

Hazard Elimination Project Evaluation

Order # 41000019151

Hazard Elimination Project W-4848

Evaluation of the Rumble Strip Installation

Cherokee County

Documents Prepared By:

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Date

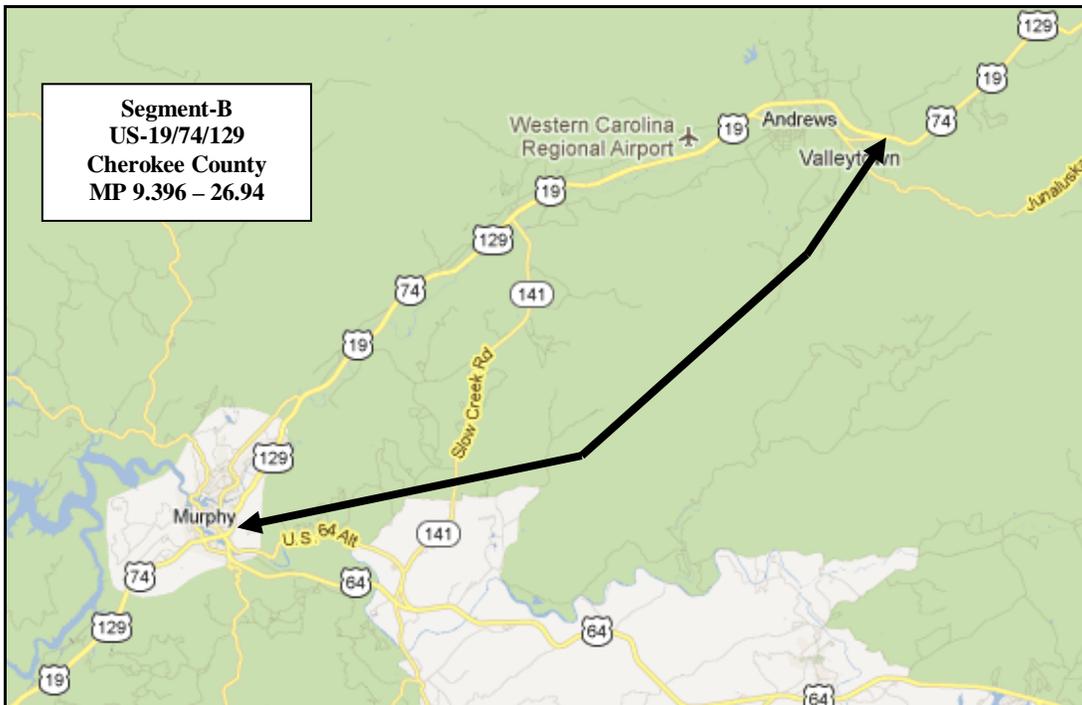
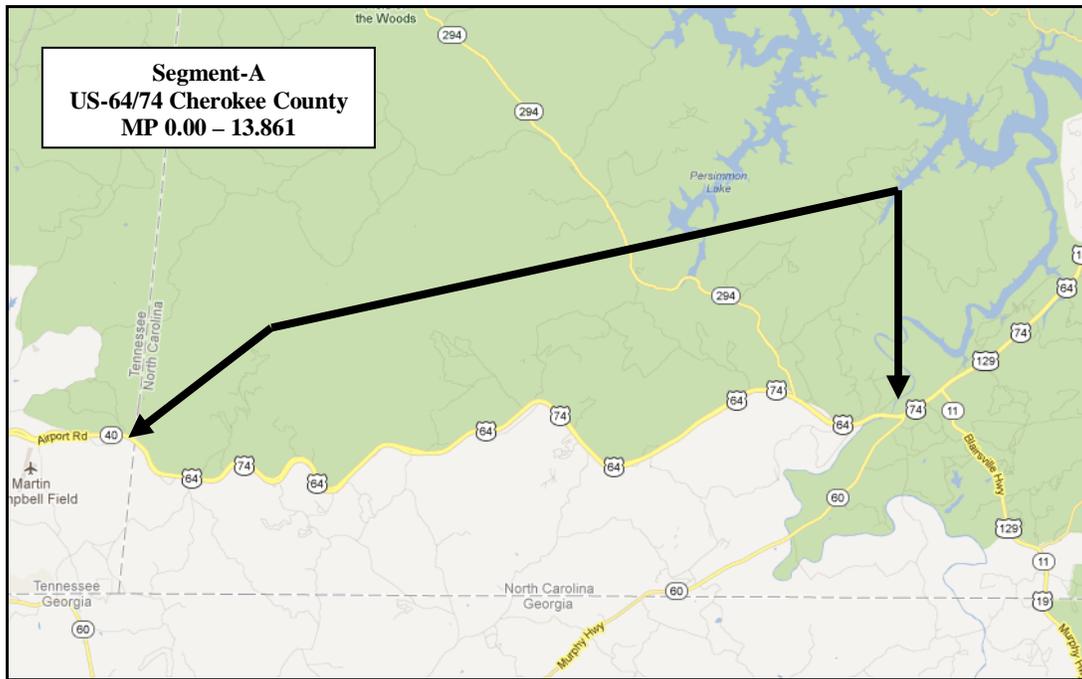
Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project Number W-4848 located along two different segments in Cherokee County, through the Towns of Murphy & Andrews:

Segment A – US 64/74 from Tennessee State Line to NC 60 (MP 0.00 – 13.861)

Segment B – US 19/74/129 from US 64 in Murphy to 0.3 mile east of US 19B (MP 9.396 – 26.940)



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 along the inside and outside shoulders of these roadway segments.

US 64-74 is a four-lane partially-controlled primary route with 3-5 foot paved outside shoulders and a 3-4 foot paved median shoulder on eastbound US 64-74. Note, westbound US 64-74 does not have a paved median shoulder. US 19-74-129 is a four-lane partially-controlled primary route with 3-5 foot paved median and outside shoulders. The speed limit on both sections is 55-mph and neither roadway section has consistent median barrier. The total countermeasure improvement distance is 31.4 miles.

The original statement of problem mentioned that vehicles were running off the road resulting in fatalities, serious injuries, and property damage. Due to the monotonous stretches of low-developed highway, lane departure crashes 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 120 reported crashes, with 46 crashes considered correctable Ran-Off Road collisions. The improvement was completed on September 1, 2007 with a total cost of \$173,000. The projected B/C Ratio was 22.39.

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 June through September 2007. The before period consisted of reported crashes from January 1, 2003 through May 31, 2007 (4 years, 5 months); and the after period consisted of reported crashes from October 1, 2007 through February 29, 2012 (4 years, 5 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>Treatment Information</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Segments	256	269	5.1 %
Total Severity Index	10.59	6.18	- 41.6 %
LD Crashes – Both Segments	97	83	- 14.4 %
Lane Departure Severity Index	14.15	8.33	- 41.1 %

<u>A: US-64/74 (MP 0.00 – 13.861)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	88	108	22.7 %
Total Severity Index	12.58	4.25	- 70.7 %
Injury Crashes			
LD Crashes – Both Directions	47	41	- 12.8 %
Lane Departure Severity Index	14.49	7.04	- 51.4 %
Contributing Factors			
Volume (2005, 2009)	5,200	4,900	- 5.8 %
Total Crash Rate (100 Million Vehicle Miles)	75.74	98.58	30.2 %
Injury Crashes			
Fatal Injury Crashes	0	1	100.0 %
Class-A Injury Crashes	11	1	- 90.9 %
Class-B Injury Crashes	17	12	- 29.4 %
Class-C Injury Crashes	8	15	87.5 %
Property Damage Only Crashes	52	79	51.9 %
Contributing Factors			
Night Crashes	33	42	27.3 %
Animal Crashes	9	41	200+ %
Wet Road Crashes	24	11	- 54.2 %
Alcohol / Drug Related	9	6	- 33.3 %

<u>A: US-64/74 Eastbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	49	54	10.2 %
EB Total Severity Index	16.89	3.91	- 76.9 %
Injury Crashes			
EB Lane Departure Crashes	27	18	- 33.3 %
EB Lane Departure Severity Index	20.31	7.27	- 64.2 %

<u>A: US-64/74 Westbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	39	54	38.5 %
WB Total Severity Index	7.16	4.60	- 35.8 %
Injury Crashes			
WB Lane Departure Crashes	20	23	15.0 %
WB Lane Departure Severity Index	6.64	6.87	3.5 %

Segment-A experienced an increase of 23 percent in Total Crashes with a 13 percent decrease in Lane Departure Crashes. However, the Total Severity Index saw a 71 percent reduction with Severe Injury Crashes (Fatal and A-injury) reduced from eleven (11) to two (2) from the before to the after period. Contributing factors include a 27 percent increase in night crashes with a significant increase in Animal crashes from nine (9) to forty-one (41) through the evaluation.

