

Hazard Elimination Project Evaluation

Order # 41000019190

Hazard Elimination Project W-4800

Evaluation of the Rumble Strip Installation on US-70 Segments

Lenoir & Craven Counties

Documents Prepared By:

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Date

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project Number W-4800 located along two different segments of US-70 in Lenoir County (Town of LaGrange) and Craven County (City of New Bern).

Segment 1 – US-70 in Lenoir County from 150 feet east of SR 1323 (Promise Land Road) eastward to 150 feet west of SR 1603 (Washington Street) bypassing the Town of LaGrange - MP 0.458 to 4.079 – *Total Length 3.621 miles*

Segment 2 – US-70 (After Period US-17) in Craven County from 0.3 mile west of NC 43 (Glenburnie Road) eastward to the Trent River Bridge – US-17 MP 8.212 to 11.630 – *Total Length 3.418 miles*

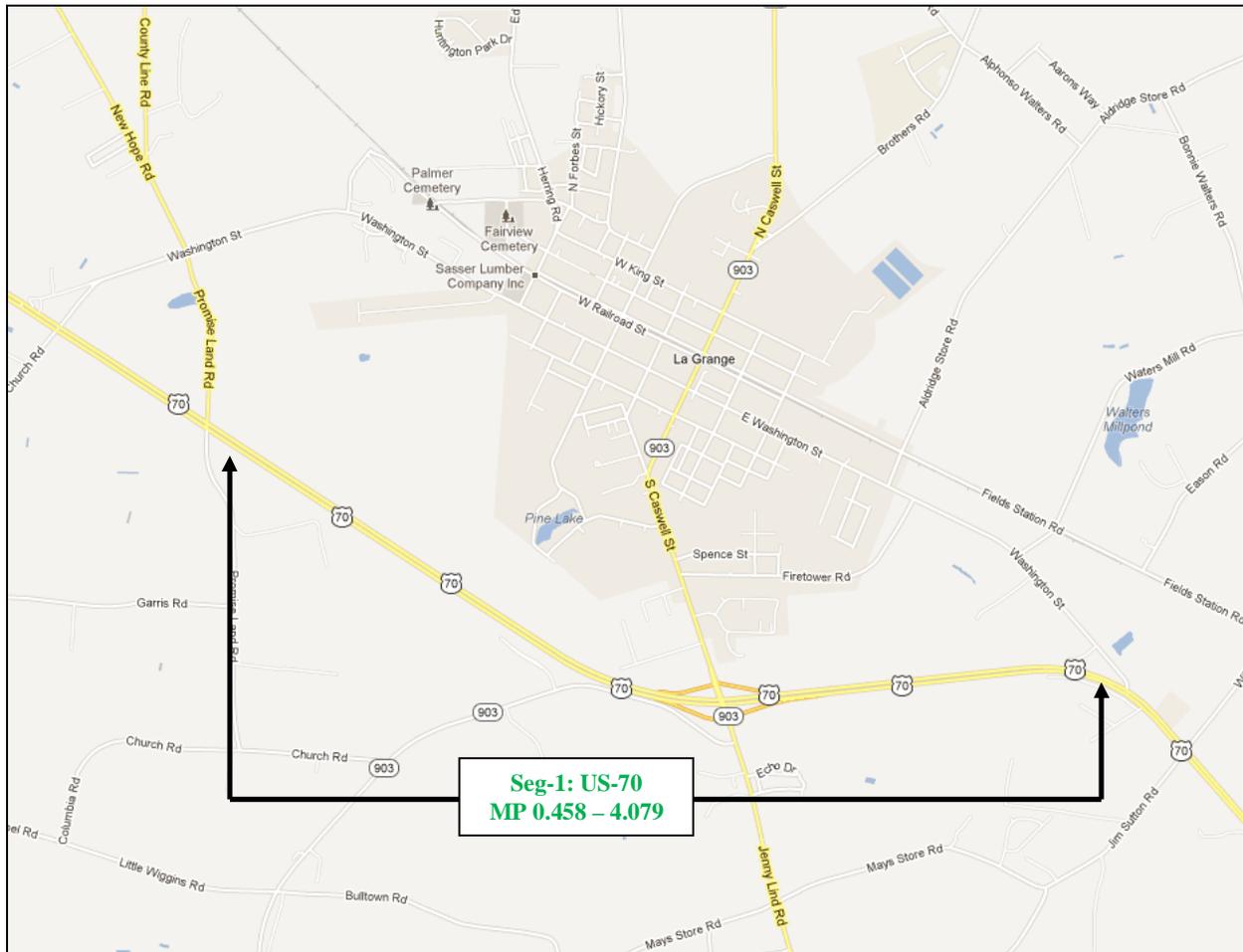


Diagram Provided from Google Maps

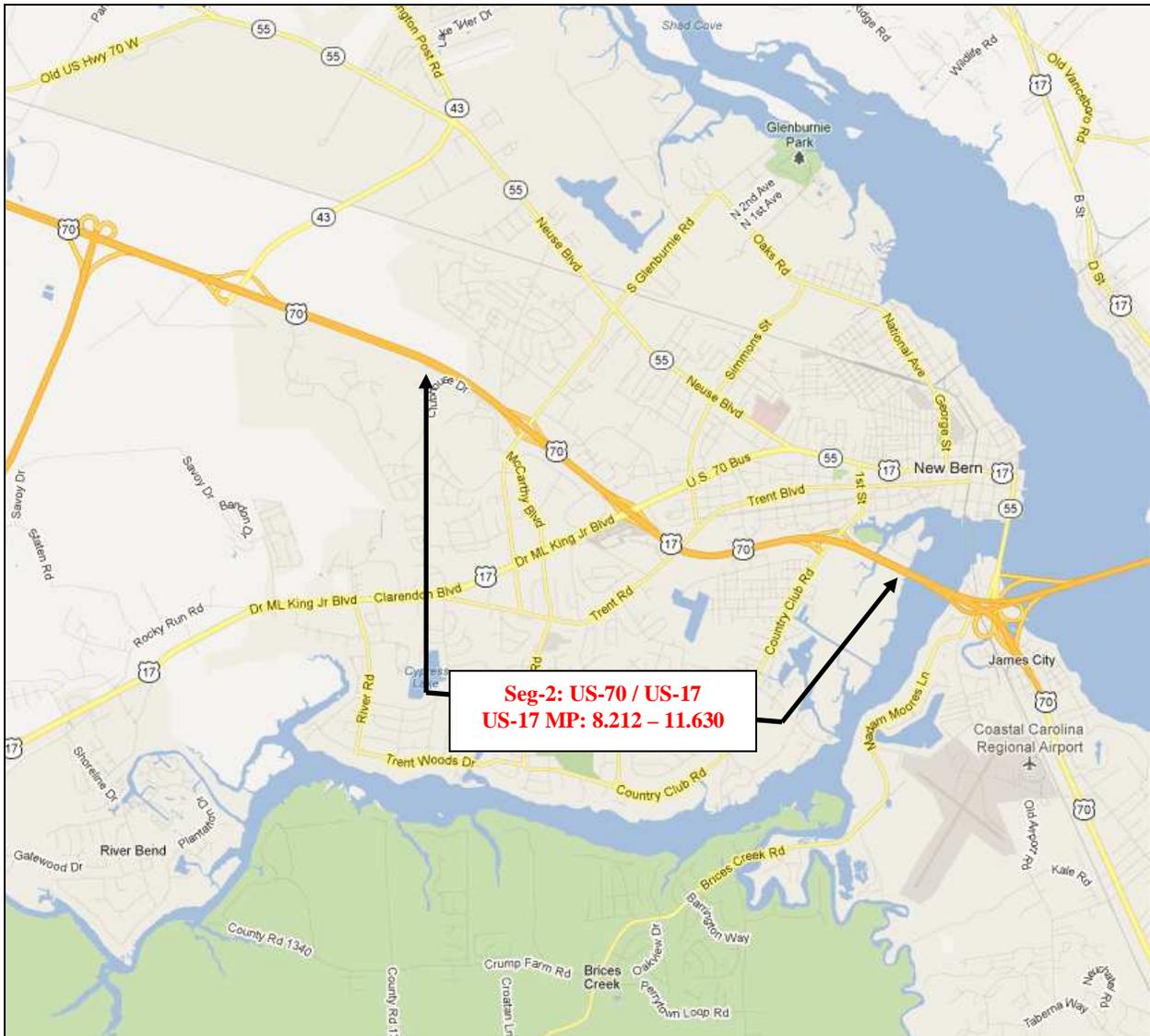


Diagram Provided from Google Maps

Project Information and Background from the Project File Folder

The hazard elimination project improvement chosen for the subject locations were the installation of milled rumble strips with thermoplastic striping along the inside and outside shoulders of these freeway style, access-controlled, roadway segments.

