Access Management and Safety Study

N. Habana Avenue at Hillsboro Plaza

City of Tampa, Florida

City Contract Number: 16-D-62426
Work Order Number: 26

Prepared for:
City of Tampa
Transportation and Stormwater Services

Prepared by:
Tindale Oliver

Tindale Oliver Project Number: 0290026-09.17

January 2018

I, W.T. Bowman, P.E. #69132, certify that I currently hold an active Professional Engineers License in the State of Florida and am competent through education or experience to provide engineering services in the civil and traffic engineering disciplines contained in this plan, print, specification, or report.

I further certify that this operational analysis was prepared by me or under my responsible charge as defined in Chapter 61G15-18.001 F.A.C. and that all statements, conclusions and recommendations made herein are true and correct to the best of my knowledge and ability.

Study Roadway:	N. Habana Avenue
Project Start:	South of Hillsboro Plaza
Project End:	W. Hillsborough Avenue
Project Location:	City of Tampa, FL

This item has been electronically signed and sealed by W. T. Bowman, P.E. on January 4 2018 using a digital signature.

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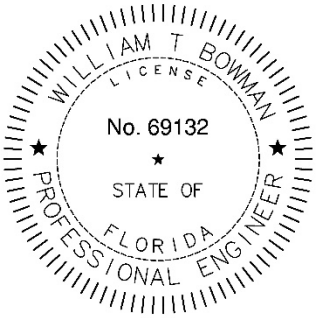

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Executive Summary

This report documents the results of a safety, operational, and access review at the intersection of N. Habana Avenue and Hillsboro Plaza. The City of Tampa requested this analysis be undertaken to analyze and recommend strategies to mitigate safety and operational concerns at the Hillsboro Plaza driveway. The primary safety concerns at this location are angle and left-turn crashes for vehicles exiting the Plaza westbound, conflicting with northbound and southbound vehicles traveling along Habana Avenue. There is an additional conflict for southbound left-turning vehicles into the plaza, conflicting with northbound vehicles. It was identified that the primary cause of these patterns is northbound vehicles using the two-way left-turn lane as an extended left-turn lane for Hillsborough Avenue. Westbound exiting vehicles do not expect and do not have adequate sight distance to anticipate and avoid this hazard.

Based on an analysis of crash patterns, field operations, and evaluation of the adjacent signalized intersection at N. Habana Avenue and W. Hillsborough Avenue, the following actions are recommended:

- Create a raised separator to channelize the northbound left-turn lane along Habana Avenue at Hillsborough Avenue, creating a 300’ left-turn lane.
- Prohibit the southbound left-turn from Habana Avenue into the Plaza driveway and require driveway traffic from the north to access the Plaza from eastbound Hillsborough Avenue.
- Provide marking and signage improvements to discourage drivers from blocking the Plaza driveway on N. Habana Avenue.

In the short term, these improvements should be implemented with raised delineators to verify that operations at the signal at N. Habana Avenue and W. Hillsborough Avenue will not be compromised consistent with the analysis for this study. After any adjustments (if necessary) are made, the project should then be advanced to permanent island construction, potentially as an application to the Florida Department of Transportation for Highway Safety Improvement Program (HSIP) funding.

1. INTRODUCTION

Tindale Oliver conducted an operational, safety, and access analysis along N. Habana Avenue at Hillsboro Plaza in Tampa, as shown in Figure 1. The City of Tampa requested this analysis to review options and make recommendations to mitigate an existing safety issue at the Hillsboro Plaza driveway on the east side of N. Habana Avenue. Tindale Oliver undertook the following tasks for this analysis:

- Collected and reviewed PM peak-hour traffic count data at the intersection of Habana Avenue and Hillsborough Avenue.
- Collected driveway and side street PM peak-hour traffic counts at Habana Avenue and the Plaza entrance at Frierson Avenue and Giddens Avenue.
- Collected PM peak-period drone footage of the northbound approach of N. Habana Avenue at W. Hillsborough Avenue to review vehicle behavior and compare to the existing model for validation.
- Reviewed 2012 to 2016 crash data in the vicinity of the driveway, exclusive of the intersection with Hillsborough Avenue.
- Developed and validated an existing conditions Synchro model for N. Habana Avenue and Hillsborough Avenue.
- Made an improvement recommendation to enhance safety and minimize the impacts on operations.
- Developed a concept of the improvement and a preliminary cost estimate.
- Conducted a field review and analysis for constructability and feasibility of the proposed and selected options.
- Estimated Benefit:Cost (BC) and Net Present Value (NPV) based on the expected crash reduction of the improvement.
- Evaluated potential scenarios for feasibility and impacts to traffic operations for the northbound approach of Habana Avenue.

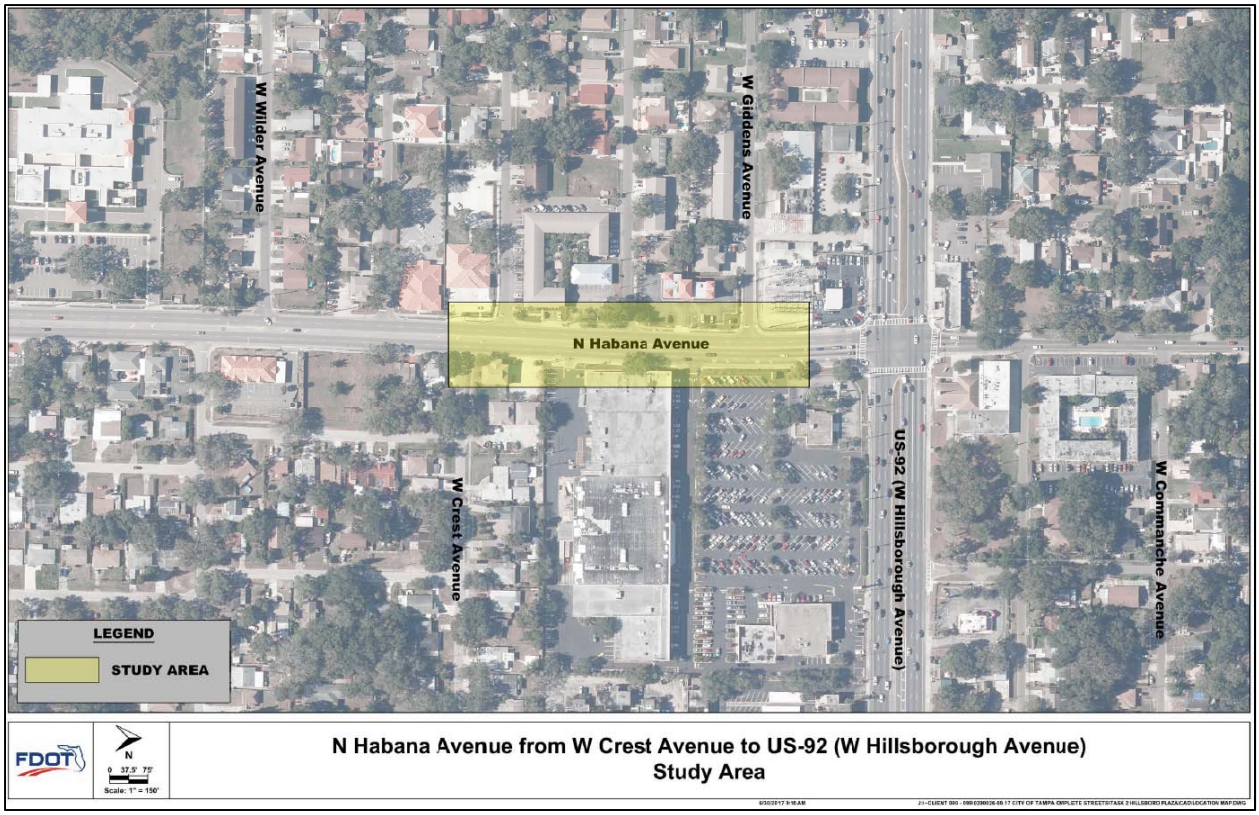


Figure 1: Hillsboro Plaza Study Area

2. Existing Conditions

Roadway Features

Habana Avenue is a four-lane divided (two-way left-turn lane) roadway from Martin Luther King Junior Boulevard to W. Hillsborough Avenue. In the study area, Habana Avenue has a posted speed of 40 mph. At the signalized intersection with W. Hillsborough Avenue, northbound Habana Avenue has left-, through-, and right-turn lanes.

The Hillsboro Plaza intersection with Habana Avenue is located approximately 330 feet south of W. Hillsborough Avenue. Hillsboro Plaza has one eastbound receiving lane (ingress) and one westbound left-turn and right-turn lane (egress).

There are two bus stops south of Hillsboro Plaza on the east and west sides of Habana Avenue.

There are street lights in the vicinity of the Hillsboro Plaza driveway along Habana Avenue. The existing conditions are shown in Figure 2.

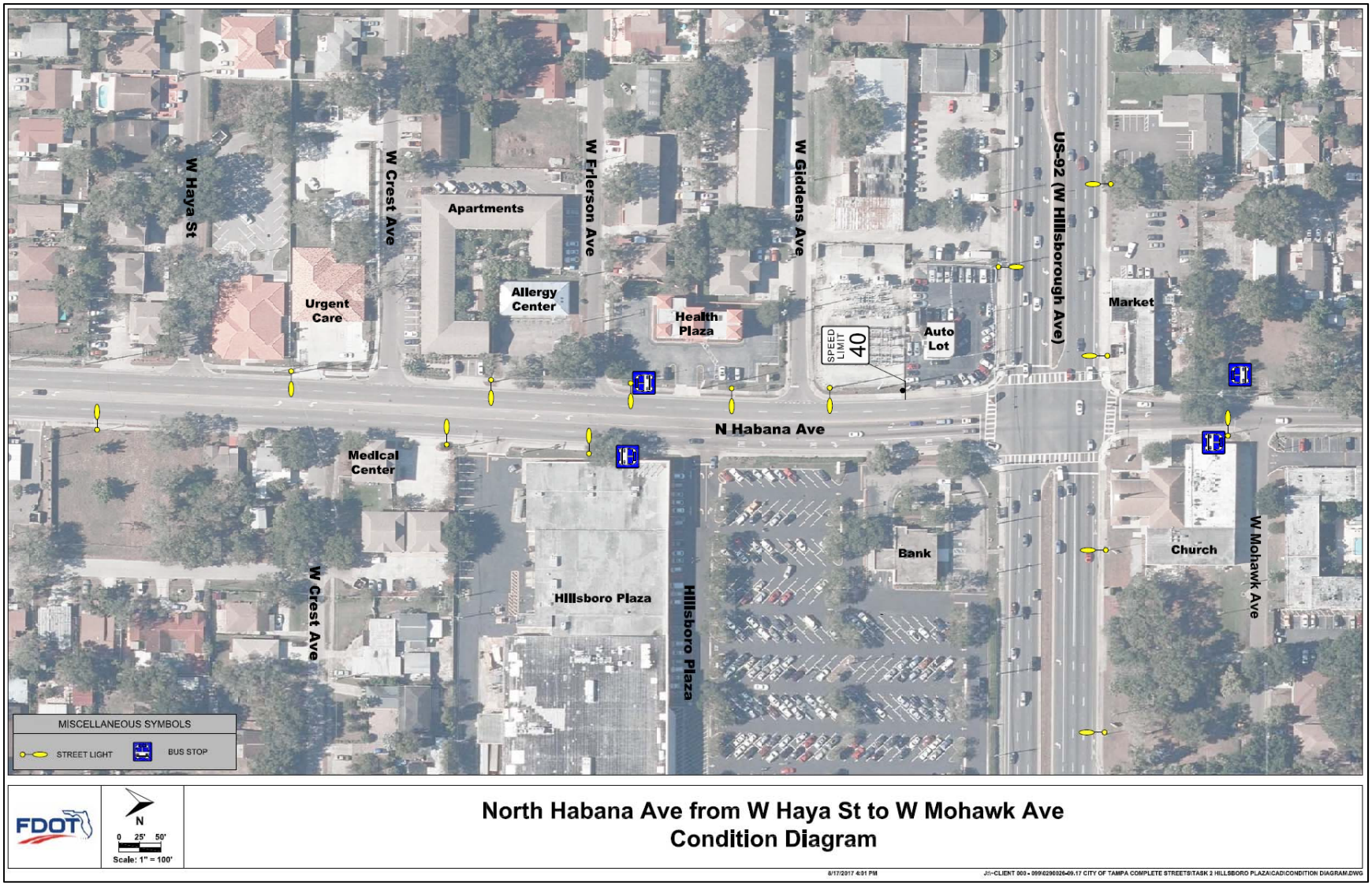


Figure 2: Existing Conditions Diagram

Traffic Volumes

For this analysis, the existing PM peak hour traffic conditions were analyzed since the PM peak period most closely corresponds with the peak trip generation of the shopping center. Existing traffic volumes were based on those collected in February 25, 2015, as part of FDOT District 7's Hillsborough Avenue Corridor Evaluation (HACE) from Memorial Highway to Nebraska Avenue. These were used for consistency with FDOT's analysis of this signalized intersection. Driveway volumes were collected for the PM peak period on July 11, 2017.

