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PRINCIPALS
Robert J. Michaud, P.E.
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MEMORANDUM

DATE: February 16, 2018
(Updated July 12, 2018)

TO: Surfside Crossing, LLC
c/o Donald F. Bracken, Jr., P.E.
Bracken Engineering
19 Old South Road
Nantucket, MA 02554

FROM: Robert J. Michaud, P.E. – Managing Principal
Daniel A. Dumais, P.E. – Senior Project Manager

RE: **Proposed Surfside Crossing Residential Development**
3-9 South Shore Road – Nantucket, MA

MDM Transportation Consultants, Inc. (MDM) has prepared this traffic impact assessment (TIA) for the proposed residential development to be located at 3-9 South Shore Road in Nantucket, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. This memorandum describes existing traffic volumes and travel speeds for South Shore Road, evaluates sight lines to/from the site driveway, estimates trip generation characteristics of the proposed development, quantifies incremental traffic impacts of the Site development on the adjacent roadways, and evaluates safety-related conditions at key study locations that provide access to the Site.

Key findings of the traffic assessment are as follows:

- *Safety Characteristics*. A review of the crash data indicated that no immediate safety countermeasures are warranted based on the crash history at the study intersection of Surfside Road at Fairgrounds Road/South Shore Road.

- *Measured Travel Speeds*. The observed 85th percentile travel speed of 38 mph is highly consistent with the posted regulatory speed limit of 35 mph along South Shore Road in the Site vicinity. The regulatory and observed travel speeds provide an appropriate basis for determining driveway sight lines to conform with sight line criteria published by AASHTO.

Figure 1

Site Location

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- *Sight Line Safety Characteristics.* Proposed clearing and regrading associated with construction of the proposed Site driveway will provide sight lines that exceed AASHTO's recommended criteria both stopping sight distance (SSD) and intersection sight distance (ISD) based on the regulatory speed limit and observed travel speeds along South Shore Road. This will provide ample visibility for vehicles approaching and leaving the Site driveways to properly exit/enter the South ShoreRoad traffic stream in a safe manner.

- *Modest Trip Generation*. The proposed development is estimated to generate approximately 88 vehicle trips (21 entering and 67 exiting) during the weekday morning peak hour and 113 vehicle trips (71 entering and 42 exiting) during the weekday evening peak hour. On a daily basis the project is estimated to generate approximately 1,272 trips with half entering and half exiting over a 24 hour period. While the Site is likely to benefit by its close proximity to public transportation and opportunities for pedestrian/bicycle use, the analysis utilizes ITE-based trip generation without downward adjustment to present a conservative analysis.

- *Adequate Roadway Capacity*. Under future Build conditions, capacity analyses indicate that the unsignalized Site Driveway approaches to South Shore Road will operate at level of service (LOS) B or better during the weekday morning and weekday evening peak hours. Under future Build conditions, capacity analyses indicate that the Surfside Road intersection with Fairgrounds Road and South Shore Road will operate with moderate delays at level of service (LOS) D or better during the peak season. The incremental traffic associated with the proposed development is not expected to materially impact operations and queue lengths at the intersection compared to No-Build conditions.

- *Site Access/Circulation.* AutoTURN analysis has been completed for the preliminary site plan using the Town's Ladder truck and single unit (SU) delivery truck. Site access, circulation aisles and parking layout provide adequate maneuvering area for the largest potential responding vehicle (ladder truck).

In summary, trip generation for the development is projected to be modest. MDM finds that incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the study intersections. The study intersections exhibit below-average crash rates based on historic crash data; safety countermeasures are therefore not warranted. Likewise, the available sight lines at the Site Driveway intersections with South Shore Road exceed the recommended sight line requirements from AASHTO. Implementation of access/egress improvements, proposed pedestrian, and bicycle improvements along with a Transportation Demand Management (TDM) program will establish a framework of minimizing Site traffic impacts by encouraging non-motorized travel modes and pedestrian/bicycle accommodation that is compatible with other projects in the area.

PROJECT DESCRIPTION

The existing Site consists of approximately 13.6± acres of undeveloped land located along South Shore Road in Nantucket, MA. Under the proposed site programming, 60 single family homes and 96 condominium units will be constructed. The proposed access/egress will be via three full-access/egress driveways along South Shore Road. The northern driveway will service the multi-family condominium units. The central and southern driveways will service 60 residential lots. A preliminary site plan prepared by Bracken Engineering, Inc. is presented in **Figure 2**.

EXISTING TRAFFIC & SAFETY CHARACTERISTICS

An overview of existing roadway conditions, traffic volumes, and safety characteristics is provided below.

South Shore Road

South Shore Road is generally a north-south local roadway under Town jurisdiction South Shore Road provides a connection between Surfside Road to the north and Hillside Avenue to the south. South Shore Road provides a single travel lane in each direction with a multi-use path (South Shore Bike Path) along its eastern side. The posted (regulatory) speed limit on South Shore Road is 35 miles per hour (mph). Land use along South Shore Street is primarily residential homes but also include the South Shore Wastewater Treatment Plant and a junk yard.

Peak Hour Traffic Volumes

Traffic volume data was collected within the study area along South Shore Road in June 2018 during the weekday morning (7:00 – 9:00 AM) and weekday evening (4:00 – 6:00 PM) peak periods. Review of Cape Cod Commission data for the Cape and Islands indicates that June is an above average traffic month (approximately 11 percent above average month conditions) but it is approximately 17 percent below peak traffic conditions which occur in July and August. Thus, the traffic counts were adjusted by 17% (increase) to represent peak season conditions. The resulting Baseline weekday morning and weekday evening peak-hour traffic volumes for the study intersection are depicted in **Figure 3**. Turning movement counts and permanent count station data are provided in the **Attachments**.

Scale: Not to Scale

Site Plan Source: Bracken Engineering, Inc.

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Figure 2

Preliminary Site Layout

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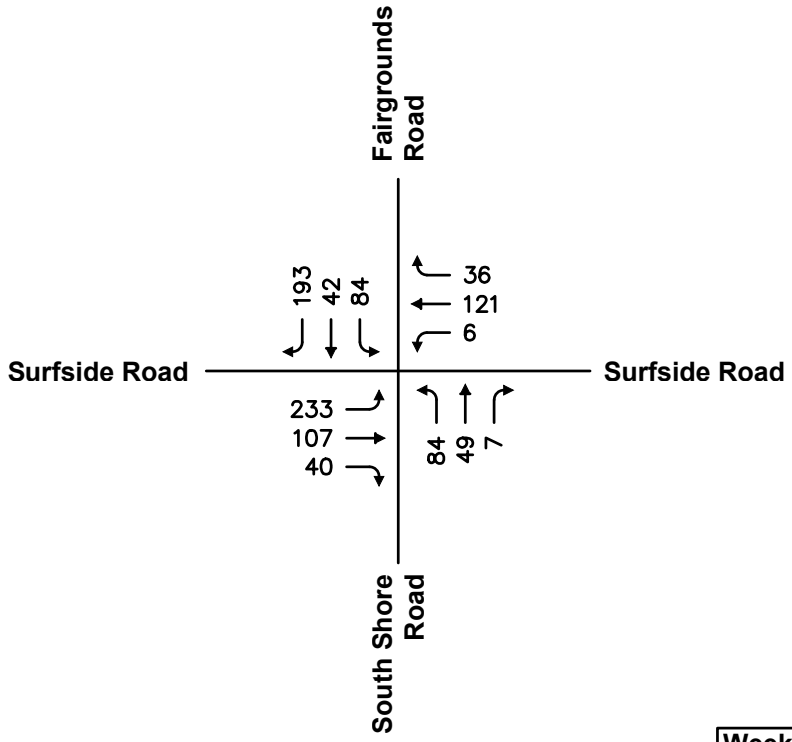
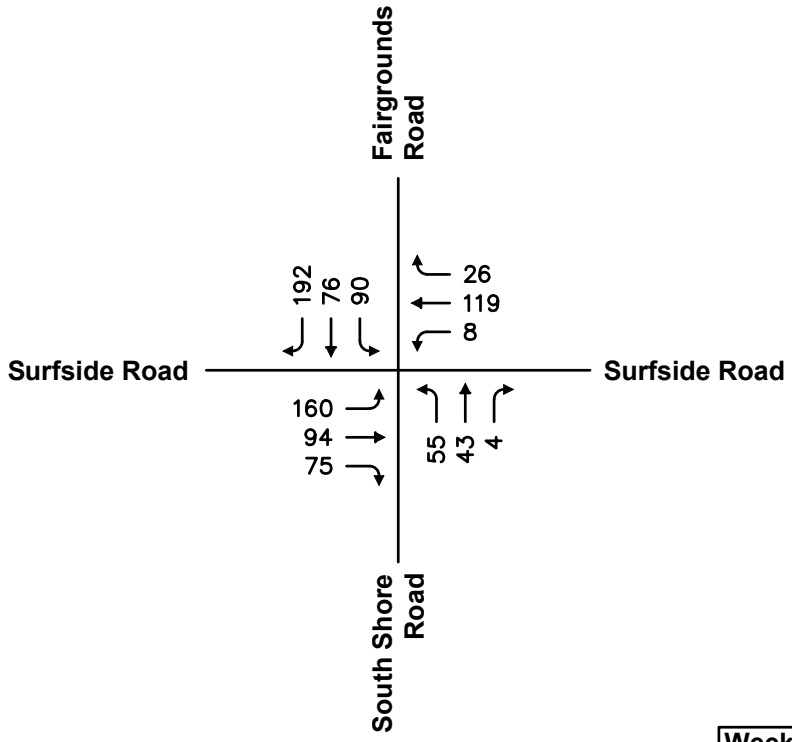


Weekday Morning Peak Hour



North
Scale: Not to Scale

Weekday Evening Peak Hour

Figure 3

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2018 Baseline Conditions
Weekday Peak Hour Volumes

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Measured Travel Speeds

Vehicle speeds were obtained for South Shore Road adjacent to the Site using a radar recorder. These measured travel speeds provide a basis for determining sight line requirements at the proposed site driveway. **Table 1** presents a summary of the travel speed data collected for South Shore Road in the site vicinity. Collected speed data are provided in the **Attachments**.

TABLE 1
SPEED STUDY RESULTS – SOUTH SHORE ROAD

Travel Direction	Regulatory Speed Limit[1]	Travel Speed	
		Mean[2]	85th Percentile[3]
Northbound	35	33	38
Southbound	35	33	38

[1] Regulatory Speed limit in miles per hour (mph).
[2] Arithmetic mean
[3] The speed at or below which 85 percent of the vehicles are traveling

As summarized in **Table 1**, the mean (average) travel speed on South Shore Road was observed to be 33 mph and the 85th percentile travel speeds were observed to be 38 mph in both the northbound and southbound directions. The observed travel speeds are highly consistent with the 35 mph regulatory speed limit.

Intersection Crash History

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the Town of Nantucket for the three-year period 2013 through 2015 (the most recent data currently available from MassDOT). Crash data for the study intersections is summarized in **Table 2** with detailed data provided in the **Attachments.**

Crash rates were calculated for the study area intersection as reported in **Table 2**. This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 5 (which includes the Town of Nantucket) crash rate to be 0.58 for unsignalized intersections. This rate represents MassDOT's "average" crash experience for District 5 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted.

TABLE 2
INTERSECTION CRASH SUMMARY
2013 THROUGH 2015[1]

Data Category	Surfside Road at Fairgrounds Road/South Shore Road
Traffic Control	Unsignalized
Crash Rate[2]	**0.17**
District 5 Avg[3]	0.58
Year:	
2013	1
2014	1
2015	0
Total	**2**
Type:	
Angle	0
Rear-End	1
Head-On	0
Sideswipe	1
Single Vehicle	0
Other/Unknown	0
Severity:	
P. Damage Only	1
Personal Injury	0
Other/Unknown	1
Conditions:	
Dry	0
Wet	1
Snow	1
Other/Unknown	0
Time:	
7:00 to 9:00 AM	0
4:00 to 6:00 PM	1
Rest of Day	1

[1] Source: MassDOT Crash Database
[2] Crashes per million entering vehicles
[3] District 5 averages = 0.58 (unsignalized)

As summarized in **Table 2**:

- *Surfside Road at Fairgrounds Road/South Shore Road.* There are a total of two (2) crashes reported at the intersection during the three-year study period resulting crash rate of 0.17. The crashes involved one rear-end type collisions and one sideswipe collision. One of the two resulted in property damage type collisions. Both of the collisions occurred under wet or snow roadway conditions. One of the collisions occurred during the weekday evening peak travel times. No pedestrian related crashes or fatalities were reported.

In summary, the study intersection experienced a crash rate below the District 5 average and no immediate safety countermeasures are warranted based on the crash history at the study intersection.

Public Transportation Facilities

The Nantucket Regional Transit Authority operates two (2) bus Routes with service within ¼ mile of the Site as follows:

- The Surfside Beach Route provides service between Washington Street and Surfside Beach with a stop at the intersection of Surfside Road and Fairgrounds Road. Service is provided everyday between late June and early September between 10:00 am and 6:00 pm and generally runs every 40 minutes.