US-70 in both locations are four-lane divided full control access facilities with paved shoulder widths varying between zero and two feet. The speed limit on both sections is listed at 55-mph; and both roadway sections have consistent median barrier. The total countermeasure improvement distance over all routes is 7.039 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 August 1, 2000 to July 31, 2003 with 89 reported crashes; 36 of which were deemed correctable Ran-Off Road collisions. The improvement was completed on March 25, 2008 with a total cost of \$161,000. The projected B/C Ratio was 5.45.

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 January through March 2008. The before period consisted of reported crashes from January 1, 2004 through December 31, 2007 (4 years); and the after period consisted of reported crashes from April 1, 2008 through March 31, 2012 (4 years). 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 including no ramp crashes. *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>Both Segments Combined</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes	182	174	- 4.4 %
Total Severity Index	4.16	2.83	- 32.0 %
Target Crashes – Lane Departure	126	101	- 19.8 %
Target Crash Severity Index	3.83	2.90	- 24.3 %

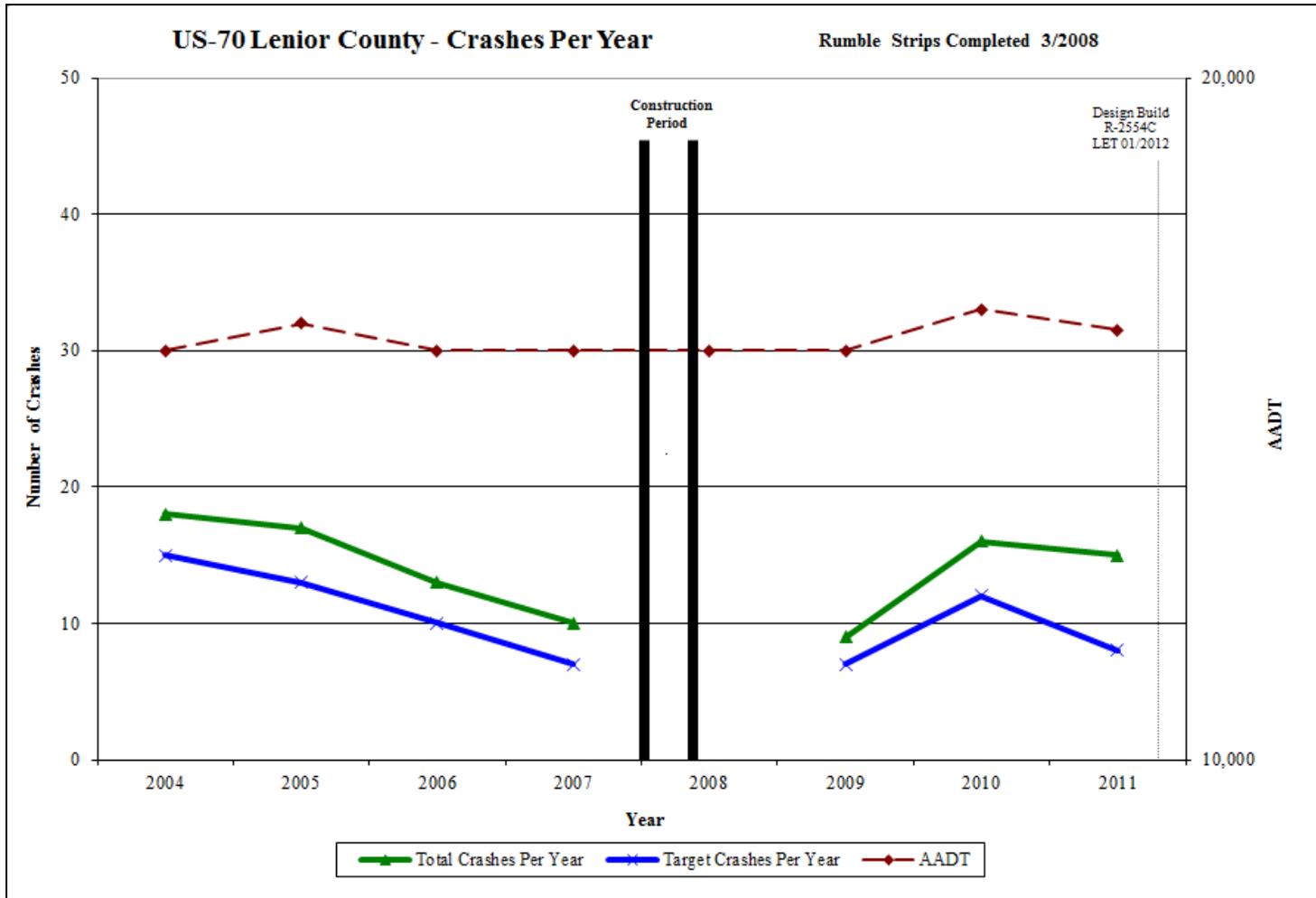
The data is further explored per segment and by direction in the tables that follow:

<u>S1: US-70 (MP 0.458 to 4.079)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	58	51	- 12.1 %
Total Severity Index	4.86	2.45	- 49.6 %
LD Crashes – Both Directions			
LD Crashes – Both Directions	45	33	- 26.7 %
Lane Departure Severity Index	3.96	3.02	- 23.7 %
Volume (2005, 20010)			
Volume (2005, 20010)	16,400	16,600	1.2 %
Total Crash Rate (100 Million Vehicle Miles)	66.85	58.07	- 13.1 %
Injury Crashes			
Fatal Injury Crashes	1	0	- 100.0 %
Class-A Injury Crashes	0	0	N/A
Class-B Injury Crashes	5	4	- 20.0 %
Class-C Injury Crashes	15	6	- 60.0 %
Property Damage Only Crashes	37	41	10.8 %
Contributing Factors			
Night Crashes	21	25	19.0 %
Animal Crashes	8	14	75.0 %
Wet Road Crashes	23	8	- 65.2 %
Alcohol / Drug Related	5	1	- 80.0 %

<u>Seg-1: US-70 Eastbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	30	34	13.3 %
EB Total Severity Index	5.99	2.52	- 57.9 %
EB Lane Departure Crashes			
EB Lane Departure Crashes	21	24	14.3 %
EB Lane Departure Severity Index	3.82	3.16	- 17.3 %

<u>Seg-1: US-70 Westbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	28	17	- 39.3 %
WB Total Severity Index	3.64	2.31	- 36.5 %
WB Lane Departure Crashes			
WB Lane Departure Crashes	24	9	- 62.5 %
WB Lane Departure Severity Index	4.08	2.64	- 35.3 %

Segment-1 experienced a reduction of 12 percent in Total Crashes with a 27 percent reduction in Lane Departure Crashes. In addition, the Total Severity Index saw a 50 percent reduction with Severe Injury Crashes (Fatal and A-injury) reduced from one (1) to zero (0) from the before to the after period. Contributing factors include a 75 percent increase in Animal crashes but a 65 percent reduction in Wet Road Crashes from twenty-three (23) to eight (8) through the evaluation.



