



# TRAFFIC IMPACT STUDY

ROCKY GORGE  
Residential Development  
City of Annapolis, Maryland

July, 2015

Prepared For:  
McClaren Engineering Group

Prepared By:  
TRAFFIC CONCEPTS, INC.  
7525 Connelley Drive  
Suite B  
Hanover, Maryland 21076  
Phone 410-760-2915  
Fax 410-760-2911

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## INTRODUCTION

As required by the Maryland State Highway Administration (SHA), Traffic Concepts, Inc. has updated a traffic impact study (dated December 2010) that was previously prepared for the Rocky Gorge residential development.

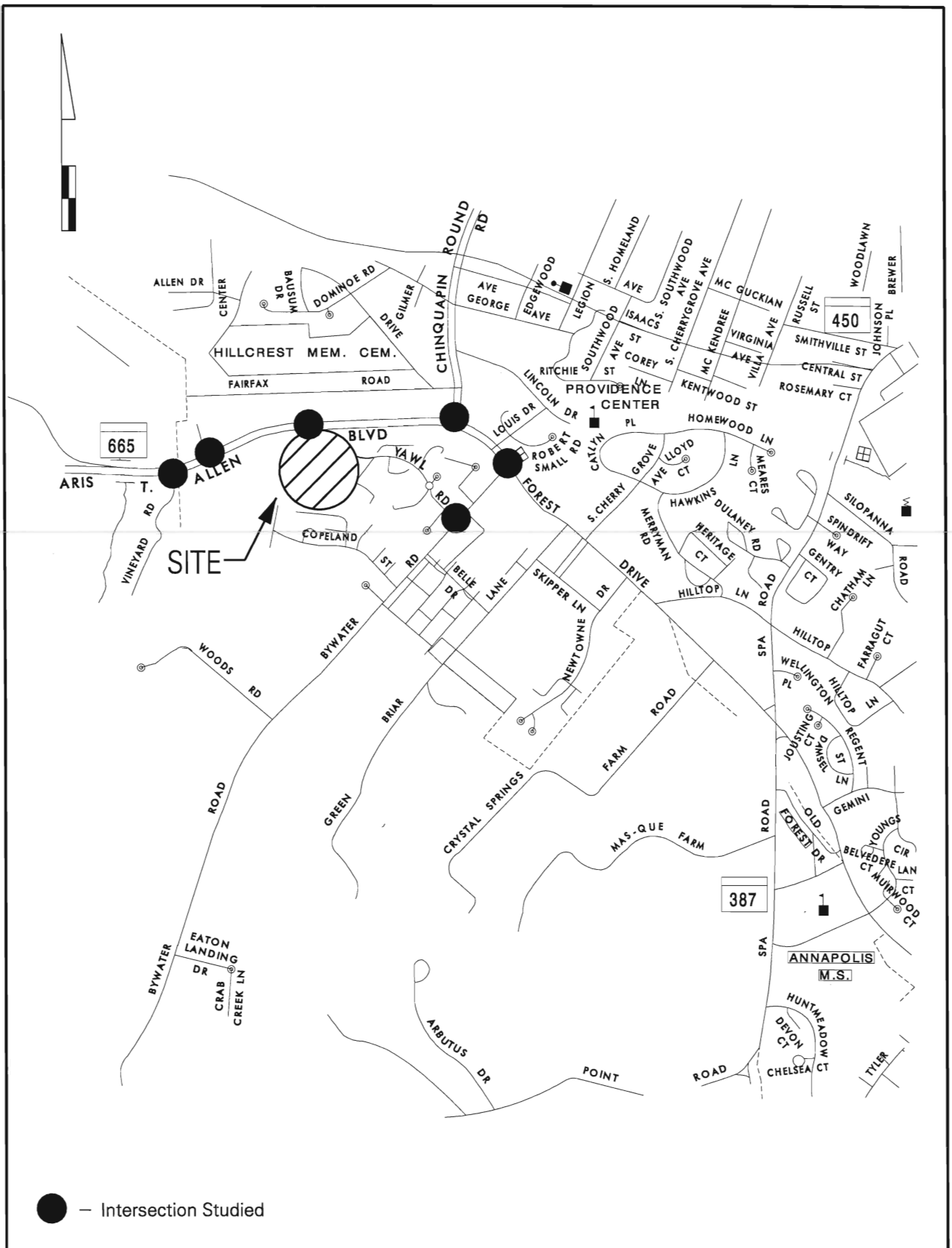
The site is located along the south side of MD 665 (Aris T. Allen Boulevard), east of the intersection of Vineyard Road and west of Chinquapin Round Road. (See Exhibit 1 for the site location). A total of 29 townhouse units and 17 single family units are planned for this development. A right-in/right-out access to MD 665 is planned for the site.

Exhibit 1 shows the locations of the key intersections studied. The following intersections were analyzed during the weekday AM and weekday PM peak periods:

### Key Intersections

- MD 665 (Aris T. Allen Blvd.)/Forest Drive @ Chinquapin Round Road
- MD 665 (Aris T. Allen Boulevard) @ Vineyard Road
- MD 665 (Aris T. Allen Boulevard) @ Godspeed Way
- MD 665 (Aris T. Allen Boulevard) @ Site Access
- Forest Drive @ Bywater Road
- Bywater Road @ Yawl Road

The key intersections were analyzed at existing, background and total future traffic conditions in accordance with the methodologies used by the SHA. Therefore, all of the intersections were analyzed using the Critical Lane Volume (CLV) method.



