

Hazard Elimination Project Evaluation

Order # 41000017689

Hazard Elimination Project W-4844

**Evaluation of the Rumble Strip Installation
I-240 around Asheville**

Buncombe County

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Transportation Mobility and Safety Division
North Carolina Department of Transportation

Principal Investigator



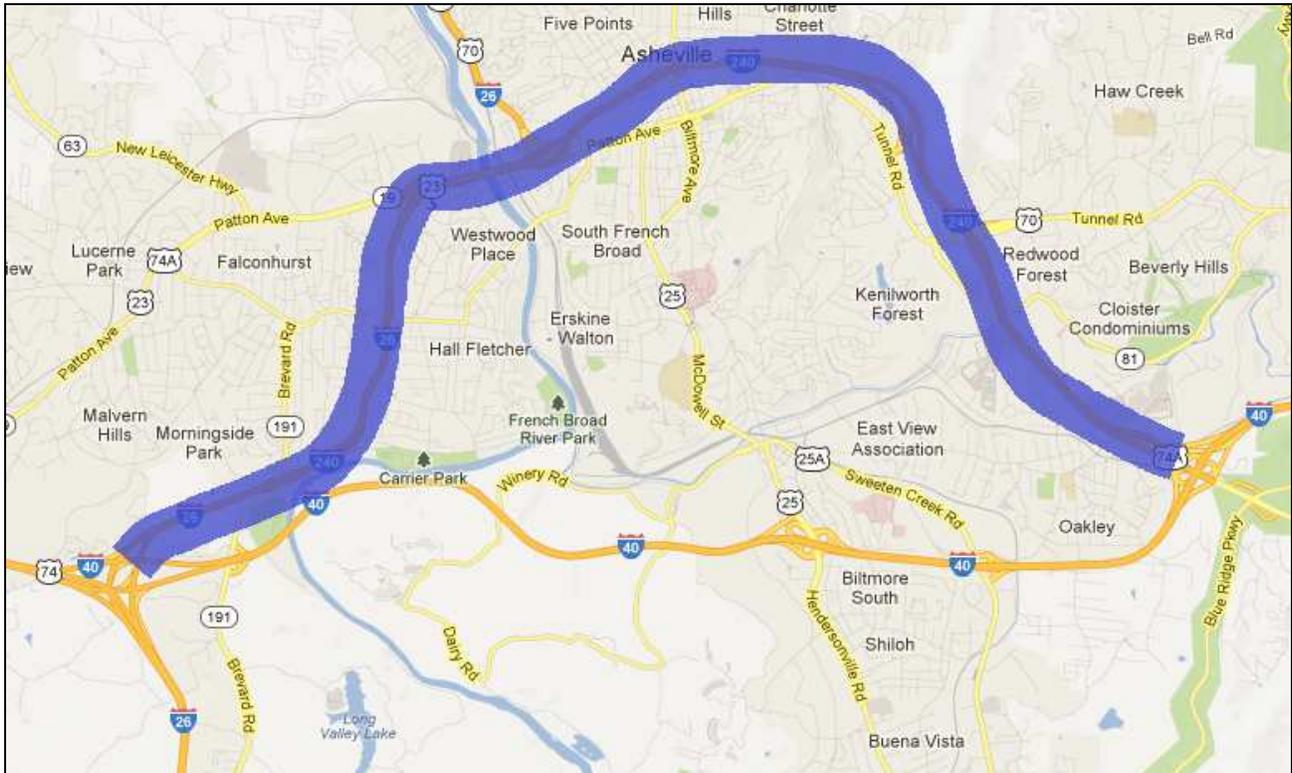
Jason B. Schronce
Traffic Safety Project Engineer

12-12-2012
Date

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-4844 located along the full route of Interstate I-240 in Buncombe County, City of Asheville. Corresponding routes of I-240 include in-part I-26, US-19/23, US-70, and US-74.



Project Information and Background from the Project File Folder

The hazard elimination project improvement chosen for the subject location was the installation of milled rumble strips along the inside and outside shoulders of this access freeway controlled roadway. I-240 is mostly a four-lane interstate with 2 to 4-foot paved median shoulders and 10-foot paved outside shoulders. Median protection exists along the section and varies between W-beam guardrail and concrete barrier wall. The total countermeasure improvement distance over the route is 9.552 miles.

The original statement of problem mentioned that vehicles were running off the road resulting in fatalities, serious injuries, and property damage. Lane departure crashes often result from fatigued or inattentive drivers. Rumble strips provide both noise and vibration as a warning to motorists that they are leaving the travel lane.

The initial crash analysis was completed from July 1, 2000 to June 30, 2003 with 353 reported crashes, 90 of which were deemed correctable Ran-Off Road collisions. The improvement was completed on September 14, 2007 with a total cost of \$123,000. The projected B/C Ratio was 13.73.

