

Hazard Elimination Project Evaluation

Order # 41000019205

Hazard Elimination Project W-4825

**Evaluation of the Rumble Strip Installation
US-220 from the Montgomery County Line to the Guilford County Line
Randolph County**

Documents Prepared By:

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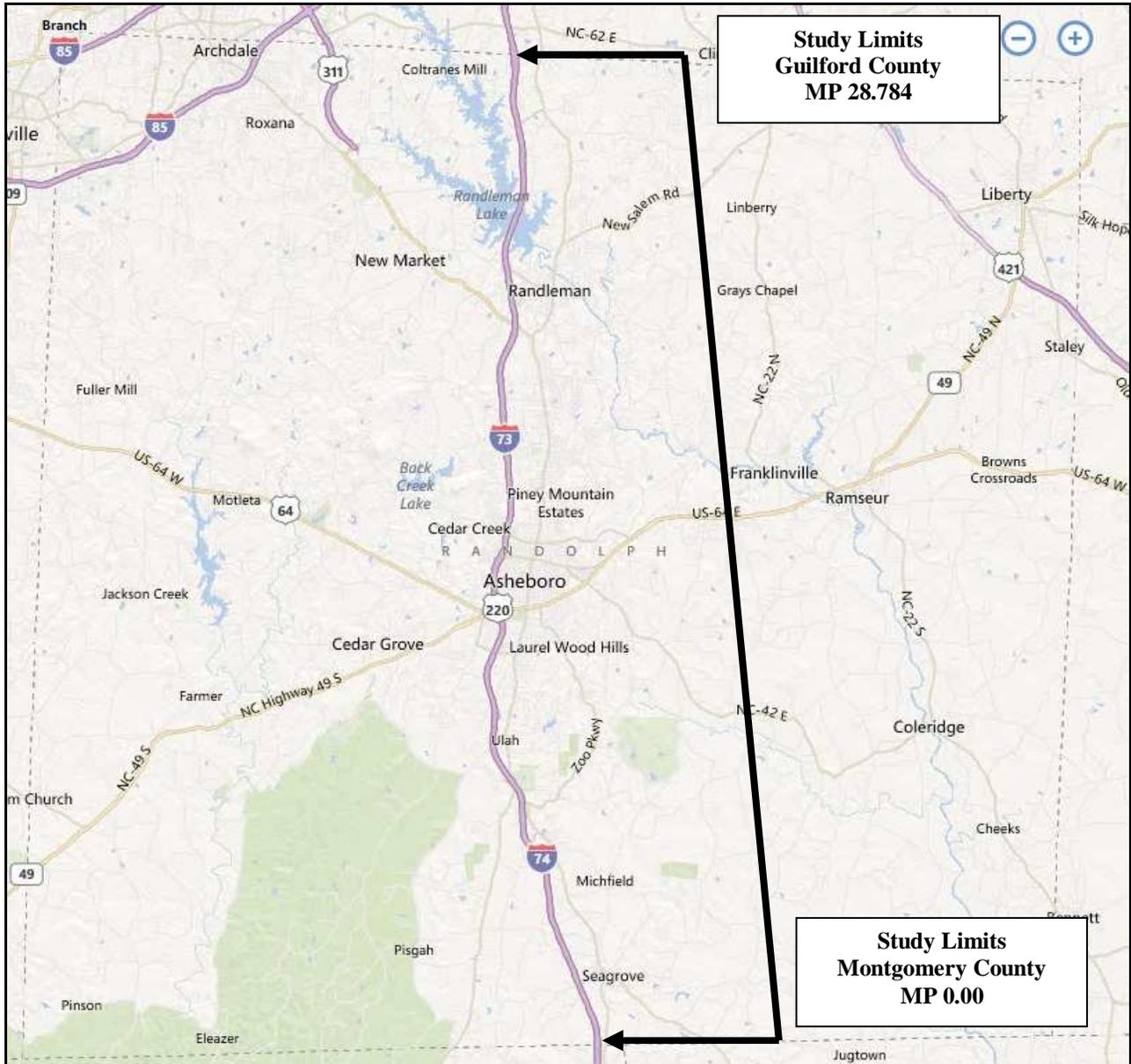
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7-5-2012
Date

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project Number W-4825 located along US-220 (also known as I-73/74 through segments) from the Montgomery County Line (Milepost 0.00) to the Guilford County Line (Milepost 28.784) through Randolph County, including the Cities of Randleman and Asheboro.



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 freeway segment.

US-220 (I-73/74) is a four-lane median divided facility with paved median and outside shoulders. The median maintains protection with three-strand cable or W-beam guardrail along the entire route. The speed limit varies between 55-mph and 65-mph. This roadway acts as the main north/south connector from central North Carolina Cities of the Triad to the State of South Carolina. The total segment length is 28.784 miles.

