

Hazard Elimination Project Evaluation

Order # 41000011166

Hazard Elimination Project W-4840

Evaluation of the Rumble Strip Installation on I-85 in Gaston County

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
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Principal Investigator



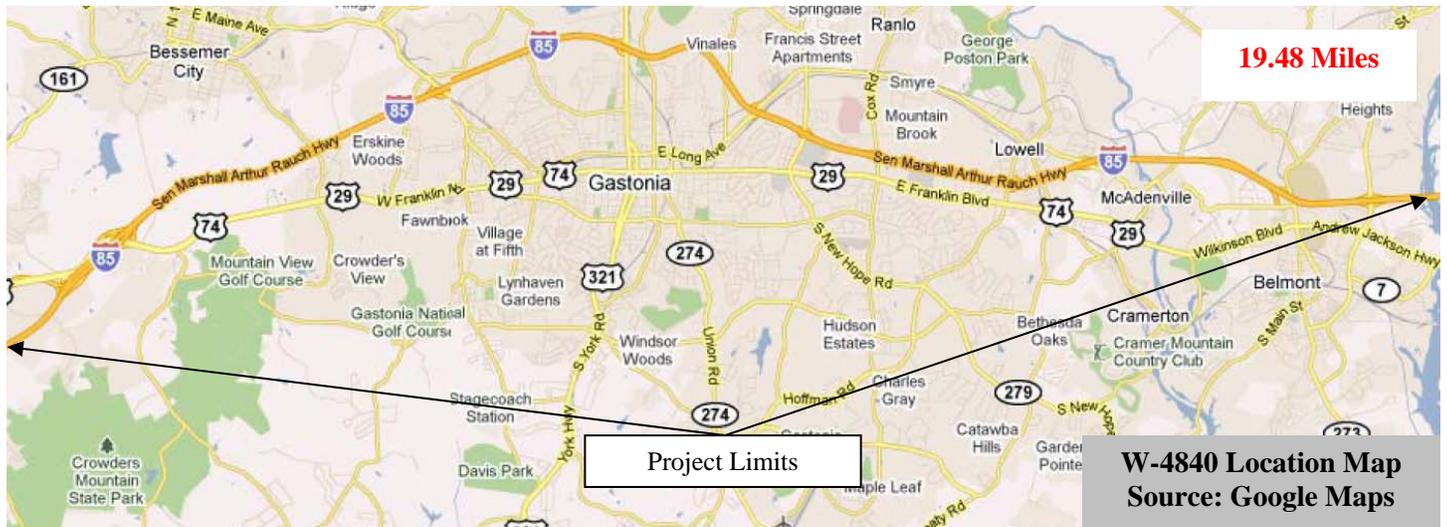
Carrie L. Simpson, PE

6/20/2011

Date

Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation



Subject Location

The treatment location includes I-85 in Gaston County from the Cleveland County Line to the Mecklenburg County Line. I-85 is a 4-lane section near the Cleveland County Line and an 8-lane section near the Mecklenburg County Line. The Interstate is a 6-lane section for a majority of the county with 4' paved median shoulders and 10' paved outside shoulders. The speed limit is 60 and 65 mph. Median protection varies between W-beam guardrail and concrete barrier wall. It's assumed that guardrail have been provided in the median for the entire duration of the study period.

Multiple additional projects were completed on this section of roadway both before and after the completion of W-4840. The following let dates for resurfacing projects are noted for your reference but not accounted for in this evaluation.

1/02	4 Sections of I-85
10/02	W-4439, I-85 from US 321 to SR 2200 [1.94 MILES]
8/05	I-4725, I-85 from NC 273 to Bridge Over the Catawba River [0.6 MILES]
7/07	I-5007, I-85 from Southfork River Bridge to Exit 27 [3.1 MILES]
5/09	I-5121, I-85 from NC 22 to Milepost 23.8 [1.8 MILES]
4/10	I-85 from Milepost 13.9 TO Milepost 17.07 (US-321 Bridges) [3.17 MILES]
9/10	I-5403, I-85 at Exit 22 Ramp

Project Information and Background from the Project File Folder

The hazard elimination project improvement chosen was the installation of milled rumble strips on the median and outside shoulders of I-85. The rumble strips are intended to provide both noise and vibration as a warning to motorists that they are leaving the travel lane. Causal factors in crashes included driver fatigue and/or inattention. The initial crash analysis was completed from August 1, 2000 through July 31, 2003 with 1534 Total Crashes, including 412 Ran-Off-Road Crashes. The improvement was completed on July 31, 2006 with a total cost of \$200,000. The projected B/C Ratio was 29.50:1.

