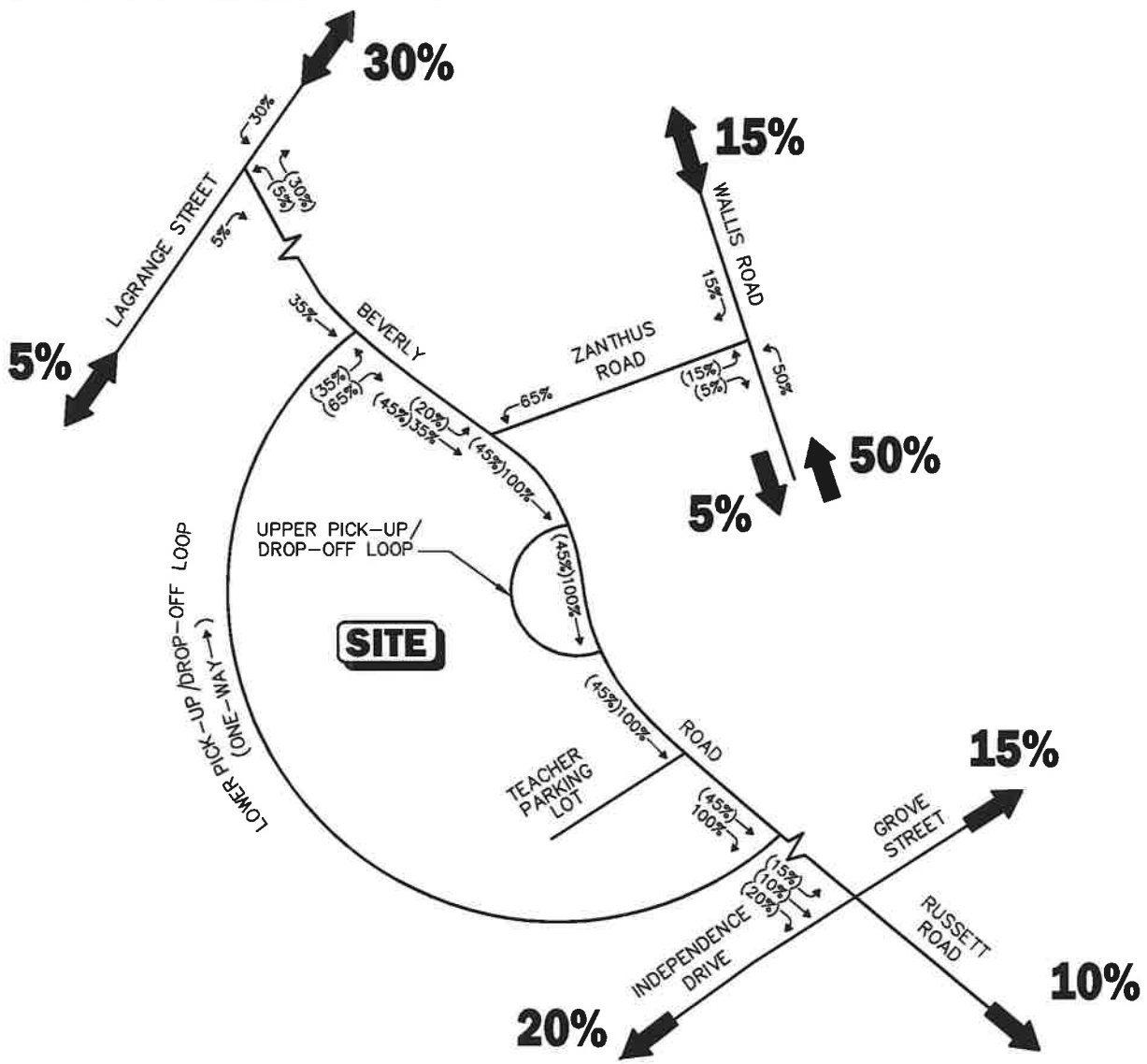

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Figure 5

Trip Distribution Map

