

Spot Safety Project Evaluation

Project Log # 200704330

Spot Safety Project # 12-95-211

Spot Safety Project Evaluation of the Multiple Actuated Flasher Installations At the Intersection of US 321 (York Hwy) and SR 2416 (Robinson Rd) Gaston 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

3-11-2009

Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 12-95-211 located at the Intersection of US 321 (York Highway) and SR 2416 (Robinson Road) in Gaston County.

The subject flasher has Sig ID 12-1560 and is located at Railroad Underpass 729980E.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of an additional stop sign and actuated flasher to control one-way movement at the railroad underpass. Located approximately 50 feet from the intersection of US 321, SR 2416 narrows to one lane to pass under a railroad tussle bridge. SR 2416 (Robinson Road) is a two-lane, two-way facility with a speed limit of 55 mph that intersects US 321 at a three-leg intersection and is under stop control. US 321 at this location is a four lane median divided facility with a posted speed limit of 55 mph.

The original statement of problem was that the ten foot one-lane underpass creates a dangerous situation when two vehicles meet traveling in opposite directions. This location was on the 1990 Highway Safety Improvement Program. From the signal diagram, two other flashers were installed at the same time for the northbound US 321 intersection with SR 2416; which indicate “Vehicle Entering From Left When Flashing” and “Vehicle Entering From Right When Flashing.”

The initial crash analysis was completed from December 1, 1991 to November 30, 1994 with ten (10) reported crashes at the railroad underpass, six (6) of which included injuries. The final completion date for the improvement at the subject intersection was on May 30, 2002 with a total cost of \$30,000.00.

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 Mach 1, 2002 to August 31, 2002. The before period consisted of reported crashes from November 1, 1995 through February 28, 2002 (6 years and 4 months); and the after period consisted of reported crashes from September 1, 2002 through December 31, 2008 (6 years and 4 months). The ending date for this evaluation 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 on US 321 and 500 feet on SR 2416 (Robinson Road) to ensure the capture of all collisions related with the railroad underpass. *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 collisions related to the one-way railroad underpass were Target Crash 1 for the applied countermeasure. Target Crash 2 collisions were identified as the angle and ran-off roadway crashes (to avoid an angle collision) at the northbound US 321 direction intersection with SR 2416.

<u>Treatment Information</u>			
	Before	After	Percent Reduction (-) Percent Increase (+)
Total crashes	30	31	3.3 %
Total Severity Index	8.77	12.15	38.5 %
Target Crash 1 – RR Flasher	6	0	- 100.0 %
Target Crash 1 Severity Index	2.23	0.00	- 100.0 %
Target Crash 2 – NB Intersection Flasher	12	22	83.3 %
Target Crash 2 Severity Index	10.40	9.49	- 8.8 %
Volume	9,850	10,700	8.6 %
<u>Injury Crash Summary – Total</u>			
Fatal injury Crashes	1	3	200.0 %
Class A injury Crashes	1	0	- 100.0 %
Class B injury Crashes	5	5	0.0 %
Class C Injury Crashes	6	11	83.3 %
Total Injury Crashes	13	19	46.2 %

The naive before and after analysis at the treatment location resulted in a 3 percent increase in Total Crashes, complete elimination of Target Crash 1 collisions, but a 38 percent increase in the Total Severity Index. The before period ADT year was 1999 and the after period ADT year was 2004.

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 3 percent increase in Total Crashes and a 22 percent increase in Combined Target Crashes. The summary results above demonstrate that both Total Crashes and Target Crashes appear to have increased at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, the crash pattern of two-vehicle collisions located at the railroad underpass was completely eliminated in the after period by the installation of the actuated flasher and additional stop control signage. However, bridge strikes at this location increased from two (2) in the before period to four (4) in the after, including one oversized tractor-trailer (after period crash 25).

The second distinct crash pattern from the diagrams show motorists attempting unsuccessfully to cross the northbound US 321 lanes from both the median crossover and SR 2416. This crash pattern increased by 83 percent from the before to the after period including one fatality angle

collision in both time periods. Vehicles who attempted to avoid an angle collision were also included in these target crashes.