Location Photographs



Naive Before and After Analysis

After reviewing the project file folder along with all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period were from January 1, 2006 through July 31, 2006. The before period consisted of reported crashes from July 1, 2001 through December 31, 2005 (4.5 years); and the after period consisted of reported crashes from August 1, 2006 through January 31, 2011 (4.5 years). The ending date for this analysis was determined by the date of available crash data at the time of analysis. The before period ADT year was 2003 and the after period ADT year was 2008.

For the purposes of this evaluation, we assumed that there were no rumble strips present in the before period and continuous rumble strips present for the duration of the after period. Note that we are unable to account for construction periods associated with other projects completed in the before and after periods.

The treatment data consisted of all mainline crashes with a 0' y-line. Target crashes are lane departure crash types.

	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	2085	2108	1.1%
Total Severity Index	4.52	3.7	-18.1%
Lane Departure Crashes – Both Directions	1347	1193	-11.4%
Lane Departure Severity Index	4.77	3.81	-20.1%
Volume	89,000	88,100	-1.0%

	Before	After	Percent Reduction (-)/ Percent Increase (+)
Injuries			
Fatal Injury Crashes	13	5	-61.5%
Class-A Injury Crashes	22	14	-36.4%
Class-B Injury Crashes	137	132	-3.6%
Class-C Injury Crashes	496	443	-10.7%
Property Damage Only Crashes	1417	1514	6.8%
Contributing Factors			
Night Crashes	659	537	-18.5%
Wet Road Crashes	518	601	16.0%
Alcohol Related	97	55	-43.3%
Lane Departure Crash Types			
Angle	157	123	-21.7%
Fixed Object	418	393	-6.0%
Head On	7	3	-57.1%
Jackknife	7	7	0.0%
Movable Object	115	115	0.0%
Overturn / Rollover	16	9	-43.8%
Parked Motor Vehicle	26	13	-50.0%
Ran Off Road (Left)	102	84	-17.6%
Ran Off Road (Right)	102	81	-20.6%
Ran Off Road (Straight)	4	1	-75.0%
Sideswipe, Same Direction	386	362	-6.2%
Sideswipe, Opposite Direction	7	2	-71.4%

The following tables divide the crash data by direction of travel:

<u>Northbound</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	1086	1036	-4.6%
Total Severity Index	4.22	4.15	-1.7%
Lane Departure Crashes	746	651	-12.7%

<u>Southbound</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	999	1072	7.3%
Total Severity Index	4.84	3.27	-32.4%
Lane Departure Crashes	601	542	-9.8%

Results and Discussion

Using naïve before and after analysis, the number of Total Crashes slightly increased while the number of Target Crashes decreased on the section of I-85 installed with rumble strips under project W-4840. The results varied slightly by direction of travel as shown above.

