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Ref.: 12015

January 17, 2017

Mr. David Armanetti
The Richmond Company, Inc.
23 Concord Street
Wilmington, MA 01887

Reg.: Supplemental Trip Generation and Traffic Impact Sensitivity Analysis
Prospective Development of Accessory, Secondary, Tertiary, or Duplex Dwellings
Proposed "Sandpiper Place" Single Family Housing Subdivisions, Nantucket, MA

Dear Dave:

Now that the density and layout of the proposed Sandpiper Place I and Sandpiper Place II single family housing subdivisions have been refined and modified, through the ongoing review of the proposals by the Town of Nantucket Planning Board and Town of Nantucket Planning and Land Use Services (PLUS) Department staff and as the result of negotiations with several of the major adjacent abutters, the total number, size, and orientation of the proposed lots seems to be coming into further focus. Based on this, ***Ron Müller & Associates*** (RMA) has prepared this letter to summarize the results of a sensitivity analysis that we have conducted to document the traffic impacts which could result from the potential development of some percentage of the proposed single family house lots within the Sandpiper Place I and Sandpiper Place II residential subdivisions with accessory, secondary, or tertiary dwellings, or with duplex units.

As you know, the traffic study[1] prepared for the proposed project assumed that the Sandpiper Place components of the project would result in the creation of a total of 100 house lots, to be occupied by single family homes. Since then, the density of the Sandpiper Place components of the project has been reduced to a total of 94 lots, with 7 of these proposed lots, comprising the (now) larger "buffer lots" reconfigured to front on Evergreen Way, and therefore will not generate vehicle trips through the main site driveway (to and from Old South Road).

[1] *Traffic Impact and Access Study, Old South Road Mixed-Use Development, Nantucket, MA;* prepared for Richmond Great Point Development LLC; prepared by Ron Müller & Associates; August 26, 2016.

In addition, based on your negotiations with several of the major adjacent abutters, primarily including the Cedar Crest III homeowner's association, it is likely that a moderate number (+/- 16 lots) of the total lots which would take access through the main site driveway (to and from Old South Road) will be restricted (by covenant) to allow for development with only single dwellings. Based on this, the sensitivity analysis that we conducted assumed that up to 71 of the remaining 87 house lots could by "eligible" for development in this manner (i.e., potentially be developed with accessory, secondary, or tertiary dwellings, or as duplex units).

In order to ensure a methodologically accurate sensitivity analysis, it was important to try to ascertain an empirical baseline, if possible, to estimate the percentage of the total amount of "eligible" lots that would be expected to be developed with multiple dwellings. Based on past experience and observations resulting from historic permit processing and from prior analysis conducted by the Town of Nantucket Planning and Land Use Services (PLUS) Department staff, it seems that only a relatively small to moderate number of all eligible lots across the Island are actually developed with accessory, secondary, or tertiary dwellings, or as duplexes, especially in circumstances where the lot sizes are relatively small, as is the case with about half of the lots proposed within the Sandpiper Place I and Sandpiper Place II residential subdivisions (i.e., lot which are less than 4,500 square feet in size, in terms of land area).

To better quantify and confirm the empirical accuracy of this assumption, staff of The Richmond Company, Inc. obtained a data base created by and sourced directly from the Town of Nantucket Assessing Department, which provided a compilation of all lots on the entire Island which were eligible for development with accessory, secondary, or tertiary dwellings, or as duplex dwellings (based on their zoning designation) and further indicated the total number of said lots that are currently developed as such (with more than a single dwelling). The results of these data, described below, were utilized to guide the assumptions or ranges analyzed in this trip generation and traffic impact sensitivity analysis.