Upon conducting a field review and after reviewing drone surveillance, it was determined that the data from the HACE study likely overestimates the southbound through movement from north of Hillsborough Avenue along Habana Avenue. A review of the southbound vehicles from drone surveillance also seemed to confirm this assumption. Therefore, a manual adjustment was applied to the southbound through movements in developing traffic volumes for analysis. The adjusted volumes are shown in Figure 3. Raw data and adjustments are included in Appendix A.

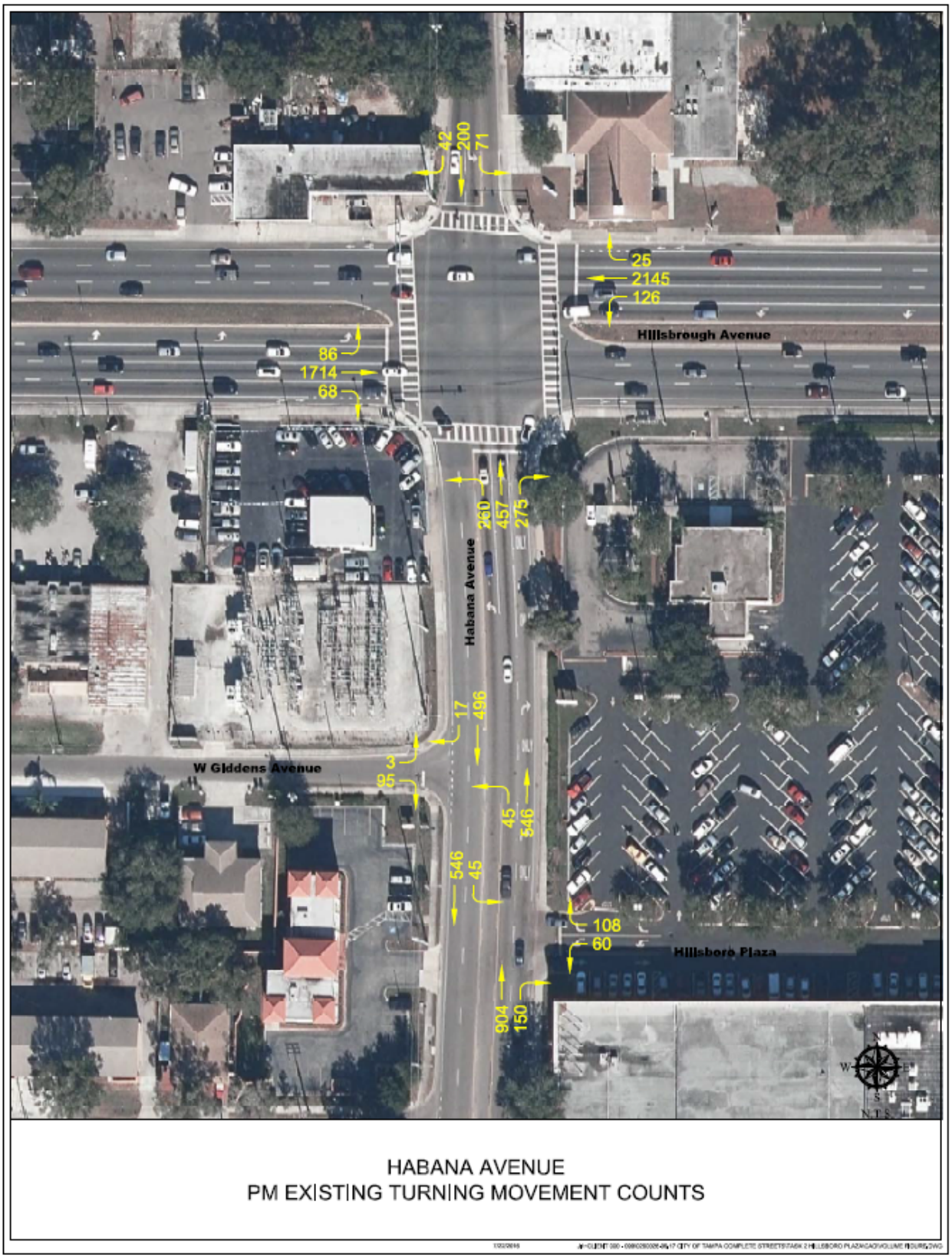


Figure 3: PM Peak-Hour Turning Movement Counts

Field Review

Field review was conducted on the afternoon of July 11th concurrent with TMC collection and drone video surveillance. Key observations include the following:

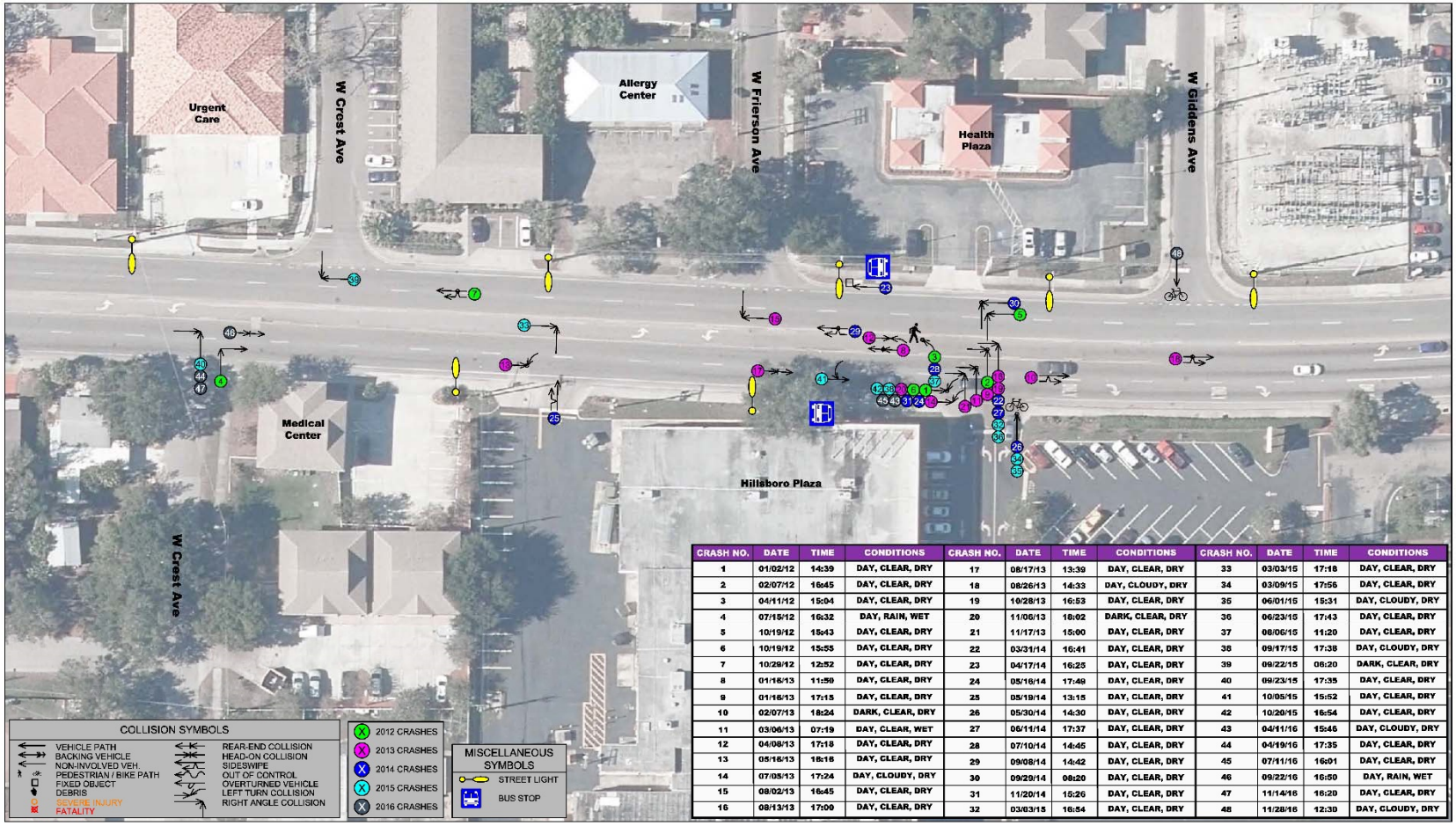
- Queues from northbound Habana Avenue at W. Hillsborough Avenue extended back through the Hillsboro Plaza driveway. This was more prevalent for the northbound thru and northbound left turn queue but occasionally the northbound right turn queue also extended back through the shopping center driveway.
- Drivers making westbound to southbound left turns exiting the shopping center frequently "nosed" through the standing queues. This sometimes resulted in frustration/honking from northbound traffic. The principal safety concern with this movement, however, is conflicts with southbound thru traffic.
- Drivers making southbound to eastbound left turns into the shopping center were also observed crossing thru the queues. The threat of rear-end crashes from southbound thru traffic is minimal because there are two southbound thru lanes and only one lane at any given time (eastbound right, southbound thru, westbound left) serving traffic onto the segment from W. Hillsborough Avenue, however, if FDOT proceeds with the HACE study concept to provide dual westbound left turn lanes at W. Hillsborough Avenue, this conflict could become more significant. A more immediate threat from this movement is with the northbound right turn lane which is more often free-flowing at the Hillsboro Plaza driveway.
- Drivers making westbound to northbound right turns seeking to access the northbound left turn lane also crossed through queues resulting in congestion and frustration at the driveway but no imminent safety threat.
- Drivers were observed making westbound to northbound right turns and then accessing the northbound left turn lane to turn onto N. Giddens Avenue. The destination of these drivers is unknown, however, it is reasonable to assume that they travelled south through the neighborhood.
- Pedestrians were observed crossing Habana Avenue in the influence area of W. Hillsborough Avenue and also to/from the bus stops immediately south of the Hillsboro Plaza driveway
- Parking operations in the throat of the Hillsboro Plaza driveway at times limited drivers ability to enter the driveway contributing to congestion on Habana Avenue
- Some southbound thru traffic appeared to be significantly exceeding the speed limit increasing the risk and potential severity of thru-the-queue crashes.

3. Crash Analysis

A five-year crash history (2012 to 2016) was reviewed in the vicinity of the study location. At the time of this analysis, the 2016 data were not considered official by the Department of Highway Safety and Motor Vehicles (DHSMV). Table 1 summarizes the crash data, and Figure 4 is a crash diagram.

