Nitsch Engineering

Traffic Impact Study

Mindess Elementary School
Ashland, MA

June 10, 2021

Prepared for:

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Nitsch Project #13609.12

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1 Introduction

Nitsch Engineering has been retained by Flansburgh Architects (FA) to prepare a Traffic Impact Study based on the schematic design for the proposed new Mindess Elementary School in Ashland. As part of the Feasibility Study, two (2) site options were considered for the reconstruction. The first option was the existing Mindess Elementary School site, at 90 Concord Street in Ashland, Massachusetts. The second option was the existing Ashland Middle School site, located at 87 W. Union Street in Ashland, Massachusetts, approximately one mile southwest of the existing Mindess Elementary School site. The team was tasked to observe the existing traffic circulation and queue lengths on adjacent streets during drop-off and pick-up periods at two (2) existing schools in Ashland and assess the site alternatives as presented in the Transportation Impact Report, dated December 5, 2019.

FA had presented the following six (6) site improvement schemes for the proposed school:

- Scheme 2A, New School Building with 635 Student Enrollment, on Existing Mindess Site, (Grades 3-5)
- Scheme 2B, New School Building with 845 Student Enrollment, on Existing Mindess Site, (Grade2-5)
- Scheme 3A, Renovate Existing and New Classroom Wing with 635 Student Enrollment, on Existing Mindess Site, (Grades 3-5)
- Scheme 3B, Renovate Existing and New Classroom Wing with 845 Student Enrollment, on Existing Mindess Site, (Grade2-5)
- Scheme 6A, New School Building with 635 Student Enrollment, on Existing Middle School Site, (Grades 3-5)
- Scheme 6B, New School Building with 845 Student Enrollment, on Existing Middle School Site, (Grade2-5)

Upon review of the Feasibility Study, it was determined by the Town that Scheme 2A, New School Building with 635 Student Enrollment, on Existing Mindess Site, (Grades 3-5) would be the preferred alternative.

This TIS will review the existing and proposed traffic volumes, operations, and safety of the adjacent surrounding roadways and intersections; as well as traffic patterns associated with the existing Mindess Elementary School, including site access/egress, parent and bus pick-up/drop-off, traffic circulation, and parking supply/demand. This TIS will also analyze existing and future conditions at the intersections within the study area to establish the impact the proposed improvements would have on traffic operations.

1.1 Study Area

The study area includes six roadways and five intersections within and adjacent to the Project site that are affected by the development.

Roadways

- Concord Street;
- Front Street;
- Raymond Marchetti Street;
- Fountain Street;
- Fisk Road, and

- Myrtle Street.

Intersections

- Concord Street at Front Street and Fountain Street (signalized);
- Concord Street at Fisk Street (unsignalized);
- Concord Street at Raymond Marchetti Street (unsignalized);
- Concord Street at Front Street (unsignalized); and
- Raymond Marchetti Street at Myrtle Street (unsignalized).

1.2 Methodology

The traffic analysis herein is summarized in the following sections:

1. An inventory of existing transportation conditions, including roadway capacities, parking, transit, pedestrian and bicycle circulation, and site conditions.
2. An evaluation of future transportation conditions and an assessment of potential traffic impacts associated with the Project and other neighboring projects. Long-term impacts are evaluated for the year 2028, based on a seven-year horizon from the 2021 base year. Expected roadway, parking, transit, and pedestrian conditions and deficiencies are identified. This section includes the following scenarios:
    a. The No-Build Scenario (2028) includes general background growth and additional vehicular traffic associated with specific proposed or planned developments and roadway changes in the vicinity of the Project site; and
    b. The Build Scenario (2028) includes specific travel demand forecasts for the Project.
3. An identification of appropriate measures to mitigate Project-related impacts.

The standards used for analysis conform to the 2009 edition of the Manual on Uniform Traffic Control Devices (MUTCD) and the 2010 edition of the Highway Capacity Manual.

The following conditions are analyzed in this report:

- Existing 2021 “Normal” Conditions;
- Future 2028 No-Build;
- Future 2028 Build; and

Figure 1 is the Locus Map showing the proximity of the Project Site and the surrounding roadway network. Figure 2 identifies the study intersections.

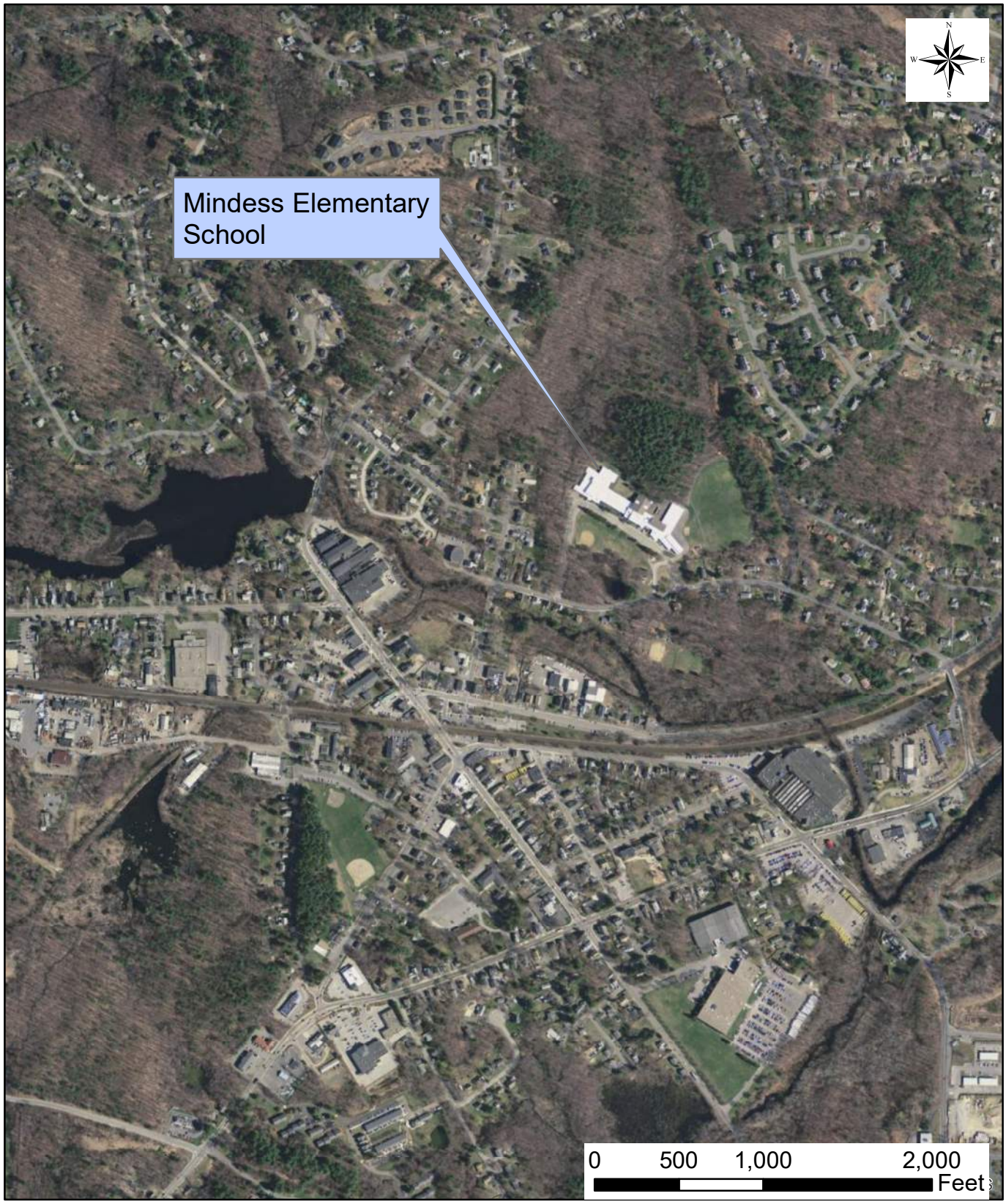

Figure 1: Locus Map
Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

Nitsch Engineering

Figure 2: Intersection Locations

Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

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2 Executive Summary

Nitsch Engineering evaluated the preferred option with respect to constructing a new Grades 3-5 Elementary School building and grounds on the existing Mindess Elementary School site for 635 students.

The proposed school option will provide many enhancements to traffic circulations and controls such as providing an extended parent queue on site, a dedicated bus loop to separate cars and buses, providing a dedicated delivery access and increased parking.

The School parking lot, when complete, will provide 252 striped parking spaces that include 8 accessible spaces. This number exceeds the 83 parking spaces recommended by the Institute of Transportation Engineers (ITE) Parking Generation for land code 520 to facilitate parental parking during drop-off and pick-up times (see Table 1). The curb at the car loop is approximately 1,400 linear feet, which can accommodate an additional 75 vehicles.

Table 1 - Proposed Parking Summary

Parking Spaces Provided	Parking Spaces Required by Institute of Transportation Engineers' Parking Generation for Land Use Code 520
252 Striped (8 Accessible)	83
75 Live Drop-Off	

The Proposed School will continue to be accessed from two driveways on Concord Street. All traffic access to the school (parental drop-off and pick-up, access to the parking lot, as well as the teachers and staff) will occur from the east driveway. The driveway will also serve as egress for all traffic to the school.

Parents dropping off and picking up their students will navigate the counterclockwise driveway, looping around the new 250-space parking lot to the designated locations. The parental loop provides 1,400 linear feet for queuing (approximately 75 vehicles). After dropping-off/picking-up their students, parents will continue to exit the site via the east driveway.

The bus pick-up/drop-off will occur at the designated bus circle accessed and egressed from the west driveway. 17 school buses will be serving the students at the new school.