Naive Before and After Analysis

After reviewing the project file folder along with all the crashes along the subject segment, the crash data omitted from this analysis to consider for an adequate construction period were the months of April through September 2007. The before period consisted of reported crashes from June 1, 2002 through March 31, 2007 (4 years, 10 months); and the after period consisted of reported crashes from October 1, 2007 through July 31, 2012 (4 years, 10 months). The ending date for this analysis was determined by the date of available crash data at the time of analysis.

The treatment data consisted of all crashes along these segments with a zero (0) foot y-line (No Ramps). *Please see attached location map for further details.*

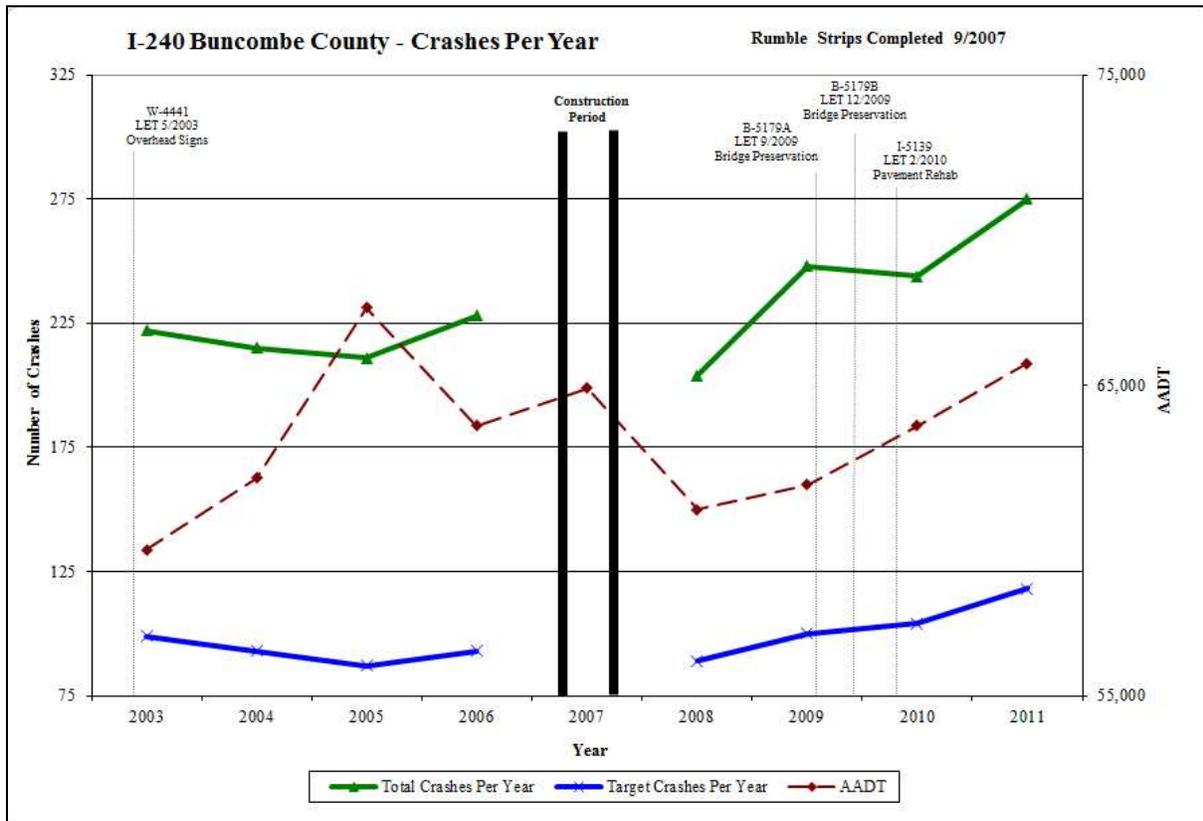
The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Freeway Lane Departure Crashes were the target crashes for the applied countermeasure. The Freeway Lane Departure Crash types considered are as follows: Angle; Fixed Object; Head-On; Jackknife; Overturn/Rollover; Parked Motor Vehicle; Ran-Off Roadway (Right, Left, Straight); and Sideswipe (Same and Opposite Direction). All lane departure crashes were independently verified.

