4 Safety Analysis

A Safety Analysis Report (SAR) was prepared by FDOT in October 2018 to document the crash statistics for the most recent five years and perform a quantitative safety analysis to predict the safety performance of the RFP Concept. The analysis follows the procedures promulgated in Chapters 18 and 19 of the Highway Safety Manual – 1st Edition Supplement 2014 by the American Association of State Highway and Transportation Officials (AASHTO) and uses the ISATe Safety Analysis tool developed under the auspices of the Federal Highway Administration (FHWA) which is based on these HSM procedures. A copy of the SAR is provided in **Appendix E**.

4.1 Crash Summary

The following section summarizes the crash statistics provided in Section 2.2 of the SAR (**Appendix E**). During the five-year period of 2011 to 2015, 661 crashes were recorded with an increasing trend in number of crashes per year, 92 crashes in 2011 and 189 crashes in 2015. Front to rear and sideswipe (same direction) were the leading crash types for the five-year period with 328 crashes and 137 crashes, respectively. Based on the safety ratio calculations performed, the last two years (2014 and 2015) resulted in safety ratios greater than 1.00, indicated a growing safety concern for the I-395 segment.

4.2 Quantitative Safety Analysis

4.2.1 Methodology

A quantitative safety analysis of the New Concept is documented in this section and follows the methodology established in the SAR. The analysis was conducted using the ISATe tool which requires the identification of the following elements:

1. Segmentation of project
    a. Freeway
    b. Ramp and collector distributor (ramp/CD) roadways
2. Data Input Parameters
3. Traffic Data

4.2.1.1 *Project Segmentation*

4.2.1.1.1 Freeways

The freeway segments for I-395 under the New Concept were defined following the framework established in the SAR and consistent with the segmentation methods when using the ISATe. **Table 4-1** and **Figure 4-1** summarize the freeway segments of I-395 for the predictive analysis.

Table 4-1: Freeway Segments

Freeway (FW) Segment No.	FW Segment Stationing		Segment Description
	From	To	
FW Segment 1	2019+60	2040+40	From SR 836 to Ramp E
FW Segment 2	2040+40	2060+35	From Ramp E to WB connector diverge
FW Segment 3	2060+35	2063+30	From WB connector diverge to EB connector merge
FW Segment 4	2063+30	2077+18	From EB connector merge to EB Biscayne Blvd on-ramp
FW Segment 5	2077+18	2079+88	From EB Biscayne Blvd on-ramp to WB Biscayne Blvd off-ramp
FW Segment 6	2079+88	2085+00	From WB Biscayne Blvd off-ramp to project terminus

