

Hazard Elimination Project Evaluation

Project Log # 200608056

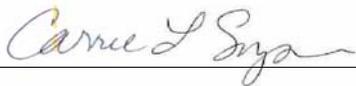
Hazard Elimination Project W-3407

Evaluation of the Shoulder Guardrail Replacements and Upgrades on US 74 at the Bridge Approaches and Bridge Rails to Bridge # 48, 49, 60, 73, 74, 79, 80, 101 and 102 Cleveland County

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Traffic Engineering and Safety Systems Branch
North Carolina Department of Transportation

Principal Investigator



2/28/08

Carrie L. Simpson, PE

Date

Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-3407 – Shoulder guardrail replacements and upgrades on US 74 at the bridge approaches and bridge rails of Bridge # 48, 49, 60, 73, 74, 79, 80, 101, and 102 in Cleveland County

Project Information and Background from the Project File Folder

The safety countermeasures chosen for the subject location were to replace the substandard shoulder guardrail, retrofit the bridges with three beam guardrail, and install 18 BCT-1 end treatments. W-3407 was combined with two other projects involving substandard guardrail and bridge attachments, W-3600 and W-4002. W-3407 covered bridge numbers 48, 49, 60, 73, 74, 79, 80, 101, and 102 on US 74. US 74 is a four-lane divided roadway with a speed limit of 55 miles per hour.

According to the project file, the previous guardrail was substandard in its post spacing, offset blocks, and end treatments, which made it deficient in its ability to protect motorists from obstructions. Also, the previous “Shoe End” treatments were found to be a safety hazard by the FHWA. Bridge #101 did not have approach guardrail or bridge-end protection in the before period. The remaining bridges had approach guardrail but it was not connected to the bridge rail.

The initial crash analysis for this location was completed from November 1, 1994 through October 31, 1997 with a total of 126 reported crashes. There were 18 Run Off Road Crashes, including 3 Fatal Injury Crashes, 12 Non-Fatal Injury Crashes, and 3 PDO Crashes. W-3407 was completed in June of 1999 at a cost of \$1,316,854.

Naïve Before and After Analysis

After reviewing the hazard elimination project file folder along with all the crashes at the subject locations, the crash data omitted from this analysis to consider for an adequate construction period was from October 1, 1998 through February 29, 2000. The before period consisted of reported crashes from October 1, 1991 through September 30, 1998 (7 Years) and the after period consisted of reported crashes from March 1, 2000 through February 28, 2007 (7 Years). The ending date for this analysis was determined by the available crash data at the time the crash analysis was completed.

The treatment data consisted of all crashes on US 74 from MP 2.35-2.67 (vicinity of Bridge #48 & 49), MP 5.51-5.71 (vicinity of Bridge #60), MP 8.19-8.55 (vicinity of Bridge # 73 & 74), MP 8.88-9.16 (vicinity of Bridge # 79 & 80), and MP 16.10-16.33 (vicinity of Bridge # 101 & 102). A total of 1.39 miles was analyzed. A 0 feet Y-line was used in the analysis. Please see the attached *Appendices* for further detail.

The following tables depict the Naïve Before and After Analysis for the Total Crashes and Target Crashes at the aggregated treatment locations. Please see *Appendix A-E* for specific crash analysis information provided separately for each location.

Note that Ran Off Road crash types were the target crashes for the applied countermeasure. Ran Off Road crash types considered are as follows: Ran Off Road – Left, Ran Off Road – Right, Ran Off Road – Straight, Fixed Object, Head-on, Sideswipe – Same Direction, Sideswipe – Opposite Direction, and Overturn / Rollover.

<i>Total Treatment Information</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	125	110	-12.0%
Total Severity Index	8.69	4.72	-45.7%
Target Crashes			
Target Crashes	81	75	-7.4%
Target Severity Index	10.47	5.27	-49.7%
Volume	20700	24200	16.9%

<i>Target Crash Information</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	3	0	-100.0%
Non-Fatal Injury Crashes	36	34	-5.6%
Total Injury Crashes	39	34	-12.8%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	35	24	-31.4%
Wet / Icy Crashes	47	35	-25.5%
Alcohol/Drug Involvement Crashes	9	6	-33.3%
<i>Target Crashes - Crash Types</i>			
Fixed Object	50	45	-10.0%
Overturn / Rollover	1	5	400.0%
Ran Off Road	17	9	-47.1%
Sideswipe - Same Direction	12	16	33.3%
Sideswipe - Opposite Direction	1	0	-100.0%

The naïve before and after analysis at the treatment location resulted in a 12 percent decrease in Total Crashes, a 7 percent decrease in Target Crashes, and a 17 percent increase in Average Daily Traffic (ADT). Further investigation shows there was a 46 percent decrease in the Severity Index for Total Crashes and a 50 percent decrease in the Severity Index for Target Crashes. The before period ADT year was 1995 and the after period ADT year was 2003.

Results and Discussion

The naïve before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 12 percent decrease in Total Crashes and a 7 percent decrease in Target Crashes. Further investigation shows that the Severity Index of Total Crashes and Target Crashes appear to have decreased by 46 and 50 percent respectively using naïve methodologies. The summary results above demonstrate that overall the treatment locations appear to have had a decrease in Total Crashes, Target Crashes, and the Severity Index from the before to the after period.

The calculated benefit to cost ratio for this project is 2.59 considering total crashes. The benefit to cost ratio considering only target crashes is 2.16. 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.

There were two predominant contributing factors associated with Target Crashes in both the before and after period. Night Crashes accounted for 43 percent of Target Crashes (35 of 81) in the before period and 32 percent of Target crashes (24 of 75) in the after period. Also, Wet / Icy conditions were a contributing factor in 58 percent of Target Crashes (47 of 81) in the before period and 47 percent of Target Crashes (35 of 75) in the after period. Target Crashes associated with both contributing factors decreased in the after period, which played a considerable role in the reduction of Target Crashes. The decrease in Target Night Crashes and Wet / Icy Crashes may be attributed to the improved delineation provided by the markers and end treatments on the upgraded guardrail.

The number of high severity Target Crashes (Fatal and Class-A Injury Crashes) decreased by 86 percent, from 7 crashes in the before period to 1 crash in the after period. The number of Class-B and Class-C Injury Target Crashes remained relatively constant, increasing 3 percent from 32 crashes in the before period to 33 crashes in the after period. The substantial decrease in high severity Target Crashes can be attributed to the replacement of substandard guardrail with upgraded guardrail and end treatments.

Because we had specific information as to exactly where each run of guardrail was placed in this project and because each location experienced differing results, specific crash information for each run of guardrail was analyzed. Please see the corresponding *Appendix* for separate crash data and discussion at each bridge location.

Appendix A: Bridge 48/49 Location

Appendix B: Bridge 60 Location

Appendix C: Bridge 73/74 Location

Appendix D: Bridge 79/80 Location

Appendix E: Bridge 101/102 Location

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.

