

Spot Safety Project Evaluation

Work Order #41000004432

Spot Safety Project # 04-01-269

Spot Safety Project Evaluation of the Installation of Transverse Rumble Strips on NC 111 at Its Intersection with NC 55 Wayne County

Documents Prepared By:

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

Principal Investigator



Brad Robinson, PE

2/17/2010

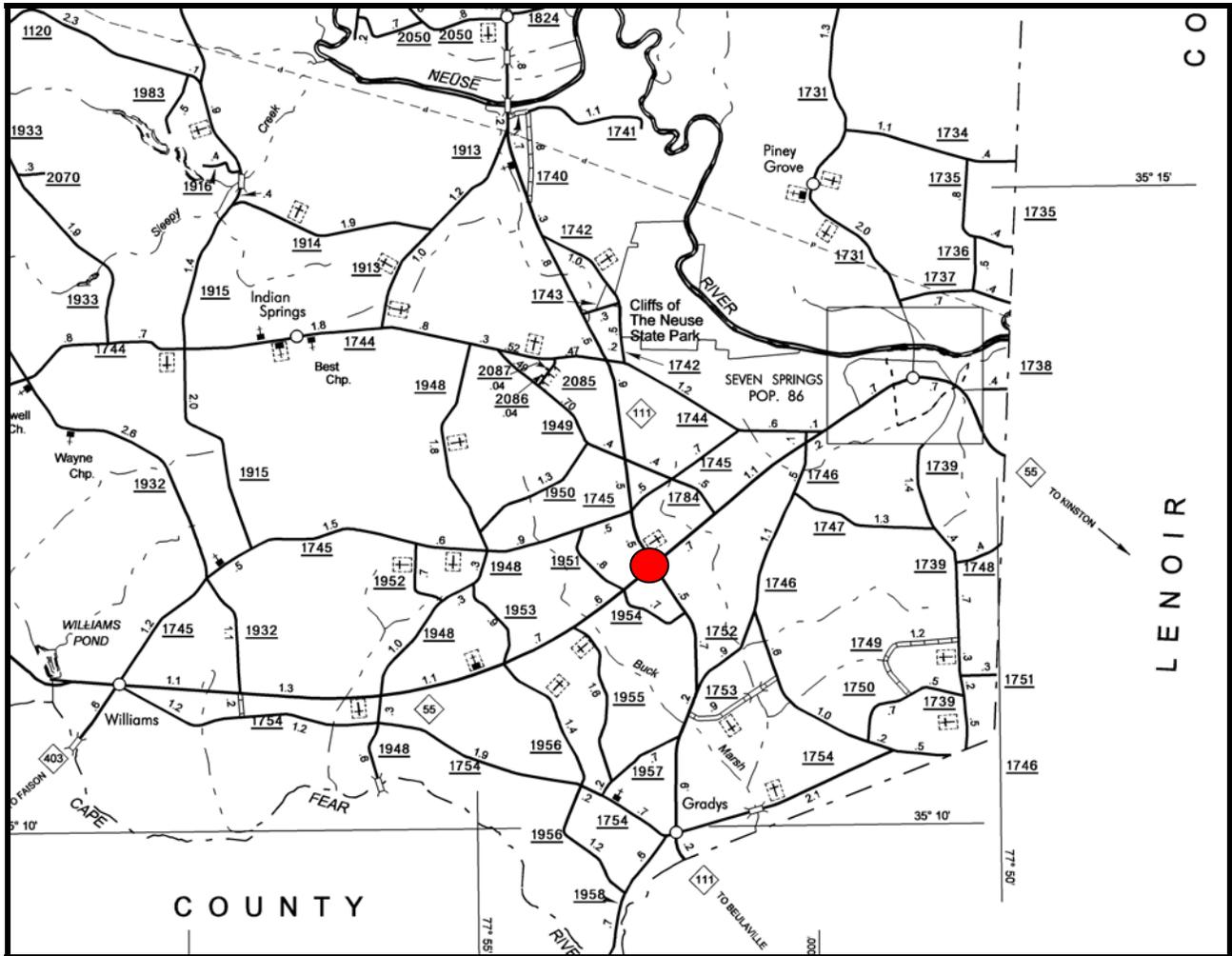
Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 04-01-269 – The Intersection of NC 111 and NC 55 in Wayne County.



Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was to install transverse thermoplastic rumble strips across NC 111 on both approaches to the intersection with NC 55.

The subject location is a four-leg intersection controlled by dual stop signs and flashers in both the before and after periods. Both roadways are two lane facilities with speed limits of 55 mph at the subject location.

The original statement of problem was that there were numerous Frontal Impact type crashes that occurred in the intersection with a high percentage resulting from vehicles failing to obey the existing stop conditions on NC 111.

The initial crash analysis was conducted from June 30, 1998 to July 1, 2001 with a total of 19 reported crashes, 6 of which were considered correctable by the chosen countermeasure. The final completion date for the improvements at the subject intersection was on February 10, 2004 with a total cost of \$3,000.00.

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 January 1, 2004 to February 29, 2004. The before period consisted of reported crashes from April 1, 1998 through December 31, 2003 (5 years and 9 months) and the after period consisted of reported crashes from March 1, 2004 through November 30, 2009 (5 years and 9 months). The ending date for this analysis was limited by the available crash data at the time the analysis was conducted.

The treatment data consisted of all reported crashes within 150 feet of the subject intersection. The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Frontal Impact Crashes resulting from a vehicle running the stop condition were the Target Crashes for the applied countermeasure. For the purposes of this analysis, a vehicle was considered to have run the stop condition if explicitly stated in the crash report or if the vehicle was estimated to have been traveling greater than 25 mph and it was not stated in the crash report that they had first come to a stop. Because of the uncertainty in this method, Frontal Impact Crashes as a whole were also focused on in the analysis, with the exception of those that did not involve a vehicle on NC 111 (such as Left Turn-Same Roadway crashes on NC 55). These crash types are considered as follows: Left Turn, same roadway; Left Turn, different roadway; Right Turn, same roadway; Right Turn, different roadway; Head On and Angle. The target crashes are clearly identified in the before and after period collision diagrams.

Treatment Information			
	Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes	45	50	11.1
Total Severity Index	15.55	7.58	-51.3
Target Crashes (Ran Stop Sign)	7	8	14.3
Target Crash Severity Index	36.66	15.10	-58.8
Frontal Impact Crashes	35	41	17.1
Frontal Impact Crash Severity Index	16.27	8.67	-46.7
Volume	7,700	7,700	0.0
Target Crash Severity Summary			
Fatal Crashes	1	1	0.0
Class A Crashes	2	0	-100.0
Class B Crashes	1	1	0.0
Class C Crashes	2	4	100
PDO Crashes	1	2	100.0

The naive before and after analysis at the treatment location resulted in a 11 percent increase in Total Crashes, a 14 percent increase in Target Crashes, and a 17 percent increase in Frontal Impact Crashes. The before period ADT year was 2001 and the after period ADT year was 2007.

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 11 percent increase in Total Crashes, a 14 percent increase in Target Crashes, and a 17 percent increase in Frontal Impact Crashes. The Total Severity Index decreased by 51 percent, the Target Severity Index decreased by 59 percent, and the Frontal Impact Crash Severity decreased by 47. The summary results above demonstrate that Total Crashes, Target Crashes, and Frontal Impact Crashes all appear to have increased at the subject location from the before to the after period.

The calculated benefit to cost ratio for this project is 261.50 considering total crashes. The benefit to cost ratio considering only target crashes is also 125.69. 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 Target Crashes in the before period included four crashes resulting from a northbound vehicle running the stop sign and three crashes resulting from a southbound vehicle running the sign. In the after period the Target Crashes included four crashes resulting from a northbound vehicle running the stop sign and four crashes resulting from southbound vehicle running the sign. There was a fatal crash in both the before and the after periods that occurred as a result of a northbound vehicle running the stop sign.

All the existing patterns of Frontal Impact Crashes increased from the before to the after period except for crashes between northbound NC 111 vehicles and eastbound NC 55 vehicles, which was reduced by 75 percent (from 8 to 2). The most prominent Frontal Impact Crash pattern in the after period was crashes between northbound NC 111 vehicles and westbound NC 55 vehicles, which experienced a 64 percent increase (from 14 to 23)

There was a Rear-End Crash in the before period on southbound NC 111 that resulted in a second fatality. A truck was stopped at the intersection and was rear-ended by a vehicle traveling 65 mph. Rear-End Crashes on this leg decreased by 50 percent from the before to the after period (from 4 to 2).