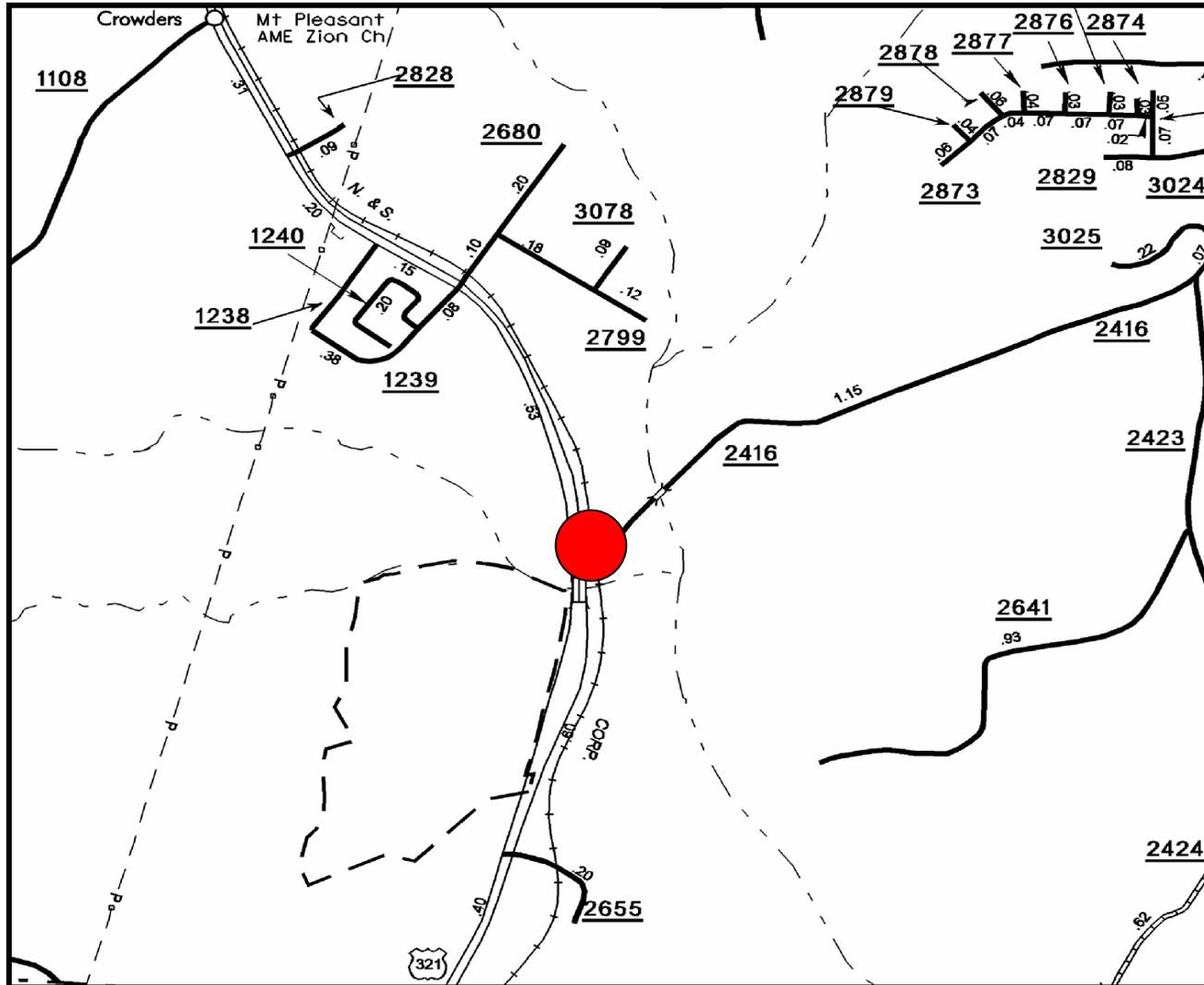
Two other after period fatality crashes occurred within our study limits at this location. Upon further review, it was determined that these two incidents were random in nature and no roadway fault was indicated. After period crash 13 involved a wrong way driver in the southbound US 321 lanes resulting in a head-on collision. After period crash 21 involved a driver under the influence losing control and impacting a stop motorist at the SR 2416 intersection with impact speeds in excessive of 70 mph.

The calculated benefit to cost ratio for this project is **(-13.39) considering total crashes**. The benefit to cost ratio **considering only the combined target crashes is (-3.34)**. 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. A negative benefit-cost ratio indicates an increase in severe injury crashes.

Please see the attached *Treatment Site Photos*. Photos are provided for all approaches to the treatment intersection including photographs of each flasher countermeasure. However, clear pictures are not present showing the northbound US 321 intersection and the potential sight distance issues leading to the angle crash pattern.

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.