TOTAL BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 74 at Bridges 48, 49, 60, 73, 74, 79, 80, BY: CLS
 COUNTY: Cleveland DATE: 1/29/2008
 FILE NO.: W-3407

DETAILED COST: TYPE IMPROVEMENT - Guardrail

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$1,316,854	10	0.149	\$196,250
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$1,316,854	10	0.149	\$196,250

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$850
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$197,100
 TOTAL COST OF PROJECT= \$1,316,854

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	7.00	8	1.14	48	6.86	69	9.86	\$733,300
AFTER	7.00	1	0.14	45	6.43	64	9.14	\$222,800

Annual Benefits from Crash Cost Savings \$510,500

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$313,400

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 2.59

TOTAL COST OF PROJECT - \$1,316,854 COMPREHENSIVE B/C RATIO - 2.59

TREATMENT BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 74 at Bridges 48, 49, 60, 73, 74, 79, 80, 1 BY: CLS
 COUNTY: Cleveland DATE: 1/29/2008
 FILE NO.: W-3407

DETAILED COST: TYPE IMPROVEMENT - **Guardrail**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$1,316,854	10	0.149	\$196,250
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$1,316,854	10	0.149	\$196,250

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$850
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$197,100
 TOTAL COST OF PROJECT= \$1,316,854

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	7.00	7	1.00	32	4.57	42	6.00	\$605,686
AFTER	7.00	1	0.14	33	4.71	41	5.86	\$179,129

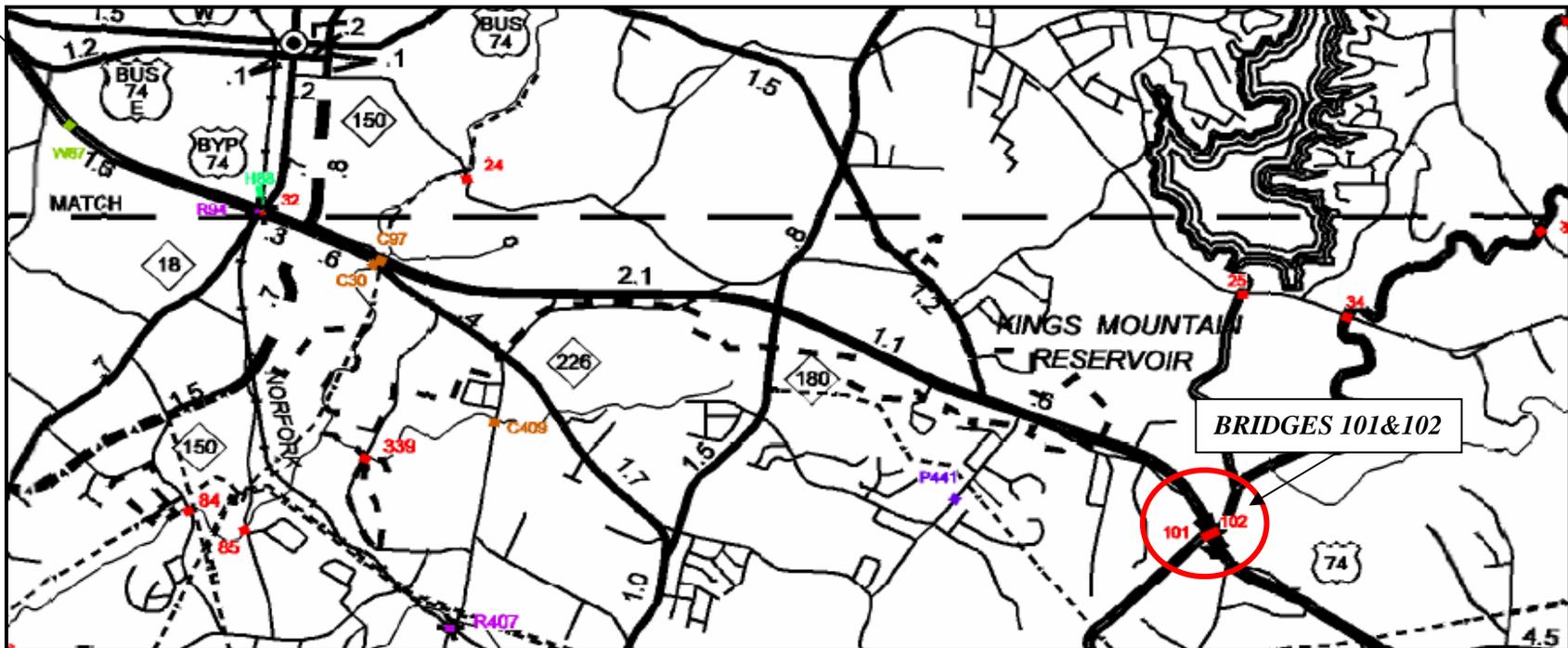
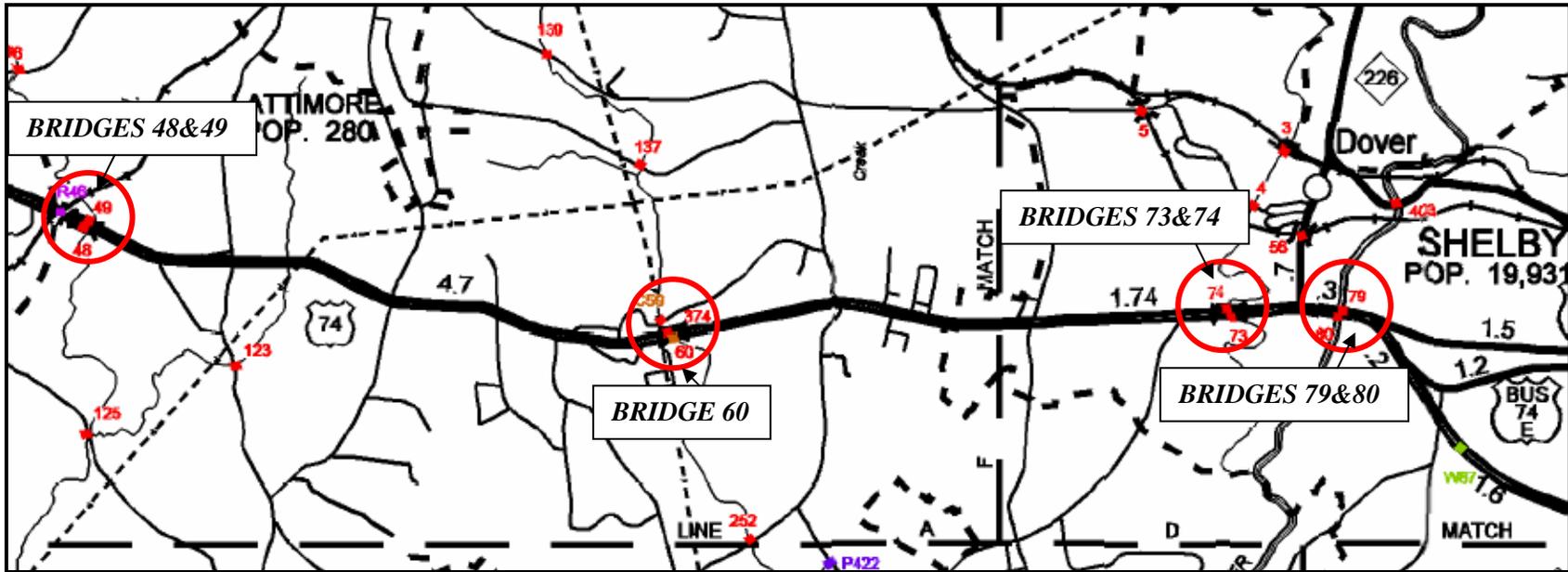
Annual Benefits from Crash Cost Savings \$426,557

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$229,457

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 2.16

TOTAL COST OF PROJECT - \$1,316,854 COMPREHENSIVE B/C RATIO - 2.16

**W-3407 LOCATION MAP:
GUARDRAIL SURROUNDING NINE BRIDGES ON US74 NEAR SHELBY IN CLEVELAND CO.**



APPENDIX A

Bridge 48/49 Location

Treatment Information – Bridges 48/49

	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	22	13	-40.9%
Total Severity Index	18.15	2.71	-85.1%
Target Crashes	18	11	-38.9%
Target Severity Index	21.13	2.35	-88.9%
Volume	13400	17000	26.9%

Target Crash Information – Bridges 48/49

	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	2	0	-100.0%
Non-Fatal Injury Crashes	10	2	-80.0%
Total Injury Crashes	12	2	-83.3%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	8	3	-62.5%
Wet / Icy Crashes	13	6	-53.8%
Alcohol/Drug Involvement Crashes	2	1	-50.0%
<i>Target Crashes - Crash Types</i>			
Fixed Object	11	8	-27.3%
Ran Off Road	5	3	-40.0%
Sideswipe - Same Direction	2	0	-100.0%

The naïve before and after analysis at the Bridge 48/49 location resulted in a 41 percent decrease in Total Crashes, a 39 percent decrease in Target Crashes, and a 27 percent increase in Average Daily Traffic (ADT).

