7. SAFETY ANALYSIS

The safety analysis focused on the freeway segments (basic and merge/diverge) in the vicinity of the interchange of I-75 at SR 951. The segments along the I-75 freeway mainline were analyzed using the Highway Safety Manual 2010 - 1st Edition (HSM 1st Edition) methodologies by means of the Enhanced Interchange Safety Analysis Tool (ISATe). The safety analysis was consistent with the procedure presented in the 2022 IARUG and the IARUG Safety Analysis Guidance.

The HSM methodologies allowed to quantitatively assess the geometric (where applicable) for the roadway segments in the study area.

The most recent five years of crash data (2017-2021) were obtained through FDOT D1 and were downloaded from various sources including FDOT's CARS database, FDOT SSOGIS database, and Signal Four Data Analytics.

7.1. HISTORICAL CRASH ANALYSIS

The historical crash analysis was initiated by evaluating the safety conditions for the segment of I-75 between the Everglades Boulevard interchange (MP 41.520) up to just east of the interchange with CR 886 (MP 43.349).

A more detailed crash analysis was conducted for the segments of I-75 directly adjacent to the interchange with SR 951/Collier Boulevard. The limits were picked as MP 49.53, approximately 3,000 feet east of the subject interchange and (MP 51.04), approximately 1,500 feet west. The limits used were selected to cover the segments along I-75 where the RFP Concept and D/B Concept were proposing changes.

The purpose of these two analyses was to determine if the segments of I-75 immediately adjacent to the interchange with SR 951/Collier Boulevard will result in different crash frequencies. Crash summary worksheets are included in **Appendix J**.

7.1.1. CRASH ANALYSIS BETWEEN EVERGLADES BOULEVARD AND EAST OF THE INTERCHANGE WITH CR 886

Table 20 summarizes the results for the crashes occurring along I-75 between Everglades Boulevard interchange (MP 41.520) and just east of CR 886 interchange (MP 43.349), a distance of approximately 1.829 miles. Within this segment a total of 379 crashes were reported. As seen in **Table 20,** the number of crashes per year were as follows: 70 crashes in 2017, 84 crashes in 2018, 67 crashes in 2019, 63 crashes in 2020, and 95 crashes in 2021. Overall, the number of crashes seems to be relatively constant through the years, except for the year 2021 where an increase of about 33% (when compared to the previous year) was calculated.

The top three leading crash types consisted of crashes with Fixed Object (28%), Sideswipe with (22%), and Rear End (21%) crashes. Additionally, there was 1 (<1%) Pedestrian and no Bicycle related crashes, during the referenced five-year period. Based on crash severity, 271 (72%) were Property Damage Only crashes, 103 (27%) were Injury crashes, and 5 (1%) were Fatal crashes. The detailed police reports of the Fatal and Pedestrian type crashes are attached in **Appendix J**. There were 144 (38%) Dark/Dusk/Dawn crashes reported and there were 67 (18%) crashes reported to have occurred under Wet/Slippery pavement conditions.

