Hazard Elimination Project Evaluation

Order # 41000000173

Hazard Elimination Project W-4441

Evaluation of the Congestion Detection System on I-240 near the Smokey Park Bridge in 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

_____ 10/15/2009

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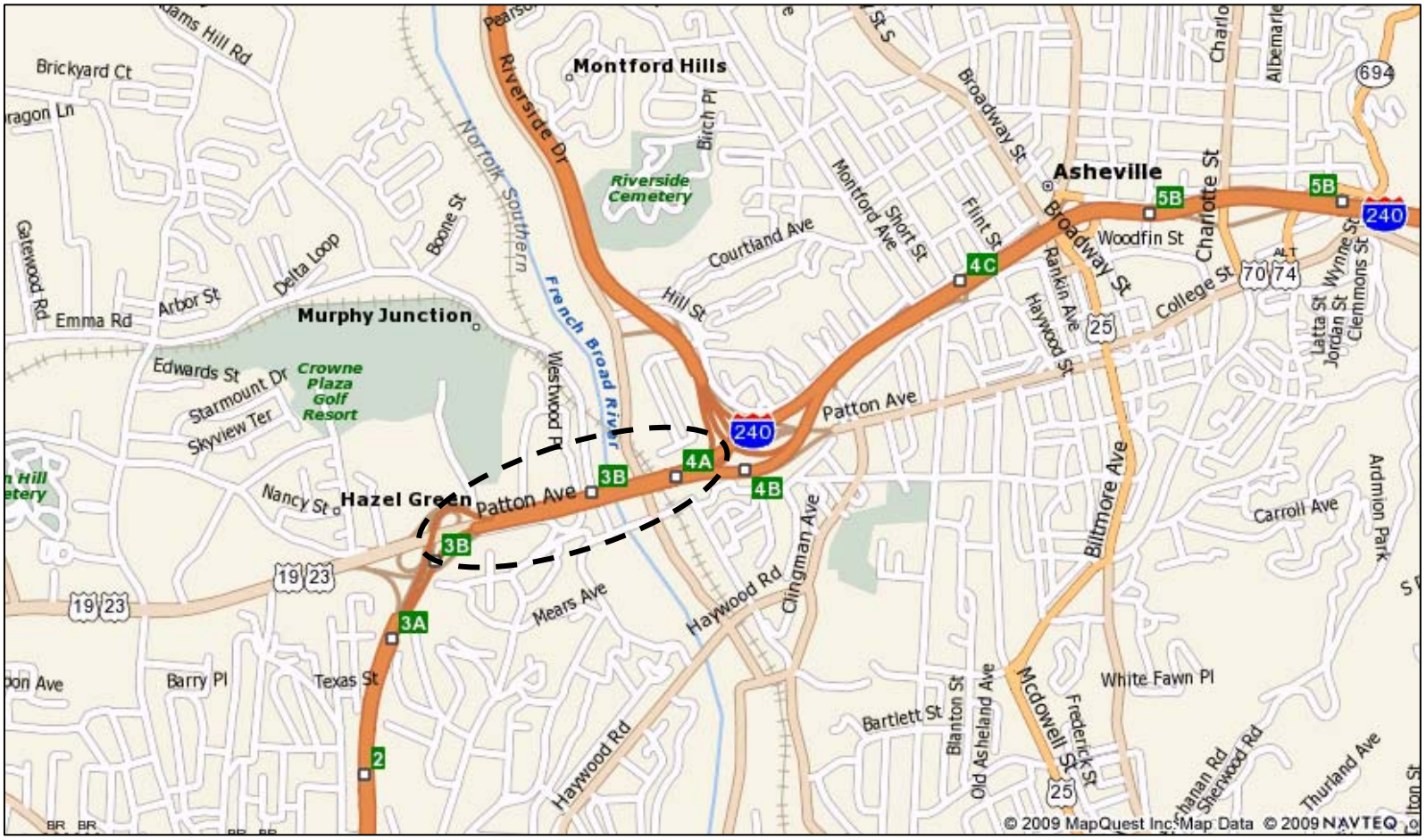
Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation

SUBJECT LOCATION

On I-240 near the Smokey Park Bridge between US 19-23-74A (Exit 3) and US 19-23 North (Exit 4) in Asheville, Buncombe County.



Location Map

PROJECT INFORMATION

The safety countermeasure chosen for the subject location was to install a congestion detection system using microwave detectors and to install overhead signs with traffic actuated flashers on three approaches (two eastbound and one westbound). See the aerial photograph for sign placement.

Overhead Sign Placement & Limits of Project Evaluation

According to the Project Report, the area between Exits 3 and 4 on I-240 becomes congested during the PM peak. This section of I-240 has six lanes (three in either direction) with a posted speed limit of 50 mph. Traffic merges from five separate on/off ramps within 0.8 mile. The alignment of the area restricts motorists from seeing slow or stopped vehicles. The warning system was intended to warn motorists of stopped or slowed traffic ahead and to reduce the chronic rear end crash pattern that had developed at this location.