Table 1: Crash Summary

Hillsboro Plaza at Habana Ave.		Crash Years					5 Year Total	Mean Crashes	%
		2012	2013	2014	2015	2016			
Crash Type	Angle	6	12	5	7	3	33	6.6	69%
	Front to Rear	0	1	0	1	2	4	0.8	8%
	Front to Front	0	0	0	0	0	0	0.0	0%
	Rear to Rear	0	0	0	0	0	0	0.0	0%
	Lost Control	0	0	0	0	0	0	0.0	0%
	Sideswipe, same direction	0	0	0	0	0	0	0.0	0%
	Pedestrian	1	0	1	1	0	3	0.6	6%
	Bicycle	0	0	1	2	1	4	3	8%
	Other, Explain in Narrative	0	0	2	0	0	2	0.4	4%
	No Data	0	0	1	0	0	1	0.2	2%
	Unknown	0	1	0	0	0	1	0.2	2%
	Total	*7*	*14*	*10*	*11*	*6*	*48*	*9.6*	100%
Injury Severity	Fatal	0	0	0	0	0	0	0.0	0%
	Incapacitating	0	0	0	0	0	0	0.0	0%
	NonIncapacitating	4	3	2	1	2	12	2.4	25%
	PossibleInjury	1	4	4	3	0	12	2.4	25%
	None	2	7	4	7	4	24	4.8	50%
	Total	*7*	*14*	*10*	*11*	*6*	*48*	9.6	*100%*
Lighting Condition	Daylight	7	12	10	10	6	45	9.0	94%
	Dawn	0	0	0	0	0	0	0.0	0%
	Dusk	0	0	0	0	0	0	0.0	0%
	Dark-Lighted	0	2	0	1	0	3	0.6	6%
	Dark-Not Lighted	0	0	0	0	0	0	0.0	0%
	Total	*7*	*14*	*10*	*11*	*6*	*48*	9.6	100%
Surface Conditions	Dry	5	11	10	11	5	42	8.4	88%
	Unknown	0	1	0	0	0	1	0.2	2%
	Wet	2	2	0	0	1	5	1.0	10%
	Total	*7*	*14*	*10*	*11*	*6*	*48*	9.6	*100%*



CRASH NO.	DATE	TIME	CONDITIONS	CRASH NO.	DATE	TIME	CONDITIONS	CRASH NO.	DATE	TIME	CONDITIONS
1	01/02/12	14:39	DAY, CLEAR, DRY	17	08/17/13	13:39	DAY, CLEAR, DRY	33	03/03/15	17:18	DAY, CLEAR, DRY
2	02/07/12	16:45	DAY, CLEAR, DRY	18	08/26/13	14:33	DAY, CLOUDY, DRY	34	03/09/15	17:56	DAY, CLEAR, DRY
3	04/11/12	15:04	DAY, CLEAR, DRY	19	10/28/13	16:53	DAY, CLEAR, DRY	35	06/01/15	15:31	DAY, CLOUDY, DRY
4	07/15/12	16:32	DAY, RAIN, WET	20	11/06/13	18:02	DARK, CLEAR, DRY	36	06/23/15	17:43	DAY, CLEAR, DRY
5	10/19/12	15:43	DAY, CLEAR, DRY	21	11/17/13	15:00	DAY, CLEAR, DRY	37	08/06/15	11:20	DAY, CLEAR, DRY
6	10/19/12	15:55	DAY, CLEAR, DRY	22	03/31/14	16:41	DAY, CLEAR, DRY	38	09/17/15	17:38	DAY, CLOUDY, DRY
7	10/29/12	12:52	DAY, CLEAR, DRY	23	04/17/14	16:25	DAY, CLEAR, DRY	39	09/22/15	08:20	DARK, CLEAR, DRY
8	01/16/13	11:50	DAY, CLEAR, DRY	24	05/16/14	17:49	DAY, CLEAR, DRY	40	09/23/15	17:35	DAY, CLEAR, DRY
9	01/16/13	17:15	DAY, CLEAR, DRY	25	05/19/14	13:15	DAY, CLEAR, DRY	41	10/05/15	15:52	DAY, CLEAR, DRY
10	02/07/13	18:24	DARK, CLEAR, DRY	26	05/30/14	14:30	DAY, CLEAR, DRY	42	10/20/15	16:54	DAY, CLEAR, DRY
11	03/06/13	07:19	DAY, CLEAR, WET	27	06/11/14	17:37	DAY, CLEAR, DRY	43	04/11/16	15:46	DAY, CLOUDY, DRY
12	04/08/13	17:18	DAY, CLEAR, DRY	28	07/10/14	14:45	DAY, CLEAR, DRY	44	04/19/16	17:35	DAY, CLEAR, DRY
13	05/16/13	18:18	DAY, CLEAR, DRY	29	09/08/14	14:42	DAY, CLEAR, DRY	45	07/11/16	16:01	DAY, CLEAR, DRY
14	07/05/13	17:24	DAY, CLOUDY, DRY	30	09/29/14	08:20	DAY, CLEAR, DRY	46	09/22/16	16:50	DAY, RAIN, WET
15	08/02/13	16:45	DAY, CLEAR, DRY	31	11/20/14	15:26	DAY, CLEAR, DRY	47	11/14/16	16:20	DAY, CLEAR, DRY
16	08/13/13	17:00	DAY, CLEAR, DRY	32	03/03/15	16:54	DAY, CLEAR, DRY	48	11/28/16	12:30	DAY, CLOUDY, DRY

FDOT

N

0 12.5' 25'

Scale: 1" = 50'

North Habana Ave from W Crest Ave to W Giddens Ave
(2012 - 2016) Collision Diagram

8/17/2017 2:56 PM

J:\~CLIENT 696 - 069\0290026-09.17 CITY OF TAMPA COMPLETE STREETS\TASK 2 HILLSBORO PLAZA\CAD\COLLISION DIAGRAM.DWG

Figure 4: Collision Diagram (2012 to 2016)

As shown, there is a concentration of certain crash types at the Hillsboro Plaza driveway:

- 10 westbound-to-northbound angle crashes (8 with vehicles using the two-way left-turn lane)
- 10 southbound-to-northbound left-turn crashes
- 2 westbound-to-southbound angle crashes
- 3 westbound left-turn to pedestrian crashes
- 3 westbound crashes with bicyclists

A detailed crash extract is provided in Appendix B.

For these key crash patterns, the detailed police report narratives were reviewed to identify any patterns as far as vehicular behavior. Several key observations were realized:

- For the westbound-to-northbound angle crashes, eight crashes were between vehicles attempting to make a westbound-to-southbound left turn and vehicles going northbound using the two-way left-turn lane, likely proceeding to make a left-turn at Hillsborough Avenue. Two crashes resulted in a serious injury.
- For the southbound-to-northbound left-turn crashes, all crashes involved a vehicle making a southbound left turn into the plaza; five crashes resulted in injury.

Based on the review of crash analysis, measures were identified to minimize these crash patterns. Proposed strategies for consideration include:

- Prevent vehicles from using the two-way left-turn lane as an approach to Hillsborough Avenue by channelizing the northbound left-turn lane at Hillsborough Avenue north of the Hillsboro Plaza driveway. The westbound vehicles from the plaza do not have adequate sight distance or anticipation of this condition, particularly when there is a northbound queue in the through and right-turn lanes.
- Remove the southbound left-turn conflict with northbound vehicles by prohibiting the southbound left-turn movement. These vehicles would be able to access the plaza via the right-in/right-out driveway on Hillsborough Avenue east of Habana Avenue. This redistribution of traffic is shown in Figure 5.

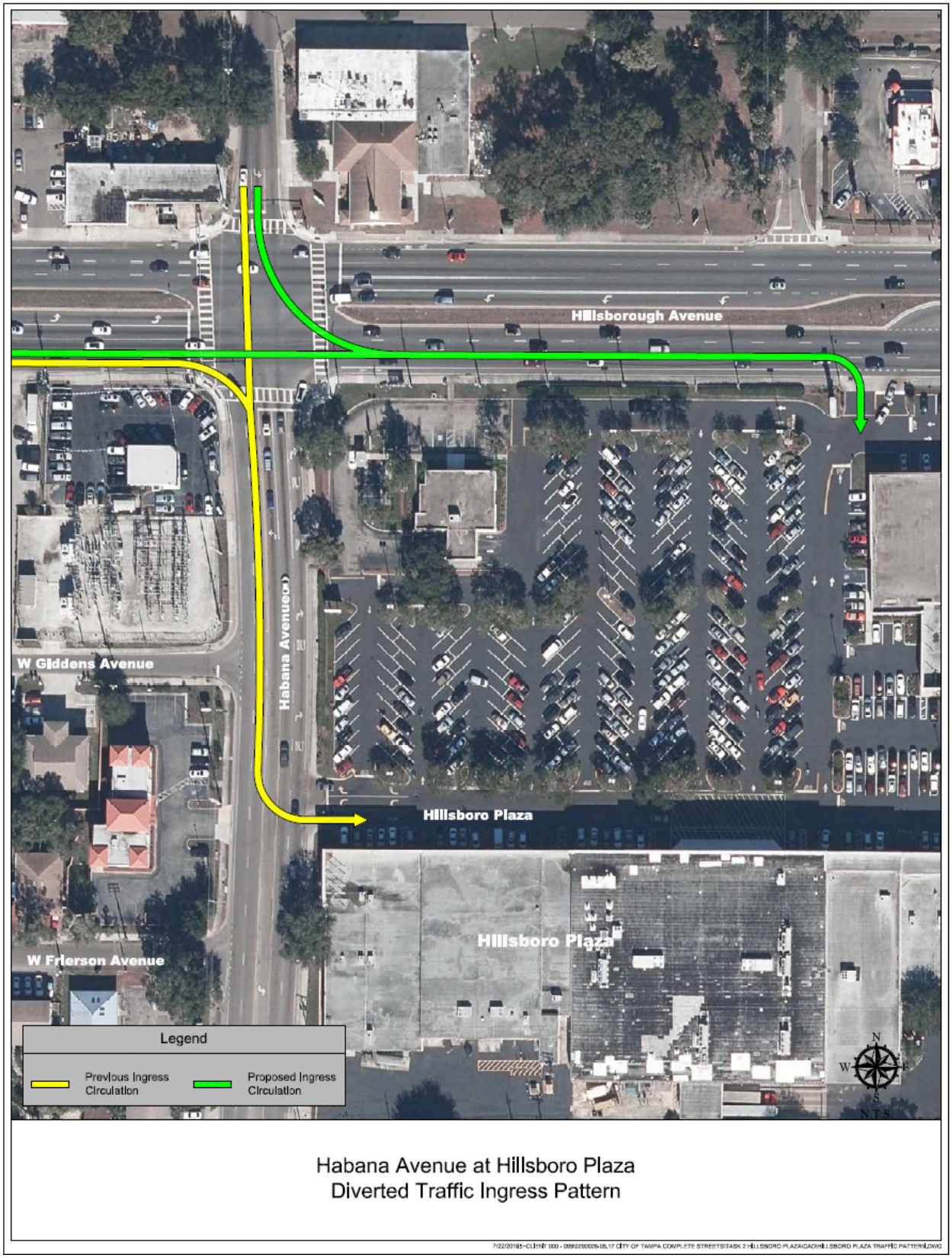


Figure 5: Diverted Traffic Ingress Pattern

4. Operational Analysis

As discussed, potential strategies were identified to mitigate crash issues. These improvements must consider potential impacts to the operation of the northbound approach to Hillsborough Avenue. Therefore, a Synchro model was developed, and SimTraffic micro-simulation was used to analyze the impacts of the improvement scenarios. The following were undertaken for the operational analysis:

- Develop a validated existing condition model using existing volumes and signal timing data.
- Review the following scenarios:
  - Split-phase northbound and southbound Habana Avenue and modify northbound lane use to a left-, shared left-through, and right-turn lane.
  - Create dual northbound left-turn lanes and shared through/right-turn lane.
  - Channelize northbound left-turn lane and provide 200' of storage.
  - Channelize northbound left-turn lane and provide 300' of storage.
  - Channelize northbound left-turn lane and provide 500' of storage.

For each of the analyzed scenarios, the cycle length remained unchanged, as did the splits for Hillsborough Avenue. Any analyzed improvements, therefore, would only introduce impacts or improvements to Habana Avenue and would not impact Hillsborough Avenue operation either at Habana Avenue or within the context of the coordinated system.

In addition, the movements into and out of the Hillsboro Plaza driveway were not included in the analysis. Synchro and SimTraffic do not effectively simulate actual interactions between vehicles at unsignalized locations within the influence area of a signalized intersection. In particular, it does not account for (or fully account for) drivers providing gaps for these movements. However, the impact on the driveway was reviewed and is discussed anecdotally herein.

Existing Conditions

A model was developed for the existing PM peak-hour conditions. The model was then reviewed versus field observations and drone video to validate that the Synchro/SimTraffic model closely matched the existing operation. With the exception of the southbound movement, all approaches showed similar operational characteristics when comparing the model and field reviews, with the exception of the southbound movement. The existing model showed significant queueing for the southbound approach. However, field reviews and drone video indicated that the movement had minimal queuing and the signal was able to process demand on each cycle. Further review of the drone video revealed southbound vehicular volume to be less than that from the previous counts. Therefore, the adjusted southbound through volume was used in the simulation.