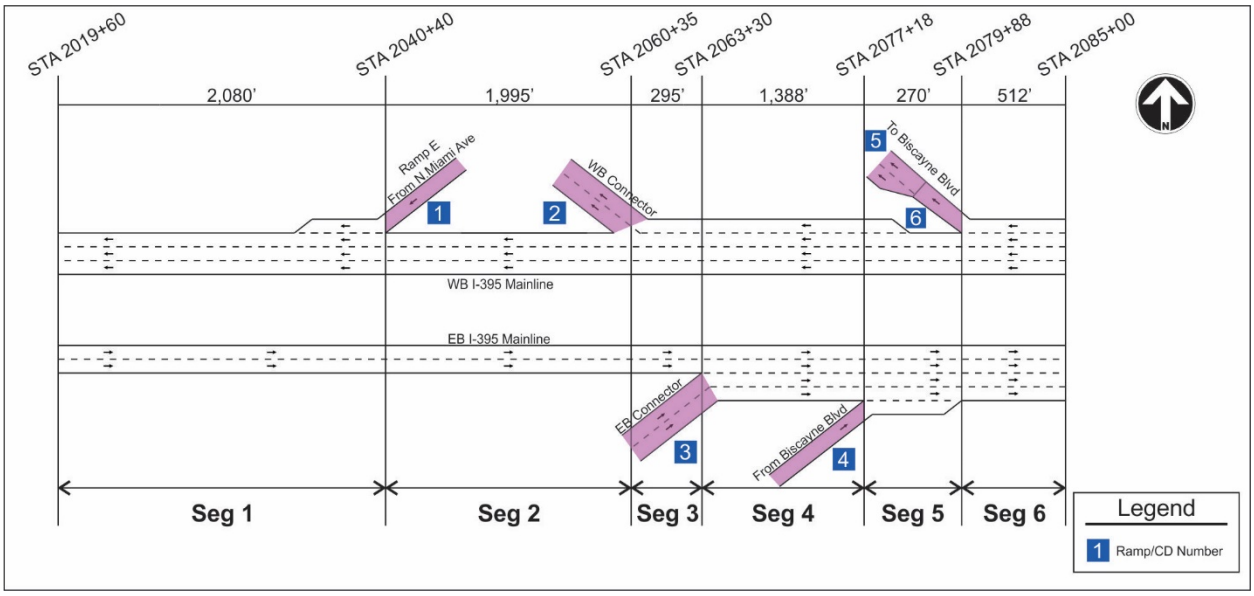

Figure 4-1: Freeway Segments Schematic

4.2.1.1.2 Ramp/CD Roadways

The ramp/CD segments for I-395 under the New Concept were defined following the framework established in the SAR and consistent with the segmentation methods when

using the ISATe. **Table 4-2** and **Figure 4-2** summarize the ramp/CD segments of I-395 for the predictive analysis. Ramp/CD Segment numbers 14, 16, and 17 are 3-lane segments that were analyzed as 2-lane segments due to ISATe limitations on number of lanes for ramp/CD segments. No other adjustments were made to ISATe input values.

Table 4-2: Ramp/CD Segments

Ramp/CD (CD) Segment No.	Segment Stationing		Segment Description
	From	To	
CD Segment 1	740+40	745+00	Ramp E from Ramp E/F diverge to WB mainline
CD Segment 2	1043+26	1060+07	WB Connector from WB mainline diverge to Ramp F
CD Segment 3	1042+52	1063+02	EB Connector from Ramp B+C to EB mainline merge
CD Segment 4	1069+34	1077+66	On-ramp from Biscayne Blvd
CD Segment 5	1074+32	1077+00	Ramp from WB MacArthur Causeway to Biscayne Blvd (Two-Lane)
CD Segment 6	1077+00	1079+74	Ramp from WB MacArthur Causeway to Biscayne Blvd (One-Lane)
CD Segment 7	910+00	921+00	Ramp from WB connector to SB I-95 (One Lane)
CD Segment 8	921+00	931+00	Ramp from WB connector to SB I-95 (Two-Lane)
CD Segment 9	742+23	745+35	Ramp F from Ramp E+F to WB connector
CD Segment 10	745+35	752+71	Ramp E+F from N. Miami Ave to Ramp E/F diverge
CD Segment 11	308+00	325+00	Ramp A
CD Segment 12	103+00	113+21	Ramp from NB I-95 to EB connector
CD Segment 13	4015+50	4030+50	Ramp to NB I-95 from WB connector
CD Segment 14	4030+50	4042+70	WB connector from NB I-95/SB I-95 diverge to Ramp F
CD Segment 15	3014+00	3025+00	Ramp from SB I-95 to EB connector
CD Segment 16	3025+00	3028+80	EB connector from SR 836 and NB I-95 ramps
CD Segment 17	3028+80	3040+00	EB connector from NB I-95 ramp to Ramp B+C/EB connector diverge
CD Segment 18	3040+00	3042+47	EB connector from Ramp B+C/EB connector diverge to Ramp B+C
CD Segment 19	3042+47	3048+50	Ramp B+C