Discussion

The number of Total Crashes at the Bridge 48/49 location decreased by 41 percent, from 22 crashes in the before period to 13 crashes in the after period. Also, the number of Target Crashes at the Bridge 48/49 location decreased by 39 percent, from 18 crashes in the before period to 11 crashes in the after period. The Total and Target Severity Index at the Bridge 48/49 location decreased by 85 and 89 percent, respectively.

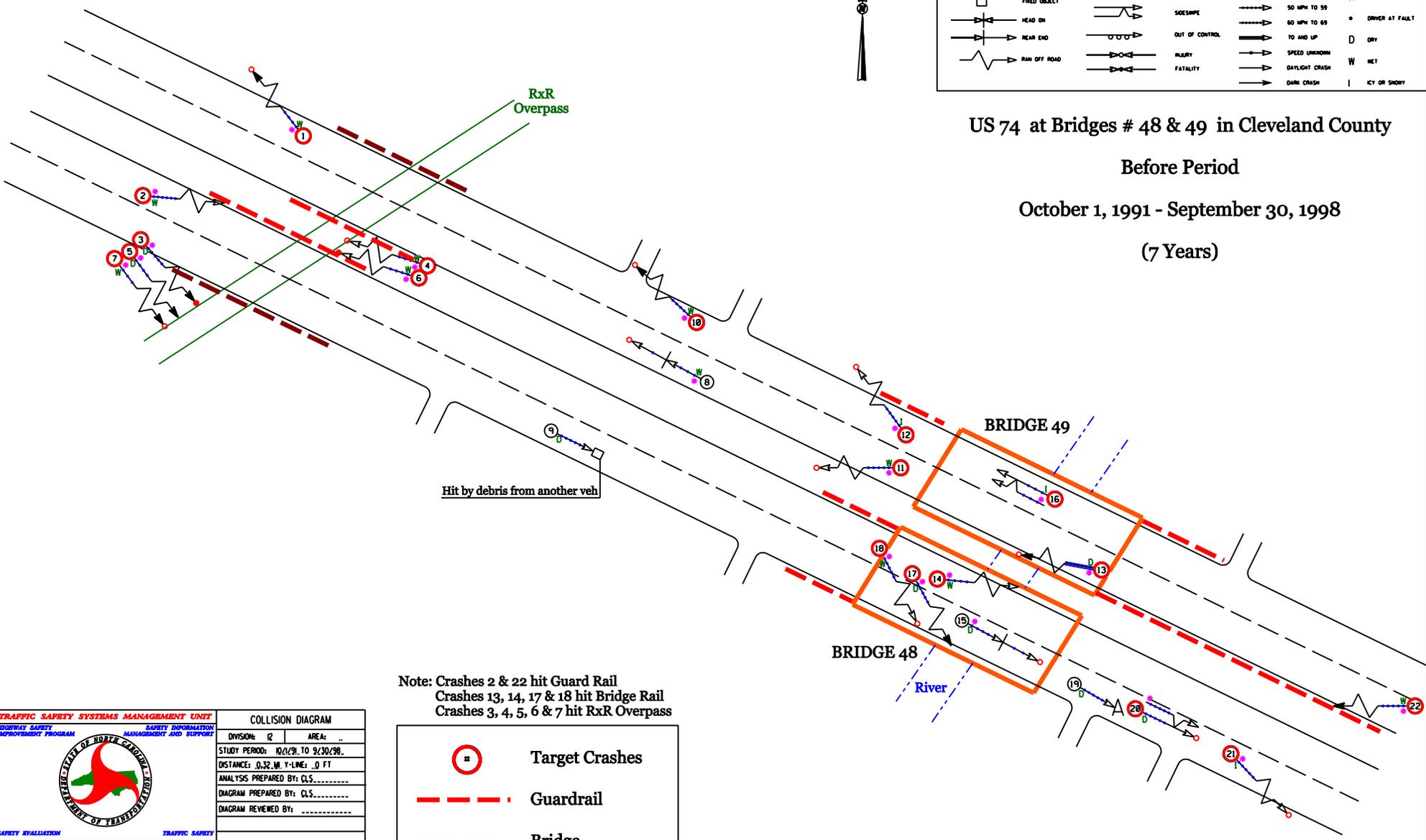
Two Fatal Injury Crashes, one Class-A Injury Crash, and one Class-B Injury Crash occurred in the before period involving vehicles running off the road and striking the railroad overpass support pier located just west of Bridges 48/49. In the after period the guardrail surrounding Bridges 48/49 was extended to join the short guardrail segments surrounding the railroad overpass, successfully providing better protection around the bridge piers.

LEGEND

→ MOVING VEHICLE	↘ ANGLE	→ 9 MPH OR LESS	P PEDESTRIAN
→ PEDESTRIAN	↘ TURNING	→ 10 MPH TO 19	B BICYCLE
☒ PARKED VEHICLE	↘ BACKING	→ 20 MPH TO 29	T TRAM
☐ PARKING VEHICLE	↘ SIDESWIPe	→ 30 MPH TO 39	A ANIMAL
□ FIRED OBJECT	↘ OUT OF CONTROL	→ 40 MPH TO 49	• DRIVER AT FAULT
→ HEAD ON	↘ HLAIRY	→ 50 MPH TO 59	→ TO AND UP
→ REAR END	↘ FATALITY	→ 60 MPH TO 69	→ TO AND DOWN
→ RAN OFF ROAD		→ SPEED UNKNOWN	→ DAYLIGHT CRASH
		→ DARK CRASH	→



US 74 at Bridges # 48 & 49 in Cleveland County
Before Period
October 1, 1991 - September 30, 1998
(7 Years)



Note: Crashes 2 & 22 hit Guard Rail
 Crashes 13, 14, 17 & 18 hit Bridge Rail
 Crashes 3, 4, 5, 6 & 7 hit RxR Overpass