The initial crash analysis for this location was completed from December 1, 1998 through November 30, 2001. There were 209 Total Crashes, including 101 Injury Rear End Crashes and 108 PDO Rear End Crashes. The final completion date was on December 19, 2004 with a total estimated cost of $560,000. The projected benefit cost ratio was 6.53:1.

NAÏVE BEFORE AND AFTER ANALYSIS

After reviewing the hazard elimination 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 was from October 1, 2004 through December 31, 2004. The before period consisted of reported crashes from May 1, 2000 through September 30, 2004 (4 years, 5 months) and the after period consisted of reported crashes from January 1, 2005 through May 31, 2009 (4 years, 5 months). The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed. The before period ADT year was 2002 and the after period ADT year was 2007.

The treatment data consisted of crashes on I-240 between Exits 3 and 4 near the Smokey Park Bridge. The crash analysis limits are denoted on the previous aerial photograph. The following tables depict the Naïve Before and After Analysis for Total Crashes and Target Crashes at the treatment location. The data is broken down by Eastbound and Westbound directions. Please note that the targeted crash type for the applied countermeasures was Rear End Crashes.

I-240EB near the Smokey Park Bridge

	Before 5/1/00-9/30/04	**After 1/1/05-5/31/09**	**Percent Increase (+)/ Percent Decrease (-)**
Total Crashes	138	161	16.7
Total Crash Severity Index	5.37	4.18	-22.2
Fatal Injury Crashes	0	1	n/a
Class A Injury Crashes	2	0	-100.0
Class B Injury Crashes	15	13	-13.3
Class C Injury Crashes	46	46	0.0
PDO Crashes	75	101	34.7
Rear End Crashes	89	101	13.5
Rear End Crash Severity Index	5.59	4.61	-17.5
Fatal Injury Crashes	0	1	n/a
Class A Injury Crashes	1	0	-100.0
Class B Injury Crashes	7	4	-42.9
Class C Injury Crashes	38	35	-7.9
PDO Crashes	43	61	41.9
Night Crashes	19	21	10.5
Wet Crashes	33	32	-3.0
PM Peak Hour Crashes (4-7 pm)	49	62	26.5
AADT	94000	99000	5.3

I-240WB near the Smokey Park Bridge

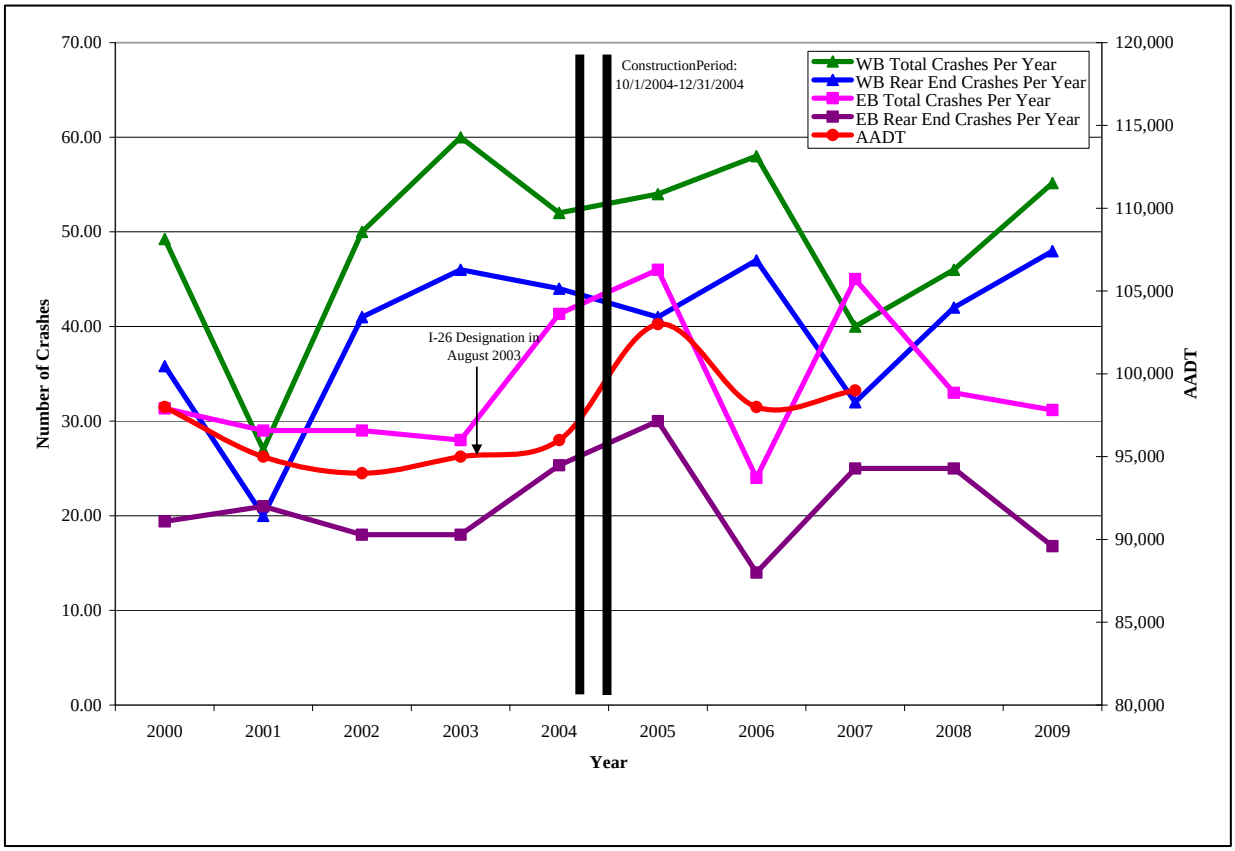
	Before 5/1/00-9/30/04	After 1/1/05-5/31/09	Percent Increase (+)/ Percent Decrease (-)
Total Crashes	209	221	5.7
Total Crash Severity Index	5.16	4.89	-5.2
Fatal Injury Crashes	1	0	n/a
Class A Injury Crashes	1	1	0.0
Class B Injury Crashes	13	11	-15.4
Class C Injury Crashes	84	95	13.1
PDO Crashes	110	114	3.6
Rear End Crashes	164	182	11.0
Rear End Crash Severity Index	4.75	5.2	9.5
Fatal Injury Crashes	0	0	n/a
Class A Injury Crashes	0	1	n/a
Class B Injury Crashes	8	6	-25.0
Class C Injury Crashes	75	87	16.0
PDO Crashes	81	88	8.6
Night Crashes	20	25	25.0
Wet Crashes	35	46	31.4
PM Peak Hour Crashes (4-7 pm)	115	117	1.7
AADT	94000	99000	5.3