The loop road around the school and the playing fields is designated for authorized vehicles only. The road is used for either deliveries to the loading dock located at the north of the school building or for emergency vehicle access.

3 Existing Conditions

3.1 Roadways

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

Concord Street

Concord Street is classified by Massachusetts Department of Transportation (MassDOT) as a local roadway and runs in the east-west directions between Fountain Street at its eastern terminus and Front Street at its western terminus. The roadway near the school is designated “School Zone” with a speed limit of 20 MPH. The posted speed limit along the roadway outside of the School Zone is 30 MPH. Bituminous concrete sidewalk is present on the northerly side of Concord Street. Bicycle accommodations are not present on Concord Street. The land use is primarily residential. The roadway is within the jurisdiction of the Town of Ashland.

Front Street

Front Street is classified by Massachusetts Department of Transportation (MassDOT) as an urban collector and runs in the east-west directions. Front Street is present between the Fountain Street at its eastern terminus and at Main Street at its western terminus. Speed limit signs are not posted on the roadway. On roadways without any posted speed limit signs, speed limit is the Prima Facie speed. In Ashland, the Prima Facie speed limit is 25 MPH. Bituminous concrete sidewalk is present on the northerly side of Front Street. Bicycle accommodations are not present on Front Street. The land use is a mixture of residential and commercial. The roadway is within the jurisdiction of the Town of Ashland.

Raymond Marchetti Street

Raymond Marchetti Street is classified by Massachusetts Department of Transportation (MassDOT) as a local roadway and runs in the southeast-northwest directions between Concord Street at its southeastern terminus and Myrtle Street at its northwestern terminus. Speed limit signs are not posted on the roadway. On roadways without any posted speed limit signs, speed limit is the Prima Facie speed. In Ashland, the Prima Facie speed limit is 25 MPH. Bituminous concrete sidewalk is present on the westerly side of Raymond Marchetti Street. Bicycle accommodations are not present on Raymond Marchetti Street The land use is primarily residential. The roadway is within the jurisdiction of the Town of Ashland.

Fountain Street

Fountain Street is classified by Massachusetts Department of Transportation (MassDOT) as an urban collector and runs in the northeast-southwest directions. Fountain Street is present between the Framingham city line at its northeastern terminus and at Union Street at its northeastern terminus. Speed limit signs are not posted on the roadway. On roadways without any posted speed limit signs, speed limit is the Prima Facie speed. In Ashland, the Prima Facie speed limit is 25 MPH. Bicycle accommodations are not present on Fountain Street. Bituminous concrete sidewalk is present on the westerly side of Fountain Street. The land use is primarily residential. The roadway is within the jurisdiction of the Town of Ashland.

Myrtle Street

Myrtle Street is classified by the MassDOT as an urban collector that runs in a general north-south direction from its northern terminus at Framingham City Line to its southern terminus at Main Street. Myrtle Street is 24 feet wide with one travel lane in each direction separated by a double yellow center line (DYCL). The roadway provides one 12-foot-wide lane in each direction. Bituminous concrete sidewalk is present on the westerly side of Myrtle Street. The roadway is maintained by the Town of Ashland. Speed limit signs are not posted on the roadway. On roadways without any posted speed limit signs, speed limit is the Prima Facie speed. In Ashland, the Prima Facie speed limit is 25 MPH. Bicycle accommodations are not present on Myrtle Street. Land use along Myrtle Street is primarily residential.

3.2 Study Intersections

The study area includes five intersections (Figure 2). To examine the existing conditions, we designated the following intersections as the main intersections of the study.

- Concord Street at Front Street and Fountain Street (signalized);
- Concord Street at Fisk Street (unsignalized);
- Concord Street at Raymond Marchetti Street (unsignalized);
- Concord Street at Front Street (unsignalized); and
- Raymond Marchetti Street at Myrtle Street (unsignalized).

Concord Street at Front Street and Fountain Street

Concord Street, Front Street, and Fountain Street intersect as a four-way signalized intersection with Concord Street approaching from the north, Fountain Street approaching from the east and the south, and Front Street approaching from the west.

The intersection includes eight-foot-wide ADA accessible crosswalks across Front Street west of the intersection, and Concord Street north of the intersection.

Concord Street at Fisk Street

Concord Street and Fisk Street intersect as a three-way unsignalized intersection with Concord Street approaching from the east and the west, and Fisk Street approaching from the north. Concord Street operates freely with no control, and Fisk Street operates with stop control. There are no ADA accessible crosswalks present at the intersection.

Concord Street at Raymond Marchetti Street and Concord Court

Concord Street, Raymond Marchetti Street and Concord Court intersect as a four-way unsignalized intersection with Concord Street approaching from the east and south, Raymond Marchetti Street approaching from the north, and Concord court approaching from the west. Raymond Marchetti Street SB and Concord Street NB operate freely with no control, and Concord Street WB and Concord Court operate with stop control. There are no ADA accessible crosswalks present at the intersection.

Concord Street at Front Street

Concord Street and Front Street intersect as a three-way unsignalized intersection with Concord Street approaching from the north, and Front Street approaching from the east and the west. Front Street operates freely with no control, and Concord Street operates with stop control.

The intersection includes eight-foot-wide crosswalks across Front Street east of the intersection, and Concord Street north of the intersection. However, ADA compliant pedestrian ramps and detection pads are not present at these crosswalks.

Raymond Marchetti Street at Myrtle Street

Myrtle Street and Raymond Marchetti Street intersect as a three-way unsignalized intersection with Raymond Marchetti Street approaching from the east, and Myrtle Street approaching from the north and the south. Myrtle Street operates freely with no control, and Raymond Marchetti Street operates with stop control. There are no ADA accessible crosswalks present at the intersection.

3.3 Mindess Elementary School Site Observations

Nitsch Engineering conducted a site visit on Wednesday, September 11, 2019 to observe the site circulation associated with the weekday morning drop-off, weekday afternoon pick-up, and general queue lengths around the school site. The weekday morning drop-off observation occurred during partly cloudy conditions with a temperature of 76 degrees. The weekday afternoon pick-up activity occurred during partly cloudy conditions with a temperature of 89 degrees.

3.3.1 Site Access and Egress

Mindess Elementary School is located at 90 Concord Street in Ashland, Massachusetts. The school is accessed from Concord Street.

3.3.2 Mindess Elementary School Traffic Circulation and Pick-up/Drop-off

Existing Morning Drop-off Circulation

The Mindess Elementary School traffic arrives at Concord Street from 7:15 AM through 8:00 AM. We observed that some parents arrive and park along the school driveway and walk their children to the school, and others drop-off their children at the front. The Principal or a teacher greet the children upon their arrival. A total of 117 parental drop-offs were observed during the morning. At the time of the site visit, we did not observe any student walkers or bicyclists at the school.

Buses arrive at the main parking lot through Concord Street from 7:15 AM through 8:00 AM. Buses drop-off the children at the exclusive bus driveway, and after dropping off students, proceed to leave the site by looping around the ball field via Concord Street. A total of 17 buses and two mini-buses (Special Ed) were observed dropping off students at the school.

Existing Afternoon Pick-up Circulation

The afternoon pick-up period occurs approximately from 2:00 PM to 2:45 PM. Parents start arriving around 2:00 PM and queue up at the school's driveway and along Concord Street westbound to wait for their children. We observed 47 vehicles in the queue along Concord Street. Once they have collected their children, they leave via Concord Street, and normal traffic returns by 3:00 PM. A total of 97 parental pick-up vehicles were observed during

afternoon dismissal. At the time of the site visit we did not observe any student walkers or bicyclists.

Buses arrive at the main parking lot through Concord Street from 2:15 PM through 2:30 PM. Buses line up at the exclusive bus driveway to pick-up the children. After picking up students, the buses proceed to leave the site by looping around the ball field via Concord Street. A total of 17 buses and two mini-buses (Special Ed) pick-up students at the school.

Table 2 tables quantifies the parent and bus drop-off/pick-up totals for the existing Mindess Elementary School.

Table 2 - Mindess School Observed Drop-Off/Pick-Up Quantity

Type	Parent		Bus		Mini-Bus/SP. ED	
	Concord Street					
Time	Drop-Off	Pick-Up	Drop-Off	Pick-Up	Drop-Off	Pick-Up
7:15 - 7:30	10					
7:30 - 7:45	71		17		2	
7:45- 8:00	36					
2:00 - 2:15		12				
2:15 - 2:30		35		17		
2:30 - 2:45		35				2
2:45 - 3:00		15				
Total	117	97	17	17	2	2

3.3.3 Parking Supply and Demand

Nitsch Engineering performed a parking supply and demand count on September 11, 2019. The utilization of the lot was taken at 9:30 AM.

A total of 94 parking spaces were counted within the parking lot at Mindess Elementary School, three of which are accessible spaces. This meets the Architectural Access Board (AAB) Code of Massachusetts Regulations (521 CMR) for the required number of handicapped parking spaces. Only one accessible space was utilized at the time of observation. The overall lot utilization at the parking lot was 97% at the time of observation.

4 Existing Traffic Conditions

4.1 Traffic Count Data

Automatic Traffic Recorder (ATR) Data

As part of the preliminary Transportation Impact Report associated with the feasibility study for the Proposed Mindess Elementary School (December 5, 2019), Nitsch Engineering had retained Precision Data Industries, LLC (PDI) of Framingham, Massachusetts to conduct 48-hour Automatic Traffic Recorder (ATR) vehicle traffic counts at Concord Street from Tuesday November 12 to Wednesday November 13, 2019. Nitsch Engineering retained PDI again to conduct 72-hour Automatic Traffic Recorder (ATR) vehicle traffic counts throughout the study area from Tuesday, April 13, 2021 to Thursday, April 15, 2021. Table 3 summarizes the ATR data. A copy of the raw traffic count data is included in Appendix A-1.