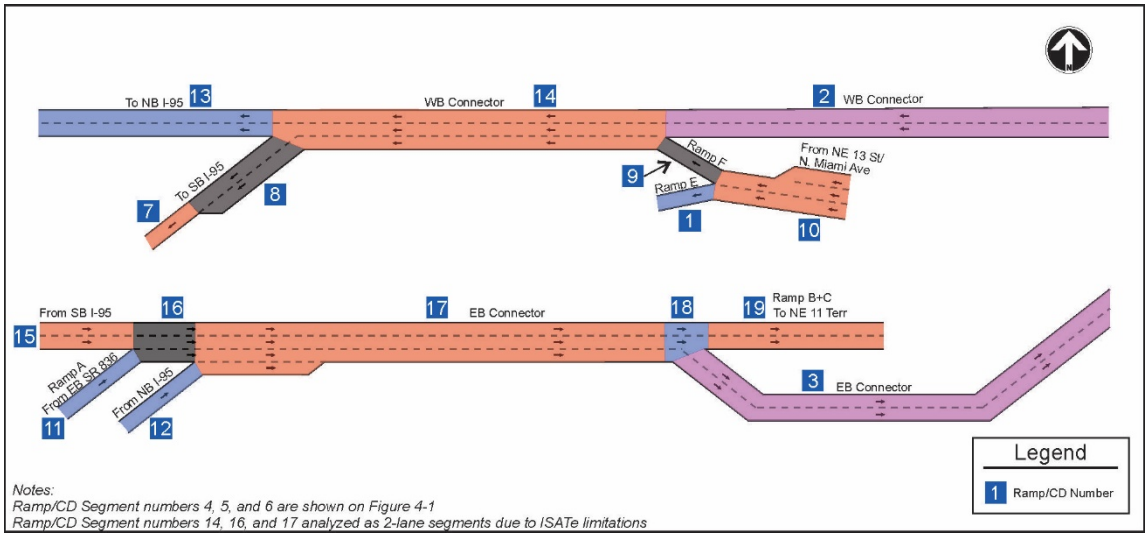

Figure 4-2: Ramp/CD Segments Schematic

4.2.1.2 *Data Input Parameters*

For “apples to apples” comparison the input parameters from the SAR were maintained and are summarized in **Table 4-3**. It should be noted that the roadway geometry inputs were extracted from the New Concept final design Line and Grade submittal.

Table 4-3: Summary of Data Inputs and Parameters

Input Field	Freeway Segments	Ramps/CD Segments
Number of through lanes	X	X
Length of segment	X	X
Presence of an entrance or exit speed-change lane	X	X
Length of speed-change lane	X	X
Average traffic speed	N/A	X
Presence of a horizontal curve, and curve information	X	X
Lane width	X	X
Outside and inside shoulder widths	X	X
Median width	X	N/A
Length of rumble strips on the inside (or median) shoulder and on the outside (or roadside) shoulder	X	N/A
Length of (and offset to) the barrier on the Left Shoulder and the barrier on the Right Shoulder	X	X
Width of median barrier	X	N/A
Presence and length of a Type B weaving section	X	N/A
Presence and length of a weaving section on a CD road segment	N/A	X
Distance to nearest upstream entrance ramp and nearest downstream exit ramp in each travel direction	X	N/A
Clear zone width	X	N/A
Proportion of AADT traffic volume in peak hours (K value)	X	N/A
Segment AADT volume	X	X
Upstream entrance ramp AADT volume	X	N/A
Downstream exit ramp AADT volume	X	N/A
Type of traffic control used at the crossroad ramp terminal to regulate intersecting traffic (none, yield, stop, signal)	N/A	X
Presence of lane added or dropped to the ramp or CD road, and length of the taper in the segment if present	N/A	X

4.2.1.3 *Traffic Data*

The future traffic volumes (year 2040) and traffic characteristics used in the analysis were obtained from the CORSIM analysis conducted for this IMR re-evaluation. Furthermore, the peak to daily traffic volume ratio used in the analysis to estimate the Annual Daily Traffic (ADT) was K=7.68%, as previously identified in **Section 2**. See **Appendix E** for traffic data summary table.

4.2.2 Future Safety Conditions

The following sections summarize the predicted crashes for I-395 freeway and ramp/CD segments obtained from the ISATe spreadsheet. The detailed spreadsheet showing the inputs and breakdown of crashes is provided in **Appendix E**.

4.2.2.1 *Freeway Segments*

Following the same numbering system used in the previous figures, the summary of the expected number of crashes and the predicted crash rates [Crashes per Million Vehicle (Veh.) Miles per year] on the Freeway segments are summarized in **Table 4-4**.