Location Map
Gaston County
Evaluation of Spot Safety Project # 12-95-211



Treatment Location: US 321 at SR 2416 (Robinson Road), Railroad Underpass 729980E

**SS# 12-95-211 Aerial Map
Gaston County**



TREATMENT SITE PHOTOS TAKEN 1/24/2008



Traveling North on US 321 (York Highway)



Traveling North on US 321



Traveling South on US 321 (York Hwy)



Traveling South on US 321 at SR 2416



Traveling West on SR 2416 (Robinson Rd)



Traveling West on SR 2416 approaching new Stop condition and flasher



Traveling West on SR 2416
“VEHICLE ENTERING WHEN FLASHING”



From US 321 Median Crossover, Crossing Northbound Traffic



At Railroad Underpass facing US 321

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 321 at SR 2416
 COUNTY: Gaston
 FILE NO.: SS 12-95-211

BY: JBS
 DATE: 3/9/2009
 NOTES: Total Crashes

DETAILED COST: TYPE IMPROVEMENT - 3 Flashers

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$30,000	10	0.149	\$4,471
	\$0	0	0.000	\$0
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$30,000	10	0.149	\$4,471

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$1,200
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$1,050
 TOTAL ANNUAL COST= \$6,721
 TOTAL COST OF PROJECT= \$30,000

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	6.34	2	0.32	11	1.74	17	2.68	\$199,416
AFTER	6.34	3	0.47	16	2.52	12	1.89	\$289,401

Annual Benefits from Crash Cost Savings (\$89,984)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$96,705)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -13.39

TOTAL COST OF PROJECT - \$30,000 COMPREHENSIVE B/C RATIO - -13.39

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: US 321 at SR 2416
 COUNTY: Gaston
 FILE NO.: SS 12-95-211

BY: JBS
 DATE: 3/9/2009
 NOTES: Combined Target Crashes

DETAILED COST: TYPE IMPROVEMENT - 3 Actuated Flashers

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$30,000	10	0.149	\$4,471
Right-of-Way	\$0	0	0.000	\$0
TOTALS	\$30,000	10	0.149	\$4,471

ESTIMATED INCREASE IN ANNUAL MAINT. COST = \$1,200
 ESTIMATED INCREASE IN ANNUAL UTILITY COST = \$1,050
 TOTAL ANNUAL COST= \$6,721
 TOTAL COST OF PROJECT= \$30,000

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	6.34	1	0.16	6	0.95	11	1.74	\$102,666
AFTER	6.34	1	0.16	15	2.37	6	0.95	\$125,142

Annual Benefits from Crash Cost Savings (\$22,476)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = (\$29,197)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -3.34