**TRAFFIC CONCEPTS, INC.**  
 7525 Connelley Drive  
 Suite B  
 Hanover, Maryland 21076  
 410-923-7101

**EXHIBIT 1**  
**Site Location**

## EXISTING CONDITION

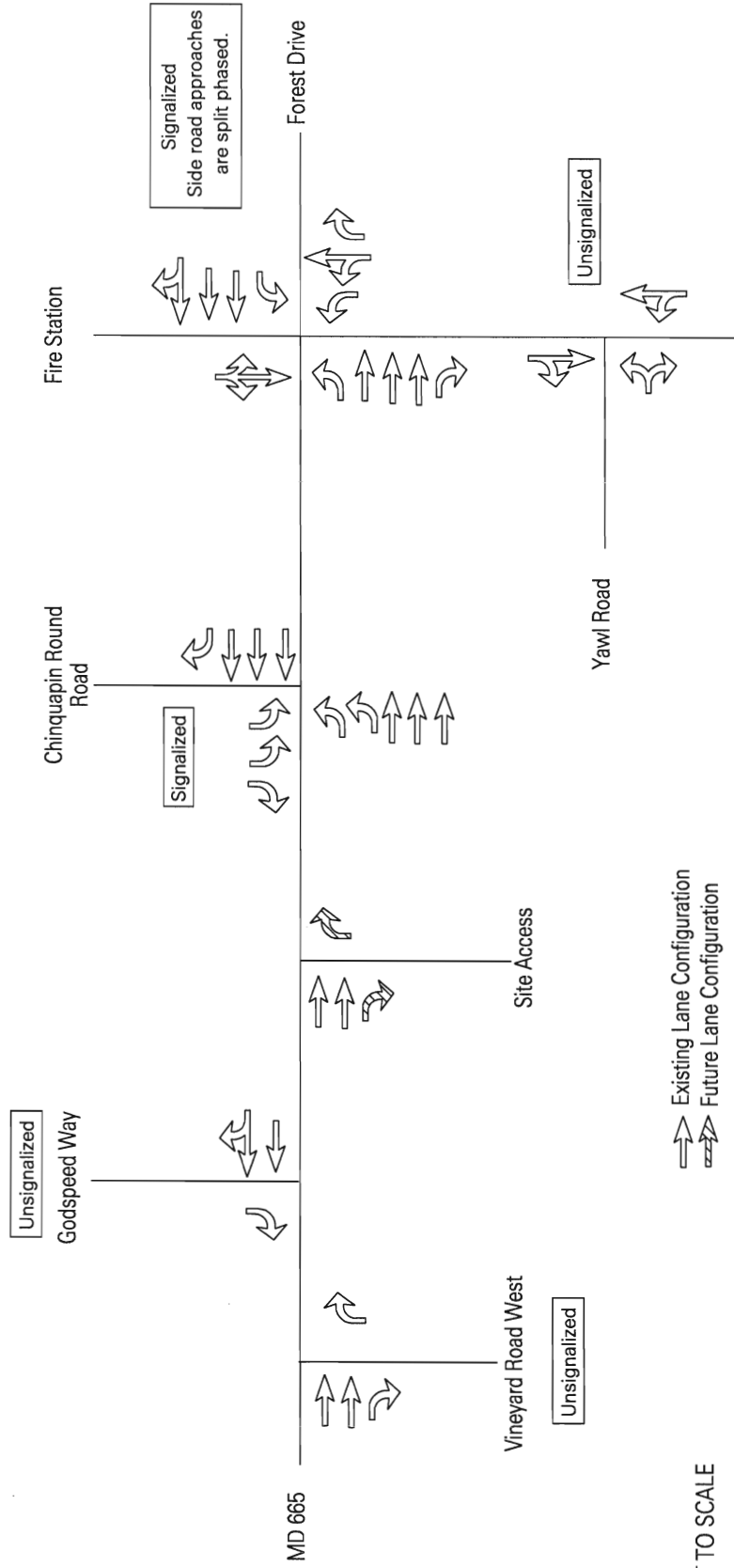
The lane configurations at the existing key intersections, and the configuration planned for the MD 665 site access are shown on Exhibit 2. Detailed intersection configuration sketches can be found in Appendix II of this report.

Traffic counts were performed at each key intersection during the weekday morning (7-9 AM) and afternoon (4-6 PM) peak hours of typical weekdays. Using these counts, the highest one hour time period of traffic flow was determined for each time period. Details of the traffic count data are included in Appendix III of this report.

Exhibit 3 has been prepared to show the peak hour turning movement volumes as discussed above at each key studied intersection. Using these volumes, each existing intersection has been analyzed utilizing the Critical Lane Volume (CLV) method, with the following results. The site access intersection was analyzed at future build-out conditions only. Copies of the CLV calculations are included in Appendix I.

### CRITICAL LANE VOLUME (CLV) ANALYSIS

	<u>AM CLV(LOS)</u>	<u>PM CLV(LOS)</u>
MD 665/Forest Drive @ Chinquapin Round Road	1321(D)	1436(D)
MD 665 @ Vineyard Road	1029(B)	1335(D)
MD 665 @ Godspeed Way	1385(D)	1139(B)
Forest Drive @ Bywater Road	1314(D)	1324(D)
Bywater Road @ Yawl Road	405(A)	503(A)