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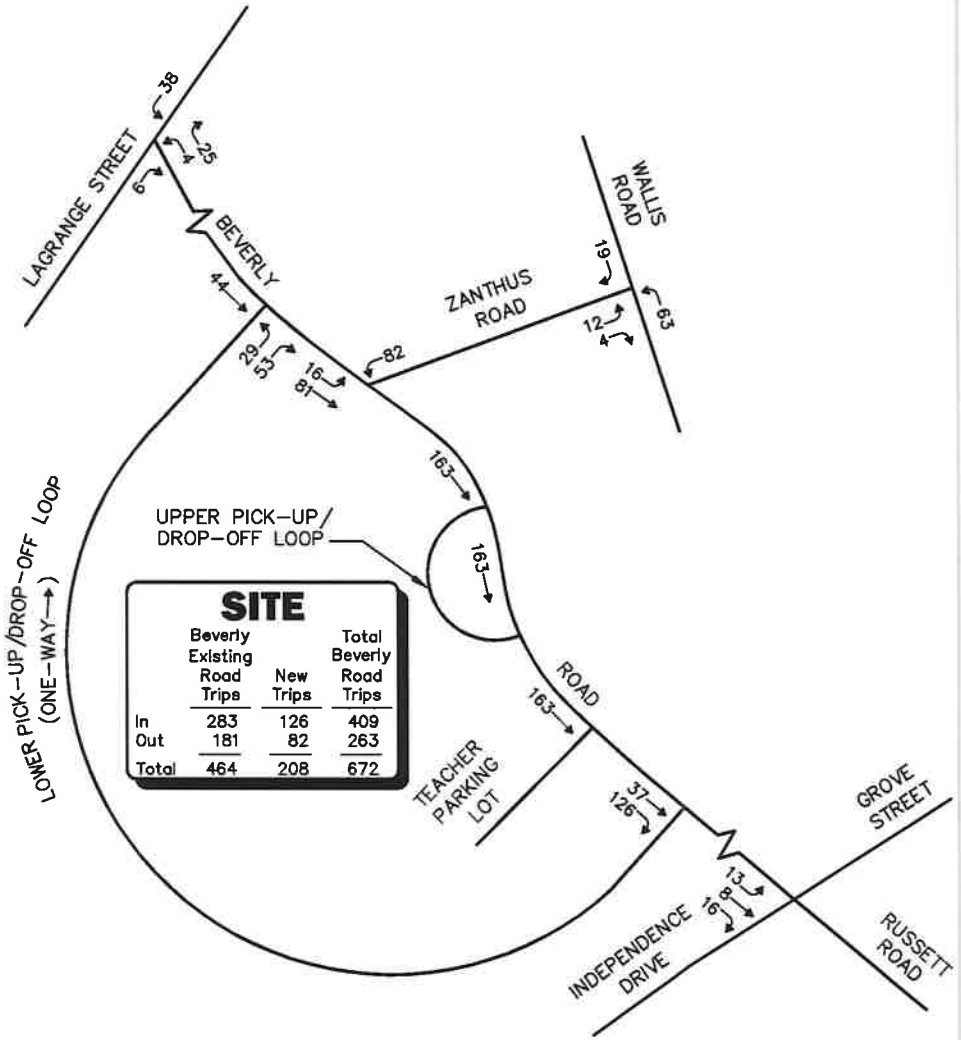
WEEKDAY MORNING PEAK HOUR



