Hillsboro Boulevard

Lane Elimination Study

Prepared for:
City of Deerfield Beach
150 NE 2nd Avenue
Deerfield Beach, Florida 33441

Prepared by:
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August 2014

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Professional Engineer's Certification

I hereby certify that I am a Licensed Professional Engineer in the State of Florida practicing with Stantec Consulting Services Inc. and that I have supervised the preparation of and approve the evaluations, findings, opinions, conclusions, and technical advice hereby reported for:

PROJECT: Hillsboro Boulevard (SR 810)
Lane Elimination Study
215612024

LOCATION: Hillsboro Boulevard between Dixie Highway (SR 811) and Federal Highway (US 1), Deerfield Beach, Florida.

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Introduction

The City of Deerfield Beach is considering improvements to vehicular, pedestrian, and bicycle safety along Hillsboro Boulevard (SR 810) from Dixie Highway (SR 811) to Federal Highway (US 1). This will be accomplished by changing the typical section from a seven-lane undivided roadway to a four-lane divided roadway with bike lanes. The proposed divided typical section is consistent with the typical sections east and west of the project limits in that they are also divided.

This study provides an assessment of the existing conditions of Hillsboro Boulevard between Dixie Highway and Federal Highway, develops a conceptual design alternative, and evaluates the impacts of the proposed lane elimination concept on existing and future traffic volumes. The project limits and corridor features are shown in Figure 1.

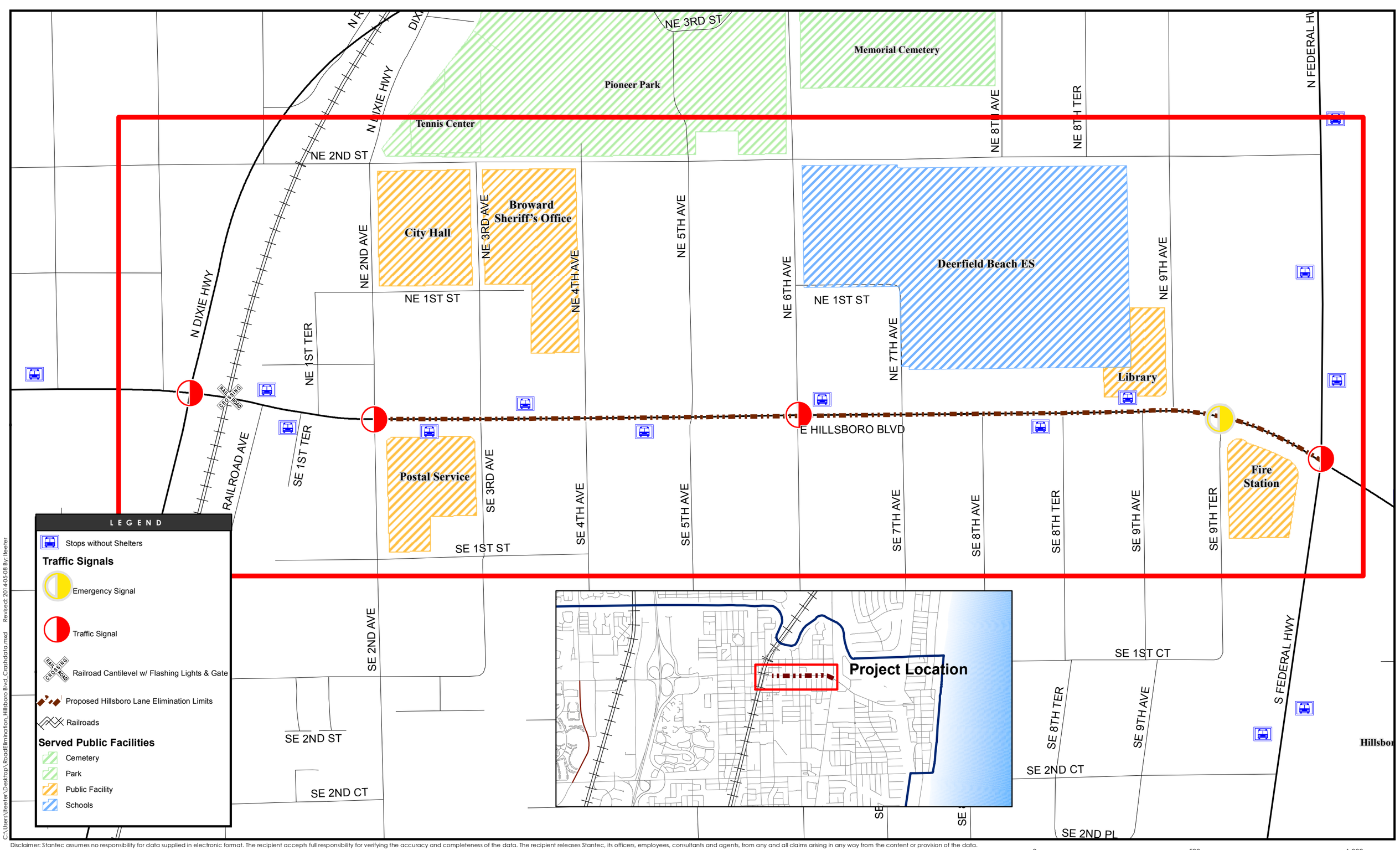

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Figure 1: Project Limits

Hillsboro Blvd Lane Elimination Study

AUGUST 2014

Prepared by: L.M.T. 04/30/14

Existing Conditions

Hillsboro Boulevard is designated as a hurricane evacuation route. Hillsboro Boulevard between Dixie Highway and NE/SE 2nd Avenue has a six-lane divided typical section, consistent with the typical section of Hillsboro Boulevard west of the project limits. The travel lanes are 11 feet wide and the right-of-way width varies from 100 feet to 120 feet. From NE/SE 2nd Avenue to Federal Highway, Hillsboro Boulevard has a seven-lane undivided typical section with three eastbound and three westbound travel lanes separated by a continuous two-way left turn lane (TWLTL). The outside travel lanes are 13 feet wide, the inside and center travel lanes are 11 feet wide, the TWLTL is 11 feet wide, and the right-of-way width is 100 feet. The posted speed on Hillsboro Boulevard within the project limits is 35 mph.

The TWLTL does not provide a protected refuge for left turning vehicles to make a two-stage left turn from side streets onto Hillsboro Boulevard or for pedestrians and bicyclists crossing Hillsboro Boulevard. Additionally, the TWLTL does not provide any access management along the corridor, as vehicle movements into and out of driveways are unrestricted.

At the Federal Highway intersection, Hillsboro Boulevard transitions from a seven-lane undivided typical section to a four-lane divided typical section with bike lanes. This is accomplished by the outside eastbound through lane becoming a right-turn only lane at Federal Highway and the southbound to westbound right-turn movement from Federal Highway free-flowing onto Hillsboro Boulevard creating the third westbound through lane west of the intersection.