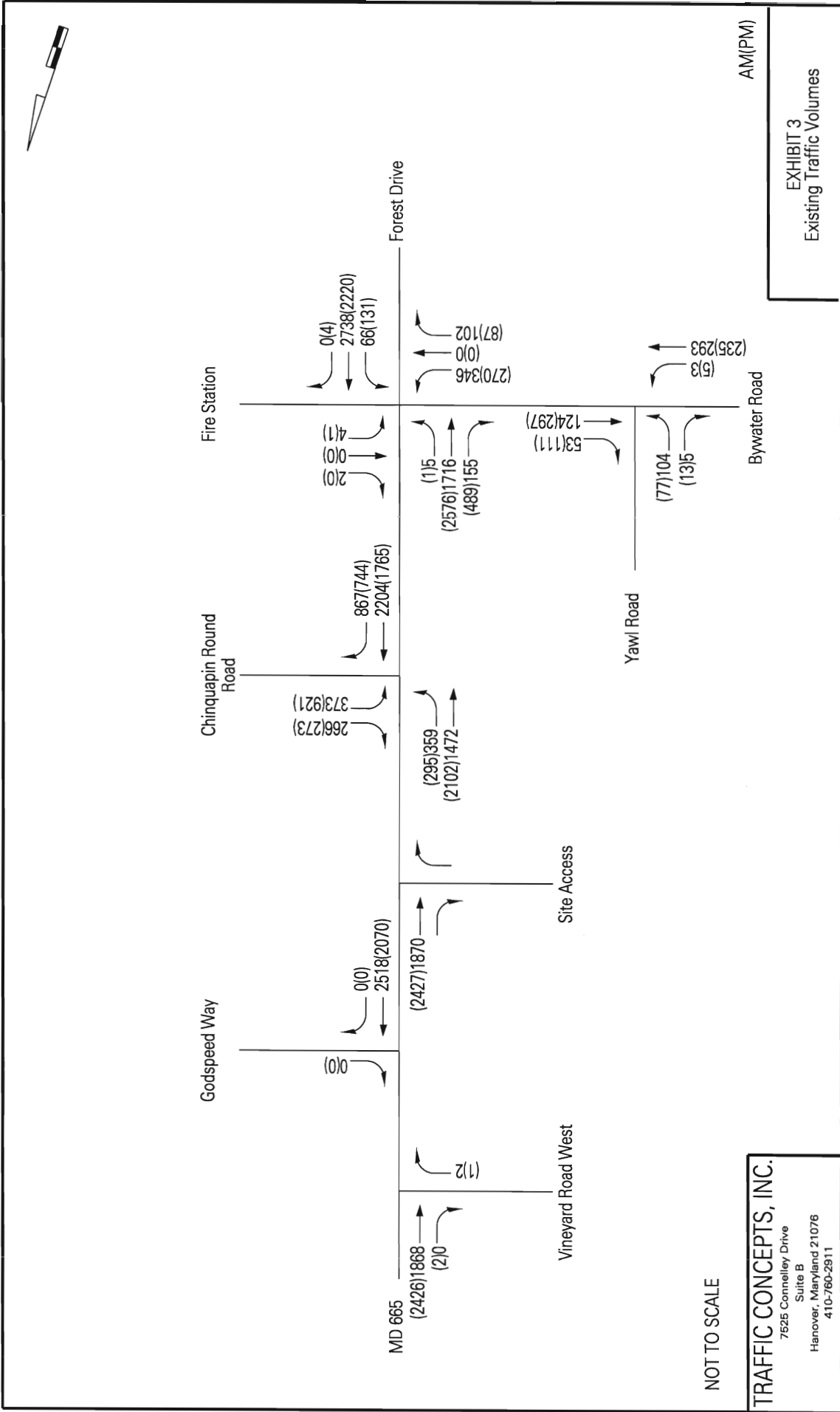


Existing Lane Configuration  
 Future Lane Configuration

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**TRAFFIC CONCEPTS, INC.**  
 7525 Connelley Drive  
 Suite B  
 Hanover, Maryland 21076  
 410-760-2911

**EXHIBIT 2**  
 Lane Configuration



## **BACKGROUND CONDITION**

The second level of analysis will include the impact of active projects that may impact the key intersections, but are not yet constructed. Since the Rocky Gorge development is expected to build-out within three (3) years, a growth factor was not applied, per SHA guidelines.

A list of active developments was provided by the City of Annapolis, which includes five (5) such developments. Locations of these developments are shown on Exhibit 4. Using the Institute of Transportation Engineers', Trip Generation Manual, 9<sup>th</sup> Edition, generation rates were determined for each development during the weekday AM and PM peak periods, with the results listed on the following page.

We have distributed the traffic generated by each background development through the study area based on the location of work centers, major access routes and housing concentrations. Details of each individual development are included in Appendix II of this report, and the combined impact of background vehicle trips are shown on Exhibit 5. These combined background volumes were added to the existing traffic volumes to determine the total background traffic volumes, as depicted on Exhibit 6.

Using these volumes, each existing intersection has been analyzed again, with the following results. Copies of the calculations are included in Appendix I.

### **CRITICAL LANE VOLUME (CLV) ANALYSIS**

	<b><u>AM CLV(LOS)</u></b>	<b><u>PM CLV(LOS)</u></b>
MD 665/Forest Drive @ Chinquapin Round Road	1360(D)	1474(E)
MD 665 @ Vineyard Road	1054(B)	1376(D)
MD 665 @ Godspeed Way	1426(D)	1170(C)
Forest Drive @ Bywater Road	1355(D)	1364(D)
Bywater Road @ Yawl Road	405(A)	503(A)