The original statement of problem mentioned that vehicles were running off the road resulting in fatalities, serious injuries, and property damage. Casual factors for vehicles leaving the roadway include driver fatigue and/or inattention. 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 August 1, 2000 to July 31, 2003 with 592 reported crashes, with 223 crashes considered correctable Ran-Off Road collisions. The improvement was completed on July 17, 2006 with a total cost of \$175,000. The projected B/C Ratio was 102.24

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 May through July 2006. The before period consisted of reported crashes from October 1, 2000 through April 30, 2006 (5 years, 7 months); and the after period consisted of reported crashes from August 1, 2006 through February 29, 2012 (5 years, 7 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 US-220 (I-73/74) 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 to their accuracy, even if coded differently within TEAAS.

<u>Treatment Information</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	954	878	- 8.0 %
Total Severity Index	4.86	3.38	- 30.5 %
LD Crashes – Both Directions	663	498	- 24.9 %
Lane Departure Severity Index	4.99	4.00	- 19.8 %

<u>US-220 Randolph (MP 0.00 – 28.784)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Volume (2003, 2009)	27,000	23,600	- 12.6 %
Total Crash Rate (100 Million Vehicle Miles)	60.23	63.39	5.2 %
Injury Crashes			
Fatal Injury Crashes	12	3	- 75.0 %
Class-A Injury Crashes	11	6	- 45.5 %
Class-B Injury Crashes	72	57	- 20.8 %
Class-C Injury Crashes	190	133	- 30.0 %
Property Damage Only Crashes	669	679	1.5 %
Contributing Factors			
Night Crashes	362	375	3.6 %
Wet Road Crashes (Codes 2, 3)	283	192	- 32.2 %
Alcohol Related	55	46	- 16.4 %
Lane Departure Crash Types			
Angle	15	6	- 60.0 %
Fixed Object	472	324	- 31.4 %
Head On	2	0	- 100.0 %
Jackknife	5	1	- 80.0 %
Left Turn, Same Roadway	1	1	0.0 %
Moveable Object	0	6	100+ %
Other Collision With Vehicle	9	8	- 11.1 %
Other Non-Collision	2	7	100+ %
Overturn / Rollover	25	11	- 56.0 %
Parked Motor Vehicle	16	3	- 81.3 %
Ran Off Road (Left)	8	16	100.0 %
Ran Off Road (Right)	14	23	64.3 %
Ran Off Road (Straight)	0	1	100.0 %
Right Turn, Same Roadway	0	1	100.0 %
Sideswipe, Opposite Direction	1	1	0.0 %
Sideswipe, Same Direction	93	89	- 4.3 %

The naive before and after analysis at the treatment location resulted in an 8 percent decrease in Total Crashes, a 25 percent decrease in Lane Departure Crashes, and a 30 percent decrease in the Total Severity Index. The before period ADT year was 2003 and the after period ADT year was 2009. To further examine the crash data, the following tables are split by direction of travel:

<u>US-220 Randolph Northbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
NB Total Crashes	436	398	- 8.7 %
NB Total Severity Index	4.17	3.59	- 13.9 %
Lane Departure Crashes			
NB Lane Departure Crashes	308	228	- 26.0 %
NB Lane Departure Severity Index	4.81	4.38	- 8.9 %

<u>US-220 Randolph Southbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
SB Total Crashes	518	480	- 7.3 %
SB Total Severity Index	5.44	3.20	- 41.2 %
SB Lane Departure Crashes	355	270	- 23.9 %
SB Lane Departure Severity Index	5.13	3.67	- 28.5 %

Results and Discussion

Reviewing the tables above, the overall segment decreased crashes by 8 percent with a 25 percent decrease in Lane Departure collisions from the before to the after period. Along with that, severe injury crashes (Fatal and A-injury) decreased from twenty-three (23) to nine (9).

Other discussion points include a 32 percent reduction in Wet Road crashes, but a small 5 percent increase in the Total Crash Rate due to a 13 percent decrease in the segment ADT. From the directional analysis, both the northbound and southbound travel lanes experienced similar lane departure crash reductions around 25 percent.