Four signalized intersections are present along the Hillsboro Boulevard corridor at Dixie Highway, NE/SE 2nd Avenue, NE/SE 6th Avenue and Federal Highway. An emergency signal is located at SE 9th Terrace for the Deerfield Beach Fire-Rescue Station No. 1. Railroad tracks cross Hillsboro Boulevard just east of the Dixie Highway intersection. The railroad crossing is equipped with a cantilever with flashing lights and gates. Please refer to Figure 1 for a graphical representation of the existing features.

Broward County Transit Route 48 runs through the project limits and has four eastbound and four westbound transit stops (without shelters). Buses must stop in the outside through lane to pick-up or drop-off passengers. Route 48 buses run approximately every 45 minutes from 5:40 AM to 9:00 PM Monday through Friday and 6:15 AM to 9:00 PM on Saturdays. The Route 48 Ridership Report from October 2013 to January 2014 was reviewed and indicates that the four eastbound and four westbound bus stops within the study area are infrequently used. For the eastbound direction, the stop at SE 8th Terrace, near the library, is the most frequented stop with 24 average daily users. The other three eastbound stops have 11 or less users. For the westbound direction, the stop at NE 9th Avenue, again near the library, is the most frequented stop with 20 average

daily users. The other three westbound stops have five or less users. The Route 48 Ridership Report is attached in Appendix A.

The existing typical section of Hillsboro Boulevard west of the project limits (six-lane divided), within the project limits (seven-lane undivided), and east of the project limits (four-lane divided) are shown in the following three pictures. As shown in the pictures, the undivided section within the project limits is not consistent with the adjacent sections of Hillsboro Boulevard.

The zoning surrounding the project is Residential Office (RSO). This zoning category was specifically created for this section of Hillsboro Blvd. When FDOT expanded Hillsboro Blvd. in the 1980's, the land use was single-family residential. To help counteract the impacts to the property owners when the roadway was expanded, the City created a Residential Office zoning category and applied it to this section of Hillsboro Blvd. It allows both single-family residential and office uses. All the homes except one have since been developed into office uses with buildings that have a residential look. A map showing the surrounding zoning and land use can be found in Appendix A.

Hillsboro Boulevard
West of Dixie Hwy looking East

Hillsboro Boulevard
East of NE/SE 6th Ave looking West

Hillsboro Boulevard
East of Federal Hwy looking West

Concept Plan Development

The proposed concept plan reconstructs Hillsboro Boulevard between NE/SE 2nd Avenue and Federal Highway from a seven-lane undivided typical section to a four-lane divided typical section with bike lanes. The concept plan does not propose to change the six-lane divided section between Dixie Highway and NE/SE 2nd Avenue. The outside eastbound through lane will be converted to a right-turn only lane at the NE/SE 2nd Avenue intersection to drop from three eastbound through lanes to two eastbound through lanes. As an alternative, the outside eastbound through lane could be converted to a right-turn only lane at the Dixie Highway intersection to drop from three eastbound through lanes to two eastbound through lanes. This alternative was not the preferred alternative and therefore not evaluated as part of the analysis.

The concept plan proposes to shift the existing outside curb line of Hillsboro Boulevard inward to create a greater buffer between the existing edge of sidewalk and the back of curb. Shifting the curb line inward will reduce the roadway width from 81 feet to 73 feet. The new typical section will consist of four 11-foot travel lanes, a 1.75-foot bike buffer, two 5-foot bike lanes, and a 15.5-foot raised center median. The 15.5-foot raised center median is less than the standard 22-foot median width, but equal to the minimum allowable median width. The proposed typical section is included in the Concept Plans attached in Appendix B.

Hillsboro Boulevard has relatively low truck volumes. Like the existing typical section, the concept plan provides a wider outside lane to better accommodate truck traffic. To accommodate truck traffic onto the side streets where left turn access is provided, the end of the median was located based on a control radius of 60 feet. The 60-foot radius allows for the predominant use of SU-30 design vehicles and the occasional use of SU-40 and WB-40 design vehicles which is sufficient to handle the type of truck traffic utilizing the side streets within the project limits.

For the eastbound approach of Federal Highway, where the outside lane becomes a right-turn only lane under the existing conditions, a 410-foot right turn pocket is provided as part of the concept plan. The 410-foot right turn lane maximizes the distance between the SE 9th Avenue and Federal Highway intersections. Installing an eastbound right-turn pocket at the Federal Highway intersection, will avoid driver confusion by eliminating the current situation of vehicles who want to continue eastbound through the Federal Highway intersection from mistakenly being in the right-turn only lane. The horizontal curve prior to the Federal Highway intersection creates limited sight distance and drivers unfamiliar with the area in the outside lane do not realize it becomes a right-turn only lane. The Federal Highway intersection is the only location where a right-turn pocket is proposed. Like the existing conditions, the concept plan does not include any other right-turn pockets for side streets.

When the raised median is installed, full access to six of the side streets will be restricted. The parallel street network north and south of Hillsboro Boulevard will allow vehicles wanting to make left turns at the restricted side streets to do so at adjacent median openings. Another alternative will be U-turns at the adjacent median openings. The following side streets will be relegated to right-in/right-out access:

- NE/SE 3rd Avenue
- NE/SE 5th Avenue
- NE/SE 7th Avenue
- SE 8th Avenue
- SE 9th Avenue
- NE 9th Avenue

For the side streets where full access is allowed, left-turn lanes onto the side street were designed based on FDOT Standard Index 301 for a design speed of 40 mph (35 mph posted speed plus 5 mph). Based on Standard Index 301, a deceleration length of 155 feet is needed. In addition to the deceleration length, a minimum of 50 feet of queue storage was provided based on guidance from the AASHTO *Green Book*. Queue lengths longer than 50 feet were based on the 95th percentile queue lengths produced from the operational analysis. Within the project limits, only the eastbound left turn lane at Federal Highway has a 95th percentile queue length greater than 50 feet.

The Access Management Classification of Hillsboro Boulevard within the project limits identified by the Florida Department of Transportation (FDOT) is 'Class 6', which refers to a roadway without a restrictive median. When Hillsboro Boulevard is converted to a divided (restrictive) roadway, it is anticipated that the Access Management Classification will change to 'Class 5' to be consistent with the sections of Hillsboro Boulevard east and west of the project limits. Class 5 requires full median openings to be spaced 1,320 feet for posted speeds of 45 mph or less. The concept plan does restrict full access at six side streets; however, the 1,320-foot spacing is still not met for the full access median openings left within the project limits. This is consistent with the other Class 5 sections of Hillsboro Boulevard east and west of the project limits where full median openings were constructed that do not meet the 1,320-foot spacing requirement. An Access Management Plan was submitted so that the FDOT Access Management Committee can approve the median openings and turn lane lengths.

Consistency with the LRTP and Comprehensive Plan

A bicycle improvement project on Hillsboro Boulevard from Federal Highway to Natura Boulevard is shown on the Cost Feasible Bicycle Projects Map in the 2035 LRTP. The improvements from this project will coincide with the timing of the addition of the bike lanes from the MPO in the project area and will help increase non-driver safety in addition to the raised medians. This section of Hillsboro Boulevard is also shown as a four lane highway in the draft 2040 LRTP. A copy of the LRTP Cost Feasible Bicycle Projects Map and the draft 2040 LRTP Need Assessment Outreach Tool with this project listed can be found in Appendix A.