The key performance measures analyzed from an operational perspective were queuing, level of service (LOS), and v/c. Delay was not included as a key performance measure, as in this case it is more a function of cycle length than the ability of the intersection to process vehicles.

The existing conditions are summarized in Table 2 and Table 3, and detailed worksheets are provided in Appendix C.

Table 2: Level of Service (LOS) Analysis – Existing Condition

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Baseline	Movement	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBTR
	V/C Ratio	0.67	0.93	0.82	1.08	0.70	0.89	0.41	0.48	0.63
	Delay (s)	102.0	64.7	115.3	103.1	54.9	83.4	56.4	58.8	72.9
	LOS	F	E	F	F	D	F	E	E	E
	Approach Delay (s)	66.4		103.8		68.5			69.7	
	Approach LOS	E		F		E			E	
	HCM 2000 Ctrl Delay	82.7								
	ICU	97.8%								
	HCM 2000 LOS	F								

Table 3: Queuing Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)						
Baseline	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	599	967	662	105	718
	Average Queue (ft)	272	546	168	71	387
	95th Queue (ft)	455	878	298	127	696
	Storage Bay (ft)	**1000**	**-**		**80**	**-**

As shown in Table 2, the northbound and southbound movements operate acceptably. Although delay, as a result of cycle length, results in LOS D and F, the v/c ratios of 0.89 and below indicate that the northbound and southbound movements are able to process during the cycle. This is consistent with the field observations.

Scenario 1: Split Phase Operation

Scenario 1 modified the northbound lane use to a left-, left/through-, and right-turn lane. The shared left/through-lane necessitates split phase operation for the northbound and southbound approaches. As shown the following tables, this modification significantly increases the v/c ratio and queuing for the northbound and southbound through movements and approaches. Additionally, the resulting v/c ratios and inability of the signal to process the northbound movement results in significant queuing for the northbound approach. The analysis results are summarized in Table 4 and Table 5, and detailed worksheets are provided in the Appendix D.

Table 4: Level of Service (LOS) Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Baseline	Movement	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBTR
	V/C Ratio	0.67	0.93	0.82	1.08	0.70	0.89	0.41	0.48	0.63
	Delay (s)	102.0	64.7	115.3	103.1	54.9	83.4	56.4	58.8	72.9
	LOS	F	E	F	F	D	F	E	E	E
	Approach Delay (s)	66.4		103.8		68.5			69.7	
	Approach LOS	E		F		E			E	
	HCM 2000 Ctrl Delay	82.7								
	ICU	97.8%								
	HCM 2000 LOS	F								

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Scenario 1 Split phase (NB & SB)	Movement	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
	V/C Ratio	0.67	0.90	0.82	1.05	0.86	1.68	0.72	0.27	0.88
	Delay (s)	102.0	59.4	115.3	88.0	100.4	400.7	88.6	73.8	106.7
	LOS	F	E	F	F	F	F	F	E	FK
	Approach Delay (s)	61.3		89.5		243.2			99.3	
	Approach LOS	E		F		F			F	
	HCM 2000 Ctrl Delay	108.4								
	ICU	106.9%								
	HCM 2000 LOS	F								

Table 5: Queuing Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)						
Baseline	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	599	967	662	105	718
	Average Queue (ft)	272	546	168	71	387
	95th Queue (ft)	455	878	298	127	696
	Storage Bay (ft)	**1000**	-		**80**	-

Habana Avenue at Hillsborough Avenue (PM Peak Hour)						
Scenario 1 Split phase (NB & SB)	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	1050	2888	2891	105	900
	Average Queue (ft)	827	2362	2205	55	525
	95th Queue (ft)	1405	3687	3874	122	951
	Storage Bay (ft)	**1000**	-		**80**	-

Due to the significant and unacceptable increase in v/c ratios and queuing, this improvement is not recommended.

Scenario 2: Dual Left-turn Lanes and Shared Through/Right-Turn Lane

Scenario 2 modified the northbound lane use to dual left-turn lanes and a shared through/right-turn lane. Although this improvement would allow for additional capacity (and less storage required) for the northbound left-turn movement, it was anticipated and verified that the movement would have significant impacts to the through and right-turn movements. As shown in

Table 6, this improvement is estimated to have significant adverse impacts to the northbound approach. Detailed worksheets are provided in Appendix D.

Table 6: Level of Service (LOS) Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Baseline	Movement	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBTR
	V/C Ratio	0.67	0.93	0.82	1.08	0.70	0.89	0.41	0.48	0.63
	Delay (s)	102.0	64.7	115.3	103.1	54.9	83.4	56.4	58.8	72.9
	LOS	F	E	F	F	D	F	E	E	E
	Approach Delay (s)	66.4		103.8		68.5			69.7	
	Approach LOS	E		F		E			E	
	HCM 2000 Ctrl Delay	82.7								
	ICU	97.8%								
	HCM 2000 LOS	F								

Habana Avenue at Hillsborough Avenue (PM Peak Hour)									
Scenario 2, Dual NB Lefts (200 ft), Shared thru-right	Movement	EBL	EBT	WBL	WBT	NBL	NBTR	SBL	SBT
	V/C Ratio	0.67	0.93	0.82	1.08	0.75	1.47	0.61	0.57
	Delay (s)	102.0	64.7	115.3	103.1	96.0	281.8	98.6	67.5
	LOS	F	E	F	F	F	F	F	E
	Approach Delay (s)	66.4		103.8		237.9		74.5	
	Approach LOS	E		F		F		E	
	HCM 2000 Ctrl Delay	113.7							
	ICU	108.5%							
	HCM 2000 LOS	F							

Table 7: Queuing Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)						
Baseline	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	599	967	662	105	718
	Average Queue (ft)	272	546	168	71	387
	95th Queue (ft)	455	878	298	127	696
	Storage Bay (ft)	**1000**	**-**		**80**	**-**

Habana Avenue at Hillsborough Avenue (PM Peak Hour)						
Scenario 2 Dual NB Left (200 ft), Shared thru-right	Movement	NBL	NBL	NBTR	SBL	SBTR
	Maximum Queue (ft)	136	250	2873	104	608
	Average Queue (ft)	8	36	2717	78	274
	95th Queue (ft)	57	166	3453	127	543
	Storage Bay (ft)	**200**	**200**	**-**	**80**	**-**

Due to the significant and unacceptable impacts of this modification, it is not recommended.

Scenario 3: Northbound Left-turn Channelization

As discussed, channelizing the northbound left-turn lane would prevent northbound vehicles from using the two-way left-turn lane to approach the intersection with Hillsborough Avenue. Removing this conflict would help mitigate westbound-to-northbound angle crashes. However, by channelizing the left-turn lane, there is potential to create queue spillback from the northbound left-turn lane into the northbound through-lane. This would result in increased congestion and queuing. The existing condition effectively provides an unlimited northbound left-turn lane. In the field, vehicles were observed queuing as far back as Crest Avenue, and the simulation model confirmed this. Therefore, the existing model assumed a 1000' northbound left-turn lane. This would allow the model to indicate what the demand would be in an unconstrained situation. Based on the existing condition, the maximum and average queuing for the northbound left-turn lane is estimated at 599' and 272', respectively.

Providing the maximum storage demonstrated in the simulation model may not be feasible, as channelizing for a distance of over 400' would impact driveways and side streets, eliminating left turns inbound and outbound. Therefore, several scenarios were reviewed:

- 200' northbound left-turn lane (would provide storage for southbound left-turn into Plaza)
- 300' northbound left-turn lane (would not provide storage for southbound left-turn lane but would provide for left turn outbound)
- 500' northbound left-turn lane (would not provide for left turns into or out of Plaza)

Performance measures for each of these are summarized in Table 8 and Table 9.

Table 8: Level of Service (LOS) Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Baseline	Movement	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBTR
	V/C Ratio	0.67	0.93	0.82	1.08	0.70	0.89	0.41	0.48	0.63
	Delay (s)	102.0	64.7	115.3	103.1	54.9	83.4	56.4	58.8	72.9
	LOS	F	E	F	F	D	F	E	E	E
	Approach Delay (s)	66.4		103.8		68.5			69.7	
	Approach LOS	E		F		E			E	
	HCM 2000 Ctrl Delay	82.7								
	ICU	97.8%								
	HCM 2000 LOS	F								

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Scenario 3 200 ft NBL	Movement	EBL	EBTR	WBL	WBTR	NBL	NBT	NBR	SBL	SBT
	V/C Ratio	0.67	0.93	0.82	1.08	1.16	0.94	0.42	0.61	0.66
	Delay (s)	102.0	64.7	115.3	103.1	195.8	95.3	59.0	98.6	75.4
	LOS	F	E	F	F	F	F	E	F	E
	Approach Delay (s)	66.4		103.8		111.6			80.6	
	Approach LOS	E		F		F			F	
	HCM 2000 Ctrl Delay	91.1								
	ICU	102.2%								
	HCM 2000 LOS	F								

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Scenario 3 300 ft NBL	Movement	EBL	EBTR	WBL	WBTR	NBL	NBT	NBR	SBL	SBT
	V/C Ratio	0.67	0.93	0.82	1.08	0.76	0.89	0.42	0.48	0.63
	Delay (s)	102.0	64.7	115.3	103.1	54.9	83.4	56.4	58.8	72.9
	LOS	F	E	F	F	D	F	E	E	E
	Approach Delay (s)	66.4		103.8		68.5			69.7	
	Approach LOS	E		F		E			E	
	HCM 2000 Ctrl Delay	82.7								
	ICU	97.8%								
	HCM 2000 LOS	F								

Habana Avenue at Hillsborough Avenue (PM Peak Hour)										
Scenario 3 500 ft NBL	Movement	EBL	EBTR	WBL	WBTR	NBL	NBT	NBR	SBL	SBT
	V/C Ratio	0.67	0.93	0.82	1.08	0.76	0.89	0.41	0.48	0.68
	Delay (s)	102.0	64.7	115.3	103.1	54.9	83.4	56.4	58.8	72.9
	LOS	F	E	F	F	D	F	E	E	E
	Approach Delay (s)	66.4		103.8		68.5			69.7	
	Approach LOS	E		F		E			E	
	HCM 2000 Ctrl Delay	82.7								
	ICU	97.8%								
	HCM 2000 LOS	F								

Table 9: Queuing Analysis

Habana Avenue at Hillsborough Avenue (PM Peak Hour)						
Baseline	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	599	967	662	105	718
	Average Queue (ft)	272	546	168	71	387
	95th Queue (ft)	455	878	298	127	696
	Storage Bay (ft)	**1000**	**-**		**80**	**-**
Scenario 3 200 ft NBL	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	250	2893	2896	105	596
	Average Queue (ft)	231	2349	2106	79	338
	95th Queue (ft)	300	3600	3915	129	531
	Storage Bay (ft)	**200**	**-**		**80**	**-**
Scenario 3 300 ft NBL	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	349	1125	331	104	477
	Average Queue (ft)	323	958	162	87	346
	95th Queue (ft)	425	1432	408	133	551
	Storage Bay (ft)	**300**	**-**		**80**	**-**
Scenario 3 500 ft NBL	Movement	NBL	NBT	NBR	SBL	SBTR
	Maximum Queue (ft)	550	799	288	105	551
	Average Queue (ft)	323	458	132	60	326
	95th Queue (ft)	577	778	251	121	523
	Storage Bay (ft)	**500**	**-**		**80**	**-**

As shown, the 200' left-turn lane scenario results in a significant increase in the through lane for the northbound through movement. A review of the simulation revealed that the additional left-turning vehicles that were storing in the northbound through lane were not only adding to queuing through presence but also were creating friction near the intersection when maneuvering into the northbound left-turn lane. This effectively reduced headways and resulted in fewer northbound vehicles processing through the intersection of Hillsborough Avenue.

At 300', additional storage is provided each cycle, and the friction point is further from the signalized intersection. The simulation results indicated a drastic improvement over the 200' scenario and queuing similar to the existing condition.

At 500', the differences with 300' were marginal. This indicates that there is no significant benefit from extending the left-turn lane past the driveway at the sacrifice of the left-turn out.

Based on this analysis, a 300' left-turn lane with prohibition of the southbound left-turn into the Plaza is the recommended improvement.

Detailed Synchro and SimTraffic Worksheets are provided in Appendix E.

