Village at Providence Point

Traffic Impact Study

July 2018

Prepared for

City of Annapolis

Prepared by

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1. Introduction and Summary

1.1. Purpose

The City of Annapolis Department of Planning and Zoning has requested a traffic impact study for the Village at Providence Point, a proposed continuing care retirement development to be constructed on an undeveloped parcel located on Forest Drive in Annapolis, Maryland. The development includes 431 units consisting of independent living apartments, cottages/duplexes, maison units, and a healthcare/nursing facility with 48 beds. The primary site access will be on Crystal Spring Farm Road. The purpose of this study is to evaluate the traffic impacts associated with the proposed development and determine recommended improvements, if necessary, to mitigate these impacts on the surrounding roadway network.

1.2. Executive Summary

The results of the traffic impact analysis are as follows:

- Under existing conditions, each of the five study intersections operate at an overall LOS D or better. At least one movement of the intersections of Forest Drive at South Cherry Grove Avenue, Forest Drive at Spa Road, and Forest Drive at Gemini Drive operate at an unacceptable LOS E or LOS F during either the AM or PM peak hour.
- Eighteen approved background developments were considered for this analysis. These developments are projected to generate 1,096 trips during the AM peak hour and 1,343 trips during the PM peak hour, with more than half of these trips expected to travel through the study area.
- Under total background conditions, two of the five intersections are projected to operate at overall LOS E or LOS F during either the AM or PM peak hour. Movement delays also degrade under total background conditions.
- The Village at Providence Point is projected to generate 76 and 82 trips during the AM and PM peak hours, respectively.
- The following geometric improvements are recommended at the intersections of Forest Drive at Crystal Spring Farm Road and Spa Road at the site driveway to improve safety for motorists accessing the Village at Providence Point development:
    - Deceleration lanes are recommended for eastbound right turns accessing Crystal Spring Farm Road and southbound right turns accessing the site from Spa Road.
    - Convert the intersection of Forest Drive at Crystal Spring Farm Road to a right-in, right-out intersection to remove potential conflicts for westbound lefts entering the site and northbound lefts exiting the site.
- Under total traffic conditions, two intersections are projected to operate at an overall LOS E or LOS F. To improve operations at these two intersections and to mitigate the impact of the site, the following capacity improvements are recommended:
    - Change the southbound lane use at the intersection of Forest Drive at South Cherry Grove Avenue from a shared through/left turn lane and a dedicated

right turn lane to a dedicated left turn lane and a shared left/through/right turn lane while maintaining split phasing in the north- and southbound directions.

- Widen the south leg of Spa Road approaching Forest Drive to add a second northbound left turn lane. The resultant lane use for this approach would be double left turn lanes and a shared through/right turn lane.

With these two improvements, the overall intersection delays and LOS will be comparable to or slightly better than the total background conditions.

2. Proposed Development

2.1. Site Location

The proposed development is located on the south side of Forest Drive, between Crystal Spring Farm Road and Spa Road, with the primary site access on Crystal Spring Farm Road. Secondary site access is proposed to connect the development to Spa Road. However, it should be noted that this site access off of Spa Road must be approved by the State Highway Administration (SHA). The location of the development is shown in **Figure 1**.

2.2. Land Use and Intensity

The proposed development consists of independent living apartments, cottages/duplexes, maison units, and a healthcare/nursing facility. The total development includes 431 units.

2.3. Site Plan

The most recent site plan for the proposed development is provided in **Appendix A**.

2.4. Phasing and Timing

Per the City of Annapolis Department of Planning and Zoning, the development will be constructed in 2020.

3. Study Area

3.1. Geographic Area

The proposed development is located in Annapolis, Maryland and the study area consists of the following five existing study intersections:

1. Forest Drive at South Cherry Grove Avenue
2. Forest Drive at Hilltop Lane
3. Forest Drive at Crystal Spring Farm Road
4. Forest Drive at Spa Road
5. Forest Drive at Gemini Drive

The study intersections are shown in **Figure 2**.

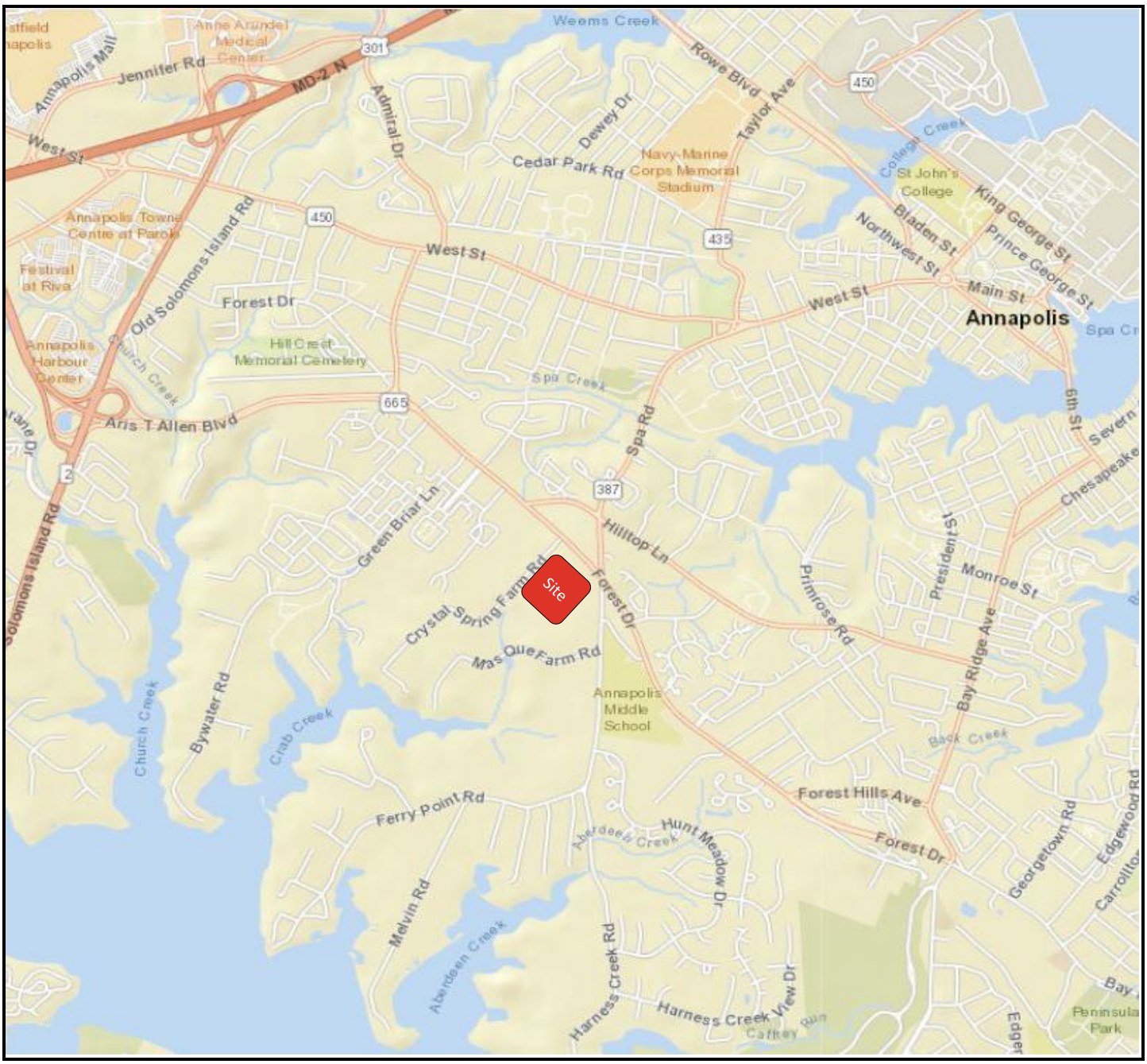

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Figure 1

Site Location Map

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Figure 2

Existing Study Intersections

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3.2. Site Accessibility

The surrounding roadway network includes the following roadways:

Forest Drive
West of Hilltop Lane, Forest Drive is classified as a principal arterial and consists of three travel lanes in each direction. East of Hilltop Lane, Forest Drive is classified as a minor arterial and typically consists of two travel lanes in each direction and a center two way left turn lane. The posted speed limit along Forest Drive is 40 MPH within the study area.

South Cherry Grove Avenue
South Cherry Grove Avenue is a local road that provides access to the Village Green development to the south of Forest Drive and the Heritage community to the north of Forest Drive. The roadway consists of two travel lanes in each direction south of Forest Drive and one travel lane in each direction north of Forest Drive. The posted speed limit along South Cherry Grove Avenue is 25 MPH.

Hilltop Lane
Hilltop Lane is classified as a minor arterial and consists of two travel lanes in each direction and a center two way left turn lane. The roadway ends at the T-intersection with Forest Drive. The posted speed limit along Hilltop Lane is 30 MPH

Spa Road
South of Forest Drive, Spa Road is classified as a collector roadway and consists of one travel lane in each direction. North of Forest Drive, Spa Road is classified as a minor arterial and typically consists of one travel lane in each direction. The posted speed limit along Spa Road is 30 MPH.

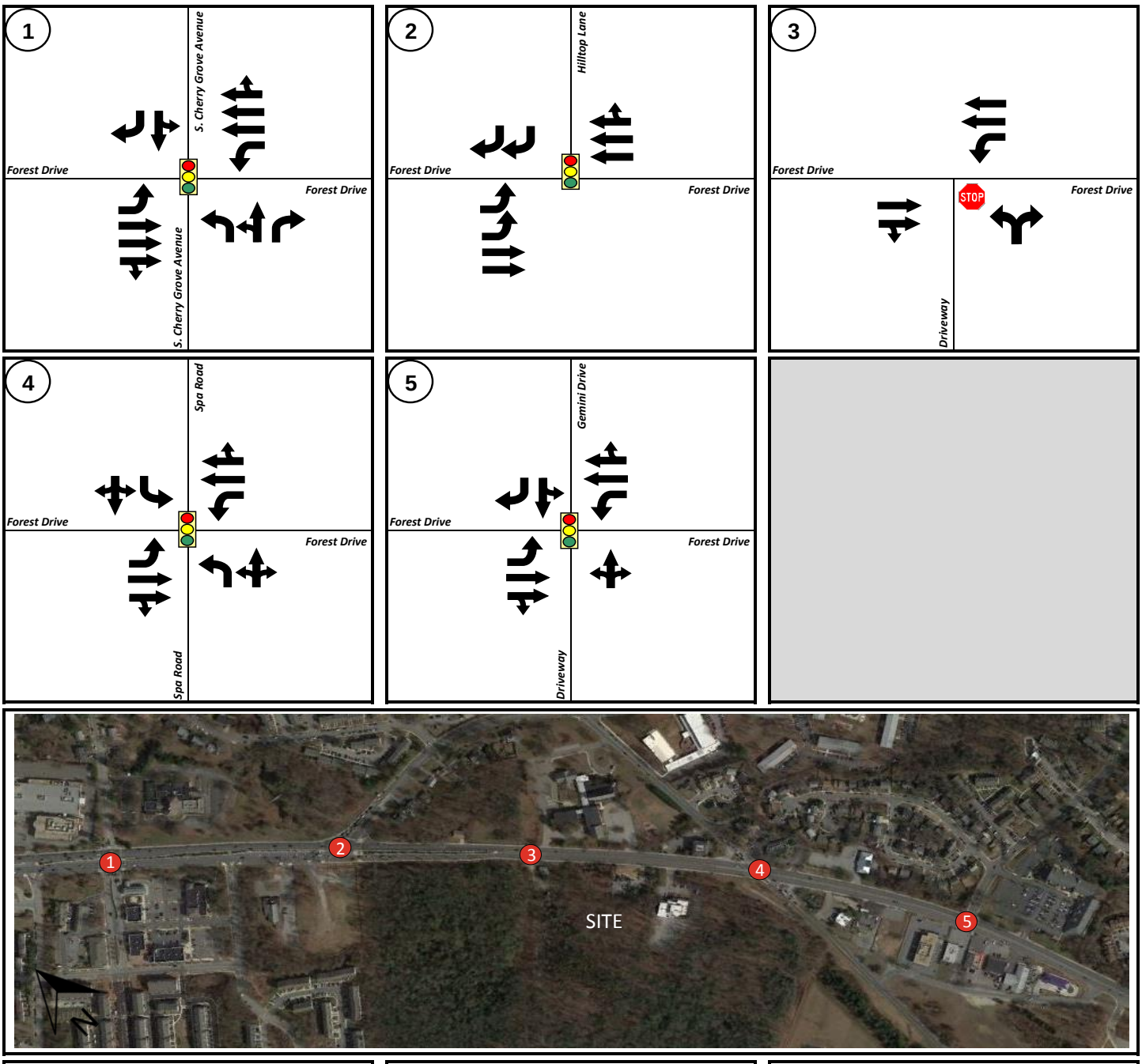
Gemini Drive
Gemini Drive is a local road that connects Forest Drive and Hilltop Lane and provides access to the residential community to the north of Forest Drive. It consists of one travel lane in each direction and has a posted speed limit of 25 MPH.

4. Existing Conditions

4.1. Physical Characteristics

Existing Lane Configurations and Traffic Control
Existing lane use and traffic control for the study intersections are shown in **Figure 3**.

Bicycle and Pedestrian Facilities
Sidewalks are located on both sides of Forest Drive within the study area, with the exception of the south side of Forest Drive between South Cherry Grove Avenue and Hilltop Lane, where a shared use path is located. Dedicated bicycle facilities are not provided on Forest Drive.



LEGEND

- Existing Lane Configuration
- Signalized Intersection
- Unsignalized Intersection
- XX Intersection Number (volume diagram)
- XX Intersection Number (located on figure)

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Figure 3

Existing Lane Use and Traffic Control

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Transit Services

Bus stops are located along east- and westbound Forest Drive. These bus stops service the Annapolis Transit Brown and Orange routes.

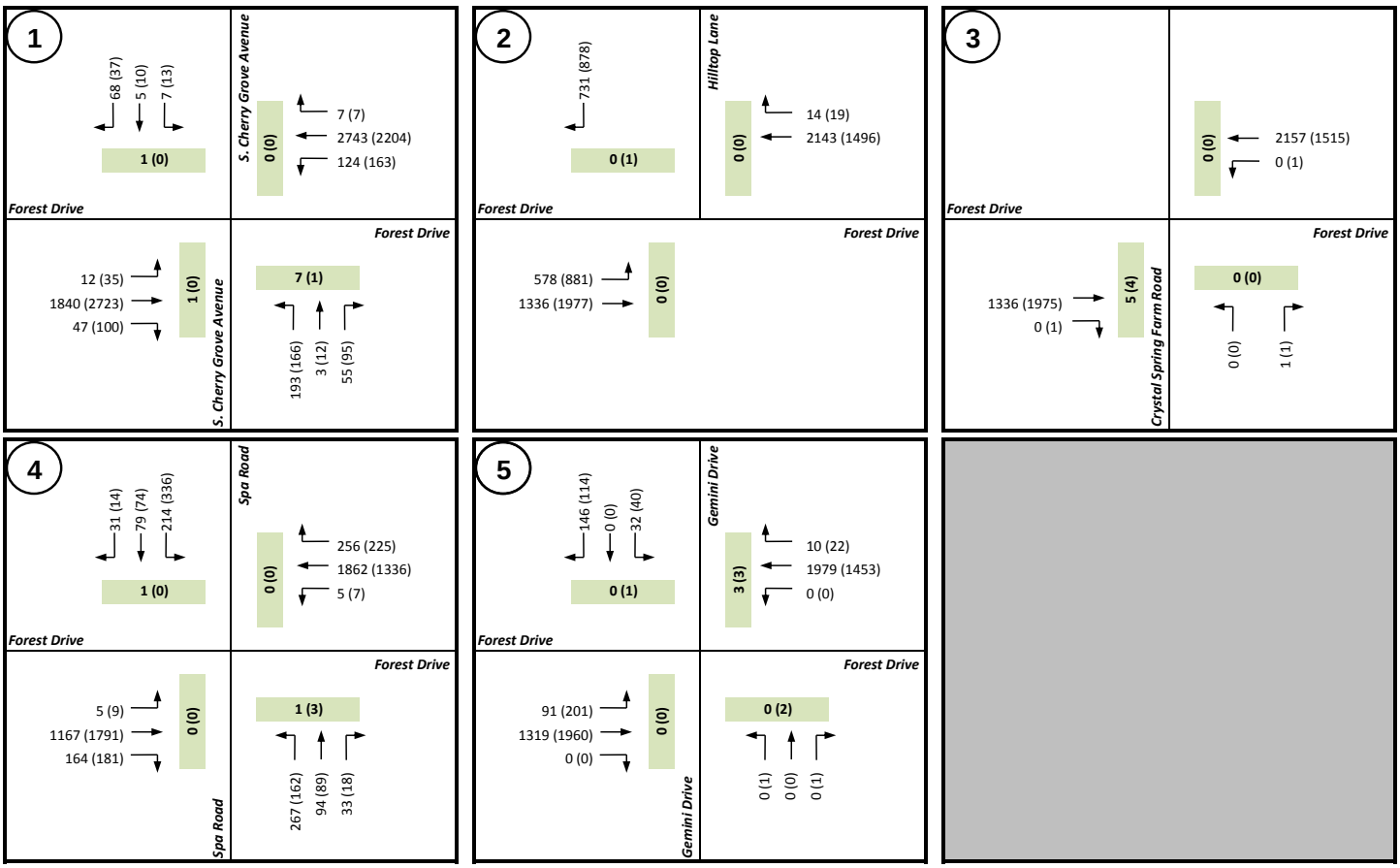
4.2. Existing Traffic Volumes

Weekday peak period turning movement counts conducted in June 2017 while schools were in session were obtained from the City of Annapolis and used for this analysis. The AM and PM peak hour volumes were balanced between intersections, and the resultant peak hour volumes are shown in **Figure 4**. The turning movement counts are provided in **Appendix B**.

4.3. Existing Level of Service

A capacity analysis was conducted for each of the study intersections using Synchro software. Synchro models traffic operations at signalized and unsignalized intersections using methodology from the *Highway Capacity Manual* (HCM). The selected measures of effectiveness (MOEs) evaluated as part of this study include delay and Level of Service (LOS). Existing conditions Synchro files were obtained from Anne Arundel County and updated to include the existing traffic volumes developed for this study. The results of the existing conditions capacity analysis are shown in **Table 1**. Synchro worksheets are included in **Appendix C**.

It should be noted that Forest Drive operates with ACS Lite adaptive control, which adjusts signal timings and offsets based on real time conditions to optimize traffic flow along the corridor. As such, the results of the capacity analysis are a conservative representation given the variability of timings across the network.



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

XX Intersection Number (located on figure)

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Figure 4

Existing Balanced AM and PM Peak Hour Volumes

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Table 1: Existing Conditions HCM Level of Service Summary

No.	Intersection	Movement	AM Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS
1	Forest Drive at South Cherry Grove Avenue	**Overall**	**21.9**	**C**	**38.9**	**D**
		EBL	18.7	B	15.9	B
		EBTR	15.4	B	47.9	D
		WBL	39.8	D	76.8	E
		WBTR	20.6	C	22.4	C
		NBL	64.6	E	56.4	E
		NBTL	64.1	E	56.5	E
		NBR	56.5	E	53.2	D
		SBTL	66.5	E	67.1	E
		SBR	65.6	E	65.0	E
2	Forest Drive at Hilltop Lane	**Overall**	**18.5**	**B**	**17.8**	**B**
		EBL	37.3	D	27.8	C
		EBT	4.4	A	5.5	A
		WBTR	12.4	B	17.5	B
		SBR	47.1	D	35.9	D
3	Forest Drive at Crystal Spring Farm Road[1]	NBLR	13.0	B	33.9	D
4	Forest Drive at Spa Road	**Overall**	**52.0**	**D**	**35.4**	**D**
		EBL	8.6	A	10.2	B
		EBTR	19.3	B	35.9	D
		WBL	9.0	A	12.3	B
		WBTR	62.2	E	16.8	B
		NBL	96.5	F	72.6	E
		NBLTR	88.5	F	69.8	E
		SBL	73.3	E	81.5	F
		SBLTR	69.8	E	78.6	E
5	Forest Drive at Gemini Drive	**Overall**	**11.4**	**B**	**8.1**	**A**
		EBL	52.4	D	34.3	C
		EBTR	0.8	A	1.0	A
		WBL	-	A	-	A
		WBTR	12.0	B	8.8	A
		NBLTR	-	A	61.4	E
		SBTL	65.9	E	66.4	E
		SBR	60.3	E	54.4	D

1 – HCM does not calculate overall intersection delay/LOS for two-way STOP controlled intersections; therefore, only the STOP controlled approach delay/LOS is reported.
2 – Peak hour volume is zero.

The results of the existing conditions capacity analysis indicate that each of the study intersections operate with an acceptable overall intersection LOS D or better during both the AM and PM peak hours. The following intersection approaches, however, operate at LOS E or LOS F during either the AM or PM peak hour.

Forest Drive at South Cherry Grove Avenue

- WBL (LOS E during the PM peak hour)
- NBL and NBTL (LOS E during the AM and PM peak hours)
- NBR (LOS E during the AM peak hour)
- SBTL (LOS E during the AM and PM peak hours)
- SBR (LOS E during the AM and PM peak hours)

Forest Drive at Spa Road

- WBTR (LOS E during the AM peak hour)
- NBL and NBLTR (LOS F during the AM peak hour and LOS E during the PM peak hour)
- SBL (LOS E during the AM peak hour and LOS F during the PM peak hour)
- SBLTR (LOS E during the AM and PM peak hours)

Forest Drive at Gemini Drive

- NBLTR (LOS E during the PM peak hour)
- SBTL (LOS E during the AM and PM peak hours)
- SBR (LOS E during the AM peak hour)

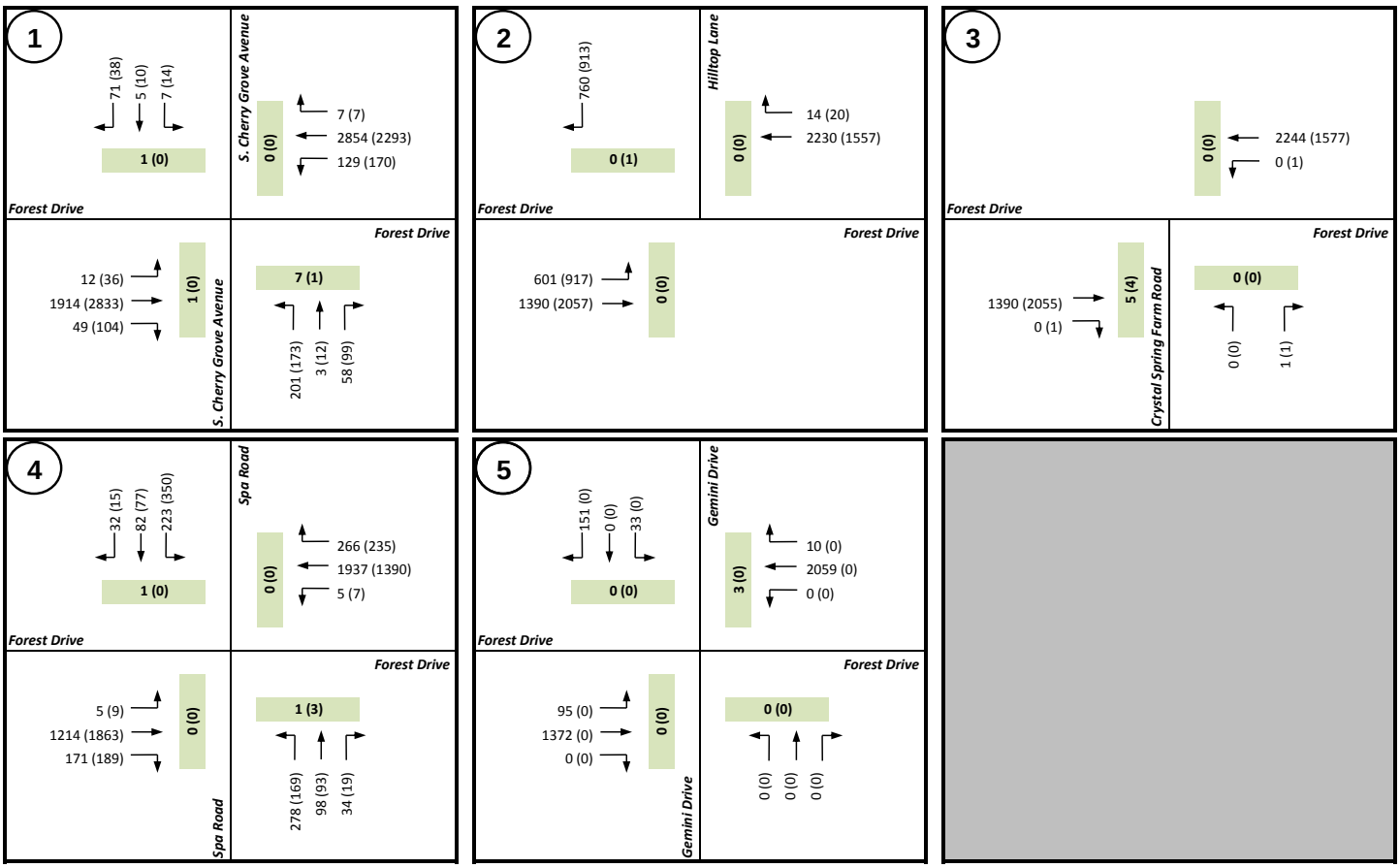
5. Background Conditions

5.1. Regional Growth

To determine the base build year traffic volumes, an annual growth rate of 2 percent was applied to the existing balanced AM and PM peak hour traffic volumes. The resultant 2020 base traffic volumes are shown in **Figure 5**.

5.2. Approved Background Developments

The City of Annapolis requested that 18 background developments, shown in **Figure 6**, be included in this study. Trips generated from these developments were either obtained from previous traffic impact studies or generated using the 9th Edition of the Institute of Transportation Engineers (ITE) *Trip Generation Manual*. Transit reduction was not considered for this study, thus providing a conservative assessment of the anticipated traffic impacts. The total trips generated by the background developments are shown in **Table 2.** The trip assignment for each background development is provided in **Appendix D**.



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

XX Intersection Number (located on figure)

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Figure 5

2020 Base AM and PM Peak Hour Volumes

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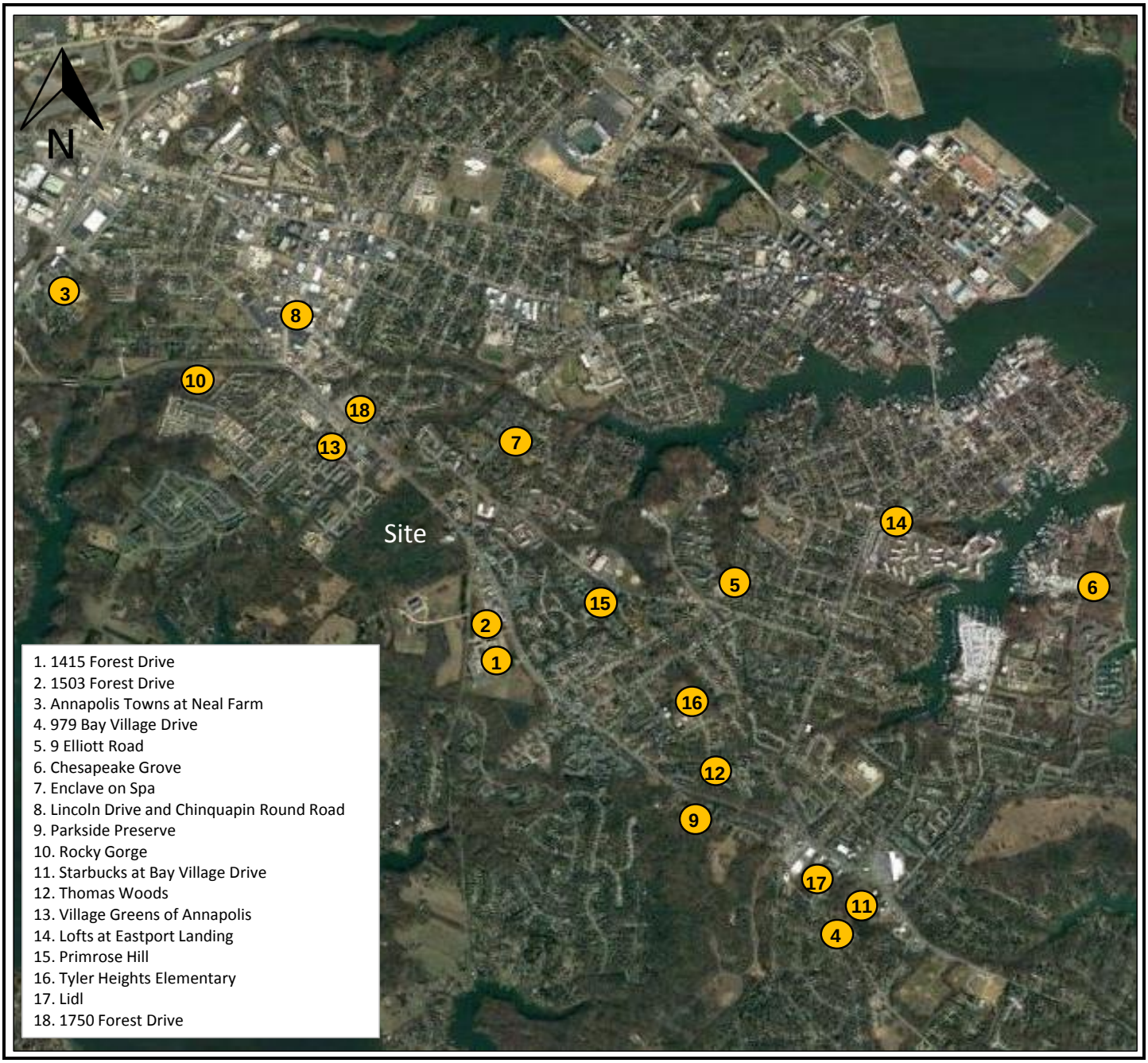

LEGEND

X Background Development

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Figure 6

Location of Background Developments

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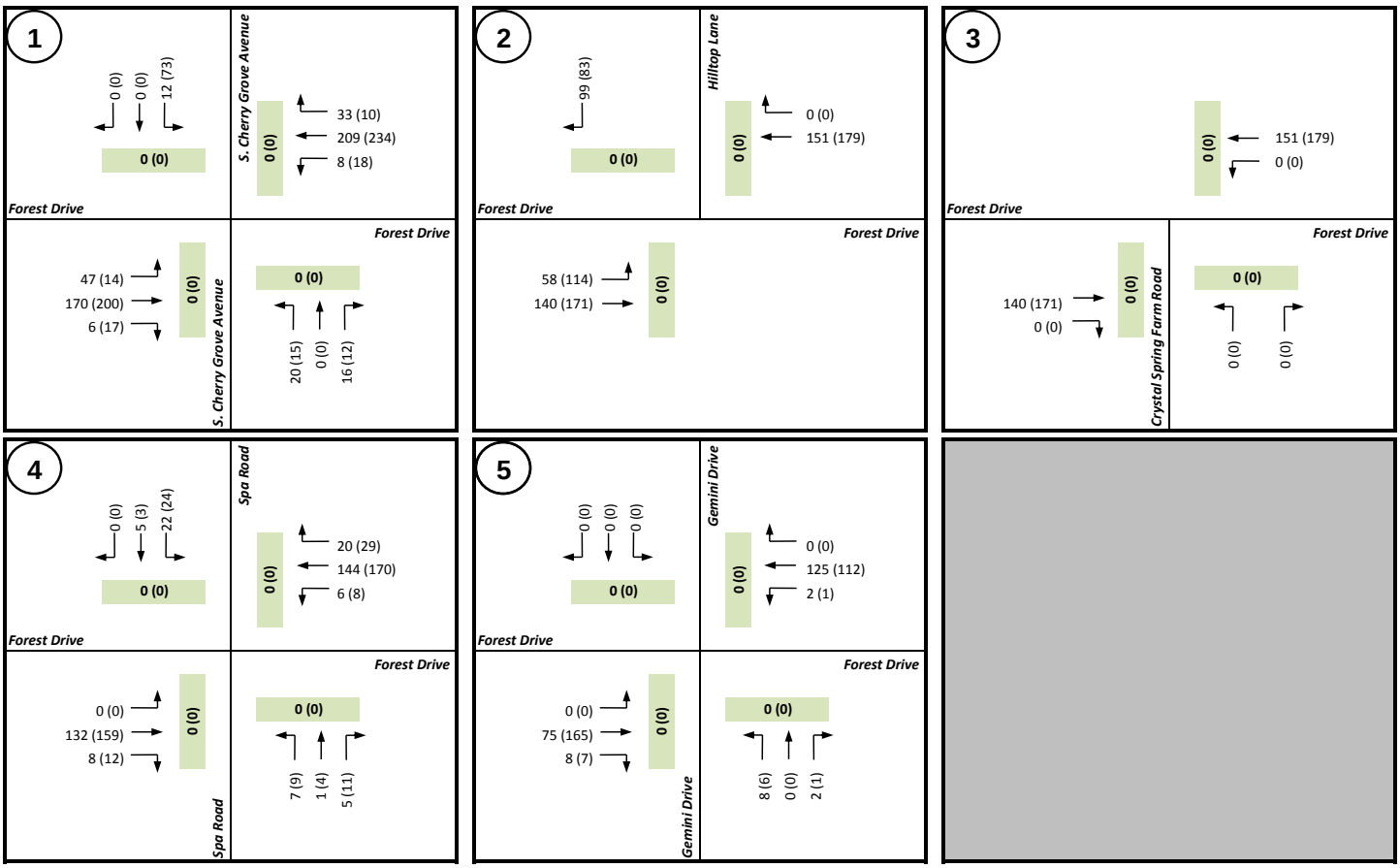
Table 2: Background Development Trip Generation

No.	Name	Size	Land Use	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
1	1415 Forest Drive[1]	2,986 GSF	826 (Specialty Retail Center)	10	10	20	8	7	15
2	1503 Forest Drive[1]	22,680 GSF	710 (General Office Building), 852 (Convenience Market), 936 (Coffee/Donut Shop)	100	61	161	46	113	159
3	Annapolis Towns at Neal Farm	50 Units	230 (Residential Condominium/Townhouse)	5	25	30	23	11	34
4	979 Bay Village Drive[2]	88 Beds	254 (Assisted Living)	11	5	16	15	17	32
5	9 Elliott Road	45 Units	230 (Residential Condominium/Townhouse)	5	22	27	21	10	31
6	Chesapeake Grove[1]	42 Units	230 (Residential Condominium/Townhouse)	5	22	27	21	10	31
7	Enclave on Spa[3]	36 Units	230 (Residential Condominium/Townhouse)	2	9	11	4	2	6
8	Lincoln Drive and Chinquapin Round Road	13,200 SF	710 (General Office Building)	6	32	38	62	31	93
9	Parkside Preserve[1]	158 Units	210, 2230 (Residential Condominium/Townhouse)	25	85	110	89	49	138
10	Rocky Gorge	48 Units	210, 230 (Residential Condominium/Townhouse)	9	33	42	28	16	44
11	Starbucks at Bay Village Drive[1]	1,850 GSF	934 (Fast-Food Restaurant with Drive-Through Window)	47	46	93	20	20	40
12	Thomas Woods[1]	10 Units	230 (Residential Condominium/Townhouse)	1	7	8	6	3	9
13	Village Greens of Annapolis[2]	89 Units	220 (Apartment)	15	36	51	41	27	68
14	Lofts at Eastport Landing[4]	935 SF /127 Units	820 (Shopping Center), 220 (Apartment)	14	52	66	53	30	83
15	Primrose Hill[4]	26 Units	230 (Residential Condominium/Townhouse)	2	9	11	9	5	14
16	Tyler Heights Elementary[5]	44,000 SF	520 (Elementary School)	0	0	0	0	0	0
17	Lidl[1]	36,170 GSF	850 (Supermarket)	76	47	123	120	115	235
18	1750 Forest Drive[6]	125,139 GSF	710 (General Office Building), 720 (Medical Office)	222	40	262	68	243	311
Total Background Trips				**555**	**541**	**1,096**	**634**	**709**	**1,343**

1 - Land use, size, and trips obtained from the Chesapeake Grove TIS dated October 2017
2 - Land use, size, and trips obtained from the Bay Village Assisted Living Development TIS dated March 2016
3 - Land use, size, and trips obtained from the Enclave at Spa Development Review Memorandum dated December 2013
4 - Land use, size, and trips obtained from the Eastport Commons Development TIA dated March 2017
5 - Per the City of Annapolis Department of Planning and Zoning, the number of students and staff is not expanding as part of the addition. Hence, no additional trips will be generated
6 - Land use, size, and trips obtained from the 1750 Forest Drive Revised Access Study dated February 2017

The total background trips shown in Table 2 were distributed within the study area consistent with the distribution assumptions identified in the traffic impact studies performed for other developments near the site. The resultant AM and PM background traffic projected for the study area is shown in **Figure 7**.