Table 4-4: Summary of I-395 Expected Crashes on Freeway Segments

Segment Number	Predicted # Crashes	Length (Mile)	ADT	Predicted[1] Crash Rate	Average[2] Vehicle Exposure	% of Network
FW Segment 1	7.12	0.39	68,138	0.73	9.70	31%
FW Segment 2	4.70	0.38	49,622	0.68	6.88	31%
FW Segment 3	1.36	0.06	78,880	0.79	1.73	5%
FW Segment 4	6.70	0.26	105,573	0.67	10.02	21%
FW Segment 5	1.90	0.05	116,341	0.89	2.12	4%
FW Segment 6	4.10	0.10	130,117	0.86	4.75	8%
Total	**25.88**	**1.24**	**Wt. Avg[3]**	**0.72**		

[1]Predicted Crash Rate = ($1X10^6$ * Predicted # Crashes)/(365*ADT*1*Length); [2] (ADT*Length*365)/$1X10^6$; [3]∑ (Lengths*Predicted Crash Rates)/ ∑Lengths

4.2.2.2 *Ramp/CD Roadways*

Following the same numbering system used in the previous figures, the summary of the expected number of crashes and the predicted crash rates [Crashes per Million Vehicle (Veh.) Miles per year] on the ramp/CD segments are summarized in **Table 4-5.**

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Table 4-5: Summary of I-395 Expected Crashes on Ramp/CD Segments

Segment Number	Predicted # Crashes	Length (Mile)	AADT	Predicted[1] Crash Rate	Average[2] Vehicle Exposure (M)	% of Network
CD Segment 1	0.581	0.09	18,555	0.95	0.61	3%
CD Segment 2	4.991	0.32	29,219	1.46	3.41	10%
CD Segment 3	5.451	0.39	26,732	1.43	3.81	12%
CD Segment 4	0.825	0.16	10,807	1.31	0.63	5%
CD Segment 5	0.317	0.05	13,776	1.26	0.25	2%
CD Segment 6	0.183	0.05	13,776	0.73	0.25	2%
CD Segment 7	1.114	0.21	15,352	0.95	1.18	6%
CD Segment 8	1.513	0.19	15,352	1.42	1.06	6%
CD Segment 9	0.305	0.07	15,404	0.77	0.39	2%
CD Segment 10	2.200	0.11	33,958	1.61	1.36	3%
CD Segment 11	1.088	0.32	14,414	0.65	1.68	10%
CD Segment 12	1.259	0.19	16,458	1.10	1.14	6%
CD Segment 13	6.486	0.28	29,232	2.17	2.99	8%
CD Segment 14	6.841	0.23	44,635	1.83	3.75	7%
CD Segment 15	2.598	0.21	20,130	1.68	1.54	6%
CD Segment 16	1.067	0.07	35,544	1.17	0.91	2%
CD Segment 17	8.910	0.21	51,016	2.28	3.91	6%
CD Segment 18	0.460	0.05	24,271	1.04	0.44	2%
CD Segment 19	0.768	0.11	24,271	0.79	0.97	3%
Total	**46.96**	**3.31**	**Wt. Avg[3]**	**1.40**		

[1]Predicted Crash Rate = (1X10^6 * Predicted # Crashes)/(365*ADT*1*Length); [2] (ADT*Length*365)/1X10^6; [3]∑ (Lengths*Predicted Crash Rates)/ ∑Lengths

4.2.3 Summary of Future Safety Conditions

As shown in **Table 4-4** and **Table 4-5**, the total expected crashes for I-395 freeway and ramp segments are 25.88 crashes and 46.96 crashes, respectively.

In order to further evaluate the safety performance of the New Concept, the results obtained from this safety analysis were compared to the results of the RFP Concept provided in the SAR. **Table 4-6** summarizes the total predicted crashes and weighted predicted crash rate.

Table 4-6: RFP Concept vs New Concept Future Safety Performance

Safety Measure	I-395			
	Freeway		Ramp/CD	
	RFP*	NEW	RFP*	NEW
Total Predicted Crashes	31.76	25.88	51.50	46.96
Weighted Predicted Crash Rate	0.77	0.72	1.44	1.40
Total Length (miles)	1.33	1.24	3.92	3.31

**For "apples to apples comparison" RFP statistics were based on Freeway segments 6 through 12 and CD segments 8, and 20 through 39 from the SAR*

As shown in **Table 4-6**, the New Concept is predicted to enhance safety conditions when compared to the RFP Concept through a reduction in total crashes, a lower crash rate on freeway segments, and equivalent crash rate for ramp/CD segments.