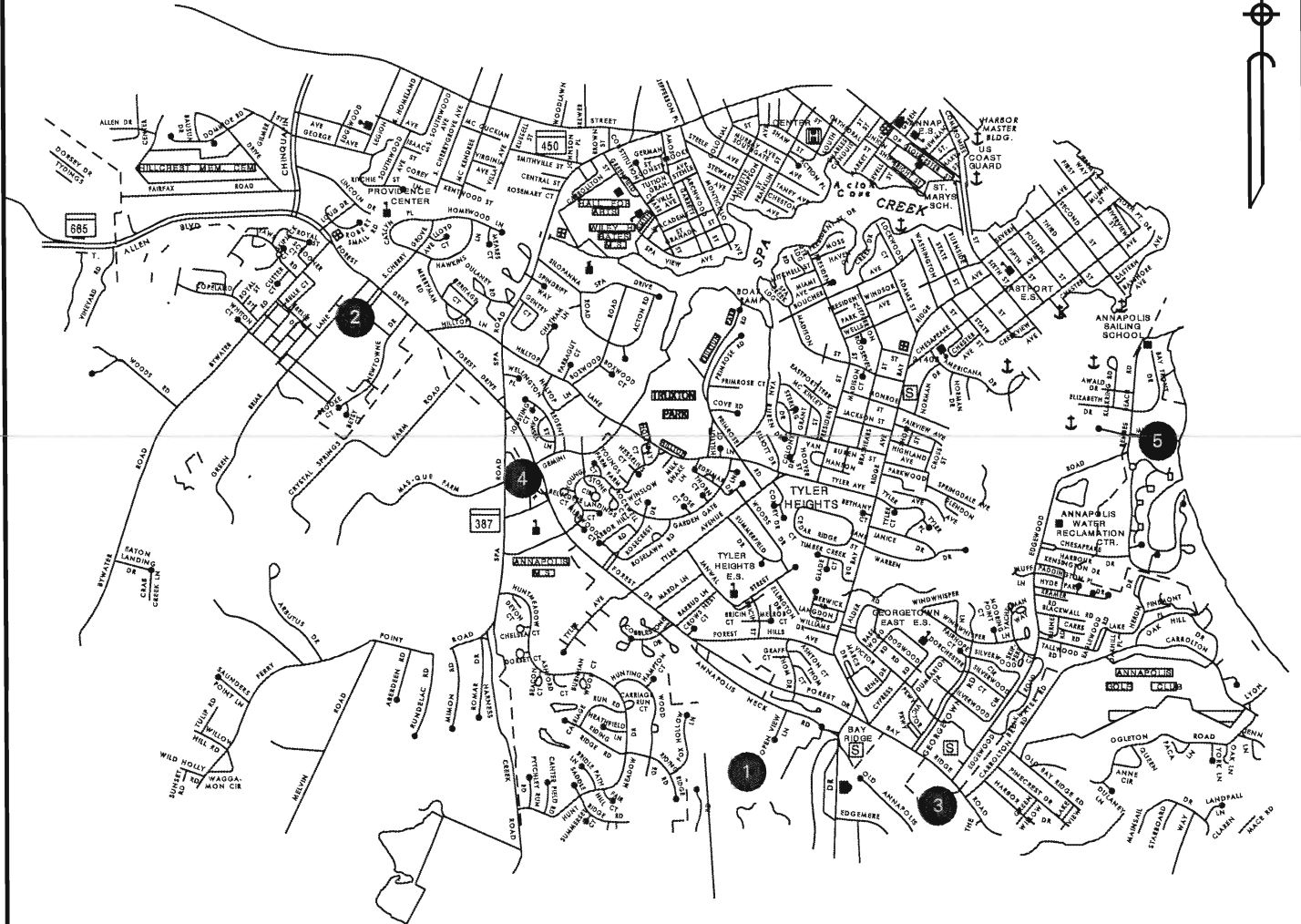


**BACKGROUND DEVELOPMENTS**

	<u>AM</u>		<u>PM</u>	
	<u>IN</u>	<u>OUT</u>	<u>IN</u>	<u>OUT</u>
1. Quiet Waters Preserve*				
<u>ITE Land Use Code 230</u>				
Per thu	0.09	0.46	0.43	0.21
72 thu	7	33	31	15
<u>ITE Land Use Code 210</u>				
Per sfu	0.20	0.61	0.67	0.39
86 sfu	17	53	58	34
<b>TOTAL BACKGROUND 1</b>	<b>24</b>	<b>86</b>	<b>89</b>	<b>49</b>
2. Village Greens				
<u>ITE Land Use Code 230</u>				
Per thu	0.09	0.44	0.41	0.20
89 thu	8	39	37	18
3. Bay Village				
<u>ITE Land Use Code 881</u>				
13 ksf Pharmacy	BUILT OUT			
<u>ITE Land Use Code 932</u>				
3 ksf Fast Food Restaurant -DOES NOT AFFECT KEY INTERSECTIONS				
Office				
<u>ITE Land Use Code 710</u>				
Per ksf	1.37	0.19	0.25	1.24
9,000 gsf	12	2	2	11
4. 1503 Forest Drive				
<u>ITE Land Use Code 710</u>				
Per ksf	1.37	0.19	0.25	1.24
18,900 gsf	26	3	5	23
<u>ITE Land Use Code 814</u>				
Per ksf **	3.28	3.56	2.81	2.21
3,780 gsf	12	14	11	8
5. Rodgers Property				
<u>ITE Land Use Code 230</u>				
Per thu	0.10	0.50	0.47	0.23
45 thu	5	22	21	10
<b>TOTAL BACKGROUNDS 2 - 5</b>	<b>63</b>	<b>80</b>	<b>76</b>	<b>70</b>

\*Distribution pattern taken directly from approved TIS (excerpt attached)

\*\* In order to create a worse-case scenario, we have used AM and PM peak hour of the generator rates.