5. Improvement Review

As requested by the City of Tampa, several improvement alternatives were reviewed that would enhance the safety of the intersection of Habana Avenue and Hillsboro Plaza. The improvements were reviewed to improve safety by reducing angle and left-turn crashes between northbound vehicles using the two-way left-turn lane along Habana Avenue and southbound left-turning or westbound left-turning vehicles entering and existing the plaza. It was determined that the most effective improvement would be to channelize the northbound left-turn movement to remove the incentive for vehicles to use the two-way left-turn lane as an extension of the marked northbound left-turn lane at Hillsborough Avenue.

As shown in the operational analysis, only two scenarios were estimated to provide adequate storage to the northbound left-turn movements and not result in significant increases in northbound queuing—300' left-turn lane and 500' (or greater) left-turn lane. The 300' option is preferred, as it maintains egress for westbound-to-southbound left-turning vehicles from the Plaza. If this movement were eliminated, efficient alternatives are not readily available on the existing roadway network. This would impact approximately 60 vehicles during the PM peak hour. These vehicles would not have an efficient egress point as an alternative.

Although this improvement eliminates the southbound left-turning movement into the Plaza, this movement is easily accommodated along Hillsborough Avenue at the Plaza's right-in/right-out access point east of Habana Avenue. This modification is estimated to redistribute approximately 45 vehicles during the PM peak hour. These vehicles would have access to the plaza east of Habana Avenue along Hillsborough Avenue.

Other improvements are also recommended to improve safety, operation, and access:

- Clearly designate the intersection of Hillsboro Plaza and Habana Avenue with markings and signs that encourage vehicles on Habana Avenue to not block the intersection.
- Install signage to alert drivers to look right when exiting the plaza for bicyclists.

If blocking continues after the improvements discussed herein and above are implemented, consider additional delineation of the driveway interaction with Habana Avenue.

- Provide a painted island south of Hillsboro Plaza to provide refuge for pedestrians in the vicinity of the bus stops. This improvement could also help mitigate the crash history of westbound left-turning vehicles colliding with pedestrians.

The recommended improvement concept is shown in Figure 6.

It should be noted that a traffic signal was considered, but dismissed as an option early in the analysis process. The proximity of the Plaza entrance to Hillsborough Avenue would have created issues with properly coordinating traffic so as not to create queuing into Hillsborough Avenue intersection. Additionally obstacles to the signal included:

- There is not sufficient available space to provide a dedicated southbound left-turn lane into the plaza as this would require modifications to the storage for the northbound left-turn a Hillsborough Avenue.
- In order to mitigate the southbound left-turn to northbound crash risk, a protected left-turn or split phase operation would be required along Habana Avenue at the plaza. Split phase operation would have required coordination between the southbound movement at the plaza and the intersection with Hillsborough Avenue. However, vehicles proceed southbound on Habana Avenue from eastbound (right turn), westbound (left turn), and southbound. Coordinating all of these movements with the southbound approach, in order to minimize queuing in the southbound direction, would require phasing that introduces significant delay for the northbound approach.

Therefore, due to geometrics, proximity to Hillsborough Avenue, and inefficient signal phasing that would be required, the signalization options was removed from consideration.

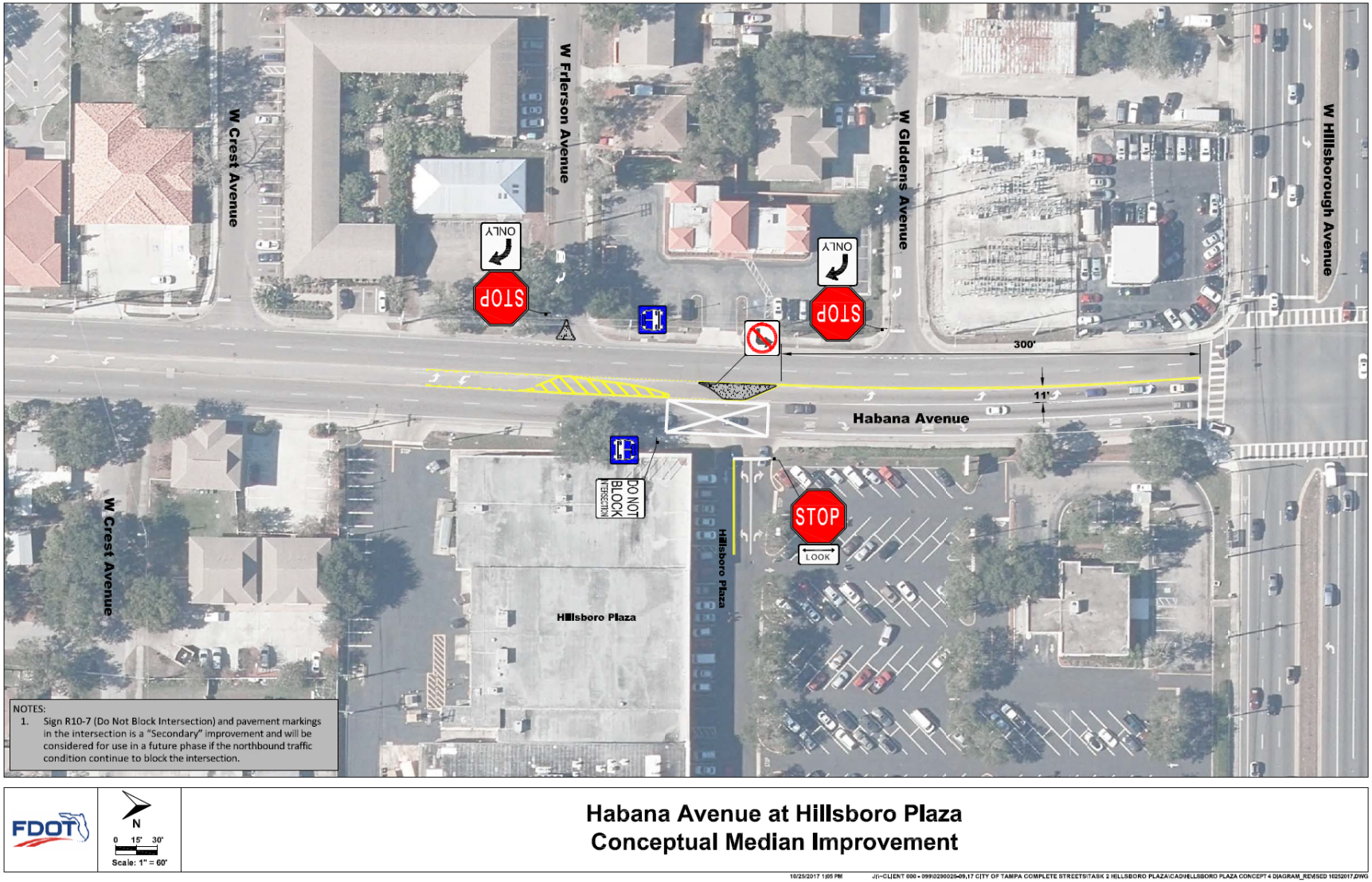


Figure 6: Conceptual Median Improvement

6. Cost Analysis

A preliminary cost estimate was developed for this improvement and is shown below.

PIN	Description	Unit	Measurement	Cost	Total
327-70-1	Milling Existing Asphalt Pavement, 1" Average Depth	SY	3951	$2.39	$9,442.89
337-7-82	Asphaltic Concrete, Traffic C, FC-9.5, PG 76-22	TN	218	$118.83	$25,904.94
522-1	Concrete Sidewalk and Driveways, 4" Thick	SY	60	$38.02	$2,281.20
700-1-11	Single Post Sign, F&I, Ground Mount, Up to 12 SF	AS	5	$352.82	$1,764.10
711-11-125	Thermoplastic, Standard, White, Solid, 24" for Stop Line	LF	100	$4.29	$429.00
711-11-141	Thermoplastic, Standard, White, 2-4 Doted Guide Line, 6"	GM	0.04	$2,078.67	$76.77
711-11-241	Thermoplastic, Standard, Yellow, 2-4 Doted Guide Line, 6"	GM	0.03	$2,078.67	$59.05
711-11-224	Thermoplastic, Standard-Open Graded Asphalt Surfaces, Yellow, Solid 18"	LF	200	$3.41	$682.00
711-11-160	Thermoplastic, Preformed, White, Message	EA	4	$133.76	$535.04
711-11-170	Thermoplastic, Preformed, White, Arrow	EA	15	$133.76	$2,006.40
711-16-101	Thermoplastic, Standard-Open Graded Asphalt Surfaces, White, Solid 6"	GM	0.5	$4,123.25	$1,897.63
711-16-201	Thermoplastic, Standard-Open Graded Asphalt Surfaces, Yellow, Solid 6"	GM	0.3	$4,179.53	$1,108.21
711-16-131	Thermoplastic, Standard-Open Graded Asphalt Surfaces, White, Skip, 10'x30'	GM	0.2	$1,436.60	$244.88
711-16-231	Thermoplastic, Standard-Open Graded Asphalt Surfaces, Yellow, Skip, 10'x30'	GM	0.04	$1,436.60	$57.46
Total					**$46,489.57**

Using the cost estimate above, a Benefit:Cost (BC) and Net Present Value (NPV) analysis was conducted for the safety benefits of this project.

- Reduce eight northbound to westbound angle crashes (those that occurred with northbound vehicles in the two-way left-turn lane
- Reduce ten northbound to southbound left-turn crashes as this movement would no longer be permitted.
- Other crash benefits from the raised island and enhanced signage were not directly accounted for in the calculation. However, benefits would be expected to all crashes in the impact area

As shown below, it is estimated that this project would have a B:C of over 40 and an NPV of $3,2 million.

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
SAFETY OFFICE ANNUAL BENEFIT COST ANALYSIS

Yellow cells require information from you.
Gray cells are automatically tabulated.

1. SUBMITTED BY:	WT Bowman	WPA NO.:	N/A	S.N.:			
2. DATE SUBMITTED:	08/18/17	SKID (I.D.):	N/A	SPEED:	40	mph	
3. FM PROJECT NO.:							
4. ALTERNATIVE NO.:		5. PRIORITY:	N/A				
6. DISTRICT 7 COUNTY:	City of Tampa/Hills. Co.	SECTION:	N/A	S.R.:	N/A	U.S. RD.:	N/A
7. BEGINNING MILE POST:		END M.P.:	N/A	LGTH:		NODE:	N/A

8. DESCRIPTION OF LOCATION/FACILITY TYPE:

Habana Avenue is a 4-lane arterial roadway that intersection Hillsborough Avenue.

The study location is the driveway to the Hilsboro Plaza approximately 350' south of Hillsborough Avenue

9. CAUSE OF CRASH PROBLEMS (LIST AND DISCUSS):

The most signficant crash problems are northbound to westbound angle crashes due to northbound vehicles using the two-way left-turn lane to travel to the left-turn lane at Hillsborough Avenue.

Additionally, there is a southbound left-turn to northbound crash problem. In the vicinity of the intersection, there have also been crashes with three pedestrians and three bicyclists.

10. PROPOSED IMPROVEMENTS (LIST AND DISCUSS):

Channelize the northbound left-turn movement to discourage the use of the two-way left-turn lane as a travel lane.

Eliminated the southbound left-turn movement into the driveway.

Additional signage and marking

COMMENTS/CRASH REDUCTION METHOD:

The improvement is estimated to reduce all southbound left-turn crashes and well as any westbound to northbound angle crashes that occur due to vehicles traveling in the northbound two-way left-turn lane.