Table 21: Entire Study Corridor Crash Statistics

I-75 Study Freeway Limits from NB CR 886 Off Ramp to EB/WB Everglades Blvd On/Off Ramps Segment/Spot with No Expected Values Available		Number of Crashes					5 Year Total Crashes	Mean Crashes Per Year	%
		Year							
		2017	2018	2019	2020	2021			
CRASH TYPE	Rear End	12	20	12	16	18	78	15.60	20.6%
	Head On	0	0	0	0	0	0	0.00	0.0%
	Angle	1	4	1	5	6	17	3.40	4.5%
	Left Turn	0	0	0	0	0	0	0.00	0.0%
	Right Turn	1	0	0	0	0	1	0.20	0.3%
	Sideswipe	15	17	22	9	19	82	16.40	21.6%
	Backed Into	0	0	0	0	0	0	0.00	0.0%
	Pedestrian	0	0	0	1	0	1	0.20	0.3%
	Bicycle	0	0	0	0	0	0	0.00	0.0%
	Fixed Object	14	26	21	16	28	105	21.00	27.7%
	Other Non-Collisions	9	7	0	3	7	26	5.20	6.9%
	Overturn/Rollover	9	2	4	2	3	20	4.00	5.3%
	Others	9	8	7	11	14	49	9.80	12.9%
	Total Crashes	**70**	**84**	**67**	**63**	**95**	**379**	**75.80**	**100.0%**
SEVERITY	PDO Crashes	43	65	49	47	67	271	54.20	71.5%
	Fatal Crashes	1	1	0	1	2	5	1.00	1.3%
	Injury Crashes	26	18	18	15	26	103	20.60	27.2%
LIGHTING CONDITIONS	Daylight	44	53	44	36	58	235	47.00	62.0%
	Dusk	0	3	1	2	3	9	1.80	2.4%
	Dawn	3	0	1	2	2	8	1.60	2.1%
	Dark	23	28	21	23	32	127	25.40	33.5%
	Unknown	0	0	0	0	0	0	0.00	0.0%
SURFACE CONDITIONS	Dry	57	70	58	55	72	312	62.40	82.3%
	Wet	13	14	9	8	23	67	13.40	17.7%
	Others	0	0	0	0	0	0	0.00	0.0%

7.1.2. STUDY INTERCHANGE

Table 22 summarizes the results of the crash analysis conducted for the I-75 segment between MP 49.53 (3,000 feet east of the interchange with SR 951/Collier Boulevard) and MP 51.04 (about 1,500 feet west of the subject interchange). Crash data and detailed police reports within the immediate area surrounding the study interchange were reviewed and crashes occurring outside the I-75 mainline study limits were removed. Based on a review of the combined crash data, a total of 57 crashes were reported within the immediate limits of the study interchange with 13 crashes in 2017, 13 crashes in 2018, 12 crashes in 2019, 2 crashes in 2020, and 17 crashes in 2021. The average crash frequency for the study interchange was approximately 13.75 crashes per year with the number of crashes in 2020 being excluded from the calculation due to being an outlier. Crash statistics, such as the existing yearly crash frequency, were compared to the future yearly crash frequency (obtained from the HSM safety analysis in **Section 7.2** of this report) to ensure that the predicted number of crashes are reasonable and accurate. The top three leading crash types consisted of Sideswipe with 17 (30%) crashes, Rear End with 10 (18%) crashes, and Fixed Objects with 9 (16%) crashes. Based on crash severity, 42 (74%) were Property Damage Only crashes, 15 (26%) were Injury crashes, and none were Fatal crashes. There were 14 (25%) Dark/Dusk/dawn crashes reported and 15 (26%) crashes occurring under Wet pavement conditions.

Table 22: Immediate Interchange Limits Crash Statistics

I-75 and SR 951 Interchange Immediate Limits Segment/Spot with No Expected Values Available		Number of Crashes Year 2017	2018	2019	2020	2021	5 Year Total Crashes	Mean Crashes Per Year	%
CRASH TYPE	Rear End	0	3	3	0	4	10	2.00	17.5%
	Head On	0	0	0	0	0	0	0.00	0.0%
	Angle	0	0	1	0	2	3	0.60	5.3%
	Left Turn	0	0	0	0	0	0	0.00	0.0%
	Right Turn	1	0	0	0	0	1	0.20	1.8%
	Sideswipe	7	4	2	0	4	17	3.40	29.8%
	Backed Into	0	0	0	0	0	0	0.00	0.0%
	Pedestrian	0	0	0	0	0	0	0.00	0.0%
	Bicycle	0	0	0	0	0	0	0.00	0.0%
	Fixed Object	0	3	3	0	3	9	1.80	15.8%
	Other Non-Collisions	3	1	0	0	1	5	1.00	8.8%
	Overturn/Rollover	2	0	0	1	1	4	0.80	7.0%
	Others	0	2	3	1	2	8	1.60	14.0%
	Total Crashes	**13**	**13**	**12**	**2**	**17**	**57**	**11.40**	**100.0%**
SEVERITY	PDO Crashes	11	11	9	2	9	42	8.40	73.7%
	Fatal Crashes	0	0	0	0	0	0	0.00	0.0%
	Injury Crashes	2	2	3	0	8	15	3.00	26.3%
LIGHTING CONDITIONS	Daylight	8	11	9	2	13	43	8.60	75.4%
	Dusk	0	0	1	0	0	1	0.20	1.8%
	Dawn	1	0	0	0	0	1	0.20	1.8%
	Dark	4	2	2	0	4	12	2.40	21.1%
	Unknown	0	0	0	0	0	0	0.00	0.0%
SURFACE CONDITIONS	Dry	12	11	8	2	9	42	8.40	73.7%
	Wet	1	2	4	0	8	15	3.00	26.3%
	Others	0	0	0	0	0	0	0.00	0.0%