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

XX Intersection Number (located on figure)

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Figure 7

Background Developments AM and PM Peak Hour Volumes

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5.3. Total Background Peak Hour Traffic Volumes

The total background traffic volumes were added to the 2020 base traffic volumes to develop the total background peak hour traffic volumes shown in **Figure 8**.

5.4. Programmed Roadway Improvements

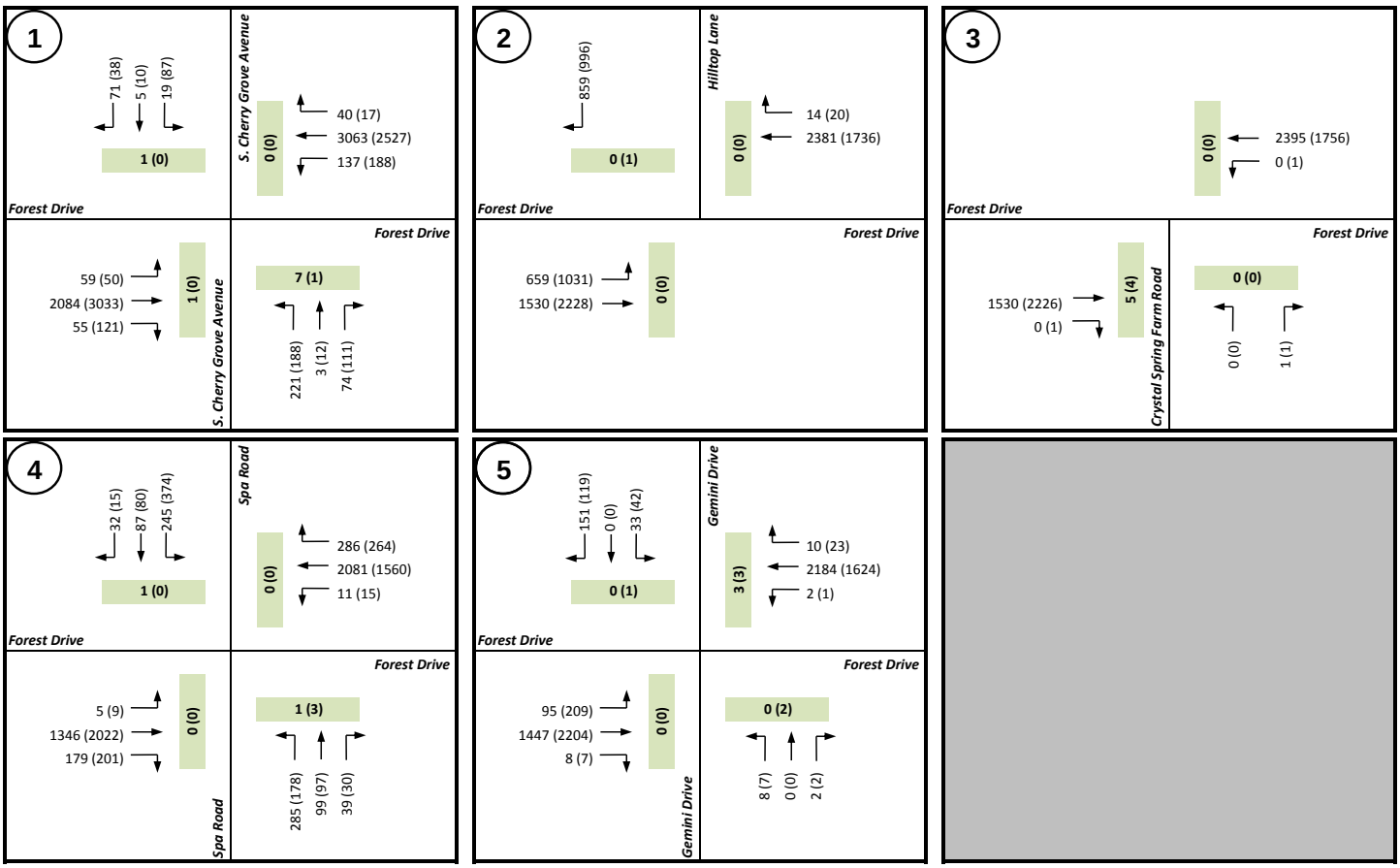
Traffic impact studies for the aforementioned background developments recommended the following roadway improvements to the study intersections:

- Extend the southbound right turn lane at the intersection of Forest Drive at South Cherry Grove Avenue to 150 feet and change the sequencing of the north- and southbound split phases.
- Extend the northbound left turn lane at the intersection of Forest Drive at Spa Road to 280 feet.

These improvements were included in the analysis for total background conditions.

5.5. Total Background Conditions Level of Service Analysis

A capacity analysis was conducted for total background conditions using the HCM methodology previously described. The results of the total background capacity analysis are shown in **Table 3**, and Synchro worksheets are provided in **Appendix E**.



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

XX Intersection Number (located on figure)

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Traffic Impact Study

Figure 8

Total Background Conditions AM and PM Peak Hour Volumes

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Table 3: Total Background Conditions HCM Level of Service Summary

No.	Intersection	Movement	AM Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS
1	Forest Drive at South Cherry Grove Avenue	**Overall**	**30.6**	**C**	**83.8**	**F**
		EBL	38.0	D	27.5	C
		EBTR	19.9	B	129.3	F
		WBL	61.8	E	122.8	F
		WBTR	32.2	C	29.5	C
		NBL	66.6	E	56.7	E
		NBTL	65.9	E	56.7	E
		NBR	55.8	E	53.9	D
		SBTL	65.8	E	81.1	F
		SBR	64.2	E	59.5	E
2	Forest Drive at Hilltop Lane	**Overall**	**19.9**	**B**	**19.7**	**B**
		EBL	37.0	D	25.9	C
		EBT	4.0	A	7.1	A
		WBTR	14.2	B	22.4	C
		SBR	50.9	D	36.8	D
3	Forest Drive at Crystal Spring Farm Road[1]	NBLR	13.7	B	34.7	D
4	Forest Drive at Spa Road	**Overall**	**88.6**	**F**	**67.2**	**E**
		EBL	10.7	B	14.8	B
		EBTR	29.1	C	95.5	F
		WBL	12.4	B	19.1	B
		WBTR	127.2	F	26.9	C
		NBL	104.6	F	76.4	E
		NBLTR	99.3	F	73.6	E
		SBL	76.6	E	87.2	F
		SBLTR	73.8	E	87.3	F
5	Forest Drive at Gemini Drive	**Overall**	**14.1**	**B**	**11.1**	**B**
		EBL	63.6	E	49.3	D
		EBTR	1.2	A	2.7	A
		WBL	3.8	A	22.2	C
		WBTR	16.2	B	13.0	B
		NBLTR	61.8	E	61.2	E
		SBTL	66.0	E	66.9	E
		SBR	60.5	E	50.6	D

1 – HCM does not calculate overall intersection delay/LOS for two-way STOP controlled intersections; therefore, only the STOP controlled approach delay/LOS is reported.
2 – Peak hour volume is zero.

The results of the total background capacity analysis indicate that each of the overall intersections operate at comparable LOS compared to existing conditions with the exception of Forest Drive at South Cherry Grove Avenue, which is projected to degrade from LOS D to LOS F during the PM peak hour, Forest Drive at Spa Road, which is projected to degrade from LOS D to LOS F and LOS D to LOS E during the AM and PM peak hours, respectively, and Forest Drive at Gemini Drive, which degrades from LOS A to LOS B during the PM peak hour. The following movements, which operate at an acceptable LOS D or better under existing conditions, degrade to LOS E or LOS F under total background conditions:

Forest Drive at South Cherry Grove Avenue

- EBTR (LOS F during the PM peak hour)
- WBL (LOS E during the AM peak hour)
- SBTL (LOS F during the PM peak hour)

Forest Drive at Spa Road

- EBTR (LOS F during the PM peak hour)
- WBTR (LOS F during the AM peak hour)
- SBLTR (LOS F during the PM peak hour)

Forest Drive at Gemini Drive

- EBL (LOS E during the AM peak hour)
- NBLTR (LOS E during the AM peak hour)

6. Site Generated Traffic

6.1. Site Trip Generation

The ITE Trip Generation Manual was used to calculate the new trips for the Village at Providence Point during the AM and PM peak hours. The site trip generation does not include transit reduction, thus providing a conservative assessment of the anticipated traffic impacts. The trips generated by the site during the AM and PM peak hour of the adjacent street are shown in **Table 4**.

Table 4: Site Development Trip Generation

Site	Size	Land Use	AM Peak Hour			PM Peak Hour			Weekday
			In	Out	Total	In	Out	Total	Total
Village at Providence Point	431 Units	255 (Continuing Care Retirement Center)	49	27	76	32	50	82	1,582

6.2. Site Trip Distribution and Assignment

Similar to the assumptions documented in the *Eastport Commons Traffic Impact Analysis*, the following directional trip distribution percentages were used:

- 30% to/from the north via Spa Road
- 5% to/from the south via Spa Road
- 10% to/from the east via Forest Drive
- 55% to/from the west via Forest Drive

Site trip assignment based on the generated site trips in Table 4 is shown in **Figure 9**.

7. Total Traffic Conditions

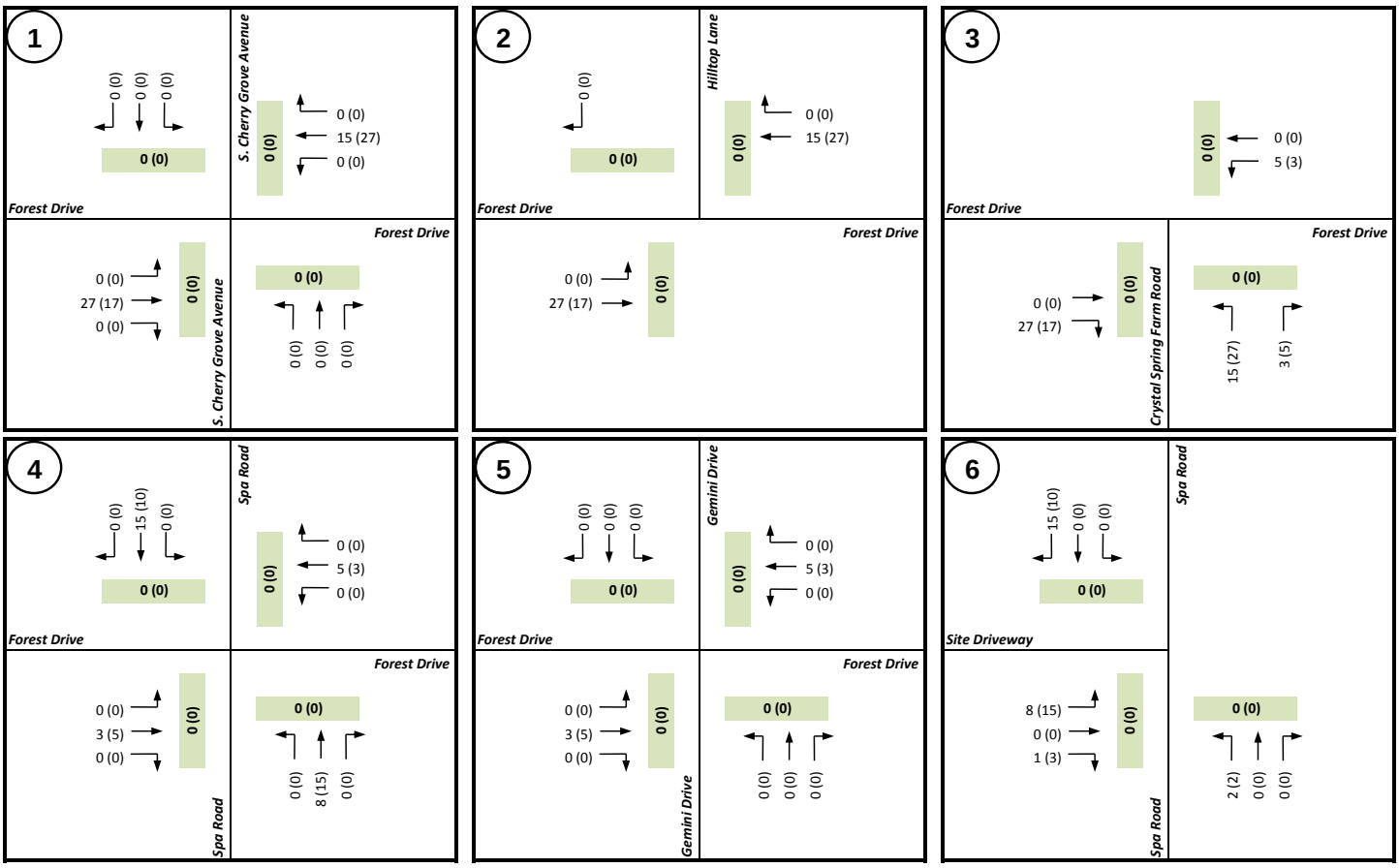
7.1. Total Traffic Volumes and Lane Use

The total traffic volumes include volumes under the background condition plus the new site traffic anticipated to be generated by the Village at Providence Point development. The total future AM and PM peak hour volumes are shown in **Figure 10**.

The total traffic analysis considers the background roadway improvements previously identified in addition to the new site driveway intersection along Spa Road. The resultant lane use and traffic control are shown in **Figure 11**.

7.2. Total Traffic Conditions Level of Service Analysis

A capacity analysis was conducted for total traffic conditions using the HCM methodology previously described. The results of the total traffic capacity analysis are shown in **Table 5**, and Synchro worksheets are provided in **Appendix F**.



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

XX Intersection Number (located on figure)

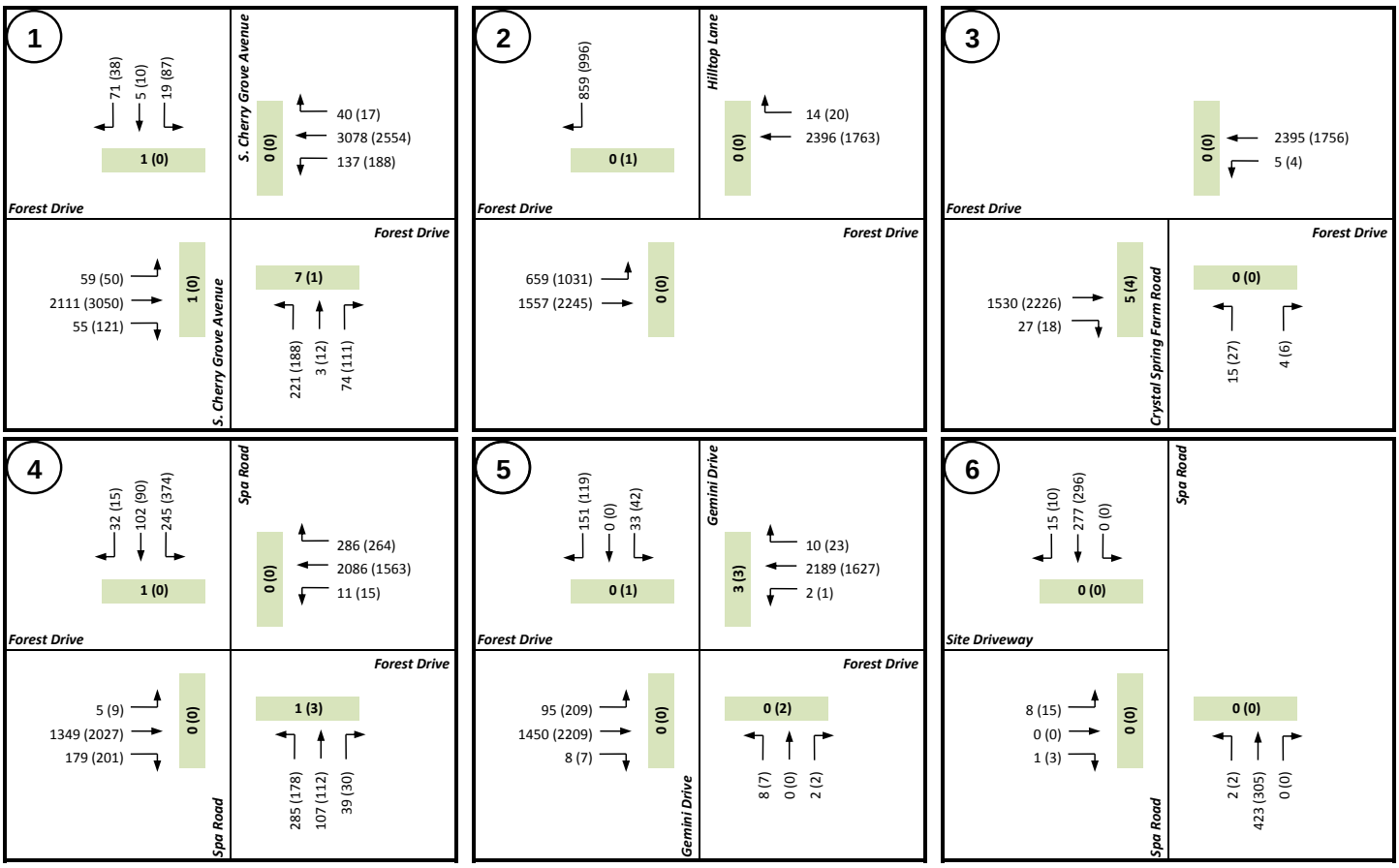
Village at Providence Point
Traffic Impact Study

Figure 9

Site Trip Assignment AM and PM Peak Hour Volumes

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

XX Intersection Number (located on figure)

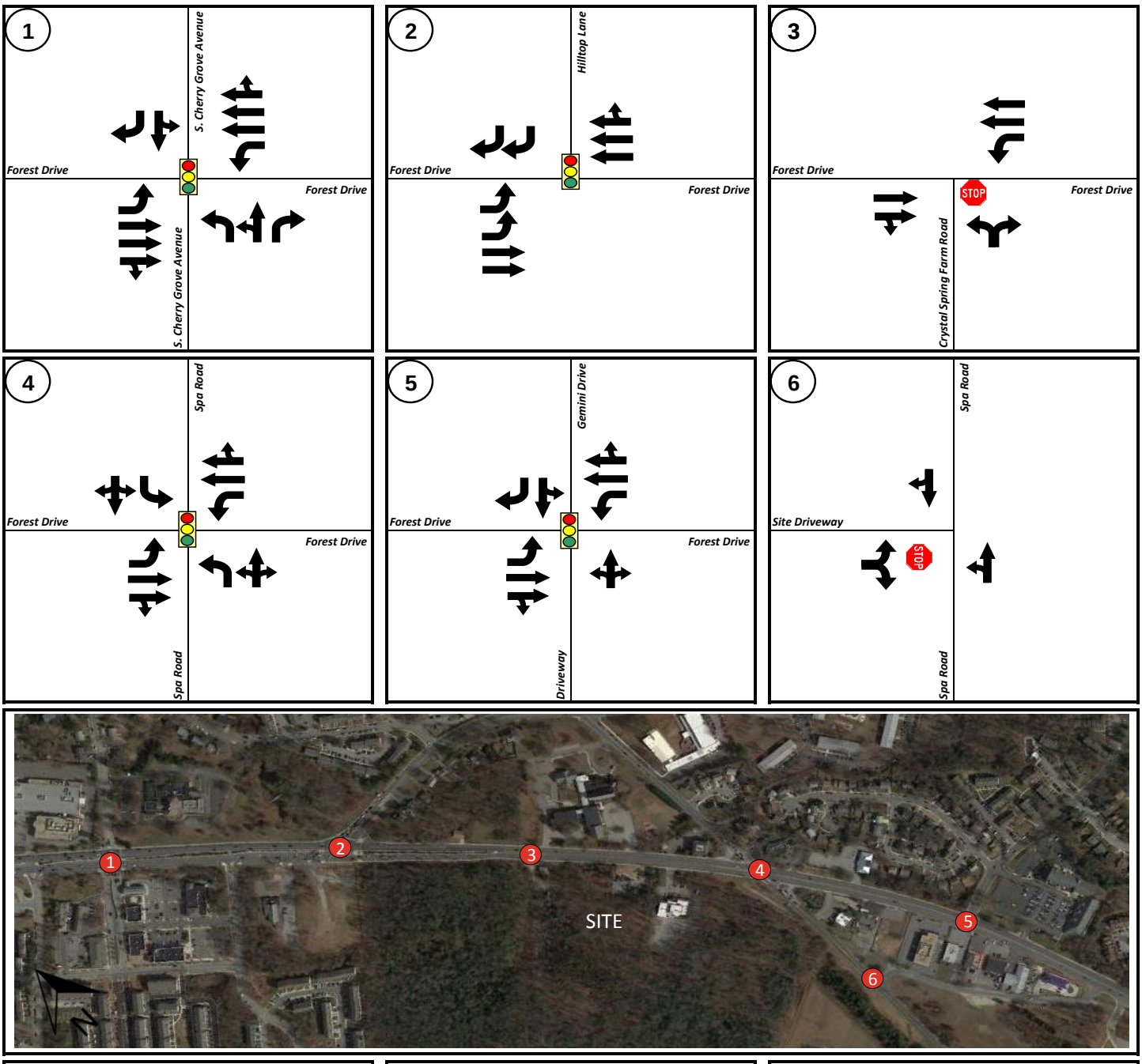
Village at Providence Point
Traffic Impact Study

Figure 10

Total Traffic Conditions AM and PM Peak Hour Volumes

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

- Proposed Lane Configuration
- Signalized Intersection
- Unsignalized Intersection
- XX Intersection Number (volume diagram)
- XX Intersection Number (located on figure)

Village at Providence Point
Traffic Impact Study

Figure 11

Total Traffic Conditions Lane Use and Traffic Control

CITY OF ANNAPOLIS

STV 100 Years

Table 5: Total Traffic Conditions HCM Level of Service Summary

No.	Intersection	Movement	AM Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS
1	Forest Drive at South Cherry Grove Avenue	**Overall**	**31.2**	**C**	**85.3**	**F**
		EBL	38.0	D	28.2	C
		EBTR	20.2	B	132.1	F
		WBL	62.1	E	123.0	F
		WBTR	33.3	C	30.0	C
		NBL	66.6	E	56.7	E
		NBTL	65.9	E	56.7	E
		NBR	55.8	E	53.9	D
		SBTL	65.8	E	81.1	F
		SBR	64.2	E	59.5	E
2	Forest Drive at Hilltop Lane	**Overall**	**19.8**	**B**	**19.8**	**C**
		EBL	36.6	D	25.9	C
		EBT	4.0	A	7.3	A
		WBTR	14.3	B	22.6	C
		SBR	50.9	D	36.8	D
3	Forest Drive at Crystal Spring Farm Road[1]	NBLR	30.9	D	19.2	C
4	Forest Drive at Spa Road	**Overall**	**91.4**	**F**	**70.9**	**E**
		EBL	11.3	B	15.1	B
		EBTR	29.6	C	101.1	F
		WBL	12.8	B	19.1	B
		WBTR	131.6	F	28.7	C
		NBL	107.9	F	78.1	E
		NBLTR	104.4	F	72.8	E
		SBL	77.6	E	92.4	F
		SBLTR	74.5	E	88.9	F
5	Forest Drive at Gemini Drive	**Overall**	**14.1**	**B**	**11.2**	**B**
		EBL	63.2	E	49.7	D
		EBTR	1.2	A	2.8	A
		WBL	3.8	A	22.5	C
		WBTR	16.3	B	13.1	B
		NBLTR	61.8	E	61.2	E
		SBTL	66.0	E	66.9	E
		SBR	60.5	E	50.6	D
6	Spa Road at Site Driveway[1]	EBLR	14.6	B	13.3	B

1 – HCM does not calculate overall intersection delay/LOS for two-way STOP controlled intersections; therefore, only the STOP controlled approach delay/LOS is reported.
2 – Peak hour volume is zero.

Consistent with the total background conditions, the results of the total traffic conditions capacity analysis indicate that each of the overall intersections operate at acceptable LOS

with the exception of Forest Drive at South Cherry Grove Avenue, which is projected to continue to operate at LOS F during the PM peak hour and Forest Drive at Spa Road, which is projected to continue to operate at LOS F and LOS E during the AM and PM peak hours, respectively, when compared to the total background conditions. A number of movements continue to operate at LOS E and LOS F during both the AM and PM peak hours. The following movements, which operate at LOS E or LOS F during total background conditions or degrade to LOS E or LOS F during the total traffic conditions, worsen under total future conditions:

Forest Drive at South Cherry Grove Avenue

- EBTR (delay increases by 2.8 seconds during the PM peak hour)
- WBL (delay increases by 0.3 seconds during the AM peak hour and 0.2 seconds during the PM peak hour)

Forest Drive at Crystal Spring Farm Road

- NBLR (delay increases by 17.2 seconds during the AM peak hour)

Forest Drive at Spa Road

- EBTR (delay increases by 5.6 seconds during the PM peak hour)
- WBTR (delay increases by 4.4 seconds during the AM peak hour)
- NBL (delay increases by 3.3 seconds during the AM peak hour and 1.7 seconds during the PM peak hour)
- NBLTR (delay increases by 5.1 seconds during the AM peak hour)
- SBL (delay increases by 1.0 seconds during the AM peak hour and 5.2 seconds during the PM peak hour)
- SBLTR (delay increases by 0.7 seconds during the AM peak hour and 1.6 seconds during the PM peak hour)

8. Queueing Analysis

Synchro software was also used to obtain 95th percentile queues for the dedicated turn lanes at the signalized intersections. The projected queues for the existing, total background, and total traffic conditions are shown in **Table 6**. Queueing reports are provided in **Appendix G**.

Table 6: Summary of 95th Percentile Queues[1] (ft)

No.	Intersection	Movement	Existing Storage Capacity (ft)	Existing Conditions		Future Storage Capacity (ft)	Total Background Conditions		Total Traffic Conditions	
				AM	PM		AM	PM	AM	PM
1	Forest Drive at South Cherry Grove Avenue	EBL	100	25	25	100	75	50	75	50
		WBL	150	100[5]	**275[6]**	150	125[5]	**325[5, 6]**	125[5]	**325[5, 6]**
		NBL	150	**155**	150	150	**175**	150	**175**	150
		NBR	240[3]	-	50	240[3]	25	75	25	75
		SBR	60	-	-	150	-	-	-	-
2	Forest Drive at Hilltop Lane	EBL	400/855[3]	350	325[5]	400/855[3]	425	400[5]	425	400[5]
		SBR	550[2]	175	175	550[2]	275	275	275	275
4	Forest Drive at Spa Road	EBL	1,030[4]	25[5]	25[5]	1,030[4]	25[5]	25[5]	25[5]	25[5]
		WBL	600[4]	25[5]	25[5]	600[4]	25[5]	25[5]	25[5]	25[5]
		NBL	130	**375[6]**	225	280	**400[6]**	250[6]	**400[6]**	275[6]
		SBL	300	250	**375[6]**	300	300[6]	**425[6]**	300[6]	**425[6]**
5	Forest Drive at Gemini Drive	EBL	200	75[5]	75[5]	200	75[5]	100[5]	75[5]	100[5]
		WBL	125	-	-	125	25	25	25	25
		SBR	110	**175**	100	110	**200**	**125**	**200**	**125**

1 - Queues rounded to the nearest 25 feet
2 - Full Length Turn Lane
3 - Double Left Turn consists of one turn bay and one full length turn lane
4 - Length of Two Way Left Turn Lane between intersections
5 - Volume for 95th percentile queue is metered by upstream signal
6 - 95th percentile volume exceeds capacity, queue may be longer
BOLD - Queue exceeds storage capacity

Table 6 shows that queues are projected to exceed the storage capacity of left and right turn storage bays at three of the four signalized intersections under total traffic conditions. For each of these left or right turns, however, the queues projected under total traffic conditions are the same as projected under total background conditions, indicating that queues are not impacted by the Village at Providence Point development.

Synchro software is unable to generate queues for unsignalized intersections, such as the two proposed site access points. For the two proposed site access points, a qualitative evaluation has been conducted based on the projected volume of traffic turning left into the development. At the Forest Drive site access, there are 5 AM and 4 PM projected peak hour site trips turning left into the development. There is an existing center two way left turn lane (TWLTL) on Forest Drive which will remove these vehicles from the adjacent through lane. The center TWLTL is approximately 900 feet in length between the site access point and Spa Road. The future peak hour volume projections for the eastbound left turn from Forest Drive onto Spa Road are 5 AM and 9 PM vehicles. Based on these volumes, the maximum number of vehicles that the 900 foot center TWLTL would need to support is 13 vehicles during the PM peak hour. Typically, a queued vehicle is estimated at 25 feet in length. Therefore, if all left turning vehicles arrived at the same time, the maximum westbound queue at the site access would be 100 feet and the maximum eastbound left turn at the Spa Road intersection would be 225 feet. As a result, the

available storage is more than sufficient to accommodate westbound left turns into the site and eastbound left turns at Spa Road. At the Spa Road access, there are only 2 AM and 2 PM peak hour site trips projected to turn left into the site. There is sufficient available pavement for through vehicles to bypass the left turn vehicles at this location.

9. Roadway and Intersection Improvements

Safety Improvements

Geometric improvements are recommended at the site driveways to improve safety for motorists entering and exiting the site. Deceleration lanes are recommended for eastbound right turns accessing Crystal Spring Farm Road and southbound right turns accessing the Spa Road driveway. The deceleration lanes should be installed in accordance with Section 4.3 of the SHA Access Manual.

Given the high volume of traffic on Forest Drive, it is also recommended that the intersection of Forest Drive at Crystal Spring Farm Road be converted to a right-in, right-out intersection. This would remove potential conflicts for westbound lefts entering the site and northbound lefts exiting the site. During the PM peak hour, queues from Spa Road occasionally extend beyond Crystal Spring Farm Road, making these movements particularly difficult. These trips would be diverted to the Spa Road site driveway via the intersection of Forest Drive at Spa Road. It's important to note that the reassignment of these trips is not projected to significantly impact the intersection of Forest Drive at Spa Road or the Spa Road site driveway.

Capacity Improvements

The results of the capacity analysis indicate that two of the four signalized study intersections are projected to continue to operate at an overall unacceptable LOS when compared to total background conditions. These intersections, Forest Drive at South Cherry Grove Avenue and Forest Drive at Spa Road, also have movements projected to operate at LOS E and/or LOS F during both the AM and PM peak hours. It is important to note, however, that these movements are also projected to operate at an unacceptable LOS during total background conditions. The Village at Providence Point development does not increase movement delay for any of these unacceptable movements by more than 6 seconds, and overall intersection delays for these intersections do not increase by more than 4 seconds. In order to improve operations and mitigate the site's impact at these two intersections, the following improvements are recommended:

- Change the southbound lane use at the intersection of Forest Drive at South Cherry Grove Avenue from a shared through/left turn lane and a dedicated right turn lane to a dedicated left turn lane and a shared left/through/right turn lane while maintaining split phasing in the north- and southbound directions.
- Widen the south leg of Spa Road approaching Forest Drive to add a second northbound left turn lane at the intersection of Forest Drive at Spa Road. The resultant lane use for this approach would be double left turn lanes and a shared through/right turn lane.

The updated HCM results at these two intersections are shown in **Table 7**. It should be noted that this capacity analysis considers the reassignment of the left turning traffic at the

intersection of Forest Drive at Crystal Spring Farm Road associated with the recommended safety improvements discussed above. Synchro worksheets are provided in **Appendix H**. Overall intersection delay and LOS remain unchanged at the other study intersections.

Table 7: Mitigation Improvements HCM Level of Service Summary

No.	Intersection	Movement	AM Peak Hour		PM Peak Hour	
			Delay (s)	LOS	Delay (s)	LOS
1	Forest Drive at South Cherry Grove Avenue	**Overall**	**31.1**	**C**	**82.4**	**F**
		EBL	38.1	D	26.1	C
		EBTR	20.0	B	131.2	F
		WBL	61.5	E	80.8	F
		WBTR	33.1	C	26.7	C
		NBL	66.6	E	56.7	E
		NBTL	65.9	E	56.7	E
		NBR	55.8	E	53.9	D
		SBL	66.2	E	95.7	F
		SBLTR	65.0	E	64.0	E
4	Forest Drive at Spa Road	**Overall**	**78.6**	**E**	**65.4**	**E**
		EBL	10.7	B	14.7	B
		EBTR	26.9	C	94.8	F
		WBL	12.5	B	25.4	C
		WBTR	115.4	F	26.4	C
		NBL	65.8	E	60.5	E
		NBTR	64.8	E	70.8	E
		SBL	77.6	E	81.8	F
		SBLTR	74.5	E	79.2	F

Table 7 indicates that with the capacity improvements, both signalized intersections will continue to operate unacceptably. However, the overall intersection delays operating at LOS E or F are projected to operate slightly better than the total background conditions, thus mitigating the impacts of the Village at Providence Point development.

10. Conclusions/Recommendations

A traffic impact study was conducted for the proposed Village at Providence Point Continuing Care Retirement Center. The development includes 431 units consisting of independent living apartments, cottages/duplexes, maison units, and a healthcare/nursing facility. The primary site access will be on Crystal Spring Farm Road. Additional site access is planned to connect the development to Spa Road. However, this site access must first be approved by the SHA. The results of the traffic impact analysis are as follows:

- Under existing conditions, each of the five study intersections operate at an overall LOS D or better. At least one movement of the intersections of Forest Drive at South Cherry Grove Avenue, Forest Drive at Spa Road, and Forest Drive at Gemini

Drive operate at an unacceptable LOS E or LOS F during either the AM or PM peak hour.

- Eighteen approved background developments were considered for this analysis. These developments are projected to generate 1,096 trips during the AM peak hour and 1,343 trips during the PM peak hour, with more than half of these trips expected to travel through the study area.
- Under total background conditions, two of the five intersections are projected to operate at overall LOS E or LOS F during either the AM or PM peak hour. Movement delays also degrade under total background conditions.
- The Village at Providence Point is projected to generate 76 and 82 trips during the AM and PM peak hours, respectively.
- The following geometric improvements are recommended at the intersections of Forest Drive at Crystal Spring Farm Road and Spa Road at the site driveway to improve safety for motorists accessing the Village at Providence Point development:
    - Deceleration lanes are recommended for eastbound right turns accessing Crystal Spring Farm Road and southbound right turns accessing the site from Spa Road.
    - Convert the intersection of Forest Drive at Crystal Spring Farm Road to a right-in, right-out intersection to remove potential conflicts for westbound lefts entering the site and northbound lefts exiting the site.
- Under total traffic conditions, two intersections projected to operate at an overall LOS E or LOS F. To improve operations at these two intersections and to mitigate the impact of the site, the following capacity improvements are recommended:
    - Change the southbound lane use at the intersection of Forest Drive at South Cherry Grove Avenue from a shared through/left turn lane and a dedicated right turn lane to a dedicated left turn lane and a shared left/through/right turn lane while maintaining split phasing in the north- and southbound directions.
    - Widen the south leg of Spa Road approaching Forest Drive to add a second northbound left turn lane. The resultant lane use for this approach would be double left turn lanes and a shared through/right turn lane.