<u>B: US-19/74/129 (MP 9.396 – 26.94)</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	168	161	- 4.2 %
Total Severity Index	9.54	7.48	- 21.6 %
LD Crashes – Both Directions	50	42	- 16.0 %
Lane Departure Severity Index	13.83	9.59	- 30.7 %
Volume (2005, 2009)	9,100	9,300	2.2 %
Total Crash Rate (100 Million Vehicle Miles)	65.24	61.18	- 6.2 %
Injury Crashes			
Fatal Injury Crashes	4	4	0.0 %
Class-A Injury Crashes	8	4	- 50.0 %
Class-B Injury Crashes	36	23	- 36.1 %
Class-C Injury Crashes	35	36	2.9 %
Property Damage Only Crashes	85	94	10.6 %
Contributing Factors			
Night Crashes	28	39	39.3 %
Animal Crashes	3	9	200.0 %
Wet Road Crashes	30	27	- 10.0 %
Alcohol / Drug Related	8	10	25.0 %

<u>B: US-19/74/129 Eastbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	82	75	- 8.5 %
EB Total Severity Index	7.59	8.91	17.4 %
EB Lane Departure Crashes	20	17	- 15.0 %
EB Lane Departure Severity Index	10.06	17.42	73.2 %

<u>B: US-19/74/129 Westbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	86	86	0.0 %
WB Total Severity Index	11.41	6.23	- 45.4 %
WB Lane Departure Crashes	30	25	- 16.7 %
WB Lane Departure Severity Index	16.35	4.26	- 74.0 %

Segment-B experienced a 4 percent reduction in Total Crashes and a 16 percent decrease in Lane Departure Crashes through the evaluation periods. The Total Severity Index reduced by 22 percent with a reduction in Severe Injury Crashes (Fatals and A-injury) from twelve (12) to eight (8) from the before to the after periods.

Results and Discussion

Reviewing the tables above, the combined segments overall increased crashes by 5 percent with a 14 percent decrease in Lane Departure collisions from the before to the after period. However, severe injury crashes (Fatal and A-injury) decreased dramatically from twenty-three (23) to ten (10) through the evaluation.

Segment-A, US-64/74 from the Tennessee State Line to Milepost 13.861, experienced a 23 percent increase in Total Crashes but a 71 percent reduction in the Total Severity Index. The segment saw a reduction of severe injury crashes (Fatal and A-injury) from eleven (11) in the before period to two (2) in the after period. The total crash increase was comprised of an increase in Animal Crashes from nine (9) to forty-one (41) through the evaluation. Lane Departure crashes experienced a thirteen (13) percent reduction overall and a fifty-one (51) percent reduction in the lane departure severity index.

Segment-B, US-19/74/129 from Murphy to Andrews, experienced a decrease of Total Crashes by four (4) percent with a twenty-two (22) percent reduction in the Total Severity Index. The segment saw a reduction of severe injury crashes (Fatal and A-injury) from twelve (12) in the before period to eight (8) in the after period. Lane departure crashes reduced by sixteen (16) percent with the same lane departure reduction in both directions of travel. Night crashes did increase by thirty-nine (39) percent and animal collisions increased from three (3) to nine (9) through the evaluation.