Table 3 - Automatic Traffic Recorder (ATR) Summary

LOCATION	PERIOD	ADT[a]		PEAK HOUR TRAFFIC			K factor[d]
		VOLUMES (vpd)[b]	DIRECTIONAL DISTRIBUTION	PERIOD	VOLUMES (vph)[c]	DIRECTIONAL DISTRIBUTION	
Concord Street east of School Driveway	Weekday	1,290	52.3% EB	Morning	260	57.3% WB	0.20
				Afternoon	194	55.7% EB	0.15
Front Street west of Concord Street	Weekday	4,170	52.0% WB	Morning	470	66.2% EB	0.11
				Afternoon	381	64.0% WB	0.09

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

Turning Movement Count (TMC) Data

PDI also conducted continuous Turning Movement Counts (TMC) data for the five main intersections of the study area, as well as the two existing school's driveways on Concord Street on Tuesday, April 13, 2021 from 7:00 AM to 9:00 AM and 1:30 PM to 3:30 PM to capture the weekday morning and afternoon peak periods. The TMC data included bicycle and pedestrian counts. The peak hours within the study area were established as 8:00 AM to 9:00 AM during the morning period, and 2:30 PM to 3:30 PM during the afternoon period. Note, as part of this study, TMC data was only collected at the five main intersections; Concord Street at Front Street and Fountain Street; Concord Street at Fisk Street (unsignalized); Concord Street at Raymond Marchetti Street (unsignalized); Concord Street at Front Street (unsignalized); and Raymond Marchetti Street at Myrtle Street (unsignalized). Since data was not collected at the Raymond Marchetti Street intersection with Alfred Road, Nitsch used the Institute of Transportation Engineers' (ITE) publication *Trip Generation, 10th Edition* (Land Use Code 210: Single-Family detached Housing) to estimate the vehicle trip rates for Alfred Road approache to the intersections.

4.2 Seasonal Adjustment

Nitsch Engineering used the MassDOT 2017 Weekday Seasonal Adjustment Factors to establish if the traffic counts needed to be seasonally adjusted. The composition of the study area falls within "Group U4-7 Urban

Arterials". Counts within Group U4-7 collected during the month of April are approximately 4% higher than average counted volumes. Therefore, no seasonal adjustment factors were applied.

4.3 COVID-19 Adjustment

Since early 2020, the COVID-19 pandemic has caused the State of Massachusetts to close most businesses, schools, retail stores, and restaurants, therefore significantly altering daily traffic operations. Specific to this project, the operation at Mindess Elementary School was hybrid.

In April 2020, MassDOT published a new Engineering Directive E-20-005, to provide guidance on how to estimate existing and future traffic counts due to traffic counts taken after March 13, 2020 which may undercount the baseline for which future years are based. Because of this, it is widely accepted to use 2019 data for baseline. Since our TMC data was collected during the pandemic, the traffic volumes were adjusted to better represent the baseline.

To do so, Nitsch Engineering used the 2019 volumes from preliminary Transportation Impact Report associated with the feasibility study for the Proposed Mindess Elementary School (December 5, 2019) to compare the 2019 hourly ATR data collected in November 2019 with the hourly ATR data collected in April 2021 to make the appropriate TMC volume adjustments and calculate the background traffic growth. Table 4 presents the daily traffic volume comparison.

Table 4 – Daily Traffic Volume Comparison

Time	2019	2021 COVID	Net Change
12:00 AM - 1:00 AM	2	1	-50%
1:00 AM - 2:00 AM	1	0	-100%
2:00 AM - 3:00 AM	0	0	0%
3:00 AM - 4:00 AM	4	0	-100%
4:00 AM - 5:00 AM	4	2	-50%
5:00 AM - 6:00 AM	22	15	-32%
6:00 AM - 7:00 AM	54	33	-39%
7:00 AM - 8:00 AM	301	252	-16%
8:00 AM - 9:00 AM	107	119	11%
9:00 AM - 10:00 AM	54	36	-33%
10:00 AM - 11:00 AM	34	38	12%
11:00 AM - 12:00 PM	46	30	-35%
12:00 PM - 1:00 PM	41	43	5%
1:00 PM - 2:00 PM	72	106	47%
2:00 PM - 3:00 PM	150	181	21%
3:00 PM - 4:00 PM	92	68	-26%
4:00 PM - 5:00 PM	116	94	-19%
5:00 PM - 6:00 PM	152	109	-28%
6:00 PM - 7:00 PM	83	64	-23%
7:00 PM - 8:00 PM	65	45	-31%
8:00 PM - 9:00 PM	28	23	-18%
9:00 PM - 10:00 PM	22	21	-5%
10:00 PM - 11:00 PM	12	8	-33%
11:00 PM - 12:00 AM	8	2	-50%
Daily	1,470	1,290	-12%
School peak hour			

Comparing the 2019 hourly ATR data with the hourly ATR from the traffic count data for this project, ATR volumes have decreased by approximately 16% during the School morning peak hour and increased by approximately 21% during the School afternoon peak hour. As a conservative measure for our analysis, we used the 16% growth along the adjacent roadways to estimate the base morning traffic volumes. Similarly, to present conservative traffic volumes in this study, Nitsch Engineering made no reduction to the afternoon counted volumes. The adjusted 2021 Existing Traffic Volumes are shown in Figure 3.

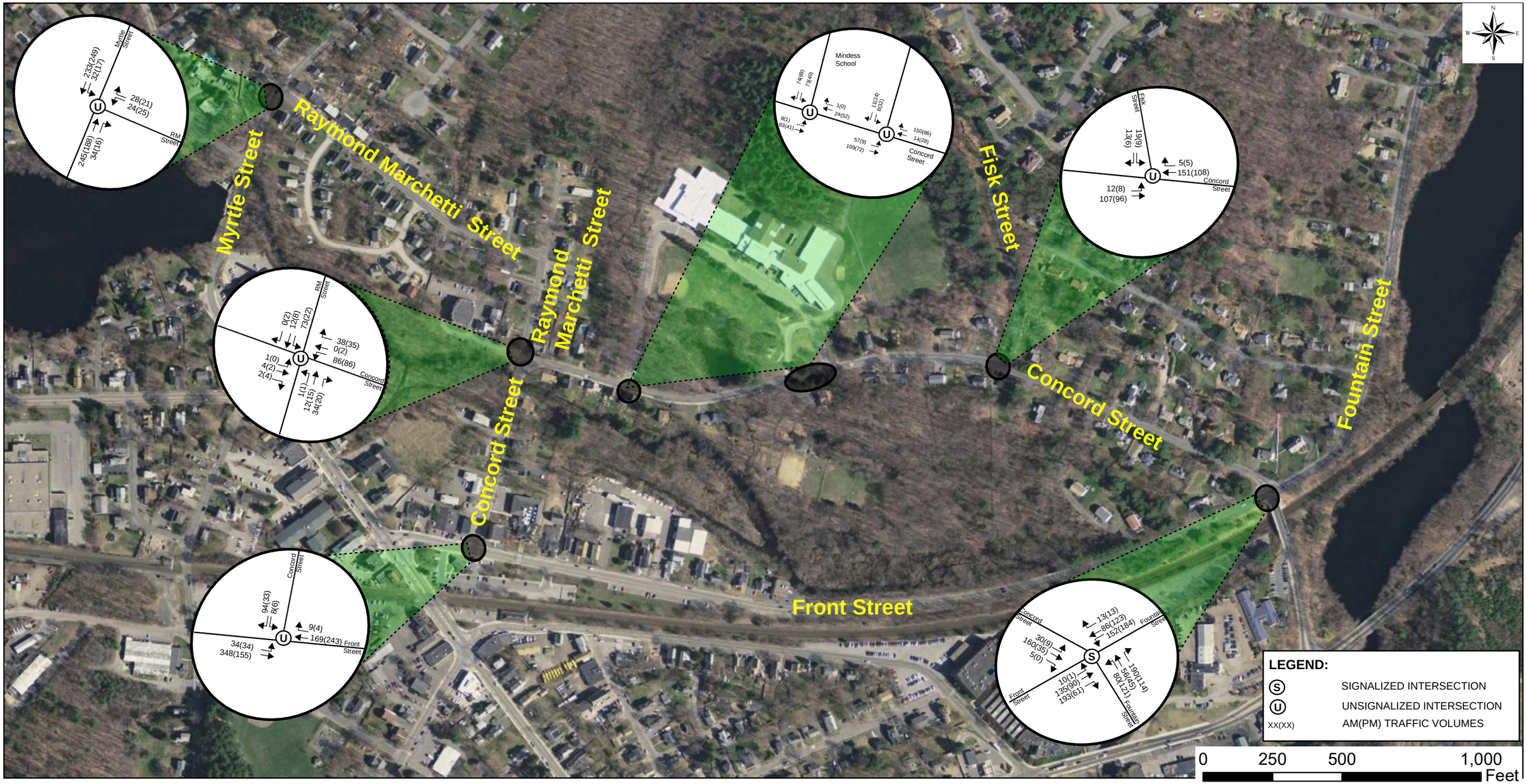

Figure 3: 2021 Existing Peak Hour Volumes

Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

Nitsch Engineering

5 Safety Analysis

5.1 Crash Data

As part of the safety analysis, it is recommended to summarize the crash data for the five most recent "closed" years. To date, 2020 is the latest year for which the crash data is finalized (closed) therefore crash data from MassDOT from 2016 to 2020 was collected and reviewed for the study area intersections. The total crashes, severity, manner of collision, and percentage that occurred during peak hours and/or wet/icy weather conditions for each intersection are presented in Table 5 – Crash Summary. A copy of the crash data is included in the Appendix.