  With these two improvements, the overall intersection delays and LOS will be comparable to or slightly better than the total background conditions.

APPENDIX

A

Village at Providence Point Traffic Impact Study
Proposed Development Site Plan

APPENDIX

B

Village at Providence Point Traffic Impact Study
Turning Movement Counts

TOTALS TURNING MOVEMENT COUNT - SUMMARY

Counted by: VCU

Intersection of: Forest Drive — Date: June 01, 2017 — Thursday

and: S Cherry Grove Drive — Weather: Clear, Warm

Location: Anne Arundel County, Maryland — Entered by: BGJ — Star Rating: 3

TIME	TRAFFIC FROM NORTH on: S Cherry Grove Drive					TRAFFIC FROM SOUTH on: S Cherry Grove Drive					TRAFFIC FROM EAST on: Forest Drive					TRAFFIC FROM WEST on: Forest Drive					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
7:00 - 7:15	13	2	1	0	16	18	0	59	0	77	0	631	29	0	660	18	301	2	1	322	1075
7:15 - 7:30	18	0	0	0	18	14	0	50	0	64	0	626	20	1	647	16	367	1	0	384	1113
7:30 - 7:45	11	2	0	0	13	21	0	43	0	64	0	635	34	0	669	14	419	2	0	435	1181
7:45 - 8:00	20	2	1	0	23	17	3	62	0	82	0	693	22	2	717	15	482	3	1	501	1323
8:00 - 8:15	13	1	1	0	15	9	0	39	0	48	3	665	38	1	707	10	479	4	0	493	1263
8:15 - 8:30	24	0	3	0	27	21	0	44	0	65	0	666	36	1	703	7	424	2	0	433	1228
8:30 - 8:45	11	2	2	0	15	8	0	48	0	56	4	704	24	0	732	15	425	2	0	442	1245
8:45 - 9:00	11	1	1	0	13	18	0	60	0	78	4	609	30	0	643	18	400	4	3	425	1159
2 Hr Totals	121	10	9	0	140	126	3	405	0	534	11	5229	233	5	5478	113	3297	20	5	3435	9587
1 Hr Totals																					
7:00 - 8:00	62	6	2	0	70	70	3	214	0	287	0	2585	105	3	2693	63	1569	8	2	1642	4692
7:15 - 8:15	62	5	2	0	69	61	3	194	0	258	3	2619	114	4	2740	55	1747	10	1	1813	4880
7:30 - 8:30	68	5	5	0	78	68	3	188	0	259	3	2659	130	4	2796	46	1804	11	1	1862	4995
7:45 - 8:45	68	5	7	0	80	55	3	193	0	251	7	2728	120	4	2859	47	1810	11	1	1869	5059
8:00 - 9:00	59	4	7	0	70	56	0	191	0	247	11	2644	128	2	2785	50	1728	12	3	1793	4895
PEAK HOUR																					
7:45 - 8:45	68	5	7	0	80	55	3	193	0	251	7	2728	120	4	2859	47	1810	11	1	1869	5059
PM																					
4:00 - 4:15	11	3	2	0	16	13	2	30	0	45	6	552	31	2	591	23	490	2	0	515	1167
4:15 - 4:30	6	4	0	0	10	22	2	35	0	59	2	512	37	0	551	28	506	9	0	543	1163
4:30 - 4:45	7	3	1	0	11	25	3	41	0	69	1	522	37	1	561	17	498	7	0	522	1163
4:45 - 5:00	8	3	2	0	13	16	4	36	0	56	1	540	36	1	578	27	631	12	0	670	1317
5:00 - 5:15	5	4	5	0	14	28	4	44	0	76	4	538	39	3	584	26	659	7	0	692	1366
5:15 - 5:30	13	0	3	0	16	33	2	42	0	77	0	560	39	1	600	21	723	5	0	749	1442
5:30 - 5:45	11	3	3	0	17	18	2	44	0	64	2	428	42	2	474	26	654	11	0	691	1246
5:45 - 6:00	24	0	1	0	25	19	2	25	0	46	1	498	29	1	529	22	597	5	1	625	1225
2 Hr Totals	85	20	17	0	122	174	21	297	0	492	17	4150	290	11	4468	190	4758	58	1	5007	10089
1 Hr Totals																					
4:00 - 5:00	32	13	5	0	50	76	11	142	0	229	10	2126	141	4	2281	95	2125	30	0	2250	4810
4:15 - 5:15	26	14	8	0	48	91	13	156	0	260	8	2112	149	5	2274	98	2294	35	0	2427	5009
4:30 - 5:30	33	10	11	0	54	102	13	163	0	278	6	2160	151	6	2323	91	2511	31	0	2633	5288
4:45 - 5:45	37	10	13	0	60	95	12	166	0	273	7	2066	156	7	2236	100	2667	35	0	2802	5371
5:00 - 6:00	53	7	12	0	72	98	10	155	0	263	7	2024	149	7	2187	95	2633	28	1	2757	5279
PEAK HOUR																					
4:45 - 5:45	37	10	13	0	60	95	12	166	0	273	7	2066	156	7	2236	100	2667	35	0	2802	5371

TOTALS TURNING MOVEMENT COUNT - SUMMARY

Counted by: VCU

Intersection of: Forest Drive
and: Hilltop Lane
Location: Anne Arundel County, Maryland

Date: June 01, 2017
Weather: Clear, Warm
Entered by: BGJ

Thursday
Star Rating: 4

TIME	TRAFFIC FROM NORTH on: Hilltop Lane					TRAFFIC FROM SOUTH on:					TRAFFIC FROM EAST on: Forest Drive					TRAFFIC FROM WEST on: Forest Drive					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
7:00 - 7:15	201	0	0	0	201	0	0	0	0	0	0	474	0	0	474	0	240	103	0	343	1018
7:15 - 7:30	174	0	0	0	174	0	0	0	0	0	2	472	0	0	474	0	269	120	0	389	1037
7:30 - 7:45	183	0	0	0	183	0	0	0	0	0	5	502	0	0	507	0	298	146	0	444	1134
7:45 - 8:00	202	0	0	0	202	0	0	0	0	0	4	521	0	0	525	0	390	156	0	546	1273
8:00 - 8:15	166	0	0	0	166	0	0	0	0	0	3	527	0	0	530	0	325	120	0	445	1141
8:15 - 8:30	180	0	0	0	180	0	0	0	0	0	2	501	0	0	503	0	318	156	0	474	1157
8:30 - 8:45	173	0	0	0	173	0	0	0	0	0	5	541	0	0	546	0	293	112	0	405	1124
8:45 - 9:00	199	0	0	0	199	0	0	0	0	0	7	444	0	0	451	0	320	136	0	456	1106
2 Hr Totals	1478	0	0	0	1478	0	0	0	0	0	28	3982	0	0	4010	0	2453	1049	0	3502	8990
1 Hr Totals																					
7:00 - 8:00	760	0	0	0	760	0	0	0	0	0	11	1969	0	0	1980	0	1197	525	0	1722	4462
7:15 - 8:15	725	0	0	0	725	0	0	0	0	0	14	2022	0	0	2036	0	1282	542	0	1824	4585
7:30 - 8:30	731	0	0	0	731	0	0	0	0	0	14	2051	0	0	2065	0	1331	578	0	1909	4705
7:45 - 8:45	721	0	0	0	721	0	0	0	0	0	14	2090	0	0	2104	0	1326	544	0	1870	4695
8:00 - 9:00	718	0	0	0	718	0	0	0	0	0	17	2013	0	0	2030	0	1256	524	0	1780	4528
PEAK HOUR																					
7:30 - 8:30	731	0	0	0	731	0	0	0	0	0	14	2051	0	0	2065	0	1331	578	0	1909	4705
PM																					
4:00 - 4:15	208	0	0	0	208	0	0	0	0	0	6	403	0	0	409	0	411	187	0	598	1215
4:15 - 4:30	203	0	0	0	203	0	0	0	0	0	4	337	0	0	341	0	467	199	0	666	1210
4:30 - 4:45	196	0	0	0	196	0	0	0	0	0	4	395	0	0	399	0	457	202	2	661	1256
4:45 - 5:00	227	0	0	0	227	0	0	0	0	0	4	355	0	0	359	0	505	215	0	720	1306
5:00 - 5:15	240	0	0	0	240	0	0	0	0	0	4	378	0	0	382	0	531	237	0	768	1390
5:15 - 5:30	215	0	0	0	215	0	0	0	0	0	7	368	0	0	375	0	469	225	0	694	1284
5:30 - 5:45	196	0	0	0	196	0	0	0	0	0	7	289	0	0	296	0	503	237	0	740	1232
5:45 - 6:00	159	0	0	0	159	0	0	0	0	0	3	358	0	0	361	0	391	161	0	552	1072
2 Hr Totals	1644	0	0	0	1644	0	0	0	0	0	39	2883	0	0	2922	0	3734	1663	2	5399	9965
1 Hr Totals																					
4:00 - 5:00	834	0	0	0	834	0	0	0	0	0	18	1490	0	0	1508	0	1840	803	2	2645	4987
4:15 - 5:15	866	0	0	0	866	0	0	0	0	0	16	1465	0	0	1481	0	1960	853	2	2815	5162
4:30 - 5:30	878	0	0	0	878	0	0	0	0	0	19	1496	0	0	1515	0	1962	879	2	2843	5236
4:45 - 5:45	878	0	0	0	878	0	0	0	0	0	22	1390	0	0	1412	0	2008	914	0	2922	5212
5:00 - 6:00	810	0	0	0	810	0	0	0	0	0	21	1393	0	0	1414	0	1894	860	0	2754	4978
PEAK HOUR																					
4:30 - 5:30	878	0	0	0	878	0	0	0	0	0	19	1496	0	0	1515	0	1962	879	2	2843	5236

TOTALS TURNING MOVEMENT COUNT - SUMMARY

Counted by: VCU

Intersection of: Forest Drive — Date: June 01, 2017 — Thursday

and: Crystal Springs Farm Road — Weather: Clear, Warm

Location: Anne Arundel County, Maryland — Entered by: BGJ — Star Rating: 5

TIME	TRAFFIC FROM NORTH on: Forest Drive					TRAFFIC FROM SOUTH on: Forest Drive					TRAFFIC FROM EAST on:					TRAFFIC FROM WEST on: Crystal Springs Farm Road					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
7:00 - 7:15	0	218	0	0	218	0	491	0	0	491	0	0	0	0	0	0	0	1	0	1	710
7:15 - 7:30	0	289	0	0	289	0	453	0	0	453	0	0	0	0	0	0	0	0	0	0	742
7:30 - 7:45	0	269	0	0	269	0	506	0	1	507	0	0	0	0	0	0	0	0	0	0	776
7:45 - 8:00	0	365	0	0	365	0	516	0	0	516	0	0	0	0	0	0	0	0	0	0	881
8:00 - 8:15	0	363	0	0	363	0	538	0	0	538	0	0	0	0	0	1	0	0	0	1	902
8:15 - 8:30	0	314	0	0	314	0	520	0	0	520	0	0	0	0	0	0	0	0	0	0	834
8:30 - 8:45	0	294	0	0	294	0	528	0	0	528	0	0	0	0	0	0	0	0	0	0	822
8:45 - 9:00	0	308	0	0	308	0	468	0	0	468	0	0	0	0	0	1	0	0	0	1	777
2 Hr Totals	0	2420	0	0	2420	0	4020	0	1	4021	0	0	0	0	0	2	0	1	0	3	6444
1 Hr Totals																					
7:00 - 8:00	0	1141	0	0	1141	0	1966	0	1	1967	0	0	0	0	0	0	0	1	0	1	3109
7:15 - 8:15	0	1286	0	0	1286	0	2013	0	1	2014	0	0	0	0	0	1	0	0	0	1	3301
7:30 - 8:30	0	1311	0	0	1311	0	2080	0	1	2081	0	0	0	0	0	1	0	0	0	1	3393
7:45 - 8:45	0	1336	0	0	1336	0	2102	0	0	2102	0	0	0	0	0	1	0	0	0	1	3439
8:00 - 9:00	0	1279	0	0	1279	0	2054	0	0	2054	0	0	0	0	0	2	0	0	0	2	3335
PEAK HOUR																					
7:45 - 8:45	0	1336	0	0	1336	0	2102	0	0	2102	0	0	0	0	0	1	0	0	0	1	3439
PM																					
4:00 - 4:15	0	457	0	0	457	0	384	0	0	384	0	0	0	0	0	0	0	1	0	1	842
4:15 - 4:30	0	452	0	0	452	0	374	0	0	374	0	0	0	0	0	0	0	0	0	0	826
4:30 - 4:45	0	460	0	0	460	0	369	1	0	370	0	0	0	0	0	0	0	0	0	0	830
4:45 - 5:00	1	494	0	0	495	0	386	0	0	386	0	0	0	0	0	0	0	0	0	0	881
5:00 - 5:15	0	501	0	0	501	0	376	0	0	376	0	0	0	0	0	0	0	0	0	0	877
5:15 - 5:30	0	502	0	1	503	0	375	0	0	375	0	0	0	0	0	1	0	0	0	1	879
5:30 - 5:45	0	463	0	0	463	0	319	0	0	319	0	0	0	0	0	1	0	0	0	1	783
5:45 - 6:00	0	425	0	0	425	0	337	0	0	337	0	0	0	0	0	1	0	0	0	1	763
2 Hr Totals	1	3754	0	1	3756	0	2920	1	0	2921	0	0	0	0	0	3	0	1	0	4	6681
1 Hr Totals																					
4:00 - 5:00	1	1863	0	0	1864	0	1513	1	0	1514	0	0	0	0	0	0	0	1	0	1	3379
4:15 - 5:15	1	1907	0	0	1908	0	1505	1	0	1506	0	0	0	0	0	0	0	0	0	0	3414
4:30 - 5:30	1	1957	0	1	1959	0	1506	1	0	1507	0	0	0	0	0	1	0	0	0	1	3467
4:45 - 5:45	1	1960	0	1	1962	0	1456	0	0	1456	0	0	0	0	0	2	0	0	0	2	3420
5:00 - 6:00	0	1891	0	1	1892	0	1407	0	0	1407	0	0	0	0	0	3	0	0	0	3	3302
PEAK HOUR																					
4:30 - 5:30	1	1957	0	1	1959	0	1506	1	0	1507	0	0	0	0	0	1	0	0	0	1	3467

TOTALS TURNING MOVEMENT COUNT - SUMMARY

Counted by: VCU

Intersection of: Forest Drive
and: Spa Road
Location: Anne Arundel County, Maryland

Date: June 01, 2017
Weather: Clear, Warm
Entered by: BGJ

Thursday
Star Rating: 4

TIME	TRAFFIC FROM NORTH on: Spa Road					TRAFFIC FROM SOUTH on: Spa Road					TRAFFIC FROM EAST on: Forest Drive					TRAFFIC FROM WEST on: Forest Drive					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
7:00 - 7:15	4	10	19	0	33	6	18	67	0	91	26	371	0	0	397	32	183	0	0	215	736
7:15 - 7:30	1	7	13	0	21	3	26	36	0	65	49	391	1	0	441	42	238	1	0	281	808
7:30 - 7:45	3	11	25	0	39	2	51	61	0	114	58	385	1	0	444	54	220	1	0	275	872
7:45 - 8:00	2	21	62	0	85	10	29	68	0	107	49	383	2	0	434	40	316	1	0	357	983
8:00 - 8:15	8	32	61	0	101	10	21	75	0	106	60	403	1	0	464	56	289	2	0	347	1018
8:15 - 8:30	17	13	55	0	85	10	26	76	0	112	66	359	1	0	426	36	266	2	0	304	927
8:30 - 8:45	4	13	36	0	53	3	18	48	0	69	81	434	1	0	516	32	258	0	0	290	928
8:45 - 9:00	3	13	45	0	61	6	18	60	0	84	62	359	0	0	421	29	262	2	0	293	859
2 Hr Totals	42	120	316	0	478	50	207	491	0	748	451	3085	7	0	3543	321	2032	9	0	2362	7131
1 Hr Totals																					
7:00 - 8:00	10	49	119	0	178	21	124	232	0	377	182	1530	4	0	1716	168	957	3	0	1128	3399
7:15 - 8:15	14	71	161	0	246	25	127	240	0	392	216	1562	5	0	1783	192	1063	5	0	1260	3681
7:30 - 8:30	30	77	203	0	310	32	127	280	0	439	233	1530	5	0	1768	186	1091	6	0	1283	3800
7:45 - 8:45	31	79	214	0	324	33	94	267	0	394	256	1579	5	0	1840	164	1129	5	0	1298	3856
8:00 - 9:00	32	71	197	0	300	29	83	259	0	371	269	1555	3	0	1827	153	1075	6	0	1234	3732
PEAK HOUR																					
7:45 - 8:45	31	79	214	0	324	33	94	267	0	394	256	1579	5	0	1840	164	1129	5	0	1298	3856
PM																					
4:00 - 4:15	6	18	71	0	95	4	21	40	0	65	82	331	1	0	414	50	397	1	0	448	1022
4:15 - 4:30	3	19	72	0	94	9	23	43	0	75	64	305	1	0	370	40	408	4	0	452	991
4:30 - 4:45	3	16	96	0	115	6	18	35	0	59	67	326	0	0	393	51	400	2	0	453	1020
4:45 - 5:00	4	18	63	0	85	6	23	50	0	79	69	312	3	0	384	41	461	2	0	504	1052
5:00 - 5:15	4	16	102	0	122	4	30	47	0	81	42	325	2	0	369	36	443	3	0	482	1054
5:15 - 5:30	3	24	75	0	102	2	18	30	0	50	47	333	2	0	382	53	472	2	0	527	1061
5:30 - 5:45	7	16	84	0	107	6	20	32	0	58	52	271	0	0	323	45	397	2	0	444	932
5:45 - 6:00	7	27	95	0	129	6	13	37	0	56	62	303	1	0	366	40	382	4	0	426	977
2 Hr Totals	37	154	658	0	849	43	166	314	0	523	485	2506	10	0	3001	356	3360	20	0	3736	8109
1 Hr Totals																					
4:00 - 5:00	16	71	302	0	389	25	85	168	0	278	282	1274	5	0	1561	182	1666	9	0	1857	4085
4:15 - 5:15	14	69	333	0	416	25	94	175	0	294	242	1268	6	0	1516	168	1712	11	0	1891	4117
4:30 - 5:30	14	74	336	0	424	18	89	162	0	269	225	1296	7	0	1528	181	1776	9	0	1966	4187
4:45 - 5:45	18	74	324	0	416	18	91	159	0	268	210	1241	7	0	1458	175	1773	9	0	1957	4099
5:00 - 6:00	21	83	356	0	460	18	81	146	0	245	203	1232	5	0	1440	174	1694	11	0	1879	4024
PEAK HOUR																					
4:30 - 5:30	14	74	336	0	424	18	89	162	0	269	225	1296	7	0	1528	181	1776	9	0	1966	4187

TOTALS TURNING MOVEMENT COUNT - SUMMARY

Counted by: VCU

Intersection of: Forest Drive
and: Gemini Drive
Location: Anne Arundel County, Maryland

Date: June 01, 2017
Weather: Clear, Warm
Entered by: BGJ

Thursday
Star Rating: 5

TIME	TRAFFIC FROM NORTH on: Gemini Drive					TRAFFIC FROM SOUTH on: Gemini Drive					TRAFFIC FROM EAST on: Forest Drive					TRAFFIC FROM WEST on: Forest Drive					TOTAL N + S + E + W
	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	RIGHT	THRU	LEFT	U-TN	TOTAL	
AM																					
7:00 - 7:15	39	0	4	0	43	0	0	0	0	0	4	442	0	0	446	0	177	20	0	197	686
7:15 - 7:30	34	0	1	0	35	0	0	0	0	0	2	433	0	0	435	0	216	26	0	242	712
7:30 - 7:45	28	0	6	0	34	0	0	0	0	0	1	464	0	0	465	1	224	21	0	246	745
7:45 - 8:00	28	0	11	0	39	0	0	0	0	0	3	508	0	0	511	0	348	26	0	374	924
8:00 - 8:15	51	0	13	0	64	0	0	0	0	0	2	462	0	0	464	0	359	21	0	380	908
8:15 - 8:30	28	0	5	0	33	0	0	0	0	0	2	502	0	0	504	0	307	19	0	326	863
8:30 - 8:45	39	0	3	1	43	0	0	0	0	0	3	507	0	0	510	0	278	25	0	303	856
8:45 - 9:00	17	0	5	0	22	0	0	0	0	0	3	466	0	0	469	0	289	30	0	319	810
2 Hr Totals	264	0	48	1	313	0	0	0	0	0	20	3784	0	0	3804	1	2198	188	0	2387	6504
1 Hr Totals																					
7:00 - 8:00	129	0	22	0	151	0	0	0	0	0	10	1847	0	0	1857	1	965	93	0	1059	3067
7:15 - 8:15	141	0	31	0	172	0	0	0	0	0	8	1867	0	0	1875	1	1147	94	0	1242	3289
7:30 - 8:30	135	0	35	0	170	0	0	0	0	0	8	1936	0	0	1944	1	1238	87	0	1326	3440
7:45 - 8:45	146	0	32	1	179	0	0	0	0	0	10	1979	0	0	1989	0	1292	91	0	1383	3551
8:00 - 9:00	135	0	26	1	162	0	0	0	0	0	10	1937	0	0	1947	0	1233	95	0	1328	3437
PEAK HOUR																					
7:45 - 8:45	146	0	32	1	179	0	0	0	0	0	10	1979	0	0	1989	0	1292	91	0	1383	3551
PM																					
4:00 - 4:15	28	0	7	0	35	0	0	0	0	0	7	369	0	0	376	1	441	33	0	475	886
4:15 - 4:30	20	0	5	0	25	0	0	0	0	0	3	352	0	0	355	0	450	55	0	505	885
4:30 - 4:45	17	0	7	0	24	0	0	0	0	0	7	402	0	0	409	0	469	41	0	510	943
4:45 - 5:00	30	0	8	0	38	1	0	0	0	1	3	331	0	0	334	0	493	58	0	551	924
5:00 - 5:15	37	0	11	0	48	0	0	1	0	1	6	376	0	0	382	0	517	35	0	552	983
5:15 - 5:30	30	0	14	0	44	0	0	0	0	0	6	344	0	0	350	0	481	66	1	548	942
5:30 - 5:45	35	0	10	0	45	1	0	0	0	1	7	311	0	0	318	1	453	40	0	494	858
5:45 - 6:00	22	0	5	0	27	2	0	0	0	2	5	334	1	0	340	1	449	44	0	494	863
2 Hr Totals	219	0	67	0	286	4	0	1	0	5	44	2819	1	0	2864	3	3753	372	1	4129	7284
1 Hr Totals																					
4:00 - 5:00	95	0	27	0	122	1	0	0	0	1	20	1454	0	0	1474	1	1853	187	0	2041	3638
4:15 - 5:15	104	0	31	0	135	1	0	1	0	2	19	1461	0	0	1480	0	1929	189	0	2118	3735
4:30 - 5:30	114	0	40	0	154	1	0	1	0	2	22	1453	0	0	1475	0	1960	200	1	2161	3792
4:45 - 5:45	132	0	43	0	175	2	0	1	0	3	22	1362	0	0	1384	1	1944	199	1	2145	3707
5:00 - 6:00	124	0	40	0	164	3	0	1	0	4	24	1365	1	0	1390	2	1900	185	1	2088	3646
PEAK HOUR																					
4:30 - 5:30	114	0	40	0	154	1	0	1	0	2	22	1453	0	0	1475	0	1960	200	1	2161	3792

APPENDIX

C

Village at Providence Point Traffic Impact Study
Existing Conditions Synchro Worksheets

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	12	1840	47	124	2743	7	193	3	55	7	5	68
Future Volume (vph)	12	1840	47	124	2743	7	193	3	55	7	5	68
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.95	1.00		0.97	1.00
Satd. Flow (prot)	1770	5063		1770	5083		1681	1688	1583		1807	1550
Flt Permitted	0.04	1.00		0.06	1.00		0.95	0.95	1.00		0.97	1.00
Satd. Flow (perm)	82	5063		106	5083		1681	1688	1583		1807	1550
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	13	2000	51	135	2982	8	210	3	60	8	5	74
RTOR Reduction (vph)	0	1	0	0	0	0	0	0	54	0	0	72
Lane Group Flow (vph)	13	2050	0	135	2990	0	107	106	6	0	13	2
Confl. Peds. (#/hr)	1		7	7		1	1					1
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		8	8		7	7	
Permitted Phases	6			2					8			7
Actuated Green, G (s)	92.9	90.8		105.3	98.2		14.5	14.5	14.5		4.7	4.7
Effective Green, g (s)	92.9	90.8		105.3	98.2		14.5	14.5	14.5		4.7	4.7
Actuated g/C Ratio	0.66	0.65		0.75	0.70		0.10	0.10	0.10		0.03	0.03
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	79	3283		192	3565		174	174	163		60	52
v/s Ratio Prot	0.00	0.40		c0.05	c0.59		c0.06	0.06			c0.01	
v/s Ratio Perm	0.11			0.48					0.00			0.00
v/c Ratio	0.16	0.62		0.70	0.84		0.61	0.61	0.04		0.22	0.05
Uniform Delay, d1	18.4	14.5		26.5	15.2		60.1	60.0	56.5		65.9	65.5
Progression Factor	1.00	1.00		1.26	1.24		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.4	0.9		6.5	1.8		4.5	4.1	0.0		0.7	0.1
Delay (s)	18.7	15.4		39.8	20.6		64.6	64.1	56.5		66.5	65.6
Level of Service	B	B		D	C		E	E	E		E	E
Approach Delay (s)		15.5			21.4			62.6			65.8	
Approach LOS		B			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	21.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	81.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	578	1336	2143	14	0	731
Future Volume (vph)	578	1336	2143	14	0	731
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.91			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	3539	5080			2787
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	3539	5080			2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	628	1452	2329	15	0	795
RTOR Reduction (vph)	0	0	0	0	0	438
Lane Group Flow (vph)	628	1452	2344	0	0	357
Turn Type	Prot	NA	NA			Over
Protected Phases	1	6	2			1
Permitted Phases						
Actuated Green, G (s)	33.8	126.6	87.8			33.8
Effective Green, g (s)	33.8	126.6	87.8			33.8
Actuated g/C Ratio	0.24	0.90	0.63			0.24
Clearance Time (s)	5.0	5.0	5.0			5.0
Vehicle Extension (s)	3.5	5.0	5.0			3.5
Lane Grp Cap (vph)	828	3200	3185			672
v/s Ratio Prot	c0.18	0.41	c0.46			0.13
v/s Ratio Perm						
v/c Ratio	0.76	0.45	0.74			0.53
Uniform Delay, d1	49.3	1.1	18.1			46.2
Progression Factor	0.69	3.71	0.68			1.00
Incremental Delay, d2	3.4	0.4	0.1			0.9
Delay (s)	37.3	4.4	12.4			47.1
Level of Service	D	A	B			D
Approach Delay (s)		14.3	12.4		47.1	
Approach LOS		B	B		D	

Intersection Summary			
HCM 2000 Control Delay	18.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1336	0	0	2157	0	1
Future Volume (Veh/h)	1336	0	0	2157	0	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1452	0	0	2345	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh)	2			2		
Upstream signal (ft)	737			1052		
pX, platoon unblocked			0.92		0.44	0.92
vC, conflicting volume			1452		2624	726
vC1, stage 1 conf vol					1452	
vC2, stage 2 conf vol					1172	
vCu, unblocked vol			1325		1370	539
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			478		179	450

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	968	484	0	1172	1172	1
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	1
cSH	1700	1700	1700	1700	1700	450
Volume to Capacity	0.57	0.28	0.00	0.69	0.69	0.00
Queue Length 95th (ft)	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	13.0
Lane LOS						B
Approach Delay (s)	0.0		0.0			13.0
Approach LOS						B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	69.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	1167	164	5	1862	256	267	94	33	214	79	31
Future Volume (vph)	5	1167	164	5	1862	256	267	94	33	214	79	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.95	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.97		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.98		0.95	0.98	
Satd. Flow (prot)	1770	3464		1770	3465		1681	1695		1681	1691	
Flt Permitted	0.05	1.00		0.11	1.00		0.95	0.98		0.95	0.98	
Satd. Flow (perm)	87	3464		206	3465		1681	1695		1681	1691	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	1268	178	5	2024	278	290	102	36	233	86	34
RTOR Reduction (vph)	0	7	0	0	7	0	0	5	0	0	6	0
Lane Group Flow (vph)	5	1439	0	5	2295	0	215	208	0	177	170	0
Confl. Peds. (#/hr)	1		1	1		1						
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	85.9	85.9		85.9	85.9		19.5	19.5		19.1	19.1	
Effective Green, g (s)	85.9	85.9		85.9	85.9		19.5	19.5		19.1	19.1	
Actuated g/C Ratio	0.61	0.61		0.61	0.61		0.14	0.14		0.14	0.14	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	53	2125		126	2126		234	236		229	230	
v/s Ratio Prot		0.42			c0.66		c0.13	0.12		c0.11	0.10	
v/s Ratio Perm	0.06			0.02								
v/c Ratio	0.09	0.68		0.04	1.08		0.92	0.88		0.77	0.74	
Uniform Delay, d1	11.1	17.9		10.7	27.0		59.5	59.1		58.4	58.1	
Progression Factor	0.49	0.99		0.81	0.75		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.2	1.6		0.4	41.8		37.0	29.4		14.9	11.7	
Delay (s)	8.6	19.3		9.0	62.2		96.5	88.5		73.3	69.8	
Level of Service	A	B		A	E		F	F		E	E	
Approach Delay (s)		19.3			62.1			92.5			71.5	
Approach LOS		B			E			F			E	

Intersection Summary			
HCM 2000 Control Delay	52.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	91	1319	0	0	1979	10	0	0	0	32	0	146
Future Volume (vph)	91	1319	0	0	1979	10	0	0	0	32	0	146
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0						5.0	5.0
Lane Util. Factor	1.00	0.95			0.95						1.00	1.00
Frpb, ped/bikes	1.00	1.00			1.00						1.00	1.00
Flpb, ped/bikes	1.00	1.00			1.00						0.99	1.00
Frt	1.00	1.00			1.00						1.00	0.85
Flt Protected	0.95	1.00			1.00						0.95	1.00
Satd. Flow (prot)	1770	3539			3537						1756	1583
Flt Permitted	0.04	1.00			1.00						0.76	1.00
Satd. Flow (perm)	83	3539			3537						1400	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	99	1434	0	0	2151	11	0	0	0	35	0	159
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	17
Lane Group Flow (vph)	99	1434	0	0	2162	0	0	0	0	0	35	142
Confl. Peds. (#/hr)									3	3		
Turn Type	pm+pt	NA		pm+pt	NA					Perm	NA	pm+ov
Protected Phases	1	6		5	2			4			8	1
Permitted Phases	6			2			4			8		8
Actuated Green, G (s)	121.6	121.6			107.8						8.4	17.2
Effective Green, g (s)	121.6	121.6			107.8						8.4	17.2
Actuated g/C Ratio	0.87	0.87			0.77						0.06	0.12
Clearance Time (s)	5.0	5.0			5.0						5.0	5.0
Vehicle Extension (s)	2.5	5.0			5.0						2.5	2.5
Lane Grp Cap (vph)	178	3073			2723						84	251
v/s Ratio Prot	0.03	0.41			c0.61							c0.04
v/s Ratio Perm	0.45										0.02	0.05
v/c Ratio	0.56	0.47			0.79						0.42	0.57
Uniform Delay, d1	29.8	2.0			9.5						63.4	57.9
Progression Factor	1.68	0.23			1.00						1.00	1.00
Incremental Delay, d2	2.2	0.4			2.5						2.4	2.4
Delay (s)	52.4	0.8			12.0						65.9	60.3
Level of Service	D	A			B						E	E
Approach Delay (s)		4.2			12.0			0.0			61.3	
Approach LOS		A			B			A			E	

Intersection Summary			
HCM 2000 Control Delay	11.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	76.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	35	2723	100	163	2204	7	166	12	95	13	10	37
Future Volume (vph)	35	2723	100	163	2204	7	166	12	95	13	10	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.96	1.00		0.97	1.00
Satd. Flow (prot)	1770	5056		1770	5083		1681	1696	1583		1812	1583
Flt Permitted	0.05	1.00		0.05	1.00		0.95	0.96	1.00		0.97	1.00
Satd. Flow (perm)	89	5056		84	5083		1681	1696	1583		1812	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	38	2960	109	177	2396	8	180	13	103	14	11	40
RTOR Reduction (vph)	0	2	0	0	0	0	0	0	89	0	0	39
Lane Group Flow (vph)	38	3067	0	177	2404	0	95	98	14	0	25	1
Confl. Peds. (#/hr)			1	1								
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		8	8		7	7	
Permitted Phases	6			2					8			7
Actuated Green, G (s)	88.4	83.8		100.8	91.2		18.5	18.5	18.5		5.2	5.2
Effective Green, g (s)	88.4	83.8		100.8	91.2		18.5	18.5	18.5		5.2	5.2
Actuated g/C Ratio	0.63	0.60		0.72	0.65		0.13	0.13	0.13		0.04	0.04
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	111	3026		204	3311		222	224	209		67	58
v/s Ratio Prot	0.01	c0.61		c0.07	0.47		0.06	c0.06			c0.01	
v/s Ratio Perm	0.20			0.55					0.01			0.00
v/c Ratio	0.34	1.01		0.87	0.73		0.43	0.44	0.07		0.37	0.03
Uniform Delay, d1	15.2	28.1		49.1	16.1		55.9	56.0	53.2		65.8	65.0
Progression Factor	1.00	1.00		1.07	1.32		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	19.8		24.1	1.1		0.5	0.5	0.0		1.3	0.1
Delay (s)	15.9	47.9		76.8	22.4		56.4	56.5	53.2		67.1	65.0
Level of Service	B	D		E	C		E	E	D		E	E
Approach Delay (s)		47.5			26.1			55.3			65.8	
Approach LOS		D			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	38.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	88.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	881	1977	1496	19	0	878
Future Volume (vph)	881	1977	1496	19	0	878
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.91			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	3539	5076			2787
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	3539	5076			2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	958	2149	1626	21	0	954
RTOR Reduction (vph)	0	0	0	0	0	452
Lane Group Flow (vph)	958	2149	1647	0	0	502
Turn Type	Prot	NA	NA			Over
Protected Phases	1	6	2			1
Permitted Phases						
Actuated Green, G (s)	49.8	126.6	71.8			49.8
Effective Green, g (s)	49.8	126.6	71.8			49.8
Actuated g/C Ratio	0.36	0.90	0.51			0.36
Clearance Time (s)	5.0	5.0	5.0			5.0
Vehicle Extension (s)	3.5	5.0	5.0			3.5
Lane Grp Cap (vph)	1221	3200	2603			991
v/s Ratio Prot	c0.28	c0.61	0.32			0.18
v/s Ratio Perm						
v/c Ratio	0.78	0.67	0.63			0.51
Uniform Delay, d1	40.3	1.6	24.6			35.4
Progression Factor	0.66	3.14	0.68			1.00
Incremental Delay, d2	1.1	0.3	0.7			0.5
Delay (s)	27.8	5.5	17.5			35.9
Level of Service	C	A	B			D
Approach Delay (s)		12.3	17.5		35.9	
Approach LOS		B	B		D	