The Transportation Element of the City's Comprehensive Plan includes proposed bike lanes for the entire length of Hillsboro Boulevard (from A1A to the Turnpike). This project will be consistent with the City's Comprehensive Plan by adding the proposed bike lanes. A copy of the City's proposed Bike Lanes Map in the Transportation Element can be found in Appendix A. The City has also recently adopted Complete Streets Goals, Objectives and Policies (GOP's) into the Comprehensive Plan. This project will be consistent with those GOP's. A copy of the adopted GOP's can be found in Appendix A.

Community Outreach and Commission Support

A public workshop was held on the lane elimination project at City Hall on April 8, 2014 at 7:30 pm. The workshop was advertised in the Sun Sentinel on March 28th and letters were sent to all property owners and business owners directly abutting Hillsboro Blvd. from NE 2nd Ave. to NE 9th Ave. Thirty-two property owners and twenty-eight business owners were notified of the workshop. The workshop was also advertised on the City's website and Facebook page and was sent out through an e-mail blast to the City's subscriber list. The local Observer newspaper also published the information about the workshop. Copies of the Sun Sentinel ad, the sign in sheet, notes from the meeting, the notification map and letters and the flyer sent for the workshop are attached in Appendix C.

City staff gave a brief presentation on why the project is needed and the benefits of reducing the number of travel lanes and adding a landscaped median. The public was invited to speak on the project and ask questions about the project. The FDOT Resurfacing, Restoration, and Rehabilitation (RRR) Project Manager was also present and spoke on the project. Specific information contained in the presentation included the current annual average daily traffic (AADT) volumes for the corridor, renderings of the proposed design, cost savings associated with doing the lane elimination project in conjunction with the FDOT RRR project, and locations of the new proposed right-in/right-out access points. The workshop was attended by sixteen people from the public. The main concerns from the workshop were the impacts of reducing the lanes from 6 to 4 would have on the traffic congestion.

On March 4, 2014 a presentation was made to the City Commission regarding the lane elimination project. A resolution to award funding to Stantec to conduct the necessary studies and provide the concept plan and report was approved by the Commission, allowing staff to move forward with the project. A resolution of support to submit the lane elimination application to FDOT was approved by the City Commission on June 17, 2014. Both resolutions are attached in Appendix D.

Crash Data Analysis

The City of Deerfield Beach provided crash data from January 2007 to December 2012 between 2nd Avenue and NE 9th Avenue. A total of 118 crashes were reported. Of the 118 reported crashes, the majority were reported at intersections. The two most prevalent crash types reported were rear-end and angle crashes. Figure 2 shows the crashes sorted by site location and Figure 3 shows the crashes sorted by crash type.

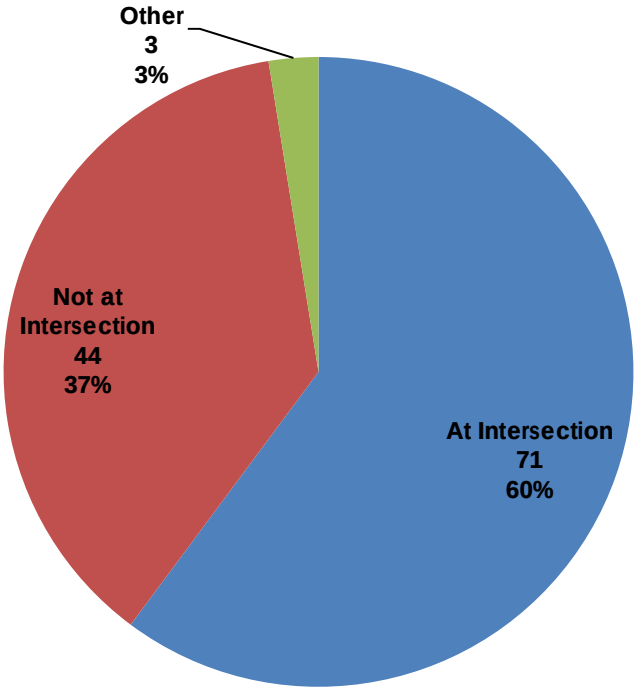

Figure 2: Crashes by Site Location

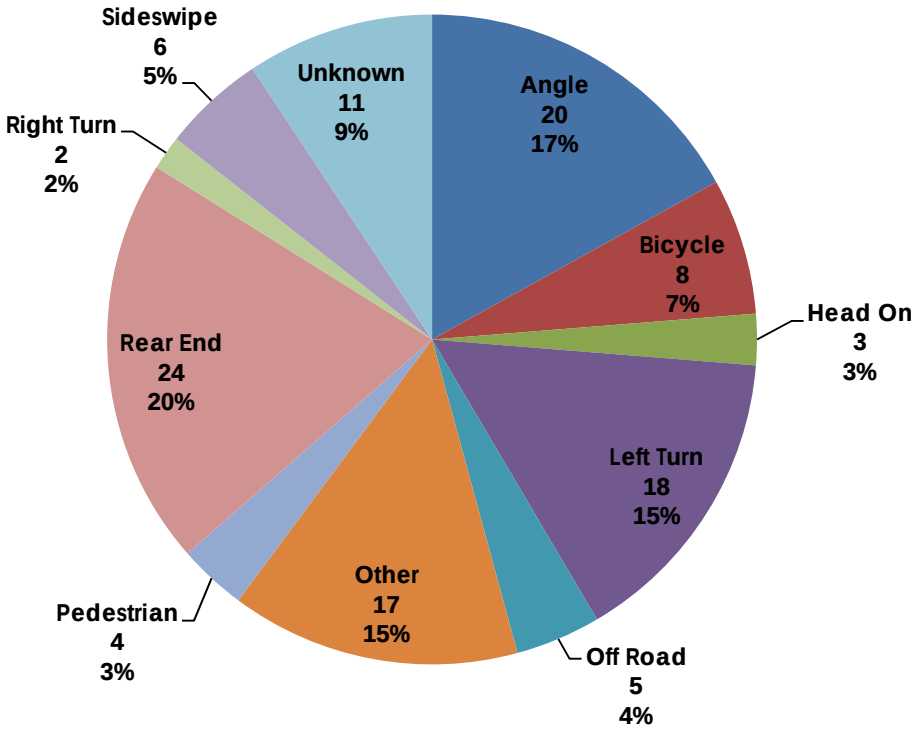

Figure 3: Crashes by Crash Type

Bicycle and pedestrian crashes represent approximately 10% of the total number of crashes. The one fatality reported occurred on September 7, 2012 when a pedestrian was struck at the NE/SE 3rd Avenue intersection. The location of the bicycle and pedestrian crashes are listed below.