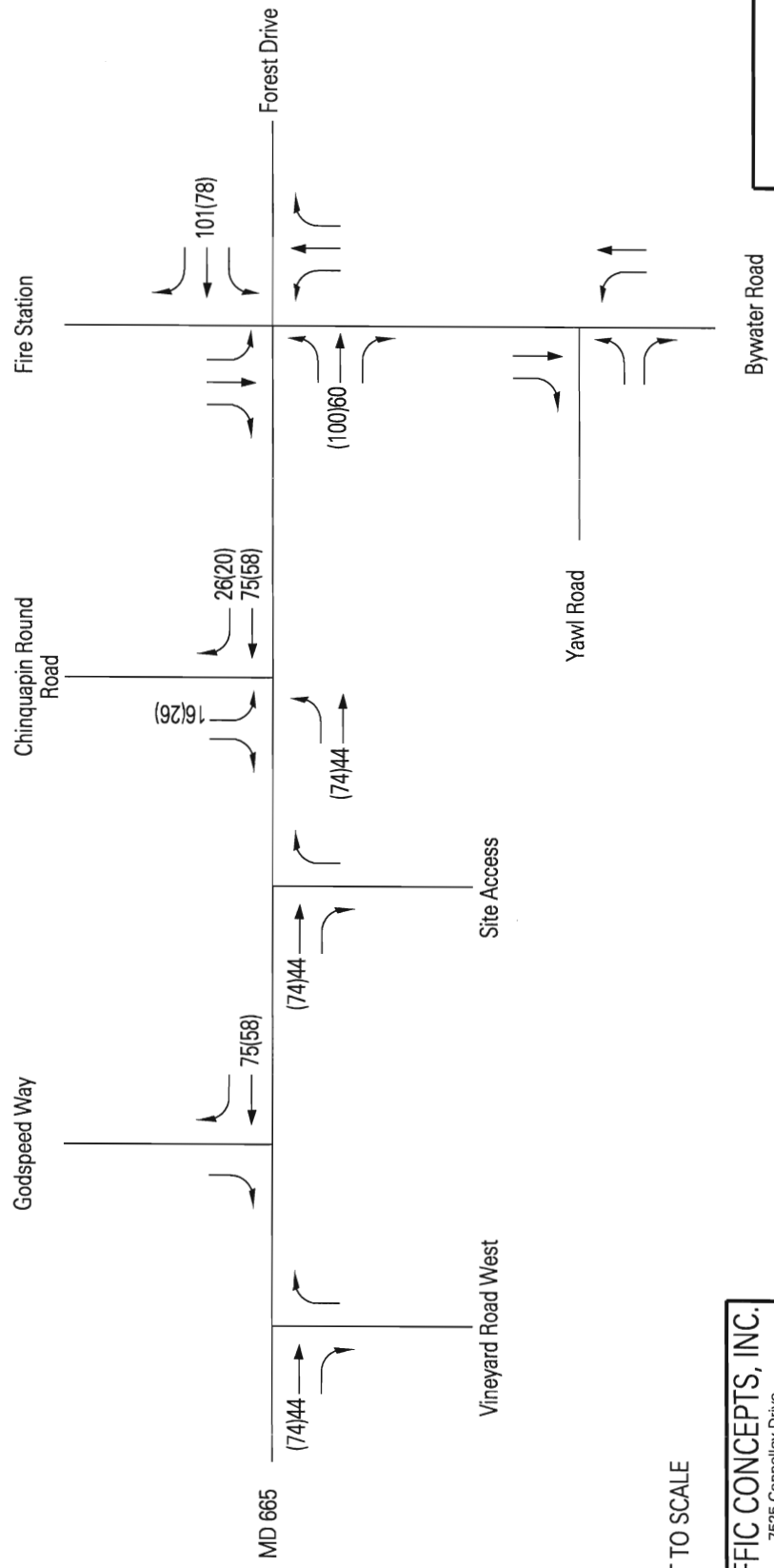


1. Quiet Waters Preserve
2. Village Greens
3. Bay Village
4. 1503 Forest Drive
5. Rodgers Property

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7525 Connelley Drive  
Suite B  
Hanover, Maryland 21076  
410-760-2911

EXHIBIT 4  
Background Development Locations



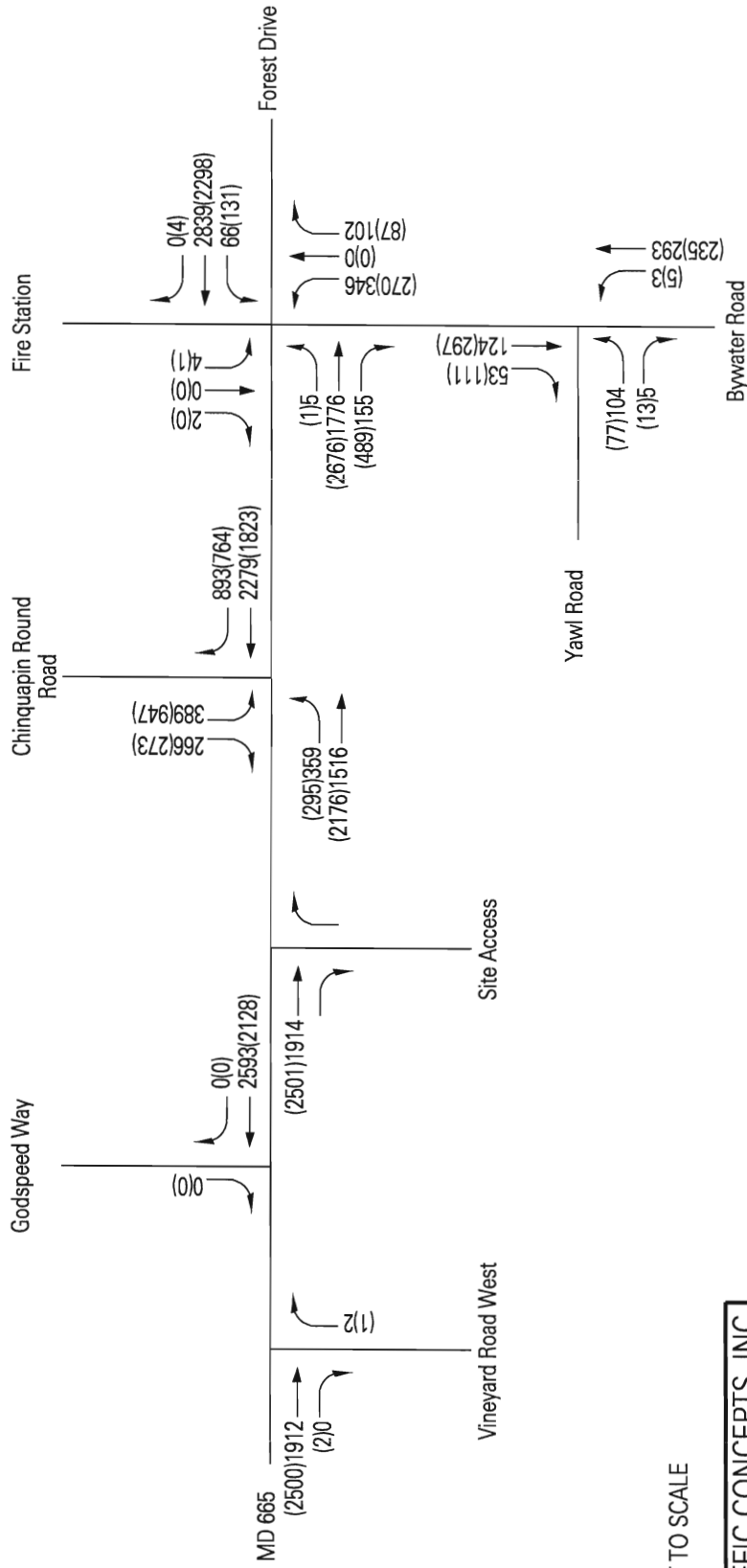
AM(PM)

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 7525 Connelley Drive  
 Suite B  
 Hanover, Maryland 21076  
 410-760-2911

Bywater Road

EXHIBIT 5  
 Background Traffic Volumes



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 7525 Connelley Drive  
 Suite B  
 Hanover, Maryland 21076  
 410-760-2911

**EXHIBIT 6**  
 Total Background Traffic Volumes

## FUTURE CONDITION

The final level of analysis evaluated the impact of the proposed Rocky Gorge residential development. As mentioned previously, 29 townhouse units and 17 single family units are planned for this development.

We have consulted the Institute of Transportation Engineers', Trip Generation Manual, 9<sup>th</sup> Edition to determine trip generation rates during the weekday AM and weekday PM peak periods, with the following results. A copy of the Trip Generation Charts are included on the following pages.