WEEKDAY AFTERNOON PEAK HOUR

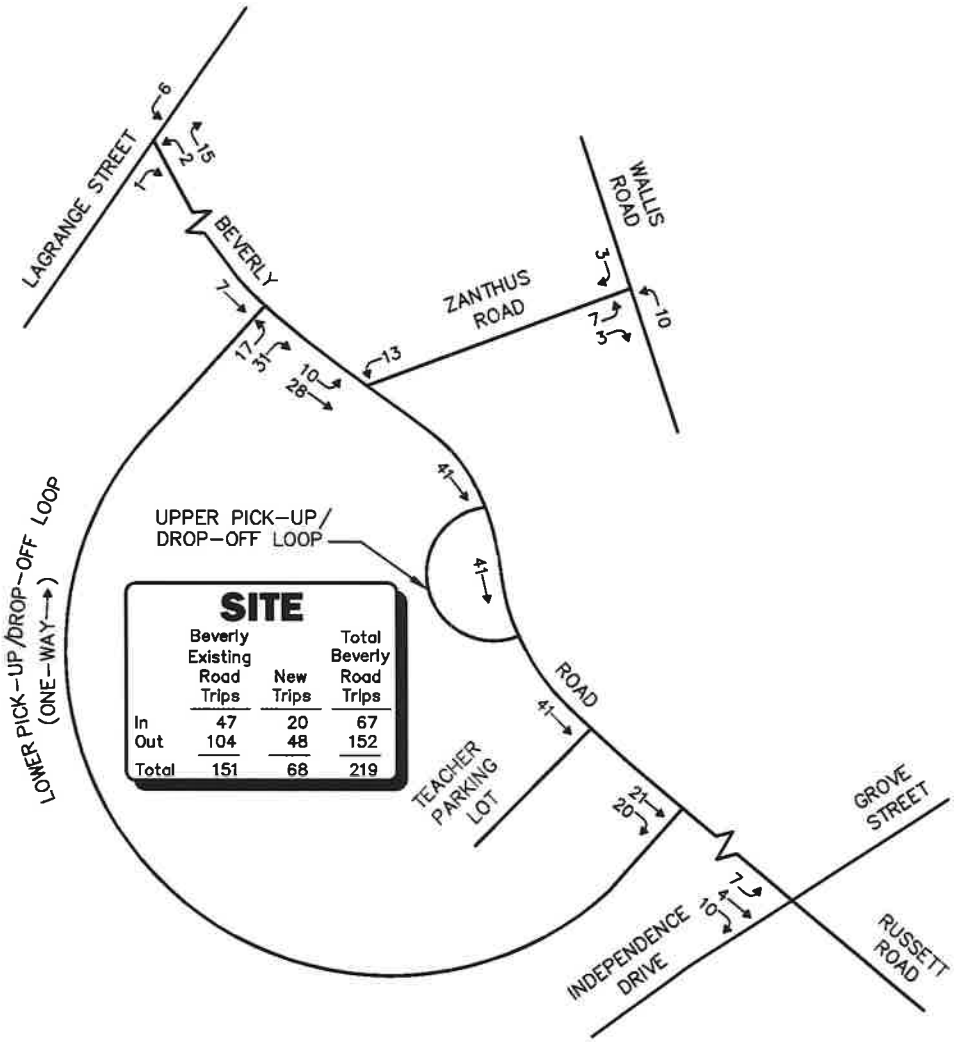


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Figure 6

School - New Trips (341 Students)