- The Miacomet Loop provides service between Washington Street and Surfside Beach with a stop at the intersection of Surfside Road and Fairgrounds Road. Service is provided everyday between late April and early October between 7:00 am and 9:00 pm – 12:00 am depending on the season and generally runs every 15 to 30 minutes.

To remain conservative no credit (trip reduction) was taken for the use of nearby public transportation. Specific route and schedule information is provided in the **Attachments**.

Bike Path

The South Shore Bike Path is located along South Shore Road along its eastern side between South Shore Wastewater Treatment Plant to the south and Surfside Road to the north. The Bike Path connects to the Fairgrounds Bike Path and Surfside Bike Path at the intersection of Surfside Road and Fairgrounds Road/South Shore Road. To remain conservative no credit (trip reduction) was taken for the use of the adjunct bike path.

Sight Line Evaluation

An evaluation of sight lines was conducted to ensure that minimum recommended sight lines are available at the site driveway intersections with South Shore Road. The evaluation documents sight lines under proposed conditions for vehicles as they relate to these roadways with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards[1] reference two types of sight distance which are relevant at the site driveway intersection: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the site driveway intersections along South Shore Road were compared to minimum SSD and ISD recommendations for the regulatory and observed travel speeds in the area.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near the design speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto South Shore Road. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the South Shore Road approaches to the site driveways. **Table 3** presents a summary of the available SSD as they relate to South Shore Road and AASHTO's recommended SSD based on regulatory and observed speeds along South Shore Road.

[1] *A policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2011.

TABLE 3
STOPPING SIGHT DISTANCE SUMMARY
SOUTH SHORE ROAD APPROACHES TO SITE DRIVEWAYS

Approach/ Travel Direction	Available SSD	AASHTO Recommended[1]		
		Regulatory Speed Limit[2]	Average Travel Speed[3]	85th Percentile Travel Speed[4]
Northern Site Driveway				
Northbound	>500 Feet	250 Feet	230 Feet	280 Feet
Southbound	280± Feet	80 Feet[5]	--	--
Central Site Driveway				
Northbound	>500 Feet	250 Feet	230 Feet	280 Feet
Southbound	450± Feet	250 Feet	230 Feet	280 Feet
Southern Site Driveway				
Northbound	>500 Feet	250 Feet	230 Feet	280 Feet
Southbound	>500 Feet	250 Feet	230 Feet	280 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet.
[2] Regulatory speed limit: 35 mph
[3]Average Speed: 33 mph NB & SB.
[4]85th Percentile travel speed: 38 mph NB & SB.
[5]Based on 15 mile per hour travel speed for vehicles turning from 4-way STOP at Surfside Road/Fairgrounds Road.

As summarized in **Table 3,** analysis results indicate that the existing available sight lines exceed AASHTO's recommended SSD criteria along South Shore Road for the posted and observed travel speeds. Stopping sight distance calculations are provided in the **Attachments**.

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "*…If the available sight distance for an entering …vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions…To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road*." AASHTO's ISD criteria are defined into several "cases". In this case, the site driveway approach is under "STOP" control. The ISD in question relates to the ability to turn either right or left onto South Shore Road.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (8 to 14.5 feet from the edge of the travel lane) for the northbound and southbound travel directions on South Shore Road. **Table 4** presents a summary of the available ISD for the departures from the site driveway and AASHTO's recommended ISD assuming continued maintenance of vegetation within the sight line triangles.

TABLE 4
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURES TO SOUTH SHORE ROAD

Approach/ Travel Direction	Available ISD	AASHTO Minimum[1] 85th Percentile Travel Speed[4]	AASHTO Ideal[1] Regulatory Speed Limit[2]
Northern Site Driveway			
Looking North	280± Feet	--	145 Feet[5]
Looking South	>500 Feet	280 Feet	230 Feet
Central Site Driveway			
Looking North	450± Feet	280 Feet	335 Feet
Looking South	>500 Feet	280 Feet	390 Feet
Southern Site Driveway			
Looking North	>500 Feet	280 Feet	335 Feet
Looking South	>500 Feet	280 Feet	390 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet. Minimum value as noted represents SSD per AASHTO guidance.
[2] Regulatory speed limit: 35 mph
[3]Average Speed: 33 mph NB & SB.
[4]85th Percentile travel speed: 38 mph NB & SB.
[5]Based on 15 mile per hour travel speed for vehicles turning from 4-way STOP at Surfside Road/Fairgrounds Road.

The results of the ISD analysis presented in **Table 4** indicate that with clearing and grading associated with the construction of the proposed site driveways, the available sight lines looking north and south from the site driveways onto South Shore Road exceed the sight line requirements from AASHTO for the regulatory and 85th percentile travel speeds. MDM recommends that any new plantings (shrubs, bushes) or physical landscape features to be located within the sight lines should also be maintained at a height of 2 feet or less above the adjacent roadway grade to ensure unobstructed lines of sight.

PROJECTED FUTURE TRAFFIC CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. For planning purposes, a five-year planning horizon (year 2023) was selected consistent with standard industry practice.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), includes existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others that are currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of the future No-Build and Build traffic volumes.

Background Growth

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

Consistent with recent traffic studies on the island, a 1.0-percent compounded annual growth rate was used (5.1 percent increase over a 5-year horizon). This growth rate is higher than historic rates and is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. MassDOT permanent count station data and background growth calculations are provided in the **Attachments**.

Development of future No-Build traffic volumes also considers traffic generated through the study area from other specific area developments. Review of Massachusetts Environmental Policy Act (MEPA) files indicates that there are no Site-specific development projects in the area that may increase baseline traffic at the study intersections.

2023 No-Build Traffic Volume Networks

In summary, to account for future traffic growth in the study area future No-Build traffic volumes are developed by increasing the baseline (2018) volumes by approximately 5.1 percent (1.0 percent compounded annually over 5 years). The resulting 2023 No-Build traffic volumes are displayed in **Figure 4**.

Trip Generation

The trip generation estimates for the proposed development of the Site are provided for the weekday morning and weekday evening periods, which correspond to the critical analysis periods for the proposed use and adjacent street traffic flow. New traffic generated by the project was estimated using trip rates published in ITE's *Trip Generation*[2] for the Land Use Code (LUC) 210 – Single-Family Detached Housing and LUC 220 – Multifamily Housing (Low-Rise).

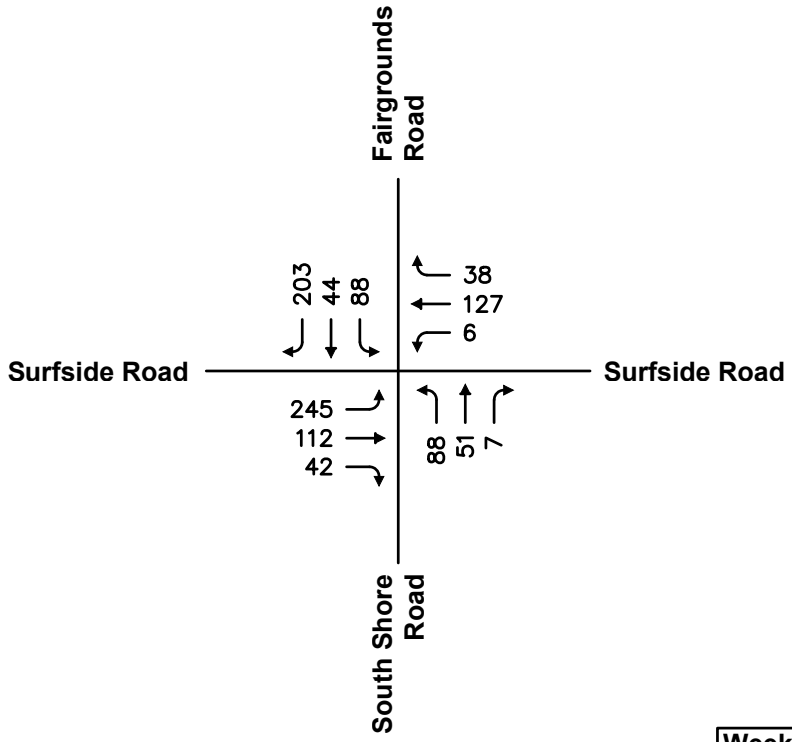
Table 5 presents the trip-generation estimates for the proposed development based on ITE methodology for the 60 single family units and 96 condominium units.

TABLE 5
TRIP-GENERATION SUMMARY

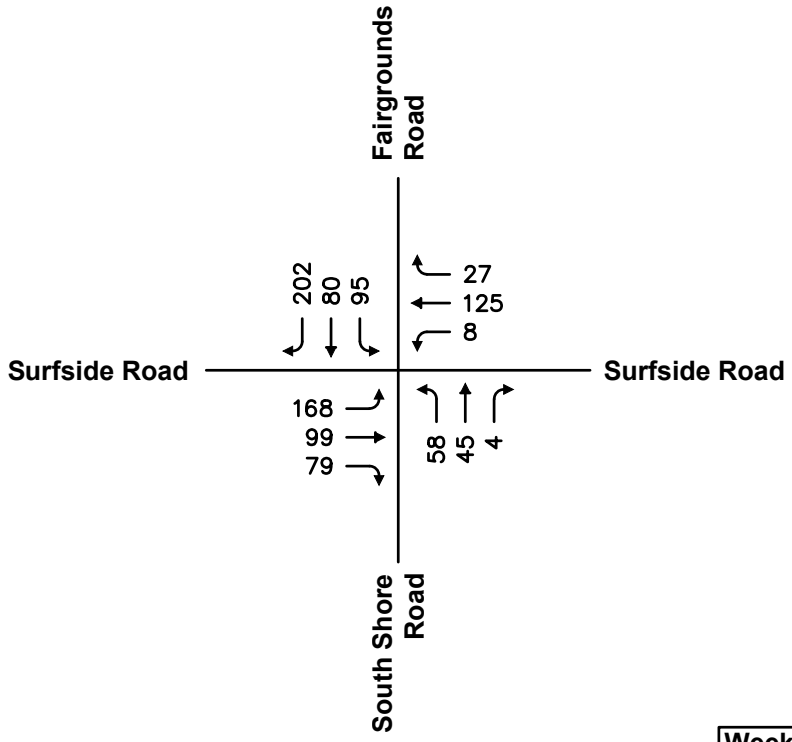
Period/Direction	Single Family[1]	Condominiums[2]	Total
Weekday Morning Peak Hour:			
Entering	11	10	21
Exiting	33	34	67
Total	44	44	88
Weekday Evening Peak Hour:			
Entering	37	34	71
Exiting	22	20	42
Total	59	54	113
Weekday Daily	570	702	1,272

[1]Based on ITE LUC 210 Single-Family Detached Housing trip rates applied to 60 units.
[2]Based on ITE LUC 220 Multifamily Housing (Low-Rise) trip rates applied to 96 units.

[2]*Trip Generation,* Ninth Edition; Institute of Transportation Engineers; Washington, DC; 2012.



Weekday Morning Peak Hour



North
Scale: Not to Scale

Weekday Evening Peak Hour

Figure 4

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2023 No-Build Conditions
Weekday Peak Hour Volumes

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As summarized in **Table 5**, the proposed development is estimated to generate approximately 88 vehicle trips (21 entering and 67 exiting) during the weekday morning peak hour and 113 vehicle trips (71 entering and 42 exiting) during the weekday evening peak hour. On a daily basis the project is estimated to generate approximately 1,272 trips with half entering and half exiting over a 24 hour period. Trip generation calculations are provided in the **Attachments**. While the Site is likely to benefit by its close proximity to public transportation and opportunities for pedestrian/bicycle use, the analysis utilizes ITE-based trip generation without downward adjustment to present a conservative analysis.

Trip Distribution

Trip distribution patterns for the proposed residential development are based on existing travel patterns observed at the study intersection of Surfside Road at Fairgrounds Road/South Shore Road. For planning purposes it was assumed that all of the trips used the study intersection to present a conservative analysis. The trip distribution percentages and new development-related trips at the Surfside Road intersection with Fairgrounds Road/South Shore Road for the weekday morning and weekday evening peak hours are quantified in **Figure 5**. Trip distribution calculations are provided in the **Attachments.**

Development-related trips for the residential development were assigned to the roadway network using the trip-generation estimates shown in **Table 5** and the distribution patterns presented in **Figure 5**. New development-related trips at each intersection approach for the weekday morning and weekday evening peak hours are quantified in **Figure 6** and **Figure 7**, respectively. Trip distribution calculations are provided in the **Attachments.**

2023 Build Traffic Conditions

2023 Build condition traffic volumes are derived by adding the incremental traffic increases for the Site to the 2023 No-Build conditions. **Figure 8** and **Figure 9** present the 2023 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours.