Intersection Summary			
HCM 2000 Control Delay	17.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1975	1	1	1515	0	1
Future Volume (Veh/h)	1975	1	1	1515	0	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2147	1	1	1647	0	1
Pedestrians	4					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	0					
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh)	2			2		
Upstream signal (ft)	736			1053		
pX, platoon unblocked			0.12		0.30	0.12
vC, conflicting volume			2148		2977	1074
vC1, stage 1 conf vol					2148	
vC2, stage 2 conf vol					830	
vCu, unblocked vol			0		0	0
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			188		190	126

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1431	717	1	824	824	1
Volume Left	0	0	1	0	0	0
Volume Right	0	1	0	0	0	1
cSH	1700	1700	188	1700	1700	126
Volume to Capacity	0.84	0.42	0.01	0.48	0.48	0.01
Queue Length 95th (ft)	0	0	0	0	0	1
Control Delay (s)	0.0	0.0	24.2	0.0	0.0	33.9
Lane LOS			C			D
Approach Delay (s)	0.0		0.0			33.9
Approach LOS						D

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	64.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	1791	181	7	1336	225	162	89	18	336	74	14
Future Volume (vph)	9	1791	181	7	1336	225	162	89	18	336	74	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.95	0.95		0.95	0.95	
Frt	1.00	0.99		1.00	0.98		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.99		0.95	0.97	
Satd. Flow (prot)	1770	3490		1770	3463		1681	1716		1681	1702	
Flt Permitted	0.06	1.00		0.05	1.00		0.95	0.99		0.95	0.97	
Satd. Flow (perm)	116	3490		87	3463		1681	1716		1681	1702	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	1947	197	8	1452	245	176	97	20	365	80	15
RTOR Reduction (vph)	0	5	0	0	9	0	0	4	0	0	2	0
Lane Group Flow (vph)	10	2139	0	8	1688	0	146	143	0	230	228	0
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	85.7	85.7		85.7	85.7		16.6	16.6		22.2	22.2	
Effective Green, g (s)	85.7	85.7		85.7	85.7		16.6	16.6		22.2	22.2	
Actuated g/C Ratio	0.61	0.61		0.61	0.61		0.12	0.12		0.16	0.16	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	71	2136		53	2119		199	203		266	269	
v/s Ratio Prot		c0.61			0.49		c0.09	0.08		c0.14	0.13	
v/s Ratio Perm	0.09			0.09								
v/c Ratio	0.14	1.00		0.15	0.80		0.73	0.70		0.86	0.85	
Uniform Delay, d1	11.5	27.1		11.6	20.6		59.6	59.3		57.4	57.3	
Progression Factor	0.61	0.68		0.64	0.69		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.2	17.4		4.9	2.6		13.1	10.5		24.1	21.3	
Delay (s)	10.2	35.9		12.3	16.8		72.6	69.8		81.5	78.6	
Level of Service	B	D		B	B		E	E		F	E	
Approach Delay (s)		35.8			16.8			71.2			80.0	
Approach LOS		D			B			E			F	

Intersection Summary			
HCM 2000 Control Delay	35.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	82.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

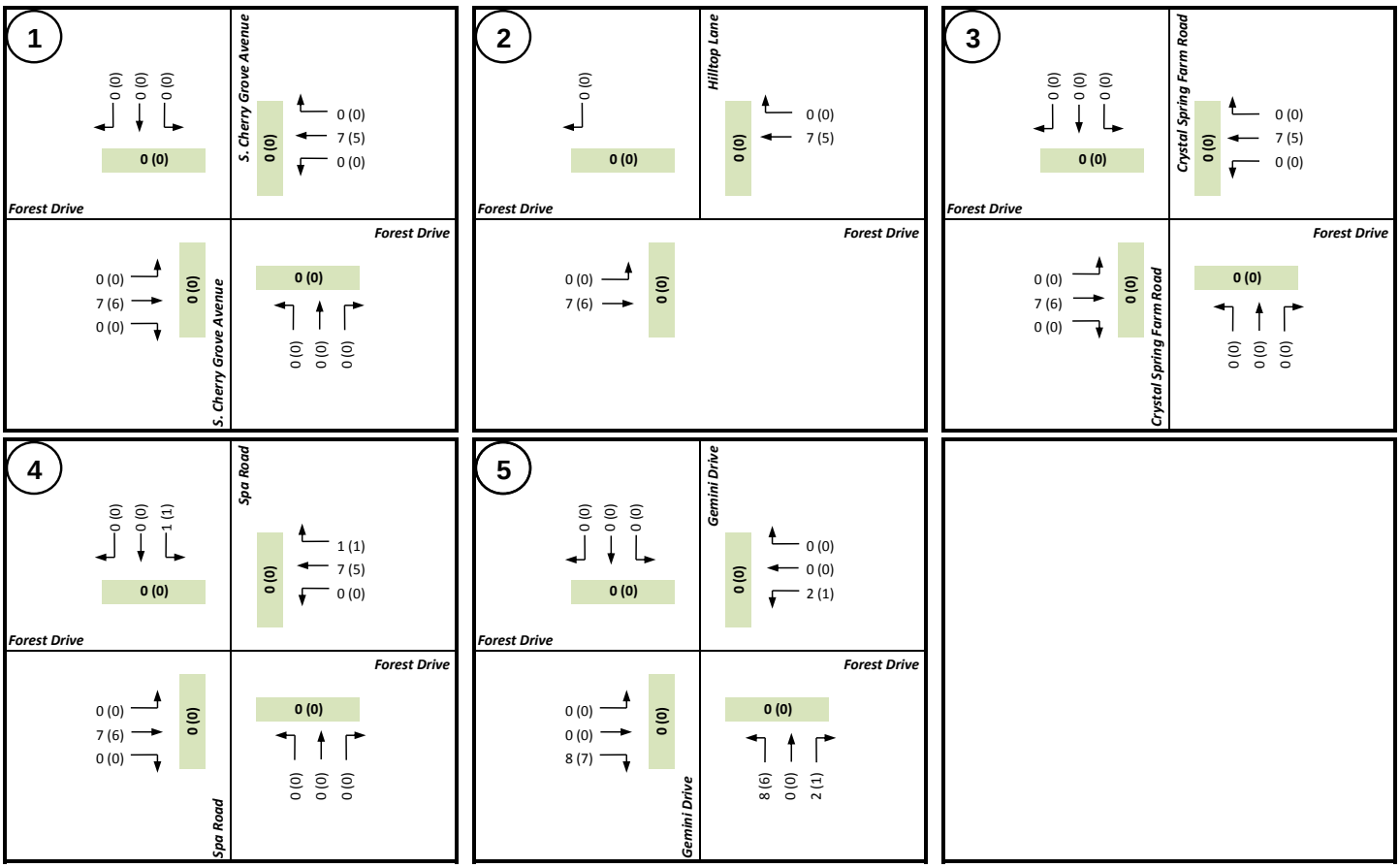
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	201	1960	0	0	1453	22	1	0	1	40	0	114
Future Volume (vph)	201	1960	0	0	1453	22	1	0	1	40	0	114
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.95			0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00			1.00			0.99			1.00	1.00
Flpb, ped/bikes	1.00	1.00			1.00			1.00			0.99	1.00
Frt	1.00	1.00			1.00			0.93			1.00	0.85
Flt Protected	0.95	1.00			1.00			0.98			0.95	1.00
Satd. Flow (prot)	1770	3539			3530			1678			1757	1583
Flt Permitted	0.11	1.00			1.00			0.88			0.76	1.00
Satd. Flow (perm)	211	3539			3530			1513			1399	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	218	2130	0	0	1579	24	1	0	1	43	0	124
RTOR Reduction (vph)	0	0	0	0	1	0	0	2	0	0	0	47
Lane Group Flow (vph)	218	2130	0	0	1602	0	0	0	0	0	43	77
Confl. Peds. (#/hr)	1		2	2		1			3	3		
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	1	6		5	2			4			8	1
Permitted Phases	6			2			4			8		8
Actuated Green, G (s)	121.1	121.1			105.6			8.9			8.9	19.4
Effective Green, g (s)	121.1	121.1			105.6			8.9			8.9	19.4
Actuated g/C Ratio	0.86	0.86			0.75			0.06			0.06	0.14
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	5.0
Vehicle Extension (s)	2.5	5.0			5.0			2.5			2.5	2.5
Lane Grp Cap (vph)	299	3061			2662			96			88	275
v/s Ratio Prot	0.05	c0.60			0.45							0.02
v/s Ratio Perm	c0.58							0.00			c0.03	0.03
v/c Ratio	0.73	0.70			0.60			0.00			0.49	0.28
Uniform Delay, d1	15.0	3.2			7.7			61.4			63.4	54.0
Progression Factor	2.11	0.19			1.00			1.00			1.00	1.00
Incremental Delay, d2	2.6	0.4			1.0			0.0			3.1	0.4
Delay (s)	34.3	1.0			8.8			61.4			66.4	54.4
Level of Service	C	A			A			E			E	D
Approach Delay (s)		4.1			8.8			61.4			57.5	
Approach LOS		A			A			E			E	

Intersection Summary			
HCM 2000 Control Delay	8.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX

D

Village at Providence Point Traffic Impact Study
Background Development Trip Assignment



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

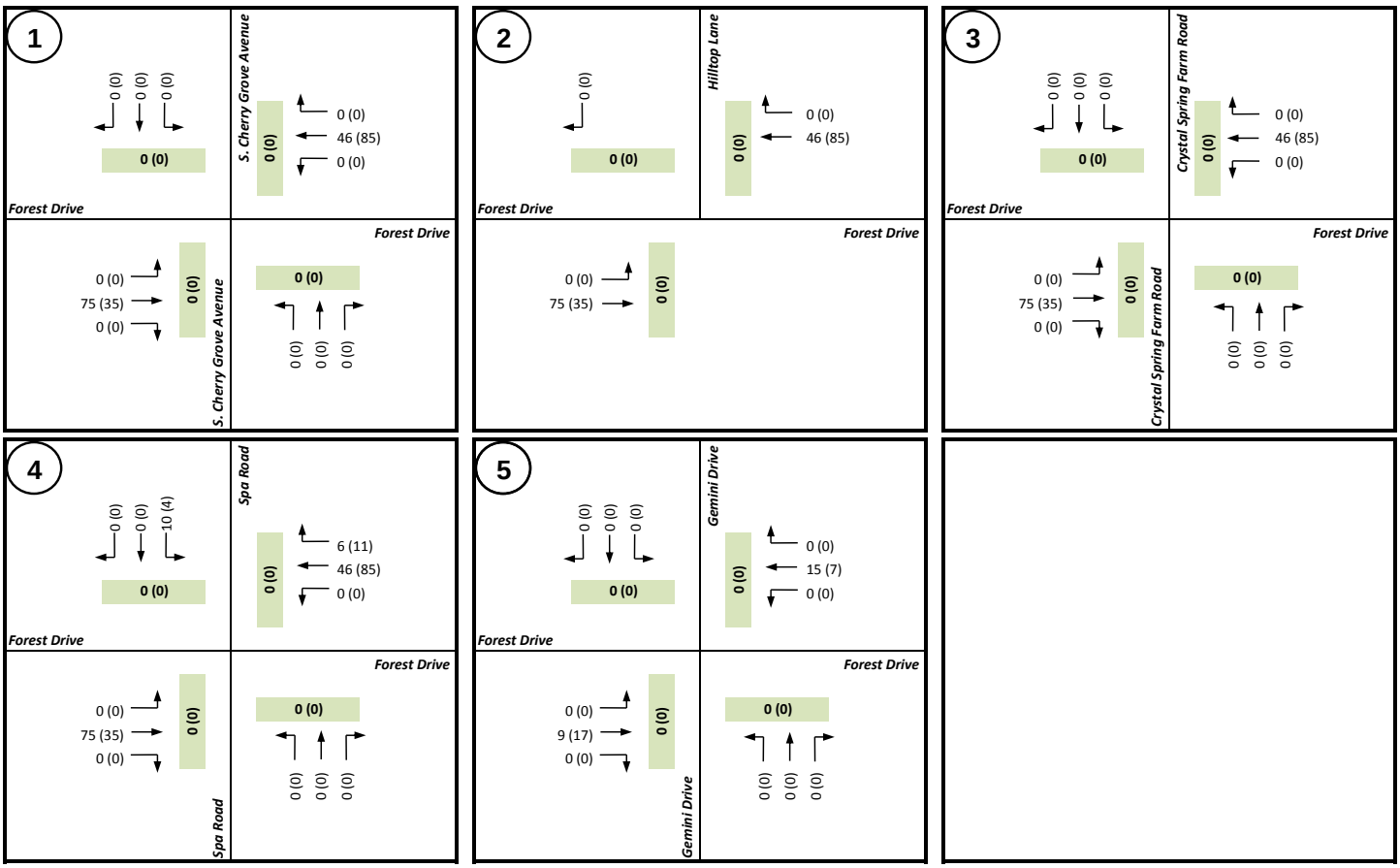
Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - 1415 Forest Drive

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

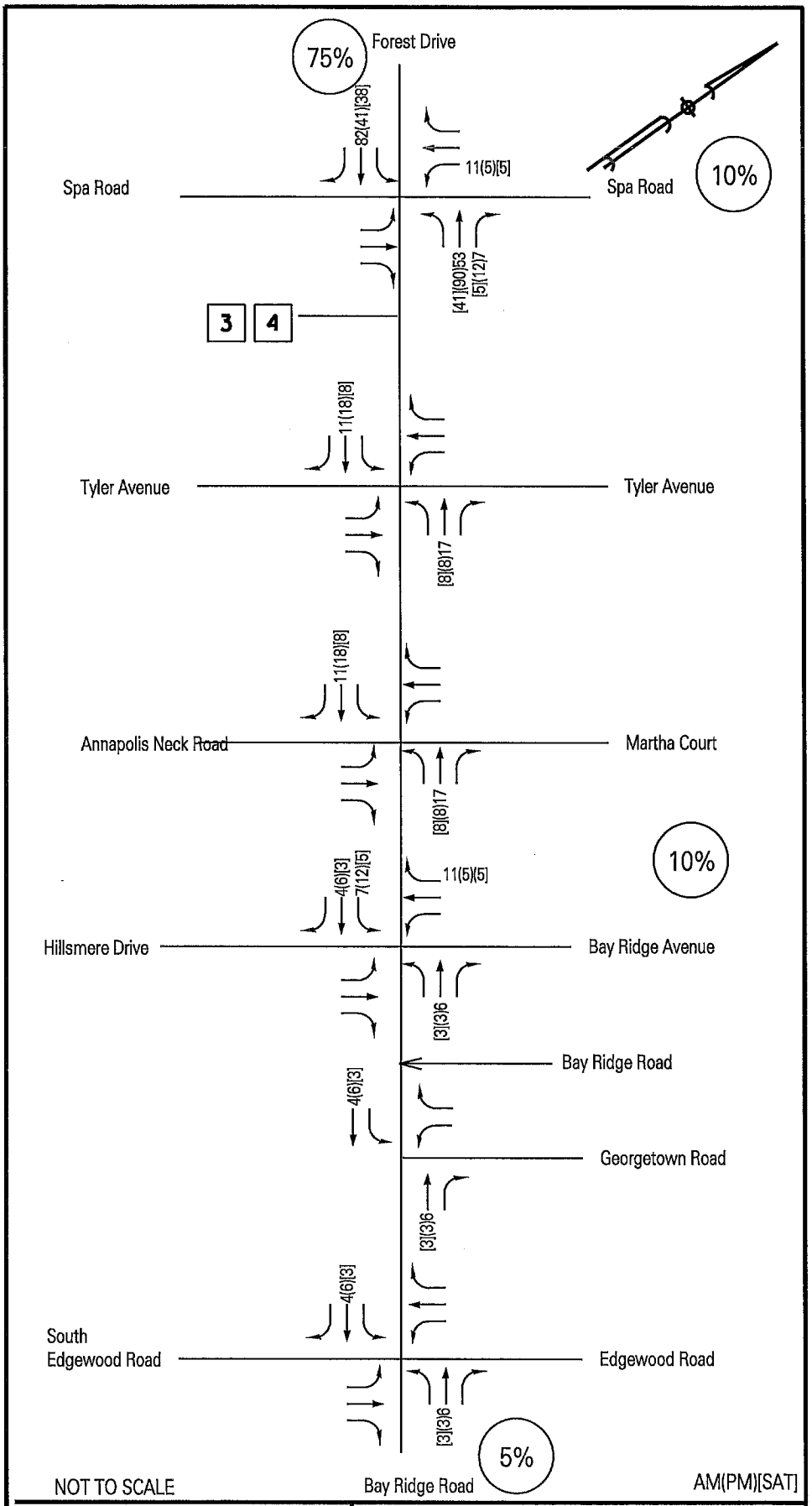
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - 1503 Forest Drive

CITY OF ANNAPOLIS

STV 100 Years



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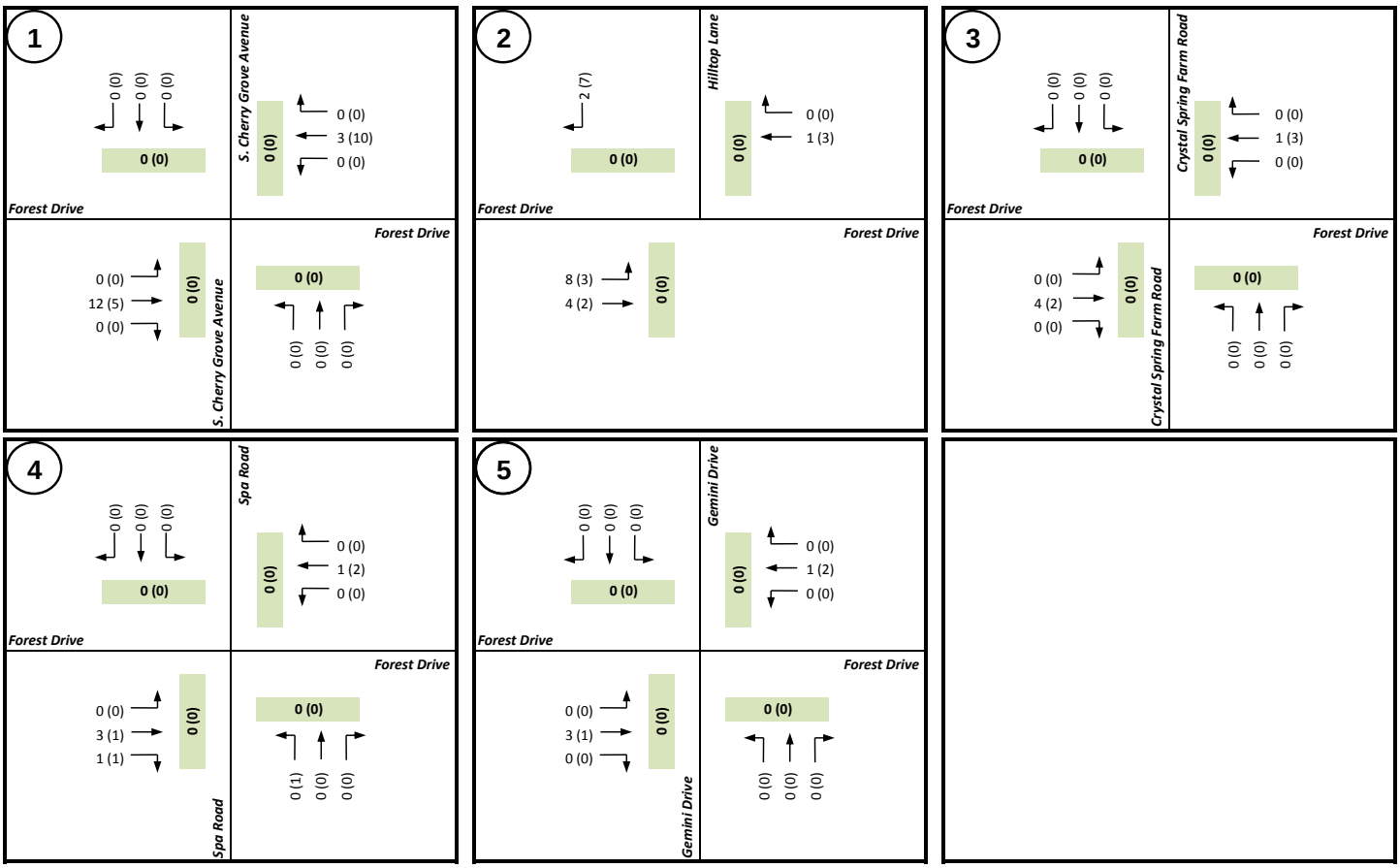
BACKGROUNDS 3 & 4

1503 Forest Drive & 1415 Forest Drive



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

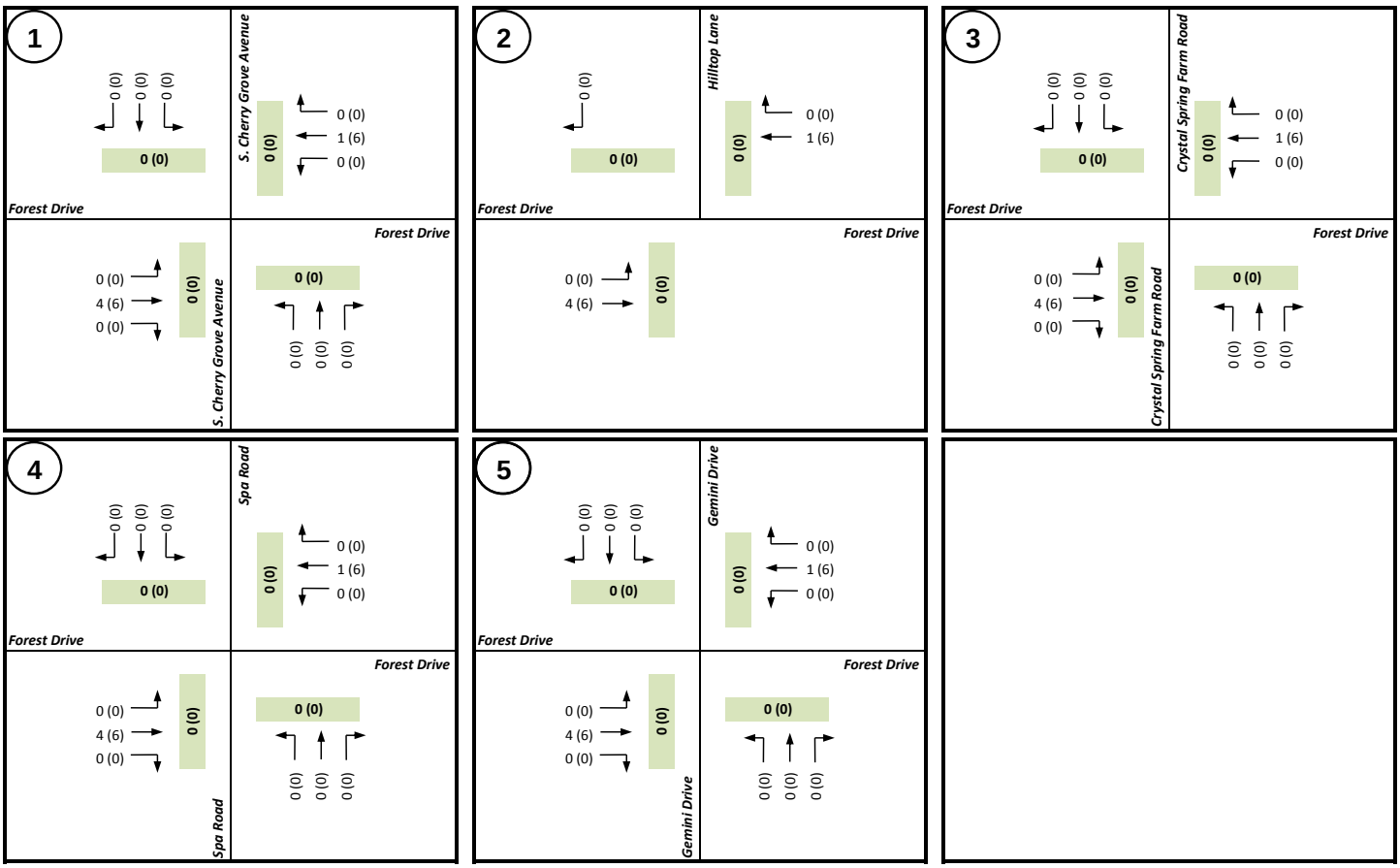
Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - Annapolis Towns at Neal Farm

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

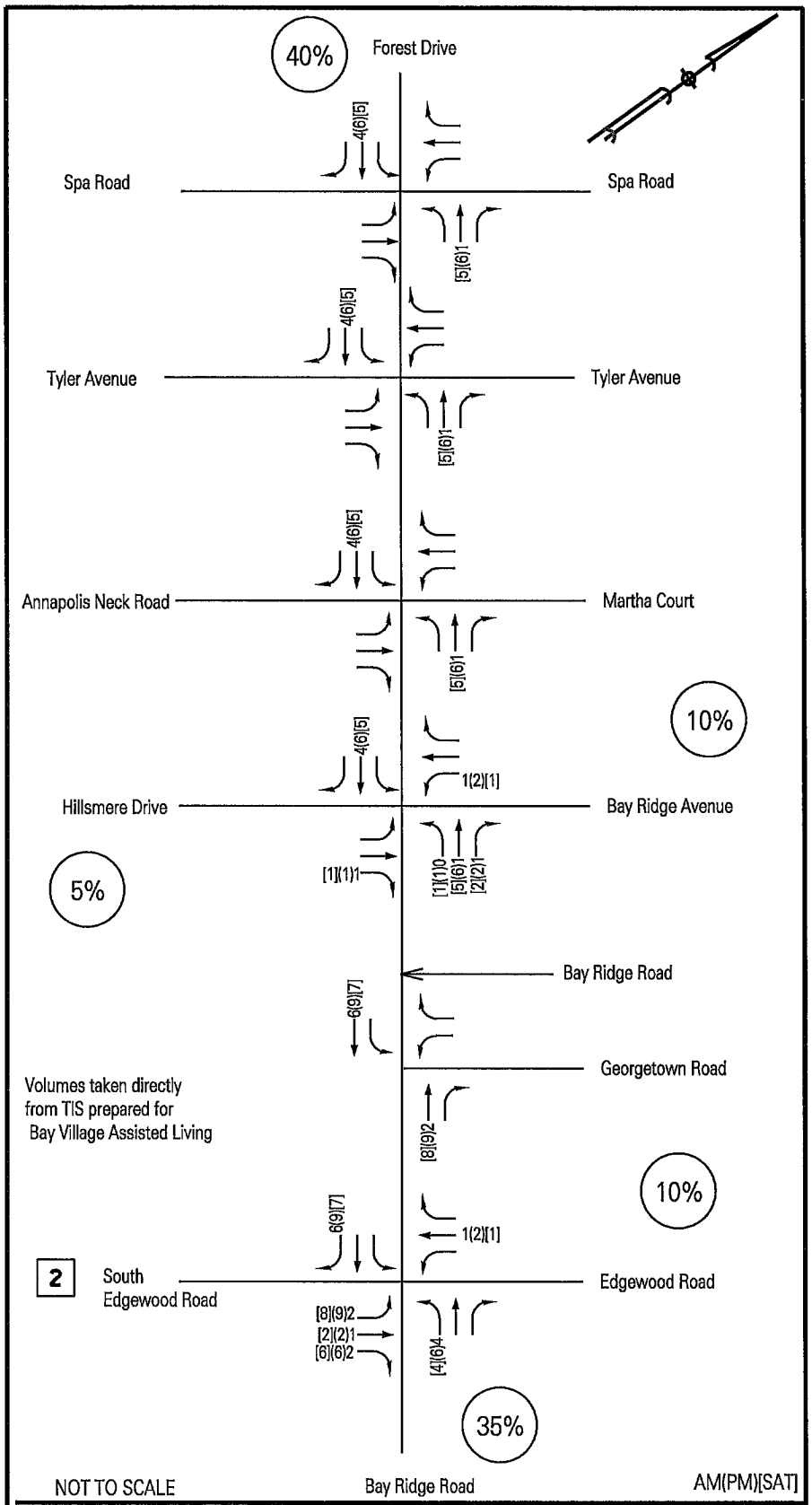
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - 979 Bay Village Drive

CITY OF ANNAPOLIS

STV 100 Years



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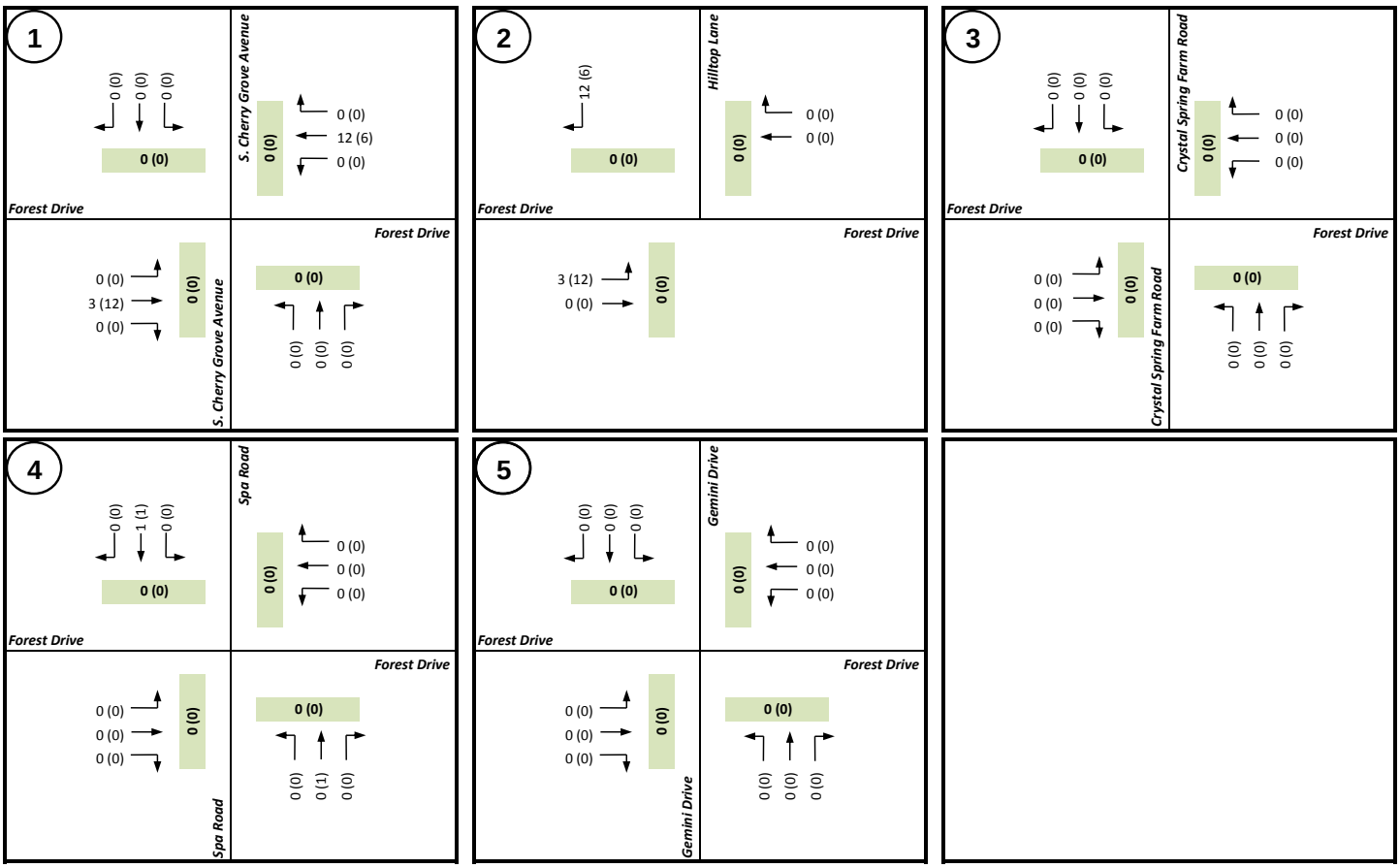
BACKGROUND 2

Bay Village Assisted Living



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

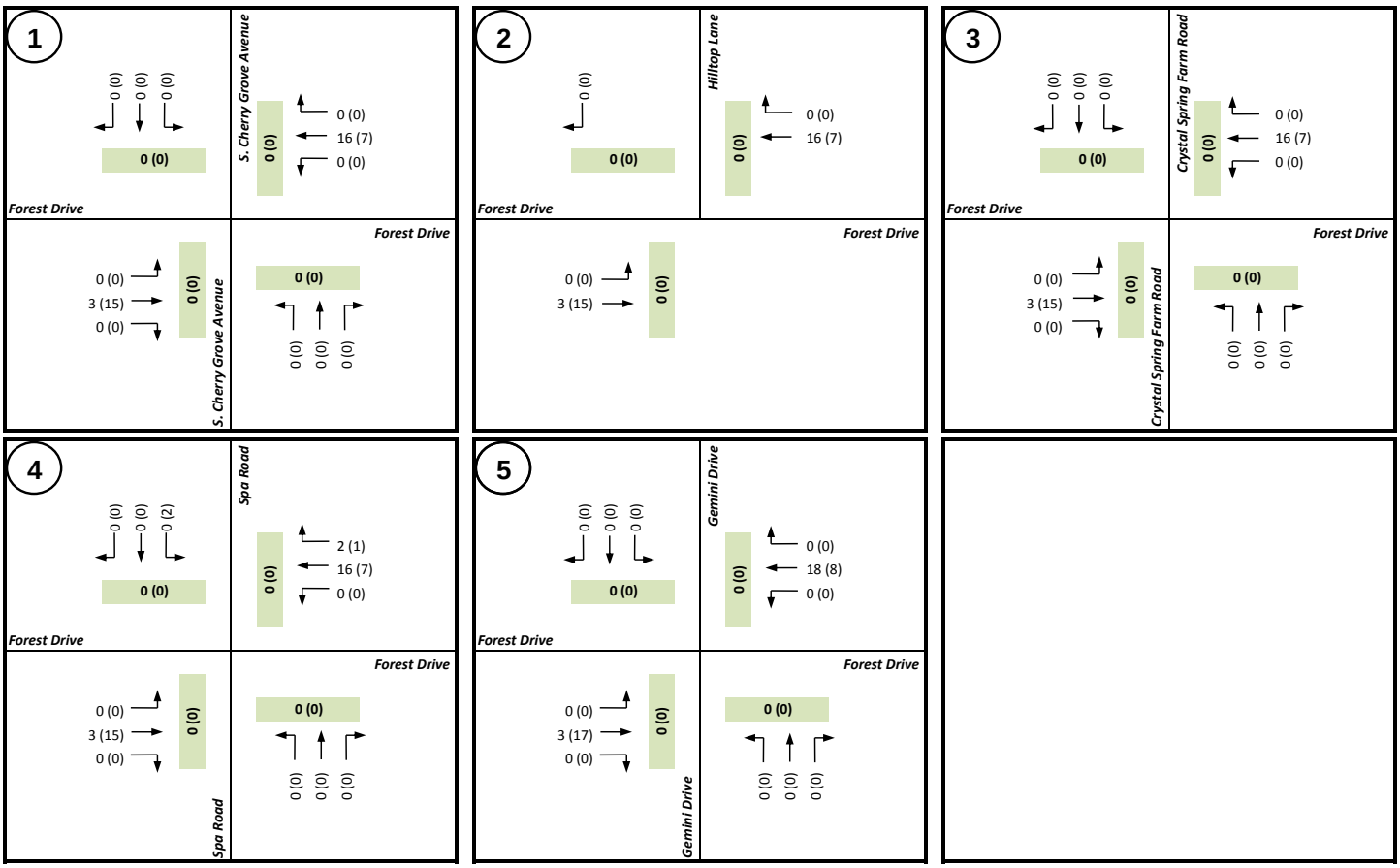
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - 9 Elliott Road