Bicycle	Pedestrian
NE/SE 2nd Avenue (3)	NE/SE 3rd Avenue (3)
NE/SE 3rd Avenue (4)	NE/SE 6th Avenue (1)
NE 9th Avenue (1)	

The proposed lane elimination project will allow for safer bicycle and pedestrian operations. Bicyclist will now be able to operate in their own designated lane and pedestrians, who choose not to cross Hillsboro Boulevard at signalized intersections, will now have a raised median as a refuge area. In addition to the safety benefits provided to bicyclists and pedestrians, the lane elimination project will provide for safer vehicular operations.

At intersections, where the majority of the crashes were reported, the two most prevalent crash types were angle and left-turn crashes. The raised median will restrict the movements at certain intersections eliminating conflict points. For intersections with full access, the wider raised median opening will allow for safer operating conditions, and dedicated left-turn lanes at intersections to provide increase driver expectations and improve driver awareness.

Data Collection

Vehicle turning movement counts were conducted at the four signalized intersections and four of the six unsignalized intersections where full access is proposed to be eliminated by the lane elimination project. Turning movements were not taken at the NE/SE 3rd Avenue intersection or the NE/SE 7th Avenue intersection because it was not originally identified as needing to be a right-in/right-out connection.

The turning movement counts were taken on Wednesday January 22, 2014 and Thursday March 22, 2014 during the AM peak-period (8:00 AM to 10:00 AM), mid-day peak-period (11:00 AM to 1:00 PM), and PM peak-period (3:30 PM to 5:30 PM) to quantify existing AM, mid-day, and PM peak-hour conditions. The turning movement counts were then adjusted by the FDOT peak-season conversion factors published for Broward County.

Broward County Traffic Engineering was contacted to obtain the signal timing data for the signalized intersection within the project limits. The peak-season factors, turning movement counts, and signal timing information are attached in Appendix E.

Operational Analysis

An operational analysis was performed for the Hillsboro Boulevard corridor within the project limits for the AM, mid-day and PM peak hours. An existing conditions analysis was performed for the year 2014 and a design year analysis was performed for the year 2040. The existing and design year analyses were performed for both no-build and build alternatives to determine if the proposed lane elimination project would adversely impact the operations of the corridor.

2014 EXISTING ANALYSIS

The existing peak-season conditions were based on turning movement counts collected at the intersections within the project limits. An arterial analysis of Hillsboro Boulevard from Dixie Highway to Federal Highway as well as an operational analysis of the four signalized intersections was performed. For the build alternative, adjustments were made to the turning movement counts at the signalized intersections to account for those vehicles that will no longer be able to make left turns at five of the unsignalized intersections within the project limits.

To reflect how motorists would adjust their travel patterns as a result of the improvements, the left turn movements from Hillsboro Boulevard were reassigned as U-turn movements at the adjacent full median opening with the exception of NE 9th Avenue. For NE 9th Avenue, it was assumed that 60% of the left turn volume would utilize NE 6th Avenue and 40% would make a U-turn at Federal Highway. Left turn movements from the side streets were reassigned as right turn movements

which made U-turns at the adjacent full median opening or as left turn movements at an adjacent intersection.

Restricting the left turn access the five unsignalized intersection will not reassign a significant amount of traffic. The largest left turn volume from Hillsboro Boulevard was recorded at NE 9th Avenue during the mid-day peak-hour when 41 vehicles made an eastbound left turn. The largest left turn volume from a side street was recorded at SE 5th Avenue during the AM peak-hour when 17 vehicles made a northbound left turn. The 2014 existing no-build and build traffic volumes in tabular and graphical form are attached in Appendix F.

The existing no-build and build intersection analysis was performed using the Synchro Software. Existing signal timing was obtained from the Broward County Traffic Engineering Department. During the AM, mid-day, and PM peak hours, Broward County has 160 second coordinated signals within the study area. To try to maintain coordination with the adjacent signals outside the study area, the coordinated cycle lengths were not modified, but the phase splits were optimized for the various scenarios. The results of the existing no-build alternative signalized intersection analysis are summarized in Table 1 and indicate that all four intersections are operating at acceptable level-of-service standards with each movement having a volume to capacity (v/c) ratio less than 1.0.

Table 1: 2014 Existing No-Build Alternative Intersection Operating Conditions

Intersection	Type	Time Period	Overall Intersection LOS	Delay (sec/veh)	Max v/c Ratio	Approach LOS			
						EB	WB	NB	SB
Dixie Hwy & Hillsboro Blvd	Signalized	AM Peak	D	37.5	0.74	D	C	D	D
		Mid-Day Peak	C	28.6	0.83	C	B	D	D
		PM Peak	D	41.4	0.77	D	C	D	E
2nd Ave & Hillsboro Blvd	Signalized	AM Peak	A	8.1	0.54	A	A	D	E
		Mid-Day Peak	A	8.1	0.61	A	A	D	E
		PM Peak	A	8.3	0.68	A	A	D	E
6th Ave & Hillsboro Blvd	Signalized	AM Peak	A	6.6	0.45	A	A	E	D
		Mid-Day Peak	A	5.8	0.54	A	A	E	D
		PM Peak	A	5.3	0.48	A	A	E	D
Federal Hwy & Hillsboro Blvd	Signalized	AM Peak	D	45.9	0.85	D	E	D	D
		Mid-Day Peak	D	49.9	0.87	D	E	D	D
		PM Peak	D	49.8	0.79	D	E	D	D

The results of the existing build alternative signalized intersection analysis are summarized in Table 2 and indicate all four intersections are anticipated to operate at acceptable level-of-service standards with each movement having a volume to capacity (v/c) ratio less than 1.0. The results of the build alternative analysis produce similar delay and v/c ratios when compared to the no-build alternative.

Table 2: 2014 Existing Build Alternative Intersection Operating Conditions

Intersection	Type	Time Period	Overall Intersection LOS	Delay (sec/veh)	Max v/c Ratio	Approach LOS			
						EB	WB	NB	SB
Dixie Hwy & Hillsboro Blvd	Signalized	AM Peak	D	38.9	0.74	D	C	D	D
		Mid-Day Peak	C	28.9	0.83	C	B	D	D
		PM Peak	D	41.9	0.77	D	C	D	E
2nd Ave & Hillsboro Blvd	Signalized	AM Peak	A	8.5	0.54	A	A	D	E
		Mid-Day Peak	A	8.8	0.61	A	A	D	E
		PM Peak	A	9.1	0.68	A	A	D	E
6th Ave & Hillsboro Blvd	Signalized	AM Peak	A	5.9	0.53	A	A	E	D
		Mid-Day Peak	A	6.6	0.55	A	A	E	D
		PM Peak	A	6.8	0.53	A	A	E	D
Federal Hwy & Hillsboro Blvd	Signalized	AM Peak	D	46.5	0.88	D	E	D	D
		Mid-Day Peak	D	50.4	0.86	D	E	D	D
		PM Peak	D	50.4	0.81	D	E	D	D

A Synchro analysis of the unsignalized intersections, where left turn access is prohibited by the build alternative, was not performed. The build alternative removes the left turn delay on Hillsboro Boulevard and improves side street delay by only allowing right turn movements, which typically experience less delay than left turn movements due to only crossing one stream of traffic.