Peak Hour Traffic Volumes

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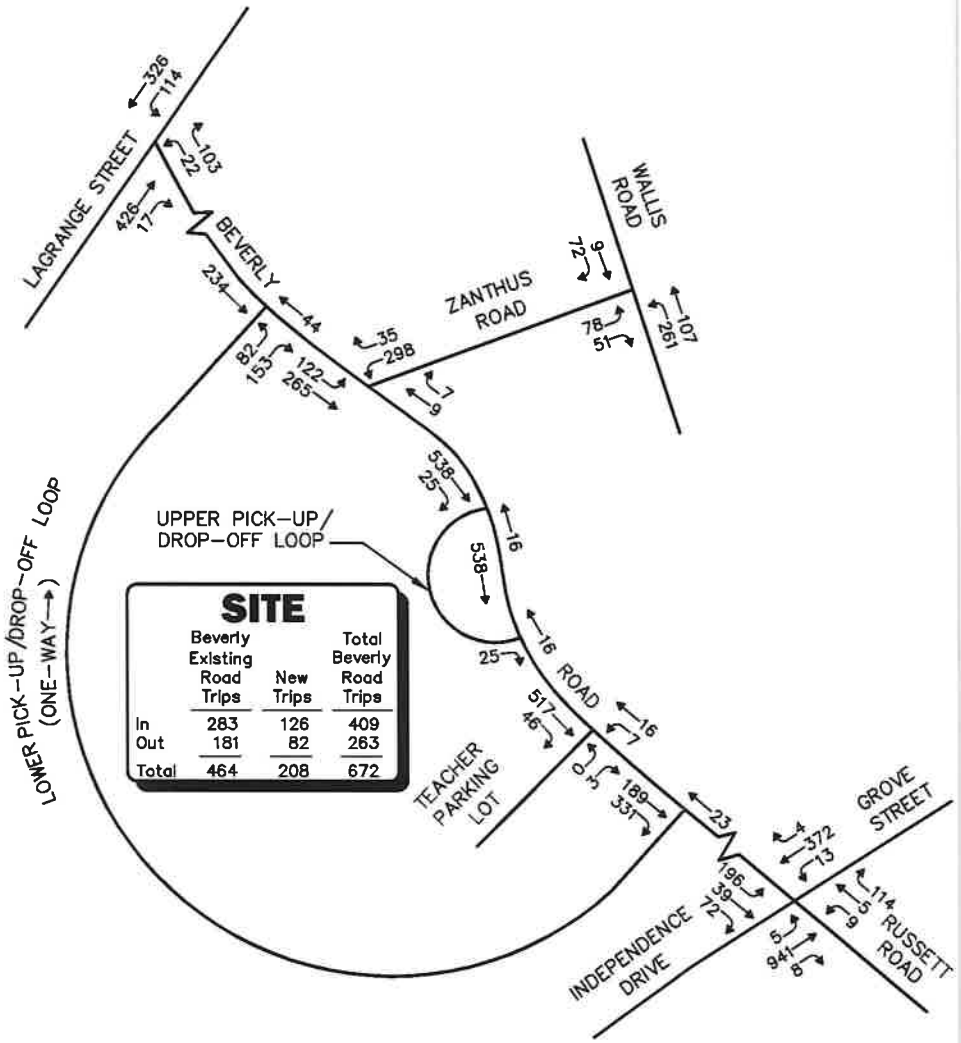
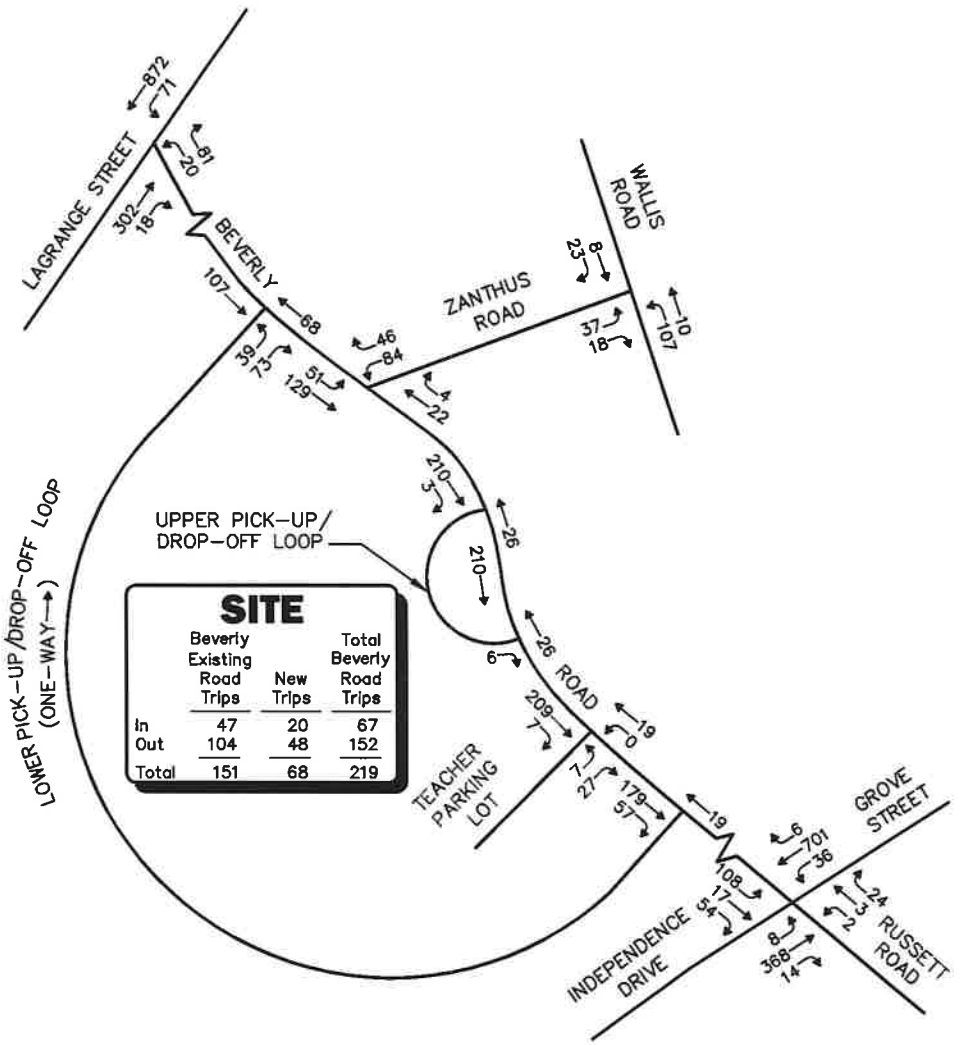
WEEKDAY MORNING PEAK HOUR