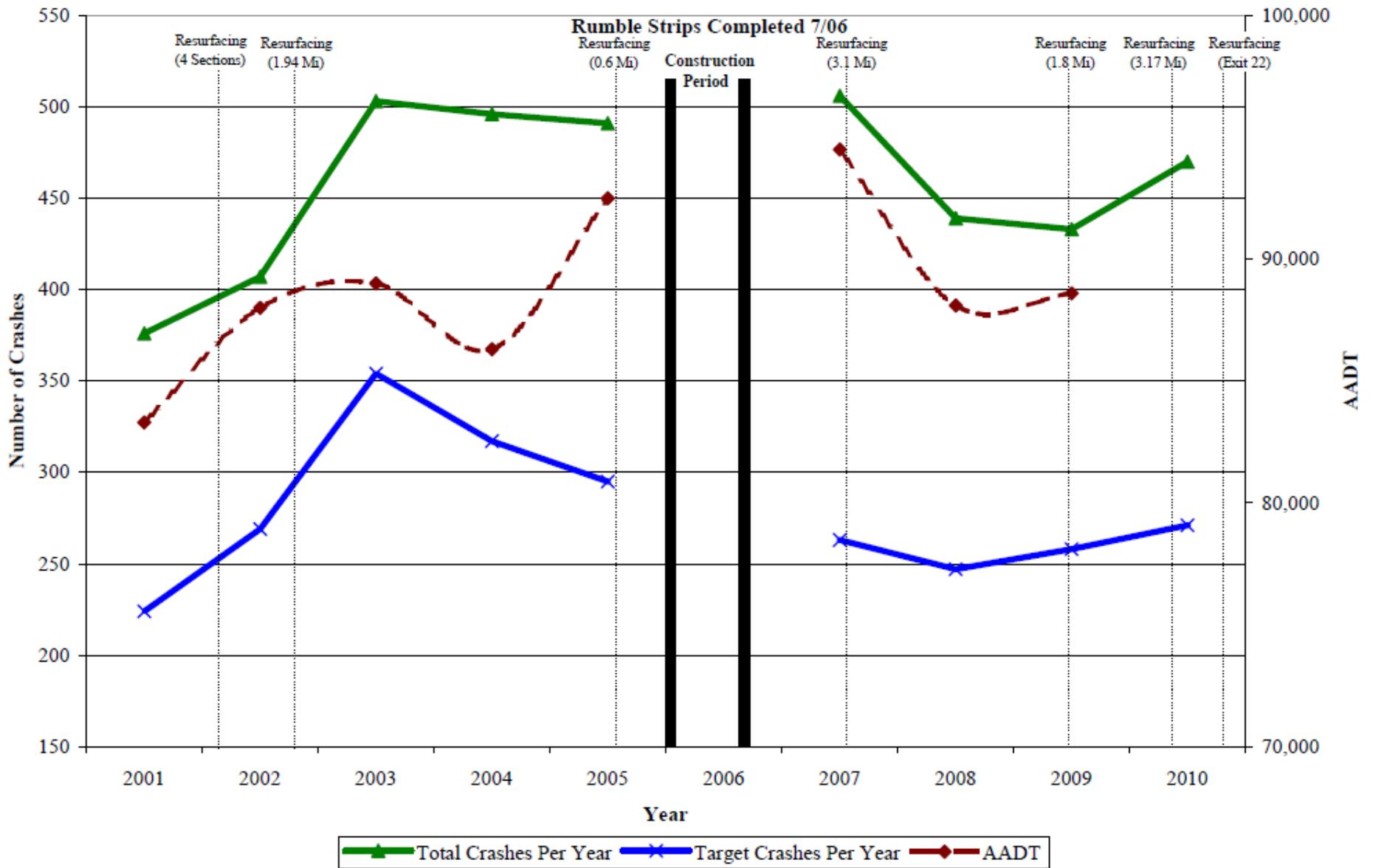
The Severity Indexes of Total and Target Crashes decreased. There were decreases in every injury category, with the most noticeable reductions in Fatal Injury and Class-A Injury Crashes.

The calculated benefit to cost ratio for W-4840 is **80.69** considering Total Crashes. The benefit to cost ratio considering only Target Crashes is **94.64**. 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 costs when applicable.

The following chart depicts the number of Total and Target Crashes per year plotted in the before and after period, along with the AADT. Crashes per year appear to generally follow the volume trends during the study period. Due to the number of other projects that likely influenced crashes during the study period, the change in crashes cannot be attributed solely to the rumble strip installations.

As the Safety Evaluation Group completes additional 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 treatment.

I-85 Gaston County - Crashes Per Year



BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: I-85
 COUNTY: Gaston
 FILE NO.: W-4840

BY: CLS
 DATE: 4/5/2011

TOTAL CRASHES

DETAILED COST: TYPE IMPROVEMENT - Rumblestrips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$200,000	10	0.149	\$29,806
		0	0.000	\$0
		0	0.000	\$0
TOTALS	\$200,000	10	0.149	\$29,806

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$29,806
 TOTAL COST OF PROJECT= \$200,000

COMPREHENSIVE COST REDUCTION:

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES						ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	
BEFORE	4.50	35	7.78	633	140.67	1417	314.89	\$9,067,356
AFTER	4.50	19	4.22	575	127.78	1514	336.44	\$6,662,267

Annual Benefits from Crash Cost Savings \$2,405,089

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$2,375,283

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 80.69

TOTAL COST OF PROJECT - \$200,000 COMPREHENSIVE B/C RATIO - 80.69

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: I-85
 COUNTY: Gaston
 FILE NO.: W-4840

BY: CLS
 DATE: 4/5/2011

TARGET CRASHES

DETAILED COST: TYPE IMPROVEMENT - Rumblestrips

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$200,000	10	0.149	\$29,806
		0	0.000	\$0
		0	0.000	\$0
TOTALS	\$200,000	10	0.149	\$29,806

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$29,806
 TOTAL COST OF PROJECT= \$200,000

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	4.50	29	6.44	389	86.44	929	206.44	\$6,676,600
AFTER	4.50	11	2.44	340	75.56	842	187.11	\$3,855,689

Annual Benefits from Crash Cost Savings \$2,820,911

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$2,791,105

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 94.64

TOTAL COST OF PROJECT - \$200,000 COMPREHENSIVE B/C RATIO - 94.64