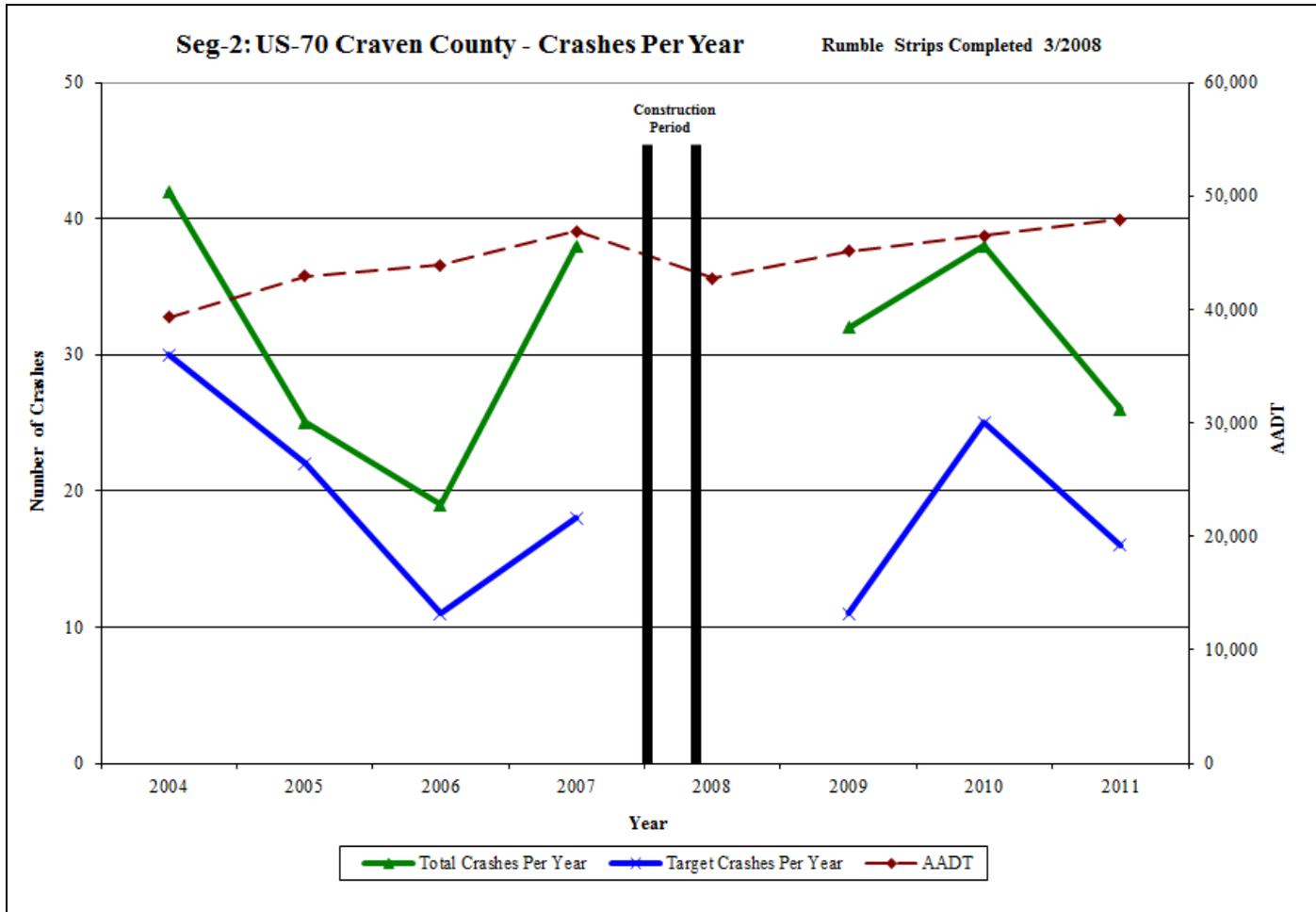
The previous chart depicts the number of Total and Target Crashes per year plotted in the before and after period for Segment-1, along with the AADT. Segment-1 total and lane departure crashes per year appear to have spiked in 2010 for an unknown conclusive reason. The TIP Letting website was searched for projects that were completed along these routes and one is listed above. However, the Safety Evaluation Group cannot conclude that other funds may have been used to complete construction, safety, or resurfacing projects along these roadway segments that may have affected crashes in the after period.

<u>S2: US-17 (MP 8.212 to 11.630)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	124	123	- 0.8 %
Total Severity Index	3.83	2.99	- 21.9 %
LD Crashes – Both Directions	81	68	- 16.0 %
Lane Departure Severity Index	3.76	2.85	- 24.2 %
Volume (2005, 2010)	42,900	46,500	8.4 %
Total Crash Rate (100 Million Vehicle Miles)	57.88	52.97	- 8.5 %
Injury Crashes			
Fatal Injury Crashes	0	0	N/A
Class-A Injury Crashes	2	0	- 100.0 %
Class-B Injury Crashes	3	8	166.7 %
Class-C Injury Crashes	24	25	4.2 %
Property Damage Only Crashes	95	90	- 5.3 %
Contributing Factors			
Night Crashes	40	46	15.0 %
Animal Crashes	18	19	5.6 %
Wet Road Crashes	41	36	- 12.2 %
Alcohol / Drug Related	5	3	- 40.0 %