WEEKDAY AFTERNOON PEAK HOUR



Notes: 1. Imbalances exist due to numerous curb cuts and side streets that are not shown.
2. Existing school traffic rerouted to accommodate new site layout.

Not To Scale

Figure 7

2025 Build
Weekday
Peak Hour Traffic Volumes

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Table 5
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2025 No-Build	2025 Build	Traffic Volume Increase Over No-Build
LaGrange Street, north of Beverly Road:			
Weekday Morning	861	969	108*
Weekday Afternoon	1,287	1,326	39*
LaGrange Street, south of Beverly Road:			
Weekday Morning	773	791	18*
Weekday Afternoon	1,205	1,212	7*
Wallis Road, north of Zanthus Road:			
Weekday Morning	215	266	51*
Weekday Afternoon	58	78	20*
Wallis Road, south of Zanthus Road:			
Weekday Morning	349	428	79*
Weekday Afternoon	126	143	17*
Independence Drive, south of Beverly Road:			
Weekday Morning	1,391	1,407	16
Weekday Afternoon	1,137	1,147	10
Grove Street, north of Beverly Road:			
Weekday Morning	1,624	1,640	16*
Weekday Afternoon	1,234	1,243	9*
Russett Road, east of Beverly Road:			
Weekday Morning	180	188	8
Weekday Afternoon	92	96	4

*Traffic Volume Increases slightly vary from the Site Generated network due to rerouting of existing school traffic.

As shown in Table 5, project-related traffic-volume increases external to the study area relative to 2025 No-Build conditions are anticipated to range from 4 to 108 vehicles during the peak periods.

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[1] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.

[1]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2000 *Highway Capacity Manual.*[2] Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the *2000 Highway Capacity Manual.* Table 6 summarizes the relationship between level of service and average control delay for two way stop controlled and all-way stop controlled intersections.

Table 6
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay
v/c ≤ 1.0	v/c > 1.0	(Seconds Per Vehicle)
A	F	≤10.0
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	>50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000; page 19-2.

[2]*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000.

Signalized Intersections

The six levels of service for signalized intersections may be described as follows:

- *LOS A* describes operations with very low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Levels of service for signalized intersections are calculated using the operational analysis methodology of the 2000 *Highway Capacity Manual*. This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. Level-of-service designations are based on the criterion of control or signal delay per vehicle. Control or signal delay is a measure of driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay. Table 7 summarizes the relationship between level of service and control delay. The tabulated control delay criterion may be applied in assigning level-of-service designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table 7
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay
v/c ≤ 1.0	v/c > 1.0	(Seconds Per Vehicle)
A	F	≤10.0
B	F	10.1 to 20.0
C	F	20.1 to 35.0
D	F	35.1 to 55.0
E	F	55.1 to 80.0
F	F	>80.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2000; page 18-6.