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - Chesapeake Grove

CITY OF ANNAPOLIS

STV 100 Years

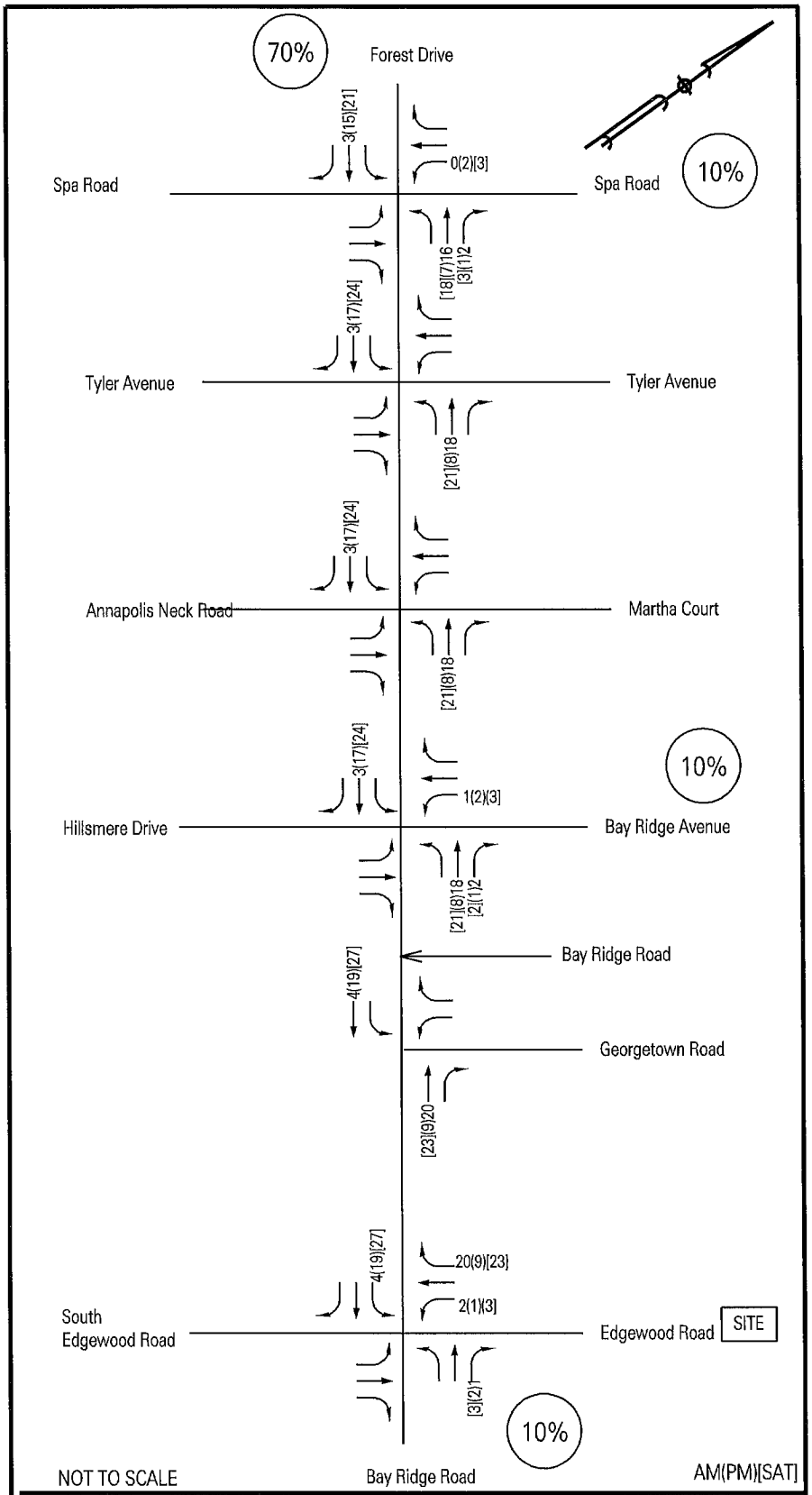


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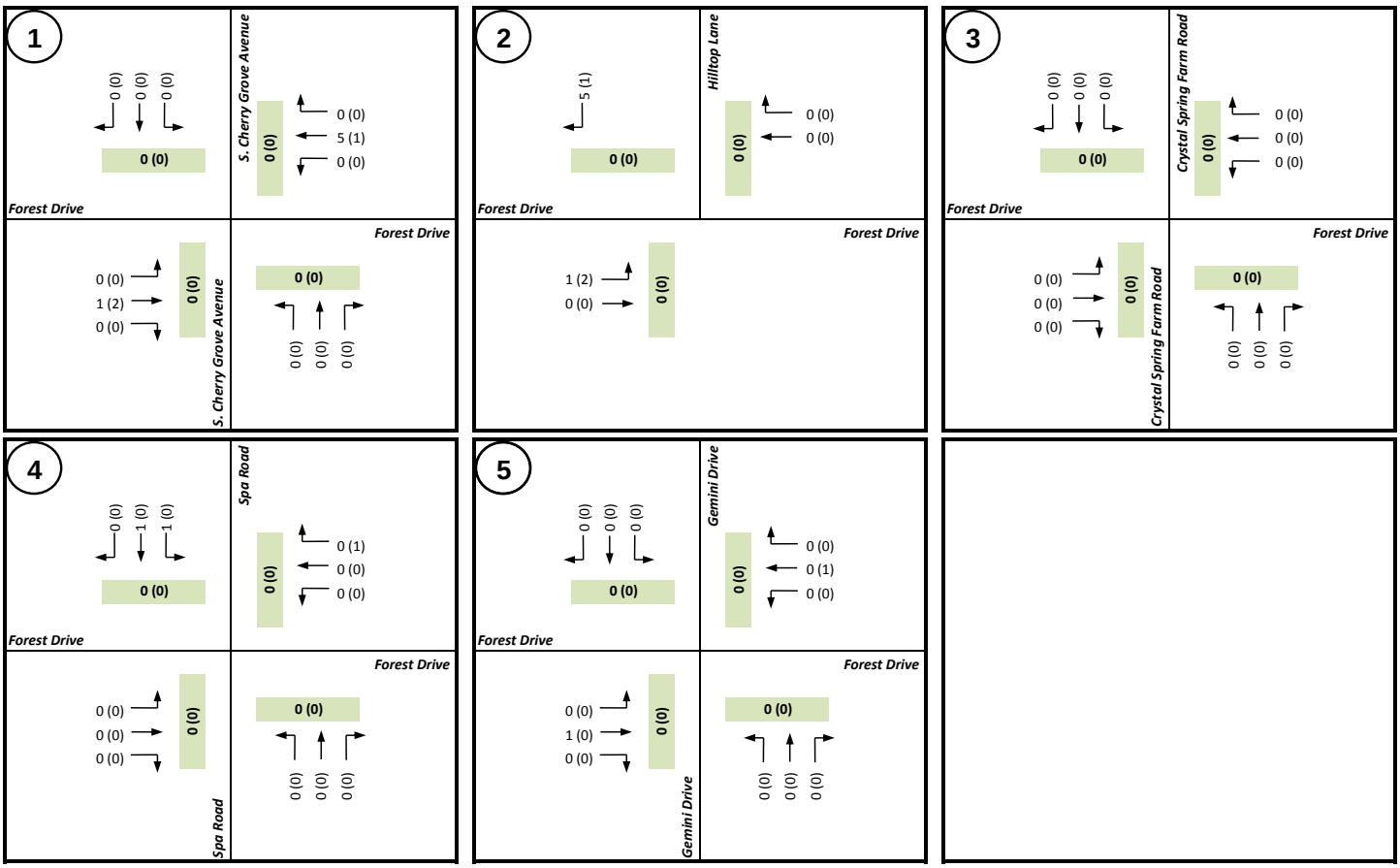
EXHIBIT 8

Site Generated Traffic



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - Enclave on Spa

CITY OF ANNAPOLIS

STV 100 Years

SEQ CHAPTER \h \r 1*City of Annapolis*
DEPARTMENT OF TRANSPORTATION
308 Chinquapin Round Road, Annapolis, Maryland 21401
Phone: 410-263-7964 410-269-0674 Fax: 410-263-4508 Internet: transit@annapolis.gov
DIRECTOR, RICHARD A. NEWELL

December 30, 2013

To: E. Thomas Smith, Chief of Current Planning

From: Iain J. Banks, Personal Transportation and Parking Specialist

Re: The Enclave at Spa Development Review

The Annapolis Department of Transportation (ADOT) has reviewed the proposed development and offers the following review.

PROPOSED DEVELOPMENT

The reviews of the traffic and transportation characteristics of the proposed The Enclave at Spa (1023 Spa Road) were based on the City's Planning and Zoning Ordinance, Title 21 and Adequate Public Facility Ordinance, Title 22.

The proposed residential development would consist of redevelopment of the property from automotive repair center and rental car business. The new development would consist of 36 single-family attached townhomes.

TRAFFIC IMPACTS

The ITE Trip Generation Manual was used to estimate the vehicle trip generation of the proposed development.

	AM Peak Hour Trips	**PM Peak Hour Trips**	**Daily Trips**
Existing Development (A) - based on 4,000 gsf	12	20	63
Proposed Development (B)	23	26	252
Net Trips (B-A)	**+11**	**+6**	**+189**

The table above highlights the vehicle trip generation of both the existing and the proposed development and shows that the total trip gain would be 189 trips per day. Due to the estimated trip increases during the AM and PM peak hours being no more

than 11 trips, the existing roadway system is fully capable of accommodating the increase without any adverse impacts.

SITE ACCESS

Access to the current site is provided through one (1) single continuous curb cut along the property's frontage. The proposed site development plan shows that this curb cut will be reduced to 24-ft wide and a sidewalk installed. The proposed plan reduces the impervious surface at the entry.

PARKING

The development is proposed to provide 144 off-street parking spaces (each unit will have 2 spaces per driveway and 2 per garage). 15 additional visitor spaces will be provided.

The proposed off-street parking spaces would satisfy the requirements of the City's parking regulations, which state that two spaces per dwelling be provided.

NON-AUTO TRANSPORTATION

The proposed development will connect the sidewalks between Gentry Court and Spindrift Way providing for enhanced pedestrian access along Spa Road.

TRANSIT SERVICES

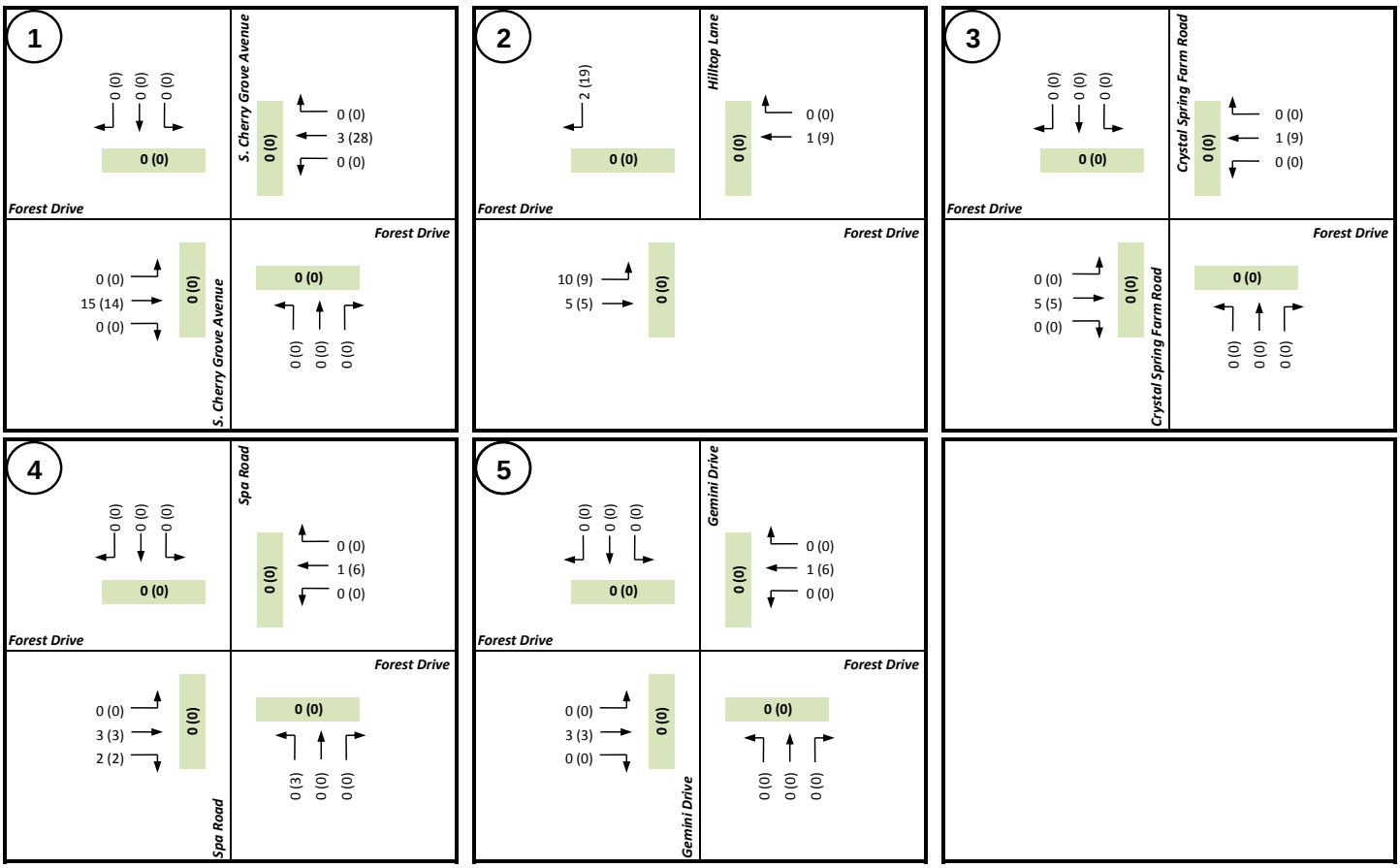
Annapolis Department of Transportation provides transit services along Spa Road and Hilltop Lane in proximity to the proposed development.

CONCLUSION

The Annapolis Department of Transportation certifies that the proposed development of 1023 Spa Road will not have any significant adverse impact on traffic conditions. ADOT welcomes the addition of the new sidewalk connection and the reduction in the existing driveway access.

Please should you have any questions or require any further information do not hesitate to contact me.

IJB



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

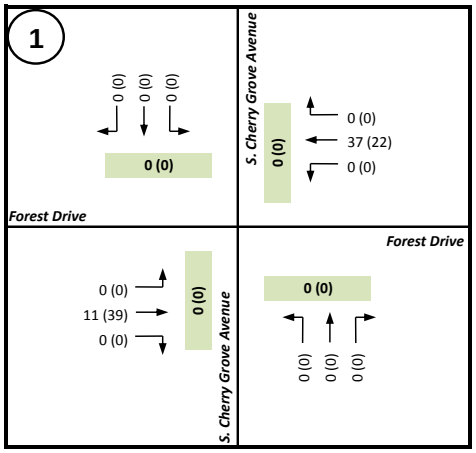
Village at Providence Point Traffic Impact Study

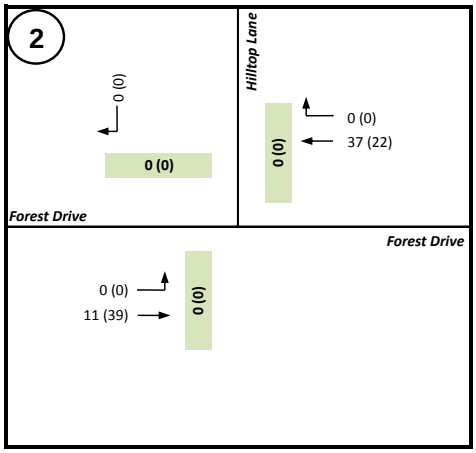
Appendix D

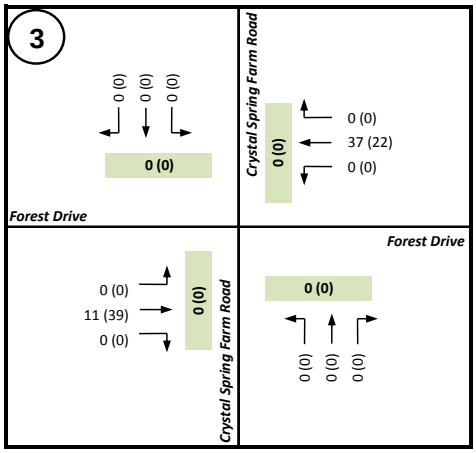
Background Development Trip Assignment - Lincoln Drive at Chinquapin Round Road

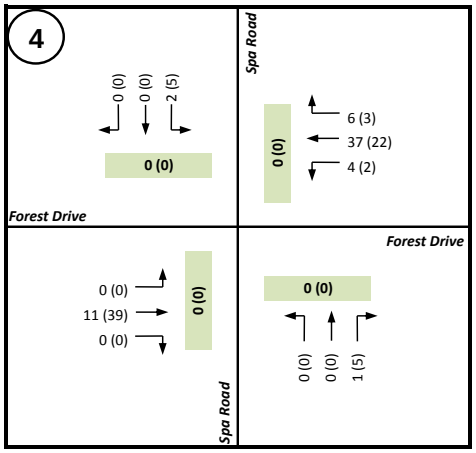
CITY OF ANNAPOLIS

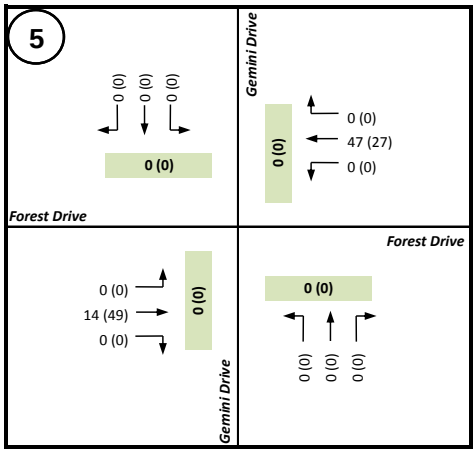
STV 100 Years











LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

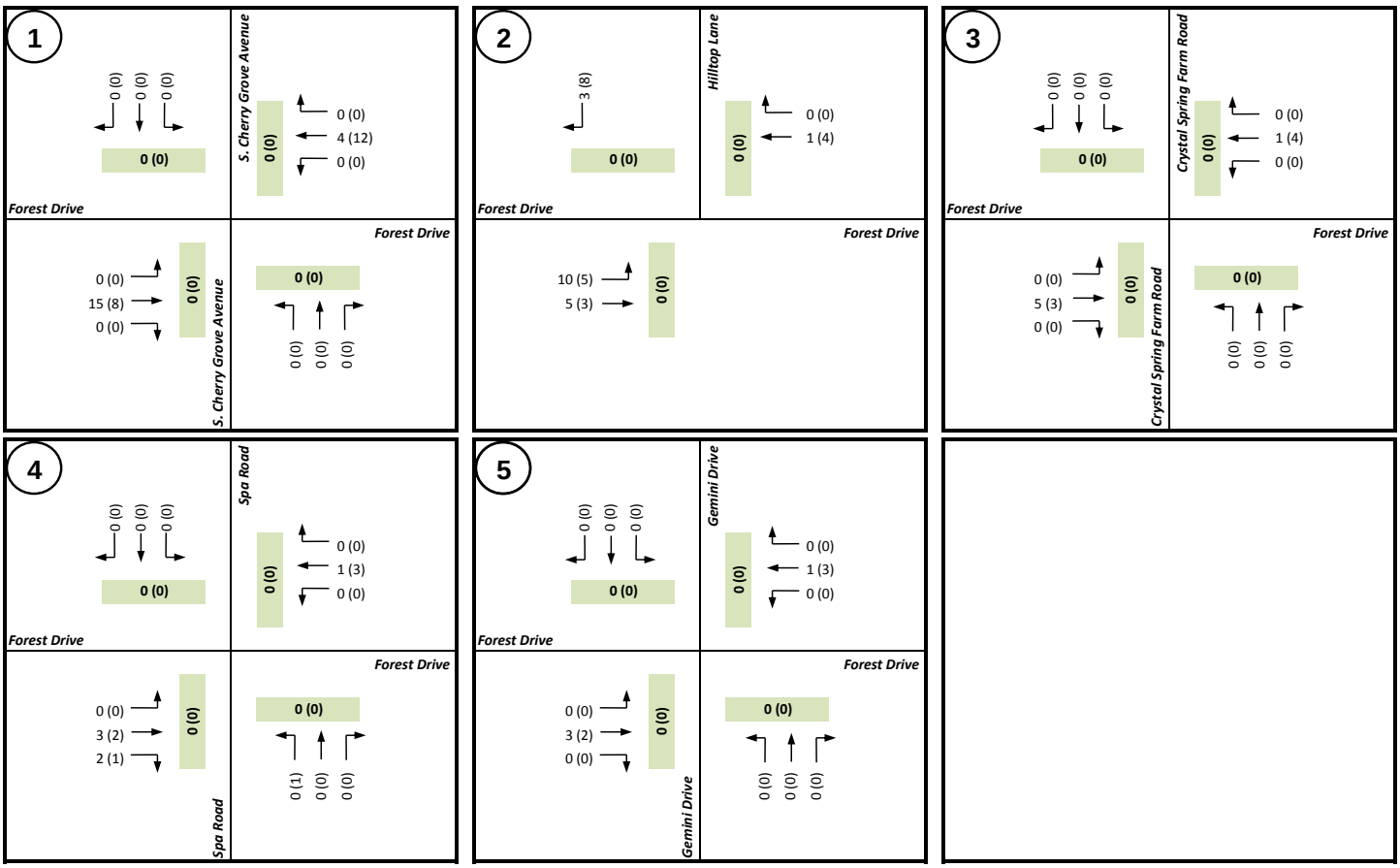
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - Parkside Preserve

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

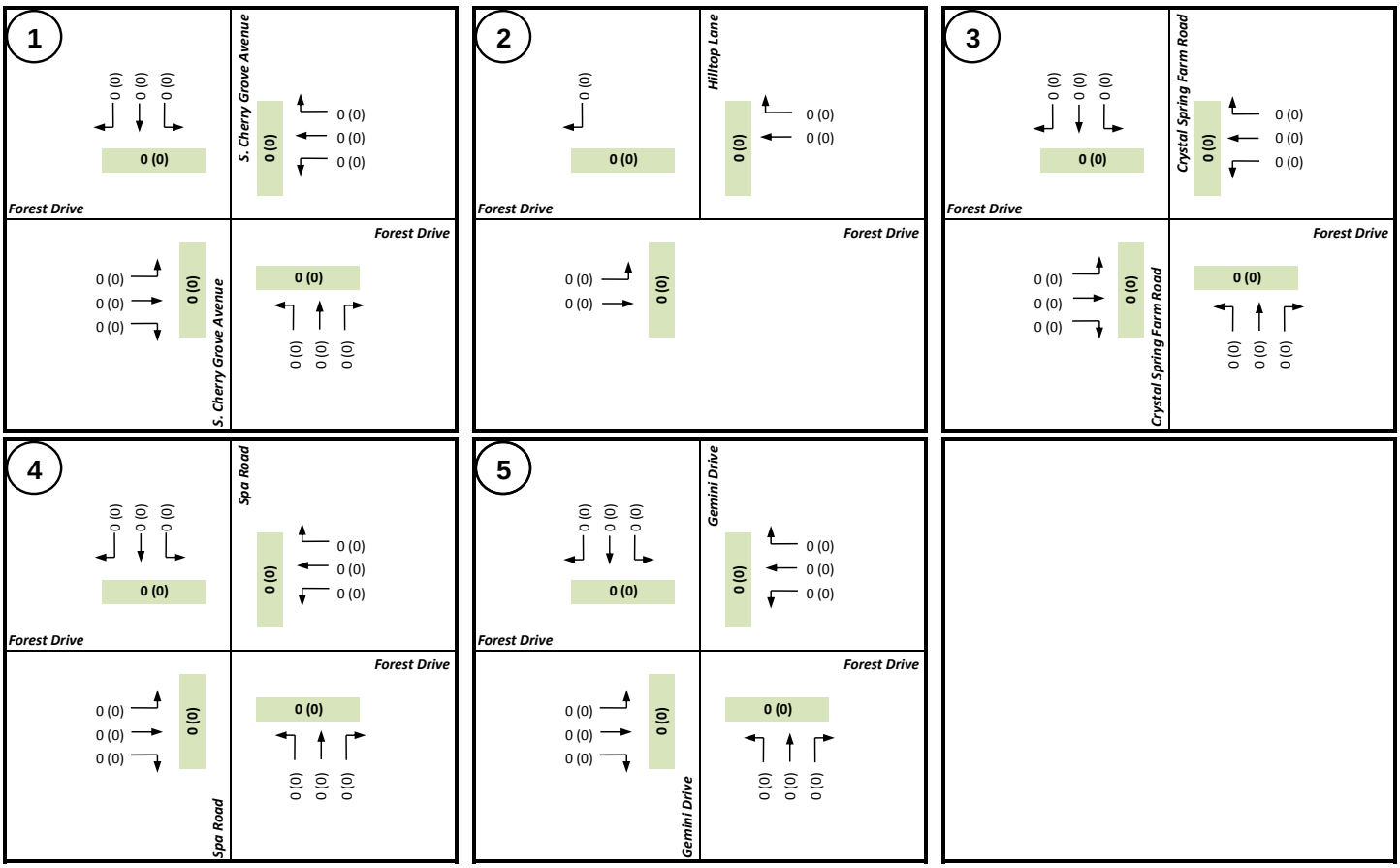
Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - Rocky Gorge

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

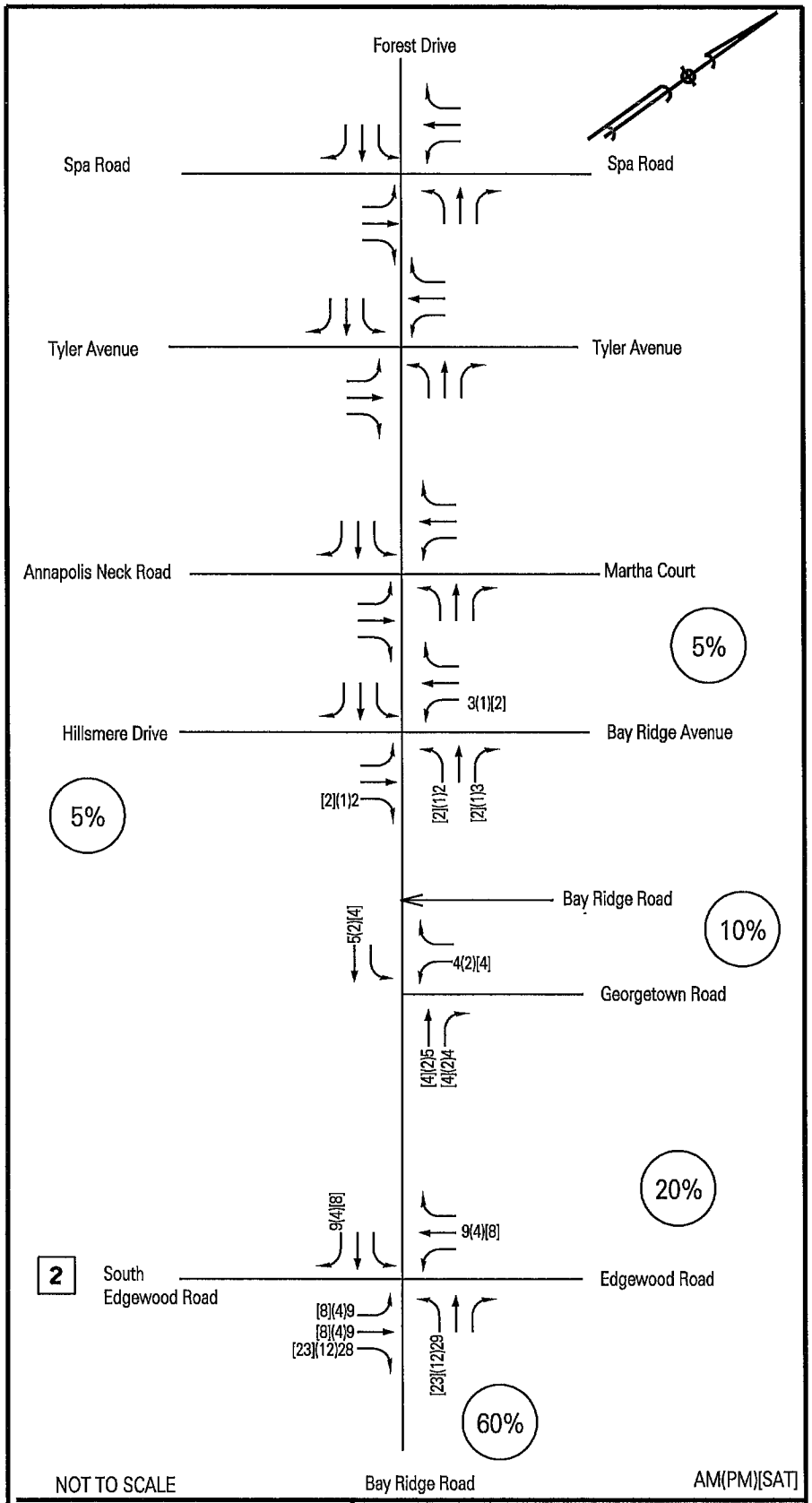
Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - Starbucks at Bay Village Drive

CITY OF ANNAPOLIS

STV 100 Years



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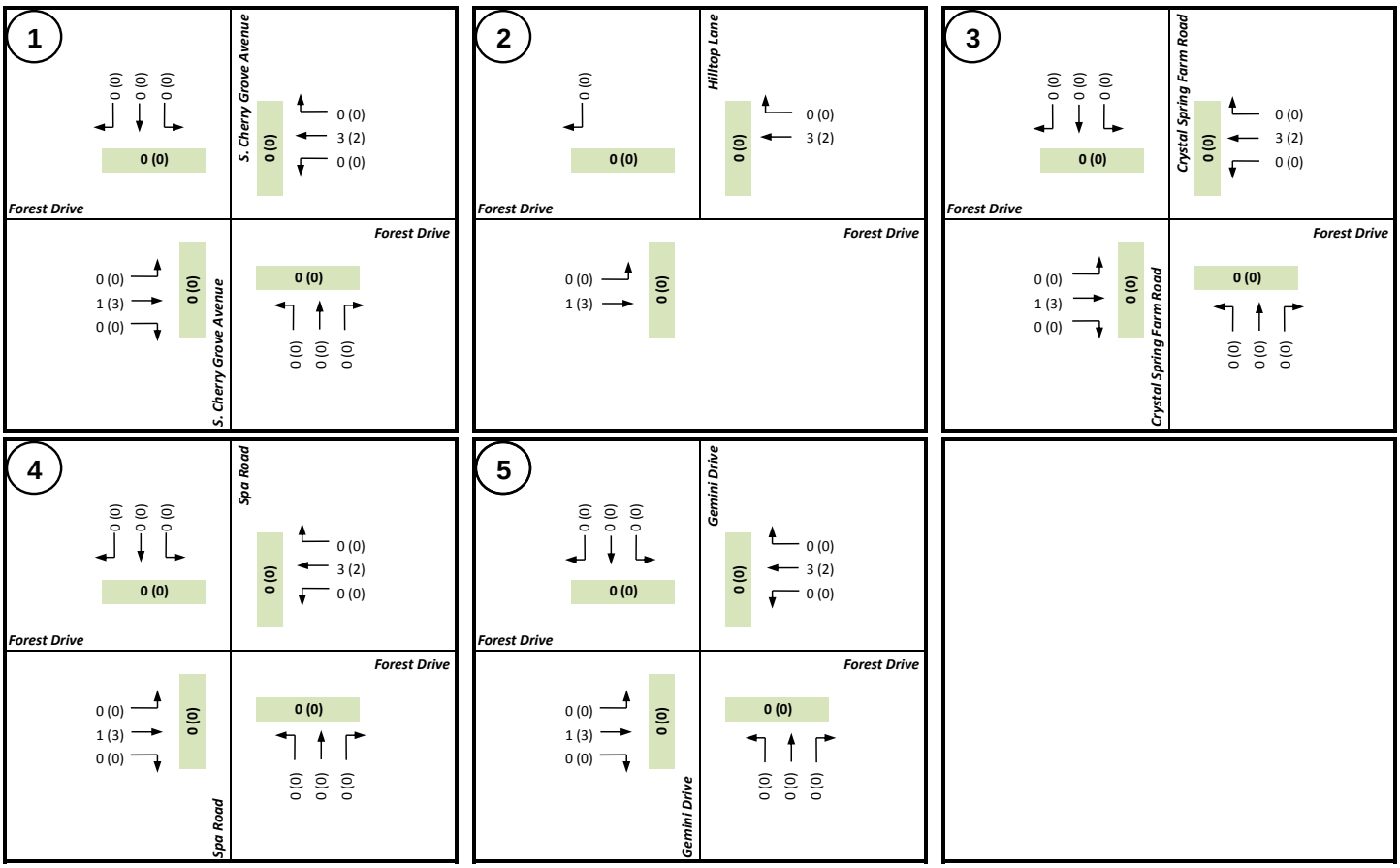
BACKGROUND 2

Bay Village - Starbucks



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

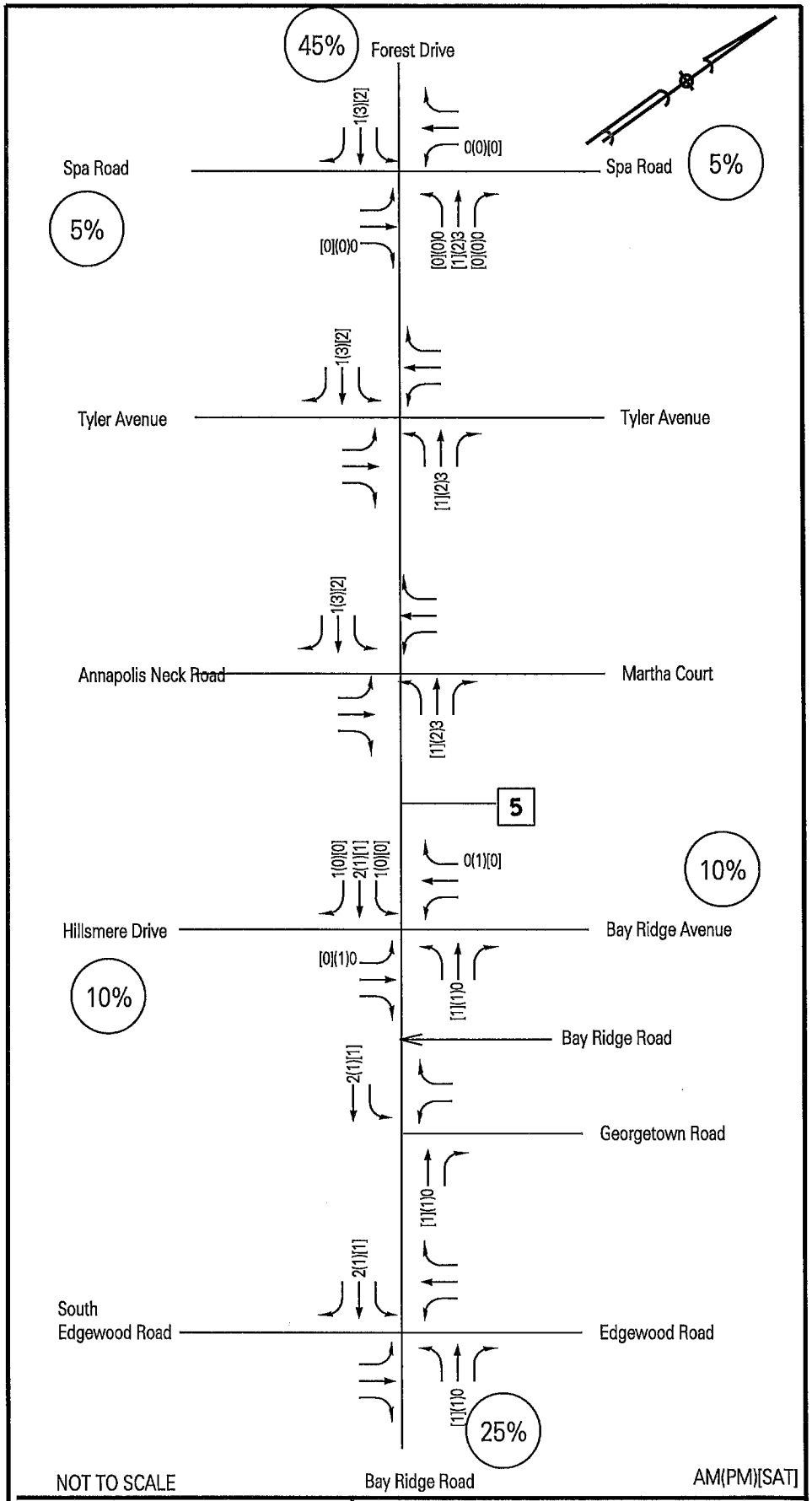
Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - Thomas Woods