⊛	Target Crashes
- - - - -	Guardrail
—————	Bridge

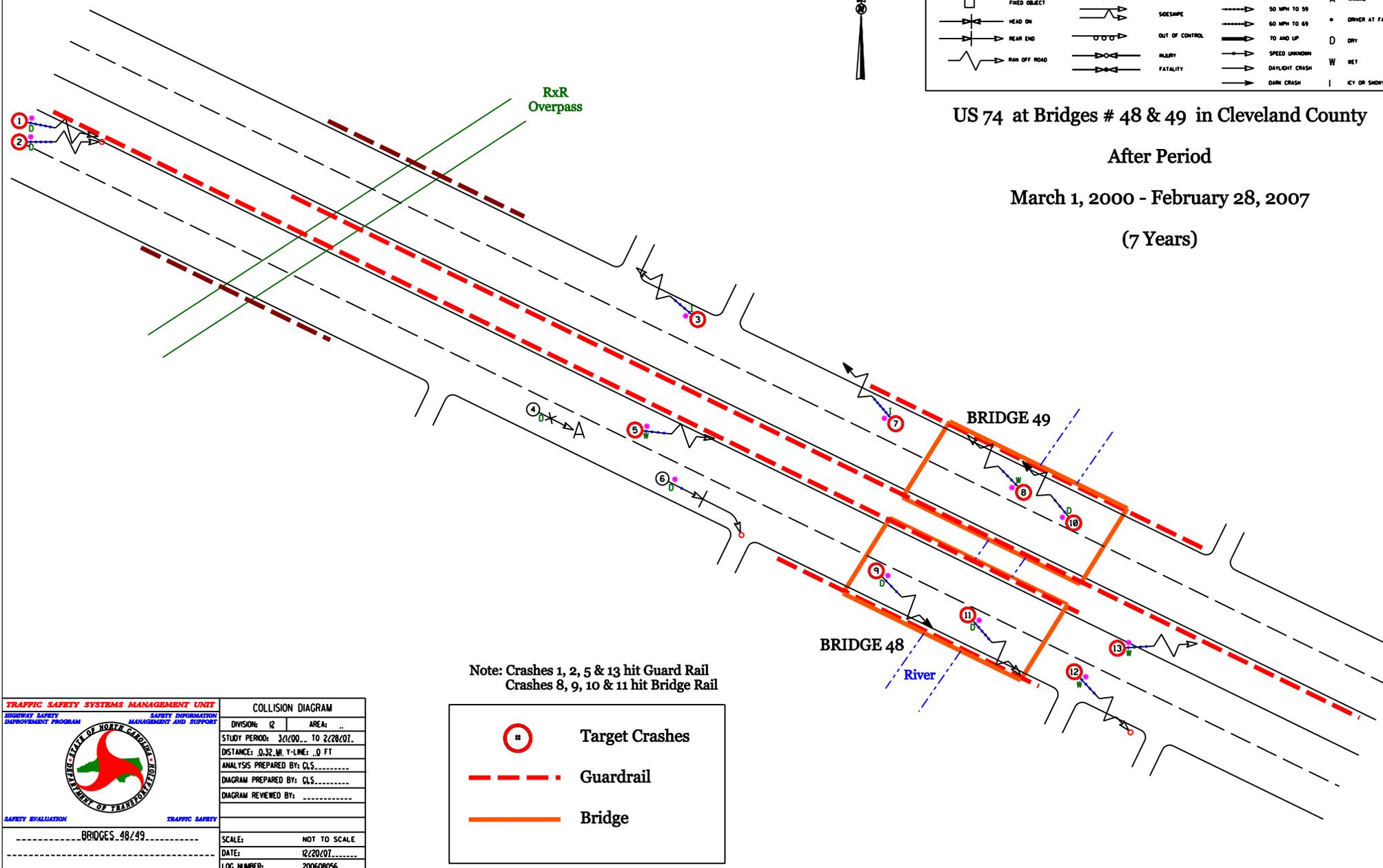
TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT	COLLISION DIAGRAM
ROADWAY SAFETY IMPROVEMENT PROGRAM	SAFETY INFORMATION MANAGEMENT AND SUPPORT
	DIVISION: 12 AREA: ..
	STUDY PERIOD: 10/1/91 TO 9/30/98
	DISTANCE: 0.32 M Y-LINE: 0 FT
	ANALYSIS PREPARED BY: CLS.....
	DIAGRAM PREPARED BY: CLS.....
	DIAGRAM REVIEWED BY:
SAFETY EVALUATION	TRAFFIC SAFETY
BRIDGES 48/49	SCALE: NOT TO SCALE
	DATE: 12/20/07
	LOG NUMBER: 200608056

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH

LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		BIICYCLE
	PARKED VEHICLE		BACKING		20 MPH TO 29		TRAIN
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		ANIMAL
	HEAD ON		MILEAGE		50 MPH TO 59		DRY
	REAR END		FATALITY		60 MPH TO 69		WET
	RAN OFF ROAD		DAYLIGHT CRASH		70 AND UP		ICY OR SHY
			DARK CRASH				

US 74 at Bridges # 48 & 49 in Cleveland County
After Period
March 1, 2000 - February 28, 2007
(7 Years)



<p>TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT</p> <p>ROADWAY SAFETY IMPROVEMENT PROGRAM</p> <p>SAFETY EVALUATION</p> <p>BRIDGES 48/49</p>	<p style="text-align: center;">COLLISION DIAGRAM</p> <p>DIVISION: 12 AREA: ..</p> <p>STUDY PERIOD: 3/1/00... TO 2/28/07</p> <p>DISTANCE: 0.32 MI. Y-LINE: 0 FT</p> <p>ANALYSIS PREPARED BY: CLS</p> <p>DIAGRAM PREPARED BY: CLS</p> <p>DIAGRAM REVIEWED BY:</p> <p>SCALE: NOT TO SCALE</p> <p>DATE: 12/20/07</p> <p>LOG NUMBER: 200608056</p>
<p>N.C. DEPARTMENT of TRANSPORTATION</p> <p>DIVISION of HIGHWAYS</p> <p>TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH</p>	

APPENDIX B

Bridge 60 Location

<i>Treatment Information – Bridge 60</i>			
	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	2	4	100.0%
Total Severity Index	42.60	4.70	-89.0%
<i>Target Crashes</i>			
Target Crashes	2	4	100.0%
Target Severity Index	42.60	4.70	-89.0%
<i>Volume</i>			
Volume	14200	18000	26.8%

<i>Target Crash Information – Bridge 60</i>			
	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	1	0	-100.0%
Non-Fatal Injury Crashes	1	2	100.0%
Total Injury Crashes	2	2	0.0%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	1	1	0.0%
Wet / Icy Crashes	1	0	-100.0%
Alcohol/Drug Involvement Crashes	0	1	N/A
<i>Target Crashes - Crash Types</i>			
Fixed Object	2	4	100.0%

The naïve before and after analysis at the Bridge 60 location resulted in a 100 percent increase in Total Crashes, a 100 percent increase in Target Crashes, and a 27 percent increase in Average Daily Traffic (ADT).

Discussion

The number of Total and Target Crashes at the Bridge 60 location increased by 100 percent, from 2 crashes in the before period to 4 crashes in the after period. All of the crashes at the location were considered Target Crashes in both the before and after period. The Total and Target Severity Index at the Bridge 60 location decreased by 89 percent. Both before period crashes (one Fatal Injury Crash and one Class-B Injury Crash) involved a vehicle striking the unprotected bridge rail end.