TOTAL COST OF PROJECT - \$30,000 COMPREHENSIVE B/C RATIO - -3.34

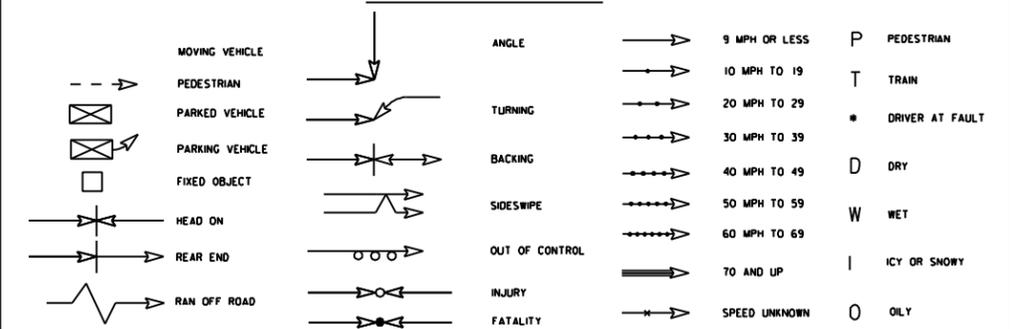
US 321 SB
York Hwy
55 MPH

US 321 NB
York Hwy
55 MPH

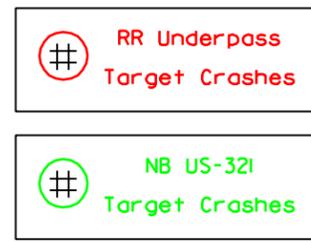
Railroad
Bridge

SR 2416
Robinson Rd
55 MPH

LEGEND



SS# 12-95-211
Gaston County
Before Period
11/1/95 - 2/28/02
US 321 at SR 2416

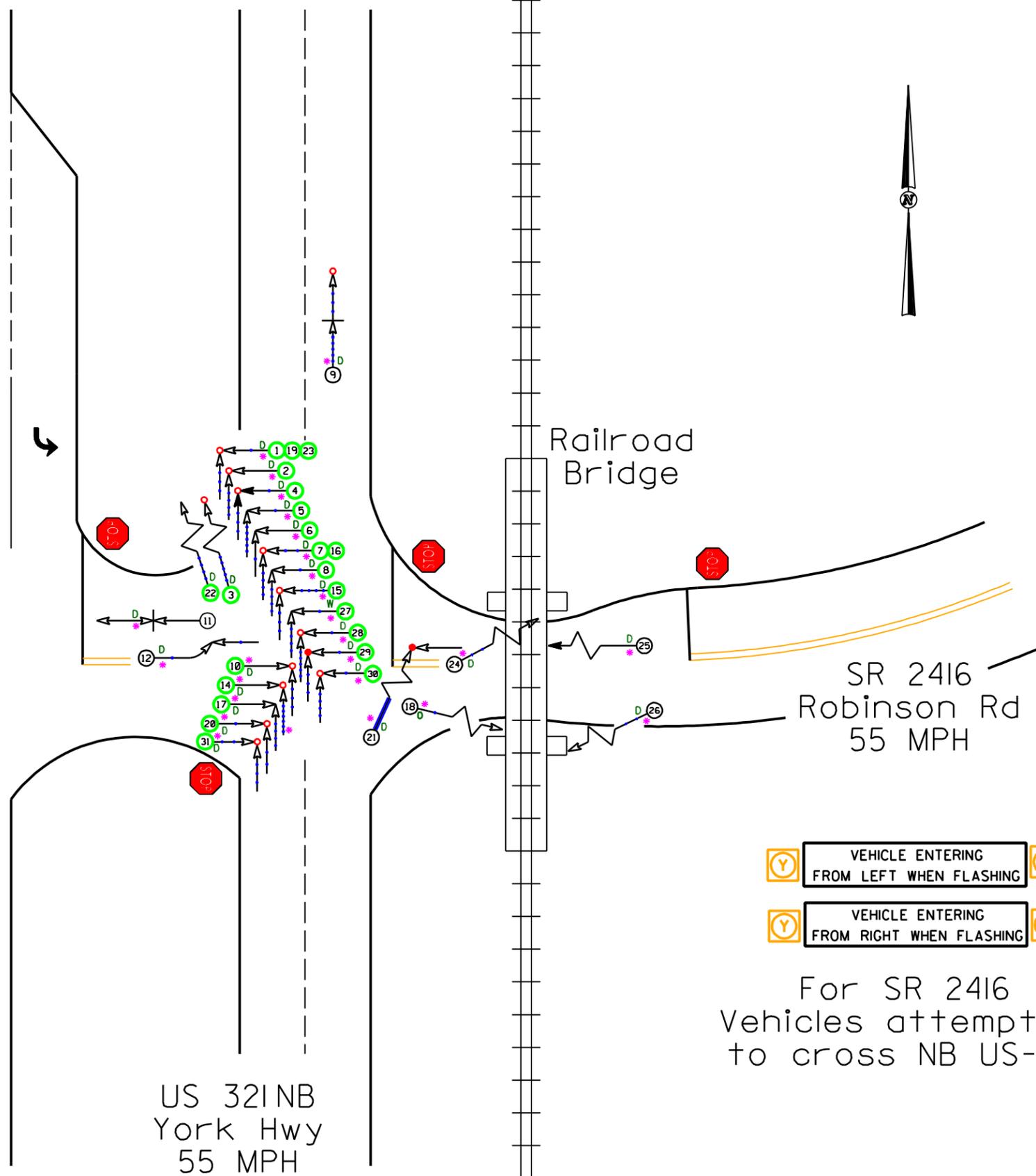


TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 12	AREA:
	STUDY PERIOD: 11/1/1995 - 2/28/2002	
	DISTANCE: Y-LINE = 150 / 500FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 3-4-2009		
LOG NUMBER: SS* 12-95-211BEFORE		

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

US 321 SB
York Hwy
55 MPH



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	OILY
RAN OFF ROAD		70 AND UP	
		SPEED UNKNOWN	

SS# 12-95-211
Gaston County
After Period
9/1/02 - 12/31/08
US 321 at SR 2416

VEHICLE ENTERING WHEN FLASHING

WB SR 2416
Countermeasure
at RR Underpass

VEHICLE ENTERING FROM LEFT WHEN FLASHING

VEHICLE ENTERING FROM RIGHT WHEN FLASHING

For SR 2416
Vehicles attempting
to cross NB US-321

RR Underpass
Target Crashes

NB US-321
Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: I2	AREA:
STUDY PERIOD: 9/1/2002 - 12/31/2008		
DISTANCE: Y-LINE = 150 / 500 FT		
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 3-4-2009		
LOG NUMBER: SS* 12-95-211AFTER		

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