In addition to the signalized intersection analysis, an arterial analysis of Hillsboro Boulevard within the project limits was performed. Like the intersection analysis, the results of the arterial analysis for the no-build and build alternatives produce similar results. Throughout the three peak periods evaluated, the build alternative increases the travel time by an average of 1.2 seconds and decreases the travel speed by an average of 0.2 mph for the eastbound direction of Hillsboro Boulevard and increases the travel time by an average of 3.0 seconds and decreases the travel speed by an average of 0.6 mph for the westbound direction of Hillsboro Boulevard. The results of the existing no-build and build alternatives are shown in Table 3.

Table 3: 2014 Existing No-Build and Build Alternative Arterial Operating Conditions

Time Period	Road Name & Segment	Travel Direction	No-Build (6-Lane)			Build (4-Lane)		
			Travel Time (sec)	Speed (mph)	LOS	Travel Time (sec)	Speed (mph)	LOS
AM Peak	**Hillsboro Boulevard**							
	Dixie Hwy to 2nd Ave	EB	18.9	21.3	C	19.7	20.5	C
		WB	**35.0**	**11.5**	**E**	**39.8**	**10.1**	**E**
	2nd Ave to 6th Ave	EB	30.4	29.4	B	30.7	29.1	B
		WB	32.1	27.8	B	32.5	27.5	B
	6th Ave to Federal Hwy	EB	77.2	14.6	D	76.8	14.7	D
		WB	43.7	25.8	B	40.8	27.7	B
	ARTERIAL TOTAL	**EB**	**126.5**	**19.2**	**C**	**127.2**	**19.1**	**C**
		WB	**110.8**	**21.9**	**C**	**113.1**	**21.4**	**C**
Mid-Day Peak	**Hillsboro Boulevard**							
	Dixie Hwy to 2nd Ave	EB	17.6	22.9	C	19.5	20.7	C
		WB	26.0	15.5	D	26.9	15.0	D
	2nd Ave to 6th Ave	EB	30.4	29.4	B	31.0	28.8	B
		WB	33.5	26.7	B	33.4	26.8	B
	6th Ave to Federal Hwy	EB	79.3	14.2	D	79.9	14.1	D
		WB	43.7	25.8	B	44.6	25.3	B
	ARTERIAL TOTAL	**EB**	**127.3**	**19.1**	**C**	**130.4**	**18.6**	**C**
		WB	**103.2**	**23.5**	**C**	**104.9**	**23.1**	**C**
PM Peak	**Hillsboro Boulevard**							
	Dixie Hwy to 2nd Ave	EB	17.5	23.0	C	18.9	21.3	C
		WB	**37.0**	**10.9**	**E**	**38.8**	**10.4**	**E**
	2nd Ave to 6th Ave	EB	30.2	29.6	B	30.5	29.3	B
		WB	33.7	26.5	B	34.5	25.9	B
	6th Ave to Federal Hwy	EB	80.3	14.1	D	78.3	14.4	D
		WB	42.8	26.4	B	45.1	25.0	B
	ARTERIAL TOTAL	**EB**	**128.0**	**19.0**	**C**	**127.7**	**19.0**	**C**
		WB	**113.5**	**21.4**	**C**	**118.4**	**20.5**	**C**

The no-build and build alternatives both result in an overall corridor level-of service of C for both the eastbound and westbound directions. All sub-segments operate at level-of-service D or better except for the westbound direction between NE/SE 2nd Avenue and Dixie Highway during the AM and PM peak hours. This condition exists in both the no-build and build alternatives. It should be noted that the build alternative is not eliminating a westbound lane between NE/SE 2nd Avenue and Dixie Highway. The build alternative does not result in significant degradation of the existing intersection or arterial operating conditions.

The existing no-build alternative Synchro intersection and arterial worksheets are provided in Appendix G, the existing build alternative Synchro intersection and arterial worksheets are provided in Appendix H, and electronic versions of the files are attached on the accompanying DVD.

2040 DESIGN YEAR ANALYSIS

The existing peak-season traffic volumes were forecast to 2040 volumes based on the results of the FDOT *Traffic Projections, 18 KIP ESAL Report* dated March 4, 2014. The 2035 Southeast Florida Regional Planning Model (SERPM) 6.5 was used to forecast future traffic volumes. Hillsboro Boulevard from NE/SE 2nd Avenue to Federal Highway was coded as a four-lane roadway to represent the conditions when the lane elimination is implemented. The SERPM exhibited a negative growth rate. In lieu of a negative growth rate, a 0.5% annual growth rate was used to forecast the 2040 volumes. Unlike, the *Traffic Projections, 18 KIP ESAL Report*, this analysis took a more conservative approach by applying the 0.5% growth rate from 2014, compared to starting it in 2017 after three years of decreased traffic volumes. The FDOT *Traffic Projections, 18 KIP ESAL Report* is attached is Appendix I.

Again, an arterial analysis of Hillsboro Boulevard from Dixie Highway to Federal Highway as well as an operational analysis of the four signalized intersections was performed. For the build alternative, the same adjustments to the turning movement counts at the signalized intersections were made to account vehicles no longer able to make left turns at five of the unsignalized intersections within the project limits. The 2040 design year no-build and build traffic volumes in tabular and graphical form are attached in Appendix C.

The Synchro software was used for the design year no-build and build intersection analysis. The results of the design year no-build alternative signalized intersection analysis are summarized in Table 4 and indicate that all four intersections are anticipated to operate at acceptable level-of-service standards with each movement having a volume to capacity (v/c) ratio less than 1.0.

Table 4: 2040 Design Year No-Build Alternative Intersection Operating Conditions

Intersection	Type	Time Period	Overall Intersection LOS	Delay (sec/veh)	Max v/c Ratio	Approach LOS			
						EB	WB	NB	SB
Dixie Hwy & Hillsboro Blvd	Signalized	AM Peak	D	43.1	0.90	D	C	E	D
		Mid-Day Peak	C	32.2	0.88	C	B	D	D
		PM Peak	D	46.6	0.88	D	C	E	E
2nd Ave & Hillsboro Blvd	Signalized	AM Peak	A	8.1	0.56	A	A	D	E
		Mid-Day Peak	A	7.9	0.65	A	A	D	E
		PM Peak	A	8.7	0.70	A	A	D	E
6th Ave & Hillsboro Blvd	Signalized	AM Peak	A	5.4	0.49	A	A	E	D
		Mid-Day Peak	A	5.6	0.57	A	A	E	D
		PM Peak	A	5.7	0.51	A	A	E	D
Federal Hwy & Hillsboro Blvd	Signalized	AM Peak	D	48.2	0.81	D	E	D	D
		Mid-Day Peak	D	53.0	0.90	D	E	D	E
		PM Peak	D	53.7	0.84	D	E	D	E

The results of the design year build alternative signalized intersection analysis are summarized in Table 5 and indicate all four intersections are anticipated to operate at acceptable level-of-service standards with each movement having a volume to capacity (v/c) ratio less than 1.0. The results of the build alternative analysis produce similar delay and v/c ratios when compared to the no-build alternative.