### Residential Development

#### ITE Land Use Code 230

Per thu	0.11	0.55	0.50	0.25
29 thu	3	16	15	7

#### ITE Land Use Code 210

Per sfu	0.32	0.95	0.79	0.46
17 sfu	5	17	13	8
<b>Total Trips</b>	<b>8</b>	<b>33</b>	<b>28</b>	<b>15</b>

We have distributed the traffic generated by this project through the study area using the same trip distribution pattern that was approved in the 2010 traffic study. These trips are shown on Exhibit 7. By combining the trips generated by the site to the total background traffic volumes, we obtain total future traffic volumes. See Exhibit 8.

Using these total future traffic volumes, each intersection has been analyzed a final time using the Critical Lane Volume (CLV) method, with the results listed on the following page. Details of all calculations are included in Appendix I.

**CRITICAL LANE VOLUME (CLV) ANALYSIS**

	<b><u>AM CLV(LOS)</u></b>	<b><u>PM CLV(LOS)</u></b>
MD 665/Forest Drive @ Chinquapin Round Road	1376(D)	1483(E)
MD 665 @ Vineyard Road	1058(B)	1391(D)
MD 665 @ Godspeed Way	1439(D)	1181(C)
Forest Drive @ Bywater Road	1355(D)	1366(D)
Bywater Road @ Yawl Road	405(A)	503(A)
MD 665 @ Site Access	1086(B)	1391(D)

Detailed Average Rate Trip Calculations  
 For 29 Dwelling Units of Residential Condominium / Townhouse(230) - [E]

Project:  
 Phase:

Open Date:  
 Analysis Date:

Description:

	Average Rate	Standard Deviation	Adjustment Factor	Driveway Volume
Avg. Weekday 2-Way Volume	7.56	0.00	1.00	219
7-9 AM Peak Hour Enter	0.11	0.00	1.00	3
7-9 AM Peak Hour Exit	0.55	0.00	1.00	16
7-9 AM Peak Hour Total	0.66	0.00	1.00	19
4-6 PM Peak Hour Enter	0.50	0.00	1.00	15
4-6 PM Peak Hour Exit	0.25	0.00	1.00	7
4-6 PM Peak Hour Total	0.75	0.00	1.00	22
AM Pk Hr, Generator, Enter	0.12	0.00	1.00	3
AM Pk Hr, Generator, Exit	0.51	0.00	1.00	15
AM Pk Hr, Generator, Total	0.63	0.00	1.00	18
PM Pk Hr, Generator, Enter	1.01	0.00	1.00	29
PM Pk Hr, Generator, Exit	0.57	0.00	1.00	17
PM Pk Hr, Generator, Total	1.58	0.00	1.00	46
Saturday 2-Way Volume	18.38	0.00	1.00	533
Saturday Peak Hour Enter	0.95	0.00	1.00	28
Saturday Peak Hour Exit	0.81	0.00	1.00	23
Saturday Peak Hour Total	1.76	0.00	1.00	51
Sunday 2-Way Volume	15.45	0.00	1.00	448
Sunday Peak Hour Enter	0.96	0.00	1.00	28
Sunday Peak Hour Exit	1.00	0.00	1.00	29
Sunday Peak Hour Total	1.95	0.00	1.00	57

The above rates were calculated from these equations:

24-Hr. 2-Way Volume:  $LN(T) = .87LN(X) + 2.46, R^2 = 0.8$   
 7-9 AM Peak Hr. Total:  $LN(T) = .8LN(X) + .26$   
 $R^2 = 0.76, 0.17 \text{ Enter}, 0.83 \text{ Exit}$   
 4-6 PM Peak Hr. Total:  $LN(T) = .82LN(X) + .32$   
 $R^2 = 0.8, 0.67 \text{ Enter}, 0.33 \text{ Exit}$   
 AM Gen Pk Hr. Total:  $LN(T) = .82LN(X) + .15$   
 $R^2 = 0.8, 0.19 \text{ Enter}, 0.81 \text{ Exit}$   
 PM Gen Pk Hr. Total:  $T = .34(X) + 35.87$   
 $R^2 = 0.82, 0.64 \text{ Enter}, 0.36 \text{ Exit}$   
 Sat. 2-Way Volume:  $T = 3.62(X) + 427.93, R^2 = 0.84$   
 Sat. Pk Hr. Total:  $T = .29(X) + 42.63$   
 $R^2 = 0.84, 0.54 \text{ Enter}, 0.46 \text{ Exit}$   
 Sun. 2-Way Volume:  $T = 3.13(X) + 357.26, R^2 = 0.88$   
 Sun. Pk Hr. Total:  $T = .23(X) + 50.01$   
 $R^2 = 0.78, 0.49 \text{ Enter}, 0.51 \text{ Exit}$

Note: A zero indicates no data available.  
 Source: Institute of Transportation Engineers  
 Trip Generation Manual, 9th Edition, 2012

Detailed Average Rate Trip Calculations  
For 17 Dwelling Units of Single Family Detached Housing(210) - [E]

Project: Aris T Allen Property  
Phase:

Open Date:  
Analysis Date:

Description:

	Average Rate	Standard Deviation	Adjustment Factor	Driveway Volume
Avg. Weekday 2-Way Volume	12.10	0.00	1.00	206
7-9 AM Peak Hour Enter	0.32	0.00	1.00	5
7-9 AM Peak Hour Exit	0.95	0.00	1.00	17
7-9 AM Peak Hour Total	1.27	0.00	1.00	22
4-6 PM Peak Hour Enter	0.79	0.00	1.00	13
4-6 PM Peak Hour Exit	0.46	0.00	1.00	8
4-6 PM Peak Hour Total	1.25	0.00	1.00	21
AM Pk Hr, Generator, Enter	0.37	0.00	1.00	6
AM Pk Hr, Generator, Exit	1.05	0.00	1.00	18
AM Pk Hr, Generator, Total	1.41	0.00	1.00	24
PM Pk Hr, Generator, Enter	0.85	0.00	1.00	14
PM Pk Hr, Generator, Exit	0.48	0.00	1.00	8
PM Pk Hr, Generator, Total	1.32	0.00	1.00	22
Saturday 2-Way Volume	11.49	0.00	1.00	195
Saturday Peak Hour Enter	0.76	0.00	1.00	13
Saturday Peak Hour Exit	0.65	0.00	1.00	11
Saturday Peak Hour Total	1.41	0.00	1.00	24
Sunday 2-Way Volume	8.59	0.00	1.00	146
Sunday Peak Hour Enter	0.56	0.00	1.00	10
Sunday Peak Hour Exit	0.50	0.00	1.00	8
Sunday Peak Hour Total	1.06	0.00	1.00	18