ANALYSIS RESULTS

Level-of-service analyses were conducted for Baseline, 2025 No-Build, and 2025 Build conditions for the study area intersections. The results of the intersection capacity analysis within the study area are described below, with a tabular summary provided in Tables 8 and 9.

Unsignalized Intersection Analysis Results

Beverly Road at LaGrange Street

Under Existing and No-Build conditions, Beverly Road operates at LOS B during the weekday morning peak hour, and at LOS C during the weekday afternoon peak hour. Under Build conditions, Beverly Road operates at LOS C during both the weekday morning and afternoon peak hours. The school will have a minor impact at this location.

Beverly Road at Zanthus Road

Under Existing and No-Build conditions, Zanthus Road operates at LOS D during the weekday morning peak hour and at LOS B during the weekday afternoon peak hour. Under Build conditions, Zanthus Road operates at LOS F during the weekday morning peak hour and LOS B during the weekday afternoon peak hour. Should Beverly Road be converted back to a two-way, the intersection operations would improve.

Zanthus Road at Wallis Road

Under Existing and No-Build conditions, Zanthus Road operates at LOS C during the weekday morning peak hour and at LOS B during the weekday afternoon peak hour. Under Build conditions, Zanthus Road operates at LOS E during the weekday morning peak hour and LOS B during the weekday afternoon peak hour. Should Beverly Road be converted back to a two-way, the intersection operations would improve.

Beverly Road at School Drop-Off/Pick-Up Circle

Under all conditions, the Student Drop-Off Circle operates at LOS C or better during the weekday morning peak hour, and at LOS B or better during the weekday afternoon peak hour.

Beverly Road at Teacher's Parking Lot

Under Existing and No-Build conditions, the Teacher's Lot operates at LOS B during the weekday morning peak hour and at LOS A during the weekday afternoon peak hour. Under Build conditions, the Teacher's Lot operates at LOS C during the weekday morning peak hour and LOS B during the weekday afternoon peak hour.

Beverly Road at Lower Drop-Off/Pick-Up Circle

Under Build conditions, the Lower Student Drop-Off Circle operates at LOS B during the weekday morning peak hour, and at LOS A during the weekday afternoon peak hour.

Signalized Intersection Analysis Result

Beverly Road at Independence Drive, Grove Street and Russett Road

Under all conditions, this intersection operates at an overall LOS F during the weekday morning peak hour, as a result of the peak school traffic, and at LOS B during the weekday afternoon peak hour. The LOS F during the morning condition is only for the short period of drop-off exiting traffic.

Table 8
UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

	2018 Existing				2025 No-Build				2025 Build			
Unsignalized Intersection Movements	Demand[a]	Delay[b]	LOS[c]	Queue[d]	Demand	Delay	LOS	Queue	Demand	Delay	LOS	Queue
Beverly Road at LaGrange Street												
Weekday Morning:												
Beverly Road WB LT/RT	37	12.7	B	7	43	13.2	B	8	125	15.2	C	28
Weekday Afternoon:												
Beverly Road WB LT/RT	56	17.5	C	24	62	20.6	C	33	101	24.6	C	64
Beverly Road at Zanthus Road												
Weekday Morning :												
Zanthus Road SB LT/RT	227	25.3	D	171	243	34.1	D	231	333	>50.0	F	1130
Weekday Afternoon:												
Zanthus Road SB LT/RT	107	10.4	B	22	115	10.6	B	24	130	12.4	B	36
Zanthus Road at Wallis Road												
Weekday Morning :												
Zanthus Road NB LT/RT	82	15.5	C	23	88	16.9	C	28	129	41.7	E	103
Weekday Afternoon:												
Zanthus Road NB LT/RT	31	10.6	B	6	33	10.8	B	7	55	11.9	B	13
Beverly Road at School Drop-Off/Pick-Up												
Weekday Morning :												
Drop-Off/Pick-Up NB LT	12	10.7	B	3	12	11.1	B	3	0	0.0	A	0
Drop-Off/Pick-Up NB RT	127	12.2	B	37	127	12.8	B	40	25	17.8	C	18
Weekday Afternoon:												
Drop-Off/Pick-Up NB LT	0	0.0	A	0	0	0.0	A	0	0	0.0	A	0
Drop-Off/Pick-Up NB RT	6	9.2	A	1	6	9.3	A	1	6	9.9	A	1
Beverly Road at Teacher Parking Lot												
Weekday Morning :												
Teacher Parking Lot NB LT/RT	3	10.9	B	0	3	11.2	B	1	3	15.4	C	1
Weekday Afternoon:												
Teacher Parking Lot NB LT/RT	34	9.5	A	4	34	9.6	A	4	34	10.2	B	5
Beverly Road at Lower Loop Exit												
Weekday Morning :												
Loop Exit EB LT	--	--	--	--	--	--	--	--	82	10.7	B	11
Loop Exit EB RT	--	--	--	--	--	--	--	--	153	10.7	B	19
Weekday Afternoon:												
Loop Exit EB LT	--	--	--	--	--	--	--	--	39	9.6	A	4
Loop Exit EB RT	--	--	--	--	--	--	--	--	73	9.1	A	7