7.2. PREDICTIVE METHOD CRASH ANALYSIS

A future conditions safety analysis was performed to compare the predicted 2045 future freeway safety performance of the RFP and D/B Concepts. The safety analysis followed the 2010 HSM (and corresponding 2014 freeways supplement), and procedures outlined in the FDOT IARUG and the FDOT Safety Crash Data Guidance. The future safety analysis utilizes ISATe as the software tool, which follows the HSM methodologies, and estimates the predicted average crash frequency for specific design elements part of the typical sections. The following sections will outline the methodology, considerations and limitations, and the segmented future RFP and D/B freeway alternatives with respective results.

7.2.1. I-75 FREEWAY SAFETY ANALYSIS METHODOLOGY

The safety analysis methodology outlined in the HSM 2010 predicts the number of crashes along a specific roadway facility by applying the HSM Safety Performance Functions (SPF) on roadway segments with similar characteristics and design elements. Proper segmentation of the roadway facility is key to develop an accurate analysis. The HSM methodology predicts the number of crashes based on the extent that each design element deviates from an “ideal” or base condition. Crash Modification Factors (CMF) are applied to the SPFs to adjust the estimates of the predicted number of crashes in each segment. The segmentation process produces a set of disaggregated segments with varying lengths, each of which is homogeneous with respect to characteristics such as traffic volumes, key geometrics design features, and traffic control features as defined in the ISATe segmentation criteria.

Important considerations, limitations, and assumptions used in the modeling procedure are summarized below:

- The ISATe safety analysis focused on the same limits assumed for the crash analysis conducted in the vicinity of the interchange of I-75 with SR 951/Collier Boulevard. Using the same limits as the historical crash analysis facilitates the comparison between the existing and expected future conditions crash frequency. In addition, RFP and D/B Concepts do not consider design changes beyond those limits. Hence, segments outside of these limits are not expected to experience a change in safety performances.
- As suggested by the HSM methodology, the default calibration factor was used since no specific field data was available. Therefore, the analysis was based on the nationwide characteristics of an average segment.
- A clear zone width of 30 feet was used for all segments which were within the influence area and in close proximity to barriers (concrete, guardrail, etc).

- Some segment lengths resulted in distances shorter than the ones recommended by HSM methodology (which are between 0.1 and 1.0 miles). However, the overall freeway design meets FDOT and/or AASHTO design criteria.

7.3. SUMMARY OF I-75 RFP AND D/B FREEWAY SEGMENTS

The results of the safety analysis per segment for the RFP Concept are presented in **Table 23** and the results of the D/B Concept are presented in **Table 24**. Similarly, the overall facility comparison between the two alternatives is summarized in **Table 25**. The detailed operational results are included in **Appendix J**.

Overall, based on the results of the safety analysis for the 2045 design year, the RFP and D/B concepts are expected to have 18.9 and 19.6 crashes/year, respectively. In other words, the crash frequency for the D/B Concept is expected to report about less than one crash/year more than the RFP Concept (0.7 crashes/year more). The probability of this 0.7 crash being categorized as high severity crash is about 2%, the same probability is expected for the RFP Concept.