RESULTS AND DISCUSSION

Using naïve before and after analysis methodologies, the Eastbound and Westbound directions of travel experienced an increase in both Total and Rearend Crashes. In the Eastbound direction, the analysis resulted in a 17 percent increase in Total Crashes and a 14 percent increase in Rear End Crashes. In the Westbound direction, the analysis resulted in a 6 percent increase in Total Crashes and an 11 percent increase in Rear End Crashes.

There was a 5 percent increase in Average Daily Traffic (ADT), an increase of 5000 vehicles/day. In August 2003, the I-26 designation was extended from the original terminus at I-40/I-240 in Asheville north to the I-81/181 junction near Kingsport, Tennessee. The designation change was a likely contributing factor to the ADT increase along this section of I-240, which coincides with I-26.

For additional analysis, the Eastbound/Westbound and Total/Rearend Crashes were graphed out along with the volume to display the change in crashes over the total analysis time frame. See the following figure. Looking at the 2007 through 2009 data trends it appears that Westbound crashes are on the rise and Eastbound crashes are on the decline.



The calculated benefit to cost ratio for this project is **2.44** considering Total Crashes in both directions of travel. The positive benefit to cost ratio for Total Crashes is attributed to the decrease in Fatal and A-Injury Crashes, which decreased by 50 percent from 4 crashes in the before period to 2 crashes in the after period. The calculated benefit to cost ratio for this project is **-2.00** considering only Target Crashes in both directions of travel. See the attached Benefit-Cost Analysis Worksheet for more information. Note that 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 costs.

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

W-4441 Location Photos (Source: Google Maps)

Driving Westbound on I-240 approaching Smokey Park Bridge

Driving Westbound on I-240 at Smokey Park Bridge

W-4441 Location Photos (Source: Google Maps)

Driving Eastbound on US 19-23 at the I-240 Merge

Driving Eastbound on I-240 at US 19-23 South Off Ramp

W-4441 Location Photos (Source: Google Maps)

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: I-240 @ Smokey Park Bridge-TOTAL CRASHES
BY: CLS
COUNTY: Buncombe
DATE: 10/6/2009
FILE NO.: W-4441

DETAILED COST: TYPE IMPROVEMENT - Congestion Detection System

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Detection Equipment	$411,555	10	0.149	$61,334
Overhead Signs	$120,060	6	0.216	$25,971
Flashers	$20,087	10	0.149	$2,994
TOTALS	$551,702	9	0.164	$90,298

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $1,300
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $500

TOTAL ANNUAL COST= $92,098
TOTAL COST OF PROJECT= $551,702

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	4	0.90	158	35.75	185	41.86	$1,460,860
AFTER	4.42	2	0.45	165	37.33	215	48.64	$1,235,973

Annual Benefits from Crash Cost Savings $224,887

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $132,789

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 2.44

TOTAL COST OF PROJECT - $551,702 COMPREHENSIVE B/C RATIO - 2.44

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: I-240 @ Smokey Park Bridge-TARGET CRASHES
COUNTY: Buncombe
FILE NO.: W-4441

BY: CLS
DATE: 10/6/2009

DETAILED COST: TYPE IMPROVEMENT - Congestion Detection System

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
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TOTAL ANNUAL COST= $92,098
TOTAL COST OF PROJECT= $551,702

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	1	0.23	128	28.96	124	28.05	$839,548
AFTER	4.42	2	0.45	132	29.86	149	33.71	$1,023,937

Annual Benefits from Crash Cost Savings ($184,389)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = ($276,487)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -2.00

TOTAL COST OF PROJECT - $551,702 COMPREHENSIVE B/C RATIO - -2.00