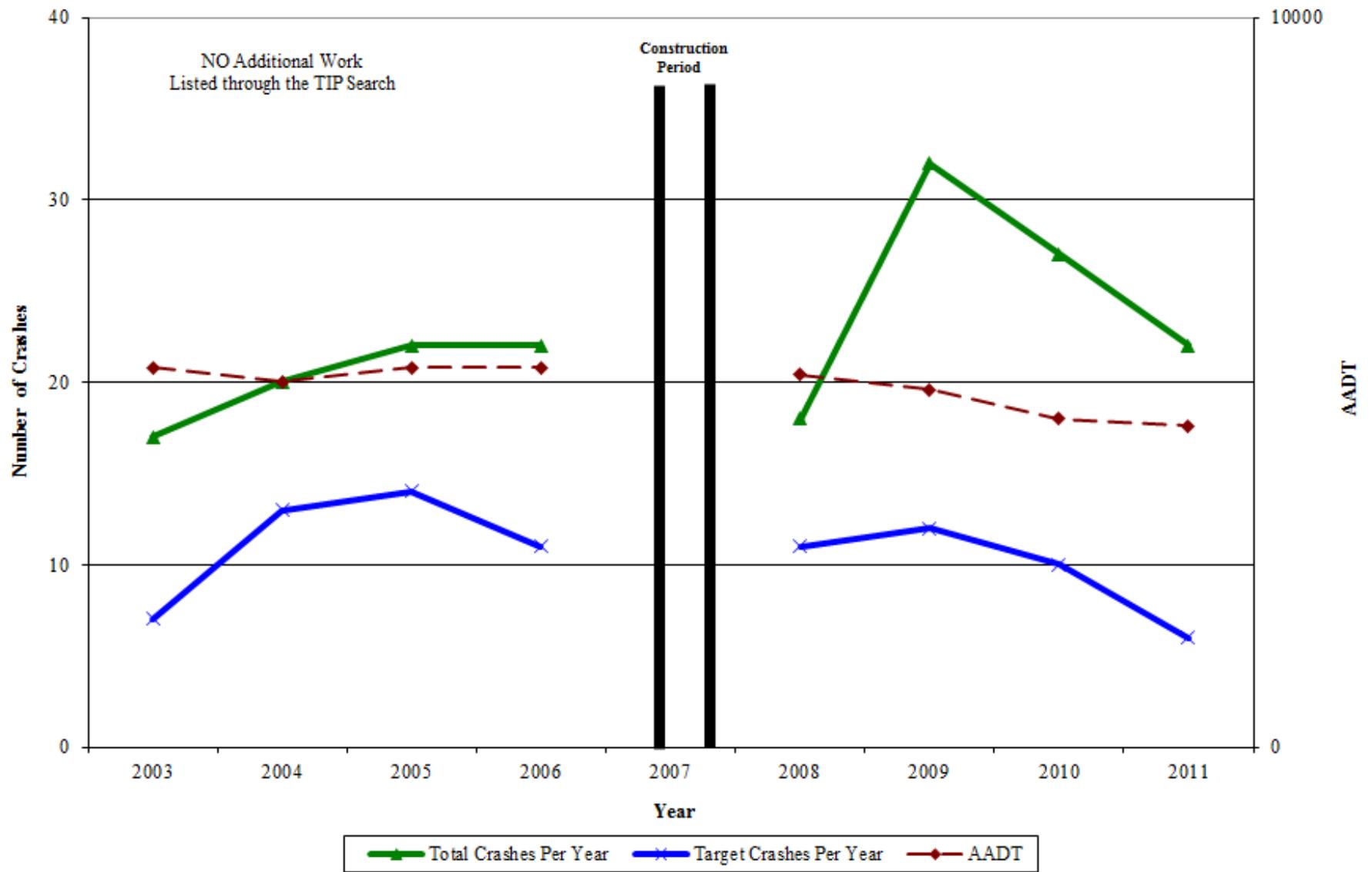
The calculated benefit to cost ratio for this project is **72.27 considering total crashes (both segments)**. The benefit to cost ratio **considering only lane departure target crashes is 49.67**. The benefits are calculated using the change in annual crash costs from the before to the after period. 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 charts depict the number of Total and Target Crashes per year plotted in the before and after period, along with the AADT for each segment. Segment-A total crashes per year appear to have spiked in 2009 for an unknown conclusive reason. The TIP Letting website was searched for projects that were completed along these routes and none were 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.

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.