US 74 at Bridge # 60 in Cleveland County

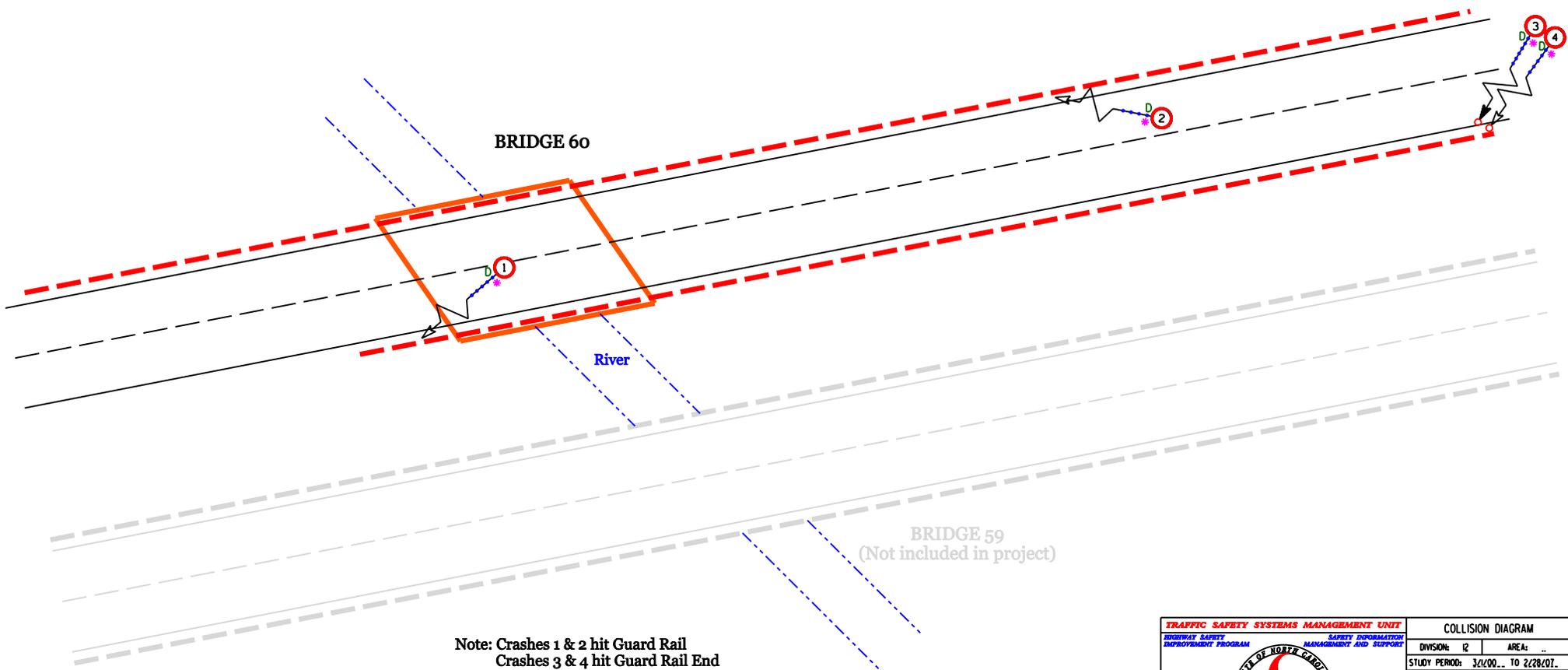
After Period

March 1, 2000 - February 28, 2007

(7 Years)



LEGEND					
	MOVING VEHICLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		10 MPH TO 19		BIICYCLE
	PAIRED VEHICLE		20 MPH TO 29		TRAIN
	PARKING VEHICLE		30 MPH TO 39		ANIMAL
	FIXED OBJECT		40 MPH TO 49		DRIVER AT FAULT
	HEAD ON		50 MPH TO 59		DRY
	REAR END		60 MPH TO 69		WET
	RAN OFF ROAD		TO AND UP		WET
			OUT OF CONTROL		ICY OR SHY
			WJURY		
			FATALITY		
			TURNING		
			BACKING		
			SIDESWIPE		
			TO AND UP		
			SPEED UNKNOWN		
			DAYLIGHT CRASH		
			DARK CRASH		



Note: Crashes 1 & 2 hit Guard Rail
Crashes 3 & 4 hit Guard Rail End

	Target Crashes
	Guardrail
	Bridge

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT		COLLISION DIAGRAM	
	SAFETY INFORMATION	DIVISION: 12	AREA: ..
STUDY PERIOD: 3/1/00... TO 2/28/07...	MANAGEMENT AND SUPPORT	DISTANCE: 0.20 MI. Y-LINE: 0 FT	
ANALYSIS PREPARED BY: CLS.....		DIAGRAM PREPARED BY: CLS.....	
DIAGRAM REVIEWED BY:			
SAFETY EVALUATION		SCALE: NOT TO SCALE	
BRIDGE 60		DATE: 12/21/07.....	
		LOG NUMBER: 200609056	
N.C. DEPARTMENT of TRANSPORTATION DIVISION of HIGHWAYS TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH			

APPENDIX C

Bridge 73/74 Location

<i>Treatment Information - Bridges 73/74</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	18	17	-5.6%
Total Severity Index	8.09	4.92	-39.2%
Target Crashes	11	11	0.0%
Target Severity Index	3.69	5.04	36.6%
Volume	21000	25000	19.0%

<i>Target Crash Information - Bridges 73/74</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	0	0	N/A
Non-Fatal Injury Crashes	4	6	50.0%
Total Injury Crashes	4	6	50.0%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	4	3	-25.0%
Wet / Icy Crashes	2	3	50.0%
Alcohol/Drug Involvement Crashes	1	0	-100.0%
<i>Target Crashes - Crash Types</i>			
Fixed Object	5	2	-60.0%
Overturn / Rollover	1	1	0.0%
Ran Off Road	2	2	0.0%
Sideswipe - Same Direction	3	6	100.0%

The naïve before and after analysis at the Bridge 73/74 location resulted in a 6 percent decrease in Total Crashes, no change in Target Crashes, and a 19 percent increase in Average Daily Traffic (ADT).

Discussion

The number of Total Crashes at the Bridge 73/74 location decreased by 6 percent, from 18 crashes in the before period to 17 crashes in the after period. Also, the number of Target Crashes at the Bridge 73/74 location remain the same, with 11 crashes in the before and after period. There was a 50 percent increase in Sideswipe-Same Direction Crashes (from 3 to 6 crashes). The Total Severity Index decreased by 39 percent and the Target Severity Index increased by 37 percent.

US 74 at Bridges # 73 & 74 in Cleveland County

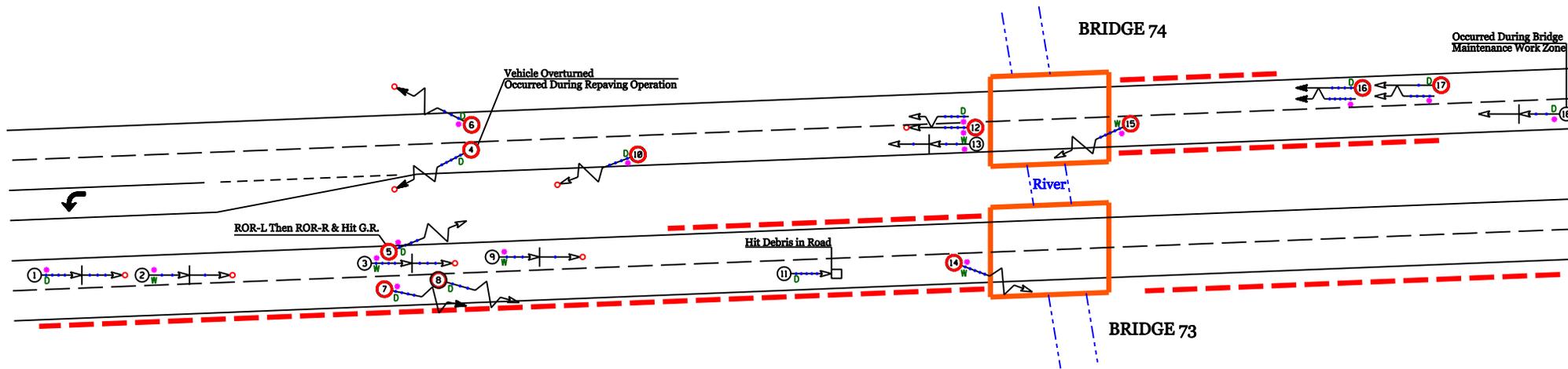
Before Period

October 1, 1991 - September 30, 1998

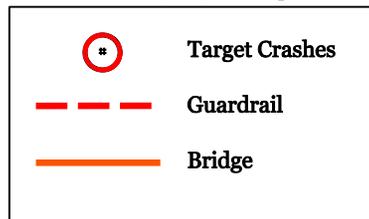
(7 Years)



LEGEND							
	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		BICYCLE
	PAIKED VEHICLE		BACKING		20 MPH TO 29		TRAIN
	PARKING VEHICLE		SHOESIDE		30 MPH TO 39		ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		DRIVER AT FAULT
	HEAD ON		HURLY		50 MPH TO 59		DRY
	REAR END		FATALITY		60 MPH TO 69		WET
	RAN OFF ROAD		DARK CRASH		TO AND UP		ICY OR SNOWY