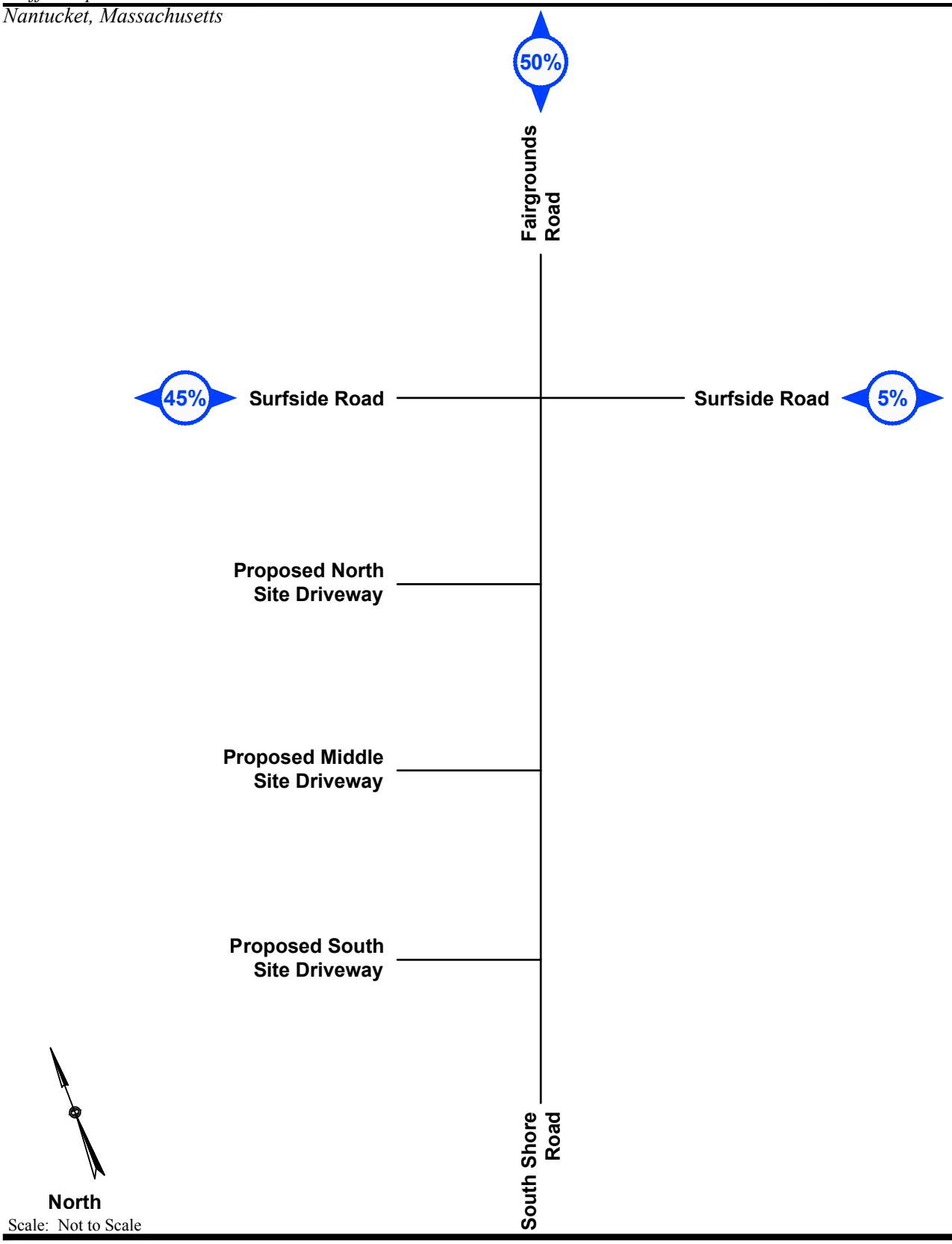

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Figure 5

Trip Distribution

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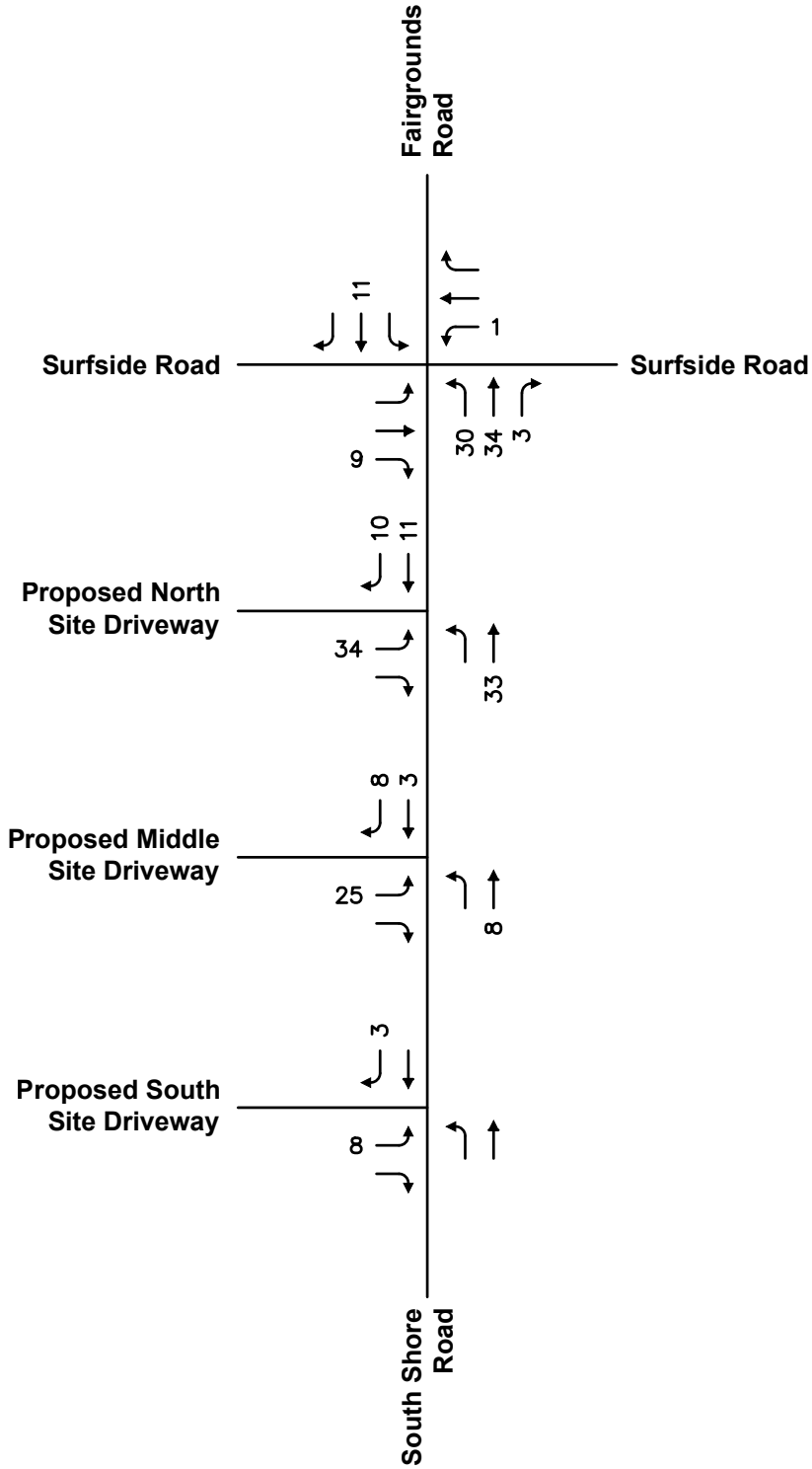

96 Apartments	
Enter	10
Exit	34
Total	44

60 Single-Family Detached Houses	
Enter	11
Exit	33
Total	44

North

Scale: Not to Scale

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Figure 6

Site Generated Trips
Weekday Morning Peak Hour Volumes

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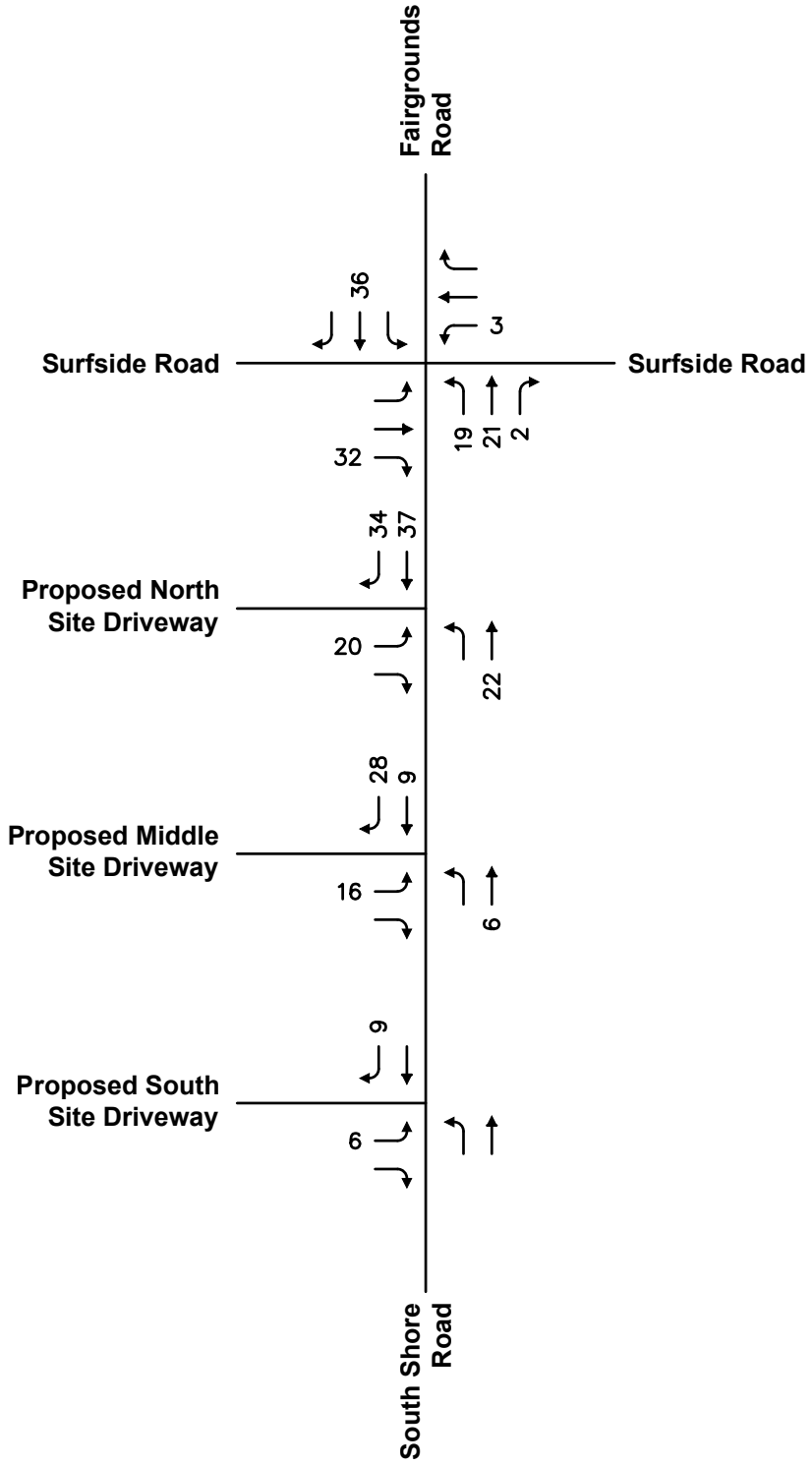