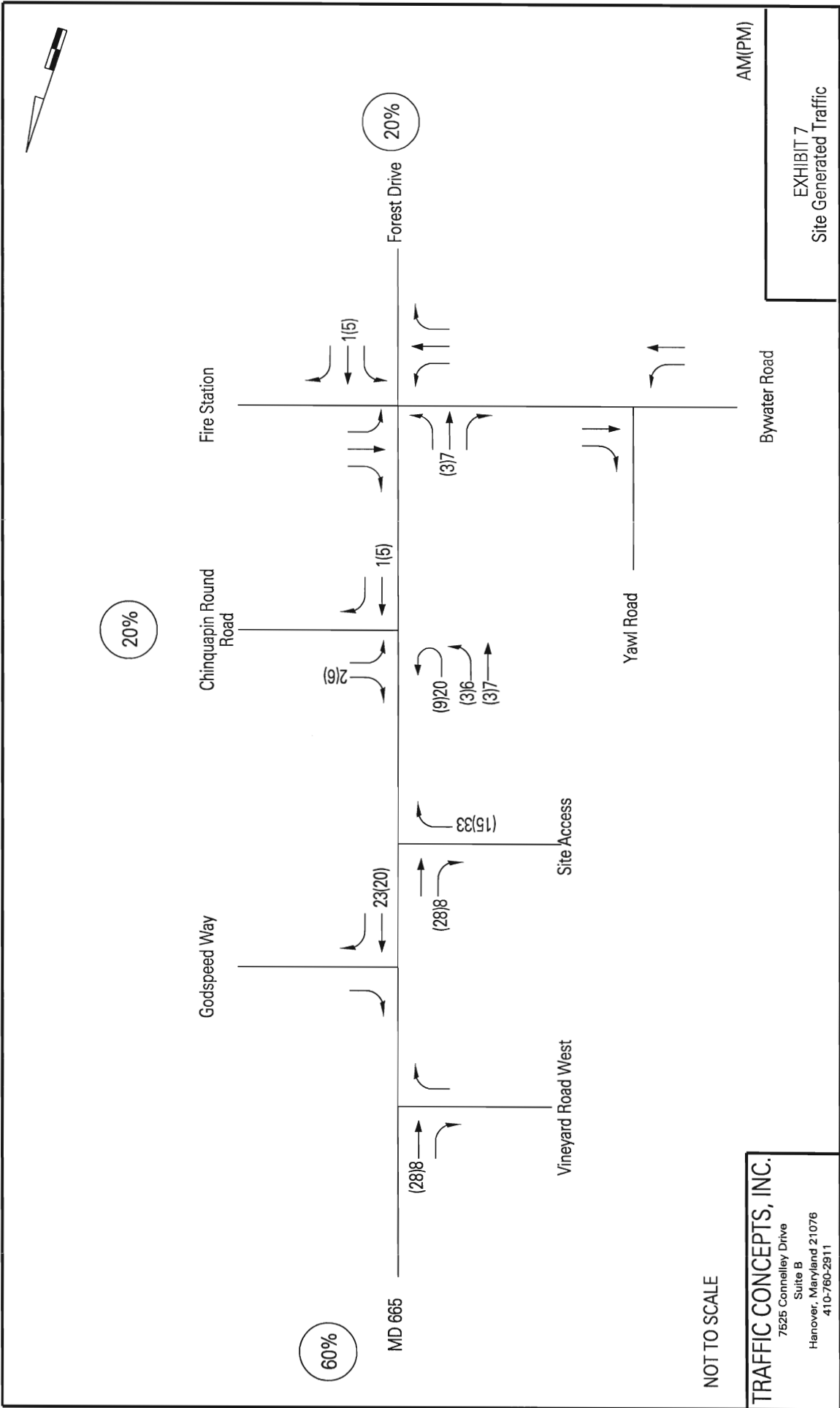
The above rates were calculated from these equations:

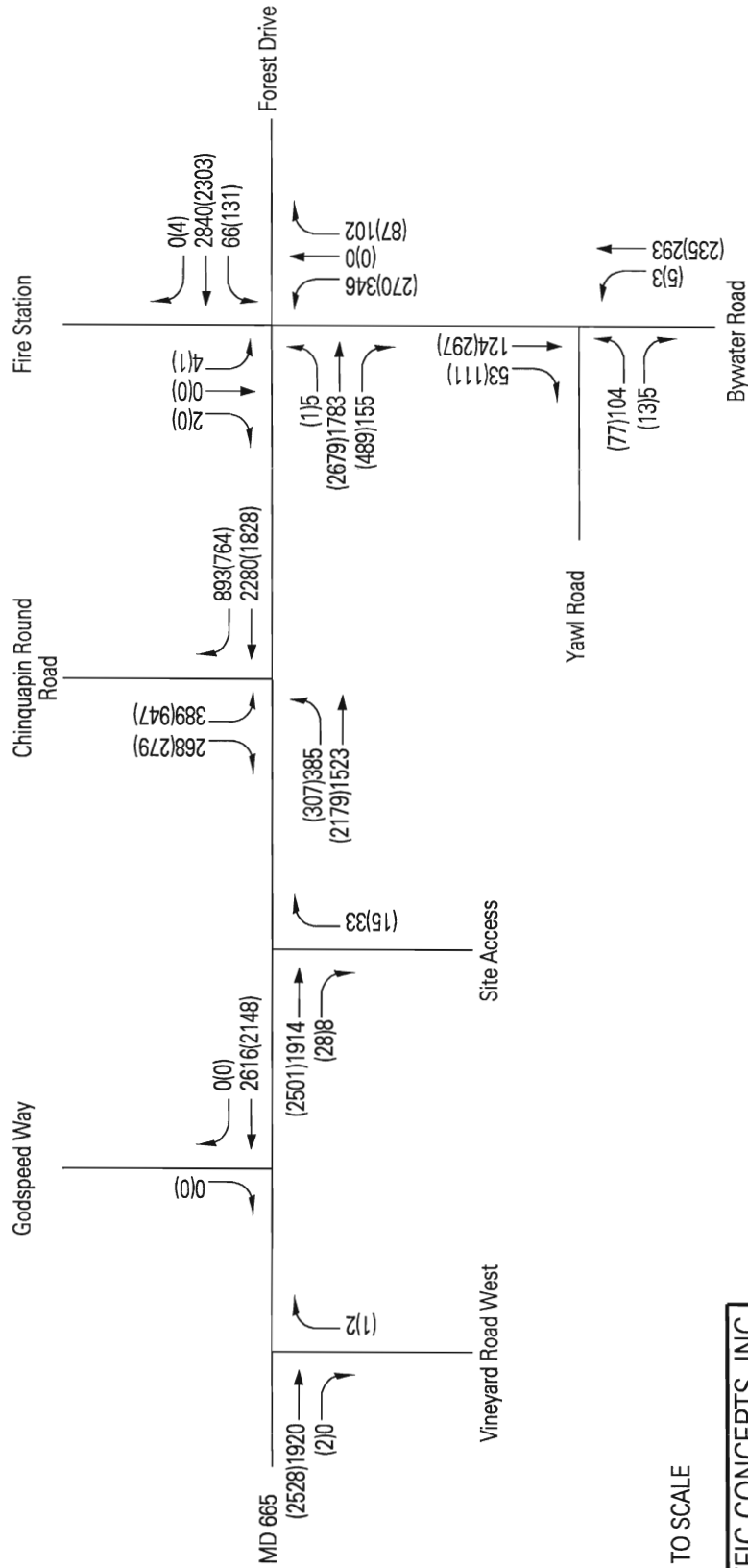
24-Hr. 2-Way Volume:  $LN(T) = .92LN(X) + 2.72, R^2 = 0.95$   
7-9 AM Peak Hr. Total:  $T = .7(X) + 9.74$   
 $R^2 = 0.89, 0.25$  Enter, 0.75 Exit  
4-6 PM Peak Hr. Total:  $LN(T) = .9LN(X) + .51$   
 $R^2 = 0.91, 0.63$  Enter, 0.37 Exit  
AM Gen Pk Hr. Total:  $T = .7(X) + 12.12$   
 $R^2 = 0.89, 0.26$  Enter, 0.74 Exit  
PM Gen Pk Hr. Total:  $LN(T) = .88LN(X) + .62$   
 $R^2 = 0.91, 0.64$  Enter, 0.36 Exit  
Sat. 2-Way Volume:  $LN(T) = .93LN(X) + 2.64, R^2 = 0.92$   
Sat. Pk Hr. Total:  $T = .89(X) + 8.77$   
 $R^2 = 0.91, 0.54$  Enter, 0.46 Exit  
Sun. 2-Way Volume:  $T = 8.63(X) + -.63, R^2 = 0.93$   
Sun. Pk Hr. Total:  $LN(T) = .91LN(X) + .31$   
 $R^2 = 0.88, 0.53$  Enter, 0.47 Exit

Note: A zero indicates no data available.  
Source: Institute of Transportation Engineers  
Trip Generation Manual, 9th Edition, 2012

TRIP GENERATION 2013, TRAFFICWARE, LLC







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7525 Connelley Drive  
 Suite B  
 Hanover, Maryland 21076  
 410-760-2911

EXHIBIT 8  
 Total Future Traffic Volumes

**WEAVING ANALYSIS**

A weaving analysis was conducted along eastbound Forest Drive, between Chinquapin Round Road and the site access, to test the weave of vehicles exiting the site access that would turn left at Chinquapin Round Road, and ensure that these vehicles have safe entry into the Forest Drive eastbound flow of traffic. The results are listed below. A copy of the worksheets are included in the appendix section of this report.

	LOS	
	<u>AM</u>	<u>PM</u>
<u>Eastbound Forest Drive</u> From Site Access to Chinquapin Round Road	B	C

## CONCLUSIONS

The results of the traffic impact study have shown that all of the key intersections continue to operate at acceptable “D” or better levels of analysis when analyzed using the Critical Lane Volume (CLV) method, with one exception, discussed in detail below.

### MD 665/Forest Drive @ Chinquapin Round Road

The intersection of MD 665/Forest Drive @ Chinquapin Round Road is projected to operate at an “E” level of service (CLV 1474) during the PM peak period at planned background traffic conditions, with or without the impact of the Rocky Gorge development.

Since all of the outbound site trips must use the MD 665 right-out access, all of the outbound site trips travel through this intersection. As is typical with a residential development, most of the exiting trips occur during the AM peak time period (33 outbound trips). During the AM peak hour, when the site has the most impact on this intersection, an acceptable “D” level of service (CLV 1377) is projected at future build-out conditions.

Less trips exit the site during the PM peak hour (15 outbound trips). Based on the CLV analysis and lane configuration of this intersection, the site will add 7 critical trips to the eastbound left/U-turn movement and 2 critical trips to the westbound thru movement.

The site access to MD 665 is planned with acceleration and deceleration lanes. A copy of the SHA access plan is included in Appendix III.

A weaving analysis was completed for the right out movement from the proposed site access, to make a left (or U-turn) at the Chinquapin Round Road intersection. This analysis indicates “B” and “C” levels of service during the AM and PM peak hours, respectively.

This is an update to an original study that was approved in 2010. This development has been included in all other traffic studies that have been prepared over the last four to five years along the Forest Drive corridor. The Forest Drive @ Chinquapin Round Road and Forest Drive @ Bywater Road intersections are at the beginning of the Forest Drive signal system, which is closely monitored by the City of Annapolis and Anne Arundel County. This system has been updated by the County to provide the latest traffic responsive system to maximize green time flow for the Forest Drive traffic. There is also currently underway a Forest Drive corridor analysis, which is being prepared to establish short and long term improvements necessary to handle anticipated traffic flows in the future. The recently submitted corridor study indicates the Forest Drive @ Chinquapin Round Road intersection works at acceptable levels of service during the AM and PM peak time periods. The analysis methodology used in the corridor study is more detailed and accounts for signal timing patterns and coordinated system operation. This analysis does include the Rocky Gorge development impact.

The results of this study show that this development will have a minimal impact at the key intersections, and will not change the levels of service from the planned background traffic conditions. The impact to the corridor is minimized with the access provided to Aris T. Allen Boulevard, rather than through the Oxford Landing development via Yawl Road. It is our recommendation that this development be approved from a traffic impact standpoint.