Table 5: 2040 Design Year Build Alternative Intersection Operating Conditions

Intersection	Type	Time Period	Overall Intersection LOS	Delay (sec/veh)	Max v/c Ratio	Approach LOS			
						EB	WB	NB	SB
Dixie Hwy & Hillsboro Blvd	Signalized	AM Peak	D	43.0	0.90	D	C	E	C
		Mid-Day Peak	C	32.8	0.88	C	B	D	D
		PM Peak	D	47.3	0.88	D	C	E	E
2nd Ave & Hillsboro Blvd	Signalized	AM Peak	A	8.9	0.56	A	A	D	E
		Mid-Day Peak	B	10.4	0.65	A	A	D	E
		PM Peak	A	9.8	0.70	A	A	D	E
6th Ave & Hillsboro Blvd	Signalized	AM Peak	A	6.2	0.56	A	A	E	D
		Mid-Day Peak	A	7.8	0.59	A	A	E	D
		PM Peak	A	7.3	0.57	A	A	E	D
Federal Hwy & Hillsboro Blvd	Signalized	AM Peak	D	48.9	0.83	D	E	D	D
		Mid-Day Peak	D	53.3	0.90	D	E	D	E
		PM Peak	D	54.5	0.88	D	E	D	E

To ensure adequate queue storage is provided for the newly created westbound left turn pocket at NE/SE 2nd Avenue signalized intersection, the eastbound and westbound left turn pockets at the NE/SE 6th Avenue signalized intersection and the eastbound left and right turn pockets at the Federal Highway signalized intersection, the 95th percentile queue lengths were reviewed. Table 6 summarizes the required turn lane lengths at the signalized intersections.

Table 6: 2040 Design Year Build Alternative Turn Lane Requirements

Intersection	Auxillary Lane	Time Period	95th Perentile Queue (ft)	Deceleration Length (ft)	Total Length (ft)	Provided Length[1] (ft)
2nd Ave & Hillsboro Blvd	WB Left	AM Peak	8	155	173	205
		Mid-Day Peak	9			
		PM Peak	18			
6th Ave & Hillsboro Blvd	EB Left	AM Peak	7	155	176	205
		Mid-Day Peak	21			
		PM Peak	7			
	WB Left	AM Peak	2	155	180	205
		Mid-Day Peak	8			
		PM Peak	25			
Federal Hwy & Hillsboro Blvd	EB Left	AM Peak	278	155	492	395[2]
		Mid-Day Peak	288			
		PM Peak	337			
	EB Right	AM Peak	154	155	521	410[3]
		Mid-Day Peak	366			
		PM Peak	265			

1. A minimum of 50 feet of queue storage was provided.
2. Provided storage length constrained by NE 9th Avenue
3. Provided storage length constrained by SE 9th Avenue

As mentioned in the Data Collection section, turning movement data was only collected at the signalized intersections and unsignalized intersections where full access was proposed to be eliminated. Data was not collected at the NE/SE 4th Avenue or SE 8th Terrace unsignalized intersections where left turn movements from Hillsboro Boulevard will still be permitted after the installation of the raised median. However, based on a maximum of 41 left turning vehicles observed during the AM, mid-day, and PM peak hours at the other four unsignalized intersections in the project limits, it is not anticipated that a large volume of vehicles requiring more than 50 feet of queue storage will be required.

In addition to the signalized intersection analysis, an arterial analysis of Hillsboro Boulevard within the project limits was performed. Like the intersection analysis, the results of the arterial analysis for the no-build and build alternatives produce similar results. Throughout the three peak periods evaluated, the build alternative increases the travel time by an average of 3.4 seconds and decreases the travel speed by an average of 0.5 mph for the eastbound direction of Hillsboro Boulevard and increases the travel time by an average of 4.7 seconds and decreases the travel speed by an average of 0.9 mph for the westbound direction of Hillsboro Boulevard. The results of the existing no-build and build alternatives are shown in Table 7.

Table 7: 2040 Design Year No-Build and Build Alternative Arterial Operating Conditions

Time Period	Road Name & Segment	Travel Direction	No-Build (6-Lane)			Build (4-Lane)		
			Travel Time (sec)	Speed (mph)	LOS	Travel Time (sec)	Speed (mph)	LOS
AM Peak	**Hillsboro Boulevard**							
	Dixie Hwy to 2nd Ave	EB	18.9	21.3	C	20.4	19.8	C
		WB	**44.2**	**9.1**	**F**	**46.1**	**8.7**	**F**
	2nd Ave to 6th Ave	EB	30.5	29.3	B	31.3	28.6	B
		WB	32.3	27.7	B	33.0	27.1	B
	6th Ave to Federal Hwy	EB	75.5	15.0	D	74.3	15.2	D
		WB	40.9	27.6	B	41.1	27.5	B
	ARTERIAL TOTAL	**EB**	**124.9**	**19.4**	**C**	**126.0**	**19.3**	**C**
		WB	**117.4**	**20.7**	**C**	**120.2**	**20.2**	**C**
Mid-Day Peak	**Hillsboro Boulevard**							
	Dixie Hwy to 2nd Ave	EB	17.3	23.3	C	22.2	18.2	C
		WB	**30.0**	**13.4**	**E**	**31.5**	**12.8**	**E**
	2nd Ave to 6th Ave	EB	30.9	28.9	B	32.5	27.5	B
		WB	32.5	27.5	B	33.1	27.0	B
	6th Ave to Federal Hwy	EB	74.2	15.2	D	74.0	15.3	D
		WB	42.6	26.5	B	45.4	24.9	B
	ARTERIAL TOTAL	**EB**	**122.4**	**19.8**	**C**	**128.7**	**18.8**	**C**
		WB	**105.1**	**23.1**	**C**	**110.0**	**22.1**	**C**
PM Peak	**Hillsboro Boulevard**							
	Dixie Hwy to 2nd Ave	EB	17.8	22.6	C	19.0	21.2	C
		WB	**39.9**	**10.1**	**E**	**42.4**	**9.5**	**F**
	2nd Ave to 6th Ave	EB	30.4	29.4	B	30.7	29.1	B
		WB	33.9	26.4	B	35.4	25.3	B
	6th Ave to Federal Hwy	EB	75.3	15.0	D	76.5	14.8	D
		WB	43.4	26.0	B	45.7	24.7	B
	ARTERIAL TOTAL	**EB**	**123.5**	**19.6**	**C**	**126.2**	**19.2**	**C**
		WB	**117.2**	**20.7**	**C**	**123.5**	**19.6**	**C**

The no-build and build alternatives both result in an overall corridor level-of service of C for both the eastbound and westbound directions. All sub-segments operate at level-of-service D or better except for the westbound direction between NE/SE 2nd Avenue and Dixie Highway. This condition exists in both the no-build and build alternatives. It should be noted that the build alternative is not eliminating a westbound lane between NE/SE 2nd Avenue and Dixie Highway. Like the existing conditions, the build alternative does not result in significant degradation of the design year intersection or arterial operating conditions.