COST NOTES

Crash cost from the PPM January 1, 2017. Table 23.6.1

11. CRASH TYPES	5 YEAR CRASHES			CRF %	TOTAL TO BE PREVENTED
Non-Serious Injury			Total		
WB Angle Crashes with NB Vehicle (Turn Lane Only)			8.0	100%	8.00
SB Left-Turn with NB Vehicle			10.0	100%	10.00
					0.00
					0.00
				SUBTOTAL:	18.00
Serious Injury	5 YEAR CRASHES			CRF	PREVENTED
None					0.00
					0.00
					0.00
					0.00
				SUBTOTAL:	0.00
Fatal Injury	5 YEAR CRASHES			CRF	PREVENTED
None					0.00
					0.00
					0.00
					0.00
				SUBTOTAL:	0.00
D. TOTAL CRASHES (ALL TYPES)	-	-	18.00		
12. TOTAL TO BE PREVENTED	-	-	18.00		18.00

13. BENEFIT	
A. TOTAL CRASH BENEFIT	$ 2,143,296
B. TOTAL ANNUAL BENEFIT:	$ 428,659.20

14. CRASH INFORMATION FOR FACILITY		
A. COST PER CRASH:	$ 119,072	
B. CRASH CLEANUP:	$ 100	per year
C. INTEREST (DISCOUNT) RATE:	4.0%	

15. ANNUAL COST OF IMPROVEMENTS				
TYPE	COST	LIFE (YR)	CRF	COST/YR
CONSTRUCTION	$ 50,000	10	0.1233	$ 6,165
MOT (10% of CST)	$ 5,000	10	0.123	$ 616
MOB (10% of CST)	$ 5,000	10	0.123	$ 616
CEI (10% of CST)	$ 5,000	10	0.123	$ 616
DESIGN (50% of CST)	$ 25,000	10	0.123	$ 3,082
H. SUBTOTAL:	$ 90,000	10.00		$ 11,096
I. CHANGE IN MAINTENANCE:				$ -
J. CRASH CLEANUP:				$ (600)
K. TOTAL ANNUAL COST:				**$ 10,496**
16. BENEFIT/COST:				**40.84**

17. NET PRESENT VALUE	
A. CURRENT YEAR	2018
B. PROJECT COMPLETION	2020
C. NPV	**$ 3,253,087**

Prepared By:	WT Bowman	Date:	12/8/2017
Approved By:		Date:	

7. Conclusions

Based on the results of this analysis, it is recommended that the City of Tampa undertake a project to channelize the northbound left-turn lane of Habana Avenue at Hillsborough Avenue. The channelization should provide as much storage as possible (approximately 300') without impeding the westbound left turn out of the Plaza driveway.

In the short term, it is recommended that the City use channelizing devices for this improvement. Once it is determined that the improvement is successful in reducing crashes with minimal impact on operation, the City could deploy a permanent project with raised medians. Such a project could be eligible for HSIP funding.

APPENDIX A

TURNING MOVEMENT COUNTS AND VOLUME ADJUSTMENTS

Hillsborough Ave at Habana Ave

Counter: 0255078
Counted By: DN_BG
Weather: Fair
Other:

File Name : Habana Ave
Site Code : 00002222
Start Date : 2/25/2015
Page No : 1

Groups Printed- 1 - Unshifted

	Habana Ave Southbound					Hillsborough Ave Westbound					Habana Ave Northbound					Hillsborough Ave Eastbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:00 AM	17	70	14	0	101	46	544	5	0	595	43	36	46	0	125	18	367	27	0	412	1233
07:15 AM	8	117	2	0	127	75	595	11	0	681	40	38	41	0	119	15	386	41	0	442	1369
07:30 AM	9	91	8	0	108	79	599	8	0	686	36	35	46	0	117	21	465	43	0	529	1440
07:45 AM	13	144	1	0	158	97	548	6	0	651	42	47	27	0	116	16	421	38	0	475	1400
Total	47	422	25	0	494	297	2286	30	0	2613	161	156	160	0	477	70	1639	149	0	1858	5442
08:00 AM	7	127	6	0	140	76	525	6	0	607	46	35	28	0	109	9	328	26	0	363	1219
08:15 AM	7	110	5	0	122	93	497	4	0	594	30	25	18	0	73	7	314	56	0	377	1166
08:30 AM	7	124	5	0	136	59	566	3	0	628	40	26	27	0	93	4	346	44	0	394	1251
08:45 AM	7	126	8	0	141	92	549	3	0	644	36	37	32	0	105	13	263	47	0	323	1213
Total	28	487	24	0	539	320	2137	16	0	2473	152	123	105	0	380	33	1251	173	0	1457	4849
04:00 PM	20	65	9	0	94	25	559	10	0	594	75	128	74	0	277	12	418	31	0	461	1426
04:15 PM	11	62	12	0	85	34	522	4	0	560	52	99	65	0	216	21	466	20	0	507	1368
04:30 PM	16	54	11	0	81	21	529	7	0	557	67	103	72	0	242	21	432	35	0	488	1368
04:45 PM	12	81	15	0	108	42	503	3	0	548	65	88	81	0	234	10	496	12	0	518	1408
Total	59	262	47	0	368	122	2113	24	0	2259	259	418	292	0	969	64	1812	98	0	1974	5570
05:00 PM	17	91	12	0	120	47	520	6	0	573	51	119	63	0	233	28	474	22	0	524	1450
05:15 PM	18	69	14	0	101	26	492	9	0	527	72	95	72	0	239	22	416	17	0	455	1322
05:30 PM	14	87	10	0	111	19	655	6	0	680	68	111	72	0	251	22	436	15	0	473	1515
05:45 PM	23	79	7	0	109	37	522	5	0	564	74	141	74	0	289	16	423	15	0	454	1416
Total	72	326	43	0	441	129	2189	26	0	2344	265	466	281	0	1012	88	1749	69	0	1906	5703
Grand Total	206	1497	139	0	1842	868	8725	96	0	9689	837	1163	838	0	2838	255	6451	489	0	7195	21564
Apprch %	11.2	81.3	7.5	0.0		9.0	90.1	1.0	0.0		29.5	41.0	29.5	0.0		3.5	89.7	6.8	0.0		
Total %	1.0	6.9	0.6	0.0	8.5	4.0	40.5	0.4	0.0	44.9	3.9	5.4	3.9	0.0	13.2	1.2	29.9	2.3	0.0	33.4	

1	2	3		4	5		6	7	8	9	10	11
Duration	Time Stamp	Count		VPS	VPH		Cum. S			Vehicles Per interval	Calc per 15 minutes	
243	4:10 PM	4		0.016461	59.26		243.00	4.05				
248	4:14 PM	18		0.072581	261.29		491.00	8.18				
292	4:19 PM	9		0.030822	110.96		783.00	13.05	13.05	31	35.63	
166	4:23 PM	8		0.048193	173.49		949.00	15.82				
545	4:26 PM	16		0.029358	105.69		1,494.00	24.90				
545	4:35 PM	26		0.047706	171.74		2,039.00	33.98	20.93	50	35.83	
279	4:45 PM	9		0.032258	116.13		2,318.00	38.63				
341	4:50 PM	13		0.038123	137.24		2,659.00	44.32	10.33	22	31.94	
540	4:55 PM	12		0.022222	80.00		3,199.00	53.32				
545	5:03 PM	33		0.06055	217.98		3,744.00	62.40	18.08	45	37.33	140.72
386	5:12 PM	22		0.056995	205.18		4,130.00	68.83				
170	5:19 PM	14		0.082353	296.47		4,300.00	71.67				
270	5:21 PM	9		0.033333	120.00		4,570.00	76.17	13.77	45	49.03	154.12
494	5:25 PM	24		0.048583	174.90		5,064.00	84.40				
276	5:34 PM	19		0.068841	247.83		5,340.00	89.00				
545	5:44 PM	16		0.029358	105.69		5,885.00	98.08	21.92	59	40.38	158.67

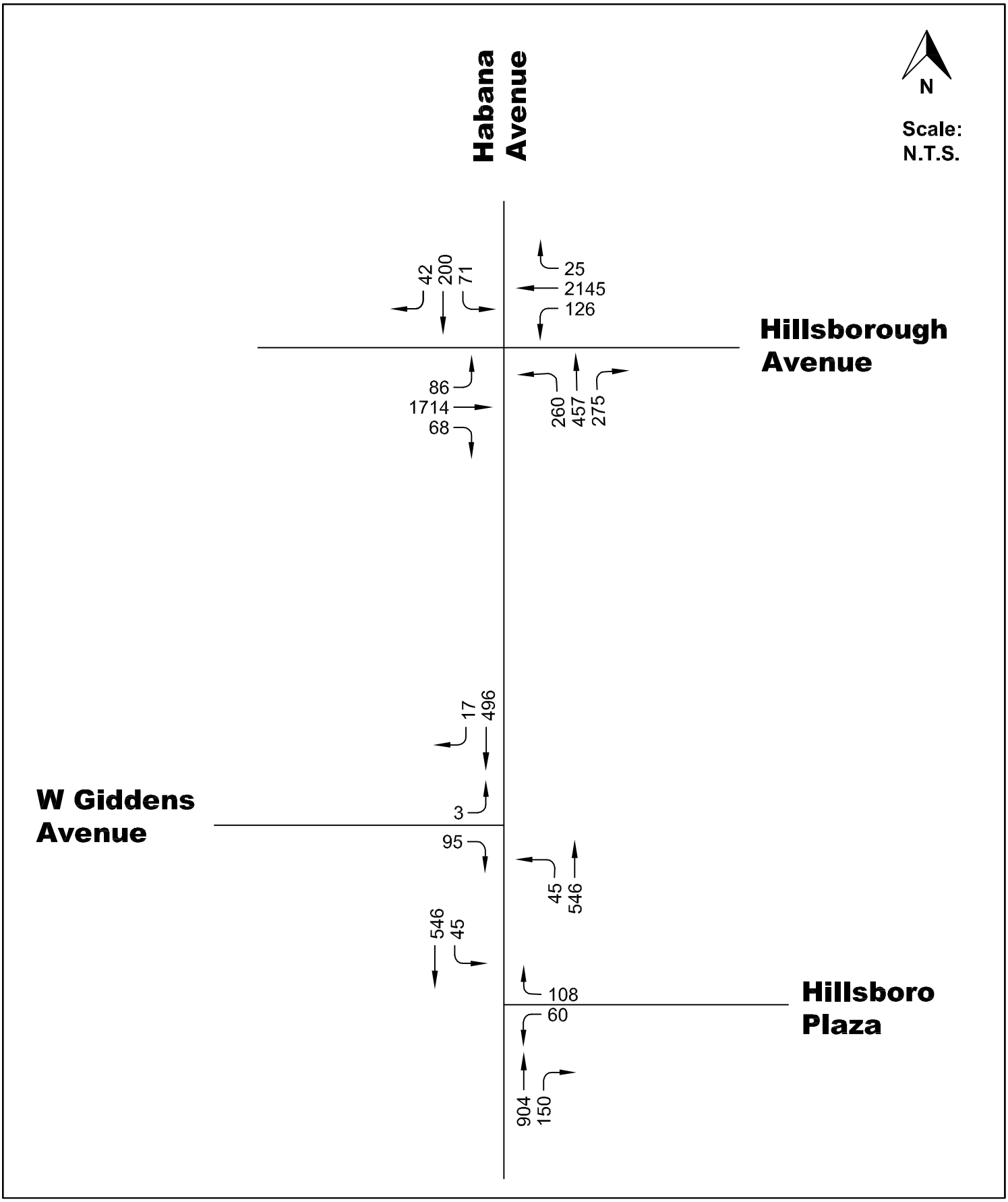
Average: 161.49

Column	Description
1	Duration of the video interval (seconds)
2	Timestamp of the video when viewing
3	Number of SB cars observed south of Hillsborough
4	Calculated vehicles per second in the interval (Column 3 divided by Column 1)
5	Extrapolated vehicles per hour for that interval (Column 4 * 3,600 s/h)
6	Cumulative videoed seconds. To be used to break up into "roughly" 15 minute intervals
7	Column 6 converted to minutes
8	"Approximately" 15-minute intervals of the count duration (time from last interval)
9	Sum of vehicles in the interval
10	Using vehicles per recorded interval, calculate estimated vehicles per 15-minutes (15/interva*vehcile
11	Vehicles in an hour, estimated

Note: The highest 15-minute interval is 50 cars per 15-minutes which estimates to 200 vph
Note: The higest videotaped hour estimates at 158
Note: The count provided used approximately 350 vph

We also conducted a field count and over 15-minutes got 43 vehicles which is in line with the data above

Based on this information, the modeling is going to use a conservative 200 vph for SBT


Habana Avenue
N
Scale: N.T.S.
Hillsborough Avenue
42
200
71
25
2145
126
86
1714
68
260
457
275
W Giddens Avenue
17
496
3
95
45
546
546
45
Hillsboro Plaza
108
60
904
150