Note: Crashes 5, 7 & 8 hit Guard Rail
Crashes 14 & 15 hit Bridge Rail



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT		COLLISION DIAGRAM	
		DIVISION: 12	AREA: ..
<small>HIGHWAY SAFETY IMPROVEMENT PROGRAM</small>	<small>SAFETY INFORMATION MANAGEMENT AND SUPPORT</small>	STUDY PERIOD: 10/1/91 TO 9/30/98	
		DISTANCE: 0.36 MI. Y-LINE: 0 FT	
		ANALYSIS PREPARED BY: CLS	
		DIAGRAM PREPARED BY: CLS	
		DIAGRAM REVIEWED BY:	
		SCALE: NOT TO SCALE	
		DATE: 12/21/01	
		LOG NUMBER: 200609056	

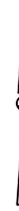
N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH

US 74 at Bridges # 73 & 74 in Cleveland County

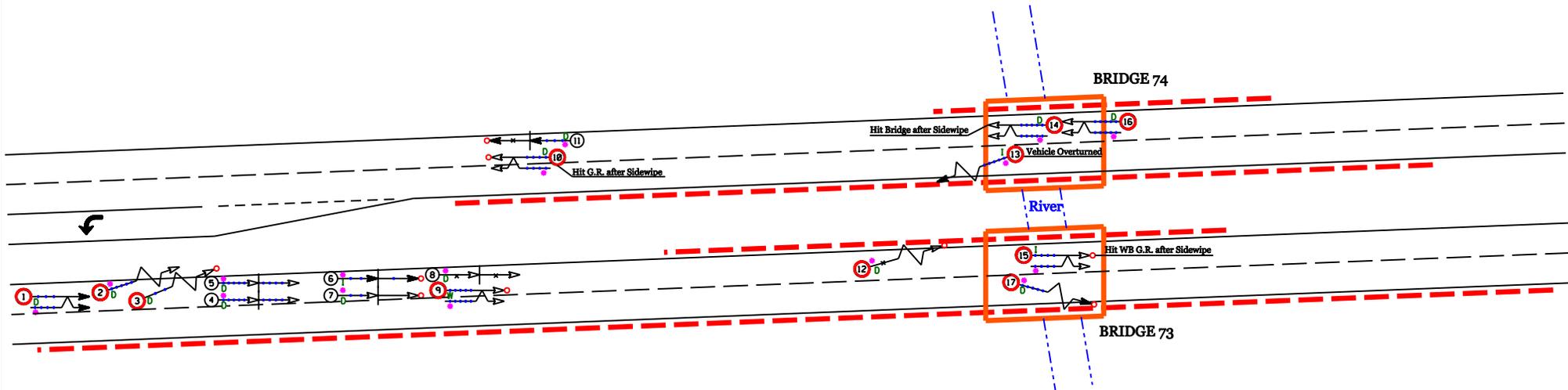
After Period

March 1, 2000 - February 28, 2007

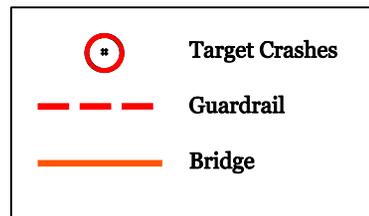
(7 Years)



LEGEND							
	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		BIICYCLE
	PAIKED VEHICLE		BACKING		20 MPH TO 29		TRAIN
	PARKING VEHICLE		SHOESHOPE		30 MPH TO 39		ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		DRIVER AT FAULT
	HEAD ON		INJURY		50 MPH TO 59		DRY
	REAR END		FATALITY		60 MPH TO 69		WET
	RAN OFF ROAD		DARK CRASH		70 AND UP		ICY OR SNOWY
					SPEED UNKNOWN		
					DAYLIGHT CRASH		
					DARK CRASH		



Note: Crashes 10, 12, 13 & 15 hit Guard Rail
Crashes 14 & 17 hit Bridge Rail



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT		COLLISION DIAGRAM	
<small>BIWAYWAY SAFETY IMPROVEMENT PROGRAM</small>	<small>SAFETY INFORMATION MANAGEMENT AND SUPPORT</small>	DIVISION: 12	AREA: ..
		STUDY PERIOD: 3/1/00 TO 2/28/07	
		DISTANCE: 0.36 MI. Y-LINE: .0 FT	
		ANALYSIS PREPARED BY: CLS	
		DIAGRAM PREPARED BY: CLS	
		DIAGRAM REVIEWED BY:	
SAFETY EVALUATION		TRAFFIC SAFETY	
BRIDGES 73/74		SCALE: NOT TO SCALE	
		DATE: 12/21/07	
		LOG NUMBER: 200609056	

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH

APPENDIX D

Bridge 79/80 Location

<i>Treatment Information – Bridges 79/80</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	50	42	-16.0%
Total Severity Index	5.48	5.80	5.8%
Target Crashes	30	31	3.3%
Target Severity Index	5.99	6.79	13.4%
Volume	28900	30000	3.8%

<i>Target Crash Information – Bridges 79/80</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	0	0	N/A
Non-Fatal Injury Crashes	11	15	36.4%
Total Injury Crashes	11	15	36.4%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	14	12	-14.3%
Wet / Icy Crashes	21	21	0.0%
Alcohol/Drug Involvement Crashes	3	3	0.0%
<i>Target Crashes - Crash Types</i>			
Fixed Object	23	20	-13.0%
Overturn / Rollover	0	1	N/A
Ran Off Road	3	3	0.0%
Sideswipe - Same Direction	4	7	75.0%

The naïve before and after analysis at the Bridge 79/80 location resulted in a 16 percent decrease in Total Crashes, a 3 percent increase in Target Crashes, and a 4 percent increase in Average Daily Traffic (ADT).

Discussion

The number of Total Crashes at the Bridge 79/80 location decreased by 16 percent, from 50 crashes in the before period to 42 crashes in the after period. Also, the number of Target Crashes at the Bridge 79/80 location increased by 3 percent, from 30 crashes in the before period to 31 crashes in the after period. Over forty percent of all Target Crashes in the after period occurred at the Bridge 79/80 location. The Total and Target Severity Index at the Bridge 79/80 location increased by 6 and 13 percent, respectively.

At the Bridge 79/80 location, Wet / Icy conditions were a contributing factor in an overwhelming 70 percent of Target Crashes (21 of 30) in the before period and 68 percent of Target Crashes (21 of 31) in the after period. Twenty three after period crashes at the Bridge 79/80 location involved a vehicle hitting the guardrail or bridge rail, 19 of these occurred in Wet / Icy pavement conditions. The largest portion of after period guardrail hits involved westbound vehicles in the curve east of Bridge 80.