[a]Demand in vehicles per hour [b]Delay in seconds per vehicle. [c]Level of service. [d]Queue Length in feet
*Geometry only existing under Build conditions with construction of Site Driveway. NB = northbound; WB = westbound; LT = left-turning movements; RT = right-turning movements

Table 9
SIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Signalized Intersection/Peak Hour/Movement	2018 Existing				2025 No-Build				2025 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d] 50th/95th	V/C	Delay	LOS	Queue 50th/95th	V/C	Delay	LOS	Queue 50th/95th
Beverly Road at Independence Drive, Grove Street and Russett Road												
Weekday Morning:												
Independence Drive EB LT/TH/RT	0.55	9.4	A	176/476	0.59	9.9	A	258/526	0.59	9.9	A	257/526
Grove Street WB LT/TH/RT	0.22	7.1	A	21/87	0.24	7.2	A	23/96	0.24	7.2	A	23/96
Russett Road NB LT/TH/RT	0.48	33.3	C	42/93	0.67	40.5	D	60/124	0.67	40.5	D	60/125
Beverly Road SB LT/TH/RT	1.93	>80.0	F	208/341	2.68	>80.0	F	252/390	2.97	>80.0	F	295/442
Overall	**0.83**	**>80.0**	**F**	--	**1.03**	**>80.0**	**F**	--	**1.09**	**>80.0**	**F**	--
Weekday Evening:												
Independence Drive EB LT/TH/RT	0.30	10.0	B	25/123	0.30	9.8	A	26/135	0.30	9.8	A	26/134
Grove Street WB LT/TH/RT	0.53	11.5	B	43/171	0.56	11.7	B	47/195	0.56	11.7	B	47/195
Russett Road NB LT/TH/RT	0.06	14.9	B	3/18	0.07	15.5	B	4/40	0.07	15.5	B	4/40
Beverly Road SB LT/TH/RT	0.66	25.5	C	37/145	0.43	20.1	C	24/193	0.48	21.0	C	28/224
Overall	**0.57**	**13.7**	**B**	--	**0.51**	**12.2**	**B**	--	**0.53**	**12.5**	**B**	--

[a]Volume-to-capacity ratio.
[b]Percentile delay per vehicle in seconds.
[c]Level-of-Service.
[d]Queue length in feet.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements

BAKER SCHOOL PARKING

PARKING

Approximately 70 parking spaces exist in the Teacher's Parking Lot off of Beverly Road, with overflow teacher parking occurring on-street. With the proposed Baker School expansion, the existing Teacher's Parking Lot of 70 parking spaces will remain, and an additional 80 parking spaces will be built under the new Baker School section. Existing parking demand during the morning period was 110 vehicles, including both the on-street and Teacher Lot. With the expanded school, staff parking is expected to be 150 vehicles, and can be accommodated in the proposed parking. On-street parking for visitors and parent pick-ups may still occur on-street.

