AECOM
1350 Deming Way
Middleton, WI 53562
aecom.com

Project name:
NCDOT INFRA Project

From:
Jeff Sandberg

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Memorandum

Subject: NCDOT INFRA Safety Analysis

AECOM is preparing an INFRA grant application for improvements to a number of highway segments and locations on I-87 in North Carolina. The application includes an analysis of the economic benefit of crash reduction for these improvements. The purpose of this memo is to document the methodology and results of the crash analysis.

Background

The projects in the INFRA grant application include a variety of improvement types. A summary of these improvements is in table 1 below:

Table 1, Project Summary

Project Number	Highway	Location	Description
I-6007	I-87	SR2233 Interchange	Convert Diamond Interchange to Diverging Diamond Interchange
I-6005	I-87	Bus US 64 to US 264	Widen from four lanes to six lanes
H141265a	I-87	US 264 to NC 58	Widen inside shoulder to 4’ and outside shoulder to 10’
U-6149	I-87	NC 58 to Thomas Road Overpass	Widen inside shoulder to 4’ and outside shoulder to 10’
H141265b	I-87	Thomas Road Overpass to Martin County Line	Widen inside shoulder to 4’ and outside shoulder to 10’
R-5869A	US 17	SR 1336/1338 Intersection	Convert At-Grade Intersection to Interchange
R-5869B	US 17	SR 1300 Intersection	Convert At-Grade Intersection to Interchange

Methodology

When completing a crash analysis that is used for the determination of the economic benefit of safety improvements, the preferred method is to complete a predictive safety evaluation in accordance with the procedures in the FHWA Highway Safety Manual (HSM). A predictive safety evaluation provides the expected safety performance of a facility based on crash history, long-term trends, and experience at similar facilities.

The three primary data sources were used to complete the predictive safety evaluation:

1. Traffic Volumes – Forecasted AADT for each project was calculated using AADT from the NCDOT AADT Web Map and annual average growth rates from the Travel Demand Model. Forecasted 2035 AADT was used as the analysis year for the 2025 – 2045 study period.

2. Crash Data – Given the effort to gather crash data for these projects, the effort to code crash statistics into the safety models, and the short timeframe to complete this analysis, crash data was not used in the analysis. This means the results are based solely on crash experience at similar sites throughout the country and not "normalized" for site crash history.

3. Roadway Geometry – Roadway geometry was determined using measurement tools in Google Earth.

A predictive safety analysis was completed for these projects using FHWA's Enhanced Interchange Safety Analysis Tool (ISATe) for freeway segments and interchanges, and the Interactive Highway Safety Design Model (IHSDM) for non-freeway segments and intersections. The analysis method compared the predictive safety analysis of the existing conditions with proposed conditions; the safety benefit of the project was calculated as the difference between the two.

ISATe and IHSDM have the ability to account for a variety of highway improvements, but many potential improvements cannot be evaluated within these programs. When planned improvements cannot be evaluated within the program, the appropriate analysis method is to complete the proposed conditions analysis in ISATe or IHSDM, then multiply the resulting predicted crash frequency by a crash modification factor (CMF) for additional improvements.

The HSM cautions against using more than two CMFs for a single analysis and using multiple CMFs that have overlapping benefit. Because of this, the analysis included no more than two CMFs and potential CMFs were qualitatively examined to assure they were reasonably independent of each other.

A summary of the method used for each project is presented in Table 2 below. All CMF ID references can be found on the website www.cmfclearghouse.org.

Table 2, Predictive Safety Analysis Methodology Summary

Project Number	Software Used	Crash Reduction Calc Method		CMF Details
		With Software?	With CMF?	
I-6007	ISATe	No	Yes	ID 8258, "Convert Diamond Interchange to DDI" (CMF=0.67 for all crash types and severities)
I-6005	ISATe	Yes	No	N/A
H141265a	ISATe	Yes	No	N/A
U-6149	ISATe	Yes	No	N/A
H141265b	ISATe	Yes	No	N/A
R-5869A	IHSDM	No	Yes	ID 459, "Convert At-Grade Intersection into grade-separated interchange" (CMF = 0.58 for all crash types and severities)
R-5869B	IHSDM	No	Yes	ID 459, "Convert At-Grade Intersection into grade-separated interchange" (CMF = 0.58 for all crash types and severities)

Evaluation Results

The estimated crash reduction results for each project is in Table 3 below. Detailed ISATe and IHSDM reports are attached.

Table 3, Crash Reduction Summary (crashes per year)

	Crash Severity					
	K	A	B	C	PDO	TOT
Project I-6007						
Existing Conditions	0	0.1	0.9	3.9	9	13.9
Crash Reduction (CMF)	**0**	**0**	**0.3**	**1.3**	**3**	**4.6**
Project I-6005						
Existing Conditions	1.6	4.4	23.4	56.7	185.3	271.4
With Improvements	1.6	4.2	22.8	36.5	136.5	201.6

Table 3, Crash Reduction Summary (crashes per year)						
	Crash Severity					
	K	A	B	C	PDO	TOT
Crash Reduction	**0**	**0.2**	**0.6**	**20.2**	**48.8**	**69.8**
Project H141265a						
Existing Conditions	1.5	3.8	19.8	30.5	90.2	145.8
With Improvements	1.2	3.1	16.2	25	81.2	126.7
Crash Reduction	**0.3**	**0.7**	**3.6**	**5.5**	**9**	**19.1**
Project U-6149						
Existing Conditions	2.2	5.7	29.5	45.6	160.8	243.8
With Improvements	1.9	5	26	40.1	147.5	220.5
Crash Reduction	**0.3**	**0.7**	**3.5**	**5.5**	**13.3**	**23.3**
Project H141265b						
Existing Conditions	0.7	1.8	9.4	14.7	43.5	70.1
With Improvements	0.6	1.5	7.9	12.3	40.5	62.8
Crash Reduction	**0.1**	**0.3**	**1.5**	**2.4**	**3**	**7.3**
Project R-5869A						
Existing Conditions	1.34				2.97	4.31
Crash Reduction (CMF)	**0.59**				**1.31**	**1.90**
Project R-5869B						
Existing Conditions	1.46				3.07	4.53
Crash Reduction (CMF)	**0.64**				**1.35**	**1.99**