In summary, the data indicates that a total of +/- 13,250 of the +/- 13,600 total existing parcels on the Island in January of 2017 (comprising +/- 97% of all parcels) were eligible (by their zoning) to be developed with accessory, secondary, or tertiary dwellings, or as duplexes. Including the cumulative total of lots in all applicable zoning districts, a total of +/- 2,090 of these +/- 13,250 eligible lots (equal to +/- 16% of all eligible lots) have been developed to date with accessory, secondary, or tertiary dwellings, or as duplexes. Within this overall (Island-wide) total, there are definitive patterns that occur, generally based on the specific zoning designation of the lot, which also often (cross) correlate to lot size.

Lots which are designated within the LUG-1 and LUG-2 zoning districts (which are larger, one and two acre sized lots) are considerably more likely to be developed in this manner; +/- 29% of all existing lots designated within the LUG-1 and LUG-2 zoning districts are currently developed with accessory, secondary, or tertiary dwellings, or as duplexes.

Lots which are designated within the R-5 zoning district, which is the zoning district in which the proposed Sandpiper Place I and Sandpiper Place II residential subdivisions are designated, and which allow for considerably smaller minimum lot sizes, equal to 5,000 square feet of land area or less, are considerably less likely to be developed in this manner; +/- 15% of all existing lots designated within the R-5 zoning district are currently developed with accessory, secondary, or tertiary dwellings, or as duplexes (slightly lower than, but very similar to the Island-wide average of +/- 16% of all total eligible lots).

This pattern correlates quite similarly for lots designated within other eligible zoning districts (based on the zoning requirement relative to minimum lot areas). Lots designated within zoning districts requiring moderately larger minimum lot areas (such as the R-10 and R-20 zoning districts) reflect considerably higher percentages of development with accessory, secondary, or tertiary dwellings, or as duplexes (averaging between +/- 22 to 23% of all eligible lots). Lots designated within zoning districts requiring moderately smaller minimum lot areas (such as the RC, RC-2, ROH, R-1, SOH, SR-10, and SR-20 zoning districts) reflect considerably lower percentages of development with accessory, secondary, or tertiary dwellings, or as duplexes (averaging between +/- 8 to 18% of all eligible lots, with a blended average that is very closely correlated to the Island-wide average of all eligible lots, of +/- 16%).

Based on these data, although it is not absolute, there is quite a clear and consistent statistical correlation that emerges which reflects that over time, across all lots which are eligible by their zoning, the smaller lots (meaning 5,000 square foot sized or smaller lots) are considerably less likely to be developed with accessory, secondary, or tertiary dwellings, or as duplexes when compared to larger lots (meaning 10,000 square foot sized or larger lots). This pattern is inherently logical; by definition, it is more difficult to "fit" one or more additional dwelling units (accessory, secondary, tertiary, etc.) on a considerably smaller lot that still meets the applicable zoning requirements, and does not result in an impractical and / or unattractive overdevelopment of the property, compared to being able to "fit" such on a larger lot (from both a zoning compliance and a practical or aesthetic standpoint).

This pattern leads one to conclude that the smaller lots (classified within the R-5 zoning district) comprising all of the eligible lots within the proposed Sandpiper Place I and Sandpiper Place II residential subdivisions, are highly unlikely to be developed with accessory, secondary, or tertiary dwellings, or as duplexes at a rate that would be higher than the very well-defined average for all R-5 zoning designated land (of 15%) or the Island-wide average (of +/- 16%).

Notwithstanding the results of these data and conclusion, in order to present a more conservative sensitivity analysis of the potential traffic impacts of the development of some of these lots within the proposed Sandpiper Place I and Sandpiper Place II residential subdivisions with accessory, secondary, or tertiary dwellings, or as duplexes, this letter presents analyses of three considerably and exponentially higher percentage scenarios, and compares the results to those provided in the traffic study:

- Scenario 1: assume 25 percent of total eligible lots (18 of 71 eligible lots) to be developed with an accessory, secondary, or tertiary dwelling, or as a duplex – a net total of 105 dwellings.

- Scenario 2: assume 50 percent of total eligible lots (36 of 71 eligible lots) to be developed with an accessory, secondary, or tertiary dwelling, or as a duplex – a net total of 123 dwellings.