US 74 at Bridges # 79 & 80 in Cleveland County

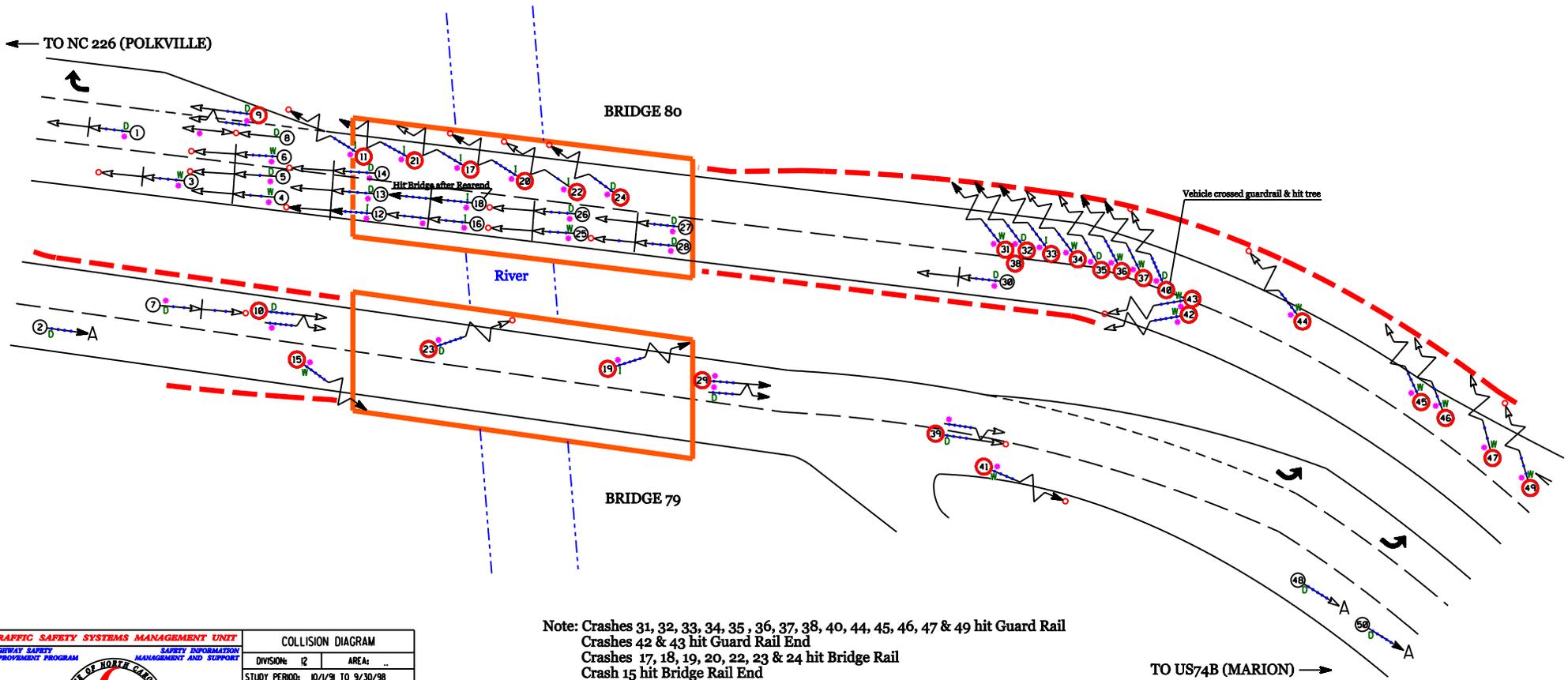
Before Period

October 1, 1991 - September 30, 1998

(7 Years)

LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		BIICYCLE
	PAIRED VEHICLE		BACKING		20 MPH TO 29		TRAIN
	PARKING VEHICLE		SHOESLIP		30 MPH TO 39		ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		DRIVER AT FAULT
	HEAD ON		HURRY		50 MPH TO 59		DRY
	REAR END		FATALITY		60 MPH TO 69		WET
	RAN OFF ROAD		DAYLIGHT CRASH		70 AND UP		ICY OR SNOWY



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT
HIGHWAY SAFETY IMPROVEMENT PROGRAM SAFETY INFORMATION MANAGEMENT AND SUPPORT

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

SAFETY EVALUATION TRAFFIC SAFETY

BRIDGES 79/80

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH

COLLISION DIAGRAM	
DIVISION: 12	AREA: ..
STUDY PERIOD: 10/1/91 TO 9/30/98	
DISTANCE: 0.28 M. Y-LINE: .0 FT	
ANALYSIS PREPARED BY: CLS	
DIAGRAM PREPARED BY: CLS	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: 12/28/01	
LOG NUMBER: 200609056	

Note: Crashes 31, 32, 33, 34, 35, 36, 37, 38, 40, 44, 45, 46, 47 & 49 hit Guard Rail
 Crashes 42 & 43 hit Guard Rail End
 Crashes 17, 18, 19, 20, 22, 23 & 24 hit Bridge Rail
 Crash 15 hit Bridge Rail End

	Target Crashes
	Guardrail
	Bridge

TO US74B (MARION) →

APPENDIX E

Bridge 101/102 Location

<i>Treatment Information – Bridges 101/102</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes	33	34	3.0%
Total Severity Index	5.54	4.05	-26.9%
Target Crashes	20	18	-10.0%
Target Severity Index	8.12	4.70	-42.1%
Volume	25800	31000	20.2%

<i>Target Crash Information – Bridges 101/102</i>	Before	After	Percent Reduction (-)/ Percent Increase (+)
<i>Target Crashes - Injuries</i>			
Fatal Injury Crashes	0	0	N/A
Non-Fatal Injury Crashes	10	9	-10.0%
Total Injury Crashes	10	9	-10.0%
<i>Target Crashes - Contributing Factors</i>			
Night Crashes	8	5	-37.5%
Wet / Icy Crashes	10	5	-50.0%
Alcohol/Drug Involvement Crashes	3	1	-66.7%
<i>Target Crashes - Crash Types</i>			
Fixed Object	9	11	22.2%
Overturn / Rollover	0	3	N/A
Ran Off Road	7	1	-85.7%
Sideswipe - Same Direction	3	3	0.0%
Sideswipe - Opposite Direction	1	0	-100.0%

The naïve before and after analysis at the Bridge 101/102 location resulted in a 3 percent increase in Total Crashes, a 10 percent decrease in Target Crashes, and a 20 percent increase in Average Daily Traffic (ADT).

Discussion

The number of Total Crashes at the Bridge 101/102 location increased by 3 percent, from 33 crashes in the before period to 34 crashes in the after period. Also, the number of Target Crashes at the Bridge 101/102 location decreased by 10 percent, from 20 crashes in the before period to 18 crashes in the after period. The Total and Target Severity Index at the Bridge 101/102 location decreased by 27 and 42 percent, respectively.

At the Bridge 101/102 location, five before period crashes (One Class-A Injury Crash, two Class-B Injury Crashes, and two Class-C Injury Crashes) involved a vehicle striking the unprotected bridge rail ends. Bridge 101 and the southern side of Bridge 102 did not have approach guardrail in the before period. In the after period, seven crashes involving guardrail hits were concentrated on westbound US 74, just east of Bridge 102.