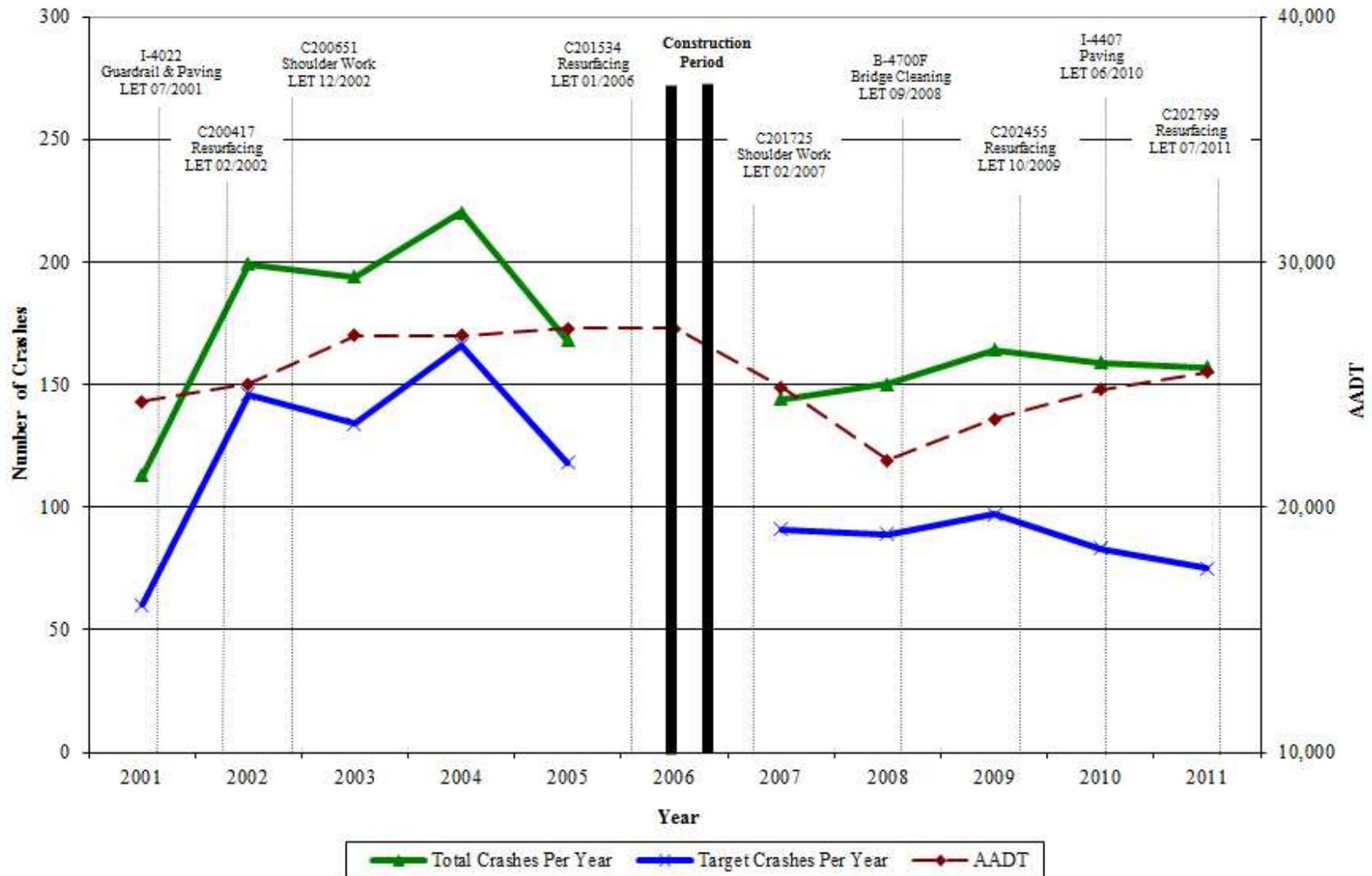
The calculated benefit to cost ratio for this project is **70.21 considering total crashes**. The benefit to cost ratio **considering only lane departure target crashes is 50.48**. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and 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.

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

As the Safety Evaluation Group completes additional 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 treatment.

US-220 (I-73/74) - Randolph County - Crashes Per Year

Rumble Strips Completed 7/2006



BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: US-220 thru Randolph		BY: JBS						
COUNTY: Randolph		DATE: 6/21/2012						
FILE NO.: W-4825								
DETAILED COST:	TYPE IMPROVEMENT - Median & Outside Rumble							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$175,000	10	0.149	\$26,080			
	Right-of-Way	\$0	0	0.000	\$0			
		\$0	0	0.000	\$0			
	TOTALS	\$175,000	10	0.149	\$26,080			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$26,080			
	TOTAL COST OF PROJECT=				\$175,000			
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	5.58	23	4.12	262	46.95	669	119.89	\$4,051,380
AFTER	5.58	9	1.61	190	34.05	679	121.68	\$2,220,376
						Annual Benefits from Crash Cost Savings		\$1,831,004
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						=	\$1,804,923	
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						=	70.21	
TOTAL COST OF PROJECT		-	\$175,000	COMPREHENSIVE B/C RATIO		-	70.21	

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: US-220 thru Randolph		BY: JBS						
COUNTY: Randolph		DATE: 6/21/2012						
FILE NO.: W-4825		Lane Departure Target Crashes						
DETAILED COST:	TYPE IMPROVEMENT - Median & Outside Rumble							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$175,000	10	0.149	\$26,080			
	Right-of-Way	\$0	0	0.000	\$0			
		\$0	0	0.000	\$0			
	TOTALS	\$175,000	10	0.149	\$26,080			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$26,080			
	TOTAL COST OF PROJECT=				\$175,000			
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	5.58	16	2.87	194	34.77	453	81.18	\$2,850,878
AFTER	5.58	7	1.25	130	23.30	361	64.70	\$1,534,462
						Annual Benefits from Crash Cost Savings		\$1,316,416
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						=	\$1,290,336	
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						=	50.48	
TOTAL COST OF PROJECT		-	\$175,000	COMPREHENSIVE B/C RATIO		-	50.48	