- Scenario 3: assume 75 percent of total eligible lots (53 of 71 eligible lots) to be developed with an accessory, secondary, or tertiary dwelling, or as a duplex – a net total of 140 dwellings.

Consistent with the methodology of the traffic study, the Institute of Transportation Engineers (ITE) *Trip Generation Manual*[2] was used to estimate the volume of traffic to be generated by the above scenarios. The ITE Land Use Code (LUC) 210 (Single Family Detached Housing) trip rates were applied and compared with the volume of traffic assumed in the traffic study for the 100 house lots, as shown in Table 1. The trip generation worksheets are attached to this letter.

Table 1
Trip Generation Comparison

Time Period	Original Assumption 100 Dwellings [a]	Scenario 1 105 Dwellings [b]	Scenario 2 123 Dwellings [c]	Scenario 3 140 Dwellings [d]
Weekday AM Peak				
Enter	20	21	24	27
Exit	60	62	72	81
Total	80	83	96	108
Weekday PM Peak				
Enter	66	69	80	89
Exit	39	41	47	53
Total	105	110	127	142
Saturday Midday Peak				
Enter	52	54	63	70
Exit	46	48	55	63
Total	98	102	118	133

[a] From Traffic Impact and Access Study.
[b] ITE Land Use Code 210 (Single Family Detached Housing) for 105 units.
[c] ITE Land Use Code 210 (Single Family Detached Housing) for 123 units.
[d] ITE Land Use Code 210 (Single Family Detached Housing) for 140 units.

[2] *Trip Generation Manual*, *9th Edition;* Institute of Transportation Engineers; Washington, DC; 2012

As shown, Scenario 1 would produce minimal additional traffic over the assumptions in the traffic study, ranging from 3 to 5 additional peak hour trips. Scenario 2, assuming that 50 percent of the eligible lots will be developed with an accessory, secondary, or tertiary dwelling, or as a duplex unit, would produce between 16 and 22 additional peak hour trips. Scenario 3, which assumes that 75 percent of the eligible lots would be developed with an accessory, secondary, or tertiary dwelling, or as a duplex, would result in 28 to 37 additional peak hour trips entering and exiting the main site driveway.

Capacity analyses were performed at the Old South Road and main site driveway intersection under the above three scenarios and the results were compared with those from the original traffic study. Beyond the site driveway intersection, the additional traffic under these scenarios would have a negligible effect on traffic operations as the traffic will split with 70 percent oriented to/from the west on Old South Road and 30 percent to/from the east.

A summary of the level-of-service analysis is provided in Table 2 and the projected volumes and analysis worksheets are attached to this letter. It should be noted that the 7 house lots that will now front on and have access exclusively to Evergreen Way were assumed to now generate through traffic on Old South Road, past the site driveway intersection. In addition, the capacity analyses assumes that the future construction of the proposed roadway improvements along Old South Road will be in place, including widening to provide a westbound left-turn lane and provision of a 10-foot wide median with 2-foot wide shoulders around the median to the west of the driveway that will provide a refuge area for left turns exiting the driveway, to be able to make the turn in a two-stage process, similar to a center turn lane.

As shown in Table 2, the additional traffic generated by conversion of some of the single family house lots into accessory, secondary, tertiary, or duplex units will have a minimal effect on traffic operations at the proposed site driveway intersection with Old South Road. Although vehicle delays and queues will increase, depending on exactly how many lots may be developed in this manner, overall acceptable traffic operations (level of service D) will remain during all peak hours, even if the exponentially higher than anticipated 75 percent of the eligible lots are developed in this manner (Scenario 3).