Table 5 - Crash Summary

Location	Number of Crashes			Severity				Manner of Collision					Percent During	
	Year	Total Crashes	Avg	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
Concord St. at Front St. and Fountain St.	2016	2	2.0	2	0	0	0	1	0	0	1	0	0%	0%
	2017	5		3	2	0	0	3	1	1	0	0	60%	40%
	2018	1		1	0	0	0	0	0	0	1	0	0%	0%
	2019	1		1	0	0	0	1	0	0	0	0	0%	0%
	2020	1		1	0	0	0	0	0	0	1	0	100%	0%
	Total	***10***		***8***	***2***	***0***	***0***	***5***	***1***	***1***	***3***	***0***	***40%***	***10%***
Concord St. at Fisk St.	2016	0	0.0	0	0	0	0	0	0	0	0	0	0%	0%
	2017	0		0	0	0	0	0	0	0	0	0	0%	0%
	2018	0		0	0	0	0	0	0	0	0	0	0%	0%
	2019	0		0	0	0	0	0	0	0	0	0	0%	0%
	2020	0		0	0	0	0	0	0	0	0	0	0%	0%
	Total	***0***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0%***	***0%***
Concord St. at School Driveways	2016	0	0.0	0	0	0	0	0	0	0	0	0	0%	0%
	2017	0		0	0	0	0	0	0	0	0	0	0%	0%
	2018	0		0	0	0	0	0	0	0	0	0	0%	0%
	2019	0		0	0	0	0	0	0	0	0	0	0%	0%
	2020	0		0	0	0	0	0	0	0	0	0	0%	0%
	Total	***0***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0%***	***0%***
Concord St. at Raymond Marchetti St.	2016	0	0.0	0	0	0	0	0	0	0	0	0	0%	0%
	2017	0		0	0	0	0	0	0	0	0	0	0%	0%
	2018	0		0	0	0	0	0	0	0	0	0	0%	0%
	2019	0		0	0	0	0	0	0	0	0	0	0%	0%
	2020	0		0	0	0	0	0	0	0	0	0	0%	0%
	Total	***0***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0%***	***0%***
Concord St. at Front St.	2016	0	0.0	0	0	0	0	0	0	0	0	0	0%	0%
	2017	0		0	0	0	0	0	0	0	0	0	0%	0%
	2018	0		0	0	0	0	0	0	0	0	0	0%	0%
	2019	0		0	0	0	0	0	0	0	0	0	0%	0%
	2020	0		0	0	0	0	0	0	0	0	0	0%	0%
	Total	***0***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0%***	***0%***
	2016	0		0	0	0	0	0	0	0	0	0	0%	0%

Myrtle St. at Raymond Marchetti St.	2017	2	0.6	2	0	0	0	1	1	0	0	0	100%	0%
	2018	0		0	0	0	0	0	0	0	0	0	0%	0%
	2019	1		1	0	0	0	0	1	0	0	0	0%	0%
	2020	0		0	0	0	0	0	0	0	0	0	0%	0%
	Total	***3***		***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***67%***	***0%***
Total	**ALL**	**13**		**11**	**2**	**0**	**0**	**6**	**3**	**1**	**3**	**0**	**46%**	**31%**

[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

A total of 13 crashes were reported for the study area intersections. In terms of severity, 11 reported property damage and two reported personal injury. In terms of the type of collision, six reported an angle collision, three were rear-end collisions, one was head on, and another three were reported as other (single vehicle crash). none of the reported crashes included a bicycle or a pedestrian. 31% of the collisions occurred during wet/icy conditions and 46% of the collisions occurred during peak traffic hours of 7:00-9:00AM or 4:00-6:00PM. Analyzing the crash data, as the crashes were of angle, rear-end or sideswipe type, the crashes were most likely caused by driver carelessness or inattentiveness.

5.2 Intersection Crash Rates

The intersection crash rate is recognized as an effective tool to measure the safety of intersections. For intersections, crash rates are expressed by the number of crashes per million entering vehicles (MEV). As of June 26, 2018, the average statewide crash rate for unsignalized intersections is 0.57 crashes per MEV and 0.78 crashes per MEV for signalized intersections. For District 3, which includes the Town of Ashland, the rate for unsignalized intersections is 0.61 crashes per MEV and 0.89 crashes per MEV for signalized intersections. As shown in Table 6 – All study Intersections are below both Statewide and Districtwide averages. Crash rate worksheets can be found in Appendix A-3.

Table 6 - Crash Rate Summary

Location	Control	Total Crashes	Crash Rate[c]	Compared to Average[d]		Compared to Average[d]	
				Statewide	District 3	Statewide	District 3
Concord St. at Front St. and Fountain St.	Signalized	10	0.46	0.78	0.89	Below	Below
Concord St. at Fisk St.	Unsignalized	0	0.0	0.57	0.61	Below	Below
Concord St. at School driveways	Unsignalized	0	0.0	0.57	0.61	Below	Below
Concord St. at Raymond Marchetti St.	Unsignalized	0	0.0	0.57	0.61	Below	Below
Concord St. at Front St.	Unsignalized	0	0.0	0.57	0.61	Below	Below
Raymond Marchetti St. at Myrtle St.	Unsignalized	3	0.25	0.57	0.61	Below	Below

6 Future No-Build Traffic Conditions

Nitsch Engineering used the 2021 existing traffic volumes as the baseline for projecting traffic volumes to future 2028 No-Build conditions. To determine future 2028 conditions, the following steps are included:

- Project existing 2021 traffic volumes seven years in the future to the horizon year (2028) using an annual background traffic growth factor to account for regional growth.
- 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 traffic operations.

6.1 Background Growth

Nitsch Engineering used the data from the MassDOT TDMS portal at the nearest MassDOT count station #4021, located on Chestnut Street just south of West Union Street, to calculate the background traffic growth. The data indicates that Average Annual Daily Traffic (AADT) was recorded at:

- 6,700 vehicles in 2010;
- 6,832 vehicles in 2011;
- 6,836 vehicles in 2012;
- 6,723 vehicles in 2013;
- 6,931 vehicles in 2014;
- 7,090 vehicles in 2015;
- 7,158 vehicles in 2016;
- 7,280 vehicles in 2017;
- 7,302 vehicles in 2018; and
- 6,956 vehicles in 2019.

As shown, the traffic has been growing in this area at an average rate of approximately 0.3% per year. We used a conservative annual background traffic growth factor of 0.5%, which is also consistent with recent MassDOT projects in eastern Massachusetts. We also believe that any potential additional traffic as a result of planned developments and area roadway improvements will be accounted for within the 0.5% per-year background growth along the adjacent roadways.

6.2 2028 No-Build Traffic Volumes

The 2028 No-Build Traffic Volumes are shown in Figure 4 and are derived by applying the traffic growth rate of 0.5% per year over the seven-year design horizon to project the 2028 traffic volumes.

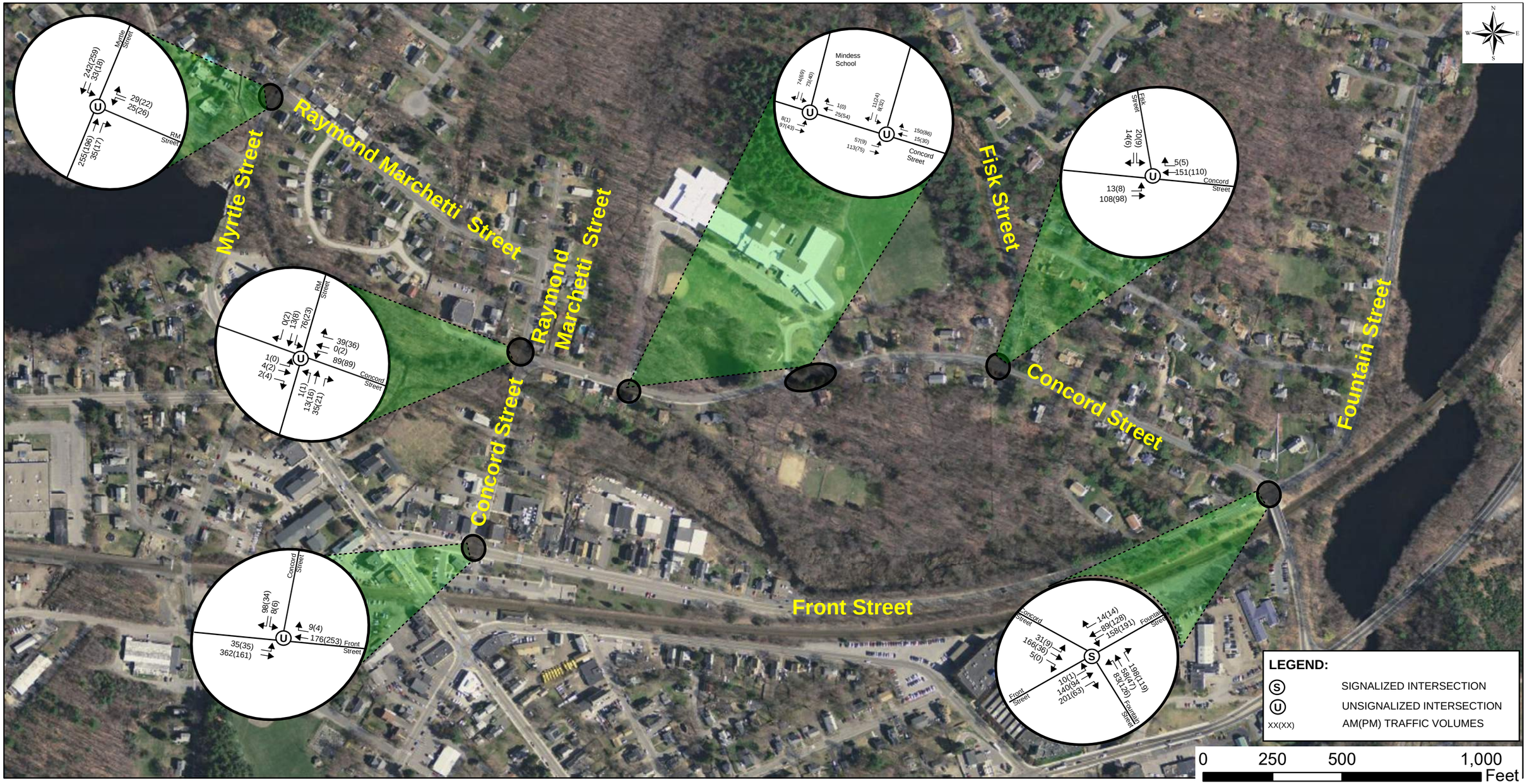

Figure 4: 2028 No-Build Peak Hour Volumes

Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

Nitsch Engineering

7 Proposed Future Conditions

We examined the feasibility of constructing a new 3-5 Grade Elementary School building on the existing Mindess Elementary School site for a projected population of 635 students.