BAKER SCHOOL SUMMARY AND RECOMMENDATIONS

SUMMARY

VAI has completed a detailed assessment of the impacts associated with the potential Baker School expansion. This assessment has been completed in accordance with State and Town standards and those of the Traffic Engineering and Transportation Planning professions for the preparation of such reports. Based on this assessment, we have noted the following with respect to the Project:

- The expansion is expected to generate approximately 208 new vehicle trips (126 vehicles entering and 82 exiting) during the weekday morning peak-hour. During the weekday afternoon peak hour the expansion is expected to generate approximately 68 new vehicle trips (20 vehicles entering and 48 exiting);
- A review of accident data researched from MassDOT indicates that area intersections experience accident rates below state averages indicating safe operations.
- Baker School is primarily a walking school with up to 58 percent of students walking.
- Currently, a crossing guard is located on Beverly Road to ensure safe crossing. Additionally, a traffic officer is stationed at the signalized intersection of Beverly Road at Independence Drive, Grove Street and Russett Road.
- Under the new plan, the lower loop will accommodate pick-up and drop-off activity for both schools. The loop road will accommodate two travel lanes, with available queuing area of over 1,000 feet.

Overall, the school expansion from 759 students to 1,100 students will increase traffic and impact delays and queues during limited periods of the day.

RECOMMENDATIONS

The following improvements have been recommended as a part of this evaluation and should be completed as part of the school expansion.

School Zone Signage

School Zone signs, pavement markings and traffic control devices (i.e., flashing school speed limit signs) should be updated along Beverly Road in consultation with the Transportation Department.

Bicycle Considerations

While bicycle usage to the site may be limited, the following should be incorporated.

- Bicycle racks should be provided proximate to the building entrance in a visible location.

Transit Usage

While transit usage will be limited to staff, the school should promote staff usage of public transportation to the school.

School Drop-Off and Pick-Up Traffic Management Plan

A central feature of the school expansion will be an upgrade to the traffic and parking management plan for school drop-off and pick-up activities. The site changes have been developed to facilitate access to the school for pedestrians, bicyclists, school buses and parents/caregivers in a safe and efficient manner. The plan includes a new loop roadway to accommodate the majority of drop-offs and pick-ups. Exiting the new loop roadway on Beverly Road, traffic can exit left or right, reducing impacts at Independence Drive and the also reducing existing queues. Limited drop-off and pick-up activity is expected on-street and at the existing loop in front of the existing school. The majority of student drop-off and pick-up will be directed to the new loop roadway.

The traffic and parking management plan should consist of the following major elements:

- The existing crossing guard along Beverly Road and police detail at Beverly Road at Independence Drive should remain.
- A staff person should be available to direct traffic at the new loop road intersection with Beverly Road.
- School staff should be stationed at the drop-off areas to manage traffic, as well as to facilitate the safety of students.
- A designated drop-off/pick-up area has been incorporated into the site plan, designed to facilitate these movements.
- A lane along the entryway will remain unobstructed during student drop-off and pick-up periods for emergency vehicles and passage of vehicles.
- Parking should be restricted to one side of Beverly Road, and the two-way flow on Beverly Road should be maintained at all times. This should limit congestion along Beverly Road and improve overall current conditions.
- Parents and caregivers will be given information on school drop-off and pick-up times and procedures at the beginning of the school year, with periodic updates and reminders provided as may be necessary.

- All staff should be required to park off-street in the designated parking lots.
- It is recommended that the two schools' start and finish times be offset by at least 15 minutes, in order to minimize impacts and reduce any peak conditions.

The elements of the traffic and parking management plan for school drop-off and pick-up activities will be reviewed and updated as may be necessary in order to ensure the safety of students and to minimize potential impacts to the safe and efficient movement of vehicles, pedestrians and bicyclists.

Construction Management Plan

A detailed Construction Management Plan should be prepared and reviewed by the Town.

Traffic Monitoring

Within three months after school opening, a traffic monitoring study should be completed to review traffic counts at the site driveways and evaluate the traffic condition within the area.

Annually, the school should assess conditions and evaluate pedestrian safety, crossing guards, and evaluate the level of student busing and make adjustments, as necessary.

Overall, a Baker School expansion will increase traffic, but will be limited to short periods in the morning and afternoon.