APPENDIX B

DETAILED CRASH EXTRACTS

Event ID	EventCrashDate	EventCrashTime	EventOnStreet	EventCrossStreet	EventImpactType	EventLightingCondition	RoadSurfaceCondition	Fatal	Incapacitating	PersonDriverCCauseMain
51954122	1/2/2012	1639	HABANA AV N	HILLSBOROUGH AV W	Angle	Daylight	Dry	0	0	Unknown
51954619	2/7/2012	1645	NORTH HABANA AVENUE	WEST FRIERSON AVENUE	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
51955561	4/11/2012	1504	HABANA AVENUE NORTH	HILLSBOROUGH AVENUE WEST	Pedestrian	Daylight	Wet	0	0	Unknown
51956849	7/15/2012	1632	HABANA AVENUE NORTH	CREST AVENUE WEST	Angle	Daylight	Wet	0	0	Ran Stop Sign
83616067	10/19/2012	1543	HABANA AVE N	GIDDENS AVE W	Angle	Daylight	Dry	0	0	Other Contributing Actions
83616201	10/19/2012	1555	N HABANA AVE	GIDDENS AVE N	Angle	Daylight	Dry	0	0	Improper Turn
83616394	10/29/2012	1252	N HABANA AVENUE	W CREST AVENUE	Angle	Daylight	Dry	0	0	Failed to Keep in Proper Lane
83884023	1/16/2013	1715	HABANA AVENUE N	GIDDENS AVENUE W	Angle	Daylight	Dry	0	0	Other Contributing Actions
83884039	1/16/2013	2350	N HABANA AVE	W FRIERSON AV	Unknown	Daylight	Unknown	0	0	Operated MV in Careless or Negligent Manner

Event ID	EventCrashDate	EventCrashTime	EventOnStreet	EventCrossStreet	EventImpactType	EventLightingCondition	RoadSurfaceCondition	Fatal	Incapacitating	PersonDriverCCauseMain
83884012	2/7/2013	1825	HABANNA	GIDDENS AV	Angle	Dark-Lighted	Dry	0	0	Other Contributing Actions
83884648	3/6/2013	719	N HABANA AVENUE	W GIDDENS AVENUE	Angle	Daylight	Wet	0	0	Failed to Yield Right-of-Way
83946265	4/8/2013	1718	HABANA AVENUE N	FRIERSON AVE W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
83946930	5/16/2013	1616	HABANA AV N	FRIERSON AV W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
84144019	7/5/2013	524	HABANA AVE N	GIDDENS AV E W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
84144474	8/2/2013	1446	HABANA AVE N	FRIERSON ST W	Angle	Daylight	Wet	0	0	Failed to Yield Right-of-Way
84144649	8/13/2013	1700	HABANA AVENUE NORTH	GIDDENS AVENUE WEST	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
83947867	8/17/2013	1339	HABANA AVE N	FRIERSON AVE W	Front to Rear	Daylight	Dry	0	0	Operated MV in Careless or Negligent Manner
84144884	8/26/2013	1433	HABANA AVE N	GIDDENS AVE	Angle	Daylight	Dry	0	0	Operated MV in Careless or Negligent Manner
83947992	10/28/2013	1653	HABANA AVE N	FRIERSON AVE W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way

Event ID	EventCrashDate	EventCrashTime	EventOnStreet	EventCrossStreet	EventImpactType	EventLightingCondition	RoadSurfaceCondition	Fatal	Incapacitating	PersonDriverCCauseMain
84407558	11/6/2013	1802	HABANA AVENUE NORTH	HILLSBOROUGH PLAZA	Angle	Dark-Lighted	Dry	0	0	Failed to Yield Right-of-Way
84407758	11/17/2013	1500	HABANA AVENUE NORTH	HILLSBOROUGH PLAZA PRIVATE DRIVE	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
84621929	3/31/2014	1641	HABANA AVE N	GIDDEN AVE W	Angle	Daylight	Dry	0	0	Failed to Keep in Proper Lane
84736490	4/17/2014	1625	HABANA AVE N	FRIERSON AVE W	No Data	Daylight	Dry	0	0	Ran off Roadway
84736993	5/16/2014	1749	HABANA AVE N	HILLSBOROUGH AVE W	Angle	Daylight	Dry	0	0	Unknown
84737039	5/19/2014	1315	HABANA AVE N	FRIERSON AVE W	Other, Explain in Narrative	Daylight	Dry	0	0	No Contributing Action
84737279	5/30/2014	1430	HABANA AVE N	GIDDENS AVE W	Bicycle	Daylight	Dry	0	0	Other Contributing Actions
84737528	6/11/2014	1737	HABANA AVE N	GIDDENS AVE W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
84738060	7/10/2014	1445	HABANA AVE N	FRIERSON AVE W	Pedestrian	Daylight	Dry	0	0	Operated MV in Careless or Negligent Manner

Event ID	EventCrashDate	EventCrashTime	EventOnStreet	EventCrossStreet	EventImpactType	EventLightingCondition	RoadSurfaceCondition	Fatal	Incapacitating	PersonDriverCCauseMain
84964783	9/8/2014	1442	HABANA AVE N	FRIERSON AVE W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
84965260	9/29/2014	820	HABANA AVE N	FRIERSON AVE W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
85612622	11/20/2014	1526	HABANA AVE N	HILLSBOROUGH AVE W	Other, Explain in Narrative	Daylight	Dry	0	0	Unknown
85788857	3/3/2015	1654	HABANA AVE N	GIDDEN AVE W	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
85788860	3/3/2015	1718	HABANA AVE N	FRIERSON AVE	Angle	Daylight	Dry	0	0	No Contributing Action
85789047	3/9/2015	1756	HABANA AVE	CREST AVE	Bicycle	Daylight	Dry	0	0	No Contributing Action
85919833	6/1/2015	1531	HABANA AVE N	GIDDENS AVE W	Bicycle	Daylight	Dry	0	0	No Contributing Action
85920345	6/23/2015	1743	HABANA AVE	GIDDENS AVE	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
86072665	8/6/2015	1120	HABANA AVE N	FRIERSON AVE W	Pedestrian	Daylight	Dry	0	0	No Contributing Action
86073655	9/17/2015	1738	HABANA AVE N	HILLSBOROUGH AVE W	Angle	Daylight	Dry	0	0	Unknown
86073749	9/22/2015	620	HABANA AVE N	CREST AVE W	Angle	Dark-Lighted	Dry	0	0	Failed to Yield Right-of-Way

Event ID	EventCrashDate	EventCrashTime	EventOnStreet	EventCrossStreet	EventImpactType	EventLightingCondition	RoadSurfaceCondition	Fatal	Incapacitating	PersonDriverCCauseMain
86073784	9/23/2015	1735	HABANA AVE N	CREST AVE W	Angle	Daylight	Dry	0	0	No Data
86074102	10/5/2015	1552	HABANA AVE N	HILLSBOROUGH AVE W	Angle	Daylight	Dry	0	0	Unknown
86074668	10/20/2015	1654	HABANA AVE N	HILLSBOROUGH AVE W	Front to Rear	Daylight	Dry	0	0	Unknown
86151514	4/11/2016	1546	HABANA AVE N	GIDDENS AVE W	Angle	Daylight	Dry	0	0	Improper Turn
86151725	4/19/2016	1735	HABANA AVE N	CREST AVE W	Angle	Daylight	Dry	0	0	No Data
86154095	7/11/2016	1601	HABANA AVE N	FRIERSON AVE W	Front to Rear	Daylight	Dry	0	0	Failed to Yield Right-of-Way
86155767	9/22/2016	1650	HABANA AVE N	CREST AVE W	Front to Rear	Daylight	Wet	0	0	Followed too Closely
86157224	11/14/2016	1620	HABANA AVE	CREST AVE	Angle	Daylight	Dry	0	0	Failed to Yield Right-of-Way
86157582	11/28/2016	1230	HABANA AVE N	GIDDENS AVE W	Bicycle	Daylight	Dry	0	0	No Data

APPENDIX C

EXISTING DELAY-LOS WORKSHEETS AND QUEUING REPORT

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	86	1714	68	126	2145	25	260	457	275	71	200	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		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	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5056		1770	5077		1770	1863	1583	1770	1814	
Flt Permitted	0.95	1.00		0.95	1.00		0.30	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	1770	5056		1770	5077		556	1863	1583	276	1814	
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)	93	1863	74	137	2332	27	283	497	299	77	217	46
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	106	0	4	0
Lane Group Flow (vph)	93	1935	0	137	2358	0	283	497	193	77	259	0
Turn Type	Prot	NA		Prot	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases							4		4	8		
Actuated Green, G (s)	15.6	82.5		18.9	85.8		78.5	59.9	59.9	56.5	45.4	
Effective Green, g (s)	15.6	82.5		18.9	85.8		78.5	59.9	59.9	56.5	45.4	
Actuated g/C Ratio	0.08	0.41		0.09	0.43		0.39	0.30	0.30	0.28	0.23	
Clearance Time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	2085		167	2178		373	557	474	160	411	
v/s Ratio Prot	0.05	0.38		c0.08	c0.46		c0.10	c0.27		0.03	0.14	
v/s Ratio Perm							0.20		0.12	0.11		
v/c Ratio	0.67	0.93		0.82	1.08		0.76	0.89	0.41	0.48	0.63	
Uniform Delay, d1	89.7	55.9		88.9	57.1		46.3	67.0	55.9	56.5	69.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.2	8.7		26.4	46.0		8.6	16.5	0.6	2.3	3.1	
Delay (s)	102.0	64.7		115.3	103.1		54.9	83.4	56.4	58.8	72.9	
Level of Service	F	E		F	F		D	F	E	E	E	
Approach Delay (s)		66.4			103.8			68.5			69.7	
Approach LOS		E			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	82.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	27.6
Intersection Capacity Utilization	97.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	TR	L	T	T	TR	L	T	R	L
Maximum Queue (ft)	300	832	809	750	430	1674	1683	1683	599	967	662	105
Average Queue (ft)	182	565	546	496	293	1400	1389	1346	272	546	168	71
95th Queue (ft)	338	855	822	756	522	2085	2077	2069	455	878	398	127
Link Distance (ft)		1757	1757	1757		1628	1628	1628		2844	2844	
Upstream Blk Time (%)						38	32	30				
Queuing Penalty (veh)						0	0	0				
Storage Bay Dist (ft)	250				380				1000			80
Storage Blk Time (%)	1	41			1	52				1		21
Queuing Penalty (veh)	3	38			4	70				2		55

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	718
Average Queue (ft)	387
95th Queue (ft)	696
Link Distance (ft)	1838
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	60
Queuing Penalty (veh)	45

Network Summary

Network wide Queuing Penalty: 217

APPENDIX D

SCENARIO 1 AND SCENARIO 2 DELAY-LOS WORKSHEETS AND QUEUING REPORTS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	86	1714	68	126	2145	25	260	457	275	71	200	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		0.95	0.95	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5056		1770	5077		1681	1765	1583	1770	1814	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5056		1770	5077		1681	1765	1583	1770	1814	
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)	93	1863	74	137	2332	27	283	497	299	77	217	46
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	115	0	4	0
Lane Group Flow (vph)	93	1935	0	137	2358	0	255	525	184	77	259	0
Turn Type	Prot	NA		Prot	NA		Split	NA	custom	Split	NA	
Protected Phases	1	6		5	2		3	3		4	4	
Permitted Phases									4			
Actuated Green, G (s)	15.6	85.5		18.9	88.8		35.5	35.5	32.5	32.5	32.5	
Effective Green, g (s)	15.6	85.5		18.9	88.8		35.5	35.5	32.5	32.5	32.5	
Actuated g/C Ratio	0.08	0.43		0.09	0.44		0.18	0.18	0.16	0.16	0.16	
Clearance Time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	2161		167	2254		298	313	257	287	294	
v/s Ratio Prot	0.05	0.38		c0.08	c0.46		0.15	c0.30		0.04	c0.14	
v/s Ratio Perm									0.12			
v/c Ratio	0.67	0.90		0.82	1.05		0.86	1.68	0.72	0.27	0.88	
Uniform Delay, d1	89.7	53.1		88.9	55.6		79.8	82.2	79.4	73.3	81.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.2	6.3		26.4	32.4		20.7	318.4	9.2	0.5	24.9	
Delay (s)	102.0	59.4		115.3	88.0		100.4	400.7	88.6	73.8	106.7	
Level of Service	F	E		F	F		F	F	F	E	F	
Approach Delay (s)		61.3			89.5			243.2			99.3	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	108.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	27.6
Intersection Capacity Utilization	106.9%	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												
Volume (vph)	86	1714	68	126	2145	25	260	457	275	71	200	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3		7.5	7.5		7.5	7.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		0.91	0.91		1.00	1.00	
Frt	1.00	0.99		1.00	1.00		1.00	0.95		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5056		1770	5077		3221	1600		1770	1814	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	0.85		0.95	1.00	
Satd. Flow (perm)	1770	5056		1770	5077		3221	1367		1770	1814	
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)	93	1863	74	137	2332	27	283	497	299	77	217	46
RTOR Reduction (vph)	0	2	0	0	1	0	0	7	0	0	4	0
Lane Group Flow (vph)	93	1935	0	137	2358	0	255	817	0	77	259	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases												
Actuated Green, G (s)	15.6	82.5		18.9	85.8		21.1	77.8		14.3	49.9	
Effective Green, g (s)	15.6	82.5		18.9	85.8		21.1	77.8		14.3	49.9	
Actuated g/C Ratio	0.08	0.41		0.09	0.43		0.11	0.39		0.07	0.25	
Clearance Time (s)	6.3	6.3		6.3	6.3		7.5	7.5		7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	138	2085		167	2178		339	556		126	452	
v/s Ratio Prot	0.05	0.38		c0.08	c0.46		0.08	c0.15		0.04	0.14	
v/s Ratio Perm								c0.42				
v/c Ratio	0.67	0.93		0.82	1.08		0.75	1.47		0.61	0.57	
Uniform Delay, d1	89.7	55.9		88.9	57.1		86.9	61.1		90.2	65.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	12.2	8.7		26.4	46.0		9.1	220.7		8.5	1.8	
Delay (s)	102.0	64.7		115.3	103.1		96.0	281.8		98.6	67.5	
Level of Service	F	E		F	F		F	F		F	E	
Approach Delay (s)		66.4			103.8			237.9			74.5	
Approach LOS		E			F			F			E	