<u>Seg-2: US-17 East/North Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	63	64	1.6 %
EB Total Severity Index	3.85	3.31	- 14.0 %
EB Lane Departure Crashes	38	27	- 28.9 %
EB Lane Departure Severity Index	2.95	2.92	- 1.0 %

<u>Seg-2: US-17 South/West Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	61	59	- 3.3 %
WB Total Severity Index	3.82	2.63	- 31.2 %
WB Lane Departure Crashes	43	41	- 4.7 %
WB Lane Departure Severity Index	4.48	2.80	- 37.5 %

Segment-2 experienced a reduction of 1 percent in Total Crashes with a 16 percent reduction in Lane Departure Crashes. In addition, the Total Severity Index saw a 22 percent reduction with Severe Injury Crashes (Fatal and A-injury) reduced from two (2) to zero (0) from the before to the after period. Contributing factors include a 15 percent increase in Night crashes with a slight decrease in wet road crashes from forty-one (41) to thirty-six (36) through the evaluation.



The previous chart depicts the number of Total and Target Crashes per year plotted in the before and after period for Segment-2, along with the AADT. Segment-2 total and lane departure crashes per year appear to have spiked prior to the rumble strip installation following a multi-year decline pace. Also, both sets of crashes again spiked in 2010 for an unknown conclusive reason. The TIP Letting website was searched for projects that were completed along these routes and none were explicated discovered. However, the Safety Evaluation Group cannot conclude that other funds may have been used to complete construction, safety, or resurfacing projects along these roadway segments that may have affected crashes in the after period.

Results and Discussion

Overall, the combined totals of each segment resulted in a 4.4 percent reduction in Total Crashes and a 20 percent reduction in Lane Departure Crashes. The severity indexes were impacted with a reduction greater than 20 percent for the both the Total and Target Crashes.

Both segments experienced a reduction in both overall Total crashes and Lane Departure collisions throughout the study periods. However, when examining the crashes by direction, the eastbound directions for both segments experienced slight increases in Total crashes. The greatest benefit was experienced by Segment-1 Westbound Direction which concluded with a 39 percent reduction in Total crashes and a 62.5 percent reduction in Lane Departure collisions.

The calculated benefit to cost ratio for this project is **20.57 considering total crashes**. The benefit to cost ratio **considering only target crashes is 9.60**. 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 intersection.

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: 2 Segments of US-70		BY: JBS							
COUNTY: Lenoir / Craven		DATE: 10/15/2012							
FILE NO.: W-4800									
DETAILED COST:	TYPE IMPROVEMENT - Shoulder & Median Rumble								
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
	Construction	\$161,000	10	0.149	\$23,994				
	Right-of-Way	\$0	0	0.000	\$0				
		\$0	0	0.000	\$0				
	TOTALS	\$161,000	10	0.149	\$23,994				
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0				
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0				
	TOTAL ANNUAL COST=				\$23,994				
	TOTAL COST OF PROJECT=				\$161,000				
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	4.00	3	0.75	47	11.75	132	33.00	\$849,400	
AFTER	4.00	0	0.00	43	10.75	131	32.75	\$355,825	
								Annual Benefits from Crash Cost Savings	\$493,575
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$469,581			
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	20.57			
TOTAL COST OF PROJECT		-	\$161,000	COMPREHENSIVE B/C RATIO		-	20.57		

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: 2 Segments of US-70		BY: JBS							
COUNTY: Lenoir / Craven		DATE: 10/15/2012							
FILE NO.: W-4800		Target - Lane Departure Crashes							
DETAILED COST:	TYPE IMPROVEMENT - Shoulder & Median Rumble								
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
	Construction	\$161,000	10	0.149	\$23,994				
	Right-of-Way	\$0	0	0.000	\$0				
		\$0	0	0.000	\$0				
	TOTALS	\$161,000	10	0.149	\$23,994				
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0				
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0				
	TOTAL ANNUAL COST=				\$23,994				
	TOTAL COST OF PROJECT=				\$161,000				
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	4.00	1	0.25	38	9.50	87	21.75	\$441,025	
AFTER	4.00	0	0.00	26	6.50	75	18.75	\$210,625	
								Annual Benefits from Crash Cost Savings	\$230,400
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$206,406			
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	9.60			
TOTAL COST OF PROJECT		-	\$161,000	COMPREHENSIVE B/C RATIO		-	9.60		