96 Apartments	
Enter	34
Exit	20
Total	54

60 Single-Family Detached Houses	
Enter	37
Exit	22
Total	59

North

Scale: Not to Scale

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Figure 7

Site Generated Trips
Weekday Evening Peak Hour Volumes

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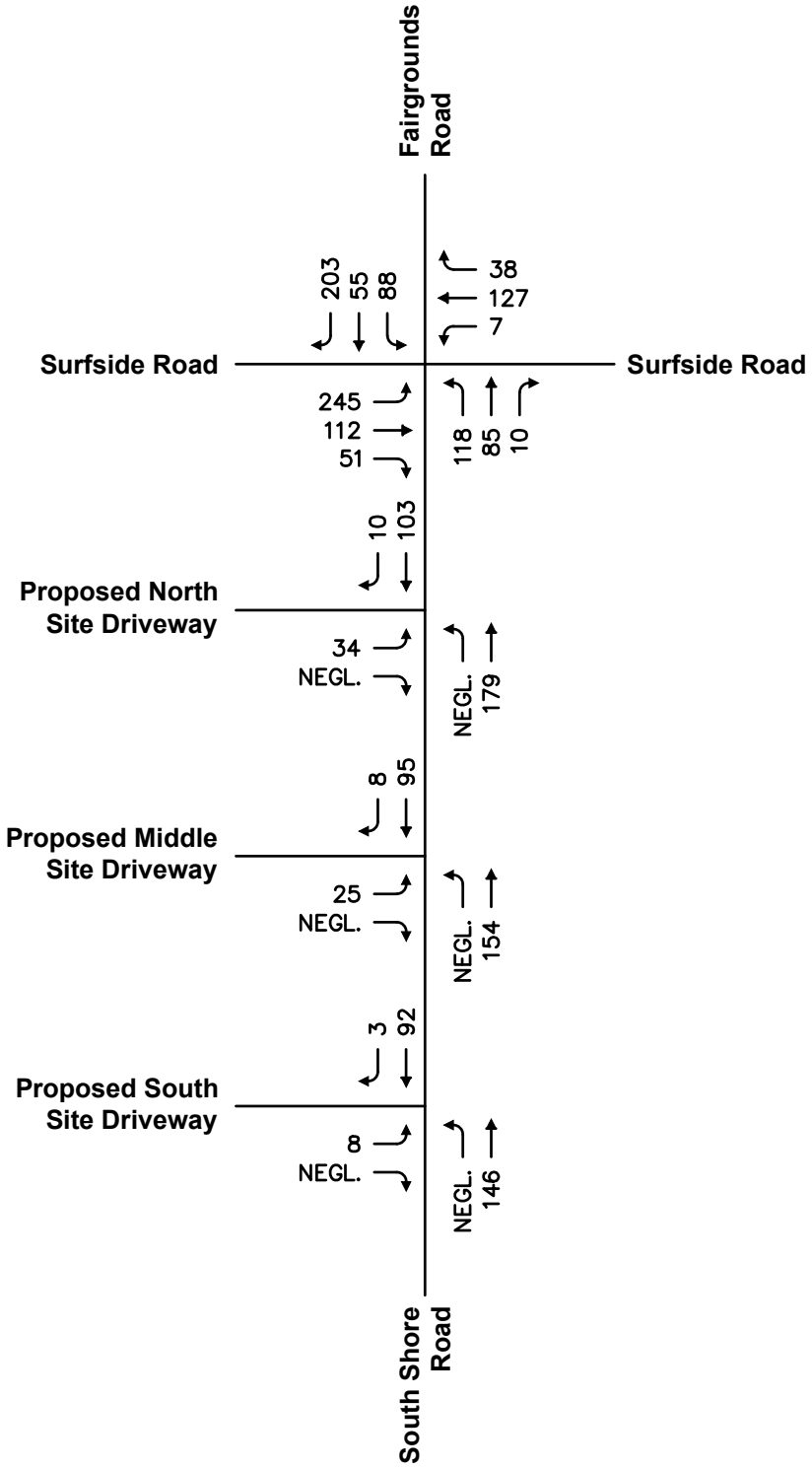

North
Scale: Not to Scale

NOTES:
NEGL. = Negligible

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Figure 8

2023 Build Conditions
Weekday Morning Peak Hour Volumes

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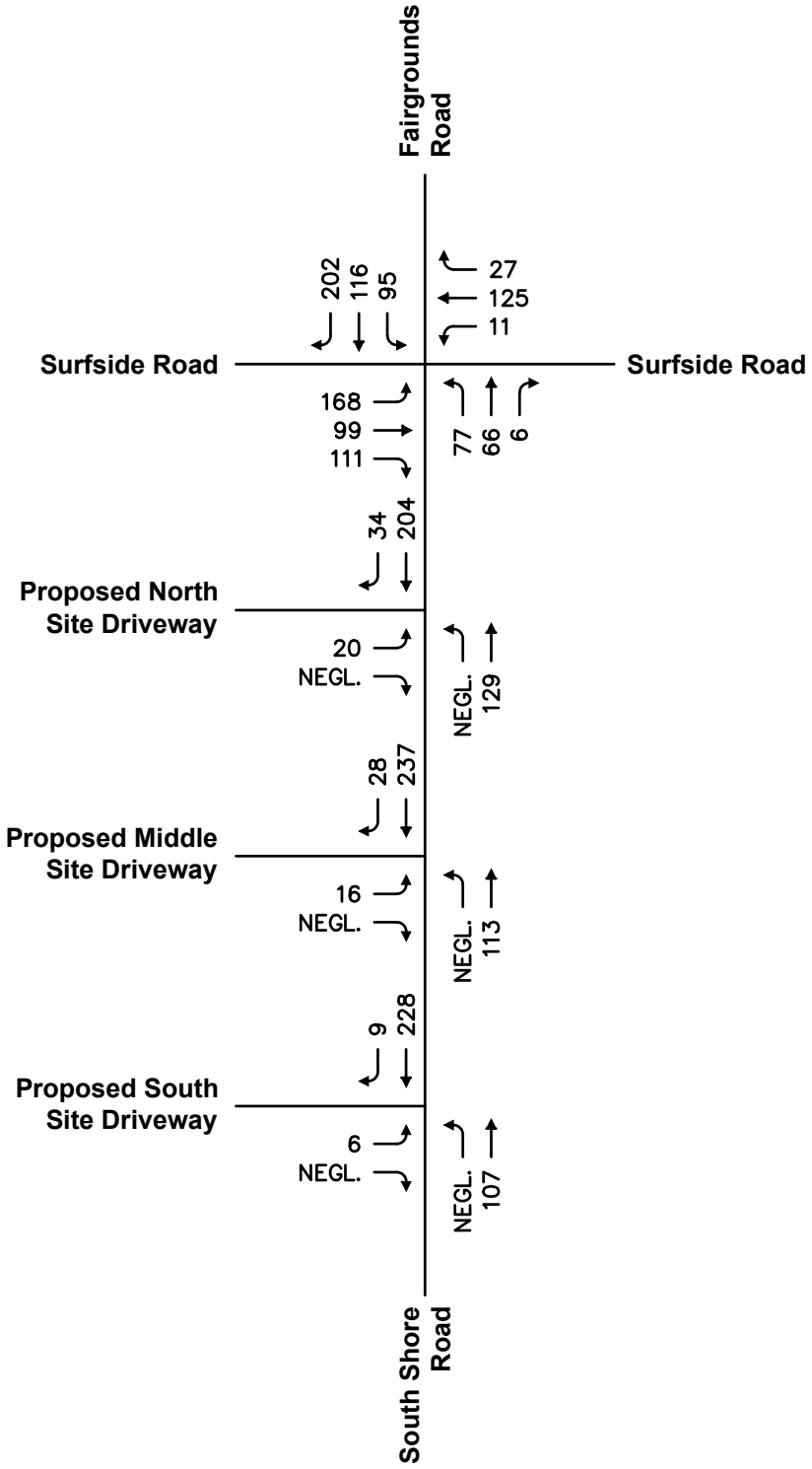

North
Scale: Not to Scale

NOTES:
NEGL. = Negligible

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Figure 9

2023 Build Conditions
Weekday Evening Peak Hour Volumes

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OPERATIONS ANALYSIS

This section provides an overview of operational analysis methodology, an assessment of driveway operations under Existing (Baseline) and projected future No-Build and Build conditions.

Analysis Methodology

Intersection capacity analyses are presented in this section for the Baseline, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements). The specific control delays and associated LOS designations are presented in the **Attachments**.

Analysis Results

Level-of-Service (LOS) analyses were conducted for the Baseline, No-Build, and Build conditions for the study intersections. The results of the intersection capacity are summarized below in **Table 6** and **Table 7**. Detailed analysis results are presented in the **Attachments**.

TABLE 6
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR (PEAK SEASON)

		2018 Baseline			2023 No-Build			2023 Build		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Surfside Road at Fairgrounds Road/South Shore Road	Eastbound	0.64	18	C	0.71	23	C	0.78	29	D
	Westbound	0.32	13	B	0.35	14	B	0.38	15	C
	Northbound	0.27	12	B	0.30	13	B	0.45	16	C
	Southbound	0.54	15	C	0.59	17	C	0.65	21	C
South Shore Road at North Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.05	11	B
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
South Shore Road at Middle Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.04	10	B
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
South Shore Road at South Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.01	10	A
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]n/a = not applicable

TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR (PEAK SEASON)

		2018 Baseline			2023 No-Build			2023 Build		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Surfside Road at Fairgrounds Road/South Shore Road	Eastbound	0.55	15	C	0.59	17	C	0.69	22	C
	Westbound	0.27	11	B	0.29	12	B	0.32	13	B
	Northbound	0.19	11	B	0.20	11	B	0.31	13	B
	Southbound	0.57	15	C	0.61	17	C	0.72	23	C
South Shore Road at North Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.03	11	B
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
South Shore Road at Middle Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.03	10	B
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
South Shore Road at South Site Driveway	Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	0.01	10	B
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service
[4]n/a = not applicable

As summarized in **Table 6 and Table 7**:

- *Surfside Road at Fairgrounds Road/South Shore Road.* Under future Build conditions, capacity analyses indicate that the Surfside Road intersection with Fairgrounds Road and South Shore Road will operate with moderate delays at level of service (LOS) D or better during the peak season. The incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the intersection compared to No-Build conditions.

- *South Shore Road at Site Driveways.* Under future Build conditions, capacity analyses indicate that the unsignalized Site Driveway approaches to South Shore Road will operate at LOS B or better during the weekday morning and weekday evening peak hours.

Queue Results

The results of the approach queue lengths from the capacity analysis are summarized below in **Table 8**. Detailed analysis results are presented in the **Attachments**.

TABLE 8
VEHICLE QUEUE ANALYSIS SUMMARY
SURFSIDE ROAD AT FAIRGROUNDS ROAD/SOUTH SHORE ROAD

		2018 Baseline	2023 No-Build	2023 Build	Difference (Δ)
Approach	Available Queue Storage Length (feet)	Maximum Queue Length[1]	Maximum Queue Length[1]	Maximum Queue Length[1]	No-Build to Build
Weekday Morning Peak Hour					
Eastbound L/T/R	>1000	4	6	7	+1
Westbound L/T/R	>1000	1	2	2	+0
Northbound L/T/R	>1000	1	1	3	+2
Southbound L/T/R	>1000	3	4	6	+2
Weekday Evening Peak Hour					
Eastbound L/T/R	>1000	3	4	5	+1
Westbound L/T/R	>1000	1	1	1	+0
Northbound L/T/R	>1000	1	1	1	+0
Southbound L/T/R	>1000	4	4	6	+2

[1]Average and 95th percentile queue lengths are reported vehicles per lane.

As presented in **Table 8,** the 95th percentile vehicle queues at the study intersections will generally be contained within available storage lanes during peak hours. During peak hours under peak summer conditions the eastbound Surfside Road approach and southbound Fairgrounds Road approach will have No-Build queues that are manageable which extend between one and two hundred feet from the intersection. The project will not significantly change queue lengths compared to No-Build conditions and will generally result in an increase of 2 vehicles or less on all approaches.

SITE ACCESS/CIRCULATION

AutoTURN analysis has been completed for the preliminary site plan using the Town's Ladder truck and a single unit (SU) delivery truck. Site access, circulation aisles and parking layout provide adequate maneuvering area for the largest potential responding vehicle (ladder truck). Supporting AutoTurn® truck turn analysis and exhibits are provided to confirm this finding (refer to the **Attachments**).

RECOMMENDATIONS AND CONCLUSIONS

Trip generation for the development is projected to be moderate with approximately 88 vehicle trips during the weekday morning peak hour and 113 vehicle trips during the weekday evening peak hour. The project will result in 1 to 2 additional trips per minute during the peak commute hours. MDM finds that incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the study intersections. The study intersections exhibit below-average crash rates based on historic crash data; safety countermeasures are therefore not warranted. Likewise, the available sight lines at the Site Driveway intersection with South Shore Road exceed the recommended sight line requirements from AASHTO.

MDM recommends the following access/egress elements to enhance safety and capacity:

- *Signage and Markings.* A STOP sign (R1-1) and STOP line pavement markings are recommended on the site driveway approaches to South Shore Road. The sign and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD).

- *Pedestrian Accommodation.* The Proponent proposes a sidewalk along the site driveways as part of the development which will provide a connection between the various units and South Shore Road. Additionally, sidewalk extends along the frontage of South Shore Road between the driveways and marked crosswalks provide access to the existing multi-use path.

- *Bicycle Accommodations.* The development should incorporate bicycle storage racks near the multi-family buildings with specific locations to be identified in the final approved Site Plans. Provide bicycle parking, including weather protected racks for residents within or proximate to the multi-family building entrances.

- *Driveway Design.* The final curb radii between the site driveways and South Shore Road should be designed to accommodate the Towns largest fire apparatus (ladder truck) and singe unit delivery vehicles.

- *Sight Line Maintenance.* The sight lines should be cleared and graded with the construction of the proposed primary site driveway approaches to South Shore Road. Any new plantings (shrubs, bushes) or physical landscape features to be located within the project driveway sight lines should also be maintained at a height of 2 feet or less above the adjacent roadway grade to ensure unobstructed lines of sight.

- *Transportation Demand Management (TDM).* TDM actions should be considered that may be appropriate to encourage alternative travel modes for residents and visitors. These include on-site amenities, bicycle storage racks, pedestrian connections, and other methods of reducing automobile use.

In summary, trip generation for the development is projected to be modest. MDM finds that incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the study intersections. The study intersections exhibit below-average crash rates based on historic crash data; safety countermeasures are therefore not warranted. Likewise, the available sight lines at the Site Driveway intersections with South Shore Road exceed the recommended sight line requirements from AASHTO. Implementation of access/egress improvements, proposed pedestrian, and bicycle improvements along with a Transportation Demand Management (TDM) program will establish a framework of minimizing Site traffic impacts by encouraging non-motorized travel modes and pedestrian/bicycle accommodation that is compatible with other projects in the area.