CITY OF ANNAPOLIS

STV 100 Years



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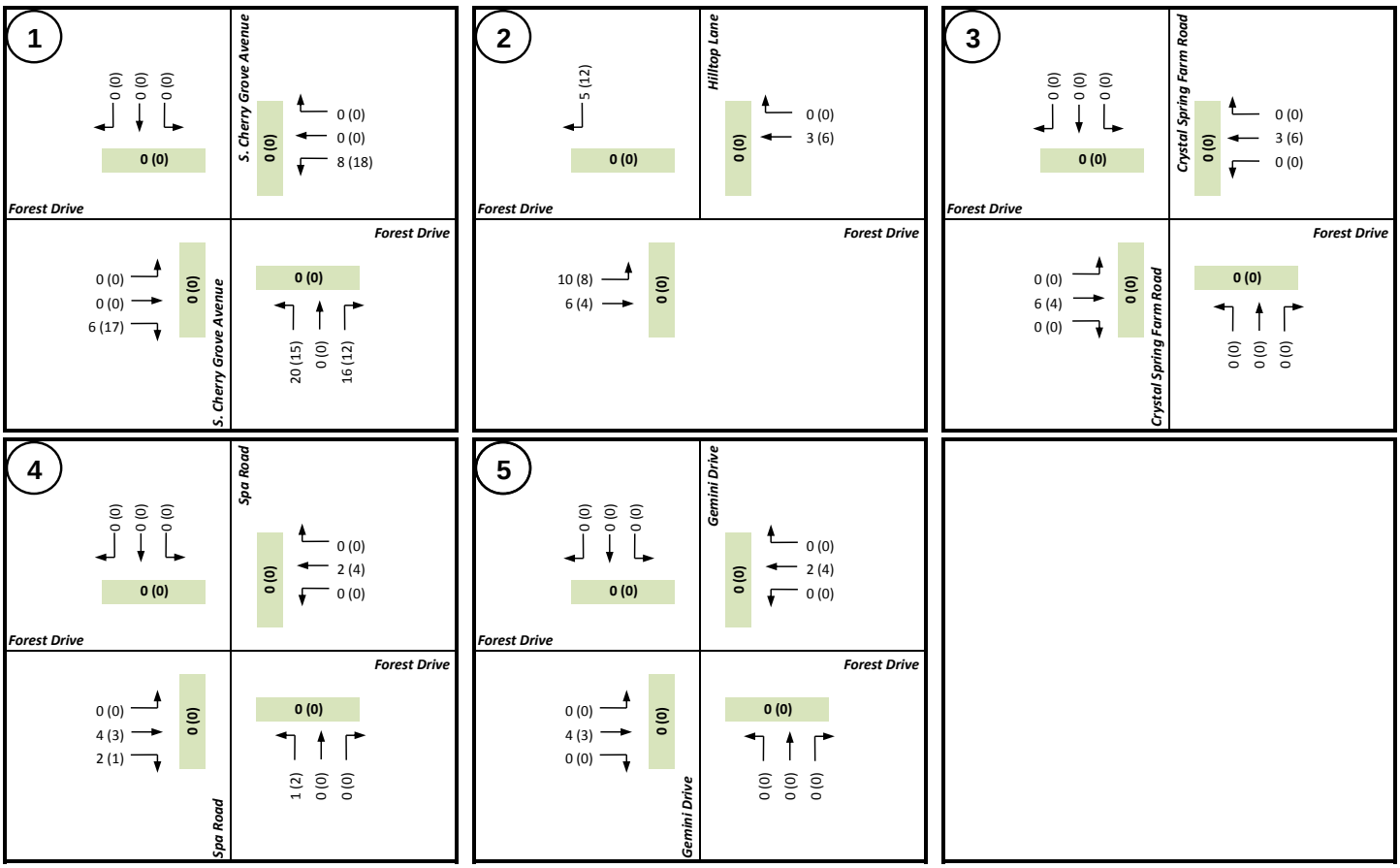
BACKGROUND 5
Thomas Woods



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - Village Greens of Annapolis

CITY OF ANNAPOLIS

STV 100 Years

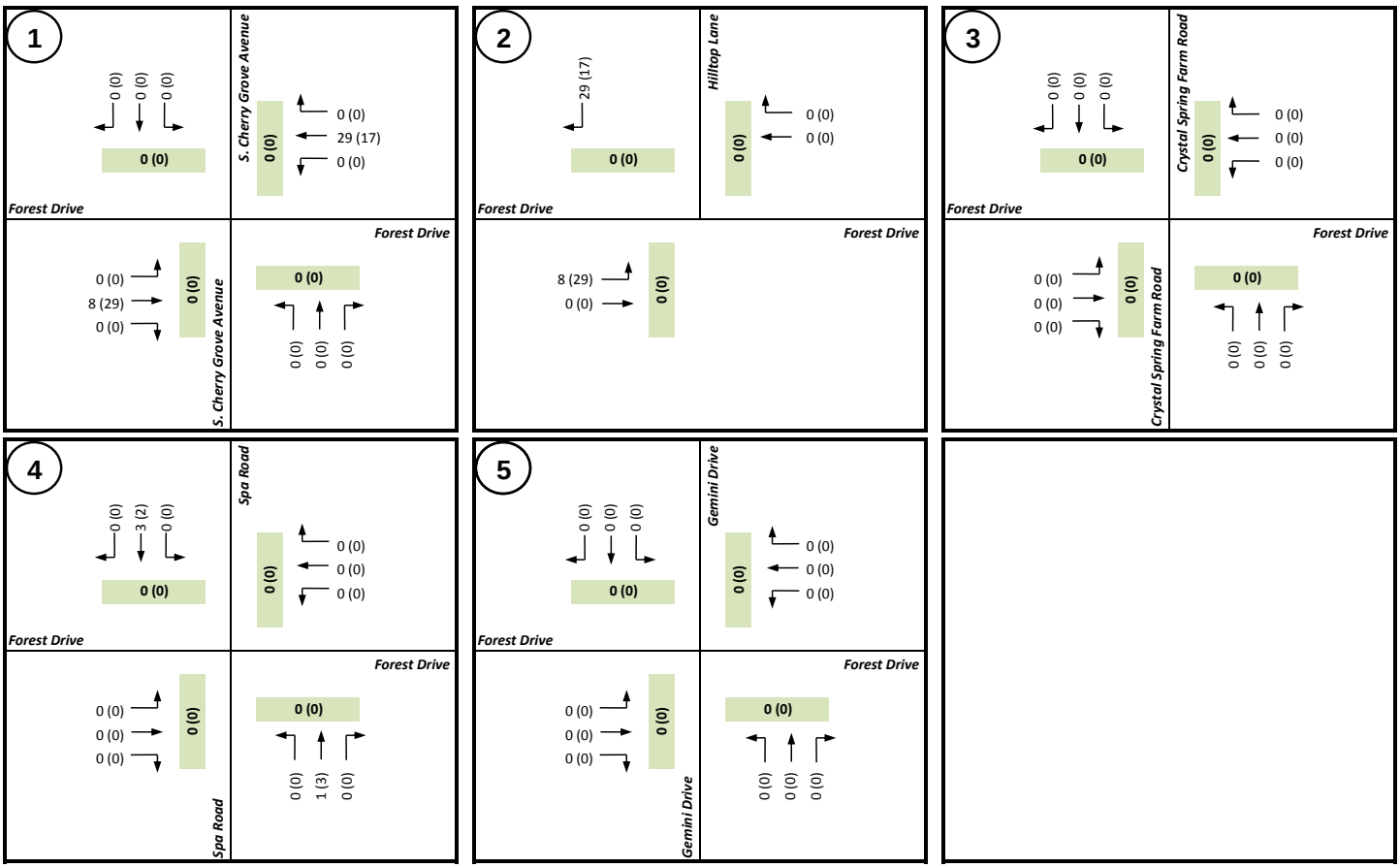
1. Village Greens of Annapolis
    a. 89 multifamily dwelling units: ITE Code 220
2. New Retail/Office
    a. 18,900 SF of general office space: ITE Code 710
    b. 3,780 SF of retail space
        i. 2,460 SF convenience market: ITE Code 852
        ii. 1,320 SF coffee/doughnut shop: ITE Code 936
3. Take One Digital Media Expansion
    a. 2,986 SF convenience market: ITE Code 852
4. Car Wash Upgrade
    a. 2,000 SF automated car wash: ITE Code 948
5. Parkside Preserve
    a. 86 single family detached housing dwelling units: ITE Code 210
    b. 72 townhouse dwelling units: ITE Code 230

The net number of trips generated per land use, and total generated by all of the background developments combined for each peak hour studied is shown in Table 3. These trip generation estimates are conservative, as no discount was taken for pass-by trips, internal capture, or non-driving modes.

Table 3: Background Site Generated Trips

Land Use	Size	AM Peak Hour		PM Peak Hour		SAT Peak Hour	
		Entry	Exit	Entry	Exit	Entry	Exit
230 - Residential Condominium/Townhouse	72 Dwelling Units	7	32	15	17	13	16
Non-pass-by		7	32	15	17	13	16
948 - Automated Car Wash	2 1000 Sq. Feet Gross Floor Area	0	0	12	11	14	14
Non-pass-by		0	0	12	11	14	14
852 - Convenience Market (Open 15-16 Hours) - 1	2.99 1000 Sq. Feet Gross Floor Area	48	49	53	55	53	55
Non-pass-by		48	49	53	55	53	55
852 - Convenience Market (Open 15-16 Hours)	2.46 1000 Sq. Feet Gross Floor Area	41	39	44	45	44	45
Non-pass-by		41	39	44	45	44	45
710 - General Office Building	18.9 1000 Sq. Feet Gross Floor Area	44	6	17	83	4	4
Non-pass-by		44	6	17	83	4	4
936 - Coffee/Donut Shop without Drive-Through Window	1.32 1000 Sq. Feet Gross Floor Area	43	42	17	17	42	45
Non-pass-by		43	42	17	17	42	45
220 - Apartment	89 Dwelling Units	15	36	41	27	56	89
Non-pass-by		15	36	41	27	56	89
210 - Single Family Detached Housing	86 Dwelling Units	19	53	60	34	46	39
Non-pass-by		19	53	60	34	46	39
Total		217	257	259	289	272	307
Total Non-pass-by		217	257	259	289	272	307

The traffic distribution within the study area, from background developments was based upon existing traffic patterns. Accordingly, 55% of the total traffic generated by the background developments was assumed to pass through the study. Figure 9 shows how this 55% of the total background site generated traffic is distributed throughout the study area.



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

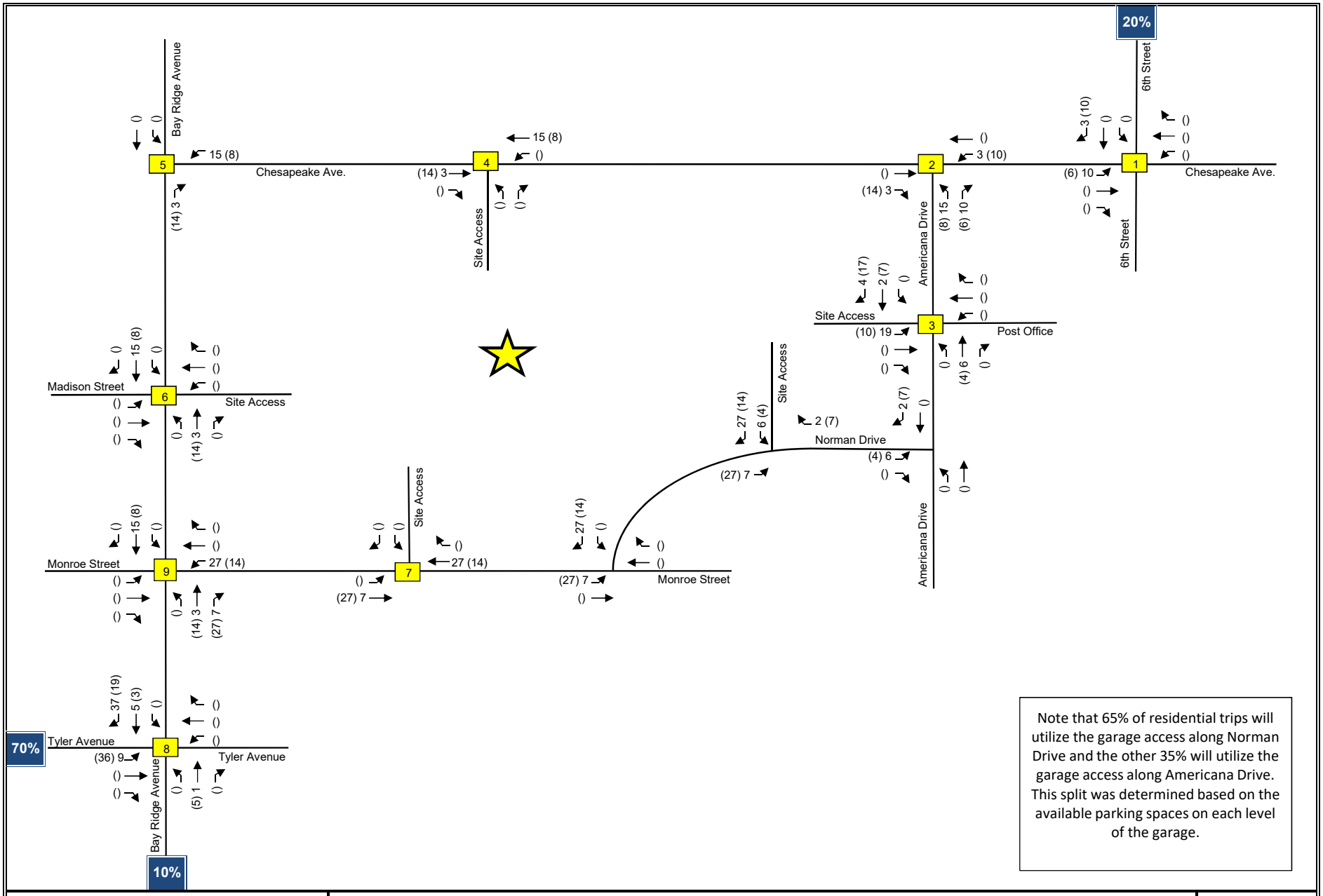
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - Lofts at Eastport Landing

CITY OF ANNAPOLIS

STV 100 Years



Note that 65% of residential trips will utilize the garage access along Norman Drive and the other 35% will utilize the garage access along Americana Drive. This split was determined based on the available parking spaces on each level of the garage.

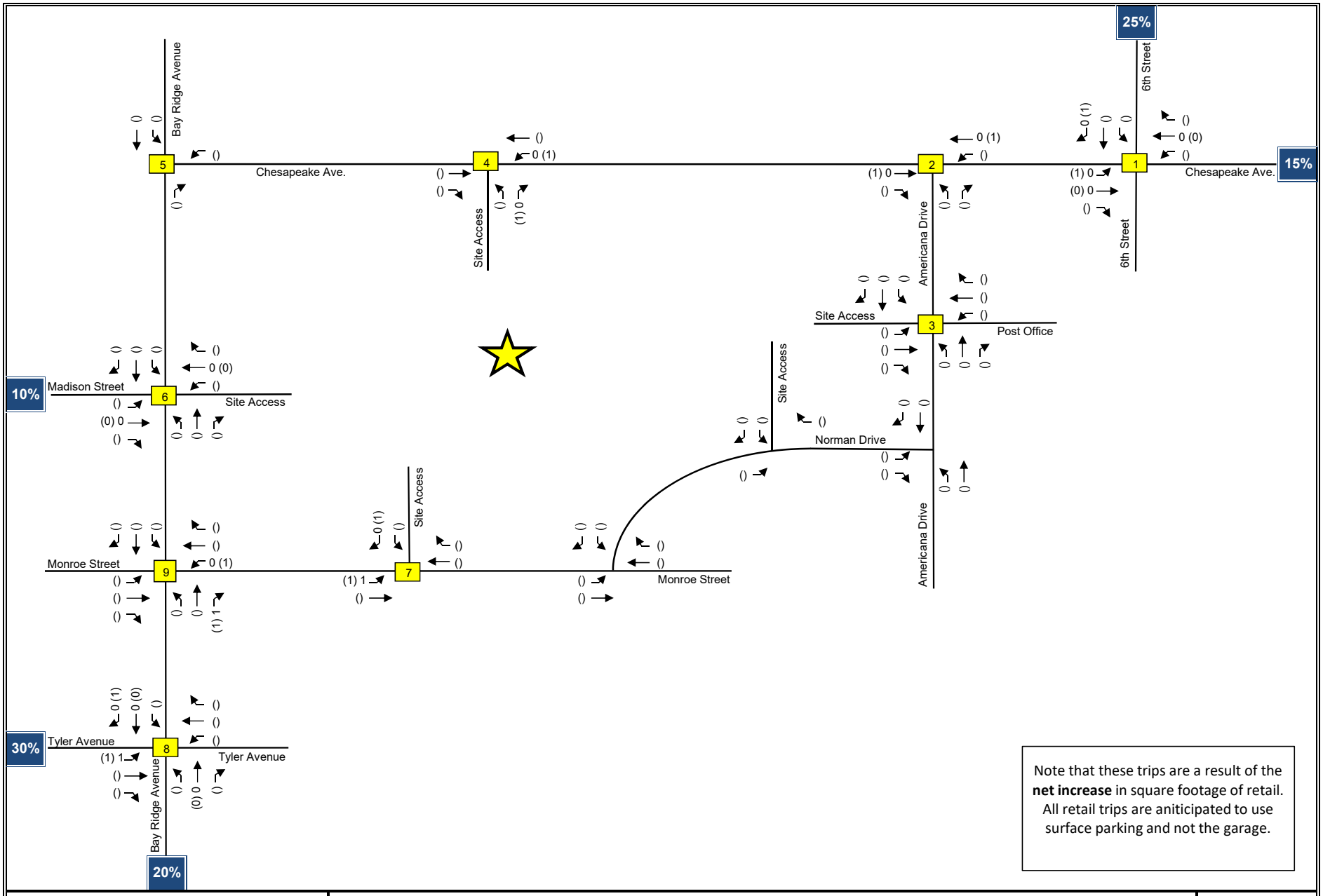
Traffic Impact Analysis

LENHART TRAFFIC CONSULTING, INC.
645 BALTIMORE ANNAPOLIS BLVD, SUITE 214
SEVERNA PARK, MD 21146
www.lenharttraffic.com

Trip Assignment for
Site (Residential)

Key: XX = AM Peak Volumes (XX) = PM Peak Volumes

Exhibit 13a



Note that these trips are a result of the **net increase** in square footage of retail. All retail trips are aniticipated to use surface parking and not the garage.

Traffic Impact Analysis

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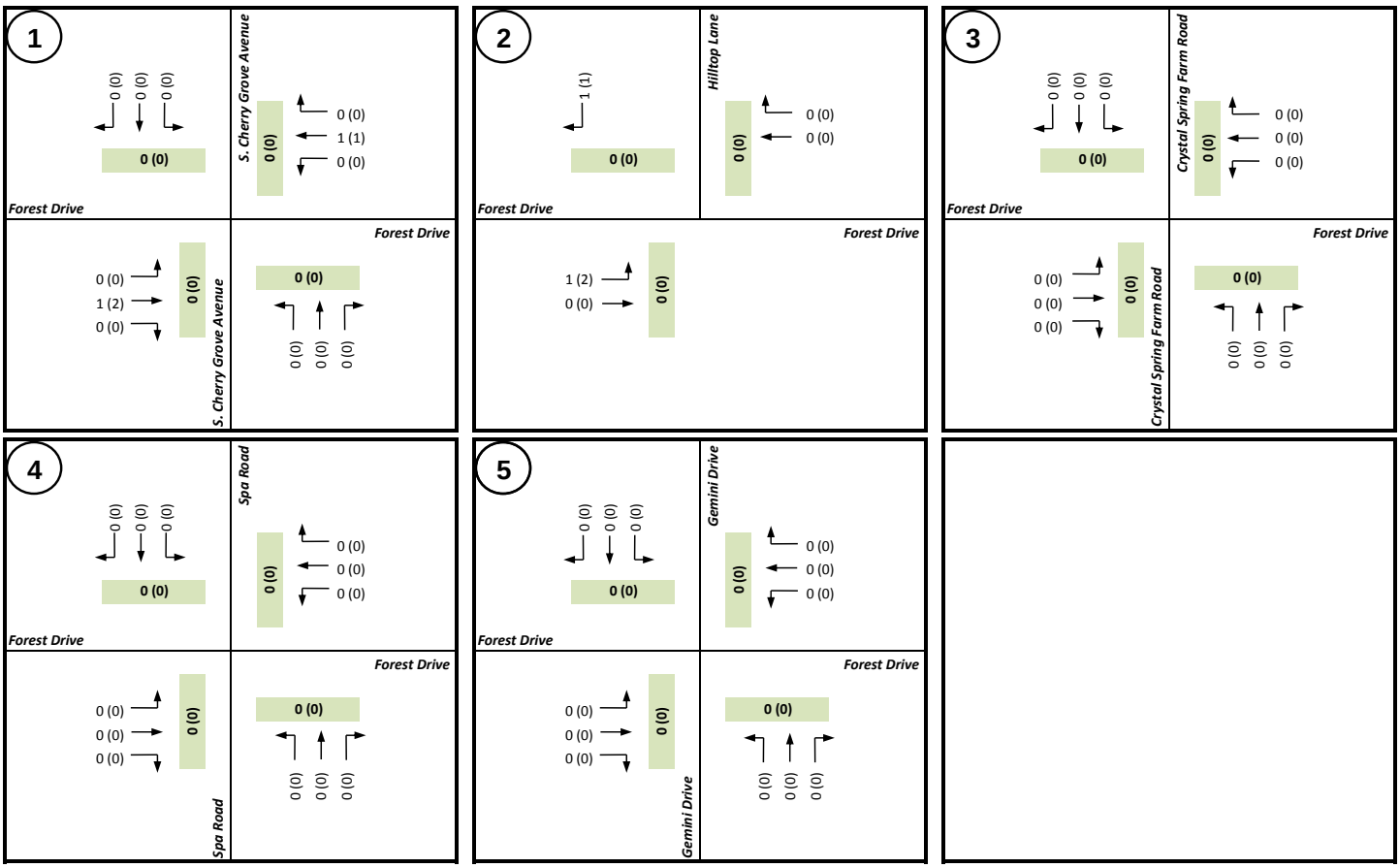
645 BALTIMORE ANNAPOLIS BLVD, SUITE 214
SEVERNA PARK, MD 21146
www.lenharttraffic.com

Trip Assignment for
Site (Retail)

Key: XX = AM Peak Volumes (XX) = PM Peak Volumes

Exhibit 13b



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

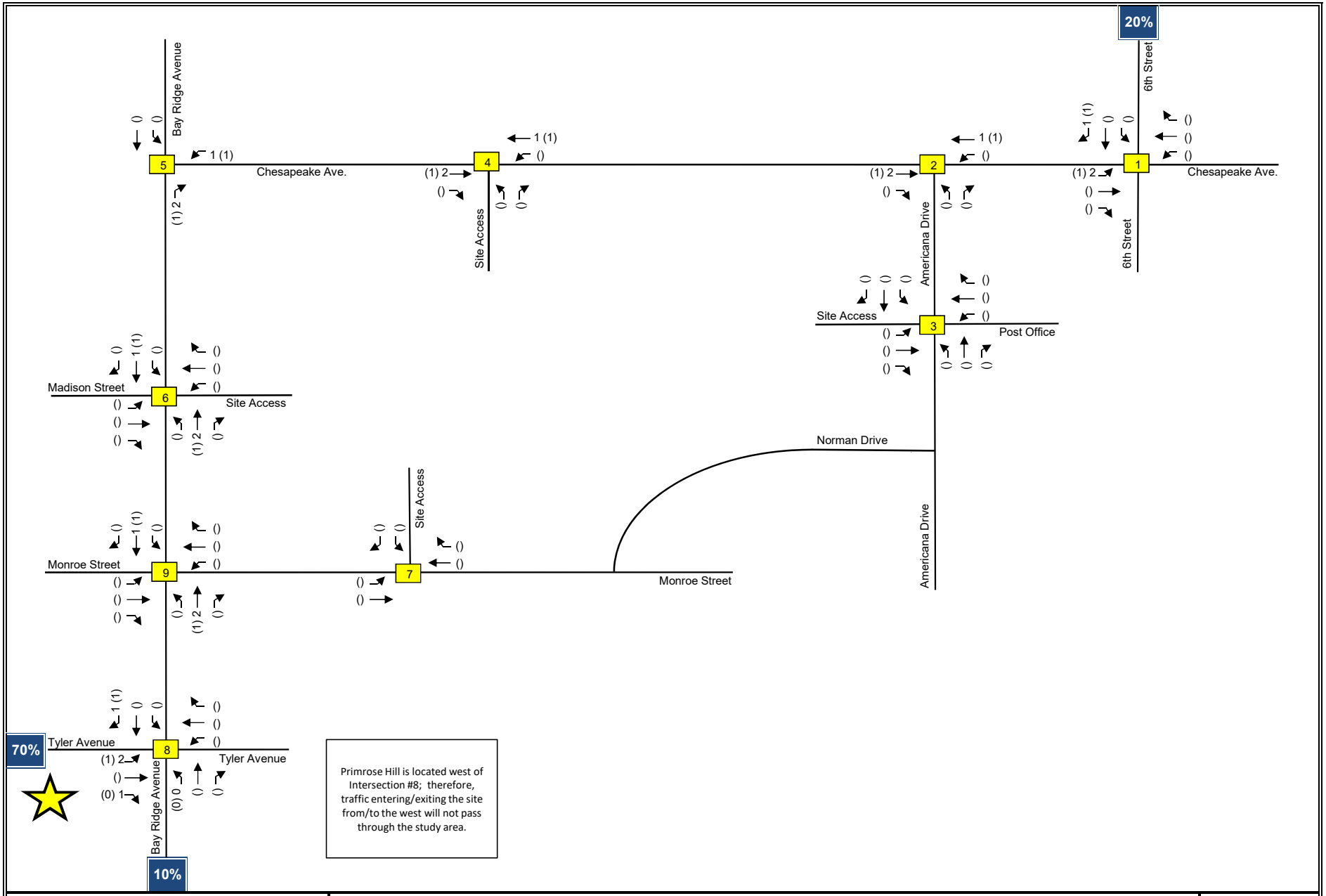
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - Primrose Hill

CITY OF ANNAPOLIS

STV 100 Years



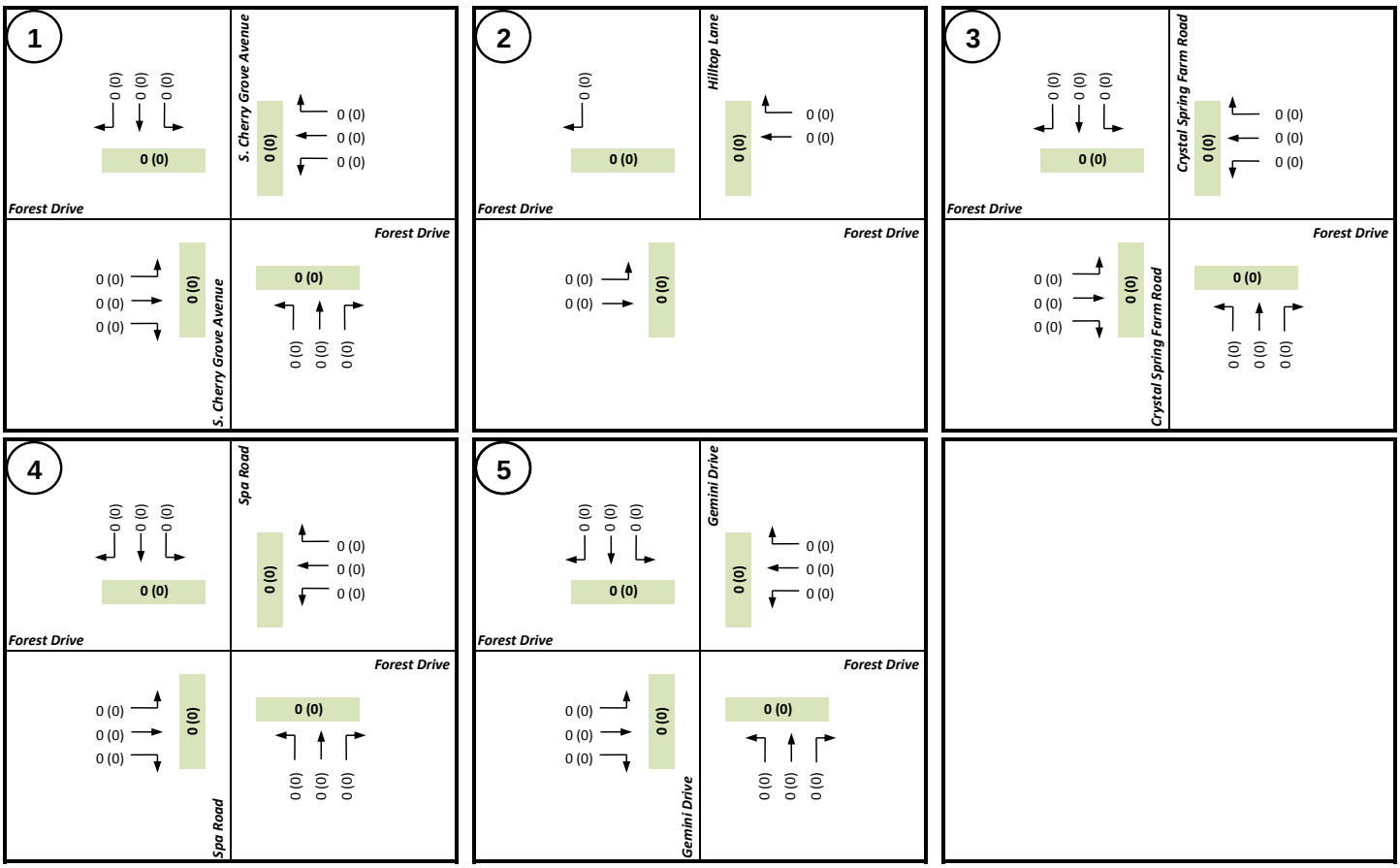
Traffic Impact Analysis

LENHART TRAFFIC CONSULTING, INC.
645 BALTIMORE ANNAPOLIS BLVD, SUITE 214
SEVERNA PARK, MD 21146
www.lenharttraffic.com

Trip Assignment for Primrose Hill

Key: XX = AM Peak Volumes (XX) = PM Peak Volumes

Exhibit E8



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

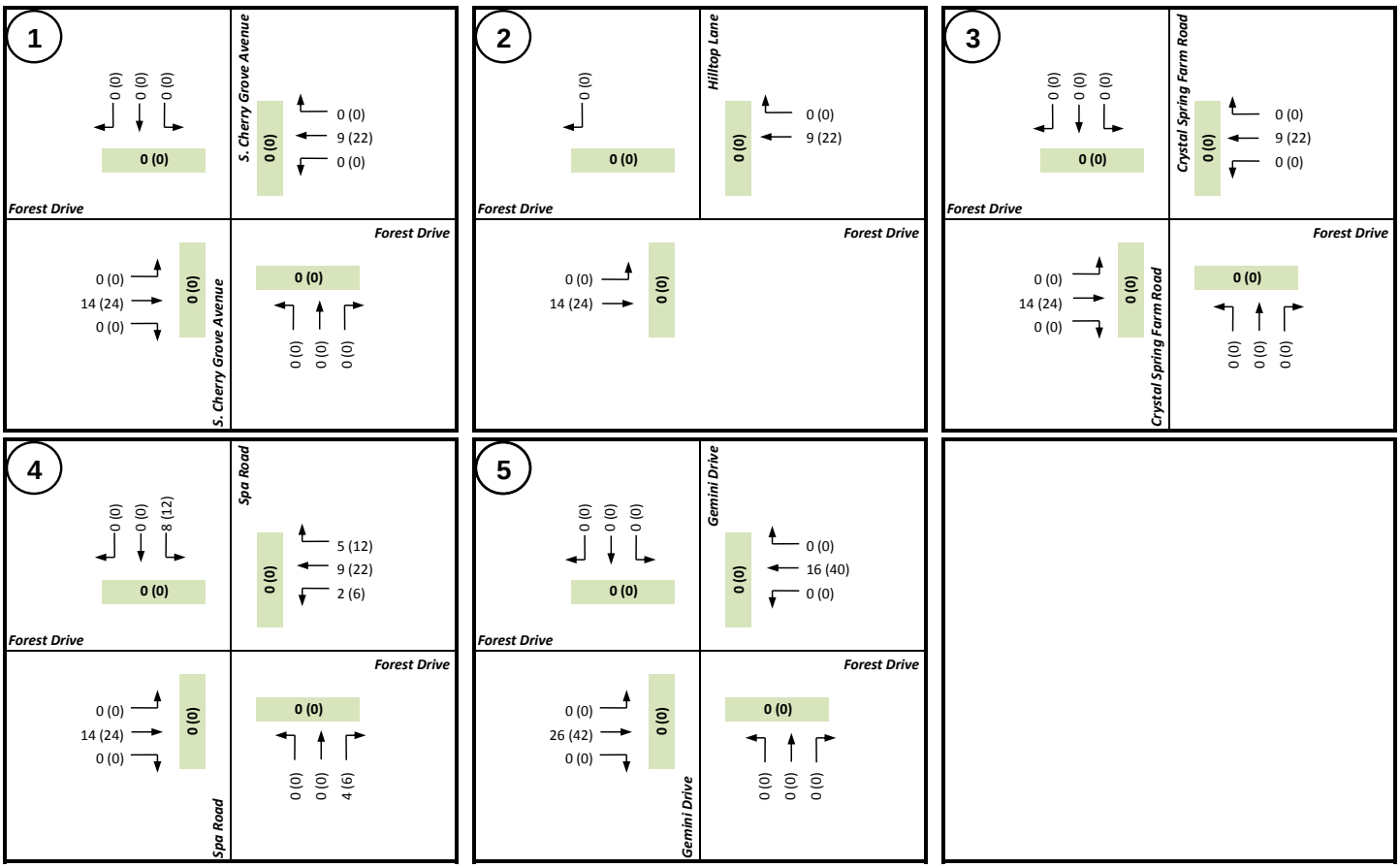
Village at Providence Point
Traffic Impact Study