Please see the attached *Treatment Site Photos*. Photos were obtained from Google Street-view. 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

LOCATION: NC 111 and NC 55
 COUNTY: Wayne
 FILE NO.: SS 04-01-269

BY: bdr
 DATE: 2/11/2010

DETAILED COST: TYPE IMPROVEMENT - **Shoulder Guardrail**

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
	\$3,000	2	0.561	\$1,682
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$3,000	2	0.561	\$1,682

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$1,682
 TOTAL COST OF PROJECT= \$3,000

COMPREHENSIVE COST REDUCTION:

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES						ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	
BEFORE	5.75	6	1.04	27	4.70	12	2.09	\$760,070
AFTER	5.75	2	0.35	24	4.17	24	4.17	\$320,139

Annual Benefits from Crash Cost Savings \$439,930

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$438,248

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 261.50

TOTAL COST OF PROJECT - \$3,000 COMPREHENSIVE B/C RATIO - 261.50

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: NC 111 and NC 55
 COUNTY: Wayne
 FILE NO.: SS 04-01-269 Target Crashes Only

BY: bdr
 DATE: 2/11/2010

DETAILED COST: TYPE IMPROVEMENT - Shoulder Guardrail

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	0	0.000	\$0
	\$3,000	2	0.561	\$1,682
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$3,000	2	0.561	\$1,682

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$0
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$0
 TOTAL ANNUAL COST= \$1,682
 TOTAL COST OF PROJECT= \$3,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

TIME PERIOD	YEARS	ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES				PDO		ANNUAL COSTS
		K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	CRASHES	CRASHES PER YR	
BEFORE	5.75	3	0.52	3	0.52	1	0.17	\$339,861
AFTER	5.75	1	0.17	5	0.87	2	0.35	\$128,417