Intersection Summary			
HCM 2000 Control Delay	113.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.29		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	27.6
Intersection Capacity Utilization	108.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	TR	L	T	T	TR	L	LT	R	L
Maximum Queue (ft)	300	771	752	717	430	1678	1671	1668	1050	2888	2891	105
Average Queue (ft)	173	521	502	450	269	1330	1302	1246	827	2362	2205	55
95th Queue (ft)	330	771	743	685	505	1981	1956	1924	1405	3687	3874	122
Link Distance (ft)		1757	1757	1757		1628	1628	1628		2844	2844	
Upstream Blk Time (%)						24	18	17		59	52	
Queuing Penalty (veh)						0	0	0		0	0	
Storage Bay Dist (ft)	250				380				1000			80
Storage Blk Time (%)	0	38				51			0	74		12
Queuing Penalty (veh)	2	35				69			0	102		32

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	900
Average Queue (ft)	525
95th Queue (ft)	951
Link Distance (ft)	1838
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	72
Queuing Penalty (veh)	55

Network Summary

Network wide Queuing Penalty: 295

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	TR	L	T	T	TR	L	L	LTR	L
Maximum Queue (ft)	300	854	818	761	430	1684	1651	1621	136	250	2873	104
Average Queue (ft)	156	543	525	474	254	1295	1263	1201	8	36	2717	78
95th Queue (ft)	314	813	792	725	488	1986	1956	1910	57	166	3453	127
Link Distance (ft)		1751	1751	1751		1634	1634	1634			2844	
Upstream Blk Time (%)						22	18	18			88	
Queuing Penalty (veh)						0	0	0			0	
Storage Bay Dist (ft)	250				380				200	200		80
Storage Blk Time (%)	0	39			0	50				0	95	37
Queuing Penalty (veh)	2	36			0	68				0	176	97

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	608
Average Queue (ft)	274
95th Queue (ft)	543
Link Distance (ft)	1838
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	33
Queuing Penalty (veh)	25

Network Summary

Network wide Queuing Penalty: 405

APPENDIX E

SCENARIO 3 DELAY-LOS WORKSHEETS AND QUEUING REPORTSAPPENDIX F

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	86	1714	68	126	2145	25	260	457	275	71	200	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		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	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5056		1770	5077		1770	1863	1583	1770	1814	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5056		1770	5077		1770	1863	1583	1770	1814	
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)	93	1863	74	137	2332	27	283	497	299	77	217	46
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	109	0	4	0
Lane Group Flow (vph)	93	1935	0	137	2358	0	283	497	190	77	259	0
Turn Type	Prot	NA		Prot	NA		Prot	NA	Perm	Prot	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases									4			
Actuated Green, G (s)	15.6	82.5		18.9	85.8		27.5	56.7	56.7	14.3	43.5	
Effective Green, g (s)	15.6	82.5		18.9	85.8		27.5	56.7	56.7	14.3	43.5	
Actuated g/C Ratio	0.08	0.41		0.09	0.43		0.14	0.28	0.28	0.07	0.22	
Clearance Time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	2085		167	2178		243	528	448	126	394	
v/s Ratio Prot	0.05	0.38		c0.08	c0.46		c0.16	c0.27		0.04	0.14	
v/s Ratio Perm									0.12			
v/c Ratio	0.67	0.93		0.82	1.08		1.16	0.94	0.42	0.61	0.66	
Uniform Delay, d1	89.7	55.9		88.9	57.1		86.2	70.0	58.4	90.2	71.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.2	8.7		26.4	46.0		109.5	25.3	0.6	8.5	3.9	
Delay (s)	102.0	64.7		115.3	103.1		195.8	95.3	59.0	98.6	75.4	
Level of Service	F	E		F	F		F	F	E	F	E	
Approach Delay (s)		66.4			103.8			111.6			80.6	
Approach LOS		E			F			F			F	

Intersection Summary			
HCM 2000 Control Delay	91.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	27.6
Intersection Capacity Utilization	102.2%	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												
Volume (vph)	86	1714	68	126	2145	25	260	457	275	71	200	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		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	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5056		1770	5077		1770	1863	1583	1770	1814	
Flt Permitted	0.95	1.00		0.95	1.00		0.30	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	1770	5056		1770	5077		556	1863	1583	276	1814	
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)	93	1863	74	137	2332	27	283	497	299	77	217	46
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	106	0	4	0
Lane Group Flow (vph)	93	1935	0	137	2358	0	283	497	193	77	259	0
Turn Type	Prot	NA		Prot	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases							4		4	8		
Actuated Green, G (s)	15.6	82.5		18.9	85.8		78.5	59.9	59.9	56.5	45.4	
Effective Green, g (s)	15.6	82.5		18.9	85.8		78.5	59.9	59.9	56.5	45.4	
Actuated g/C Ratio	0.08	0.41		0.09	0.43		0.39	0.30	0.30	0.28	0.23	
Clearance Time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	2085		167	2178		373	557	474	160	411	
v/s Ratio Prot	0.05	0.38		c0.08	c0.46		c0.10	c0.27		0.03	0.14	
v/s Ratio Perm							0.20		0.12	0.11		
v/c Ratio	0.67	0.93		0.82	1.08		0.76	0.89	0.41	0.48	0.63	
Uniform Delay, d1	89.7	55.9		88.9	57.1		46.3	67.0	55.9	56.5	69.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.2	8.7		26.4	46.0		8.6	16.5	0.6	2.3	3.1	
Delay (s)	102.0	64.7		115.3	103.1		54.9	83.4	56.4	58.8	72.9	
Level of Service	F	E		F	F		D	F	E	E	E	
Approach Delay (s)		66.4			103.8			68.5			69.7	
Approach LOS		E			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	82.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	27.6
Intersection Capacity Utilization	97.8%	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												
Volume (vph)	86	1714	68	126	2145	25	260	457	275	71	200	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Lane Util. Factor	1.00	0.91		1.00	0.91		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	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5056		1770	5077		1770	1863	1583	1770	1814	
Flt Permitted	0.95	1.00		0.95	1.00		0.30	1.00	1.00	0.15	1.00	
Satd. Flow (perm)	1770	5056		1770	5077		556	1863	1583	276	1814	
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)	93	1863	74	137	2332	27	283	497	299	77	217	46
RTOR Reduction (vph)	0	2	0	0	1	0	0	0	106	0	4	0
Lane Group Flow (vph)	93	1935	0	137	2358	0	283	497	193	77	259	0
Turn Type	Prot	NA		Prot	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases							4		4	8		
Actuated Green, G (s)	15.6	82.5		18.9	85.8		78.5	59.9	59.9	56.5	45.4	
Effective Green, g (s)	15.6	82.5		18.9	85.8		78.5	59.9	59.9	56.5	45.4	
Actuated g/C Ratio	0.08	0.41		0.09	0.43		0.39	0.30	0.30	0.28	0.23	
Clearance Time (s)	6.3	6.3		6.3	6.3		7.5	7.5	7.5	7.5	7.5	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	138	2085		167	2178		373	557	474	160	411	
v/s Ratio Prot	0.05	0.38		c0.08	c0.46		c0.10	c0.27		0.03	0.14	
v/s Ratio Perm							0.20		0.12	0.11		
v/c Ratio	0.67	0.93		0.82	1.08		0.76	0.89	0.41	0.48	0.63	
Uniform Delay, d1	89.7	55.9		88.9	57.1		46.3	67.0	55.9	56.5	69.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	12.2	8.7		26.4	46.0		8.6	16.5	0.6	2.3	3.1	
Delay (s)	102.0	64.7		115.3	103.1		54.9	83.4	56.4	58.8	72.9	
Level of Service	F	E		F	F		D	F	E	E	E	
Approach Delay (s)		66.4			103.8			68.5			69.7	
Approach LOS		E			F			E			E	

Intersection Summary			
HCM 2000 Control Delay	82.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	200.0	Sum of lost time (s)	27.6
Intersection Capacity Utilization	97.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	TR	L	T	T	TR	L	T	R	L
Maximum Queue (ft)	300	738	722	671	430	1506	1503	1398	250	2893	2896	105
Average Queue (ft)	167	500	480	444	265	1071	1034	953	231	2349	2106	79
95th Queue (ft)	327	756	726	677	502	1679	1628	1537	300	3600	3915	129
Link Distance (ft)		1757	1757	1757		1628	1628	1628		2844	2844	
Upstream Blk Time (%)						6	4	3		55	35	
Queuing Penalty (veh)						0	0	0		0	0	
Storage Bay Dist (ft)	250				380				200			80
Storage Blk Time (%)	0	36			0	48			54	34		40
Queuing Penalty (veh)	3	33			3	65			263	95		104

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	596
Average Queue (ft)	338
95th Queue (ft)	531
Link Distance (ft)	1838
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	47
Queuing Penalty (veh)	36

Network Summary

Network wide Queuing Penalty: 601

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	TR	L	T	T	TR	L	T	R	L
Maximum Queue (ft)	299	555	546	488	381	665	666	624	349	1125	331	104
Average Queue (ft)	173	388	370	327	256	489	464	417	323	958	162	87
95th Queue (ft)	343	643	631	578	469	814	794	748	425	1432	408	133
Link Distance (ft)		1757	1757	1757		1628	1628	1628		2844	2844	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	250				380				300			80
Storage Blk Time (%)		32				28			6	54		36
Queuing Penalty (veh)		28				35			29	140		86

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	477
Average Queue (ft)	346
95th Queue (ft)	551
Link Distance (ft)	1838
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	52
Queuing Penalty (veh)	37

Network Summary

Network wide Queuing Penalty: 354

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	TR	L	T	T	TR	L	T	R	L
Maximum Queue (ft)	300	646	631	595	430	969	922	809	550	799	288	105
Average Queue (ft)	159	443	425	380	257	662	632	569	323	458	132	60
95th Queue (ft)	332	673	648	595	496	1053	1005	925	577	778	251	121
Link Distance (ft)		1757	1757	1757		1628	1628	1628		2844	2844	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	250				380				500			80
Storage Blk Time (%)	0	33			0	34			1	10		12
Queuing Penalty (veh)	0	28			0	42			4	26		30

Intersection: 3: Habana Ave & Hillsborough Ave

Movement	SB
Directions Served	TR
Maximum Queue (ft)	551
Average Queue (ft)	326
95th Queue (ft)	523
Link Distance (ft)	1838
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	61
Queuing Penalty (veh)	43

Network Summary

Network wide Queuing Penalty: 175