Appendix D

Background Development Trip Assignment - Tyler Heights Elementary

CITY OF ANNAPOLIS

STV 100 Years



LEGEND

Right Turn Movement
Through Movement
Left Turn Movement

XX (XX): AM (PM) Peak Hour Vehicular Volume
AA (BB): AM (PM) Peak Hour Pedestrian Volume

XX Intersection Number (volume diagram)

X Intersection Number (located on figure)

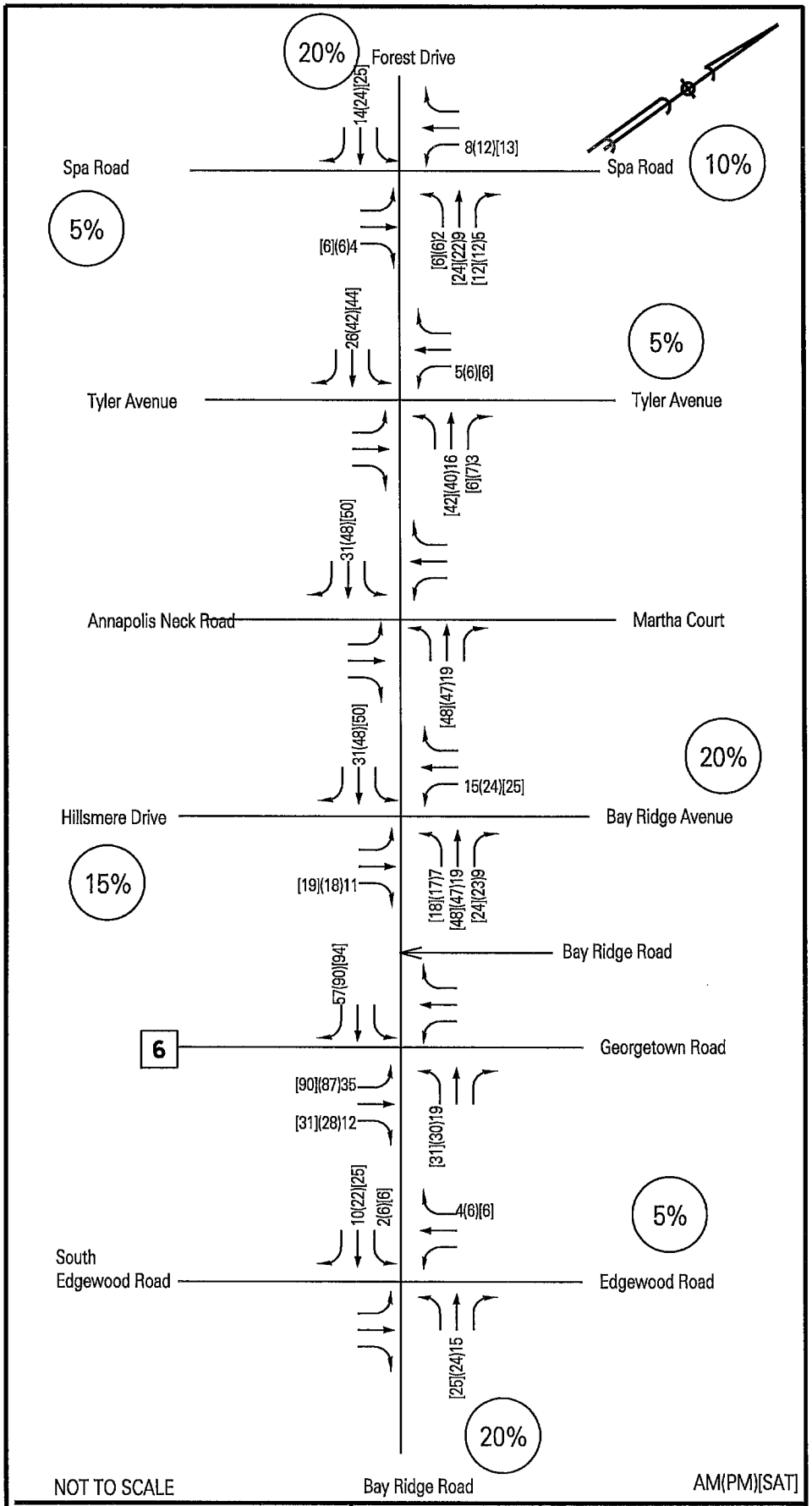
Village at Providence Point Traffic Impact Study

Appendix D

Background Development Trip Assignment - Lidl

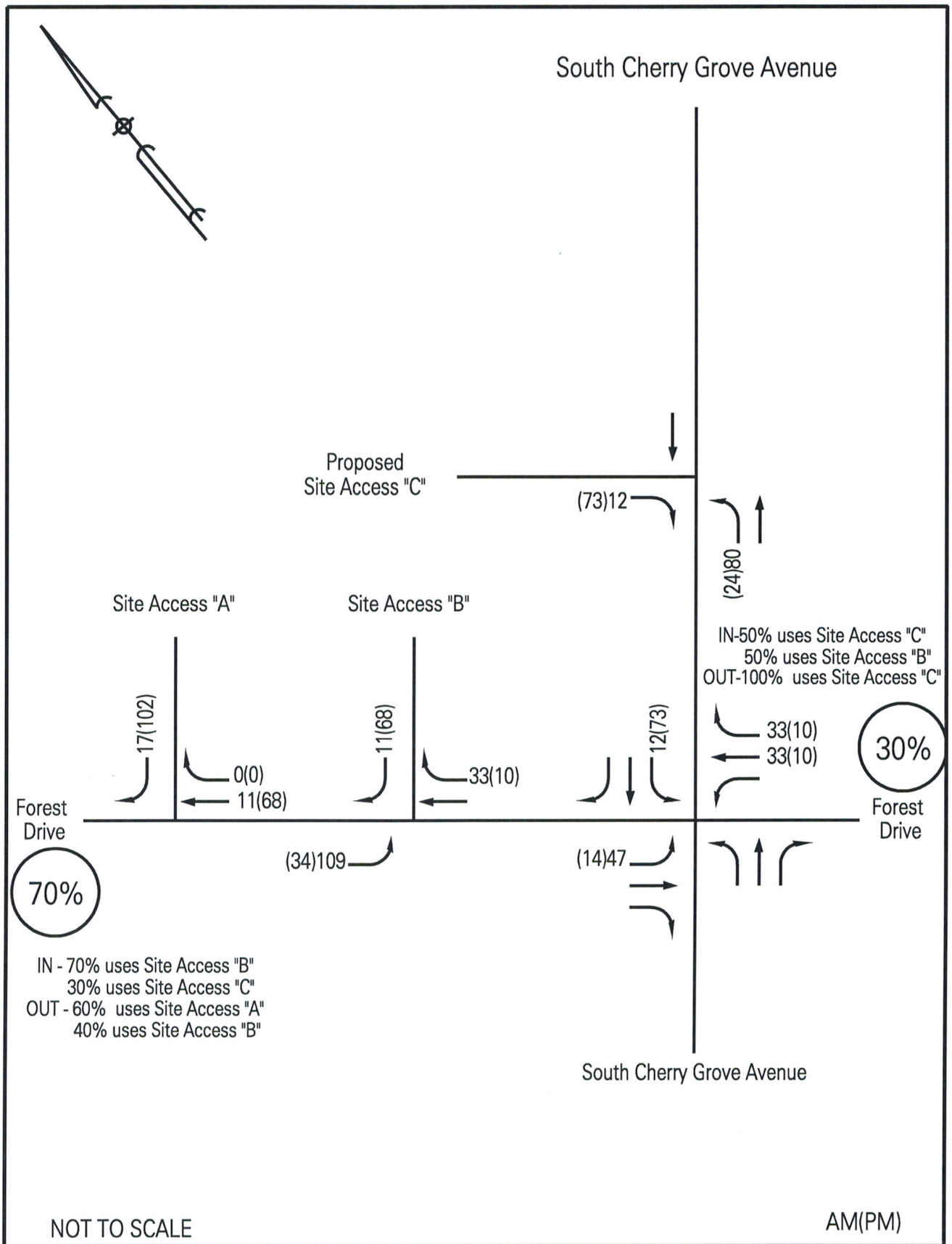
CITY OF ANNAPOLIS

STV 100 Years



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

BACKGROUND 6
Lidl Grocery Store - New Trips



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

Site Generated Traffic
(87,597 gsf general office
37,542 gsf medical office)

APPENDIX

E

Village at Providence Point Traffic Impact Study
Total Background Synchro Worksheets

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	59	2084	55	137	3063	40	221	3	74	19	5	71
Future Volume (vph)	59	2084	55	137	3063	40	221	3	74	19	5	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.95	1.00		0.96	1.00
Satd. Flow (prot)	1770	5063		1770	5074		1681	1687	1583		1790	1554
Flt Permitted	0.05	1.00		0.04	1.00		0.95	0.95	1.00		0.96	1.00
Satd. Flow (perm)	85	5063		81	5074		1681	1687	1583		1790	1554
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	2265	60	149	3329	43	240	3	80	21	5	77
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	71	0	0	74
Lane Group Flow (vph)	64	2323	0	149	3371	0	122	121	9	0	26	3
Confl. Peds. (#/hr)	1		7	7		1	1					1
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		7	7		8	8	
Permitted Phases	6			2					7			8
Actuated Green, G (s)	92.1	87.3		102.9	93.1		15.4	15.4	15.4		6.2	6.2
Effective Green, g (s)	92.1	87.3		102.9	93.1		15.4	15.4	15.4		6.2	6.2
Actuated g/C Ratio	0.66	0.62		0.74	0.66		0.11	0.11	0.11		0.04	0.04
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	113	3157		187	3374		184	185	174		79	68
v/s Ratio Prot	0.02	0.46		c0.06	c0.66		c0.07	0.07			c0.01	
v/s Ratio Perm	0.35			0.53					0.01			0.00
v/c Ratio	0.57	0.74		0.80	1.00		0.66	0.65	0.05		0.33	0.05
Uniform Delay, d1	34.2	18.3		40.5	23.4		59.8	59.7	55.8		64.9	64.1
Progression Factor	1.00	1.00		1.24	0.89		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.8	1.6		11.6	11.4		6.8	6.2	0.0		0.9	0.1
Delay (s)	38.0	19.9		61.8	32.2		66.6	65.9	55.8		65.8	64.2
Level of Service	D	B		E	C		E	E	E		E	E
Approach Delay (s)		20.4			33.5			63.7			64.6	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	30.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	89.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	659	1530	2381	14	0	859
Future Volume (vph)	659	1530	2381	14	0	859
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.91			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	3539	5081			2787
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	3539	5081			2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	716	1663	2588	15	0	934
RTOR Reduction (vph)	0	0	0	0	0	429
Lane Group Flow (vph)	716	1663	2603	0	0	505
Turn Type	Prot	NA	NA			Over
Protected Phases	1	6	2			1
Permitted Phases						
Actuated Green, G (s)	35.7	126.6	85.9			35.7
Effective Green, g (s)	35.7	126.6	85.9			35.7
Actuated g/C Ratio	0.26	0.90	0.61			0.26
Clearance Time (s)	5.0	5.0	5.0			5.0
Vehicle Extension (s)	3.5	5.0	5.0			3.5
Lane Grp Cap (vph)	875	3200	3117			710
v/s Ratio Prot	c0.21	0.47	c0.51			0.18
v/s Ratio Perm						
v/c Ratio	0.82	0.52	0.83			0.71
Uniform Delay, d1	49.1	1.2	21.4			47.5
Progression Factor	0.66	2.92	0.65			1.00
Incremental Delay, d2	4.4	0.4	0.3			3.5
Delay (s)	37.0	4.0	14.2			50.9
Level of Service	D	A	B			D
Approach Delay (s)		13.9	14.2		50.9	
Approach LOS		B	B		D	

Intersection Summary			
HCM 2000 Control Delay	19.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	84.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1530	0	0	2395	0	1
Future Volume (Veh/h)	1530	0	0	2395	0	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1663	0	0	2603	0	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh)	2			2		
Upstream signal (ft)	737			1052		
pX, platoon unblocked			0.89		0.46	0.89
vC, conflicting volume			1663		2964	832
vC1, stage 1 conf vol					1663	
vC2, stage 2 conf vol					1302	
vCu, unblocked vol			1504		1889	574
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			394		140	413

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1109	554	0	1302	1302	1
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	1
cSH	1700	1700	1700	1700	1700	413
Volume to Capacity	0.65	0.33	0.00	0.77	0.77	0.00
Queue Length 95th (ft)	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	13.7
Lane LOS						B
Approach Delay (s)	0.0		0.0			13.7
Approach LOS						B

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	1346	179	11	2081	286	285	99	39	245	87	32
Future Volume (vph)	5	1346	179	11	2081	286	285	99	39	245	87	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.95	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.97		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.98		0.95	0.98	
Satd. Flow (prot)	1770	3467		1770	3465		1681	1692		1681	1694	
Flt Permitted	0.05	1.00		0.07	1.00		0.95	0.98		0.95	0.98	
Satd. Flow (perm)	88	3467		122	3465		1681	1692		1681	1694	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	1463	195	12	2262	311	310	108	42	266	95	35
RTOR Reduction (vph)	0	7	0	0	7	0	0	6	0	0	6	0
Lane Group Flow (vph)	5	1651	0	12	2566	0	229	225	0	197	193	0
Confl. Peds. (#/hr)	1		1	1		1						
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	84.3	84.3		84.3	84.3		20.0	20.0		20.2	20.2	
Effective Green, g (s)	84.3	84.3		84.3	84.3		20.0	20.0		20.2	20.2	
Actuated g/C Ratio	0.60	0.60		0.60	0.60		0.14	0.14		0.14	0.14	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	52	2087		73	2086		240	241		242	244	
v/s Ratio Prot		0.48			c0.74		c0.14	0.13		c0.12	0.11	
v/s Ratio Perm	0.06			0.10								
v/c Ratio	0.10	0.79		0.16	1.23		0.95	0.93		0.81	0.79	
Uniform Delay, d1	11.8	21.2		12.3	27.9		59.5	59.3		58.1	57.9	
Progression Factor	0.63	1.24		0.81	0.77		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.2	2.8		2.5	105.8		45.1	39.9		18.6	15.9	
Delay (s)	10.7	29.1		12.4	127.2		104.6	99.3		76.6	73.8	
Level of Service	B	C		B	F		F	F		E	E	
Approach Delay (s)		29.1			126.6			101.9			75.2	
Approach LOS		C			F			F			E	

Intersection Summary			
HCM 2000 Control Delay	88.6	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	101.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	95	1447	8	2	2184	10	8	0	2	33	0	151
Future Volume (vph)	95	1447	8	2	2184	10	8	0	2	33	0	151
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	1.00			0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.95	1.00
Satd. Flow (prot)	1770	3536		1770	3537			1739			1757	1583
Flt Permitted	0.04	1.00		0.15	1.00			0.75			0.75	1.00
Satd. Flow (perm)	66	3536		275	3537			1365			1388	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	103	1573	9	2	2374	11	9	0	2	36	0	164
RTOR Reduction (vph)	0	0	0	0	0	0	0	10	0	0	0	14
Lane Group Flow (vph)	103	1582	0	2	2385	0	0	1	0	0	36	150
Confl. Peds. (#/hr)									3	3		
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	1	6		5	2			4			8	1
Permitted Phases	6			2			4			8		8
Actuated Green, G (s)	121.5	115.5		108.3	107.3			8.5			8.5	17.7
Effective Green, g (s)	121.5	115.5		108.3	107.3			8.5			8.5	17.7
Actuated g/C Ratio	0.87	0.82		0.77	0.77			0.06			0.06	0.13
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	2.5	5.0		2.5	5.0			2.5			2.5	2.5
Lane Grp Cap (vph)	169	2917		223	2710			82			84	256
v/s Ratio Prot	c0.04	0.45		0.00	c0.67							c0.04
v/s Ratio Perm	0.49			0.01				0.00			0.03	0.06
v/c Ratio	0.61	0.54		0.01	0.88			0.01			0.43	0.59
Uniform Delay, d1	42.8	3.9		3.8	11.7			61.8			63.4	57.7
Progression Factor	1.42	0.21		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	3.1	0.4		0.0	4.5			0.0			2.5	2.8
Delay (s)	63.6	1.2		3.8	16.2			61.8			66.0	60.5
Level of Service	E	A		A	B			E			E	E
Approach Delay (s)		5.1			16.2			61.8			61.5	
Approach LOS		A			B			E			E	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	3033	121	188	2527	17	188	12	111	87	10	38
Future Volume (vph)	50	3033	121	188	2527	17	188	12	111	87	10	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.96	1.00		0.96	1.00
Satd. Flow (prot)	1770	5053		1770	5080		1681	1695	1583		1783	1583
Flt Permitted	0.05	1.00		0.05	1.00		0.95	0.96	1.00		0.96	1.00
Satd. Flow (perm)	95	5053		89	5080		1681	1695	1583		1783	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	3297	132	204	2747	18	204	13	121	95	11	41
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	84	0	0	38
Lane Group Flow (vph)	54	3426	0	204	2765	0	108	109	37	0	106	3
Confl. Peds. (#/hr)			1	1								
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		7	7		8	8	
Permitted Phases	6			2					7			8
Actuated Green, G (s)	83.3	78.4		94.6	84.7		18.8	18.8	18.8		11.1	11.1
Effective Green, g (s)	83.3	78.4		94.6	84.7		18.8	18.8	18.8		11.1	11.1
Actuated g/C Ratio	0.59	0.56		0.68	0.61		0.13	0.13	0.13		0.08	0.08
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	115	2829		194	3073		225	227	212		141	125
v/s Ratio Prot	0.02	c0.68		c0.08	0.54		0.06	c0.06			c0.06	
v/s Ratio Perm	0.26			0.62					0.02			0.00
v/c Ratio	0.47	1.21		1.05	0.90		0.48	0.48	0.17		0.75	0.03
Uniform Delay, d1	26.4	30.8		49.8	24.0		56.1	56.1	53.7		63.1	59.5
Progression Factor	1.00	1.00		1.12	1.10		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	98.5		66.8	3.2		0.6	0.6	0.1		18.0	0.0
Delay (s)	27.5	129.3		122.8	29.5		56.7	56.7	53.9		81.1	59.5
Level of Service	C	F		F	C		E	E	D		F	E
Approach Delay (s)		127.7			35.9			55.7			75.1	
Approach LOS		F			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	83.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	96.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	1031	2228	1736	20	0	996
Future Volume (vph)	1031	2228	1736	20	0	996
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.91			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	3539	5077			2787
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	3539	5077			2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1121	2422	1887	22	0	1083
RTOR Reduction (vph)	0	0	1	0	0	439
Lane Group Flow (vph)	1121	2422	1908	0	0	644
Turn Type	Prot	NA	NA			Over
Protected Phases	1	6	2			1
Permitted Phases						
Actuated Green, G (s)	52.4	126.6	69.2			52.4
Effective Green, g (s)	52.4	126.6	69.2			52.4
Actuated g/C Ratio	0.37	0.90	0.49			0.37
Clearance Time (s)	5.0	5.0	5.0			5.0
Vehicle Extension (s)	3.5	5.0	5.0			3.5
Lane Grp Cap (vph)	1284	3200	2509			1043
v/s Ratio Prot	c0.33	c0.68	0.38			0.23
v/s Ratio Perm						
v/c Ratio	0.87	0.76	0.76			0.62
Uniform Delay, d1	40.7	2.0	28.7			35.6
Progression Factor	0.62	3.40	0.75			1.00
Incremental Delay, d2	0.7	0.2	0.9			1.2
Delay (s)	25.9	7.1	22.4			36.8
Level of Service	C	A	C			D
Approach Delay (s)		13.0	22.4		36.8	
Approach LOS		B	C		D	

Intersection Summary			
HCM 2000 Control Delay	19.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	2226	1	1	1756	0	1
Future Volume (Veh/h)	2226	1	1	1756	0	1
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2420	1	1	1909	0	1
Pedestrians	4					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	0					
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh)	2			2		
Upstream signal (ft)	736			1053		
pX, platoon unblocked			0.11		0.39	0.11
vC, conflicting volume			2421		3381	1210
vC1, stage 1 conf vol					2420	
vC2, stage 2 conf vol					960	
vCu, unblocked vol			0		0	0
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			99		100	99
cM capacity (veh/h)			183		441	122

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1613	808	1	954	954	1
Volume Left	0	0	1	0	0	0
Volume Right	0	1	0	0	0	1
cSH	1700	1700	183	1700	1700	122
Volume to Capacity	0.95	0.48	0.01	0.56	0.56	0.01
Queue Length 95th (ft)	0	0	0	0	0	1
Control Delay (s)	0.0	0.0	24.8	0.0	0.0	34.7
Lane LOS			C			D
Approach Delay (s)	0.0		0.0			34.7
Approach LOS						D

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	2022	201	15	1560	264	178	97	30	374	80	15
Future Volume (vph)	9	2022	201	15	1560	264	178	97	30	374	80	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.95	0.95		0.95	0.95	
Frt	1.00	0.99		1.00	0.98		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.99		0.95	0.97	
Satd. Flow (prot)	1770	3491		1770	3462		1681	1702		1681	1702	
Flt Permitted	0.05	1.00		0.05	1.00		0.95	0.99		0.95	0.97	
Satd. Flow (perm)	89	3491		89	3462		1681	1702		1681	1702	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	2198	218	16	1696	287	193	105	33	407	87	16
RTOR Reduction (vph)	0	5	0	0	9	0	0	6	0	0	2	0
Lane Group Flow (vph)	10	2411	0	16	1974	0	164	161	0	252	256	0
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	83.7	83.7		83.7	83.7		17.5	17.5		23.3	23.3	
Effective Green, g (s)	83.7	83.7		83.7	83.7		17.5	17.5		23.3	23.3	
Actuated g/C Ratio	0.60	0.60		0.60	0.60		0.12	0.12		0.17	0.17	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	53	2087		53	2069		210	212		279	283	
v/s Ratio Prot		c0.69			0.57		c0.10	0.09		0.15	c0.15	
v/s Ratio Perm	0.11			0.18								
v/c Ratio	0.19	1.16		0.30	0.95		0.78	0.76		0.90	0.91	
Uniform Delay, d1	12.8	28.1		13.8	26.3		59.4	59.2		57.2	57.3	
Progression Factor	0.74	0.77		0.60	0.66		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	73.9		10.9	9.5		17.0	14.4		30.0	30.1	
Delay (s)	14.8	95.5		19.1	26.9		76.4	73.6		87.2	87.3	
Level of Service	B	F		B	C		E	E		F	F	
Approach Delay (s)		95.2			26.8			75.0			87.3	
Approach LOS		F			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	67.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	96.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	209	2204	7	1	1624	23	7	0	2	42	0	119
Future Volume (vph)	209	2204	7	1	1624	23	7	0	2	42	0	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	1.00			0.97			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.95	1.00
Satd. Flow (prot)	1770	3537		1770	3531			1736			1757	1583
Flt Permitted	0.08	1.00		0.04	1.00			0.77			0.75	1.00
Satd. Flow (perm)	141	3537		76	3531			1385			1389	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	227	2396	8	1	1765	25	8	0	2	46	0	129
RTOR Reduction (vph)	0	0	0	0	1	0	0	9	0	0	0	31
Lane Group Flow (vph)	227	2404	0	1	1789	0	0	1	0	0	46	98
Confl. Peds. (#/hr)	1		2	2		1			3	3		
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	1	6		5	2			4			8	1
Permitted Phases	6			2			4			8		8
Actuated Green, G (s)	120.9	114.9		101.5	100.5			9.1			9.1	24.5
Effective Green, g (s)	120.9	114.9		101.5	100.5			9.1			9.1	24.5
Actuated g/C Ratio	0.86	0.82		0.72	0.72			0.06			0.06	0.18
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	2.5	5.0		2.5	5.0			2.5			2.5	2.5
Lane Grp Cap (vph)	300	2902		67	2534			90			90	333
v/s Ratio Prot	c0.08	c0.68		0.00	0.51							0.03
v/s Ratio Perm	0.57			0.01				0.00			c0.03	0.03
v/c Ratio	0.76	0.83		0.01	0.71			0.01			0.51	0.29
Uniform Delay, d1	33.7	7.0		22.2	11.3			61.2			63.3	50.2
Progression Factor	1.43	0.35		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	1.0	0.3		0.1	1.7			0.0			3.6	0.4
Delay (s)	49.3	2.7		22.2	13.0			61.2			66.9	50.6
Level of Service	D	A		C	B			E			E	D
Approach Delay (s)		6.7			13.0			61.2			54.9	
Approach LOS		A			B			E			D	

Intersection Summary			
HCM 2000 Control Delay	11.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

APPENDIX

F

Village at Providence Point Traffic Impact Study
Total Traffic Synchro Worksheets

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	59	2111	55	137	3078	40	221	3	74	19	5	71
Future Volume (vph)	59	2111	55	137	3078	40	221	3	74	19	5	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.95	1.00		0.96	1.00
Satd. Flow (prot)	1770	5063		1770	5074		1681	1687	1583		1790	1554
Flt Permitted	0.05	1.00		0.04	1.00		0.95	0.95	1.00		0.96	1.00
Satd. Flow (perm)	85	5063		81	5074		1681	1687	1583		1790	1554
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	2295	60	149	3346	43	240	3	80	21	5	77
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	71	0	0	74
Lane Group Flow (vph)	64	2353	0	149	3388	0	122	121	9	0	26	3
Confl. Peds. (#/hr)	1		7	7		1	1					1
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		7	7		8	8	
Permitted Phases	6			2					7			8
Actuated Green, G (s)	92.1	87.3		102.9	93.1		15.4	15.4	15.4		6.2	6.2
Effective Green, g (s)	92.1	87.3		102.9	93.1		15.4	15.4	15.4		6.2	6.2
Actuated g/C Ratio	0.66	0.62		0.74	0.66		0.11	0.11	0.11		0.04	0.04
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	113	3157		187	3374		184	185	174		79	68
v/s Ratio Prot	0.02	0.46		c0.06	c0.67		c0.07	0.07			c0.01	
v/s Ratio Perm	0.35			0.53					0.01			0.00
v/c Ratio	0.57	0.75		0.80	1.00		0.66	0.65	0.05		0.33	0.05
Uniform Delay, d1	34.2	18.5		40.7	23.5		59.8	59.7	55.8		64.9	64.1
Progression Factor	1.00	1.00		1.24	0.89		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.8	1.6		11.5	12.5		6.8	6.2	0.0		0.9	0.1
Delay (s)	38.0	20.2		62.1	33.3		66.6	65.9	55.8		65.8	64.2
Level of Service	D	C		E	C		E	E	E		E	E
Approach Delay (s)		20.7			34.5			63.7			64.6	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	31.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	659	1557	2396	14	0	859
Future Volume (vph)	659	1557	2396	14	0	859
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.91			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	3539	5081			2787
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	3539	5081			2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	716	1692	2604	15	0	934
RTOR Reduction (vph)	0	0	0	0	0	429
Lane Group Flow (vph)	716	1692	2619	0	0	505
Turn Type	Prot	NA	NA			Over
Protected Phases	1	6	2			1
Permitted Phases						
Actuated Green, G (s)	35.7	126.6	85.9			35.7
Effective Green, g (s)	35.7	126.6	85.9			35.7
Actuated g/C Ratio	0.26	0.90	0.61			0.26
Clearance Time (s)	5.0	5.0	5.0			5.0
Vehicle Extension (s)	3.5	5.0	5.0			3.5
Lane Grp Cap (vph)	875	3200	3117			710
v/s Ratio Prot	c0.21	0.48	c0.52			0.18
v/s Ratio Perm						
v/c Ratio	0.82	0.53	0.84			0.71
Uniform Delay, d1	49.1	1.2	21.6			47.5
Progression Factor	0.66	2.91	0.65			1.00
Incremental Delay, d2	4.3	0.4	0.3			3.5
Delay (s)	36.6	4.0	14.3			50.9
Level of Service	D	A	B			D
Approach Delay (s)		13.7	14.3		50.9	
Approach LOS		B	B		D	

Intersection Summary			
HCM 2000 Control Delay	19.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	1530	27	5	2395	15	4
Future Volume (Veh/h)	1530	27	5	2395	15	4
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	1663	29	5	2603	16	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh)	2			2		
Upstream signal (ft)	737			1052		
pX, platoon unblocked			0.89		0.47	0.89
vC, conflicting volume			1692		2989	846
vC1, stage 1 conf vol					1678	
vC2, stage 2 conf vol					1312	
vCu, unblocked vol			1528		1907	576
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			99		88	99
cM capacity (veh/h)			384		138	409

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1109	583	5	1302	1302	20
Volume Left	0	0	5	0	0	16
Volume Right	0	29	0	0	0	4
cSH	1700	1700	384	1700	1700	159
Volume to Capacity	0.65	0.34	0.01	0.77	0.77	0.13
Queue Length 95th (ft)	0	0	1	0	0	11
Control Delay (s)	0.0	0.0	14.5	0.0	0.0	30.9
Lane LOS			B			D
Approach Delay (s)	0.0		0.0			30.9
Approach LOS						D

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	1349	179	11	2086	286	285	107	39	245	102	32
Future Volume (vph)	5	1349	179	11	2086	286	285	107	39	245	102	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.95	0.95		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.97		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.98		0.95	0.99	
Satd. Flow (prot)	1770	3467		1770	3465		1681	1694		1681	1700	
Flt Permitted	0.05	1.00		0.06	1.00		0.95	0.98		0.95	0.99	
Satd. Flow (perm)	89	3467		119	3465		1681	1694		1681	1700	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	1466	195	12	2267	311	310	116	42	266	111	35
RTOR Reduction (vph)	0	7	0	0	7	0	0	5	0	0	5	0
Lane Group Flow (vph)	5	1654	0	12	2571	0	232	231	0	205	202	0
Confl. Peds. (#/hr)	1		1	1		1						
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	83.8	83.8		83.8	83.8		20.0	20.0		20.7	20.7	
Effective Green, g (s)	83.8	83.8		83.8	83.8		20.0	20.0		20.7	20.7	
Actuated g/C Ratio	0.60	0.60		0.60	0.60		0.14	0.14		0.15	0.15	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	53	2075		71	2074		240	242		248	251	
v/s Ratio Prot		0.48			c0.74		c0.14	0.14		c0.12	0.12	
v/s Ratio Perm	0.06			0.10								
v/c Ratio	0.09	0.80		0.17	1.24		0.97	0.95		0.83	0.80	
Uniform Delay, d1	12.0	21.6		12.5	28.1		59.7	59.5		57.9	57.7	
Progression Factor	0.69	1.24		0.81	0.77		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.1	2.9		2.6	110.0		48.3	44.8		19.7	16.8	
Delay (s)	11.3	29.6		12.8	131.6		107.9	104.4		77.6	74.5	
Level of Service	B	C		B	F		F	F		E	E	
Approach Delay (s)		29.5			131.0			106.1			76.0	
Approach LOS		C			F			F			E	

Intersection Summary			
HCM 2000 Control Delay	91.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.13		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	95	1450	8	2	2189	10	8	0	2	33	0	151
Future Volume (vph)	95	1450	8	2	2189	10	8	0	2	33	0	151
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	1.00			0.98			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.95	1.00
Satd. Flow (prot)	1770	3536		1770	3537			1739			1757	1583
Flt Permitted	0.04	1.00		0.15	1.00			0.75			0.75	1.00
Satd. Flow (perm)	66	3536		274	3537			1365			1388	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	103	1576	9	2	2379	11	9	0	2	36	0	164
RTOR Reduction (vph)	0	0	0	0	0	0	0	10	0	0	0	14
Lane Group Flow (vph)	103	1585	0	2	2390	0	0	1	0	0	36	150
Confl. Peds. (#/hr)									3	3		
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	1	6		5	2			4			8	1
Permitted Phases	6			2			4			8		8
Actuated Green, G (s)	121.5	115.5		108.3	107.3			8.5			8.5	17.7
Effective Green, g (s)	121.5	115.5		108.3	107.3			8.5			8.5	17.7
Actuated g/C Ratio	0.87	0.82		0.77	0.77			0.06			0.06	0.13
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	2.5	5.0		2.5	5.0			2.5			2.5	2.5
Lane Grp Cap (vph)	169	2917		222	2710			82			84	256
v/s Ratio Prot	c0.04	0.45		0.00	c0.68							c0.04
v/s Ratio Perm	0.49			0.01				0.00			0.03	0.06
v/c Ratio	0.61	0.54		0.01	0.88			0.01			0.43	0.59
Uniform Delay, d1	42.9	3.9		3.8	11.8			61.8			63.4	57.7
Progression Factor	1.40	0.21		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	3.1	0.4		0.0	4.6			0.0			2.5	2.8
Delay (s)	63.2	1.2		3.8	16.3			61.8			66.0	60.5
Level of Service	E	A		A	B			E			E	E
Approach Delay (s)		5.0			16.3			61.8			61.5	
Approach LOS		A			B			E			E	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	87.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	8	1	2	423	277	15
Future Volume (Veh/h)	8	1	2	423	277	15
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	1	2	460	301	16
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)					716	
pX, platoon unblocked						
vC, conflicting volume	773	309	317			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	773	309	317			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	367	731	1243			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	10	462	317
Volume Left	9	2	0
Volume Right	1	0	16
cSH	386	1243	1700
Volume to Capacity	0.03	0.00	0.19
Queue Length 95th (ft)	2	0	0
Control Delay (s)	14.6	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	14.6	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	33.9%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/13/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	3050	121	188	2554	17	188	12	111	87	10	38
Future Volume (vph)	50	3050	121	188	2554	17	188	12	111	87	10	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.96	1.00		0.96	1.00
Satd. Flow (prot)	1770	5053		1770	5080		1681	1695	1583		1783	1583
Flt Permitted	0.05	1.00		0.05	1.00		0.95	0.96	1.00		0.96	1.00
Satd. Flow (perm)	95	5053		89	5080		1681	1695	1583		1783	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	3315	132	204	2776	18	204	13	121	95	11	41
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	84	0	0	38
Lane Group Flow (vph)	54	3444	0	204	2794	0	108	109	37	0	106	3
Confl. Peds. (#/hr)			1	1								
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	1	6		5	2		7	7		8	8	
Permitted Phases	6			2					7			8
Actuated Green, G (s)	83.3	78.4		94.6	84.7		18.8	18.8	18.8		11.1	11.1
Effective Green, g (s)	83.3	78.4		94.6	84.7		18.8	18.8	18.8		11.1	11.1
Actuated g/C Ratio	0.59	0.56		0.68	0.61		0.13	0.13	0.13		0.08	0.08
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	115	2829		194	3073		225	227	212		141	125
v/s Ratio Prot	0.02	c0.68		c0.08	0.55		0.06	c0.06			c0.06	
v/s Ratio Perm	0.26			0.62					0.02			0.00
v/c Ratio	0.47	1.22		1.05	0.91		0.48	0.48	0.17		0.75	0.03
Uniform Delay, d1	27.1	30.8		49.8	24.3		56.1	56.1	53.7		63.1	59.5
Progression Factor	1.00	1.00		1.14	1.09		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	101.3		66.4	3.5		0.6	0.6	0.1		18.0	0.0
Delay (s)	28.2	132.1		123.0	30.0		56.7	56.7	53.9		81.1	59.5
Level of Service	C	F		F	C		E	E	D		F	E
Approach Delay (s)		130.5			36.4			55.7			75.1	
Approach LOS		F			D			E			E	