<u>I-240 (MP 0.00 – 9.552)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	1024	1218	18.9 %
Total Severity Index	5.38	3.79	- 29.6 %
LD Crashes – Both Directions	443	509	14.9 %
Lane Departure Severity Index	5.63	3.73	- 33.7 %
Volume (2004, 2010)	62,000	63,700	2.7 %
Total Crash Rate (100 Million Vehicle Miles)	97.96	113.35	15.7 %
Injury Crashes			
Fatal Injury Crashes	5	4	- 20.0 %
Class-A Injury Crashes	14	5	- 64.3 %
Class-B Injury Crashes	97	64	- 34.0 %
Class-C Injury Crashes	315	304	- 3.5 %
Property Damage Only Crashes	593	841	41.8 %
Contributing Factors			
Night Crashes	231	233	0.9 %
Animal Crashes	3	4	33.3 %
Wet Road Crashes	289	343	18.7 %
Alcohol / Drug Related	35	46	31.4 %

<u>I-240 Eastbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	407	521	28.0 %
EB Total Severity Index	6.07	3.73	- 38.6 %
EB Lane Departure Crashes	181	217	19.9 %
EB Lane Departure Severity Index	6.47	3.99	- 38.3 %

<u>I-240 Westbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	617	697	13.0 %
WB Total Severity Index	4.93	3.84	- 22.1 %
WB Lane Departure Crashes	262	292	11.5 %
WB Lane Departure Severity Index	5.05	3.53	- 30.1 %

This roadway segment experienced an increase of 19 percent in Total Crashes with a 15 percent increase in Lane Departure Crashes. In addition, the Total Severity Index saw a 30 percent reduction with Severe Injury Crashes (Fatal and A-injury) decreasing from nineteen (19) to nine (9) from the before to the after period.



The previous chart depicts the number of Total and Target Crashes per year plotted in the before and after period for I-240, along with the AADT. Total crashes per year appear to have spiked in 2009 and continued an upward trend during the after period. The TIP Letting website was searched for projects that were completed along this route and the four (4) discovered are listed above. However, the Safety Evaluation Group cannot conclude that other funds may have been used to complete construction, safety, or resurfacing projects along this roadway segment that may have affected crashes in the after period.

Results and Discussion

Overall, the data tables above indicate an increase in Total and Lane Departure crashes along I-240 through the evaluation between 15 and 20 percent. However, both severities reduced by an average of 30 percent with a significant reduction in severe injury crashes (Fatal & A-injuries) from nineteen (19) to nine (9).

From examining the tables closely, the wet road crashes did increase by 19 percent in the after period but night crashes were nearly identical in both periods. All crash severities experienced a reduction in the after period except for "Property Damage Only" collisions which increased by 42 percent.

The calculated benefit to cost ratio for this project is **69.05 considering total crashes**. The benefit to cost ratio **considering only target crashes is 49.46**. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and other benefits related to the project are not considered in this analysis. The costs of the project include the actual construction costs as well as the increase in annual maintenance and utility costs.

As the Safety Evaluation Group completes additional spot safety reviews for this type of countermeasure, we will be able to provide objective and definite information regarding actual crash reduction factors for this type of countermeasure.

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: I-240		BY: JBS						
COUNTY: Buncombe		DATE: 11/7/2012						
FILE NO.: W-4844								
DETAILED COST:	TYPE IMPROVEMENT - Rumble							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$123,000	10	0.149	\$18,331			
	Right-of-Way	\$0	0	0.000	\$0			
		\$0	0	0.000	\$0			
	TOTALS	\$123,000	10	0.149	\$18,331			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$18,331			
	TOTAL COST OF PROJECT=				\$123,000			
COMPREHENSIVE COST REDUCTION:								
ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES								
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.83	19	3.93	412	85.30	593	122.77	\$4,712,195
AFTER	4.83	9	1.86	368	76.19	841	174.12	\$3,446,439
						Annual Benefits from Crash Cost Savings		\$1,265,756
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$1,247,425		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	69.05		
TOTAL COST OF PROJECT		-	\$123,000	COMPREHENSIVE B/C RATIO		-	69.05	

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: I-240		BY: JBS						
COUNTY: Buncombe		DATE: 11/7/2012						
FILE NO.: W-4844		Target - Lane Departure Crashes						
DETAILED COST:	TYPE IMPROVEMENT - Rumble							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$123,000	10	0.149	\$18,331			
	Right-of-Way	\$0	0	0.000	\$0			
		\$0	0	0.000	\$0			
	TOTALS	\$123,000	10	0.149	\$18,331			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$18,331			
	TOTAL COST OF PROJECT=				\$123,000			
COMPREHENSIVE COST REDUCTION:								
ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES								
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.83	13	2.69	144	29.81	286	59.21	\$2,546,542
AFTER	4.83	6	1.24	126	26.09	377	78.05	\$1,639,979
						Annual Benefits from Crash Cost Savings		\$906,563
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$888,233		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	49.46		
TOTAL COST OF PROJECT		-	\$123,000	COMPREHENSIVE B/C RATIO		-	49.46	