Table 2
2023 Build Conditions Level-of-Service Analysis Summary - With Improvements
Old South Road at Main Site Driveway

Location/Peak Hour/Movement	Original Traffic Study				Scenario 1				Scenario 2				Scenario 3			
	v/c[a]	Del.[b]	LOS[c]	Queue[d]	v/c	Delay	LOS	Queue	v/c	Delay	LOS	Queue	v/c	Delay	LOS	Queue
Weekday AM Peak																
NB Left	0.45	25.4	D	75	0.45	25.6	D	75	0.48	26.6	D	75	0.50	27.7	D	75
NB Right	0.18	14.3	B	25	0.19	14.3	B	25	0.19	14.4	B	25	0.20	14.5	B	25
WB Left	0.03	9.0	A	25	0.03	9.0	A	25	0.04	9.0	A	25	0.04	9.1	A	25
Weekday PM Peak																
NB Left	0.40	30.1	D	50	0.41	30.6	D	50	0.44	32.0	D	75	0.46	33.5	D	75
NB Right	0.18	16.8	C	25	0.18	16.9	C	25	0.19	17.0	C	25	0.19	17.2	C	25
WB Left	0.11	10.3	B	25	0.11	10.4	B	25	0.11	10.4	B	25	0.12	10.5	B	25
Sat Midday Peak																
NB Left	0.37	24.6	C	50	0.37	25.0	D	50	0.40	25.9	D	50	0.42	27.0	D	50
NB Right	0.15	14.5	B	25	0.15	14.5	B	25	0.16	14.6	B	25	0.16	14.7	B	25
WB Left	0.08	9.5	A	25	0.08	9.5	A	25	0.08	9.6	A	25	0.08	9.6	A	25

[a] Volume-to-capacity ratio.
[b] Average control delay (sec./vehicle).
[c] Level of service.
[d] 95th percentile queue in feet, assuming 25 feet/vehicle.

It is noted that if the prospective density restrictions currently being negotiated between Richmond Great Point Development LLC and the Cedar Crest III homeowner's association to restrict +/- 16 of the 87 total lots (excluding the 7 lots that have been modified to take access to and from Evergreen Way) that are currently proposed within the Sandpiper Place I and Sandpiper Place II residential subdivisions from being developed for multiple dwelling units are modified from those summarized herein (to restrict fewer lots) or are not consummated, and all 87 total "eligible" lots are unrestricted as such, and are eligible to be developed with multiple dwelling units, based on the clear and consistent statistical patterns that are described in detail in this letter, given that only +/- 15% of all R-5 zoning designated lots on the Island are actually developed with multiple dwellings, it is highly unlikely that the prospective development of these additional 16 lots in this manner, or some lesser number, even if it were to occur, would result in a statistically meaningful change to either the trip generation totals or the traffic impact analyses described herein.

Please feel free to contact me should you have any questions regarding these sensitivity analyses.

Sincerely,

Ron Müller & Associates

Ronald Müller, P.E.
Principal

Attachments

Institute of Transportation Engineers (ITE); 9th Edition

Land Use Code (LUC) 210 - Single-Family Detached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 105

Weekday Daily

Ln T = 0.92 Ln (X) + 2.72
Ln T = 7.00
T = 1098.44
T = 1,100 vehicle trips
with 50% (550 vpd) entering and 50% (550 vpd) exiting.

Use Average Rate for < 20 Units:
T = 9.52 (X)
T = 999.60
T = 1,000 vehicle trips
with 500 vpd entering and 500 vpd exiting.

Weekday Morning Peak Hour Of Adjacent Street Traffic

T = 0.70 (X) + 9.74
T = 83.24
T = 83 vehicle trips
with 25% (21 vph) entering and 75% (62 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.75 (X)
T = 78.75
T = 79 vehicle trips
with 20 vpd entering and 59 vpd exiting.

Weekday Evening Peak Hour Of Adjacent Street Traffic

Ln T = 0.90 Ln (X) + 0.51
Ln T = 4.70
T = 109.79
T = 110 vehicle trips
with 63% (69 vph) entering and 37% (41 vph) exiting.

Use Average Rate for < 20 Units:
T = 1.00 (X)
T = 105.00
T = 105 vehicle trips
with 66 vpd entering and 39 vpd exiting.