Annual Benefits from Crash Cost Savings \$211,443

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = \$209,761

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 125.69

TOTAL COST OF PROJECT - \$3,000 COMPREHENSIVE B/C RATIO - 125.69

Treatment Site Photos from Google Street-View



Looking northeast on NC 55



Looking southwest on NC 55



Looking northwest toward intersection on NC 111 at rumble strip location



Looking northwest on NC 111



Looking southeast towards intersection on NC 111 at rumble strip location

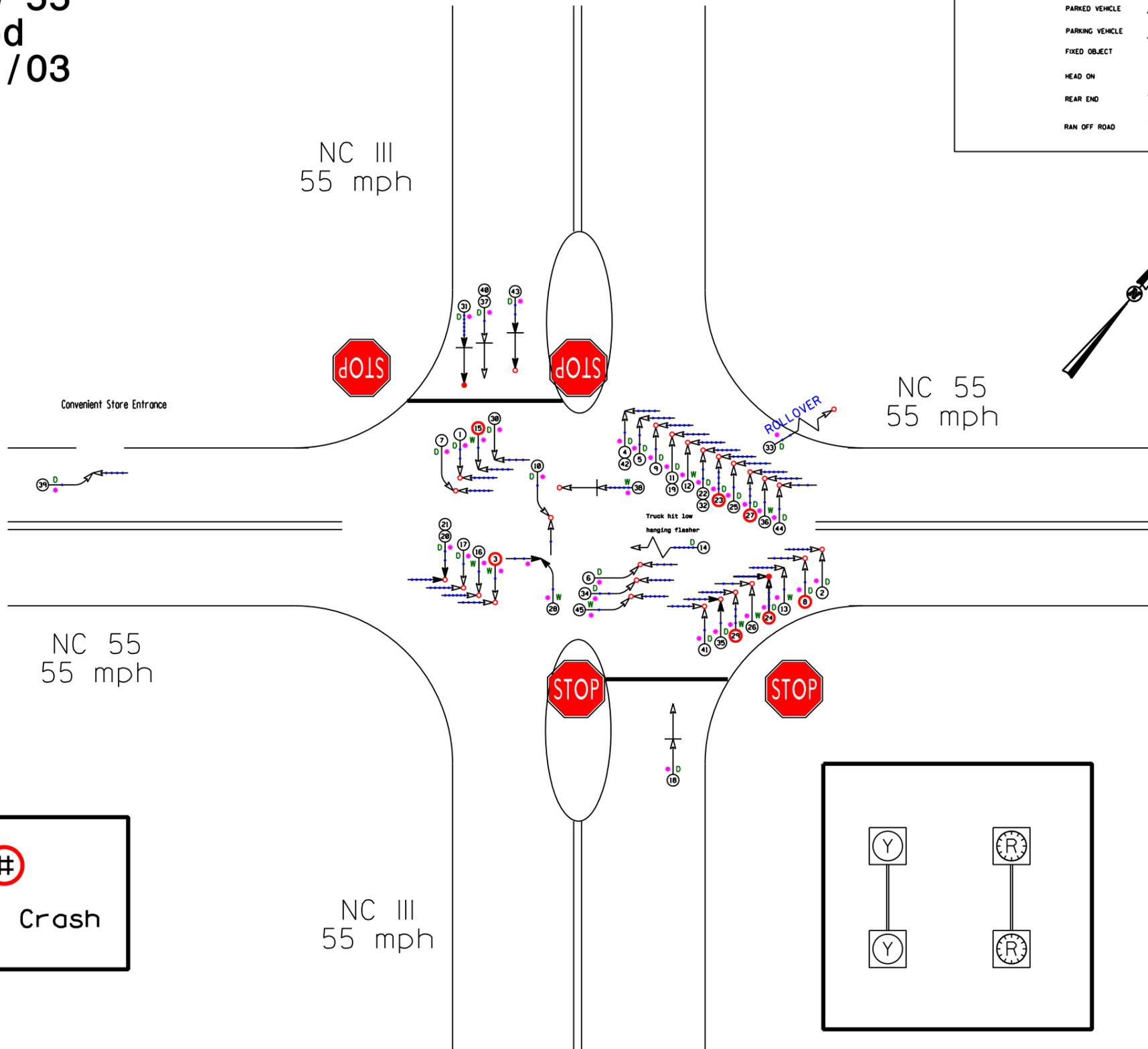


Looking southeast on NC 111

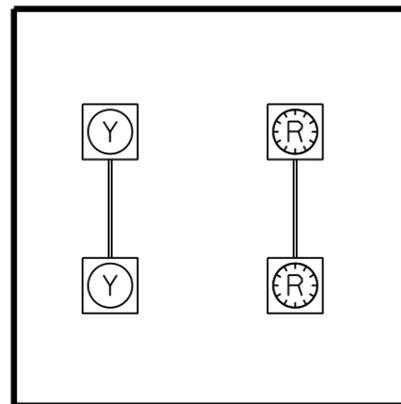
Wayne County
 NC 111 at NC 55
 BEFORE Period
 4/1/98-12/31/03

LEGEND

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



 Target Crash



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 4	AREA:
	STUDY PERIOD: 4/1/98-12/31/03	
	DISTANCE: Y-LINE : 150 FT	
ANALYSIS PREPARED BY: BDR		
ANALYSIS CHECKED BY:		
DIAGRAM PREPARED BY: BDR		
DIAGRAM REVIEWED BY:		
SCALE: NOT TO SCALE		
DATE: February 200		
LOG NUMBER: 4000004432		

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

Wayne County
 NC 111 at NC 55
 AFTER Period
 3/1/04-11/30/09

Rumble Strips
 (Distance from intersection
 not to scale)

NC III
 55 mph

Convenient Store Entrance

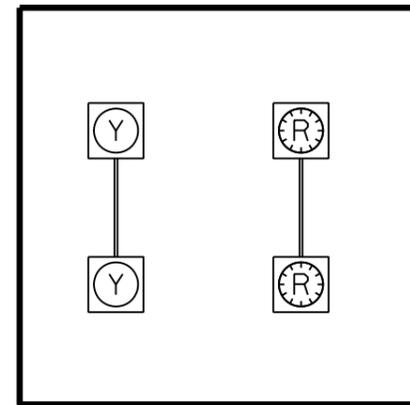
NC 55
 55 mph

NC III
 55 mph

Rumble Strips
 (Distance from intersection
 not to scale)

LEGEND

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



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT



COLLISION DIAGRAM	
DIVISION: 4	AREA:
STUDY PERIOD: 3/1/04-11/30/09	
DISTANCE: Y-LINE + 150 FT	
ANALYSIS PREPARED BY: BDR	
ANALYSIS CHECKED BY:	
DIAGRAM PREPARED BY: BDR	
DIAGRAM REVIEWED BY:	
SCALE: NOT TO SCALE	
DATE: February 200	
LOG NUMBER: 4000004432	

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