The 2040 design year no-build alternative Synchro intersection and arterial worksheets are provided in Appendix J, the 2040 design year build alternative Synchro intersection and arterial worksheets are provided in Appendix K, and electronic versions of the files are attached on the accompanying DVD.

Qualitative Assessment

As the operational analysis demonstrated, reducing the number of through lanes from six to four will not have an adverse impact on the operation of the corridor. In addition, the proposed lane elimination project will provide numerous benefits to the Hillsboro Boulevard corridor. Benefits provided by the lane elimination project include:

- Improved access management which improves traffic flow and reduces potential conflict points
- Improved safety at side street and driveway access points by reducing conflict points
- Improved safety for vehicles by providing a raised median and dedicated left-turn lanes
- Improved safety for pedestrians, and bicyclist by providing a raised median
- Safer bicycle operations with a dedicated bicycle lane and bike buffer
- Increased buffer between the travel lanes and sidewalk
- Enhanced lighting and landscaping
- Consistency with the adjacent sections of Hillsboro Boulevard
- Improved driver expectation for the eastbound right turn movement at Federal Highway by providing a dedicated right turn lane

With most roadway projects, no matter how great the benefits may be, improvements may also have their drawbacks. The Hillsboro Boulevard lane elimination project is no different. The potential drawbacks to the lane elimination project are:

- Reduced capacity
- Increased bus blockage
- Less convenient side street and driveway access

While the lane elimination project will reduce the capacity of the corridor, the existing volumes are more in line with four-lane roadway volumes. Since the future traffic volumes are conducive to a four-lane roadway, it is unlikely that the lane elimination will result in the diversion of any traffic onto parallel facilities. Additionally, there is not parallel route that provides a more attractive alternative to the 0.67 mile stretch of Hillsboro Boulevard where the lane elimination is proposed.

The operational analysis confirms that a four-lane facility will adequately accommodate the future traffic volumes. The no-build and build alternatives produce similar operating results. Given that minimal growth is expected along the corridor, it is not anticipated that additional capacity of the two eliminated through lanes will be needed in the next 30 years. Because of that, the benefits (listed above) gained by eliminating the lanes and changing to a four-lane typical section far outweigh the drawbacks.

This is especially important because Hillsboro Boulevard is designated as a hurricane evacuation route. Because the existing roadway volumes are more in line with volumes of a four lane roadway, minimal growth is expected along the corridor, and the fact that the lane elimination project will match the four-lane typical section east of the project limits, the project is not anticipated to reduce the overall efficiency of the evacuation route.

By reducing the travel lanes from six to four, the percentage of vehicles blocked by busses stopped to pick-up or drop-off passengers will increase. However, the frequency of the bus service (45 minute headways) and limited number of stops will not have a significant impact to traffic flow. Traffic operations within the project limits will be comparable to the four-lane section of Hillsboro Boulevard to the east of the project limits which is serviced by the same bus route.

Broward County Transit was contacted and according to the Transportation Development Plan, slated improvements within the next ten years are to extend Route 48 to the Coconut Creek Casino and expand the span service. The expanded span service is the only improvement currently on the books. The expanded span service will extend the hours of operation later into the evening. The slated improvements are not anticipated to create a significant change in from the current bus operations, especially given that the low ridership within the study area and the headway between buses will not change.

At the five unsignalized intersections where full access will be restricted, a vehicle wanting to make a left turn movement from Hillsboro Boulevard onto the side street will need to make a U-turn at an adjacent median opening or a left turn at a different side street and use the parallel roadway network to get to their destination. A vehicle wanting to make a left turn movement from a side street onto Hillsboro Boulevard will need to make a right turn and then a U-turn at the adjacent full median opening, or use the parallel roadway network in order to make a left turn movement at an adjacent intersection.

The roadway network in the vicinity of Hillsboro Boulevard allows vehicles needing to make the restricted movements numerous alternatives. Based on the volumes collected at the impacted unsignalized intersections, the proposed improvements would not impact a significant amount of traffic. Additionally, FDOT research has shown that making a right turn and then a U-turn at an

adjacent median opening is safer than making a left turn from a side street at an unsignalized intersection.

Cost Estimate

The estimated cost for the lane elimination project is shown in Table 8 and includes design, permitting, construction, and construction support activities. No additional right-of-way needs are required for construction. The costs developed for this report should be used for preliminary estimating purposes only and represents present day costs.

This project will coincide with the scheduled FDOT RRR project for Hillsboro Boulevard from Military Trail to Federal Highway. Construction for this segment is scheduled to take place in the Spring of 2016. Because of this, most of the funding, about 65%, will be covered under the scope of the RRR project such as milling, new asphalt, restriping, etc. The Broward MPO is contributing $2.4 million to cover the costs of adding bike lanes throughout the scope of the RRR project, including the lane elimination area. The Broward MPO is also contributing an additional $279,701 to cover the costs of adding the median and pedestrian lighting. The remaining costs for landscaping irrigation will be paid by the City using the Road and Bridge Fund.