Saturday Daily

Ln T = 0.93 Ln (X) + 2.64
Ln T = 6.97
T = 1062.29
T = 1,060 vehicle trips
with 50% (530 vpd) entering and 50% (530 vpd) exiting.

Use Average Rate for < 20 Units:
T = 9.91 (X)
T = 1,040.55
T = 1,040 vehicle trips
with 520 vpd entering and 520 vpd exiting.

Saturday Midday Peak Hour Of Generator

T = 0.89 (X) +8.77
T = 102.22
T = 102 vehicle trips
with 53% (54 vph) entering and 47% (48 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.93 (X)
T = 97.65
T = 98 vehicle trips
with 53 vpd entering and 45 vpd exiting.

Sunday Daily

T = 8.63 (X) - 0.63
T = 905.52
T = 910 vehicle trips
with 50% (455 vpd) entering and 50% (455 vpd) exiting.

Use Average Rate for < 20 Units:
T = 8.62 (X)
T = 905.10
T = 910 vehicle trips
with 455 vpd entering and 455 vpd exiting.

Sunday Midday Peak Hour Of Generator

Ln T = 0.91 Ln (X) + 0.31
Ln T = 4.55
T = 94.17
T = 94 vehicle trips
with 53% (50 vph) entering and 47% (44 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.86 (X)
T = 90.30
T = 90 vehicle trips
with 48 vpd entering and 42 vpd exiting.

Institute of Transportation Engineers (ITE); 9th Edition

Land Use Code (LUC) 210 - Single-Family Detached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 123

Weekday Daily

Ln T = 0.92 Ln (X) + 2.72
Ln T = 7.15
T = 1270.56
T = 1,270 vehicle trips
with 50% (635 vpd) entering and 50% (635 vpd) exiting.

Use Average Rate for < 20 Units:
T = 9.52 (X)
T = 1,170.96
T = 1,170 vehicle trips
with 585 vpd entering and 585 vpd exiting.

Weekday Morning Peak Hour Of Adjacent Street Traffic

T = 0.70 (X) + 9.74
T = 95.84
T = 96 vehicle trips
with 25% (24 vph) entering and 75% (72 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.75 (X)
T = 92.25
T = 92 vehicle trips
with 23 vpd entering and 69 vpd exiting.

Weekday Evening Peak Hour Of Adjacent Street Traffic

Ln T = 0.90 Ln (X) + 0.51
Ln T = 4.84
T = 126.59
T = 127 vehicle trips
with 63% (80 vph) entering and 37% (47 vph) exiting.

Use Average Rate for < 20 Units:
T = 1.00 (X)
T = 123.00
T = 123 vehicle trips
with 77 vpd entering and 46 vpd exiting.

Saturday Daily

Ln T = 0.93 Ln (X) + 2.64
Ln T = 7.12
T = 1230.69
T = 1,230 vehicle trips
with 50% (615 vpd) entering and 50% (615 vpd) exiting.

Use Average Rate for < 20 Units:
T = 9.91 (X)
T = 1,218.93
T = 1,220 vehicle trips
with 610 vpd entering and 610 vpd exiting.

Saturday Midday Peak Hour Of Generator

T = 0.89 (X) +8.77
T = 118.24
T = 118 vehicle trips
with 53% (63 vph) entering and 47% (55 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.93 (X)
T = 114.39
T = 114 vehicle trips
with 62 vpd entering and 52 vpd exiting.

Sunday Daily

T = 8.63 (X) - 0.63
T = 1060.86
T = 1,060 vehicle trips
with 50% (530 vpd) entering and 50% (530 vpd) exiting.

Use Average Rate for < 20 Units:
T = 8.62 (X)
T = 1,060.26
T = 1,060 vehicle trips
with 530 vpd entering and 530 vpd exiting.

Sunday Midday Peak Hour Of Generator

Ln T = 0.91 Ln (X) + 0.31
Ln T = 4.69
T = 108.75
T = 109 vehicle trips
with 53% (58 vph) entering and 47% (51 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.86 (X)
T = 105.78
T = 106 vehicle trips
with 56 vpd entering and 50 vpd exiting.

Institute of Transportation Engineers (ITE); 9th Edition

Land Use Code (LUC) 210 - Single-Family Detached Housing

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 140

Weekday Daily

Ln T = 0.92 Ln (X) + 2.72
Ln T = 7.27
T = 1431.26
T = 1,430 vehicle trips
with 50% (715 vpd) entering and 50% (715 vpd) exiting.

Use Average Rate for < 20 Units:
T = 9.52 (X)
T = 1,332.80
T = 1,330 vehicle trips
with 665 vpd entering and 665 vpd exiting.

Weekday Morning Peak Hour Of Adjacent Street Traffic

T = 0.70 (X) + 9.74
T = 107.74
T = 108 vehicle trips
with 25% (27 vph) entering and 75% (81 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.75 (X)
T = 105.00
T = 105 vehicle trips
with 26 vpd entering and 79 vpd exiting.

Weekday Evening Peak Hour Of Adjacent Street Traffic

Ln T = 0.90 Ln (X) + 0.51
Ln T = 4.96
T = 142.23
T = 142 vehicle trips
with 63% (89 vph) entering and 37% (53 vph) exiting.

Use Average Rate for < 20 Units:
T = 1.00 (X)
T = 140.00
T = 140 vehicle trips
with 88 vpd entering and 52 vpd exiting.

Saturday Daily

Ln T = 0.93 Ln (X) + 2.64
Ln T = 7.24
T = 1388.15
T = 1,390 vehicle trips
with 50% (695 vpd) entering and 50% (695 vpd) exiting.

Use Average Rate for < 20 Units:
T = 9.91 (X)
T = 1,387.40
T = 1,390 vehicle trips
with 695 vpd entering and 695 vpd exiting.

Saturday Midday Peak Hour Of Generator

T = 0.89 (X) +8.77
T = 133.37
T = 133 vehicle trips
with 53% (70 vph) entering and 47% (63 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.93 (X)
T = 130.20
T = 130 vehicle trips
with 70 vpd entering and 60 vpd exiting.

Sunday Daily

T = 8.63 (X) - 0.63
T = 1207.57
T = 1,210 vehicle trips
with 50% (605 vpd) entering and 50% (605 vpd) exiting.

Use Average Rate for < 20 Units:
T = 8.62 (X)
T = 1,206.80
T = 1,210 vehicle trips
with 605 vpd entering and 605 vpd exiting.

Sunday Midday Peak Hour Of Generator

Ln T = 0.91 Ln (X) + 0.31
Ln T = 4.81
T = 122.35
T = 122 vehicle trips
with 53% (65 vph) entering and 47% (57 vph) exiting.

Use Average Rate for < 20 Units:
T = 0.86 (X)
T = 120.40
T = 120 vehicle trips
with 64 vpd entering and 56 vpd exiting.

Ron Müller & Associates
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Project: 12015 / Nantucket
Calc. By: RM Date: 12/9/16
Title: Sensitivity Analysis w/ Duplex Units
Sheet: Of:

	AM	PM	Sat.
Scenario 1	← 543 ↖ 29 573 → 48 ↓ ↑ 130 ↗ 81	← 586 ↖ 74 696 → 149 ↓ ↑ 88 ↗ 62	← 521 ↖ 62 587 → 107 ↓ ↑ 97 ↗ 62
Scenario 2	← 543 ↖ 30 573 → 50 ↓ ↑ 137 ↗ 84	← 586 ↖ 77 696 → 157 ↓ ↑ 93 ↗ 63	← 521 ↖ 64 587 → 114 ↓ ↑ 102 ↗ 64
Scenario 3	← 543 ↖ 31 573 → 53 ↓ ↑ 144 ↗ 86	← 586 ↖ 80 696 → 163 ↓ ↑ 97 ↗ 65	← 521 ↖ 66 587 → 119 ↓ ↑ 108 ↗ 66

Intersection	
Int Delay, s/veh	3.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	573	48	29	543	130	81
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	0
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	0	0	7	0	0
Mvmt Flow	623	52	32	590	141	88

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	675	0	1302	649
Stage 1	-	-	-	-	649	-
Stage 2	-	-	-	-	653	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	926	-	179	473
Stage 1	-	-	-	-	524	-
Stage 2	-	-	-	-	522	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	926	-	173	473
Mov Cap-2 Maneuver	-	-	-	-	313	-
Stage 1	-	-	-	-	524	-
Stage 2	-	-	-	-	504	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	21.3
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	313	473	-	-	926	-
HCM Lane V/C Ratio	0.451	0.186	-	-	0.034	-
HCM Control Delay (s)	25.6	14.3	-	-	9	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	2.2	0.7	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	696	149	74	586	88	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	100
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	6	0	0	2	0	0
Mvmt Flow	757	162	80	637	96	67

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	918	0	1636	838
Stage 1	-	-	-	-	838	-
Stage 2	-	-	-	-	798	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	752	-	112	369
Stage 1	-	-	-	-	428	-
Stage 2	-	-	-	-	447	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	752	-	100	369
Mov Cap-2 Maneuver	-	-	-	-	234	-
Stage 1	-	-	-	-	428	-
Stage 2	-	-	-	-	399	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.2	24.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	234	369	-	-	752	-
HCM Lane V/C Ratio	0.409	0.183	-	-	0.107	-
HCM Control Delay (s)	30.6	16.9	-	-	10.4	-
HCM Lane LOS	D	C	-	-	B	-
HCM 95th %tile Q(veh)	1.9	0.7	-	-	0.4	-

Intersection	
Int Delay, s/veh	2.7

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	587	107	62	521	97	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	0
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	0	0	3	0	0
Mvmt Flow	638	116	67	566	105	67

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	754	0	1397	696
Stage 1	-	-	-	-	696	-
Stage 2	-	-	-	-	701	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	865	-	157	445
Stage 1	-	-	-	-	498	-
Stage 2	-	-	-	-	496	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	865	-	145	445
Mov Cap-2 Maneuver	-	-	-	-	284	-
Stage 1	-	-	-	-	498	-
Stage 2	-	-	-	-	458	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	20.9
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	284	445	-	-	865	-
HCM Lane V/C Ratio	0.371	0.151	-	-	0.078	-
HCM Control Delay (s)	25	14.5	-	-	9.5	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	1.6	0.5	-	-	0.3	-

Intersection	
Int Delay, s/veh	3.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	573	50	30	543	137	84
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	0
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	0	0	7	0	0
Mvmt Flow	623	54	33	590	149	91

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	677	0	1305	650
Stage 1	-	-	-	-	650	-
Stage 2	-	-	-	-	655	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	924	-	178	473
Stage 1	-	-	-	-	523	-
Stage 2	-	-	-	-	521	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	924	-	172	473
Mov Cap-2 Maneuver	-	-	-	-	312	-
Stage 1	-	-	-	-	523	-
Stage 2	-	-	-	-	502	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	22
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	312	473	-	-	924	-
HCM Lane V/C Ratio	0.477	0.193	-	-	0.035	-
HCM Control Delay (s)	26.6	14.4	-	-	9	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	2.4	0.7	-	-	0.1	-

Intersection	
Int Delay, s/veh	2.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	696	157	77	586	93	63
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	100
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	6	0	0	2	0	0
Mvmt Flow	757	171	84	637	101	68

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	927	0	1646	842
Stage 1	-	-	-	-	842	-
Stage 2	-	-	-	-	804	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	746	-	111	367
Stage 1	-	-	-	-	426	-
Stage 2	-	-	-	-	444	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	746	-	~ 99	367
Mov Cap-2 Maneuver	-	-	-	-	232	-
Stage 1	-	-	-	-	426	-
Stage 2	-	-	-	-	394	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.2	25.9
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	232	367	-	-	746	-
HCM Lane V/C Ratio	0.436	0.187	-	-	0.112	-
HCM Control Delay (s)	32	17	-	-	10.4	-
HCM Lane LOS	D	C	-	-	B	-
HCM 95th %tile Q(veh)	2.1	0.7	-	-	0.4	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	2.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	587	114	64	521	102	64
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	0
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	0	0	3	0	0
Mvmt Flow	638	124	70	566	111	70

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	762	0	1405	700
Stage 1	-	-	-	-	700	-
Stage 2	-	-	-	-	705	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	859	-	155	443
Stage 1	-	-	-	-	496	-
Stage 2	-	-	-	-	494	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	859	-	142	443
Mov Cap-2 Maneuver	-	-	-	-	281	-
Stage 1	-	-	-	-	496	-
Stage 2	-	-	-	-	454	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	21.5
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	281	443	-	-	859	-
HCM Lane V/C Ratio	0.395	0.157	-	-	0.081	-
HCM Control Delay (s)	25.9	14.6	-	-	9.6	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	1.8	0.6	-	-	0.3	-

Intersection	
Int Delay, s/veh	3.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	573	53	31	543	144	86
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	0
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	0	0	7	0	0
Mvmt Flow	623	58	34	590	157	93

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	680	0	1310	652
Stage 1	-	-	-	-	652	-
Stage 2	-	-	-	-	658	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	922	-	177	471
Stage 1	-	-	-	-	522	-
Stage 2	-	-	-	-	519	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	922	-	170	471
Mov Cap-2 Maneuver	-	-	-	-	311	-
Stage 1	-	-	-	-	522	-
Stage 2	-	-	-	-	500	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	22.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	311	471	-	-	922	-
HCM Lane V/C Ratio	0.503	0.198	-	-	0.037	-
HCM Control Delay (s)	27.7	14.5	-	-	9.1	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	2.7	0.7	-	-	0.1	-

Intersection	
Int Delay, s/veh	3.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	696	163	80	586	97	65
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	100
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	6	0	0	2	0	0
Mvmt Flow	757	177	87	637	105	71

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	934	0	1656	845
Stage 1	-	-	-	-	845	-
Stage 2	-	-	-	-	811	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	741	-	109	366
Stage 1	-	-	-	-	425	-
Stage 2	-	-	-	-	440	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	741	-	~ 96	366
Mov Cap-2 Maneuver	-	-	-	-	229	-
Stage 1	-	-	-	-	425	-
Stage 2	-	-	-	-	388	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.3	27
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	229	366	-	-	741	-
HCM Lane V/C Ratio	0.46	0.193	-	-	0.117	-
HCM Control Delay (s)	33.5	17.2	-	-	10.5	-
HCM Lane LOS	D	C	-	-	B	-
HCM 95th %tile Q(veh)	2.2	0.7	-	-	0.4	-

Notes

~: Volume exceeds capacity $: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection	
Int Delay, s/veh	3.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	587	119	66	521	108	66
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	0	0
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	4	0	0	3	0	0
Mvmt Flow	638	129	72	566	117	72

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	767	0	1413	703
Stage 1	-	-	-	-	703	-
Stage 2	-	-	-	-	710	-
Critical Hdwy	-	-	4.1	-	6.4	6.2
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	-	-	2.2	-	3.5	3.3
Pot Cap-1 Maneuver	-	-	856	-	153	441
Stage 1	-	-	-	-	495	-
Stage 2	-	-	-	-	491	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	856	-	140	441
Mov Cap-2 Maneuver	-	-	-	-	279	-
Stage 1	-	-	-	-	495	-
Stage 2	-	-	-	-	450	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	22.3
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	279	441	-	-	856	-
HCM Lane V/C Ratio	0.421	0.163	-	-	0.084	-
HCM Control Delay (s)	27	14.7	-	-	9.6	-
HCM Lane LOS	D	B	-	-	A	-
HCM 95th %tile Q(veh)	2	0.6	-	-	0.3	-