Additionally, based on a review of the historical crash data (**Section 7.1**), the existing crash frequency (with the diamond interchange configuration) is about 13.75 crashes/year. The predicted crash frequency for the D/B Concept is about 19.6 crashes/year which represents an increase of about 5.85 crashes/year, while the increase for the RFP Concept is about 5.15 crashes/year. Therefore, the slight increase in the predicted number of crashes for the D/B Concept seems reasonable. The D/B concepts presents two merge points along the eastbound direction. One merge point relates to the new southbound to eastbound loop ramp and the second merge point relates to northbound to eastbound entrance ramp. The RFP Concept only presents one merge point in the eastbound direction. The difference in the number of entrance ramps between D/B Concept and the RFP Concept may be related to a higher number of lane changing maneuvers (along the I-75 mainline) and therefore, slightly higher probabilities for crashes to occur. However, as it is indicated by the summary presented in **Table 25**, the increase in number of crashes is almost insignificant, and it is only evident in the minor injury and property damage only crashes.

Although the D/B Concept presents two merge points along the eastbound direction and the RFP Concept only one, it has to be mentioned that both entrance ramps (for the D/B Concept) will provide acceleration lanes along the I-75 mainline. These acceleration lanes will allow drivers to enter the freeway without immediately performing lane changing maneuvers. The length of the auxiliary lanes will provide enough distance for drivers to accelerate and gain the appropriate merging speed with the I-75 freeway mainline traffic. Thus, reducing the probabilities of collisions occurring in high traffic turbulence areas such as ramps.

Table 23: Summary of 2045 RFP Freeway Safety Conditions

Segment No.	Segment Description	Crash Severity					Total(s)
		(K)	(A)	(B)	(C)	(O)	
		Fatal	Incapacitating Injury	Non-Incapacitating Injury	Minor Injury	Property Damage Only	
1	Start (STA 245+00) to SR 951 EB On Ramp	0.0	0.1	0.3	0.9	2.3	3.6
2	SR 951 EB On Ramp to SR 951 WB Off Ramp	0.0	0.0	0.1	0.4	1.1	1.7
3	SR 951 WB Off Ramp to SR 951 WB On Ramp Loop	0.0	0.1	0.3	1.1	2.5	4.1
4	SR 951 WB On Ramp Loop to SR 951 WB On Ramp	0.0	0.0	0.1	0.4	1.1	1.7
5	SR 951 WB On Ramp to SR 951 EB Off Ramp	0.0	0.0	0.1	0.2	0.6	0.9
6	SR 951 EB Off Ramp to END (STA 330+00)	0.0	0.1	0.5	1.7	4.7	7.0
Total(s)		0.1	0.3	1.4	4.8	12.3	18.9

Table 24: Summary of 2045 D/B Freeway Safety Conditions

Segment No.	Segment Description	Crash Severity					Total(s)
		(K)	(A)	(B)	(C)	(O)	
		Fatal	Incapacitating Injury	Non-Incapacitating Injury	Minor Injury	Property Damage Only	
1	START (STA 245+00) to I-75 EB Lane Drop	0.0	0.0	0.1	0.2	0.6	0.9
2	I-75 EB Lane Drop to SR 951 EB On & WB Off Ramps	0.0	0.1	0.3	1.1	2.8	4.4
3	SR 951 EB On & WB Off Ramps to SR 951 WB On Ramp Loop	0.0	0.0	0.2	0.6	1.3	2.1
4	SR 951 WB On Ramp Loop to SR 951 EB On Ramp Loop	0.0	0.0	0.1	0.4	0.8	1.3
5	SR 951 EB On Ramp Loop to SR 951 WB On Ramp	0.0	0.0	0.2	0.9	2.2	3.4
6	SR 951 WB On Ramp to SR 951 EB Off Ramp	0.0	0.0	0.0	0.2	0.4	0.7
7	SR 951 EB Off Ramp to END (STA 330+00)	0.0	0.1	0.5	1.7	4.6	6.8
Total(s)		0.1	0.3	1.4	5.0	12.7	19.6

Table 25: Summary of 2045 RFP and D/B Freeway Safety Conditions

Alternative	Crash Severity					Total
	(K)	(A)	(B)	(C)	(O)	
	Fatal	Incapacitating Injury	Non-Incapacitating Injury	Minor Injury	Property Damage Only	
RFP	0.1	0.3	1.4	4.8	12.3	18.9
D/B	0.1	0.3	1.4	5.0	12.7	19.6

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