

TRAFFIC ACCESS AND IMPACT STUDY

**Slate Upper School
5100 Outer Ridge Road
North Haven, Connecticut**



**Prepared for:
Jennifer Staple-Clark**

November 2020

December 2, 2020

Ms. Jennifer Staple-Clark
Slate School
124 Mansfield Road,
North Haven, Connecticut 06473

Dear Ms. Staple-Clark:

We are pleased to submit this Traffic Report for your review and submission to the Town of North Haven as part of the Application for the proposed Upper School to be located at 5100 Outer Ridge Road in North Haven. This report is a supplemental report to a report prepared by your Traffic Consultant and submitted to the Town of North Haven. This second report is a separate analysis of existing and future traffic conditions at the proposed site. It also addresses School access considerations, traffic volumes, estimates for School traffic, School traffic distribution, accident history, potential impacts and recommendations for modifications to Outer Ridge Road to provide a uniformed pavement width along and near the site frontage.

A School of this type and size is estimated to generate a total of 192 and 137 vehicle trip ends during the weekday morning School arrival and weekday afternoon School departure time periods, respectively. This is based on a total of 100 students and 15 staff members arriving and departing during the School-related peak hour conditions. Estimates for School traffic are based on assumptions and a reference to trip generation rates provided by the Institute of Transportation Engineers (ITE) in a recent publication with a reference to a Private Schools and the breakdown of arrival and departure patterns for students and the number of students that may remain on-Campus at the end of the School day.

The increase in traffic volumes on Outer Ridge Road and nearby intersections will have an insignificant impact in overall operations along the site frontage since current traffic volumes along the site frontage are significantly low during peak periods, as it relates to School activity. Based on a review of the traffic volumes, completion of analyses indicating Level of Service "A" (indicating minimal to no delays) appropriate access can be provided to the School. The proposal is to construct a new driveway north of the southerly property line to Outer Ridge Road to serve all pick-up and drop-off activity, and staff and visitors parking on the Campus during the School day.

It is proposed that a minor widening of Outer Ridge Road be provided near the School Campus frontage to the immediate north at the northerly property line and immediately south of the southerly property line be provided an appropriate two-way traffic flow in a 24-foot wide paved travel way, which will provide one travel lane in each direction. A double yellow centerline will be maintained on

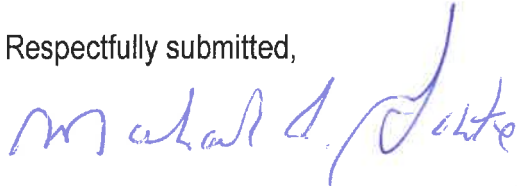
Ms. Jennifer Staple-Clark

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this roadway along the site frontage. Appropriate intersection sight distance (ISD) will be provided at the location of the proposed driveway, which meets standards followed by the Connecticut Department of Transportation (CTDOT) and for the actual 85th percentile speed of motorists traveling on this road. The posted speed limit is 25 miles per hour; however, motorists were identified driving approximately 33 miles per hour in each direction and; therefore, the higher speed was used to determine appropriate ISD. Based on the higher speed the appropriate measurements were applied to a profile plan prepared by the Applicant's Traffic Consultant, which determined that adequate ISD can be provided in each direction within the existing 50-foot wide right-of-way of this Town-maintained roadway.

Respectfully submitted,



Michael A. Galante
Director of Traffic
Hardesty & Hanover, LLC

Enclosure

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SUMMARY

A Traffic Impact and Access Study was completed for the proposed Upper School to be located on Outer Ridge Road in North Haven. The proposal is to have up to 100 students and 15 staff at the School on a regular basis Monday through Friday. This School will not have the typical start and end of the School day at the exact same time and students will be permitted to arrive between 8:00 and 9:00 A.M. and depart the School between 3:00 and 4:00 P.M. on a regular basis. This will benefit the anticipated School-related traffic so that not all parents and staff will arrive at the same time; however, spread out over a one-hour period.

This School is estimated to generate 192 and 137 vehicle trip ends during the weekday morning and weekday afternoon peak hours, respectively, as it relates to the School departure time periods noted above. It is anticipated that full enrollment will occur by 2029 and; therefore, this traffic analysis of the proposed School access drive to Outer Ridge Road is based on a 2029 design year.

Results of the analysis indicate that this driveway will operate at Level of Service "A," which represents little or no delay during peak hours, as it relates to School activity. This excellent Level of Service and measurement of delay is mainly due to the very low volume found on Outer Ridge Road and along the site frontage, which is anticipated to continue into the future.

To accommodate the proposed site access drive, which will be located north of the southerly property line to Outer Ridge Road, is placed at a location to maximize intersection sight distance (ISD) to both north and south. Further, the Applicant proposes to provide a minor widening of Outer Ridge Road to provide and maintain a consistent 24-foot wide pavement to the immediate north and immediate south of the site frontage on this roadway. This road measures 24 feet in width along the entire site frontage and the minor widening will compliment this roadway condition.

INTRODUCTION

This report was prepared to provide the Town with a second traffic analysis for the proposed Slate Upper School. This report addresses area roadways, baseline traffic volumes, estimates for site traffic generation for the proposed School for both the typical weekday morning and weekday afternoon, as it relates to School arrivals and departures, future traffic volumes, possible impacts and need for mitigation.

Project Understanding

The proposal is to construct a new Upper Private School for approximately 100 students grades 7 through 12, which includes 10 students for a pre-Kindergarten program.

The site is currently developed with a vacant Mount Carmel Christian Church building, which will be repurposed and upgraded and include a separate building for classrooms. Further, access will be developed into the site and provide an area for parent drop-off and staff and parent parking. The access drive will be located as short distance north of the southerly property boundary to Ridge Road. The new driveway has been placed at a location to maximize intersection sight distance (ISD) in both directions on this roadway.

The design year for full occupancy and use of the new building is 2029. Students will arrive in increments over the next several years to reach full capacity of the buildings.

EXISTING CONDITIONS

This section of the report provides a description of area roadways immediately adjacent to the Subject Property. It includes a description of Outer Ridge Road and other nearby roadways, for reference purposes. Traffic data obtained along the site frontage provided by the Applicant's Traffic Consultant and completed in February 2020 prior to the current pandemic conditions, which have significantly impacted current traffic volume and patterns. This section also includes discussion of accident data obtained for purposes of completing this Traffic Report.

Roadways

The following is a description of roadways immediately adjacent to the Subject Property.

1. Outer Ridge Road – This road is also designated Ridge Road and is a Town-maintained roadway providing access to the site. It is a north-south roadway beginning to the north at a T-type intersection located in the Town of Hamden at a cross road designated Mount Carmel Avenue. Outer Ridge Road continues in a southerly direction traversing a residential area and intersecting with Ridge Road to the south, as well as Blue Hills Road.

In the vicinity of the site frontage it is a two-lane roadway providing one travel lane in each direction. The current pavement width is approximately 18 feet to 24 feet. The posted speed limit in this area is 25 miles per hour. This road currently includes a double yellow centerline, asphalt curbs in certain locations and street lights.

As noted above, this road intersects with Mount Carmel Avenue in the Town of Hamden. The northbound approach Outer Ridge Road is controlled with a STOP sign.

2. Mount Carmel Avenue – This is two-lane, east-west, local road maintained by the Town of Hamden. It was recently repaved and provides a double yellow centerline. The posted speed limit is 25 miles per hour.