Intersection Summary			
HCM 2000 Control Delay	85.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	97.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	1031	2245	1763	20	0	996
Future Volume (vph)	1031	2245	1763	20	0	996
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0			5.0
Lane Util. Factor	0.97	0.95	0.91			0.88
Frt	1.00	1.00	1.00			0.85
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	3539	5077			2787
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	3539	5077			2787
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1121	2440	1916	22	0	1083
RTOR Reduction (vph)	0	0	1	0	0	439
Lane Group Flow (vph)	1121	2440	1937	0	0	644
Turn Type	Prot	NA	NA			Over
Protected Phases	1	6	2			1
Permitted Phases						
Actuated Green, G (s)	52.4	126.6	69.2			52.4
Effective Green, g (s)	52.4	126.6	69.2			52.4
Actuated g/C Ratio	0.37	0.90	0.49			0.37
Clearance Time (s)	5.0	5.0	5.0			5.0
Vehicle Extension (s)	3.5	5.0	5.0			3.5
Lane Grp Cap (vph)	1284	3200	2509			1043
v/s Ratio Prot	c0.33	c0.69	0.38			0.23
v/s Ratio Perm						
v/c Ratio	0.87	0.76	0.77			0.62
Uniform Delay, d1	40.7	2.1	29.0			35.6
Progression Factor	0.62	3.48	0.75			1.00
Incremental Delay, d2	0.7	0.2	1.0			1.2
Delay (s)	25.9	7.3	22.6			36.8
Level of Service	C	A	C			D
Approach Delay (s)		13.2	22.6		36.8	
Approach LOS		B	C		D	

Intersection Summary			
HCM 2000 Control Delay	19.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	2226	18	4	1756	27	6
Future Volume (Veh/h)	2226	18	4	1756	27	6
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2420	20	4	1909	29	7
Pedestrians	4					
Lane Width (ft)	12.0					
Walking Speed (ft/s)	3.5					
Percent Blockage	0					
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh)	2			2		
Upstream signal (ft)	736			1053		
pX, platoon unblocked			0.11		0.39	0.11
vC, conflicting volume			2440		3396	1220
vC1, stage 1 conf vol					2430	
vC2, stage 2 conf vol					966	
vCu, unblocked vol			0		0	0
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)					5.8	
tF (s)			2.2		3.5	3.3
p0 queue free %			98		93	94
cM capacity (veh/h)			183		432	122

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	1613	827	4	954	954	36
Volume Left	0	0	4	0	0	29
Volume Right	0	20	0	0	0	7
cSH	1700	1700	183	1700	1700	289
Volume to Capacity	0.95	0.49	0.02	0.56	0.56	0.12
Queue Length 95th (ft)	0	0	2	0	0	11
Control Delay (s)	0.0	0.0	25.2	0.0	0.0	19.2
Lane LOS			D			C
Approach Delay (s)	0.0		0.1			19.2
Approach LOS						C

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	2027	201	15	1563	264	178	112	30	374	90	15
Future Volume (vph)	9	2027	201	15	1563	264	178	112	30	374	90	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.95	0.95		0.95	0.95	
Frt	1.00	0.99		1.00	0.98		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.99		0.95	0.97	
Satd. Flow (prot)	1770	3491		1770	3462		1681	1710		1681	1705	
Flt Permitted	0.05	1.00		0.05	1.00		0.95	0.99		0.95	0.97	
Satd. Flow (perm)	90	3491		90	3462		1681	1710		1681	1705	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	2203	218	16	1699	287	193	122	33	407	98	16
RTOR Reduction (vph)	0	5	0	0	9	0	0	6	0	0	2	0
Lane Group Flow (vph)	10	2416	0	16	1977	0	174	168	0	260	259	0
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	83.0	83.0		83.0	83.0		18.1	18.1		23.4	23.4	
Effective Green, g (s)	83.0	83.0		83.0	83.0		18.1	18.1		23.4	23.4	
Actuated g/C Ratio	0.59	0.59		0.59	0.59		0.13	0.13		0.17	0.17	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	53	2069		53	2052		217	221		280	284	
v/s Ratio Prot		c0.69			0.57		c0.10	0.10		c0.15	0.15	
v/s Ratio Perm	0.11			0.18								
v/c Ratio	0.19	1.17		0.30	0.96		0.80	0.76		0.93	0.91	
Uniform Delay, d1	13.1	28.5		14.1	27.1		59.2	58.9		57.5	57.3	
Progression Factor	0.75	0.76		0.59	0.67		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	79.3		10.8	10.7		18.8	13.9		34.9	31.6	
Delay (s)	15.1	101.1		19.1	28.7		78.1	72.8		92.4	88.9	
Level of Service	B	F		B	C		E	E		F	F	
Approach Delay (s)		100.7			28.6			75.4			90.6	
Approach LOS		F			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	70.9	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	97.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	209	2209	7	1	1627	23	7	0	2	42	0	119
Future Volume (vph)	209	2209	7	1	1627	23	7	0	2	42	0	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00			1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			0.99	1.00
Frt	1.00	1.00		1.00	1.00			0.97			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.95	1.00
Satd. Flow (prot)	1770	3537		1770	3531			1736			1757	1583
Flt Permitted	0.08	1.00		0.04	1.00			0.77			0.75	1.00
Satd. Flow (perm)	140	3537		75	3531			1385			1389	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	227	2401	8	1	1768	25	8	0	2	46	0	129
RTOR Reduction (vph)	0	0	0	0	1	0	0	9	0	0	0	30
Lane Group Flow (vph)	227	2409	0	1	1792	0	0	1	0	0	46	99
Confl. Peds. (#/hr)	1		2	2		1			3	3		
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		Perm	NA	pm+ov
Protected Phases	1	6		5	2			4			8	1
Permitted Phases	6			2			4			8		8
Actuated Green, G (s)	120.9	114.9		101.4	100.4			9.1			9.1	24.6
Effective Green, g (s)	120.9	114.9		101.4	100.4			9.1			9.1	24.6
Actuated g/C Ratio	0.86	0.82		0.72	0.72			0.06			0.06	0.18
Clearance Time (s)	5.0	5.0		5.0	5.0			5.0			5.0	5.0
Vehicle Extension (s)	2.5	5.0		2.5	5.0			2.5			2.5	2.5
Lane Grp Cap (vph)	301	2902		66	2532			90			90	334
v/s Ratio Prot	c0.08	c0.68		0.00	0.51							0.03
v/s Ratio Perm	0.57			0.01				0.00			c0.03	0.03
v/c Ratio	0.75	0.83		0.02	0.71			0.01			0.51	0.29
Uniform Delay, d1	34.0	7.1		22.4	11.4			61.2			63.3	50.2
Progression Factor	1.44	0.35		1.00	1.00			1.00			1.00	1.00
Incremental Delay, d2	0.9	0.3		0.1	1.7			0.0			3.6	0.4
Delay (s)	49.7	2.8		22.5	13.1			61.2			66.9	50.5
Level of Service	D	A		C	B			E			E	D
Approach Delay (s)		6.8			13.1			61.2			54.8	
Approach LOS		A			B			E			D	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	84.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	15	3	2	305	296	10
Future Volume (Veh/h)	15	3	2	305	296	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	16	3	2	332	322	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)					714	
pX, platoon unblocked						
vC, conflicting volume	664	328	333			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	664	328	333			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	100	100			
cM capacity (veh/h)	425	714	1226			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	19	334	333
Volume Left	16	2	0
Volume Right	3	0	11
cSH	454	1226	1700
Volume to Capacity	0.04	0.00	0.20
Queue Length 95th (ft)	3	0	0
Control Delay (s)	13.3	0.1	0.0
Lane LOS	B	A	
Approach Delay (s)	13.3	0.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	27.6%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX

G

Village at Providence Point Traffic Impact Study
Queueing Worksheets

Queues
1: South Cherry Grove & Forest Drive

07/13/2018

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	13	2051	135	2990	107	106	60	13	74
v/c Ratio	0.11	0.62	0.70	0.81	0.61	0.61	0.21	0.18	0.39
Control Delay	9.0	17.0	40.9	20.3	73.7	73.2	1.7	70.2	5.8
Queue Delay	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
Total Delay	9.0	17.0	40.9	21.1	73.7	73.2	1.7	70.2	5.8
Queue Length 50th (ft)	3	376	47	798	101	100	0	12	0
Queue Length 95th (ft)	11	581	m101	#1142	154	153	0	35	0
Internal Link Dist (ft)		963		918		597		459	
Turn Bay Length (ft)	100		150		150				60
Base Capacity (vph)	129	3321	235	3713	300	301	394	90	206
Starvation Cap Reductn	0	0	0	398	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.62	0.57	0.90	0.36	0.35	0.15	0.14	0.36

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	628	1452	2344	795
v/c Ratio	0.76	0.43	0.72	0.72
Control Delay	39.0	7.6	13.6	16.2
Queue Delay	0.0	0.0	0.1	0.2
Total Delay	39.0	7.6	13.7	16.4
Queue Length 50th (ft)	270	0	217	98
Queue Length 95th (ft)	346	730	m603	180
Internal Link Dist (ft)		918	472	
Turn Bay Length (ft)	400			
Base Capacity (vph)	907	3362	3273	1161
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	124	53
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.69	0.43	0.74	0.72

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	5	1446	5	2302	215	213	177	176
v/c Ratio	0.09	0.68	0.04	1.08	0.92	0.88	0.77	0.74
Control Delay	10.2	20.0	11.0	63.9	99.7	91.3	79.9	74.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.2	20.0	11.0	63.9	99.7	91.3	79.9	74.2
Queue Length 50th (ft)	2	637	1	~1247	205	196	165	156
Queue Length 95th (ft)	m2	132	m2	#543	#364	#350	248	240
Internal Link Dist (ft)		972		437		705		557
Turn Bay Length (ft)	125		125		135			
Base Capacity (vph)	54	2132	125	2132	240	247	276	283
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.68	0.04	1.08	0.90	0.86	0.64	0.62

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	SBT	SBR
Lane Group Flow (vph)	99	1434	2162	35	159
v/c Ratio	0.55	0.46	0.79	0.37	0.62
Control Delay	39.4	0.9	12.9	71.4	58.3
Queue Delay	0.0	0.0	5.8	0.0	0.1
Total Delay	39.4	0.9	18.7	71.4	58.4
Queue Length 50th (ft)	41	2	535	31	120
Queue Length 95th (ft)	m82	72	788	65	187
Internal Link Dist (ft)		308	1225	342	
Turn Bay Length (ft)	190				
Base Capacity (vph)	179	3123	2748	170	255
Starvation Cap Reductn	0	258	0	0	0
Spillback Cap Reductn	0	0	537	0	2
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.55	0.50	0.98	0.21	0.63

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
1: South Cherry Grove & Forest Drive

07/13/2018

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	38	3069	177	2404	95	98	103	25	40
v/c Ratio	0.31	1.00	0.86	0.71	0.43	0.44	0.35	0.32	0.25
Control Delay	15.1	44.5	67.8	24.8	59.7	60.0	12.0	75.5	3.7
Queue Delay	0.0	16.4	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Total Delay	15.1	60.9	67.8	24.8	59.7	60.0	12.1	75.5	3.7
Queue Length 50th (ft)	11	~1143	~122	794	80	83	0	22	0
Queue Length 95th (ft)	24	#1219	#283	808	138	144	52	55	0
Internal Link Dist (ft)		979		918		597		459	
Turn Bay Length (ft)	100		150		150				60
Base Capacity (vph)	142	3067	205	3388	300	302	367	90	171
Starvation Cap Reductn	0	0	0	100	0	0	0	0	0
Spillback Cap Reductn	0	141	0	0	0	0	26	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.27	1.05	0.86	0.73	0.32	0.32	0.30	0.28	0.23

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	958	2149	1647	954
v/c Ratio	0.78	0.64	0.61	0.66
Control Delay	28.1	10.5	18.5	11.1
Queue Delay	0.0	0.1	0.0	0.0
Total Delay	28.1	10.6	18.5	11.1
Queue Length 50th (ft)	252	60	145	97
Queue Length 95th (ft)	m318	m1093	#638	177
Internal Link Dist (ft)		918	472	
Turn Bay Length (ft)	400			
Base Capacity (vph)	1299	3362	2688	1491
Starvation Cap Reductn	0	246	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.74	0.69	0.61	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	10	2144	8	1697	146	147	230	230
v/c Ratio	0.14	1.00	0.15	0.80	0.73	0.71	0.86	0.85
Control Delay	12.7	37.6	15.0	17.6	80.3	75.3	86.1	83.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.7	37.6	15.0	17.6	80.3	75.3	86.1	83.0
Queue Length 50th (ft)	1	~1145	2	645	135	132	211	209
Queue Length 95th (ft)	m5	#493	m3	762	213	208	#364	#357
Internal Link Dist (ft)		973		437		708		557
Turn Bay Length (ft)	125		125		135			
Base Capacity (vph)	70	2140	53	2126	240	249	282	287
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	1.00	0.15	0.80	0.61	0.59	0.82	0.80

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	218	2130	1603	2	43	124
v/c Ratio	0.73	0.68	0.60	0.01	0.43	0.40
Control Delay	24.4	1.1	9.5	0.0	73.9	30.3
Queue Delay	0.0	0.2	0.0	0.0	0.0	0.0
Total Delay	24.4	1.3	9.6	0.0	73.9	30.3
Queue Length 50th (ft)	65	55	326	0	38	54
Queue Length 95th (ft)	m73	m58	439	0	76	112
Internal Link Dist (ft)		308	1259	280	342	
Turn Bay Length (ft)	190					
Base Capacity (vph)	304	3111	2689	232	170	314
Starvation Cap Reductn	0	229	0	0	0	0
Spillback Cap Reductn	0	0	54	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.74	0.61	0.01	0.25	0.39

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
1: South Cherry Grove & Forest Drive

07/13/2018

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	64	2325	149	3372	122	121	80	26	77
v/c Ratio	0.51	0.74	0.80	0.99	0.66	0.65	0.27	0.33	0.39
Control Delay	32.0	21.7	58.9	30.5	75.5	74.9	2.5	75.7	5.7
Queue Delay	0.0	0.0	0.0	24.7	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	21.7	58.9	55.2	75.5	74.9	2.5	75.7	5.7
Queue Length 50th (ft)	14	510	82	~1130	114	113	0	23	0
Queue Length 95th (ft)	64	720	m116	#1415	173	172	3	57	0
Internal Link Dist (ft)		963		918		597		459	
Turn Bay Length (ft)	100		150		150				150
Base Capacity (vph)	131	3159	218	3411	300	301	394	90	207
Starvation Cap Reductn	0	0	0	238	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.74	0.68	1.06	0.41	0.40	0.20	0.29	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	716	1663	2603	934
v/c Ratio	0.82	0.49	0.81	0.82
Control Delay	38.6	6.9	15.1	24.7
Queue Delay	0.0	0.0	1.5	2.7
Total Delay	38.6	6.9	16.6	27.4
Queue Length 50th (ft)	313	0	239	185
Queue Length 95th (ft)	421	712	m589	285
Internal Link Dist (ft)		918	472	
Turn Bay Length (ft)	400			
Base Capacity (vph)	907	3362	3203	1160
Starvation Cap Reductn	0	131	0	0
Spillback Cap Reductn	0	0	390	129
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.79	0.51	0.93	0.91

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	5	1658	12	2573	229	231	197	199
v/c Ratio	0.10	0.79	0.17	1.23	0.95	0.94	0.81	0.80
Control Delay	12.6	30.0	15.1	128.4	106.4	99.9	82.8	78.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.6	30.0	15.1	128.4	106.4	99.9	82.8	78.1
Queue Length 50th (ft)	3	838	3	~1544	221	215	183	177
Queue Length 95th (ft)	m2	241	m4	#1668	#397	#389	#288	#271
Internal Link Dist (ft)		972		437		691		557
Turn Bay Length (ft)	125		125		280			
Base Capacity (vph)	52	2094	72	2094	240	247	276	284
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.79	0.17	1.23	0.95	0.94	0.71	0.70

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	103	1582	2	2385	11	36	164
v/c Ratio	0.61	0.52	0.01	0.87	0.08	0.38	0.64
Control Delay	46.2	1.1	2.5	17.2	1.0	72.2	59.9
Queue Delay	0.0	0.1	0.0	46.4	0.0	0.0	0.1
Total Delay	46.2	1.2	2.5	63.6	1.0	72.2	60.0
Queue Length 50th (ft)	52	3	0	723	0	32	127
Queue Length 95th (ft)	m80	m84	2	1049	0	66	196
Internal Link Dist (ft)		308		1225	280	342	
Turn Bay Length (ft)	190		150				
Base Capacity (vph)	170	3068	301	2735	214	168	258
Starvation Cap Reductn	0	274	0	0	0	0	0
Spillback Cap Reductn	0	0	0	678	0	0	2
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.57	0.01	1.16	0.05	0.21	0.64

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
1: South Cherry Grove & Forest Drive

07/13/2018

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	54	3429	204	2765	108	109	121	106	41
v/c Ratio	0.43	1.21	1.06	0.89	0.48	0.48	0.41	0.75	0.19
Control Delay	22.4	127.4	108.7	29.7	61.3	61.3	18.4	93.1	2.0
Queue Delay	0.0	0.2	0.0	0.5	0.0	0.0	0.6	0.0	0.0
Total Delay	22.4	127.6	108.7	30.2	61.3	61.3	18.9	93.1	2.0
Queue Length 50th (ft)	16	~1396	~177	946	91	92	18	~116	0
Queue Length 95th (ft)	42	#1464	m#321	998	156	156	77	#243	0
Internal Link Dist (ft)		979		918		597		459	
Turn Bay Length (ft)	100		150		150				150
Base Capacity (vph)	142	2835	193	3110	300	302	362	141	214
Starvation Cap Reductn	0	0	0	88	0	0	0	0	0
Spillback Cap Reductn	0	295	0	0	0	0	70	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	1.35	1.06	0.91	0.36	0.36	0.41	0.75	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	1121	2422	1909	1083
v/c Ratio	0.87	0.72	0.74	0.73
Control Delay	26.4	13.6	22.7	15.4
Queue Delay	0.0	0.1	0.0	0.2
Total Delay	26.4	13.7	22.8	15.6
Queue Length 50th (ft)	362	1108	227	172
Queue Length 95th (ft)	m409	m934	m#791	267
Internal Link Dist (ft)		918	472	
Turn Bay Length (ft)	400			
Base Capacity (vph)	1299	3362	2595	1490
Starvation Cap Reductn	0	202	0	0
Spillback Cap Reductn	0	0	30	61
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.86	0.77	0.74	0.76

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	10	2416	16	1983	164	167	252	258
v/c Ratio	0.19	1.16	0.30	0.95	0.78	0.77	0.90	0.91
Control Delay	17.8	97.3	22.7	28.0	83.8	78.8	90.4	90.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.8	97.3	22.7	28.0	83.8	78.8	90.4	90.2
Queue Length 50th (ft)	3	~1425	4	894	152	148	238	242
Queue Length 95th (ft)	m5	#1509	m6	#1100	#246	234	#413	#422
Internal Link Dist (ft)		973		437		703		557
Turn Bay Length (ft)	125		125		280			
Base Capacity (vph)	53	2091	53	2077	240	249	285	290
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	1.16	0.30	0.95	0.68	0.67	0.88	0.89

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	227	2404	1	1790	10	46	129
v/c Ratio	0.75	0.79	0.01	0.70	0.07	0.46	0.37
Control Delay	34.5	3.1	3.0	13.1	0.9	75.2	35.6
Queue Delay	0.0	0.4	0.0	0.3	0.0	0.0	0.0
Total Delay	34.5	3.5	3.0	13.4	0.9	75.2	35.7
Queue Length 50th (ft)	115	70	0	464	0	41	69
Queue Length 95th (ft)	m100	m89	1	544	0	81	133
Internal Link Dist (ft)		308		1259	280	342	
Turn Bay Length (ft)	190		150				
Base Capacity (vph)	302	3055	130	2561	216	168	352
Starvation Cap Reductn	0	219	0	0	0	0	0
Spillback Cap Reductn	0	0	0	257	0	0	2
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.85	0.01	0.78	0.05	0.27	0.37

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
1: South Cherry Grove & Forest Drive

07/13/2018

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	64	2355	149	3389	122	121	80	26	77
v/c Ratio	0.51	0.75	0.80	0.99	0.66	0.65	0.27	0.33	0.39
Control Delay	32.0	22.0	58.8	31.5	75.5	74.9	2.5	75.7	5.7
Queue Delay	0.0	0.0	0.0	26.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.0	22.0	58.8	57.5	75.5	74.9	2.5	75.7	5.7
Queue Length 50th (ft)	14	523	83	~1154	114	113	0	23	0
Queue Length 95th (ft)	64	737	m115	#1427	173	172	3	57	0
Internal Link Dist (ft)		963		918		597		459	
Turn Bay Length (ft)	100		150		150				150
Base Capacity (vph)	131	3159	218	3411	300	301	394	90	207
Starvation Cap Reductn	0	0	0	238	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.75	0.68	1.07	0.41	0.40	0.20	0.29	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	716	1692	2619	934
v/c Ratio	0.82	0.50	0.82	0.82
Control Delay	38.3	7.0	15.2	24.7
Queue Delay	0.0	0.0	1.8	2.7
Total Delay	38.3	7.0	17.0	27.4
Queue Length 50th (ft)	314	0	243	185
Queue Length 95th (ft)	422	726	m589	285
Internal Link Dist (ft)		918	472	
Turn Bay Length (ft)	400			
Base Capacity (vph)	907	3362	3203	1160
Starvation Cap Reductn	0	131	0	0
Spillback Cap Reductn	0	0	402	130
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.79	0.52	0.94	0.91

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	5	1661	12	2578	232	236	205	207
v/c Ratio	0.09	0.80	0.17	1.24	0.97	0.96	0.83	0.81
Control Delay	13.4	30.3	15.3	132.6	109.2	104.4	83.7	79.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.4	30.3	15.3	132.6	109.2	104.4	83.7	79.4
Queue Length 50th (ft)	3	840	3	~1559	224	222	190	186
Queue Length 95th (ft)	m3	252	m4	#1674	#403	#404	#306	#296
Internal Link Dist (ft)		972		437		636		557
Turn Bay Length (ft)	125		125		280			
Base Capacity (vph)	53	2082	71	2082	240	247	276	284
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.80	0.17	1.24	0.97	0.96	0.74	0.73

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	103	1585	2	2390	11	36	164
v/c Ratio	0.61	0.52	0.01	0.87	0.08	0.38	0.64
Control Delay	45.7	1.1	2.5	17.3	1.0	72.2	59.9
Queue Delay	0.0	0.1	0.0	46.4	0.0	0.0	0.1
Total Delay	45.7	1.2	2.5	63.7	1.0	72.2	60.0
Queue Length 50th (ft)	52	3	0	727	0	32	127
Queue Length 95th (ft)	m79	m84	2	1056	0	66	196
Internal Link Dist (ft)		308		1225	280	342	
Turn Bay Length (ft)	190		150				
Base Capacity (vph)	170	3068	300	2735	214	168	258
Starvation Cap Reductn	0	274	0	0	0	0	0
Spillback Cap Reductn	0	0	0	693	0	0	2
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.61	0.57	0.01	1.17	0.05	0.21	0.64

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
1: South Cherry Grove & Forest Drive

07/13/2018

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	54	3447	204	2794	108	109	121	106	41
v/c Ratio	0.43	1.22	1.06	0.90	0.48	0.48	0.41	0.75	0.19
Control Delay	22.4	130.1	108.6	30.1	61.3	61.3	18.4	93.1	2.0
Queue Delay	0.0	0.2	0.0	0.6	0.0	0.0	0.6	0.0	0.0
Total Delay	22.4	130.3	108.6	30.7	61.3	61.3	18.9	93.1	2.0
Queue Length 50th (ft)	16	~1409	~178	961	91	92	18	~116	0
Queue Length 95th (ft)	42	#1476	m#315	1009	156	156	77	#243	0
Internal Link Dist (ft)		979		918		597		459	
Turn Bay Length (ft)	100		150		150				150
Base Capacity (vph)	142	2835	193	3110	300	302	362	141	214
Starvation Cap Reductn	0	0	0	87	0	0	0	0	0
Spillback Cap Reductn	0	306	0	0	0	0	70	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	1.36	1.06	0.92	0.36	0.36	0.41	0.75	0.19

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBT	SBR
Lane Group Flow (vph)	1121	2440	1938	1083
v/c Ratio	0.87	0.73	0.75	0.73
Control Delay	26.4	13.9	22.9	15.4
Queue Delay	0.0	0.2	0.0	0.2
Total Delay	26.4	14.0	22.9	15.6
Queue Length 50th (ft)	361	1118	230	172
Queue Length 95th (ft)	m407	m937	m#801	267
Internal Link Dist (ft)		918	472	
Turn Bay Length (ft)	400			
Base Capacity (vph)	1299	3362	2595	1490
Starvation Cap Reductn	0	202	0	0
Spillback Cap Reductn	0	0	38	62
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.86	0.77	0.76	0.76

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	10	2421	16	1986	174	174	260	261
v/c Ratio	0.19	1.17	0.31	0.96	0.80	0.77	0.93	0.91
Control Delay	18.1	102.3	22.7	29.6	85.2	78.2	94.8	91.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	18.1	102.3	22.7	29.6	85.2	78.2	94.8	91.2
Queue Length 50th (ft)	3	~1431	4	897	162	154	249	248
Queue Length 95th (ft)	m5	#1513	m6	#1103	#270	#253	#433	#428
Internal Link Dist (ft)		973		437		634		557
Turn Bay Length (ft)	125		125		280			
Base Capacity (vph)	52	2075	52	2061	240	250	283	288
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	1.17	0.31	0.96	0.72	0.70	0.92	0.91

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBT	SBT	SBR
Lane Group Flow (vph)	227	2409	1	1793	10	46	129
v/c Ratio	0.75	0.79	0.01	0.70	0.07	0.46	0.37
Control Delay	35.2	3.2	3.0	13.2	0.9	75.2	36.0
Queue Delay	0.0	0.4	0.0	0.3	0.0	0.0	0.0
Total Delay	35.2	3.6	3.0	13.5	0.9	75.2	36.0
Queue Length 50th (ft)	119	70	0	465	0	41	70
Queue Length 95th (ft)	m97	m88	1	545	0	81	134
Internal Link Dist (ft)		308		1259	280	342	
Turn Bay Length (ft)	190		150				
Base Capacity (vph)	301	3055	130	2559	216	168	352
Starvation Cap Reductn	0	218	0	0	0	0	0
Spillback Cap Reductn	0	0	0	261	0	0	2
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.85	0.01	0.78	0.05	0.27	0.37

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

APPENDIX

H

Village at Providence Point Traffic Impact Study
Total Traffic with Improvements Synchro Worksheets

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/25/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	59	2111	55	137	3078	40	221	3	74	19	5	71
Future Volume (vph)	59	2111	55	137	3078	40	221	3	74	19	5	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0	5.5	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00	0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00		1.00	1.00	0.85	1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.95	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5063		1770	5074		1681	1687	1583	1681	1498	
Flt Permitted	0.05	1.00		0.04	1.00		0.95	0.95	1.00	0.95	1.00	
Satd. Flow (perm)	85	5063		81	5074		1681	1687	1583	1681	1498	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	64	2295	60	149	3346	43	240	3	80	21	5	77
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	71	0	74	0
Lane Group Flow (vph)	64	2354	0	149	3388	0	122	121	9	19	10	0
Confl. Peds. (#/hr)	1		7	7		1	1					1
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	
Protected Phases	1	6		5	2		7	7		8	8	
Permitted Phases	6			2					7			
Actuated Green, G (s)	92.3	87.5		103.1	93.3		15.4	15.4	15.4	6.0	6.0	
Effective Green, g (s)	92.3	87.5		103.1	93.3		15.4	15.4	15.4	5.5	6.0	
Actuated g/C Ratio	0.66	0.62		0.74	0.67		0.11	0.11	0.11	0.04	0.04	
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	113	3164		187	3381		184	185	174	66	64	
v/s Ratio Prot	0.02	0.46		c0.06	c0.67		c0.07	0.07		c0.01	0.01	
v/s Ratio Perm	0.35			0.53					0.01			
v/c Ratio	0.57	0.74		0.80	1.00		0.66	0.65	0.05	0.29	0.16	
Uniform Delay, d1	34.2	18.4		40.7	23.4		59.8	59.7	55.8	65.3	64.6	
Progression Factor	1.00	1.00		1.23	0.90		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.8	1.6		11.5	12.0		6.8	6.2	0.0	0.9	0.4	
Delay (s)	38.1	20.0		61.5	33.1		66.6	65.9	55.8	66.2	65.0	
Level of Service	D	C		E	C		E	E	E	E	E	
Approach Delay (s)		20.5			34.3			63.7			65.2	
Approach LOS		C			C			E			E	

Intersection Summary			
HCM 2000 Control Delay	31.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	5	1349	179	16	2081	286	300	107	39	245	102	32
Future Volume (vph)	5	1349	179	16	2081	286	300	107	39	245	102	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.97	1.00		0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.96		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.99	
Satd. Flow (prot)	1770	3467		1770	3465		3433	1788		1681	1700	
Flt Permitted	0.05	1.00		0.07	1.00		0.95	1.00		0.95	0.99	
Satd. Flow (perm)	87	3467		129	3465		3433	1788		1681	1700	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	1466	195	17	2262	311	326	116	42	266	111	35
RTOR Reduction (vph)	0	7	0	0	7	0	0	10	0	0	5	0
Lane Group Flow (vph)	5	1654	0	17	2566	0	326	148	0	205	202	0
Confl. Peds. (#/hr)	1		1	1		1						
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	86.0	86.0		86.0	86.0		17.8	17.8		20.7	20.7	
Effective Green, g (s)	86.0	86.0		86.0	86.0		17.8	17.8		20.7	20.7	
Actuated g/C Ratio	0.61	0.61		0.61	0.61		0.13	0.13		0.15	0.15	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	53	2129		79	2128		436	227		248	251	
v/s Ratio Prot		0.48			c0.74		c0.09	0.08		c0.12	0.12	
v/s Ratio Perm	0.06			0.13								
v/c Ratio	0.09	0.78		0.22	1.21		0.75	0.65		0.83	0.80	
Uniform Delay, d1	11.1	19.9		12.0	27.0		58.9	58.2		57.9	57.7	
Progression Factor	0.69	1.23		0.78	0.75		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.1	2.5		3.2	95.1		6.9	6.6		19.7	16.8	
Delay (s)	10.7	26.9		12.5	115.4		65.8	64.8		77.6	74.5	
Level of Service	B	C		B	F		E	E		E	E	
Approach Delay (s)		26.9			114.8			65.5			76.0	
Approach LOS		C			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	78.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	98.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
1: South Cherry Grove & Forest Drive

07/25/2018

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	3050	121	188	2554	17	188	12	111	87	10	38
Future Volume (vph)	50	3050	121	188	2554	17	188	12	111	87	10	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0	5.5	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00	0.95	0.95	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00		0.95	0.96	1.00	0.95	0.99	
Satd. Flow (prot)	1770	5053		1770	5080		1681	1695	1583	1681	1595	
Flt Permitted	0.05	1.00		0.05	1.00		0.95	0.96	1.00	0.95	0.99	
Satd. Flow (perm)	95	5053		89	5080		1681	1695	1583	1681	1595	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	3315	132	204	2776	18	204	13	121	95	11	41
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	84	0	35	0
Lane Group Flow (vph)	54	3444	0	204	2794	0	108	109	37	76	36	0
Confl. Peds. (#/hr)			1	1								
Turn Type	pm+pt	NA		pm+pt	NA		Split	NA	Perm	Split	NA	
Protected Phases	1	6		5	2		7	7		8	8	
Permitted Phases	6			2					7			
Actuated Green, G (s)	83.4	78.5		97.1	87.2		18.8	18.8	18.8	8.6	8.6	
Effective Green, g (s)	83.4	78.5		97.1	87.2		18.8	18.8	18.8	8.1	8.6	
Actuated g/C Ratio	0.60	0.56		0.69	0.62		0.13	0.13	0.13	0.06	0.06	
Clearance Time (s)	5.0	5.5		5.0	5.5		5.0	5.0	5.0	5.0	5.0	
Vehicle Extension (s)	2.0	5.0		2.0	5.0		2.0	2.0	2.0	2.0	2.0	
Lane Grp Cap (vph)	115	2833		225	3164		225	227	212	97	97	
v/s Ratio Prot	0.02	c0.68		c0.09	0.55		0.06	c0.06		c0.05	0.02	
v/s Ratio Perm	0.26			0.54					0.02			
v/c Ratio	0.47	1.22		0.91	0.88		0.48	0.48	0.17	0.78	0.37	
Uniform Delay, d1	25.0	30.8		49.1	22.1		56.1	56.1	53.7	65.1	63.1	
Progression Factor	1.00	1.00		1.12	1.09		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.1	100.5		25.8	2.7		0.6	0.6	0.1	30.7	0.9	
Delay (s)	26.1	131.2		80.8	26.7		56.7	56.7	53.9	95.7	64.0	
Level of Service	C	F		F	C		E	E	D	F	E	
Approach Delay (s)		129.6			30.4			55.7			80.4	
Approach LOS		F			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	82.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	97.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	9	2027	201	19	1559	264	205	112	30	374	90	15
Future Volume (vph)	9	2027	201	19	1559	264	205	112	30	374	90	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		0.97	1.00		0.95	0.95	
Frt	1.00	0.99		1.00	0.98		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	0.97	
Satd. Flow (prot)	1770	3491		1770	3462		3433	1803		1681	1705	
Flt Permitted	0.05	1.00		0.05	1.00		0.95	1.00		0.95	0.97	
Satd. Flow (perm)	89	3491		89	3462		3433	1803		1681	1705	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	10	2203	218	21	1695	287	223	122	33	407	98	16
RTOR Reduction (vph)	0	5	0	0	9	0	0	7	0	0	2	0
Lane Group Flow (vph)	10	2416	0	21	1973	0	223	148	0	260	259	0
Turn Type	Perm	NA		Perm	NA		Split	NA		Split	NA	
Protected Phases		6			2		3	3		4	4	
Permitted Phases	6			2								
Actuated Green, G (s)	83.9	83.9		83.9	83.9		16.1	16.1		24.5	24.5	
Effective Green, g (s)	83.9	83.9		83.9	83.9		16.1	16.1		24.5	24.5	
Actuated g/C Ratio	0.60	0.60		0.60	0.60		0.12	0.12		0.18	0.18	
Clearance Time (s)	5.5	5.5		5.5	5.5		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	5.0	5.0		5.0	5.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	53	2092		53	2074		394	207		294	298	
v/s Ratio Prot		c0.69			0.57		0.06	c0.08		c0.15	0.15	
v/s Ratio Perm	0.11			0.24								
v/c Ratio	0.19	1.15		0.40	0.95		0.57	0.71		0.88	0.87	
Uniform Delay, d1	12.7	28.0		14.7	26.1		58.6	59.7		56.4	56.2	
Progression Factor	0.75	0.75		0.64	0.66		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.3	73.7		16.1	9.1		1.9	11.1		25.4	23.0	
Delay (s)	14.7	94.8		25.4	26.4		60.5	70.8		81.8	79.2	
Level of Service	B	F		C	C		E	E		F	E	
Approach Delay (s)		94.5			26.4			64.7			80.5	
Approach LOS		F			C			E			F	

Intersection Summary			
HCM 2000 Control Delay	65.4	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	15.5
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group