US 74 at Bridges # 101 & 102 in Cleveland County

Before Period

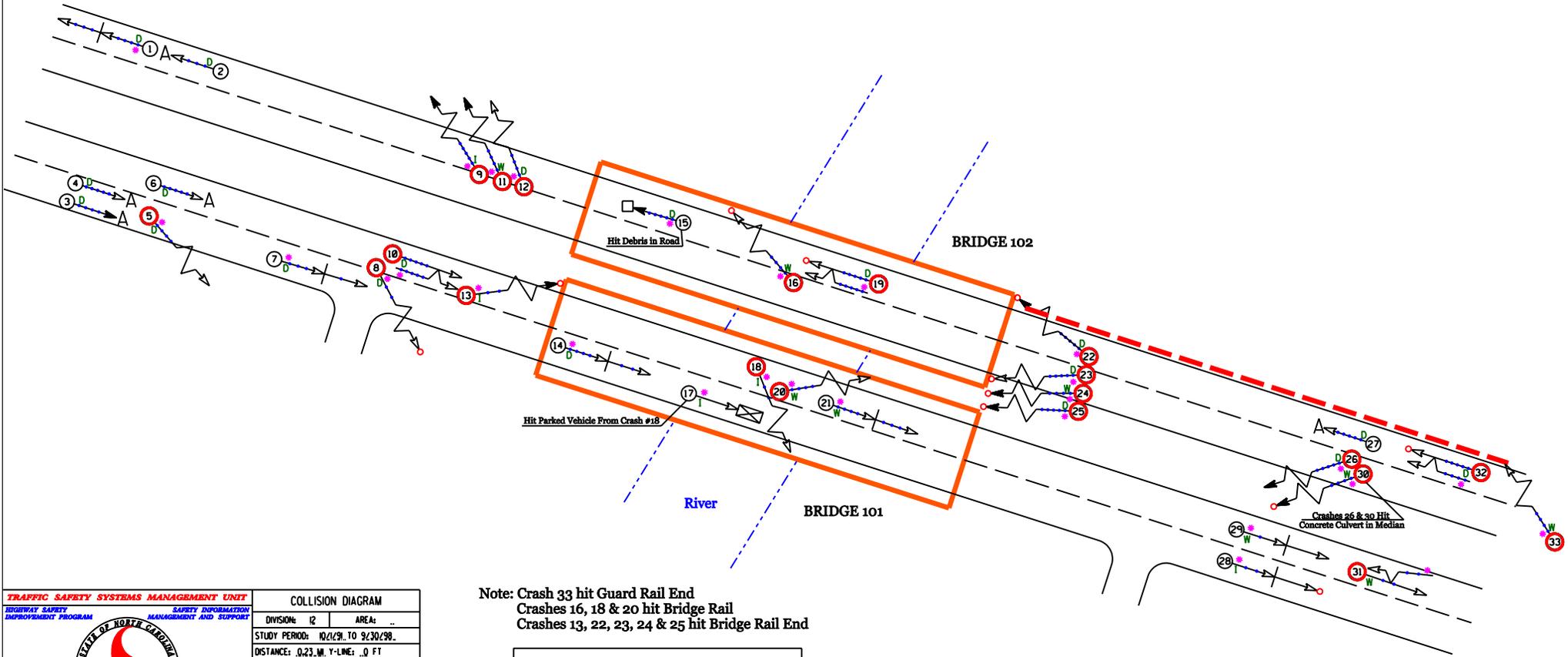
October 1, 1991 - September 30, 1998

(7 Years)



LEGEND

MOVING VEHICLE	ANGLE	9 MPH OR LESS	PEDESTRIAN
PEDESTRIAN	TURNING	10 MPH TO 19	BICYCLE
PARKED VEHICLE	BACKING	20 MPH TO 29	TRAIN
PARKING VEHICLE	SHOESHOPE	30 MPH TO 39	ANIMAL
FIXED OBJECT	OUT OF CONTROL	40 MPH TO 49	DRIVER AT FAULT
HEAD ON	HURRY	50 MPH TO 59	DRY
REAR END	FATALITY	60 MPH TO 69	WET
RAN OFF ROAD	DARK CRASH	70 AND UP	ICY OR SNOWY
		SPEED UNKNOWN	
		DAYLIGHT CRASH	



Note: Crash 33 hit Guard Rail End
 Crashes 16, 18 & 20 hit Bridge Rail
 Crashes 13, 22, 23, 24 & 25 hit Bridge Rail End

	Target Crashes
	Guardrail
	Bridge

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT	
HIGHWAY SAFETY IMPROVEMENT PROGRAM	
SAFETY INFORMATION MANAGEMENT AND SUPPORT	
SAFETY EVALUATION	
TRAFFIC SAFETY	
BRIDGES 101/102	
SCALE: NOT TO SCALE	
DATE: 1/9/07	
LOG NUMBER: 200609056	
<p>N.C. DEPARTMENT of TRANSPORTATION DIVISION of HIGHWAYS TRAFFIC ENGINEERING AND SAFETY SYSTEMS BRANCH</p>	

US 74 at Bridges # 101 & 102 in Cleveland County

After Period

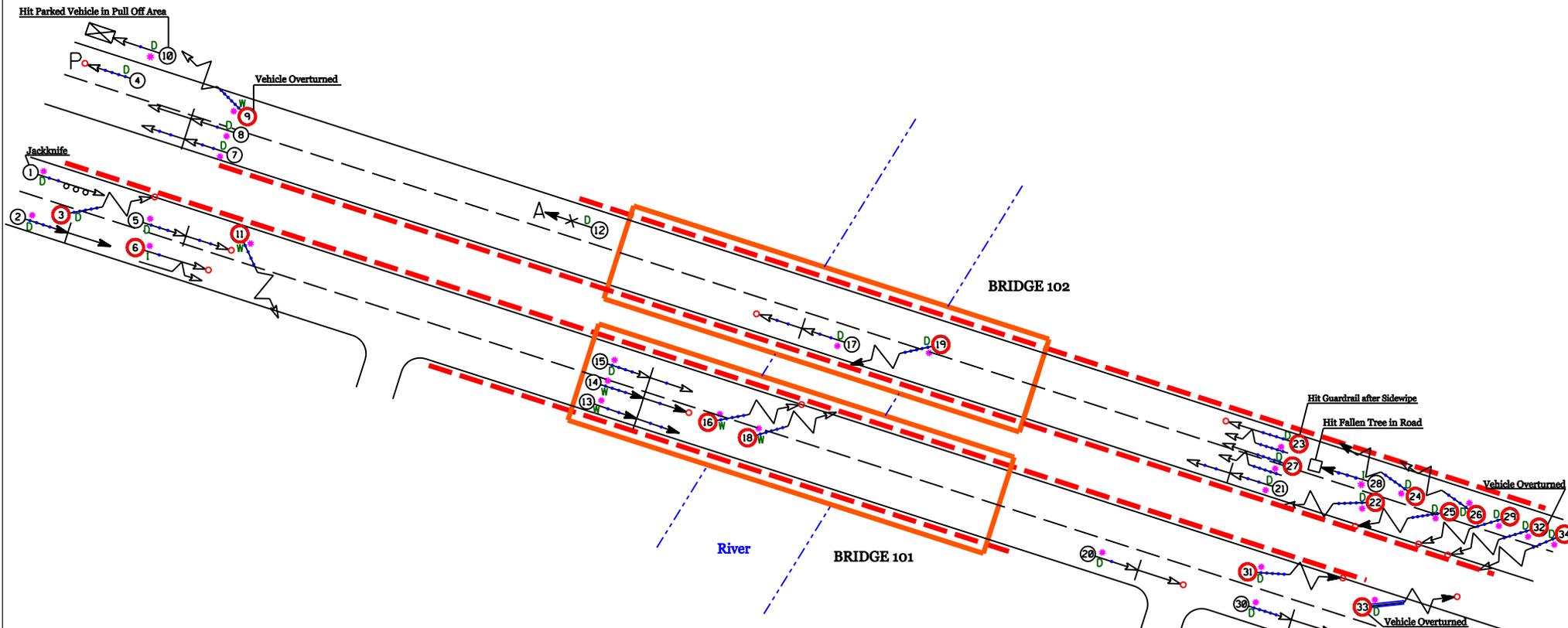
March 1, 2000 - February 28, 2007

(7 Years)



LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		P PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		B BICYCLE
	PAIRED VEHICLE		BACKING		20 MPH TO 29		T TRAIN
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		A ANIMAL
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		* DRIVER AT FAULT
	HEAD ON		INJURY		50 MPH TO 59		D DRY
	REAR END		FATALITY		60 MPH TO 69		W WET
	RAN OFF ROAD		DARK CRASH		70 AND UP		I ICY OR SNOWY
			SPEED UNKNOWN		DAYLIGHT CRASH		
			DAYLIGHT CRASH		DARK CRASH		



Note: Crashes 3, 22, 23, 24, 25, 26, 29, 31 & 32 hit Guard Rail
 Crash 34 hit Guard Rail End
 Crashes 16, 18 & 19 hit Bridge Rail

	Target Crashes
	Guardrail
	Bridge

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT		COLLISION DIAGRAM	
<small> HIGHWAY SAFETY IMPROVEMENT PROGRAM SAFETY EVALUATION SAFETY INFORMATION MANAGEMENT AND SUPPORT TRAFFIC SAFETY </small>	DIVISION: 12 STUDY PERIOD: 3/1/00 TO 2/28/07 DISTANCE: 0.23 MI. Y-LINE: 0 FT ANALYSIS PREPARED BY: CLS DIAGRAM PREPARED BY: CLS DIAGRAM REVIEWED BY:	AREA: ..	
		SCALE: NOT TO SCALE	
BRIDGES 101/102		DATE: 1/9/07	
		LOG NUMBER: 200609056	

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH