

Spot Safety Project Evaluation

Project Log # 200901009

Spot Safety Project # 07-01-226

**Spot Safety Project Evaluation of the Intersection Realignment
At the Intersection of NC 87 / NC 770 (Harrington Hwy)
and SR 2039 (Bethlehem Church Rd)
City of Eden, Rockingham County**

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Transportation Mobility and Safety Division
North Carolina Department of Transportation

Principal Investigator



Jason B. Schronce

2-17-2009

Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 07-01-226 located at the Intersection of NC 87 / NC 770 (Harrington Highway), also listed as SR 1533, and SR 2039 (Bethlehem Church Road) in Rockingham County.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the realignment of SR 2039 to create a 90 degree intersection. NC 87 / 770 (Harrington Hwy) and SR 2039 (Bethlehem Church Rd) are both two-lane facilities at the subject intersection with no turn lanes and speed limits of 55 mph on all approaches. The subject location is a rural crossroads intersection, which is controlled by stop condition on the SR 2039 approaches. In the before period, SR 2039 had concrete dividers for right turn yield movements which were removed during the realignment process. Both SR 2039 approaches now have centerline concrete islands for dual posted stop signs.

The original statement of problem was that the intersection alignment hindered sight distance causing an angle type crash pattern. The project intent was to reduce the number of angle collisions.

The initial crash analysis was completed from June 1, 1998 to May 31, 2001 with fourteen (14) reported crashes, thirteen (13) of which were deemed correctable. The final completion date for the improvement at the subject intersection was on September 30, 2003 with a total cost of \$140,000.00.

Naive Before and After Analysis

After reviewing the spot safety 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 July through September 2003. The before period consisted of reported crashes from June 1, 1998 through June 30, 2003 (5 years and 1 month); and the after period consisted of reported crashes from October 1, 2003 through October 31, 2008 (5 years and 1 month). 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 within 150 feet of the subject intersection. *Please see attached location map and photos for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Intersection Angle and Left Turn Crashes involving SR 2039 vehicles were the target crashes for the applied countermeasure. The Frontal Impact Crash types considered are as follows: Left turn, different roadways and Angle.

<u>Treatment Information</u>			
	Before	After	Percent Reduction (-) Percent Increase (+)
Total crashes	28	11	- 60.7 %
Total Severity Index	7.94	9.91	24.8 %
Target Crashes	24	6	- 75.0 %
Target Crash Severity Index	8.48	14.87	75.4 %
Volume	9,600	9,800	2.08 %
<u>Injury Crash Summary</u>			
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	1	1	0.0 %
Class B injury Crashes	5	1	- 80.0 %
Class C Injury Crashes	11	2	- 81.8 %
Total Injury Crashes	17	4	- 76.5 %

The naive before and after analysis at the treatment location resulted in a 61 percent decrease in Total Crashes, a 75 percent decrease in Target Crashes, but a 25 percent increase in the Total Severity Index. The before period ADT year was 2000 and the after period ADT year was 2006.

Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in a 61 percent decrease in Total Crashes and a 75 percent decrease in Target Crashes. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have decreased at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, a large portion of crashes at the intersection in the before period (23 of 28) were the result of a vehicle attempting to cross Harrington Highway and creating angle type collisions. After the intersection realignment, this pattern was significantly reduced to four (4), one of which was a ran-off roadway crash where the driver attempted to void the angle collision. Redefining the intersection angle to 90 degrees and removing the right turn slip lane made a significant positive impact on the intersection sight distance and the driver's capacity to make a safe decision.

The calculated benefit to cost ratio for this project is **2.26 considering total crashes**. The benefit to cost ratio **considering only target crashes is 2.30**. 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.

Please see the attached *Treatment Site Photos*. Photos are provided for all approaches to the treatment intersection. 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.

TREATMENT SITE PHOTOS TAKEN 1-26-2009



Traveling North on SR 2039 (Bethlehem Church Rd)



Traveling North on SR 2039



Traveling East on NC 87 / 770 (Harrington Highway)



Traveling East on Harrington Highway



Traveling South on SR 2039 (Bethlehem Church Road)



Traveling South on SR 2039 (Bethlehem Church Road)



Traveling West on NC 87 / 770 (Harrington Highway)



Traveling West on Harrington Highway

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: NC 87 / 770 at SR 2039
 COUNTY: Rockingham
 FILE NO.: SS 07-01-226

BY: JBS
 DATE: 2/10/2009
 NOTES: Total Crashes

DETAILED COST: TYPE IMPROVEMENT - Intersection Realignment

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$140,000	10	0.149	\$20,864
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$140,000	10	0.149	\$20,864

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$800
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$21,664
 TOTAL COST OF PROJECT= \$140,000

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	5.09	1	0.20	16	3.14	11	2.16	\$163,242
AFTER	5.09	1	0.20	3	0.59	7	1.38	\$114,204

Annual Benefits from Crash Cost Savings \$49,037

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$27,373

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 2.26

TOTAL COST OF PROJECT - \$140,000 COMPREHENSIVE B/C RATIO - 2.26

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: NC 87 / 770 at SR 2039
 COUNTY: Rockingham
 FILE NO.: SS 07-01-226

BY: JBS
 DATE: 2/10/2009
 NOTES: Target Crashes - Intersection Angle

DETAILED COST: TYPE IMPROVEMENT - Intersection Realignment

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COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

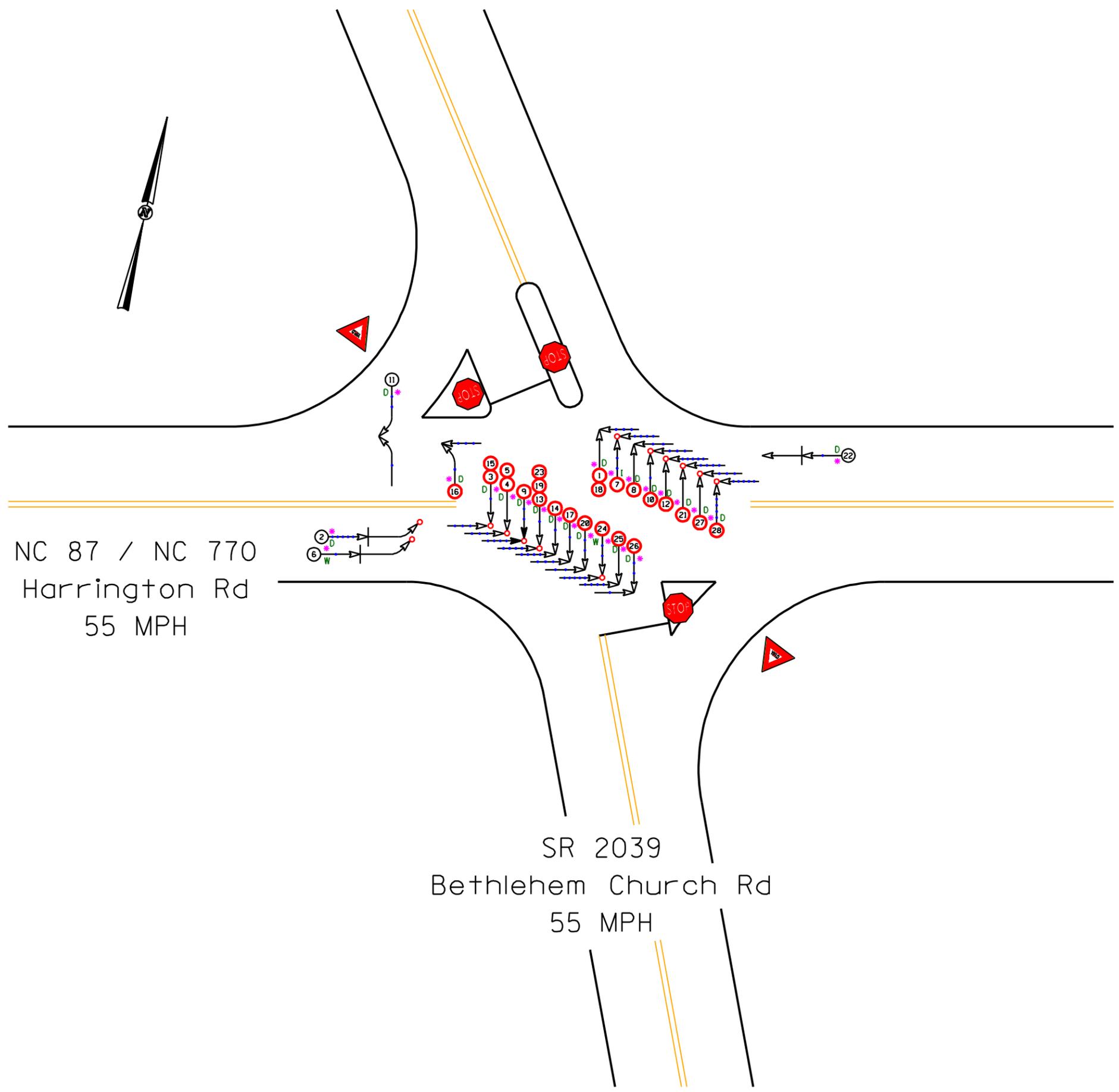
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	5.09	1	0.20	14	2.75	9	1.77	\$154,637
AFTER	5.09	1	0.20	1	0.20	4	0.79	\$104,833

Annual Benefits from Crash Cost Savings \$49,804

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$28,139

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 2.30

TOTAL COST OF PROJECT - \$140,000 COMPREHENSIVE B/C RATIO - 2.30



LEGEND

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

SS# 07-01-226
 Rockingham County
 City of Eden
 BEFORE Period
 6/1/98 - 6/30/03

NC 87 / NC 770
 Harrington Rd
 55 MPH

SR 2039
 Bethlehem Church Rd
 55 MPH

Target Crashes

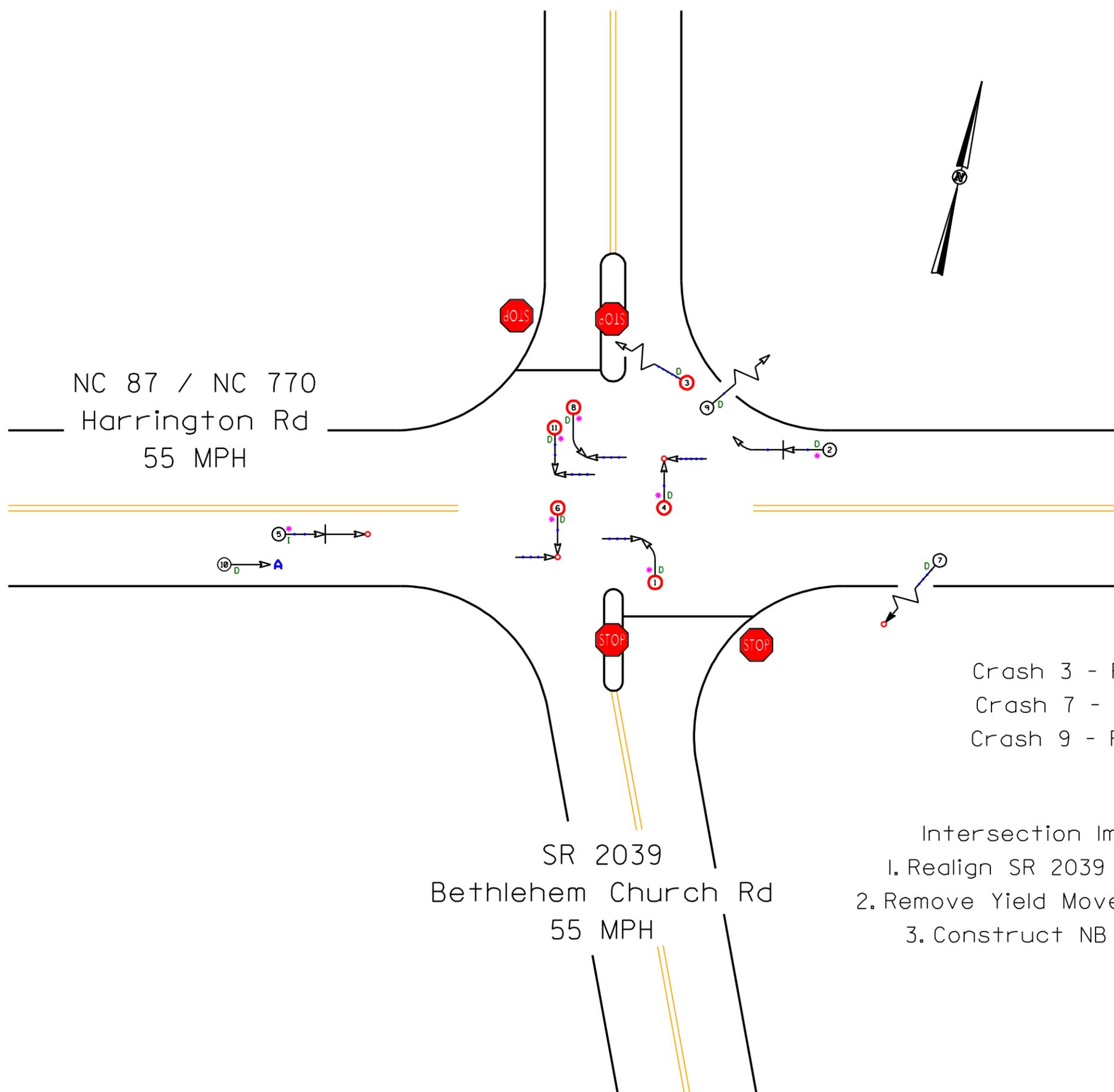
TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 7	AREA: 1
	STUDY PERIOD: 6/1/1998 - 6/30/2003	
	DISTANCE: Y-LINE = 150 FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 2-9-2009		
LOG NUMBER: SS* 07-01-226 BEFORE		

N.C. DEPARTMENT of TRANSPORTATION
 DIVISION of HIGHWAYS
 TRANSPORTATION MOBILITY and
 SAFETY DIVISION

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

SS# 07-01-226
 Rockingham County
 City of Eden
 AFTER Period
 10/1/03 - 10/31/08



Crash Notes:

- Crash 3 - Ran Off Road to avoid Angle Collision
- Crash 7 - Ran Off Road to avoid Deer Collision
- Crash 9 - Ran Off Road to avoid ped in median

Intersection Improvements:

1. Realign SR 2039 to 90 degrees
2. Remove Yield Movements & Medians
3. Construct NB Center Island

Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 7	AREA: 1
STUDY PERIOD: 10/1/2003 - 10/31/2008	
DISTANCE: Y-LINE = 150FT	
ANALYSIS PREPARED BY: JBS	
ANALYSIS CHECKED BY: BR	
DIAGRAM PREPARED BY: JBS	
DIAGRAM REVIEWED BY: ST	
SCALE: NOT TO SCALE	
DATE: 2-9-2009	
LOG NUMBER: SS* 07-01-226 AFTER	

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRANSPORTATION MOBILITY and
SAFETY DIVISION