ATTACHMENTS

- Traffic Volume Data
- Seasonal/ Yearly Growth Data
- Speed Data
- Crash Data
- Public Transportation Information
- Sight Distance Calculations
- Trip Generation
- Trip Distribution Calculations
- Capacity Analysis
- AutoTURN® Analysis

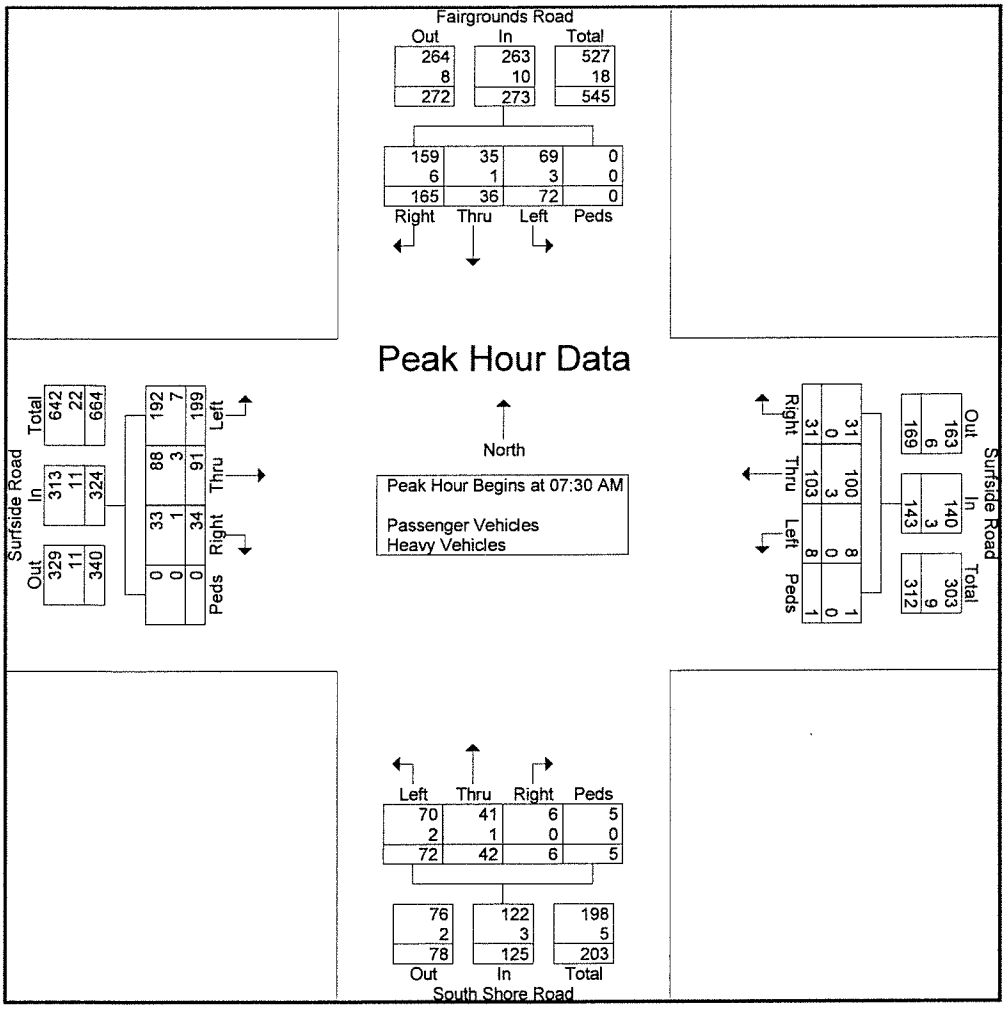
□ Traffic Volume Data

MDM Transportation Consultants, INC.

28 Lord Road, Suite 280
Marlborough, MA

File Name : Surfside at South Shore June AM
Site Code : 959
Start Date : 6/28/2018
Page No : 2

	Fairgrounds Road From North					Surfside Road From East					South Shore Road From South					Surfside Road From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	**45**	**12**	15	0	72	6	18	0	0	24	1	10	17	1	29	8	16	47	0	71	196
07:45 AM	43	8	**23**	0	**74**	**10**	**35**	2	**1**	**48**	**2**	9	19	0	30	8	24	47	0	79	**231**
08:00 AM	42	9	22	0	73	8	26	**5**	0	39	1	11	**20**	**2**	**34**	**9**	23	**53**	0	85	231
08:15 AM	35	7	12	0	54	7	24	1	0	32	2	**12**	16	2	32	9	**28**	52	0	**89**	207
Total Volume	165	36	72	0	273	31	103	8	1	143	6	42	72	5	125	34	91	199	0	324	865
% App. Total	60.4	13.2	26.4	0		21.7	72	5.6	0.7		4.8	33.6	57.6	4		10.5	28.1	61.4	0		
PHF	.917	.750	.783	.000	.922	.775	.736	.400	.250	.745	.750	.875	.900	.625	.919	.944	.813	.939	.000	.910	.936
Passenger Vehicles																					
% Passenger Vehicles	96.4	97.2	95.8	0	96.3	100	97.1	100	100	97.9	100	97.6	97.2	100	97.6	97.1	96.7	96.5	0	96.6	96.9
Heavy Vehicles																					
% Heavy Vehicles	3.6	2.8	4.2	0	3.7	0	2.9	0	0	2.1	0	2.4	2.8	0	2.4	2.9	3.3	3.5	0	3.4	3.1



MDM Transportation Consultants, INC.

28 Lord Road, Suite 280
Marlborough, MA

N/S: Fairgrounds Rd/South Shore Rd
E/W: Surfside Rd
Nantucket, MA

File Name : Surfside at South Shore June AM
Site Code : 959
Start Date : 6/28/2018
Page No : 1

Groups Printed- Passenger Vehicles - Heavy Vehicles

	Fairgrounds Road From North					Surfside Road From East					South Shore Road From South					Surfside Road From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	16	9	6	0	31	9	17	0	0	26	2	19	7	3	31	6	19	35	0	60	148
07:15 AM	22	1	7	0	30	9	18	3	1	31	1	12	26	1	40	5	15	66	0	86	187
07:30 AM	45	12	15	0	72	6	18	0	0	24	1	10	17	1	29	8	16	47	0	71	196
07:45 AM	43	8	23	0	74	10	35	2	1	48	2	9	19	0	30	8	24	47	0	79	231
Total	126	30	51	0	207	34	88	5	2	129	6	50	69	5	130	27	74	195	0	296	762
08:00 AM	42	9	22	0	73	8	26	5	0	39	1	11	20	2	34	9	23	53	0	85	231
08:15 AM	35	7	12	0	54	7	24	1	0	32	2	12	16	2	32	9	28	52	0	89	207
08:30 AM	39	11	13	0	63	11	17	3	1	32	1	9	15	1	26	6	11	44	0	61	182
08:45 AM	31	9	19	0	59	11	22	0	2	35	3	9	18	2	32	8	25	66	0	99	225
Total	147	36	66	0	249	37	89	9	3	138	7	41	69	7	124	32	87	215	0	334	845
Grand Total	273	66	117	0	456	71	177	14	5	267	13	91	138	12	254	59	161	410	0	630	1607
Apprch %	59.9	14.5	25.7	0		26.6	66.3	5.2	1.9		5.1	35.8	54.3	4.7		9.4	25.6	65.1	0		
Total %	17	4.1	7.3	0	28.4	4.4	11	0.9	0.3	16.6	0.8	5.7	8.6	0.7	15.8	3.7	10	25.5	0	39.2	
Passenger Vehicles																					
% Passenger Vehicles	96.7	97	97.4	0	96.9	100	96.6	100	100	97.8	100	96.7	97.1	100	97.2	96.6	96.9	96.6	0	96.7	97
Heavy Vehicles																					
% Heavy Vehicles	3.3	3	2.6	0	3.1	0	3.4	0	0	2.2	0	3.3	2.9	0	2.8	3.4	3.1	3.4	0	3.3	3

MDM Transportation Consultants, INC.

28 Lord Road, Suite 280
Marlborough, MA

File Name : Surfside at South Shore June PM
Site Code : 959
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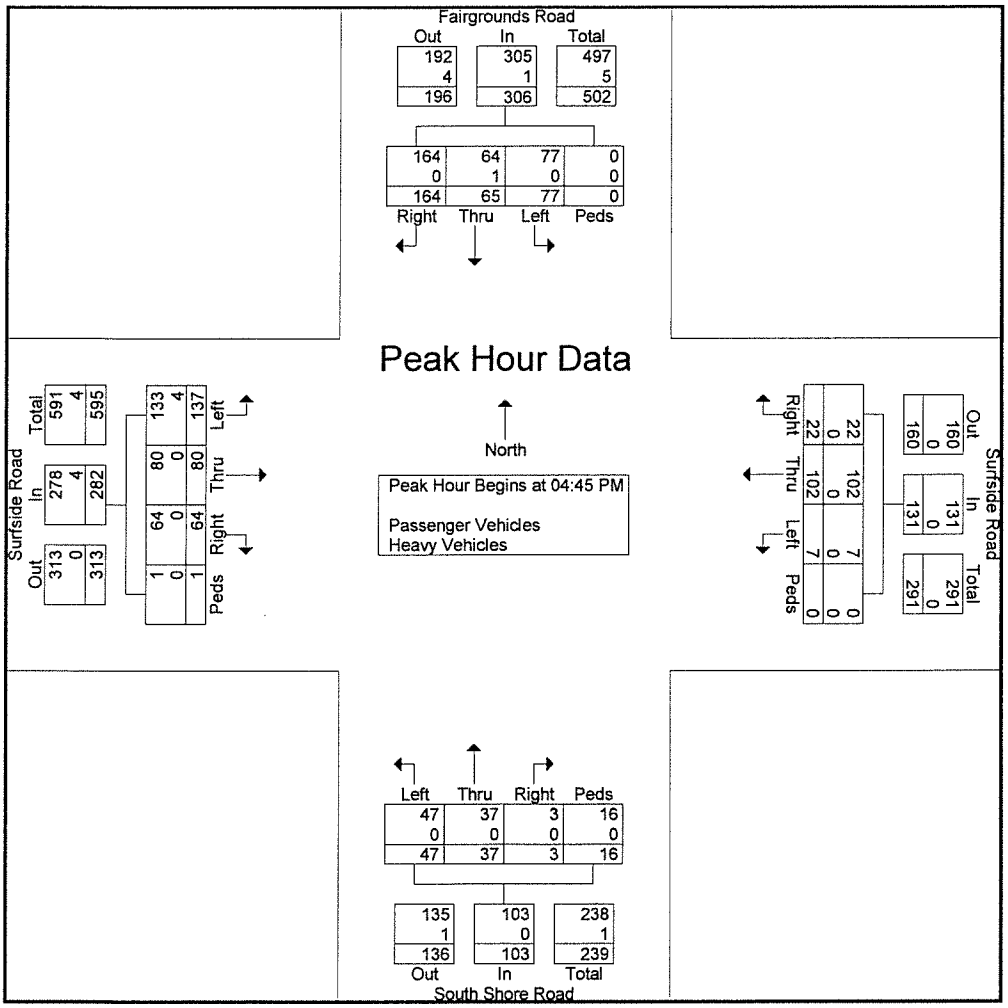
	Fairgrounds Road From North					Surfside Road From East					South Shore Road From South					Surfside Road From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	39	15	**26**	0	80	6	21	**3**	0	30	**1**	**16**	**14**	**6**	**37**	15	**23**	36	0	74	**221**
05:00 PM	**50**	**20**	15	0	**85**	2	17	2	0	21	0	7	12	3	22	**19**	21	34	0	74	202
05:15 PM	28	11	21	0	60	5	**33**	1	0	39	1	7	11	3	22	15	15	27	**1**	58	179
05:30 PM	47	19	15	0	81	**9**	31	1	0	**41**	1	7	10	4	22	15	21	**40**	0	**76**	220
Total Volume	164	65	77	0	306	22	102	7	0	131	3	37	47	16	103	64	80	137	1	282	822
% App. Total	53.6	21.2	25.2	0		16.8	77.9	5.3	0		2.9	35.9	45.6	15.5		22.7	28.4	48.6	0.4		
PHF	.820	.813	.740	.000	.900	.611	.773	.583	.000	.799	.750	.578	.839	.667	.696	.842	.870	.856	.250	.928	.930
Passenger Vehicles % Passenger Vehicles	100	98.5	100	0	99.7	100	100	100	0	100	100	100	100	100	100	100	100	97.1	100	98.6	99.4
Heavy Vehicles % Heavy Vehicles	0	1.5	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	2.9	0	1.4	0.6



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28 Lord Road, Suite 280
Marlborough, MA

N/S: Fairgrounds Rd/South Shore Rd
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Groups Printed- Passenger Vehicles - Heavy Vehicles

	Fairgrounds Road From North					Surfside Road From East					South Shore Road From South					Surfside Road From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	45	19	12	0	76	3	21	1	1	26	1	7	4	3	15	11	22	22	0	55	172
04:15 PM	33	19	16	0	68	10	14	1	1	26	1	8	6	2	17	8	19	36	0	63	174
04:30 PM	32	17	16	0	65	8	15	4	0	27	5	14	13	0	32	15	26	40	0	81	205
04:45 PM	39	15	26	0	80	6	21	3	0	30	1	16	14	6	37	15	23	36	0	74	221
Total	149	70	70	0	289	27	71	9	2	109	8	45	37	11	101	49	90	134	0	273	772
05:00 PM	50	20	15	0	85	2	17	2	0	21	0	7	12	3	22	19	21	34	0	74	202
05:15 PM	28	11	21	0	60	5	33	1	0	39	1	7	11	3	22	15	15	27	1	58	179
05:30 PM	47	19	15	0	81	9	31	1	0	41	1	7	10	4	22	15	21	40	0	76	220
05:45 PM	53	14	12	0	79	9	17	1	2	29	2	5	9	3	19	8	27	49	0	84	211
Total	178	64	63	0	305	25	98	5	2	130	4	26	42	13	85	57	84	150	1	292	812
Grand Total	327	134	133	0	594	52	169	14	4	239	12	71	79	24	186	106	174	284	1	565	1584
Apprch %	55.1	22.6	22.4	0		21.8	70.7	5.9	1.7		6.5	38.2	42.5	12.9		18.8	30.8	50.3	0.2		
Total %	20.6	8.5	8.4	0	37.5	3.3	10.7	0.9	0.3	15.1	0.8	4.5	5	1.5	11.7	6.7	11	17.9	0.1	35.7	
Passenger Vehicles																					
% Passenger Vehicles	99.7	98.5	100	0	99.5	100	100	100	100	100	100	100	100	100	100	100	98.3	97.9	100	98.4	99.2
Heavy Vehicles																					
% Heavy Vehicles	0.3	1.5	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	1.7	2.1	0	1.6	0.8

□ Seasonal Data/ Yearly Growth

CAPE COD
COMMISSION

Table 5: Monthly Adjustment Factors for Cape Cod

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011*	1.26	1.25	1.20	1.06	0.96	0.89	0.76	0.76	0.92	0.99	1.08	1.14
2010	1.26	1.25	1.19	1.08	0.95	0.88	0.77	0.76	0.93	1.00	1.08	1.15
2009	1.26	1.25	1.19	1.08	0.95	0.88	0.77	0.76	0.93	1.00	1.08	1.15
2008	1.21	1.25	1.19	1.08	0.96	0.89	0.78	0.76	0.93	1.00	1.07	1.14
2007	1.25	1.21	1.17	1.06	0.96	0.86	0.78	0.79	0.93	1.00	1.08	1.14
2006	1.26	1.20	1.18	1.04	0.96	0.86	0.78	0.79	0.93	0.99	1.07	1.12
2005	1.27	1.23	1.18	1.06	0.96	0.85	0.77	0.78	0.93	0.99	1.08	1.15
2004	1.27	1.23	1.18	1.06	0.96	0.85	0.77	0.78	0.93	0.99	1.08	1.15
2003	1.29	1.23	1.16	1.06	0.99	0.87	0.79	0.77	0.95	0.99	1.07	1.14
2002	1.30	1.24	1.16	1.06	0.98	0.86	0.79	0.78	0.93	0.97	1.08	1.14
2001	1.34	1.27	1.18	1.06	0.97	0.86	0.78	0.78	0.94	0.97	1.08	1.13
2000	1.37	1.28	1.20	1.07	0.96	0.87	0.77	0.78	0.93	0.97	1.09	1.14
1999	1.37	1.29	1.23	1.09	0.96	0.87	0.76	0.77	0.94	0.99	1.10	1.15
1998	1.39	1.27	1.23	1.11	0.95	0.87	0.76	0.76	0.93	0.99	1.10	1.16
1997	1.38	1.29	1.22	1.10	0.96	0.86	0.76	0.75	0.92	0.99	1.10	1.19
1996	1.41	1.30	1.22	1.07	0.96	0.86	0.75	0.75	0.91	0.99	1.10	1.19
1995	1.36	1.33	1.24	1.07	0.97	0.86	0.75	0.75	0.90	0.99	1.10	1.19
1994	1.35	1.31	1.25	1.06	0.93	0.86	0.73	0.74	0.89	0.97	1.09	1.15
1993	1.35	1.30	1.24	1.07	0.92	0.85	0.75	0.75	0.90	0.99	1.10	1.17
1992	1.37	1.32	1.29	1.08	0.94	0.87	0.75	0.76	0.90	1.01	1.14	1.21
1991	1.39	1.30	1.22	1.08	0.94	0.87	0.76	0.77	0.95	1.02	1.12	1.20
1990	1.31	1.26	1.16	1.06	0.96	0.85	0.73	0.74	0.94	0.99	1.10	1.22
1989	1.37	1.38	1.25	1.13	0.99	0.89	0.72	0.73	0.94	1.03	1.15	1.17
1988	1.38	1.30	1.21	1.10	0.99	0.83	0.72	0.73	0.91	1.02	1.11	1.15
1987	1.40	1.39	1.23	1.10	0.94	0.85	0.71	0.73	0.96	1.02	1.18	1.25
1986	1.35	1.31	1.21	1.09	1.05	0.84	0.73	0.75	0.96	1.04	1.17	1.22
1985	1.31	1.26	1.17	1.07	0.96	0.92	0.84	0.83	0.97	0.97	1.14	1.16
1984	1.55	1.36	1.46	1.12	1.03	0.85	0.73	0.73	0.94	1.07	1.14	1.24
1983	1.53	1.51	1.30	1.15	0.98	0.82	0.65	0.66	0.87	1.07	1.23	1.30

Source: Massachusetts Highway Department / Mass DOT
*2011 is the last year that MassDOT has supplied monthly adjustment factors

- Speed Data

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA 01752
508-303-0370
www.mdmtrans.com

N/S: South Shore Road
Near Proposed Site Driveway
Nantucket, MA

Date Start: 24-Jan-18
Site Code: 959
Station ID:

Southbound

Date Start: 24-Jan-18

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
01/24/18	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	4	5	7	30	38	23	7	0	0	0	0	0	0	0	114	37
13:00	0	0	0	24	28	17	4	2	0	0	0	0	0	0	75	38
14:00	1	0	4	18	34	23	5	1	0	0	0	0	0	0	86	38
15:00	1	1	6	22	34	19	7	1	0	0	0	0	0	0	91	38
16:00	0	2	5	30	47	36	9	0	0	0	0	0	0	0	129	38
17:00	4	2	8	36	46	15	4	0	0	0	0	0	0	0	115	35
18:00	2	0	3	15	25	16	6	0	0	0	0	0	0	0	67	38
19:00	0	2	1	6	20	7	4	0	0	0	0	0	0	0	40	38
20:00	0	0	0	8	13	11	2	1	0	0	0	0	0	0	35	38
21:00	1	1	0	4	9	4	1	0	0	0	0	0	0	0	20	37
22:00	0	1	0	3	4	2	3	0	0	0	0	0	0	0	13	41
23:00	0	0	0	0	4	1	0	0	0	0	0	0	0	0	5	36

Statistics		
	10 MPH Pace Speed :	26-35 MPH
	85th Percentile :	38 MPH
	95th Percentile :	41 MPH
	Number of Vehicles > 30 MPH :	533
	Percent of Vehicles > 30 MPH :	67.5%
	Mean Speed(Average) :	33 MPH

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA 01752
508-303-0370
www.mdmtrans.com

N/S: South Shore Road
Near Proposed Site Driveway
Nantucket, MA

Date Start: 24-Jan-18
Site Code: 959
Station ID:

Southbound

Date Start: 24-Jan-18

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
01/25/18	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2	43
01:00	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	38
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
03:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	34
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
05:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	34
06:00	0	0	0	4	7	5	5	1	0	0	0	0	0	0	22	42
07:00	2	1	0	19	13	17	6	1	1	0	0	0	0	0	60	39
08:00	1	2	3	9	32	17	5	2	0	0	0	0	0	0	71	38
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
17:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
18:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
19:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
20:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
21:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
22:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
23:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Statistics		
	10 MPH Pace Speed :	31-40 MPH
	85th Percentile :	39 MPH
	95th Percentile :	44 MPH
	Number of Vehicles > 30 MPH :	116
	Percent of Vehicles > 30 MPH :	73.0%
	Mean Speed(Average) :	34 MPH

Stats		
	Mean Speed(Average) :	33 MPH
	85th Percentile :	38 MPH
	95th Percentile :	42 MPH
	Number of Vehicles > 30 MPH :	649
	Percent of Vehicles > 30 MPH :	68.4%

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N/S: South Shore Road
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Nantucket, MA

Date Start: 24-Jan-18
Site Code: 959
Station ID:

Northbound

Date Start: 24-Jan-18

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
01/24/18	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	3	3	10	26	51	27	3	0	0	0	0	0	0	0	123	37
13:00	1	0	1	17	28	18	10	4	0	0	0	0	0	0	79	41
14:00	1	0	0	10	27	16	10	1	0	0	0	0	0	0	65	40
15:00	1	1	2	20	36	31	9	1	0	0	0	0	0	0	101	39
16:00	1	1	5	16	40	22	8	1	0	0	0	0	0	0	94	38
17:00	1	1	9	26	35	17	5	0	0	0	0	0	0	0	94	37
18:00	0	0	0	14	15	12	0	0	0	0	0	0	0	0	41	37
19:00	0	0	1	4	10	9	4	0	0	0	0	0	0	0	28	39
20:00	0	1	1	5	3	5	2	0	0	0	0	0	0	0	17	39
21:00	0	0	2	8	8	5	1	0	1	0	0	0	0	0	25	38
22:00	0	0	1	4	1	0	2	1	0	0	0	0	0	0	9	44
23:00	0	0	0	1	2	0	0	0	0	0	0	0	0	0	3	33

Statistics		
	10 MPH Pace Speed :	31-40 MPH
	85th Percentile :	38 MPH
	95th Percentile :	42 MPH
	Number of Vehicles > 30 MPH :	481
	Percent of Vehicles > 30 MPH :	70.8%
	Mean Speed(Average) :	33 MPH

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Date Start: 24-Jan-18
Site Code: 959
Station ID:

Northbound

Date Start: 24-Jan-18

Start Time	1 15	16 20	21 25	26 30	31 35	36 40	41 45	46 50	51 55	56 60	61 65	66 70	71 75	76 999	Total	85th Percent
01/25/18	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	39
01:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
02:00	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	34
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*
05:00	1	0	1	2	1	3	1	0	0	0	0	0	0	0	9	39
06:00	1	1	2	8	23	9	3	1	0	0	0	0	0	0	48	38
07:00	0	1	9	30	45	44	11	2	0	0	0	0	0	0	142	39
08:00	3	1	4	17	38	24	8	2	0	2	0	0	0	0	99	39
09:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
12 PM	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
13:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
14:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
15:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
17:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
18:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
19:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
20:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
21:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
22:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
23:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Statistics		
	10 MPH Pace Speed :	31-40 MPH
	85th Percentile :	39 MPH
	95th Percentile :	43 MPH
	Number of Vehicles > 30 MPH :	219
	Percent of Vehicles > 30 MPH :	73.0%
	Mean Speed(Average) :	33 MPH

Stats		
	Mean Speed(Average) :	33 MPH
	85th Percentile :	38 MPH
	95th Percentile :	42 MPH
	Number of Vehicles > 30 MPH :	700
	Percent of Vehicles > 30 MPH :	71.5%

- Crash Data

Moving Massachusetts Forward. massDOT Highway

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Nantucket, MA COUNT DATE : Jun-18

DISTRICT : 5 UNSIGNALIZED : X SIGNALIZED :

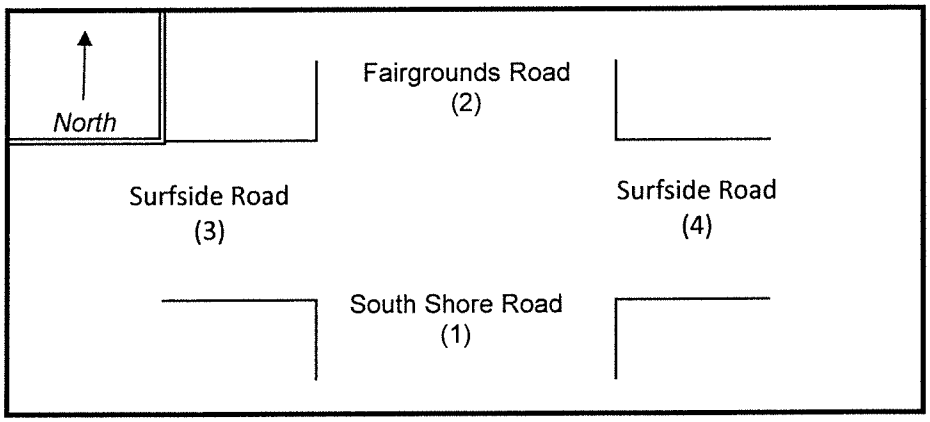
~ INTERSECTION DATA ~

MAJOR STREET : Surfside Road

MINOR STREET(S) : Fairgrounds Road

South Shore Road

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (PM) :	102	358	329	153		942

" K " FACTOR : 0.090 INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : 10,467

TOTAL # OF CRASHES : 2 # OF YEARS : 3 AVERAGE # OF CRASHES PER YEAR (**A**) : 0.67

CRASH RATE CALCULATION : 0.17 RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments : MassDOT District 5 Avg: Signalized = 0.76; Unsignalized = 0.58

Project Title & Date: 959 - Nantucket

massDOT

MassDOT Crash Report for NANTUCKET

Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Most Harmful Events	Vehicle Configuration	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance from Nearest Roadway Intersection	Distance from Nearest Milemarker	Distance from Nearest Exit	Distance from Nearest Landmark	Non Motorist Type
2015																					
4052149	NANTUCKET	26-Jan-2015	4:10 PM	Not Reported	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic	V1: Not reported / V2: Not reported	V1: Collision with motor vehicle in traffic / V2: Collision with motor vehicle in traffic	V1: Light truck(van, mini-van, panel, pickup, sport utility) with only four tires / V2: Light truck(van, mini-van, panel, pickup, sport utility) with only four tires	Ice	Dusk	Snow/Blowing sand, snow	FAIRGROUNDS ROAD / SURFSIDE ROAD					
2014																					
3958286	NANTUCKET	17-Oct-2014	8:59 AM	Property damage only (none injured)	2	0	0	Sideswipe, opposite direction	V1: Traveling straight ahead / V2: Traveling straight ahead	V1: Eastbound / V2: Southbound	V1: Collision with motor vehicle in traffic / V2: Collision with motor vehicle in traffic	V1: Passenger car / V2: Light truck(van, mini-van, panel, pickup, sport utility) with only four tires	Wet	Daylight	Clear/Clear		FAIR GROUND ROAD / SURFSIDE ROAD				
2013																					

□ Public Transportation Information

the WAVE
Nantucket Regional Transit Authority

Downtown Nantucket

- FERRY TO HARWICH PORT (SEASONAL)
- FERRY TO HYANNIS (YEAR ROUND)
- FERRY TO MARTHA'S VINEYARD (SEASONAL)

Madaket Route
Jetties Beach Route
Miacomet Loop
Surfside Beach Route
Airport Route
Sconset Via Old South Route
Sconset Via Milestone Road Route
Sconset Via Polpis Road Route
Mid Island Loop

Nantucket Harbor
Nantucket Sound
Atlantic Ocean

LEGEND

- Airport Route
- Jetties Beach Route
- Madaket Route
- Miacomet Loop
- Mid Island Loop
- Sconset Via Old South Route
- Sconset Via Milestone Road Route
- Sconset Via Polpis Road Route
- Surfside Beach Route
- Bike Path
- Major Downtown Bus Stop (see other side for list of all bus stops)
- Greenhound Bus Stop
- Park and Ride Lot
- Point of Interest
- Hospital
- ATM
- Information
- Lightbouse
- Public Restrooms
- Taxi Stand
- Walking Area

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Design by Smartmaps, Inc.

Scan in the QR Code to download your real-time WAVE app.

Access real time information about bus locations, estimated bus arrivals, and announcements that could impact your trip from your computer or internet-enabled cell phone at nrta.transloc.com

TransLoc

Made Possible By
Main NANTUCKET

□ Sight Distance Calculations

Stopping Sight Distance - Regulatory

Approaches to Site Driveway

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	NB	35	128.625	117.4	246.0
Direction 2	SB	35	128.625	117.4	246.0

INPUTS	Direction 1	Direction 2
Travel Direction	NB	SB
Speed	35	35
Grade	0	0
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = V^2 / (30 x ((a/32.2)+G))

Where:
t = reaction time (sec)
V = travel speed (mph)
G= roadway grade
a - deceleration rate (ft/sec^2)

Stopping Sight Distance - Average

Approaches to Site Driveway

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	NB	33	121.275	104.4	226
Direction 2	SB	33	121.275	104.4	226

INPUTS	Direction 1	Direction 2
Travel Direction	NB	SB
Speed	33	33
Grade	0	0
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = V^2 / (30 x ((a/32.2)+G))

Where:
t = reaction time (sec)
V = travel speed (mph)
G= roadway grade
a - deceleration rate (ft/sec^2)

Stopping Sight Distance - Observed 85th Percentile

Approaches to Site Driveway

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	NB	38	139.65	138.4	278
Direction 2	SB	38	139.65	138.4	278

INPUTS	Direction 1	Direction 2
Travel Direction	NB	SB
Speed	38	38
Grade	0	0
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = V^2 / (30 x ((a/32.2)+G))

Where:
t = reaction time (sec)
V = travel speed (mph)
G= roadway grade
a - deceleration rate (ft/sec^2)

□ Trip Generation

Institute of Transportation Engineers (ITE) 10th Edition
Land Use Code (LUC) 210 - Single-Family Detached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 60

AVERAGE WEEKDAY DAILY

T = 9.5* (X)
T = 9.5* 60
T = 570.00
T = 570 vehicle trips
with 50% (285 vpd) entering and 50% (285 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.74* (X)
T = 0.74 * 60
T = 44.40
T = 44 vehicle trips
with 25% (11 vph) entering and 75% (33 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.99* (X)
T = 0.99* 60
T = 59.40
T = 59 vehicle trips
with 63% (37 vph) entering and 37% (22 vph) exiting.

SATURDAY DAILY

T = 9.54* (X)
T = 9.54* 60
T = 572.40
T = 572 vehicle trips
with 50% (286 vph) entering and 50% (286 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

T = 0.93* (X)
T = 0.93* 60
T = 55.80
T = 56 vehicle trips
with 54% (30 vph) entering and 46% (26 vph) exiting.

Institute of Transportation Engineers (ITE) 10th Edition
Land Use Code (LUC) 220 - Multifamily Housing (Low-Rise)

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 96

AVERAGE WEEKDAY DAILY

T = 7.32 * X
T = 7.32 * 96
T = 702.72
T = 702 vehicle trips
with 50% (**351** vpd) entering and 50% (**351** vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.46 * X
T = 0.46 * 96
T = 44.16
T = 44 vehicle trips
with 23% (**10** vph) entering and 77% (**34** vph) exiting.

WEEKDAY MORNING PEAK HOUR OF GENERATOR

T = 0.56 * X
T = 0.56 * 0
T = 53.76
T = 54 vehicle trips
with 28% (**15** vph) entering and 72% (**39** vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.56 * X
T = 0.56 * 96
T = 53.76
T = 54 vehicle trips
with 63% (**34** vph) entering and 37% (**20** vph) exiting.

WEEKDAY EVENING PEAK HOUR OF GENERATOR

T = 0.67 * X
T = 0.67 * 0
T = 64.32
T = 64 vehicle trips
with 59% (**38** vph) entering and 41% (**26** vph) exiting.

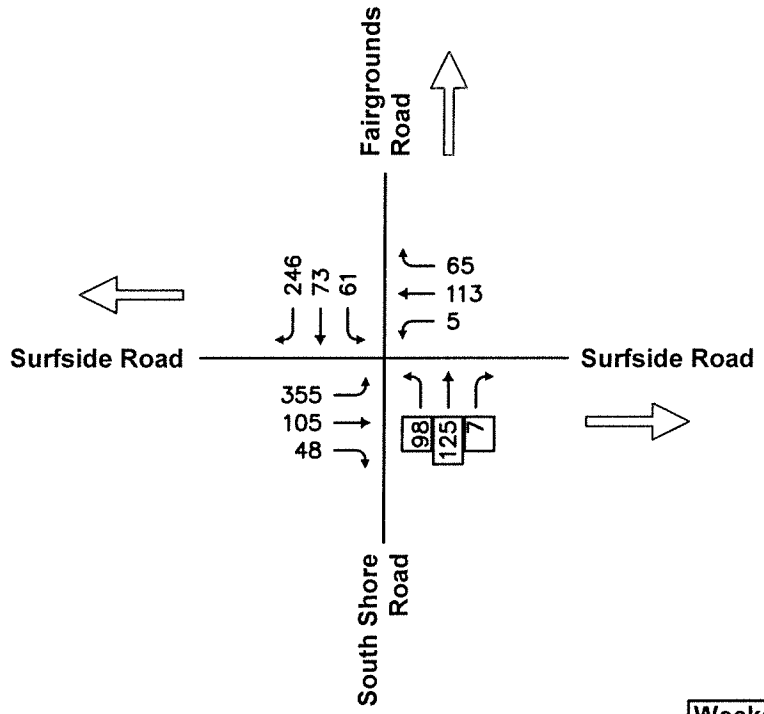
SATURDAY DAILY

T = 8.14 * X
T = 8.14 * 96
T = 781.44
T = 782 vehicle trips
with 50% (**391** vpd) entering and 50% (**391** vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

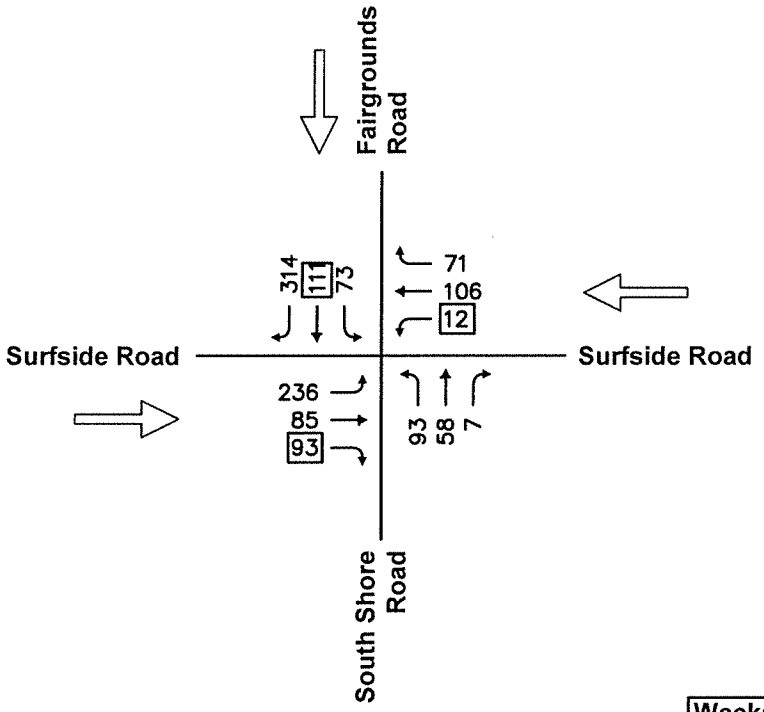
T = 0.70 * X
T = 0.70 * 96
T = 67.20
T = 67 vehicle trips
with 49% (**33** vph) entering and 51% (**34** vph) exiting.

□ Trip Distribution Calculations



VOLUME IN	%
98	43%
125	54%
7	7%
230	100%

Weekday Morning Peak Hour



VOLUME OUT	%
93	43%
111	51%
12	6%
216	100%

North

Scale: Not to Scale

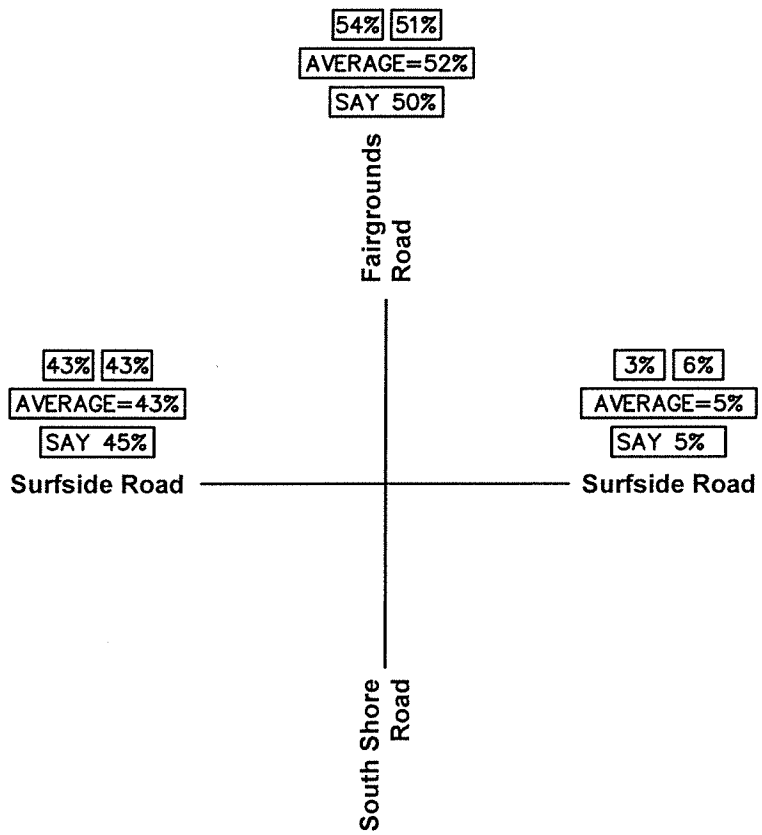
Weekday Evening Peak Hour

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Attachments

Trip Distribution Calculations
(From February Counts)
Step 1

Date: July 2018



North

Scale: Not to Scale

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Attachments

Trip Distribution Calculations
(From February Counts)
Step 2

Date: July 2018

□ Capacity Analysis

Intersection	
Intersection Delay, s/veh	15.6
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	223	107	40	0	6	121	36	0	84	49	7
Peak Hour Factor	0.92	0.94	0.94	0.94	0.92	0.94	0.94	0.94	0.92	0.94	0.94	0.94
Heavy Vehicles, %	2	1	0	10	2	33	0	5	2	7	3	0
Mvmt Flow	0	237	114	43	0	6	129	38	0	89	52	7
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	18.4	12.8	12.1
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	60%	60%	4%	26%
Vol Thru, %	35%	29%	74%	13%
Vol Right, %	5%	11%	22%	61%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	140	370	163	319
LT Vol	84	223	6	84
Through Vol	49	107	121	42
RT Vol	7	40	36	193
Lane Flow Rate	149	394	173	339
Geometry Grp	1	1	1	1
Degree of Util (X)	0.273	0.632	0.321	0.536
Departure Headway (Hd)	6.603	5.884	6.657	5.792
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	547	618	543	628
Service Time	4.615	3.884	4.668	3.792
HCM Lane V/C Ratio	0.272	0.638	0.319	0.54
HCM Control Delay	12.1	18.4	12.8	15.3
HCM Lane LOS	B	C	B	C
HCM 95th-tile Q	1.1	4.4	1.4	3.2

Intersection

Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	84	42	193
Peak Hour Factor	0.92	0.94	0.94	0.94
Heavy Vehicles, %	2	5	0	0
Mvmt Flow	0	89	45	205
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	15.3
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	14
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	160	94	75	0	8	119	26	0	55	43	4
Peak Hour Factor	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	1	0	4	2	0	2	0	2	0	3	0
Mvmt Flow	0	172	101	81	0	9	128	28	0	59	46	4
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	15.2	11	10.7
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	54%	49%	5%	25%
Vol Thru, %	42%	29%	78%	21%
Vol Right, %	4%	23%	17%	54%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	102	329	153	358
LT Vol	55	160	8	90
Through Vol	43	94	119	76
RT Vol	4	75	26	192
Lane Flow Rate	110	354	165	385
Geometry Grp	1	1	1	1
Degree of Util (X)	0.187	0.546	0.266	0.567
Departure Headway (Hd)	6.144	5.555	5.823	5.302
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	579	647	612	678
Service Time	4.229	3.618	3.901	3.363
HCM Lane V/C Ratio	0.19	0.547	0.27	0.568
HCM Control Delay	10.7	15.2	11	15.1
HCM Lane LOS	B	C	B	C
HCM 95th-tile Q	0.7	3.3	1.1	3.6

Intersection

Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	90	76	192
Peak Hour Factor	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	0	2	1
Mvmt Flow	0	97	82	206
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	15.1
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	18.2
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	245	112	42	0	6	127	38	0	88	51	7
Peak Hour Factor	0.92	0.94	0.94	0.94	0.92	0.94	0.94	0.94	0.92	0.94	0.94	0.94
Heavy Vehicles, %	2	1	0	10	2	33	0	5	2	7	3	0
Mvmt Flow	0	261	119	45	0	6	135	40	0	94	54	7
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	22.7	13.6	12.8
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	60%	61%	4%	26%
Vol Thru, %	35%	28%	74%	13%
Vol Right, %	5%	11%	22%	61%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	146	399	171	335
LT Vol	88	245	6	88
Through Vol	51	112	127	44
RT Vol	7	42	38	203
Lane Flow Rate	155	424	182	356
Geometry Grp	1	1	1	1
Degree of Util (X)	0.296	0.712	0.349	0.592
Departure Headway (Hd)	6.87	6.038	6.897	5.982
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	522	599	520	602
Service Time	4.932	4.082	4.953	4.031
HCM Lane V/C Ratio	0.297	0.708	0.35	0.591
HCM Control Delay	12.8	22.7	13.6	17.4
HCM Lane LOS	B	C	B	C
HCM 95th-tile Q	1.2	5.8	1.6	3.9

Intersection

Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	88	44	203
Peak Hour Factor	0.92	0.94	0.94	0.94
Heavy Vehicles, %	2	5	0	0
Mvmt Flow	0	94	47	216
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	17.4
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	15.3
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	168	99	79	0	8	125	27	0	58	45	4
Peak Hour Factor	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	1	0	4	2	0	2	0	2	0	3	0
Mvmt Flow	0	181	106	85	0	9	134	29	0	62	48	4
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	16.6	11.5	11.1
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	54%	49%	5%	25%
Vol Thru, %	42%	29%	78%	21%
Vol Right, %	4%	23%	17%	54%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	107	346	160	377
LT Vol	58	168	8	95
Through Vol	45	99	125	80
RT Vol	4	79	27	202
Lane Flow Rate	115	372	172	405
Geometry Grp	1	1	1	1
Degree of Util (X)	0.205	0.587	0.286	0.611
Departure Headway (Hd)	6.423	5.681	6.088	5.422
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	563	629	594	661
Service Time	4.423	3.764	4.088	3.501
HCM Lane V/C Ratio	0.204	0.591	0.29	0.613
HCM Control Delay	11.1	16.6	11.5	16.8
HCM Lane LOS	B	C	B	C
HCM 95th-tile Q	0.8	3.8	1.2	4.2

Intersection

Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	95	80	202
Peak Hour Factor	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	0	2	1
Mvmt Flow	0	102	86	217
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	16.8
HCM LOS	C

Lane

Intersection	
Intersection Delay, s/veh	21.8
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	245	112	51	0	7	127	38	0	118	85	10
Peak Hour Factor	0.92	0.94	0.94	0.94	0.92	0.94	0.94	0.94	0.92	0.94	0.94	0.94
Heavy Vehicles, %	2	1	0	10	2	33	0	5	2	7	3	0
Mvmt Flow	0	261	119	54	0	7	135	40	0	126	90	11
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	28.6	15.1	16
HCM LOS	D	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	55%	60%	4%	25%
Vol Thru, %	40%	27%	74%	16%
Vol Right, %	5%	12%	22%	59%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	213	408	172	346
LT Vol	118	245	7	88
Through Vol	85	112	127	55
RT Vol	10	51	38	203
Lane Flow Rate	227	434	183	368
Geometry Grp	1	1	1	1
Degree of Util (X)	0.449	0.777	0.383	0.652
Departure Headway (Hd)	7.234	6.442	7.543	6.381
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	501	560	479	563
Service Time	5.234	4.53	5.543	4.476
HCM Lane V/C Ratio	0.453	0.775	0.382	0.654
HCM Control Delay	16	28.6	15.1	20.8
HCM Lane LOS	C	D	C	C
HCM 95th-tile Q	2.3	7.1	1.8	4.7

Intersection

Intersection Delay, s/veh
Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	88	55	203
Peak Hour Factor	0.92	0.94	0.94	0.94
Heavy Vehicles, %	2	5	0	0
Mvmt Flow	0	94	59	216
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	20.8
HCM LOS	C

Lane

Intersection

Int Delay, s/veh 1.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	34	0	0	179	103	10
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	2	2	0
Mvmt Flow	36	0	0	188	108	11

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	302	114	119	0	-	0
Stage 1	114	-	-	-	-	-
Stage 2	188	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	694	944	1482	-	-	-
Stage 1	916	-	-	-	-	-
Stage 2	849	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	694	944	1482	-	-	-
Mov Cap-2 Maneuver	694	-	-	-	-	-
Stage 1	916	-	-	-	-	-
Stage 2	849	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1482	-	694	-	-
HCM Lane V/C Ratio	-	-	0.052	-	-
HCM Control Delay (s)	0	-	10.5	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Intersection	
Int Delay, s/veh	0.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	25	0	0	154	95	8
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	2	2	0
Mvmt Flow	26	0	0	162	100	8

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	266	104	108	0	-	0
Stage 1	104	-	-	-	-	-
Stage 2	162	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	727	956	1495	-	-	-
Stage 1	925	-	-	-	-	-
Stage 2	872	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	727	956	1495	-	-	-
Mov Cap-2 Maneuver	727	-	-	-	-	-
Stage 1	925	-	-	-	-	-
Stage 2	872	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.1	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1495	-	727	-	-
HCM Lane V/C Ratio	-	-	0.036	-	-
HCM Control Delay (s)	0	-	10.1	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection

Int Delay, s/veh 0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	8	0	0	146	92	3
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	2	2	0
Mvmt Flow	8	0	0	154	97	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	252	98	100	0	-	0
Stage 1	98	-	-	-	-	-
Stage 2	154	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	741	963	1505	-	-	-
Stage 1	931	-	-	-	-	-
Stage 2	879	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	741	963	1505	-	-	-
Mov Cap-2 Maneuver	741	-	-	-	-	-
Stage 1	931	-	-	-	-	-
Stage 2	879	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.9	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1505	-	741	-	-
HCM Lane V/C Ratio	-	-	0.011	-	-
HCM Control Delay (s)	0	-	9.9	-	-
HCM Lane LOS	A	-	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Intersection Delay, s/veh	19.7
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	168	99	111	0	11	125	27	0	77	66	6
Peak Hour Factor	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	1	0	4	2	0	2	0	2	0	3	0
Mvmt Flow	0	181	106	119	0	12	134	29	0	83	71	6
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	21.8	12.9	12.9
HCM LOS	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	52%	44%	7%	23%
Vol Thru, %	44%	26%	77%	28%
Vol Right, %	4%	29%	17%	49%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	149	378	163	413
LT Vol	77	168	11	95
Through Vol	66	99	125	116
RT Vol	6	111	27	202
Lane Flow Rate	160	406	175	444
Geometry Grp	1	1	1	1
Degree of Util (X)	0.304	0.691	0.323	0.725
Departure Headway (Hd)	6.822	6.119	6.636	5.88
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	524	589	540	613
Service Time	4.894	4.175	4.708	3.933
HCM Lane V/C Ratio	0.305	0.689	0.324	0.724
HCM Control Delay	12.9	21.8	12.9	23
HCM Lane LOS	B	C	B	C
HCM 95th-tile Q	1.3	5.4	1.4	6.1

Intersection

Intersection Delay, s/veh
Intersection LOS

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	95	116	202
Peak Hour Factor	0.92	0.93	0.93	0.93
Heavy Vehicles, %	2	0	2	1
Mvmt Flow	0	102	125	217
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	23
HCM LOS	C

Lane

Intersection

Int Delay, s/veh 0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	20	0	0	129	204	34
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	2	2	0
Mvmt Flow	21	0	0	136	215	36

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	369	233	251	0	-	0
Stage 1	233	-	-	-	-	-
Stage 2	136	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	635	811	1326	-	-	-
Stage 1	810	-	-	-	-	-
Stage 2	895	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	635	811	1326	-	-	-
Mov Cap-2 Maneuver	635	-	-	-	-	-
Stage 1	810	-	-	-	-	-
Stage 2	895	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.9	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1326	-	635	-	-
HCM Lane V/C Ratio	-	-	0.033	-	-
HCM Control Delay (s)	0	-	10.9	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection

Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	16	0	0	113	176	28
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	2	2	0
Mvmt Flow	17	0	0	119	185	29

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	319	200	215	0	-	0
Stage 1	200	-	-	-	-	-
Stage 2	119	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	678	846	1367	-	-	-
Stage 1	838	-	-	-	-	-
Stage 2	911	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	678	846	1367	-	-	-
Mov Cap-2 Maneuver	678	-	-	-	-	-
Stage 1	838	-	-	-	-	-
Stage 2	911	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1367	-	678	-	-
HCM Lane V/C Ratio	-	-	0.025	-	-
HCM Control Delay (s)	0	-	10.4	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Vol, veh/h	6	0	0	107	167	9
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	2	2	0
Mvmt Flow	6	0	0	113	176	9

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	294	181	185	0	-	0
Stage 1	181	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.1	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.2	-	-	-
Pot Cap-1 Maneuver	701	867	1402	-	-	-
Stage 1	855	-	-	-	-	-
Stage 2	917	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	701	867	1402	-	-	-
Mov Cap-2 Maneuver	701	-	-	-	-	-
Stage 1	855	-	-	-	-	-
Stage 2	917	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.2	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1402	-	701	-	-
HCM Lane V/C Ratio	-	-	0.009	-	-
HCM Control Delay (s)	0	-	10.2	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

□ AutoTURN® Analysis

Site Plan Source: Bracken Engineering, Inc.

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers
28 Lord Road, Suite 280
Marlborough, MA 01752

Scale: As Noted
DWG No. 959 Autoturn.dwg

Date: February 2018
Project No. 959

Proposed Development
Nantucket, Massachusetts

SCALE
0 20 40 80 120 FEET

Exhibit 1
Autoturn Analysis
Nantucket Fire Truck

Site Plan Source: Bracken Engineering, Inc.

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers
28 Lord Road, Suite 280
Marlborough, MA 01752

Scale: As Noted
DWG No. 959 Autoturn.dwg

Date: February 2018
Project No. 959

Proposed Development
Nantucket, Massachusetts

SCALE
0 20 40 80 120 FEET

Exhibit 2
Autoturn Analysis
Single Unit Truck