Table 8: Cost Estimate

Item No.	Item Description	Unit	Quantity	Unit Cost	Cost
	Engineering Design and Permitting[1]	LS	1	$ 328,669.35	$ 328,670
	Construction Engineering Inspection[2]	LS	1	$ 219,112.90	$ 219,113
0101 1	Mobilization[2]	LS	1	$ 219,112.90	$ 219,113
0102 1	Maintenance of Traffic[1]	LS	1	$ 328,669.35	$ 328,670
0110 1 1	Clearing & Grubbing	AC	0.74	$ 36,170.38	$ 26,767
0110 4	Removal of Existing Concrete Pavement	SY	1,159	$ 42.28	$ 49,014
0120 1	Regular Excavation	CY	60	$ 12.89	$ 774
0160 4	Type B Stabilization	SY	40	$ 8.13	$ 326
0162 1 12	Prepared Soil Layer, Finish Soil, 12"	SY	2,650	$ 6.00	$ 15,900
0285 706	Optional Base Group 06	SY	40	$ 16.77	$ 671
0327 70 2	Milling Existing Asphalt Pavement, 3.5" Avg. Depth	SY	25,700	$ 2.35	$ 60,395
0334 1 13	Superpave Asphaltic Concrete, Traffic C	TN	2,840	$ 104.95	$ 298,058
0337 7 43	Asphaltic Concrete FC, Traffic C, FC 12.5, PG 76-22	TN	2,130	$ 97.90	$ 208,527
0425 1910	Inlets, Closed Flume	EA	15	$ 7,224.00	$ 108,360
0425 5	Manhole, Adjust	EA	1	$ 500.10	$ 501
0520 1 10	Concrete Curb and Gutter, Type F	LF	6,410	$ 25.03	$ 160,443
0520 2 4	Concrete Curb, Type D	LF	2,250	$ 24.21	$ 54,473
0522 1	Concrete Sidewalk and Driveways, 4" Thick	SY	3,415	$ 52.24	$ 178,400
0522 2	Concrete Sidewalk and Driveways, 6" Thick	SY	290	$ 58.99	$ 17,108
0580 1 1	Landscape Complete - Small Plants	LS	1	$ 130,000.00	$ 130,000
0580 1 2	Landscape Complete - Large Plants	LS	1	$ 227,750.00	$ 227,750
0590 70	Irrigation System	LS	1	$ 30,000.00	$ 30,000
0700 1 11	Single Post Sign, F&I, Less than 12 SF	EA	12	$ 550.00	$ 6,600
0700 1 50	Single Post Sign, Relocate	EA	2	$ 188.15	$ 377
0705 11 3	Delineator, Flexible High Visibility Median	EA	8	$ 162.31	$ 1,299
0706 3	Reflective Pavement Markers (W/R)	EA	222	$ 3.37	$ 749
0706 3	Reflective Pavement Markers (Y/Y)	EA	40	$ 3.37	$ 135
0710 11290	Painted Pavement Markings, Yellow, Island Nose	SF	10	$ 2.00	$ 20
0711 11123	Thermoplastic, White, Solid, 12"	LF	2185	$ 1.89	$ 4,130
0711 11125	Thermoplastic, White, Solid, 24"	LF	1275	$ 3.70	$ 4,718
0711 11151	Thermoplastic, White, Skip, 6" (6/10)	LF	170	$ 1.04	$ 177
0711 11151	Thermoplastic, White, Skip, 6" (2/4)	LF	1475	$ 1.04	$ 1,534
0711 11160	Thermoplastic, Pavement Message (SCHOOL)	EA	6	$ 151.02	$ 907
0711 11160	Thermoplastic, Pavement Message (ONLY)	EA	3	$ 151.02	$ 454
0711 11170	Thermoplastic, Arrows (Right Directional Arrow)	EA	7	$ 54.31	$ 381
0711 11170	Thermoplastic, Arrows (Left Directional Arrow)	EA	18	$ 54.31	$ 978
0711 11251	Thermoplastic, Yellow, Skip, 6" (6/10)	LF	168	$ 1.01	$ 170
0711 14160	Thermoplastic, Preformed, Pavement Message (Bike Symbol)	EA	19	$ 260.92	$ 4,958
0711 14170	Thermoplastic, Preformed, Arrows (Bike Thru Arrow)	EA	19	$ 199.17	$ 3,785
0711 16111	Thermoplastic, Std - Other Surfaces, White, Solid, 6"	NM	1.70	$ 4,308.39	$ 7,325
0711 16131	Thermoplastic, Std - Other Surfaces, White, Skip, 6" (10/30)	GM	0.88	$ 1,293.00	$ 1,138
0711 16133	Thermoplastic, Std - Other Surfaces, White, Skip, 12" (3/9)	GM	0.05	$ 2,068.09	$ 104
0711 16211	Thermoplastic, Std - Other Surfaces, Yellow, Solid, 6"	NM	0.95	$ 4,434.49	$ 4,213
0999 00	Light Pole Complete - Special Design	EA	30	$ 19,317.00	$ 579,510
0999 10	Utility Adjustments[3]	LS	1	$ 109,556.45	$ 109,557
	OPINION OF COST				$ 3,396,252

1. Assumed 15% of the construction cost

2. Assumed 10% of the construction cost

3. Assumed 5% of the construction cost

Conclusion

The Hillsboro Boulevard Lane Elimination project aims to improve vehicular, pedestrian, and bicycle safety along Hillsboro Boulevard (SR 810) from Dixie Highway (SR 811) to Federal Highway (US 1). This will be accomplished by changing the typical section from a seven-lane undivided roadway to a four-lane divided roadway with bike lanes. The proposed divided typical section is consistent with the typical sections east and west of the project limits in that they are also divided.

The concept plan proposes to shift the existing outside curb line of Hillsboro Boulevard inward to create a greater buffer between the existing edge of sidewalk and the back of curb. Shifting the curb line inward will reduce the roadway width from 81 feet to 73 feet. The new typical section will consist of four 11-foot travel lanes, a 1.75-foot bike buffer, two 5-foot bike lanes, and a 15.5-foot raised center median.

When the raised median is installed, full access to six side streets will be restricted. The parallel street network north and south of Hillsboro Boulevard will allow vehicles wanting to make left turns at the restricted side streets to do so at adjacent median openings. Another alternative will be U-turns at the adjacent median openings. The following side streets will be relegated to right-in/right-out access:

- NE/SE 3rd Avenue
- NE/SE 5th Avenue
- NE/SE 7th Avenue
- SE 8th Avenue
- SE 9th Avenue
- NE 9th Avenue

Like the existing conditions, the concept plan does not propose right-turn pockets for any of side streets. For the eastbound approach of Federal Highway, where the outside lane becomes a right-turn only lane under the existing conditions, a 410-foot right turn pocket is provided as part of the concept plan.

An operational analysis was performed for the Hillsboro Boulevard corridor within the project limits for the AM, mid-day and PM peak hours. An existing conditions analysis was performed for the year 2014 and a design year analysis was performed for the year 2040. The existing and design year analyses were performed for both no-build and build alternatives and demonstrate that reducing the number of through lanes from six to four will not have an adverse impact on the operation of the corridor. The build alternative does not result in significant degradation of either the existing or design year intersection or arterial operating conditions. Both the no-build and build alternatives produce similar level-of-service, delay, travel time, and speed results.

In addition, the lane elimination project will provide numerous benefits to the Hillsboro Boulevard corridor including:

- Improved access management which improves traffic flow and reduces potential conflict points
- Improved safety at side street and driveway access points by reducing conflict points
- Improved safety for vehicles by providing a raised median and dedicated left-turn lanes
- Improved safety for pedestrians, and bicyclist by providing a raised median
- Safer bicycle operations with a dedicated bicycle lane and bike buffer
- Increased buffer between the travel lanes and sidewalk
- Enhanced lighting and landscaping
- Consistency with the adjacent sections of Hillsboro Boulevard
- Improved driver expectation for the eastbound right turn movement at Federal Highway by providing a dedicated right turn lane

Given that the existing and future traffic volumes are more in line with four-lane roadway volumes, the lane elimination does not create any adverse operational impacts. With the added benefits listed above, it is recommended that Hillsboro Boulevard within the project limits be converted from a seven-lane undivided roadway to a four-lane divided roadway with bike lanes.

APPENDIX A

ROUTE 48 RIDERSHIP REPORT

ZONING AND FUTURE LAND USE MAP

LRTP COST FEASIBLE BICYCLE MAP

2040 LRTP NEED ASSESSMENT OUTREACH TOOL

BICYCLE FACILITIES MAP

CITY OF DEERFIELD BEACH COMPLETE STREETS GOPs