3. Ridge Road (Southerly Section) – Ridge Road continues in a southerly direction south of the Outer Ridge Road/Blue Hills Road intersection. This is a T-type intersection in an area that serves single family homes. The northbound approach of Ridge Road at the Outer Ridge Road/Blue Hills Road intersection is controlled with a STOP sign. All roads at this T-type intersection are controlled with double yellow centerlines and provide one travel lane in each direction. This area does not provide any curbing of any kind.

Figure 1 provides a graphic illustration of area roads near the Subject Property. Photographs of Outer Ridge Road near the Subject Property frontage are included in the Appendix of this report.

Traffic Volumes

Traffic data was provided by the Applicant's Traffic Consultant and used in this analysis since collecting traffic data after mid-March of this year would be inappropriate without a reference to other traffic data. Traffic data was provided with the use of Automatic Traffic Recorder (ATR) installed on February 11, 2020 through February 12, 2020. The data was obtained for a 48-hour period and identified the peak hour conditions for Outer Ridge Road along the site frontage. Based on a review of the traffic data and specifically addressing the time periods appropriate for the beginning of the anticipated School day and dismissal, the traffic volumes for 8:00 to 9:00 A.M. and 3:00 to 4:00 P.M. were identified. It was found that the two-way volume on Outer Ridge Road along the site frontage was 35 and 50 vehicles from 8:00 to 9:00 A.M. and 3:00 to 4:00 P.M., respectively.

These time periods were selected since the anticipated start of the School day will be between 8:00 and 9:00 A.M., with dismissal between 3:00 and 4:00 P.M. Figure 2 provides a graphic illustration of the recorded two-way volumes along the site frontage for both the weekday morning and weekday afternoon peak hours. It graphically illustrates that during the morning peak hour the northbound traffic along the site frontage was 20 vehicles and 11 vehicles traveling southbound. The morning peak period indicates a commuter traffic pattern for northbound motorists traveling toward Mount Carmel Avenue, which provides access to Quinnipiac University and State Route 10 to west of the intersection and site.

During the weekday afternoon peak hour, as it relates to dismissal for the proposed School, the southbound volume along the site frontage was recorded at 29 vehicles and 20 vehicles northbound. The



MT. CARMEL AVENUE

SITE

OUTER RIDGE ROAD

MOUNTAIN BROOK ROAD

BLUE HILLS ROAD

RIDGE RD.

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SITE LOCATION MAP

SLATE UPPER SCHOOL
5100 Outer Ridge Road
North Haven, Connecticut



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ASSOCIATES & Hanover

1

Scale in Feet

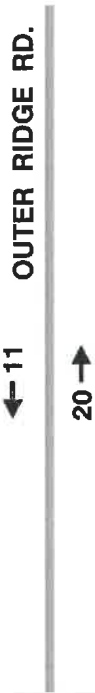
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**Weekday Morning School Arrivals Peak Hour
(8:00 to 9:00 A.M.)**

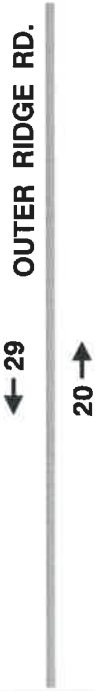


SITE



**Weekday Afternoon School Departures Peak Hour
(3:00 to 4:00 P.M.)**

SITE



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NOTE:
The 2020 Existing Traffic Volumes are from a Traffic Study prepared by Milone & MacBroom, dated November 5, 2020. An ATR was installed from February 11 to February 12, 2020.

2020 EXISTING CONDITIONS

SLATE UPPER SCHOOL
5100 Outer Ridge Road
North Haven, Connecticut



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total two-way volume is higher than the morning peak hour and the southbound traffic pattern indicates commuters traveling home at the end of the day or exiting Quinnipiac University activities.

Accident Experience

Accident data was obtained from the Connecticut Crash Data Repository for a period beginning July 1, 2017 through June 30, 2020. This data was obtained for the Outer Ridge Road intersection at Mount Carmel Avenue and on Outer Ridge Road, between Mount Carmel Avenue to the north and Blue Hills Road to the south. Further, this data was obtained for the Blue Hills Road intersection to the south of the Subject Property.

The data indicates that at the Mount Carmel Avenue intersection there were two reported accidents during the three-year period. This two accidents were limited to property damage and both accidents involved a motorist hitting a fixed object. Contributing factors were one motorist driving off the road and another motorist improperly backing at the intersection. One accident occurred during daylight hours and one accident occurred during evening hours. In both cases the roadway surface was drive and weather conditions were clear.

For Outer Ridge Road along the site frontage and between the intersections of Mount Carmel Avenue to the north and Blue Hills Road to the south there were no reported accidents.

For the Outer Ridge Road/Ridge Road/Blue Hills Road intersection for the same three-year period there were no reported accidents at the intersection. Table 1 provides a summary of the accident data and the accident report information is included in the Appendix of this report.

Table 1
ACCIDENT EXPERIENCE – OUTER RIDGE ROAD
 Slate Upper School
 5100 Outer Ridge Road
 North Haven, Connecticut

ACCIDENT CHARACTERISTICS	OUTER RIDGE ROAD					
	At Mount Carmel Avenue		Between Mount Carmel Avenue and Blue Hills Road		At Blue Hills Road	
	Total	%	Total	%	Total	%
Year						
• 2017/2018	0	0	0	0	0	0
• 2018/2019	1	50	0	0	0	0
• 2019/2020	1	50	0	0	0	0
• Total	2	100	0	0	0	0
Accident Severity						
• Property Damage	2	100	0	0	0	0
• Injury	0	0	0	0	0	0
Collision Type						
• Fixed Object	2	100	0	0	0	0
Contributing Factor						
• Ran Off Road	1	50	0	0	0	0
• Improper Backing	1	50	0	0	0	0
Light Condition						
• Daylight	1	50	0	0	0	0
• Dark – Lighted	1	50	0	0	0	0
Surface Condition						
• Dry	2	100	0	0	0	0
Weather Conditions						
• Clear	2	100	0	0	0	0

Source: Connecticut Crash Data Repository.

Notes:

- 1) The latest accident data available before COVID-19 conditions is from February 1, 2017 to January 31, 2020.
- 2) 2017/2018 = February 1, 2017 to January 31, 2018.
- 3) 2018/2019 = February 1, 2018 to January 31, 2019.
- 4) 2019/2020 = February 1, 2019 to January 31, 2020.

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FUTURE TRAFFIC CONDITIONS

This section of the report provides a description of the projected 2029 design year no-build traffic volumes for Outer Ridge Road at the site. It also includes a description of estimates for School-related traffic based on the number of students and a comparison to trip generation rates provided by the Institute of Transportation Engineers (ITE), for reference purposes and an estimates of students.

The estimates for School traffic were based on discussions with the Connecticut Department of Transportation (CTDOT) Planning Division and determined appropriate for the purposes of completing this analysis.

Based on a previous Study completed for the Slate School located on Mansfield Road, it was determined at that time that 10 percent of the students will be from the same household and; therefore, carpool to and from School. For the purposes of completing the analysis for this proposed Upper School there will be no School bus activity and; therefore, all students will arrive by car either driving for the upper class students and/or being dropped off by parents for all others. The same 10 percent carpool adjustment will be applied

This School is unique in that it will have flexible start and end time periods for students to arrive and depart on a typical School day. The benefit of this program is that not all students will arrive for the beginning of the School day bell and will not be dismissed at the end of the School day bell, which would result in a peak in traffic for 15 to 20 minute period. Therefore, the arrival and departure of School students, in this case and for this particular proposed School, will be spread out over a one-hour period from 8:00 to 9:00 A.M. in the morning and from 3:00 to 4:00 P.M. in the afternoon. This reduces the typical School peaks and spreads traffic out over a period of time minimizing potential impacts and need for mitigation.

To reference and develop traffic patterns an assumption of vehicle occupancy for students it is estimated that the 100 students and the occupancy of 1.10 people per vehicle would result in generating 182 and 132 vehicle trip ends during the weekday morning arrival and weekday afternoon School departure peak hours, respectively. It is estimated that the 10 staff members anticipated to work at the School will arrive during the 8:00 to 9:00 A.M. time period, with 5 staff members leaving during the School dismissal time

period. Therefore, the overall School-related traffic estimated for this analysis is a total of 192 and 137 vehicle trip ends during the weekday morning and weekday afternoon peak hours, as it relates to School activity, respectively. Table 2 provides a more detailed breakdown of entering and exiting School-related traffic for students and staff and overall for the Campus on a daily and typical weekday.

No-Build Traffic Volumes

It is anticipated that the School will be in full operation with all classes occupied by 2029. Therefore, the 2020 baseline traffic volumes previously described were expanded by a growth rate of 0.75 percent based on discussions with CTDOT Planning Division. Figure 3 provides a representation of the anticipated 2029 no-build traffic volumes. It is further assumed that there is no significant development to occur near the Subject Property over the next nine years. However, it is important to note that it is possible that Quinnipiac University may have an expansion, which is currently not planned, in process over the next several years, which could impact traffic volumes on area roadways.

Access Considerations

As previously noted, the site will be served by one access drive to be located near the southerly property line of the School frontage on Outer Ridge Road. This one driveway will serve all activities within the Campus including drop-off and pick-ups and all parking activities.

The Applicant's Traffic Consultant has conducted Speed Studies to determine the appropriate and necessary ISD needed at the proposed new access drive. Based on Studies conducted with a posted speed limit of 25 miles per hour on Outer Ridge Road and actual Speed Studies conducted determined the actual 85th percentile speed of motorists traveling in Outer Ridge Road was determined that northbound traffic was traveling at 33.7 miles per hour and southbound traffic was traveling at 33.1 miles per hour. This data is obtained on the use of an ATR machine to measure both volume and speed collected in mid-February 2020. Based on profiles completed by the Applicant's Traffic Consultant 370 feet is available in both directions and meet the standards for the required ISD of 372 feet to the south and 365 feet to the north.

The Site Plan prepared by Milone & MacBroom developed, with the proposed School access drive placed at a location to maximize ISD in each direction. To accommodate this sightline and to provide improvements along Outer Ridge Road/Ridge Road a minor widening is proposed to the immediate south of

Table 2
 SCHOOL TRAFFIC GENERATION – PEAK HOURS
 Slate Upper School
 5100 Outer Ridge Road
 North Haven, Connecticut

LAND USE	SIZE	VEHICLE OCCUPANCY	TRAFFIC DIRECTION	VEHICLE TRIP ENDS	
				Weekday Morning School Arrivals	Weekday Afternoon School Departures
Private School	100 Students	1.10	Enter	91	66
			Exit	<u>91</u>	<u>66</u>
			Total	182	132
	15 Staff Members	1.00	Enter	10	0
			Exit	<u>0</u>	<u>5</u>
			Total	10	5
Total School Traffic			Enter	101	66
			Exit	<u>91</u>	<u>71</u>
			Total	192	137

Source:

- 1) Based on our analysis of the Slate School, 124 Mansfield Road in North Haven, it was estimated that 10 percent of the students are from the same household and/or will carpool, which was considered a conservative assumption. There were no school buses proposed at that School. Therefore, the same assumptions were used for the proposed Slate Upper School. The proposed School will have a flexible start and end times for students; therefore, arrivals and departures will be spread out almost evenly throughout the peak hours. Based on a review of the Institute of Transportation Engineers (ITE) "Trip Generation," 10th Edition, trip rates for land use code #536, Private School (K-12), the weekday afternoon trip rates are 73 percent of the weekday morning trip rates; therefore, it is assumed that 27 percent of the students will remain on-campus for after School activities.
- 2) There will be a total of 15 staff members (17 staff used in the analysis). It is assumed that 10 of the 15 staff members will arrive during the weekday morning arrivals peak hour, while 5 of the 15 staff members will depart during the weekday afternoon departure peak hour.

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Weekday Morning School Arrivals Peak Hour



SITE



Weekday Afternoon School Departures Peak Hour

SITE



2029 NO-BUILD CONDITIONS

NOTE:
An annual growth rate of 0.75 percent was employed to the horizon year 2029, as per CTDOT Planning Division.

SLATE UPPER SCHOOL
5100 Outer Ridge Road
North Haven, Connecticut



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the Subject Property and to the immediate north of the Subject Property near the northerly property line to be provide and maintain a standard 24-foot width of this road. Other sections and specifically along the site frontage a 24-foot wide pavement is already provided. Based on our field inspection and measurements, a review of profiles and Studies prepared by the Applicant's Traffic Consultant, we agree with the ISD provided and required. Table 3 provides a more detailed breakdown of the ISD analysis prepared by our office.

School Traffic Distribution and Assignment

Based on an evaluation of current traffic patterns and the anticipation of where students may reside and attend this School it is assumed a majority of the students will arrive to and from the south on Outer Ridge Road/Ridge Road and other local roads within the Town of North Haven. Therefore, 70 percent of the School-related traffic will arrive and depart to the south, with the remaining 30 percent traveling to and from the north on Outer Ridge Road to access Mount Carmel Avenue. Figure 4 provides this breakdown and distribution patterns, which is applied to the estimates of site traffic, which was previously described.

Figure 5 provides a graphic illustration of the anticipated School-related traffic for both the weekday morning and weekday afternoon peak hours, as it relates to School arrivals in the morning and School departures during the afternoon. It indicates the level of traffic by turning movements at this proposed School access drive.

Build Traffic Volumes

Figure 6 provides a graphic illustration of the 2029 build traffic volumes. This is based on adding the School-related traffic, previously described, to the previously described 2029 no-build traffic volumes.

Capacity Analysis Procedures and Analysis and Results

Capacity analysis procedures are provided in the Appendix of this report. The analyses completed following a SYNCHRO commuter model and the information provided by the Transportation Research Board (TRB) and following criteria set forth in the Highway Capacity Manual (HCM), 6th Edition.

Results of the analyses are summarized in Table 4 for the proposed School access drive to Outer Ridge Road. Results of the analysis for the weekday morning arrivals and weekday afternoon departures indicate it will operate at Level of Service "A" for all exiting movements and the northbound left turn

Table 3
 INTERSECTION SIGHT DISTANCE (ISD) ANALYSIS
 Slate Upper School
 5100 Outer Ridge Road
 North Haven, Connecticut

INTERSECTION	ISD TO THE LEFT			ISD TO THE RIGHT		
	Distance Available (Feet)	Distance Required (Feet)		Distance Available (Feet)	Distance Required (Feet)	
		Posted Speed	85 th Percentile Speed		Posted Speed	85 th Percentile Speed
	Left	25 MPH	33.7 MPH	Right	25 MPH	33.1 MPH
Outer Ridge Road at Site Access Drive	370	280	372	370	280	365

Source: Connecticut Department of Transportation Highway Design Manual 2003 Edition, Revised January 2011, Section 11-2.03.01 Figure 11-2C and Section 11-2.03.02.

Noted:

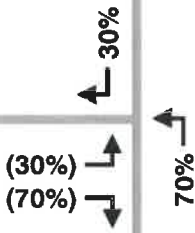
1. Outer Ridge Road is a two-travel lane roadway in the vicinity of the site.
2. The speed limit is 25 miles per hour on Outer Ridge Road in the vicinity of the site.
3. The 85th percentile speed of vehicles at the site access drive was measured to be 33.7 and 33.1 miles per hour in the northbound and southbound directions, respectively. A Speed Study using an ATR was conducted by Milone & MacBroom from February 11 to February 12, 2020.
4. Available intersection sight distance volumes were obtained through a survey shown in the Sight Distance Exhibit prepared by Milone and MacBroom.



OUTER RIDGE RD.

SITE

Site Access Driveway



SITE TRAFFIC DISTRIBUTION

SLATE UPPER SCHOOL
5100 Outer Ridge Road
North Haven, Connecticut



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4

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SITE TRAFFIC
Enter 00%
Exit (00%)

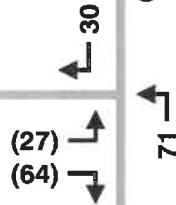
Weekday Morning School Arrivals Peak Hour



SITE

Site Access
Driveway

OUTER RIDGE RD.



SITE TRAFFIC:

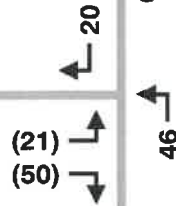
Enter 101
Exit (91)
Total 192 Vehicle Trip Ends

Weekday Afternoon School Departures Peak Hour

SITE

Site Access
Driveway

OUTER RIDGE RD.



SITE TRAFFIC:

Enter 66
Exit (71)
Total 137 Vehicle Trip Ends

**SCHOOL
TRAFFIC GENERATION AND ASSIGNMENT**

SLATE UPPER SCHOOL
5100 Outer Ridge Road
North Haven, Connecticut



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5

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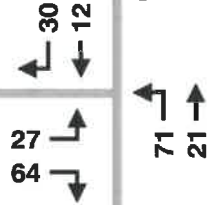
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Weekday Morning School Arrivals Peak Hour



SITE

Site Access Driveway

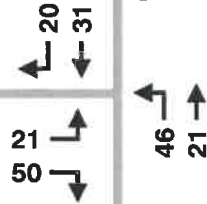


OUTER RIDGE RD.

Weekday Afternoon School Departures Peak Hour

SITE

Site Access Driveway



OUTER RIDGE RD.

2029 BUILD TRAFFIC VOLUMES

**SLATE UPPER SCHOOL
5100 Outer Ridge Road
North Haven, Connecticut**



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NOTE:
The 2029 Build Traffic Volumes includes the 2029 No-Build Traffic Volumes and School Traffic Generation.

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Table 4
 CAPACITY AND STORAGE/QUEUE ANALYSIS RESULTS – MEASURE OF EFFECTIVENESS (MOE) –
 SCHOOL PEAK HOURS
 Slate Upper School
 5100 Outer Ridge Road
 North Haven, Connecticut

INTERSECTION	CONTROL TYPE	STORAGE/ LINK LENGTH	PHYSICAL UNITS	2029 BUILD CONDITIONS					
				Weekday Morning Arrivals			Weekday Afternoon Departures		
				LOS/ Delay	V/C Ratio	Queue Length	LOS/ Delay	V/C Ratio	Queue Length
Outer Ridge Road at Site Access Drive	TWSC	50 1,680	EB Ln1	A/9.3	0.106	10	A/9.2	0.082	8
			NB L	A/7.4	0.049	5	A/7.4	0.032	3

Notes:

- Synchro 10.0/HCM 6th Edition results are used for capacity analysis.
- Level of Service determining parameter is called the service measure.
- For TWSC Intersections: Level of Service/Average Control delay per vehicle (seconds/vehicle).
- V/C ratio indicates the amount of congestion for each Movement and Lane. Any V/C ratio greater than or equal to one indicates that the Movement and Lane are operating at above capacity.
- The Queue Length rows show the 95th percentile maximum queue length in feet.
- The Queue Length is for each lane. The total queue length is divided by the number of lanes and the lane utilization factor.
- The 95th percentile queue is the maximum back of the queue with the 95th percentile traffic volumes.
- **Bolded** 95th percentile queue exceeds the storage available.
- TWSC = Two-Way STOP Control.
- Physical Units consist of the following:
 1. TWSC Intersections: Critical Lane and Critical Movement.

NB = Northbound
 L = Left Turn

EB = Eastbound
 T = Through

SB = Southbound
 R = Right Turn

WB = Westbound
 Ln = Lane

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 11/23/20

movements into the School Campus. Capacity analysis worksheets are included in the Appendix of this report.

These results indicate little or no delay for traffic entering and exiting the School Campus. It is important to note that traffic volume levels on Outer Ridge Road are significantly low during peak hours and the addition of School-related traffic during these peak hours will have an insignificant impact on traffic operations.

Findings

A Traffic Impact and Access Study was completed for the proposed Upper School to be located on Outer Ridge Road in North Haven. The proposal is to have up to 100 students and 15 staff at the School on a regular basis Monday through Friday. This School will not have the typical start and end of the School day at the exact same time and students will be permitted to arrive between 8:00 and 9:00 A.M. and depart the School between 3:00 and 4:00 P.M. on a regular basis. This will benefit the anticipated School-related traffic so that not all parents and staff will arrive at the same time; however, spread out over a one-hour period.

This School is estimated to generate 192 and 137 vehicle trip ends during the weekday morning and weekday afternoon peak hours, respectively, as it relates to the School departure time periods noted above. It is anticipated that full enrollment will occur by 2029 and; therefore, this traffic analysis of the proposed School access drive to Outer Ridge Road is based on a 2029 design year.

Results of the analysis indicate that this driveway will operate at Level of Service "A," which represents little or no delay during peak hours, as it relates to School activity. This excellent Level of Service and measurement of delay is mainly due to the very low volume found on Outer Ridge Road and along the site frontage, which is anticipated to continue into the future.

To accommodate the proposed site access drive, which will be located north of the southerly property line to Outer Ridge Road, is placed at a location to maximize intersection sight distance (ISD) to both north and south. Further, the Applicant proposes to provide a minor widening of Outer Ridge Road to provide and maintain a consistent 24-foot wide pavement to the immediate north and immediate south of the site frontage

APPENDIX

PHOTOGRAPHS



Upper Ridge Road Facing North at Site Frontage



Upper Ridge Road Facing South at Site Frontage

December 1, 2020

FREDERICK P. CLARK / Hardesty
ASSOCIATES / & Hanover

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Exhibit 1

ACCIDENT HISTORY

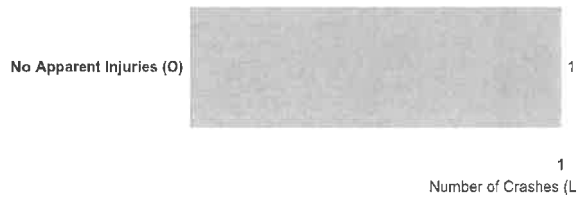
Collision Analysis Safety Tables

Crash Severity	Top 10 Routes	Time and Date of Crashes	Crash Conditions	Roadway Features 1	Roadway Features 2	Contributing Factors
----------------	---------------	--------------------------	------------------	--------------------	--------------------	----------------------

Queries Selected: Town: *Hamden*, Date (Year: *All* or *2/1/2017* to *1/31/2020*), Severity: *All*, Route Class: *Local*, Road Number: *All*, Local Road Name: *RIDGE RD NO 2*, Mile Markers: *-1* to *117.36*

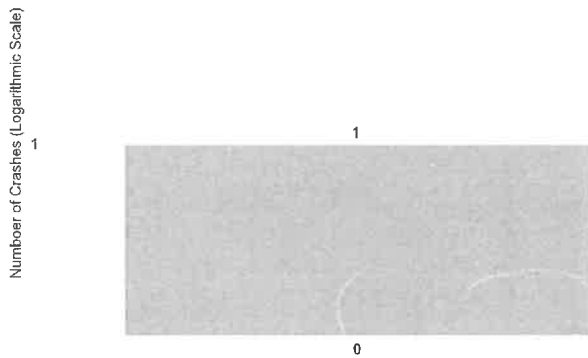
These figures display **crash-level data only** and provide the totals for crashes involving an injury of that type.

Injury Status of Crashes

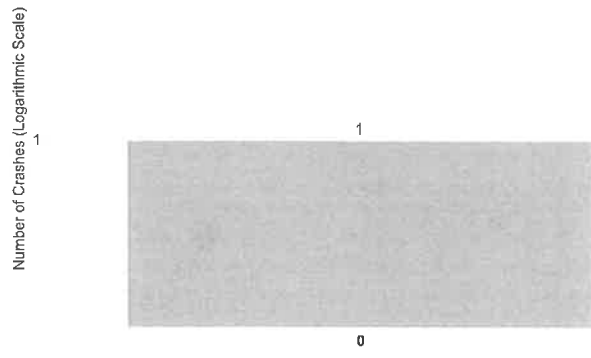


Crash Severity	Crashes	% of All Crashes
No Apparent Injuries (0)	1.000	100.00%
Grand Total	1.000	100.00%

Injuries per Crash



Fatalities per Crash



Injuries per Crash	Crashes	% of All Crashes
0	1.000	100.00%
Grand Total	1.000	100.00%

Fatalities per Crash	Crashes	% of All Crashes
0	1.000	100.00%
Grand Total	1.000	100.00%

These data are exempt from discovery or admission under 23 U.S.C 409. Data Extracted 11/01/2020

Collision Analysis Safety Tables

Crash Severity	Top 10 Routes	Time and Date of Crashes	Crash Conditions	Roadway Features 1	Roadway Features 2	Contributing Factors
----------------	---------------	--------------------------	------------------	--------------------	--------------------	----------------------

Queries Selected: Town: *Hamden*, Date (Year: *All* or *2/1/2017* to *1/31/2020*), Severity: *All*, Route Class: *Local*, Road Number: *All*, Local Road Name: *RIDGE RD NO 2*, Mile Markers: *-1* to *117.36*

Month and Date of Crashes

Crashes	2019	% of All Crashes	Crashes	% of All Crashes
Oct	1.000	100.0%	26	100.0%
Total	1.000	100.0%		

Time and Day of the Week

Crashes	% of All Crashes	Hour of Crash Time	Crashes	% of All Crashes
Saturday	100.00%	8 PM	1.000	100.00%
Grand Total	100.00%	Grand Total	1.000	100.00%

These data are exempt from discovery or admission under 23 U.S.C 409. Data Extracted 11/01/2020

Collision Analysis Safety Tables

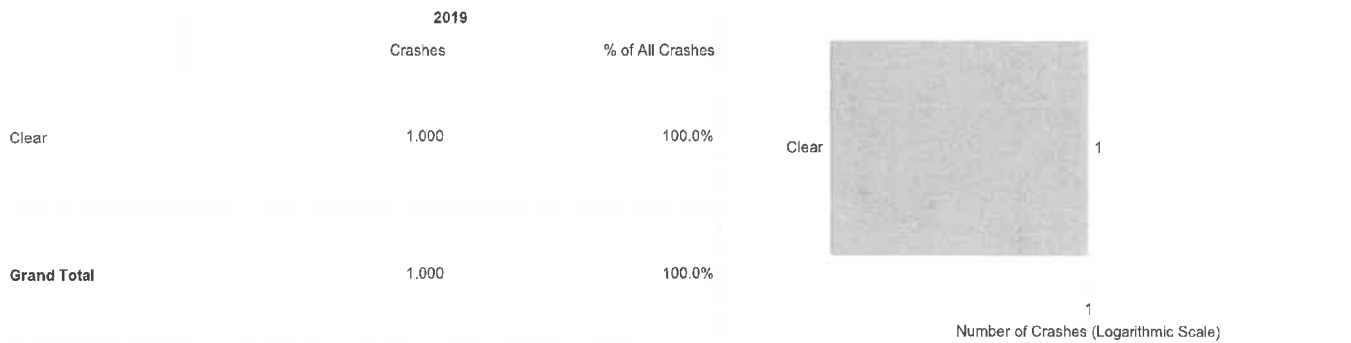
Crash Severity	Top 10 Routes	Time and Date of Crashes	Crash Conditions	Roadway Features 1	Roadway Features 2	Contributing Factors
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Queries Selected: Town: *Hamden*, Date (Year: *All* or *2/1/2017* to *1/31/2020*), Severity: *All*, Route Class: *Local*, Road Number: *All*, Local Road Name: *RIDGE RD NO 2*, Mile Markers: *-1* to *117.36*

Traffic Surface Conditions



Weather Conditions



Light Conditions



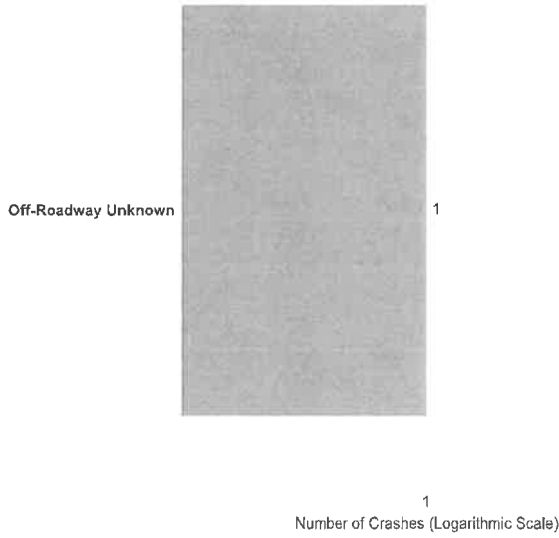
These data are exempt from discovery or admission under 23 U.S.C 409, Data Extracted 11/01/2020

Collision Analysis Safety Tables

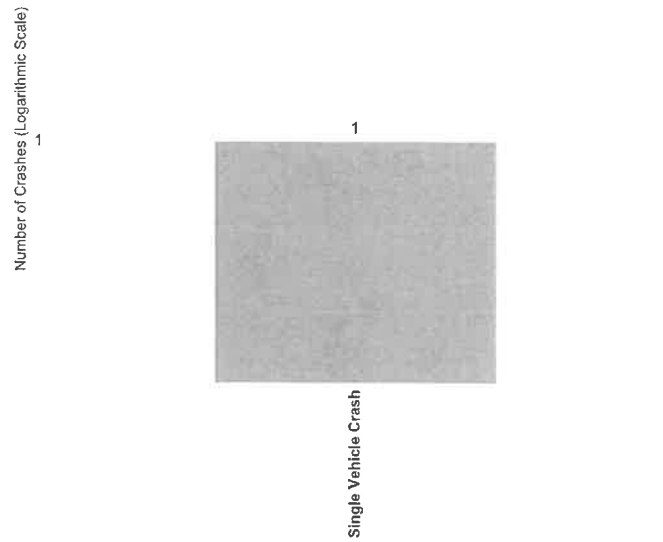
Roadway Features 2	Contributing Factors	Contributing Factors-Vehicle	Crash Manner and Location	First Harmful Event 1	First Harmful Event 2	Vehicle Crash Events
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Queries Selected: Town: *Hamden*, Date (Year: *All* or *2/1/2017* to *1/31/2020*), Severity: *All*, Route Class: *Local*, Road Number: *All*, Local Road Name: *RIDGE RD NO 2*, Mile Markers: *-1* to *117.36*

Location of First Harmful Event



Manner of Crashes



Location Of First Harmful Event	Crashes	% of All Crashes	Manner Of Crash	Crashes	% of All Crashes
Off-Roadway Unknown	1.000	100.00%	Single Vehicle Crash	1.000	100.00%
Grand Total	1.000	100.00%	Grand Total	1.000	100.00%

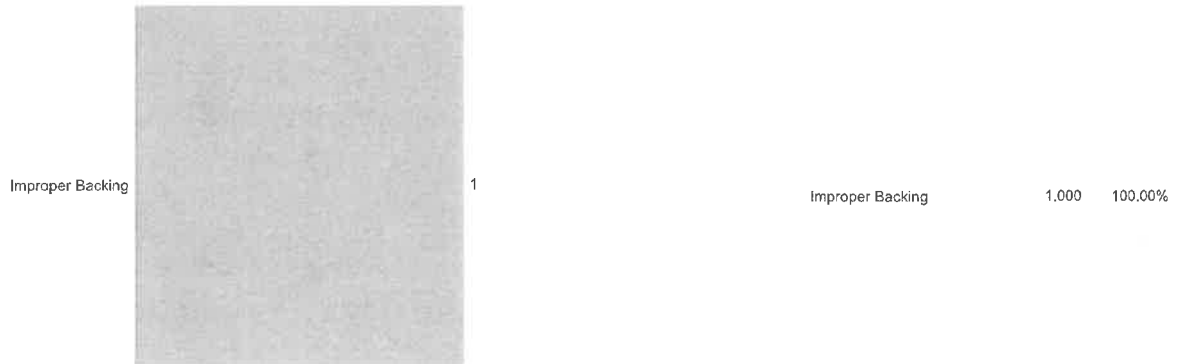
These data are exempt from discovery or admission under 23 U.S.C 409. Data Extracted 11/01/2020

Collision Analysis Safety Tables

Seatbelt Use	Airbag Deployment	Ejection Status and Injuries	Driver Actions	Driver Distraction	Pedestrians	Motorcycle Crashes
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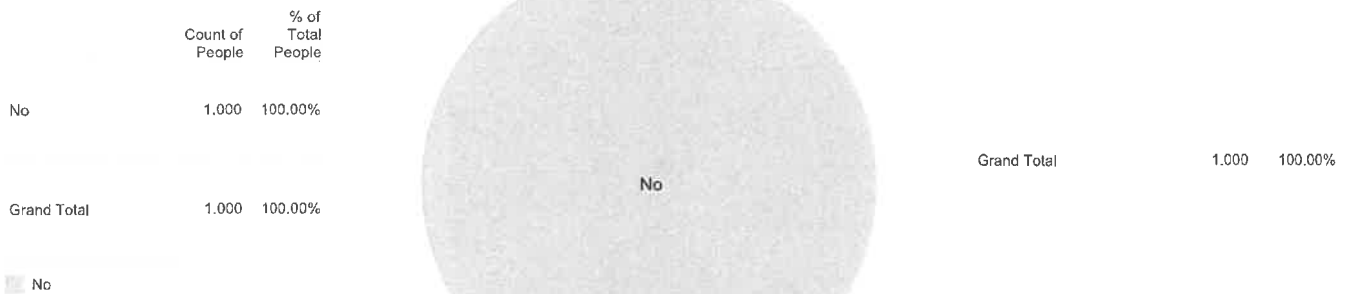
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Drivers' First Actions



1
Number of Drivers (Logarithmic Scale)

Speed Related



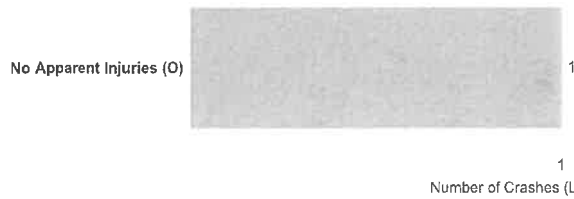
Collision Analysis Safety Tables

Crash Severity	Top 10 Routes	Time and Date of Crashes	Crash Conditions	Roadway Features 1	Roadway Features 2	Contributing Factors
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Queries Selected: Town: North Haven, Date (Year: All or 2/1/2017 to 1/31/2020), Severity: All, Route Class: Local, Road Number: All, Local Road Name: All, Mile Markers: 2.16 to 117.36

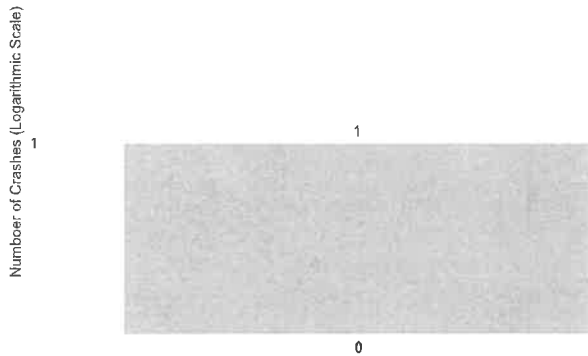
These figures display crash-level data only and provide the totals for crashes involving an injury of that type.

Injury Status of Crashes



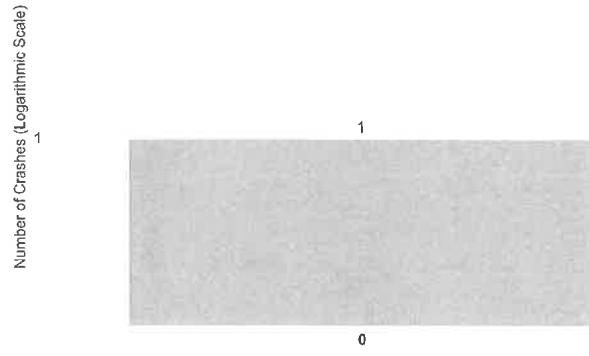
Crash Severity	Crashes	% of All Crashes
No Apparent Injuries (0)	1.000	100.00%
Grand Total	1.000	100.00%

Injuries per Crash



Injuries per Crash	Crashes	% of All Crashes
0	1.000	100.00%
Grand Total	1.000	100.00%

Fatalities per Crash



Fatalities per Crash	Crashes	% of All Crashes
0	1.000	100.00%
Grand Total	1.000	100.00%

These data are exempt from discovery or admission under 23 U.S.C 409. Data Extracted 11/01/2020

Collision Analysis Safety Tables

Crash Severity	Top 10 Routes	Time and Date of Crashes	Crash Conditions	Roadway Features 1	Roadway Features 2	Contributing Factors
----------------	---------------	--------------------------	------------------	--------------------	--------------------	----------------------

Queries Selected: Town: *North Haven*, Date (Year: *All* or *2/1/2017* to *1/31/2020*), Severity: *All*, Route Class: *Local*, Road Number: *All*, Local Road Name: *All*, Mile Markers: *2.16* to *117.36*

Month and Date of Crashes

Crashes	2018 % of All Crashes	5	1
Dec			
Dec	1.000	100.0%	
Total	1.000	100.0%	

Time and Day of the Week

Crashes	8 AM	1	Hour of Crash Time	Crashes	% of All Crashes
Wednesday			8 AM	1.000	100.00%
Wednesday	1.000		Grand Total	1.000	100.00%
Crashes	1.000		Grand Total	1.000	
% of Total Crashes	100.00%				100.00%

These data are exempt from discovery or admission under 23 U.S.C 409. Data Extracted 11/01/2020

Collision Analysis Safety Tables

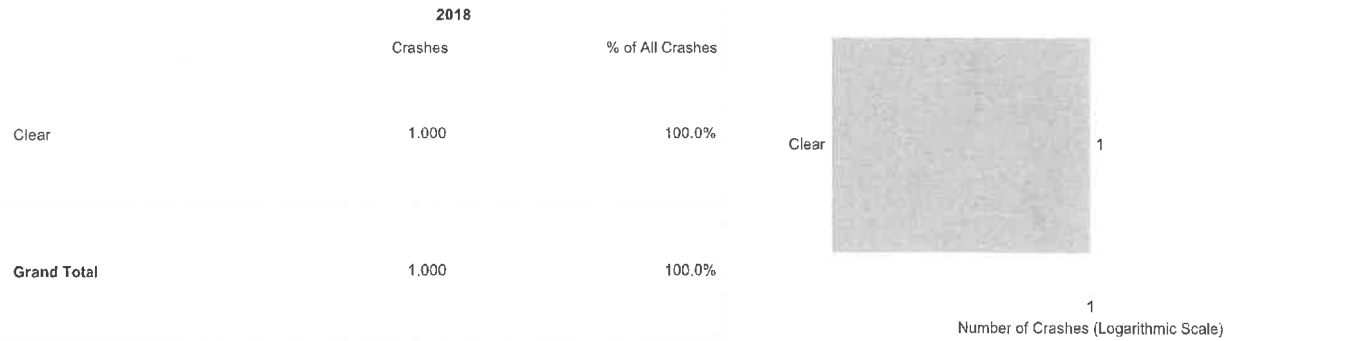
Crash Severity	Top 10 Routes	Time and Date of Crashes	Crash Conditions	Roadway Features 1	Roadway Features 2	Contributing Factors
----------------	---------------	--------------------------	------------------	--------------------	--------------------	----------------------

Queries Selected: Town: North Haven, Date (Year: All or 2/1/2017 to 1/31/2020), Severity: All, Route Class: Local, Road Number: All, Local Road Name: All, Mile Markers: 2.16 to 117.36

Traffic Surface Conditions



Weather Conditions



Light Conditions



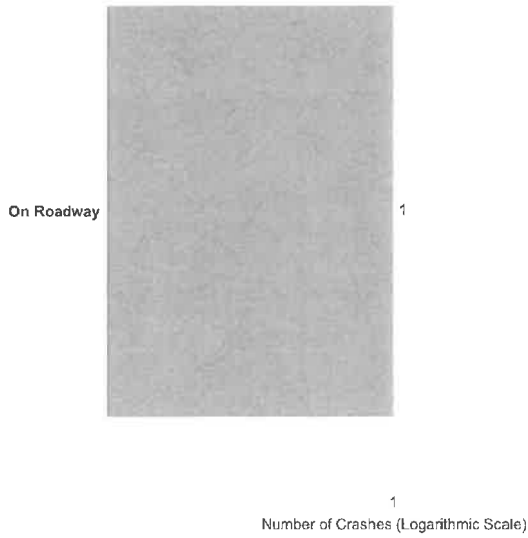
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Collision Analysis Safety Tables

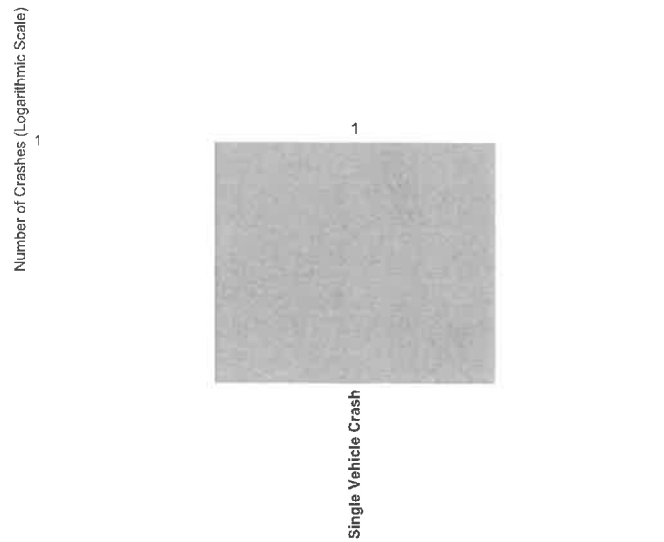
Roadway Features 2	Contributing Factors	Contributing Factors-Vehicle	Crash Manner and Location	First Harmful Event 1	First Harmful Event 2	Vehicle Crash Events
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Queries Selected: Town: North Haven, Date (Year: All or 2/1/2017 to 1/31/2020), Severity: All, Route Class: Local, Road Number: All, Local Road Name: All, Mile Markers: 2.16 to 117.36

Location of First Harmful Event



Manner of Crashes



Location Of First Harmful..	Crashes	% of All Crashes	Manner Of Crash	Crashes	% of All Crashes
On Roadway	1.000	100.00%	Single Vehicle Crash	1.000	100.00%
Grand Total	1.000	100.00%	Grand Total	1.000	100.00%

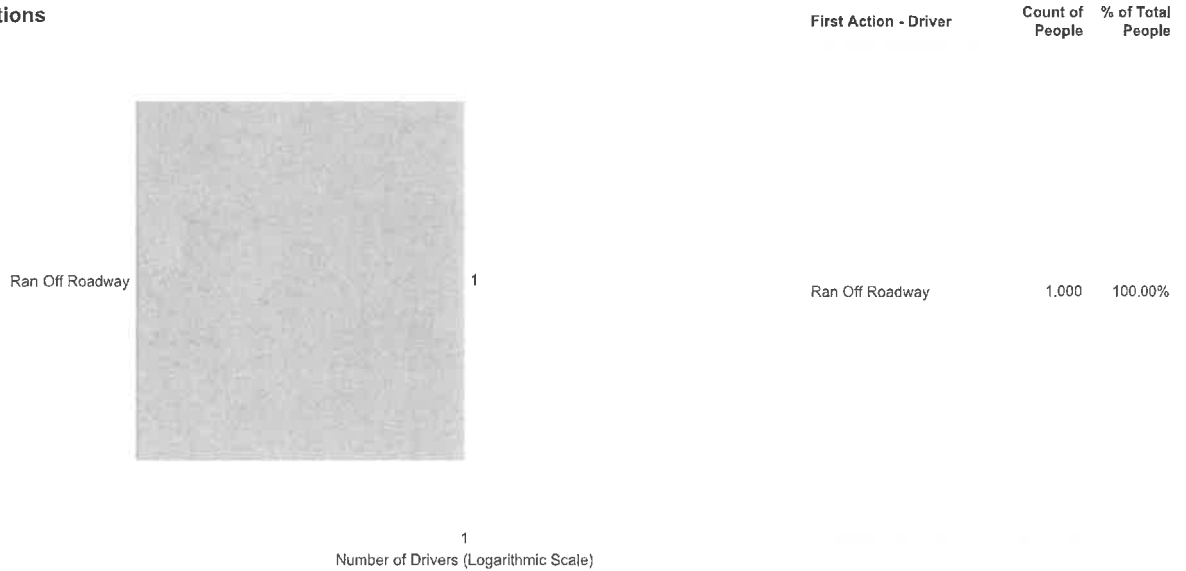
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Collision Analysis Safety Tables

Seatbelt Use	Airbag Deployment	Ejection Status and Injuries	Driver Actions	Driver Distraction	Pedestrians	Motorcycle Crashes
--------------	-------------------	------------------------------	-----------------------	--------------------	-------------	--------------------

Queries Selected: Town: North Haven, Date (Year: All or 2/1/2017 to 1/31/2020), Severity: All, Route Class: Local, Road Number: All, Local Road Name: All, Mile Markers: 2.16 to 117.36

Drivers' First Actions



Speed Related

	Count of People	% of Total People
Unknown	1.000	100.00%
Grand Total	1.000	100.00%

CAPACITY ANALYSIS PROCEDURES

CAPACITY ANALYSIS PROCEDURES

Intersections – Four methods of analysis are needed to evaluate different kinds of intersections. These methods are based on procedures found in the Sixth Edition of the Highway Capacity Manual 2016 and are described below.

Two-Way STOP-Controlled Intersections (TWSC)

One typical configuration is a four-leg intersection, where the major street is uncontrolled, while the minor street is controlled by STOP signs. The other typical configuration is a three-leg intersection, where the single minor-street approach is controlled by a STOP sign.

Theoretical Basic – Gap-acceptance models begin with the recognition that TWSC Intersections give no positive indication or control to the driver on the minor street as to when it is appropriate to leave the stop line and enter the major street. The driver must determine when a gap on the major street is large enough to permit entry and when to enter, on the basis of the relative priority of the competing movements. This decision-making process has been formalized analytically into what is commonly known as gap-acceptance theory. Gap-acceptance theory includes three basic elements: the size and distribution (availability) of gaps on the major street, the usefulness of these gaps to the minor-street drivers, and the relative priority of the various movements at the intersection.

Critical Headway and Follow-Up Headway – The *critical headway* is defined as the minimum interval in the major street traffic stream that allows intersection entry for one minor-street vehicle. Thus, the driver's critical headway is the minimum headway that would be acceptable. Critical headway can be estimated on the basis of observations of the largest rejected and smallest accepted headway for a given intersection. The *follow-up headway* is defined as the time between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major-street headway, under a condition of continuous queuing on the minor street.

Base Critical Headways for TWSC Intersections

VEHICLE MOVEMENT	BASE CRITICAL HEADWAY		
	Two Lanes	Four Lanes	Six Lanes
Left turn from major	4.1	4.1	5.3
U-turn from major	N/A	6.4 (wide) 6.9 (narrow)	5.6
Right turn from minor	6.2	6.9	7.1
Through traffic On major	1-stage:6.5 2-stage, stage I: 5.5 2-stage, Stage II: 5.5	1-stage:6.5 2-stage, stage I: 5.5 2-stage, Stage II: 5.5	1-stage:6.5* 2-stage, stage I: 5.5* 2-stage, Stage II: 5.5*
Left turn from minor	1-stage:7.1 2-stage, stage I: 6.1 2-stage, Stage II: 6.1	1-stage:7.5 2-stage, stage I: 6.5 2-stage, Stage II: 6.5	1-stage:6.4 2-stage, stage I: 7.3 2-stage, Stage II: 6.7

*Use caution; values estimated

Base Follow-up Headways for TWSC Intersections

VEHICLE MOVEMENT	BASE FOLLOW-UP HEADWAY		
	Two Lanes	Four Lanes	Six Lanes
Left turn from major	2.2	2.2	3.1
U-turn from major	N/A	2.5 (wide) 3.1 (narrow)	2.3
Right turn from minor	3.3	3.3	3.9
Through traffic on major	4.0	4.0	4.0
Left turn from minor	3.5	3.5	3.8

Level Of Service Criteria – LOS for a TWSC intersection is determined by the computed or measured control delay. For motor vehicles, LOS is determined for each minor-street movement (or shared movement) as well as major-street left turn. LOS is not defined for the intersection as a whole or for major-street approaches. LOS F is assigned to the movement if the volume-to-capacity ratio for the movement exceeds 1.0, regardless of the control delay.

Automobile Mode – The methodology applies to TWSC intersections with up to three lanes (either shared or exclusive) on the major-street approaches and up to three lanes on the minor-street

approaches (with no more than one exclusive lane for each movement on the minor-street approach). Effects from other intersections are accounted for only in situations in which a TWSC intersection is located on an urban street segment between coordinated signalized intersections. In this situation, the intersection can be analyzed by using the procedures in urban street segment.

Level-of Service Criteria for Automobile Mode

CONTROL DELAY (SECONDS PER VEHICLE)	LOS BY VOLUME-TO-CAPACITY RATIO	
	1.0	>1.0
0- 10	A	F
>10 to 15	B	F
>15 to 25	C	F
>25 to 35	D	F
>35 to 50	E	F
>50	F	F

Note: The LOS criteria apply to each lane on a given approach and to each approach on the minor street. LOS is not calculated for major-street approaches or for the intersection as a whole.

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Revised 12-12

CAPACITY ANALYSIS WORKSHEETS

CAPACITY ANALYSIS WORKSHEETS

Build Conditions

Intersection

Int Delay, s/veh	6.1					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔			↕	↕	
Traffic Vol, veh/h	27	64	71	21	12	30
Future Vol, veh/h	27	64	71	21	12	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	29	70	77	23	13	33

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	207	30	46	0	0
Stage 1	30	-	-	-	-
Stage 2	177	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	781	1044	1562	-	-
Stage 1	993	-	-	-	-
Stage 2	854	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	742	1044	1562	-	-
Mov Cap-2 Maneuver	742	-	-	-	-
Stage 1	943	-	-	-	-
Stage 2	854	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.3	5.7	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1562	-	932	-	-
HCM Lane V/C Ratio	0.049	-	0.106	-	-
HCM Control Delay (s)	7.4	0	9.3	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.2	-	0.4	-	-

Intersection

Int Delay, s/veh	5.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖			↗	↘	
Traffic Vol, veh/h	21	50	46	21	31	20
Future Vol, veh/h	21	50	46	21	31	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	23	54	50	23	34	22

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	168	45	56	0	-
Stage 1	45	-	-	-	-
Stage 2	123	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	822	1025	1549	-	-
Stage 1	977	-	-	-	-
Stage 2	902	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	795	1025	1549	-	-
Mov Cap-2 Maneuver	795	-	-	-	-
Stage 1	945	-	-	-	-
Stage 2	902	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.2	5.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1549	-	944	-	-
HCM Lane V/C Ratio	0.032	-	0.082	-	-
HCM Control Delay (s)	7.4	0	9.2	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	-	-