7.1 Proposed Development

The site will be expanded to accommodate the additional trips generated by the school which may include additional busses, additional parent drop-off/pick-up, and additional faculty. Access to the site will be provided via two reconfigured existing driveways, one serving the designated bus loop, other serving the staff, visitors and parking lots and drop-off/pick-up locations. The bus pick-up/drop-off will occur at the designated bus loop accessed from the westerly driveway on Concord Street. A total of 253 parking spaces will be provided on-site, including four accessible parking stalls, which are expected to primarily serve faculty and visitors. Significant queuing capacity is proposed on-site so parents will be able to circulate through the site and park on the side of the drive aisles instead of utilizing the parking spaces temporarily and/or park along Concord Street.

7.2 Proposed Trip Generation

Information for the number of faculty and busses has not been provided as it is still being determined amongst the school system. Since the projected school population remains unchanged at 635 students, Nitsch Engineering used the Institute of Transportation Engineers' (ITE) publication *Trip Generation, 10th Edition* to estimate the vehicle trip rates for the proposed schools and establish the net trips by comparing the rates with the data collected in April 2021. These trips include parents, faculty, and busses. To remain conservative in our analysis, we used zero value for the negative net trips.

Trip generation rates for the elementary school were based on Land Use Code (LUC) 520 (Elementary School). The weekday morning drop-off and weekday afternoon pick-up trips are outlined in Table 7.

Table 7 - Existing and Proposed Trip Generation

Time	Mindess School		
	Existing with 647 Students	Redeveloped with 635 Students (ITE LUC 520)	Net Increase
Weekday Daily	-	1200	-
Entering	-	600	-
Exiting	-	600	-
Weekday Morning Peak	333	413	80
Entering	207	223	16
Exiting	126	190	64
Weekday Afternoon Peak	260	216	0
Entering	95	97	2
Exiting	165	119	0
*The additional trips shown represent the net trips between the existing COVID-19 trips and the future trips associated with the redevelopment			

As illustrated in Table 7, the proposed new school totaling 635 students would result in approximately 1,200 daily trips (600 trips in and 600 trips out), with 80 additional trips (16 trips in and 64 trips out) during the weekday morning drop-off time. However, no additional trips are expected during the weekday afternoon pick-up time except for 2 trips entering the school.

7.3 Trip Distribution and Assignment

The trips to/from the proposed school will be distributed and assigned based on the existing travel patterns and logical travel routes through the existing roadway network within the Town of Ashland. The Trip Distribution percentages specific to the proposed school are shown in Figure 5.

The resultant trip assignment volumes for the weekday morning and weekday afternoon peak hours were calculated by multiplying the trip distribution by the additional school-related trips from Table 7. The net trip assignment volumes are shown in Figure 6 for the weekday morning and the weekday afternoon peak hours.

7.4 Proposed 2028 Build Volumes

For the proposed school, the corresponding trip assignment volumes were balanced based on the proposed access and egress to the site and added to the 2028 No-Build Volumes to yield the 2028 Build Volumes. The 2028 Build Volumes are shown in Figure 7.

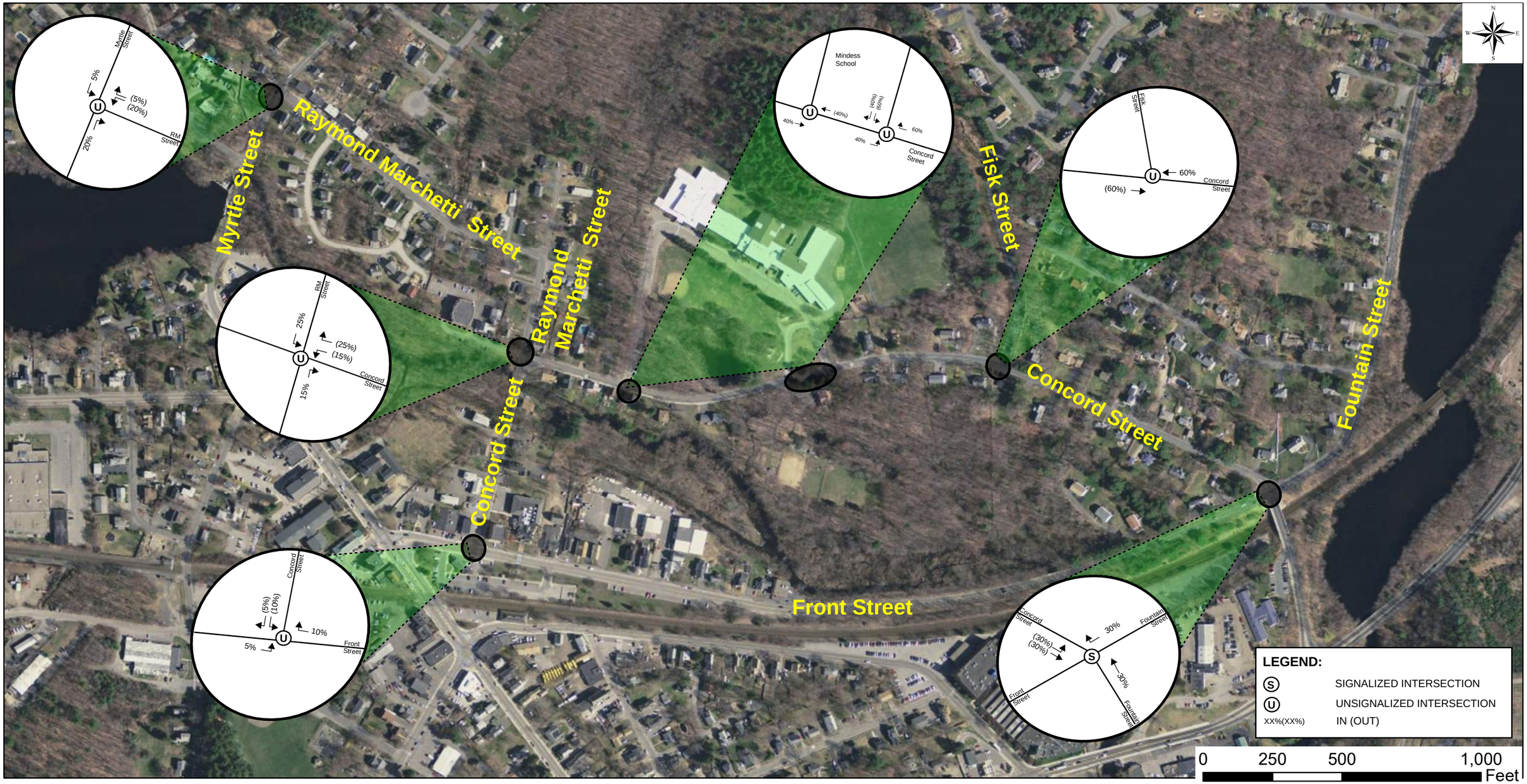

Figure 5: Trip Distribution

Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

Nitsch Engineering

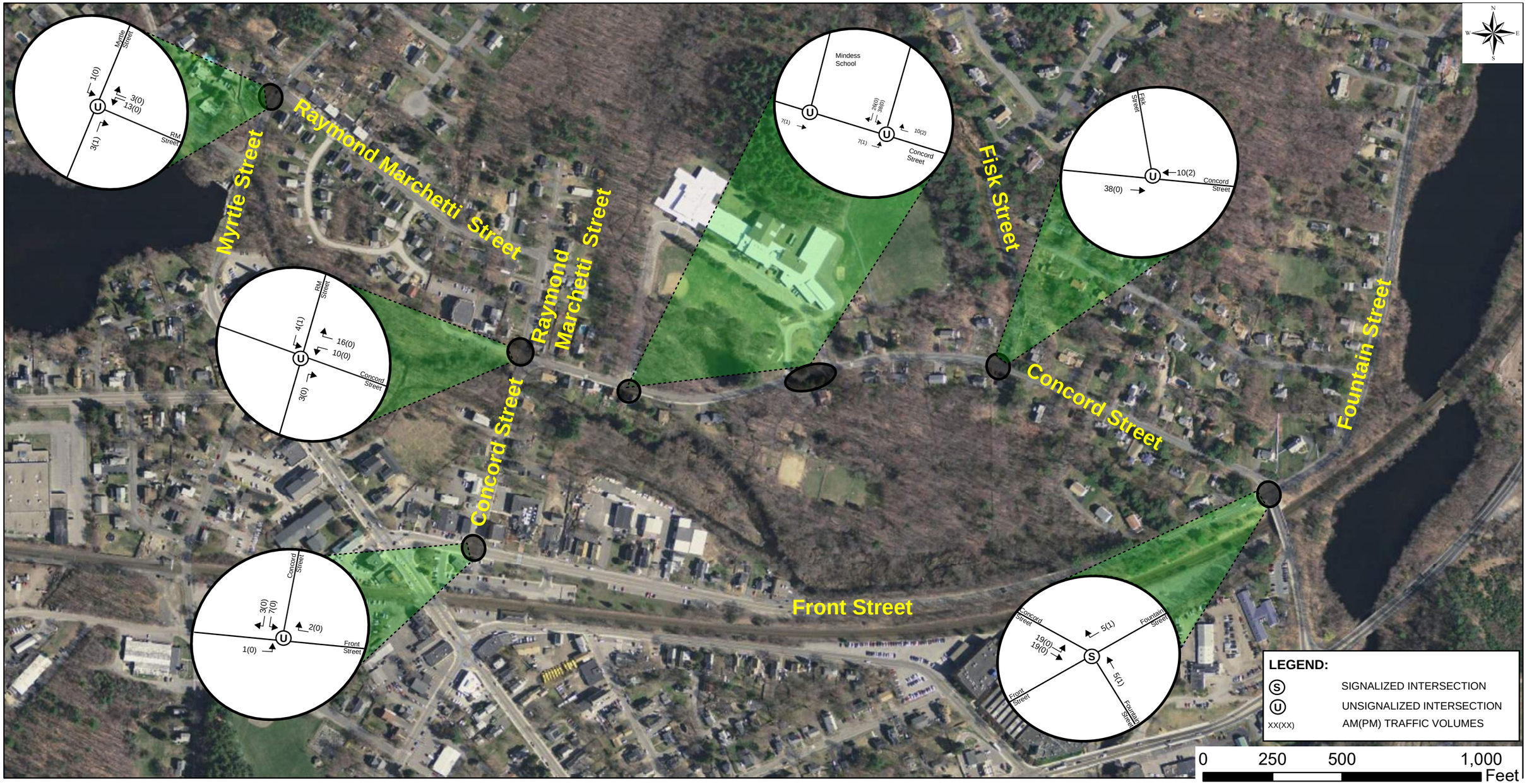

Figure 6: Trip Assignment

Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

Nitsch Engineering

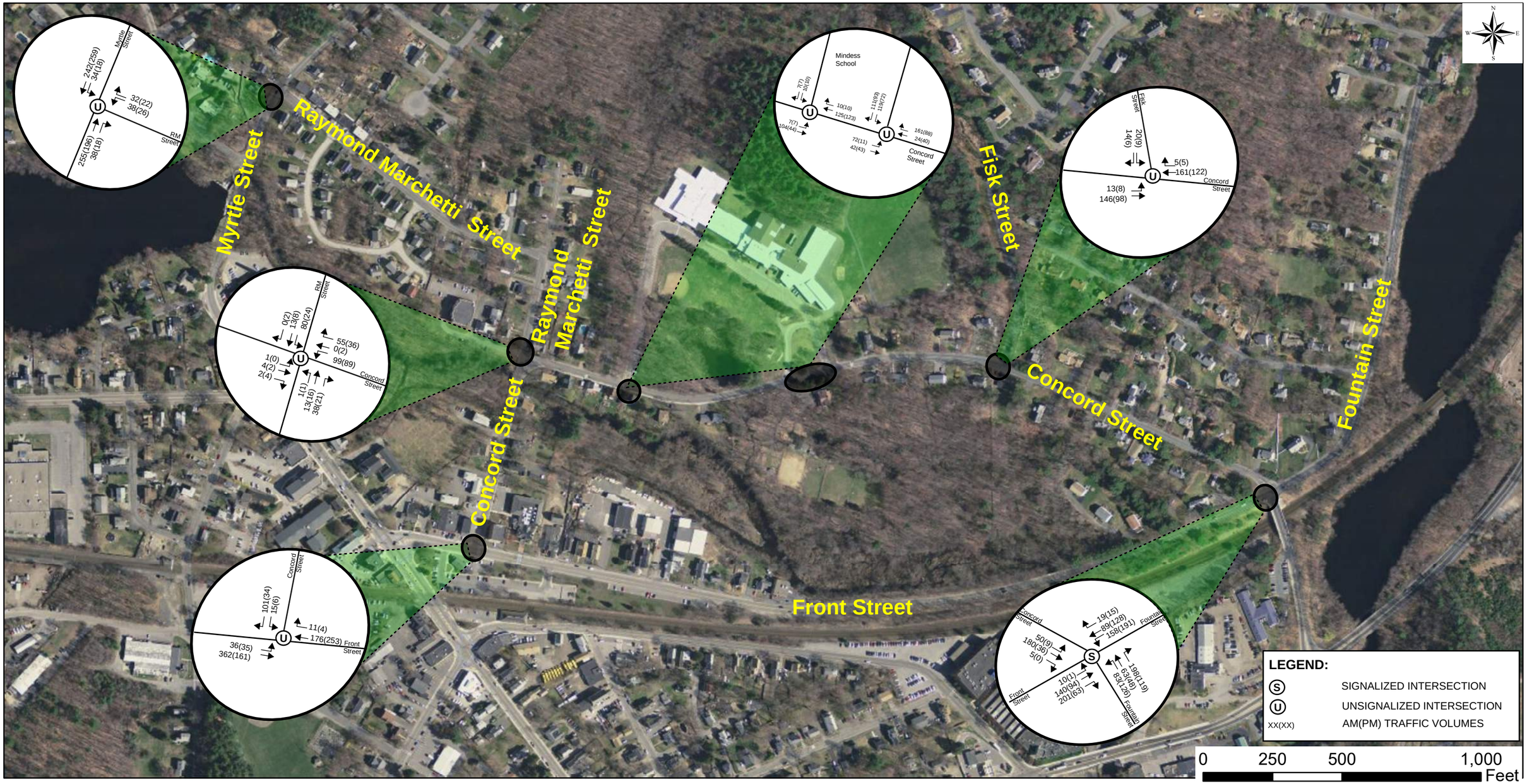

Figure 7: 2028 Build Peak Hour Volumes

Mindess Elementary School
Ashland, MA

Data Source: MassGIS
Nitsch Project #13609.1

Nitsch Engineering

7.5 Parking Generation and Adequacy

Nitsch Engineering used the Institute of Transportation Engineers' (ITE) publication *Parking Generation Manual, 5th Edition* to estimate the parking demand for the proposed development. Parking generation rates for the proposed school were based on Land Use Code (LUC) 520 (Elementary School). The calculated parking demand for the new school with projected student population of 635 students is 83 spaces.

The School parking lot, when complete, will provide 252 striped parking spaces that include 8 accessible spaces. This number exceeds the 83 parking spaces recommended by the Institute of Transportation Engineers (ITE) Parking Generation for LUC 520. The curb at the car loop is approximately 1,400 linear feet, which can accommodate an additional 75 vehicles.

Table 8 - Proposed Parking Summary

Parking Spaces Provided	Parking Spaces Required by ITE Parking Generation for LUC 520
252 Striped (8 Accessible)	83
75 Live Drop-Off	

8 Traffic Operations

8.1 Evaluation Criteria

Traffic operations at intersections are evaluated using the performance measures of average vehicular delay, level of service (LOS), volume-to-capacity (v/c) ratio, and average and 95th percentile queue lengths.

LOS is a qualitative measure that describes operating conditions through letter designations, from A to F. It is defined for intersections in terms of average control delay per vehicle. LOS A indicates the most favorable condition, with minimum traffic delay. LOS F represents the worst condition where there is significant traffic delay. LOS D or better is typically considered desirable for peak-hour operation in urban and suburban settings. The delay designations for each LOS level differ slightly between signalized and unsignalized intersections due to driver expectations and behavior. Table summarizes the LOS criteria for intersections as used in this analysis.

Table 9 - Intersection Level of Service Criteria

Level of Service	Average Control Delay (sec/veh)	
	Signalized	Unsignalized
A	0-10	0-10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50
Source: HCM 2000		

For signalized intersections, LOS is reported by lane group, by approach, and for the entire intersection. For unsignalized intersections, the analysis assumes that the traffic on the mainline is not affected by traffic on the side street. As such, an unsignalized intersection's LOS is generally reported for left-turns on the mainline and all side street movements, and an overall intersection LOS is not determined.

The v/c ratio is a measure of congestion at an intersection approach. The capacity of a facility is the maximum hourly rate at which persons or vehicles reasonably can be expected to traverse a point or a uniform section of a lane or roadway under prevailing roadway, traffic, and control conditions. A v/c ratio below one indicates that the intersection approach has adequate capacity to serve the arriving traffic demand. A v/c ratio that approaches or exceeds 1.0 indicates traffic congestion or poor operating conditions. In that situation, vehicles arrive faster than they can be served, so queue lengths can theoretically grow indefinitely, which is the unstable condition.

Since arrival volumes fluctuate throughout the peak hour, queue lengths vary. The average (50th percentile) queue length represents the maximum back of queue on a typical cycle for a signalized intersection. Average queue lengths are not reported for unsignalized intersections. The 95th percentile queue, reported for both signalized and unsignalized intersections, occurs with 95th percentile traffic volumes, and its length commonly denotes the farthest extent of the vehicle queue.

8.2 Capacity Analyses

Nitsch Engineering performed traffic analyses to evaluate traffic operations for the 2021 Existing Conditions, 2028 No-Build Conditions, and 2028 Build Conditions during the weekday morning and weekday afternoon peak hours at the study intersections using Trafficware's Synchro 10 software. Synchro uses, in part, the traffic operational analysis methodology of the Transportation Research Board's *Highway Capacity Manual* (HCM).[1] We generated the results of the capacity analyses using Synchro's Percentile Delay Method for delay, v/c ratio, and queue lengths, supported by HCM 2000 methodology for unsignalized intersection analysis. The Synchro output sheets for the capacity analyses are included in Appendix A-4.

8.3 2021 Existing Capacity Analysis

Nitsch Engineering analyzed the 2021 Existing Conditions traffic operations at the study intersections based on the existing traffic counts performed by PDI in April 2021. The Level of Service Summary is shown in Table 10.

[1] *Highway Capacity Manual 2000 (HCM 2000)*, Transportation Research Board, Washington, D.C., 2000.

Table 10 - Capacity Analysis Summary: 2021 Existing Conditions

Location	Direction / Movement[a]	Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
		v/c Ratio[b]	Delay[c]	LOS	Queue[d] 50th	Queue[d] 95th	v/c Ratio[b]	Delay[c]	LOS	Queue[d] 50th	Queue[d] 95th
Concord St. at Front St. and Fountain St. *[signalized]*	Front St. EB - LTR	0.96	32.1	C	203	469	0.26	7.4	A	21	58
	Fountain St. WB - LTR	1.13	115.5	F	151	225	0.76	23.4	C	104	156
	Fountain St. NB – LTR	0.85	29.1	C	121	52	0.78	25.5	C	99	136
	Concord St. SB - LTR	0.69	24.4	C	100	100	0.12	12.3	B	14	27
	Total	1.13	43.5	D			0.78	20.7	C		
Concord St. at Fiske St. *[unsignalized]*	Concord St. EB - TR	0.03	1.3	A		2	0.01	0.5	A		1
	Concord St. WB - LT	0.29	0.0	A		0	0.15	0.0	A		0
	Steven Ln. SB - LR	0.17	15.3	C		15	0.05	11.1	B		4
Concord St. at School Dr West *[unsignalized]*	Concord St. EB - TR	0.01	1.1	A		1	0.00	0.6	A		0
	Concord St. WB - LT	0.03	0.0	A		0	0.07	0.0	A		0
	School Dr. SB - LR	0.57	14.7	B		93	0.25	10.6	B		24
Concord St. at School Dr East *[unsignalized]*	Concord St. EB - TR	0.11	3.3	A		9	0.01	1.0	A		1
	Concord St. WB - LT	0.28	0.0	A		0	0.19	0.0	A		0
	School Dr. SB - LR	0.10	12.9	B		8	0.09	10.1	B		7
Concord St. at Raymond Marchetti St. *[unsignalized]*	Concord Ct. EB - LTR	0.03	12.0	B		2	0.01	8.9	A		1
	Concord St. WB - LTR	0.63	21.3	C		110	0.29	10.8	B		30
	Concord St. NB - LTR	0.00	0.4	A		0	0.00	0.6	A		0
	R Marchetti SB- LTR	0.11	6.9	A		9	0.02	4.4	A		1
Concord St. at Front St. *[unsignalized]*	Front St. EB - TR	0.03	0.9	A		3	0.05	2.4	A		4
	Front St. WB - LT	0.15	0.0	A		0	0.21	0.0	A		0
	Concord St. SB - LR	0.19	11.6	B		17	0.09	11.7	B		7
Myrtle St. at Raymond Marchetti St. *[unsignalized*	Myrtle St. NB - LTR	0.20	0.0	A		0	0.14	0.0	A		0
	Myrtle St. SB -LT	0.05	1.8	A		4	0.02	0.8	A		1
	R Marchetti WB- LTR	0.15	13.8	B		13	0.12	11.3	B		10

[a] Direction: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound; Movement: L = Left-turn, T = Through movement, R = Right-turn
[b] Overall v/c ratio is the maximum v/c ratio among lane groups
[c] Average vehicle delay (seconds)
[d] 50th and 95th percentile queue lengths (feet) based upon average vehicle length of 25 feet
~ Volume exceeds capacity, queue is theoretically infinite; queue shown is maximum after two cycles
# 95th percentile volume exceeds capacity, queue may be longer; queue shown is maximum after two cycles

Under 2021 Existing conditions, the signalized intersection of Concord Street at Front Street and Fountain Street operates at LOS D in the morning peak hour and at LOS C in the afternoon peak hour. The Fountain Street westbound approach operates at LOS F in the morning peak hour and at LOS C in the afternoon peak hour. The remaining lane groups at the intersection operate at LOS C or better in both the morning and afternoon peak hours.

All of the approaches at the remaining unsignalized intersections operate at LOS C or better and the approaches at these intersections are experiencing minimal queueing.

8.4 2028 No-Build Capacity Analysis

Nitsch Engineering analyzed the 2028 No-Build Conditions traffic operations at the study intersections. The 2028 No-Build Condition represents the 2021 Existing Conditions and projects a traffic increase at the rate of 0.5% per year between 2021 and 2028. The Level of Service Summary is shown in Table 11.

Table 11 - Capacity Analysis Summary: 2028 No-Build Conditions

Location	Direction / Movement[a]	Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
		v/c Ratio[b]	Delay[c]	LOS	Queue[d] 50th	Queue[d] 95th	v/c Ratio[b]	Delay[c]	LOS	Queue[d] 50th	Queue[d] 95th
Concord St. at Front St. and Fountain St. *[signalized]*	Front St. EB - LTR	1.00	42.3	D	274	501	0.27	7.7	A	25	60
	Fountain St. WB - LTR	1.30	181.3	F	180	247	0.78	25.4	C	120	165
	Fountain St. NB – LTR	0.86	30.8	C	129	55	0.80	27.6	C	115	143
	Concord St. SB - LTR	0.70	24.7	C	105	104	0.12	12.4	B	15	27
	Total	1.30	59.3	E			0.80	22.3	C		
Concord St. at Fiske St. *[unsignalized]*	Concord St. EB - TR	0.03	1.3	A		2	0.01	0.5	A		1
	Concord St. WB - LT	0.29	0.0	A		0	0.15	0.0	A		0
	Steven Ln. SB - LR	0.18	15.4	C		16	0.05	11.2	B		4
Concord St. at School Dr West *[unsignalized]*	Concord St. EB - TR	0.01	1.1	A		1	0.00	0.6	A		0
	Concord St. WB - LT	0.03	0.0	A		0	0.07	0.0	A		0
	School Dr. SB - LR	0.58	14.8	B		94	0.25	10.7	B		25
Concord St. at School Dr East *[unsignalized]*	Concord St. EB - TR	0.11	3.3	A		9	0.01	1.0	A		1
	Concord St. WB - LT	0.28	0.0	A		0	0.19	0.0	A		0
	School Dr. SB - LR	0.10	13.0	B		8	0.09	10.2	B		7
Concord St. at Raymond Marchetti St. *[unsignalized]*	Concord Ct. EB - LTR	0.03	12.2	B		2	0.01	8.9	A		1
	Concord St. WB - LTR	0.67	23.5	C		126	0.30	10.9	B		32
	Concord St. NB - LTR	0.00	0.4	A		0	0.00	0.6	A		0
	R Marchetti SB- LTR	0.11	6.9	A		9	0.02	4.5	A		1
Concord St. at Front St. *[unsignalized]*	Front St. EB - TR	0.03	0.9	A		3	0.05	2.4	A		4
	Front St. WB - LT	0.16	0.0	A		0	0.22	0.0	A		0
	Concord St. SB - LR	0.20	11.8	B		18	0.09	11.9	B		7
Myrtle St. at Raymond Marchetti St. *[unsignalized*	Myrtle St. NB - LTR	0.21	0.0	A		0	0.14	0.0	A		0
	Myrtle St. SB -LT	0.05	1.8	A		4	0.02	0.8	A		1
	R Marchetti WB- LTR	0.16	14.2	B		15	0.13	11.4	B		11

[a] Direction: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound; Movement: L = Left-turn, T = Through movement, R = Right-turn
[b] Overall v/c ratio is the maximum v/c ratio among lane groups
[c] Average vehicle delay (seconds)
[d] 50th and 95th percentile queue lengths (feet) based upon average vehicle length of 25 feet
~ Volume exceeds capacity, queue is theoretically infinite; queue shown is maximum after two cycles
# 95th percentile volume exceeds capacity, queue may be longer; queue shown is maximum after two cycles

Under 2028 No-Build conditions, v/c ratios and delays at the intersection of Concord Street at Front Street and Fountain Street are expected to increase from 2021 Existing conditions. the intersection will operate at LOS E in the morning peak hour and at LOS C in the afternoon peak hour. The Fountain Street westbound approach will continue to operate at LOS F in the morning peak hour and at LOS C in the afternoon peak hour. The remaining lane groups at the intersection will continue to operate at LOS C or better in both the morning and afternoon peak hours.

All of the approaches at the remaining unsignalized intersections will continue to operate at LOS C or better and the approaches at these intersections will experience minimal queueing.

8.5 2028 Build Capacity Analysis

Nitsch Engineering analyzed the 2028 Build Conditions traffic operations at the study intersections for the proposed school. The 2028 Build Conditions represent the 2028 No-Build Conditions traffic volumes in addition to the proposed school net volumes. The Level of Service Summary is shown in Table 12.

Table 12 - Capacity Analysis Summary: 2028 Build Conditions

Location	Direction / Movement[a]	Weekday Morning Peak Hour					Weekday Afternoon Peak Hour				
		v/c Ratio[b]	Delay[c]	LOS	Queue[d] 50th	Queue[d] 95th	v/c Ratio[b]	Delay[c]	LOS	Queue[d] 50th	Queue[d] 95th
Concord St. at Front St. and Fountain St. *[signalized]*	Front St. EB - LTR	1.02	46.7	D	336	501	0.27	7.7	A	25	60
	Fountain St. WB - LTR	1.39	218.2	F	200	258	0.79	25.7	C	122	166
	Fountain St. NB – LTR	0.86	31.5	C	138	58	0.80	27.6	C	117	144
	Concord St. SB - LTR	0.88	40.7	D	137	130	0.12	12.4	B	15	27
	Total	1.39	69.8	E			0.80	22.4	C		
Concord St. at Fiske St. *[unsignalized]*	Concord St. EB - TR	0.03	1.1	A		2	0.01	0.5	A		1
	Concord St. WB - LT	0.31	0.0	A		0	0.17	0.0	A		0
	Steven Ln. SB - LR	0.20	17.1	C		18	0.05	11.4	B		4
Concord St. at School Dr West *[unsignalized]*	Concord St. EB - TR	0.01	1.0	A		1	0.02	2.9	A		2
	Concord St. WB - LT	0.15	0.0	A		0	0.18	0.0	A		0
	School Dr. SB - LR	0.09	11.2	B		7	0.06	11.2	B		5
Concord St. at School Dr East *[unsignalized]*	Concord St. EB - TR	0.14	5.9	A		12	0.02	1.8	A		1
	Concord St. WB - LT	0.31	0.0	A		0	0.20	0.0	A		0
	School Dr. SB - L	0.84	50.0	E		188	0.36	13.4	B		41
	School Dr. SB - R	0.38	12.7	B		45	0.42	12.4	B		53
Concord St. at Raymond Marchetti St. *[unsignalized]*	Concord Ct. EB - LTR	0.03	12.6	B		3	0.01	8.9	A		1
	Concord St. WB - LTR	0.80	31.9	D		191	0.30	11.0	B		32
	Concord St. NB - LTR	0.00	0.4	A		0	0.00	0.6	A		0
	R Marchetti SB- LTR	0.12	7.0	A		0	0.02	4.6	A		1
Concord St. at Front St. *[unsignalized]*	Front St. EB - TR	0.03	1.0	A		3	0.05	2.4	A		4
	Front St. WB - LT	0.16	0.0	A		0	0.22	0.0	A		0
	Concord St. SB - LR	0.24	12.9	B		24	0.09	11.9	B		8
Myrtle St. at Raymond Marchetti St. *[unsignalized*	Myrtle St. NB - LTR	0.22	0.0	A		0	0.14	0.0	A		0
	Myrtle St. SB -LT	0.05	1.9	A		4	0.02	0.8	A		1
	R Marchetti WB- LTR	0.23	15.6	C		22	0.13	11.5	B		11

[a] Direction: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound;
Movement: L = Left-turn, T = Through movement, R = Right-turn
[b] Overall v/c ratio is the maximum v/c ratio among lane groups
[c] Average vehicle delay (seconds)
[d] 50th and 95th percentile queue lengths (feet) based upon average vehicle length of 25 feet
~ Volume exceeds capacity, queue is theoretically infinite; queue shown is maximum after two cycles
# 95th percentile volume exceeds capacity, queue may be longer; queue shown is maximum after two cycles

Under 2028 Build conditions, v/c ratios and delays at the intersection of Concord Street at Front Street and Fountain Street are expected to increase from 2021 Existing conditions. the intersection will operate at LOS E in the morning

peak hour and at LOS C in the afternoon peak hour. The Fountain Street westbound approach will continue to operate at LOS F in the morning peak hour and at LOS C in the afternoon peak hour. The remaining lane groups at the intersection will continue to operate at LOS C or better in both the morning and afternoon peak hours.

At the reconfigured new intersection of Concord Street and School East Driveway, the School Driveway dedicated left-turn approach will operate at LOS E in the morning. This will be only for a period of approximately one hour, after which the traffic conditions return to normal. The approach will operate at LOS B in the afternoon peak hours. The remaining lane groups at the intersection will operate at LOS B or better in both the morning and afternoon peak hours.

All of the approaches at the remaining unsignalized intersections will continue to operate at LOS B or better and the approaches at these intersections are experiencing minimal queueing.

9 Sight Distance

Stopping Sight Distance (SSD) is the length of the roadway ahead that is visible to the driver and should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path. Stopping sight distance is the sum of the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the brakes are applied, and the distance needed to stop the vehicle from the instant brake application begins.

Intersection Sight Distance (ISD) is the length of the leg of the departure sight triangle along the major road in both directions for a vehicle stopped on the minor road waiting to depart. The critical departure sight triangles for the new school driveways are for traffic approaching from either the left or right for left turns from the driveways onto Concord Street. The methods for determining the sight distances needed by drivers approaching intersections are based on the same principles as stopping sight distance, but incorporate modified assumptions based on observed driver behavior at intersections.

The SSD and ISD values associated with a given design speed are shown in Table 13. The sight distance evaluations for the intersection are shown in Table 14.

Table 13 - Sight Distance Criteria

Design Speed (MPH)	**Design Stopping Sight Distance Value[1] (SSD)** (FT)	**Recommended Intersection Sight Distance Value[2] (ISD)** (FT)
15	80	170
20	115	225
25	155	280
30	200	335
35	250	390
40	305	445
45	360	500
50	425	555
55	495	610
60	570	665
65	645	720
70	730	775
75	820	830
80	910	885
Source: *A Policy on Geometric Design of Highways and Streets, AASHTO, Washington DC (2011)*		
[1]Design value based on a grade of less than 3%, a brake reaction distance predicted on a time of 2.5 seconds and a deceleration rate of 11.2 ft/s^2		
[2]Recommended value based on Case B1 - a stopped passenger car to turn left onto a two-lane highway with no median and grades 3% or less		

The posted speed limit for Concord Street at the project site is 20 MPH because of the School Zone, with the 85th percentile speeds of 38 MPH at both the eastbound and the westbound directions. To be conservative, we used the 85th percentile speeds for the sight distance analysis.

Table 14 - Proposed Sight Distance Evaluation

Intersection	Posted Speed (MPH)	85th Speed (MPH)	Minimum (FEET)[1,2]	Measured (FEET)	Obstruction
Concord Street at the School Driveway					
Stopping Sight Distance:					
Concord Street Eastbound	20	38	283	450	
Concord Street Westbound	20	38	283	430	
Intersection Sight Distance:					
Looking to the right from Driveway	20	38	423	>450	
Looking to the left from Driveway	20	38	423	>430	

Source: A Policy on Geometric Design of Highways and Streets, AASHTO, Washington DC (2011)
[1] Table 3-1. Stopping Sight Distance on Level Roadways
[2] Table 9-6. Design Intersection Sight Distance - Case B1, Left Turn from Stop

As shown in Table 14 both SSD and ISD values at the new school driveway exceed the minimum values.

10 Conclusions and Recommendations

10.1 Conclusions

Nitsch Engineering has been retained by Flansburgh Architects t to prepare a Traffic Impact Study (TIS) based on the schematic design for the new Mindess Elementary School proposed to be constructed on the existing Mindess Elementary School grounds located at 90 Concord Street in Ashland.

We studied five intersections, one signalized and four unsignalized, to establish the impact the larger school with additional enrollment would have on intersection traffic operations.

We examined the build condition with respect to the projected student enrollment at the proposed school. We anticipate that the following summarizes the vehicular circulation at the school during morning drop-off and afternoon pick-up periods:

- During the morning drop-off, 223 vehicles (parents and staff) will arrive via east driveway on Concord Street between 7:00 AM and 8:00 AM to drop-off their students. The children will be dropped-off at the car loop, and the vehicles will exit to Concord Street. Our analysis indicates that during the morning drop-off, the 95th Percentile Queue length exiting the School driveway for the left turns onto Concord Street will be 188 feet (approximately 10 vehicles), and for the right turns onto Concord Street will be 45 feet (approximately 3 vehicles). The 95th Percentile Queue length for the right-turns entering the School driveway from Concord Street westbound will be 12 feet (approximately 1 vehicles).
- During the afternoon pick-up, 97 vehicles will start arriving between 2:30 and 3:10pm. Once the parents have picked up their children, they will proceed to exit the parking lot via east driveway to Concord Street. Our analysis indicates that during the afternoon pick-up, the 95th Percentile Queue length exiting the School driveway for the left turns onto Concord Street will be 41 feet (approximately 3 vehicles), and for the right turns onto Concord Street will be 53 feet (approximately 3 vehicles). The 95th Percentile Queue length for the right-turns entering the School driveway from Concord Street westbound will be 1 foot (approximately 1 vehicles).
- The bus pick-up/drop-off will occur at the designated bus loop accessed from the west driveway on Concord Street.

Based on the capacity analysis for the proposed school, traffic operations at all the intersections will remain generally unchanged from No-Build conditions.

10.2 Mitigation Measures

Based on the proposed new Mindess School, as well as coordination with the Town and the MSBA Nitsch Engineering offers the following recommendations:

- Continue designating Concord Street as a School Zone under State and local statute and install the appropriate School Zone signs.
- Enhance pedestrian experience along Concord Street by considering improvements to the existing sidewalk on north side and accessible ramps where needed to accommodate children walking to school and Safe Route to School; and providing advanced school warning signage for entering and exiting traffic.
- Reach out to parents via social media to increase safety awareness.

10.3 Mitigation Strategies and Ongoing Coordination

MassDOT has a Safe Routes to School program (Federally funded initiative by DOT) that can assist in funding infrastructure improvements tied to the School. The Program's objective is to increase safe biking and walking among elementary and middle school students. It uses a collaborative, community-focused approach that bridges the gap between health and transportation. Types of projects that can be funded through the Program are: Sidewalk improvements, traffic calming improvements, pedestrian, and bicycle crossing improvements, on- and off-street bicycle facilities, secure bicycle parking facilities, and traffic diversion improvements.

Infrastructure improvements, such as roadway changes, sidewalks and other improvements can also be planned for and funded under other Town programs.