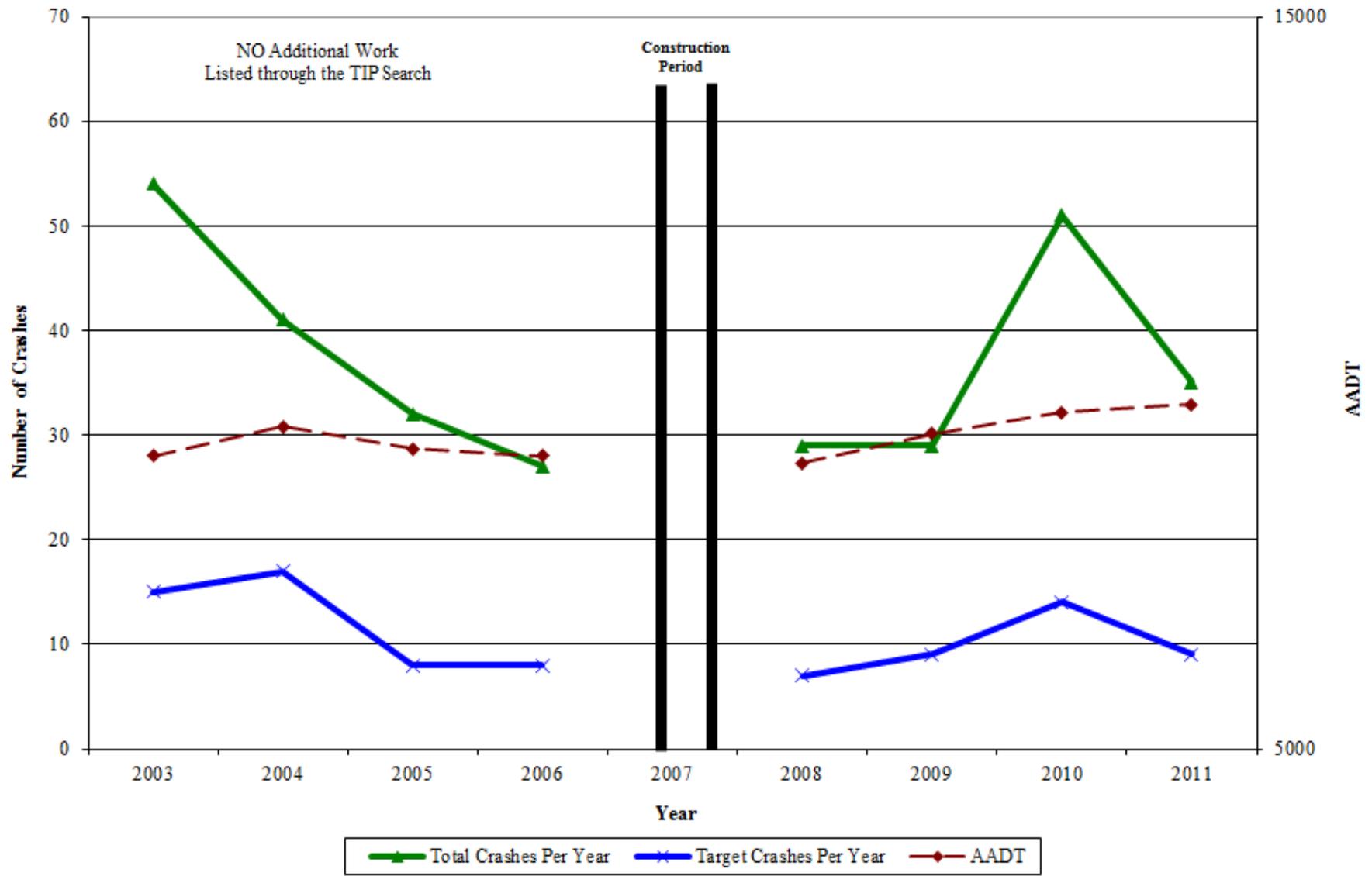
Seg-1: US-64/74 Cherokee County - Crashes Per Year

Rumble Strips Completed 9/2007



Seg-2: US-19/74/129 Cherokee County - Crashes Per Year

Rumble Strips Completed 9/2007



BENEFIT-COST ANALYSIS WORKSHEET - Total Combined Crashes

LOCATION: US 64-74 & 19-74-129		BY: JBS						
COUNTY: Cherokee		DATE: 7/9/2012						
FILE NO.: W-4848								
DETAILED COST:	TYPE IMPROVEMENT -	Rumble Strips						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$173,000	10	0.149	\$25,782			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$173,000	10	0.149	\$25,782			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$25,782			
	TOTAL COST OF PROJECT=				\$173,000			
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	4.42	23	5.20	96	21.72	137	31.00	\$3,845,950
AFTER	4.42	10	2.26	86	19.46	173	39.14	\$1,982,783
							Annual Benefits from Crash Cost Savings	\$1,863,167
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$1,837,385		
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	72.27		
	TOTAL COST OF PROJECT	-	\$173,000		COMPREHENSIVE B/C RATIO	-		72.27

BENEFIT-COST ANALYSIS WORKSHEET - Target Combined Crashes

LOCATION: US 64-74 & 19-74-129		BY: JBS						
COUNTY: Cherokee		DATE: 7/9/2012						
FILE NO.: W-4848		Lane Departure Target Crashes						
DETAILED COST:	TYPE IMPROVEMENT -	Rumble Strips						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$173,000	10	0.149	\$25,782			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$173,000	10	0.149	\$25,782			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$25,782			
	TOTAL COST OF PROJECT=				\$173,000			
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	4.42	14	3.17	29	6.56	54	12.22	\$2,179,231
AFTER	4.42	5	1.13	31	7.01	47	10.63	\$898,665
							Annual Benefits from Crash Cost Savings	\$1,280,566
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$1,254,784		
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	49.67		
	TOTAL COST OF PROJECT	-	\$173,000		COMPREHENSIVE B/C RATIO	-		49.67