

Spot Safety Project Evaluation

Order # 41000001051

Spot Safety Project # 14-01-212

**Spot Safety Project Evaluation of the Signal Installation
NC 280 (Boylston Hwy) at SR 1316 / SR 1422
Henderson 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

10-12-2009

Date

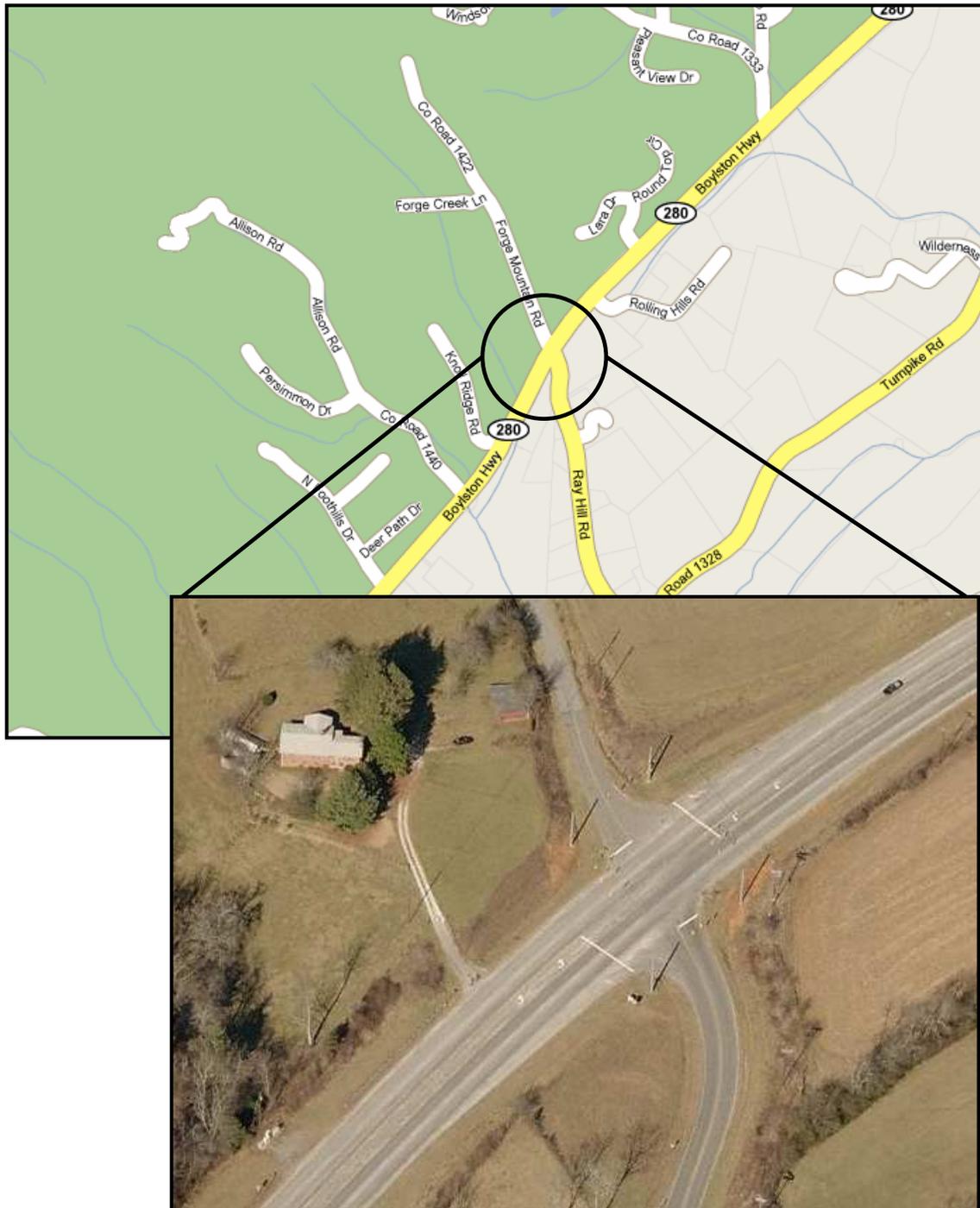
Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 14-01-212 located at the Intersection of NC 280 (Boylston Highway) and SR 1316 (Ray Hill Road) / SR 1422 (Forge Mountain Road) in Henderson County, near the Town of Big Knob.

The Sig ID is 14-1137 for this newly installed traffic signal.



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 intersection traffic signal. NC 280 is a five-lane facility with a center turn lane and a speed limit of 55 mph. SR 1316 (Ray Hill Road) and SR 1422 (Forge Mountain Road) are both two-lane facilities at the subject intersection with non-posted 55 mph speed limits. SR 1422 is a rural dead end residential street within the Pisgah National Forest. The subject location is a four-leg crossroads intersection, which was controlled by stop conditions on the side street approaches in the before period.

The original statement of problem was that increased vehicle usage has lead to congestion and delay at this location. The intended purpose of this signal was to help regulate the right-of-way assignment and reduce the congestion and delay.

The initial crash analysis was completed from April 1, 1998 to March 1, 2001 with ten (10) reported crashes, five (5) of which were deemed correctable including two A-injury collisions. The signal installation date for this improvement was determined to be between July and October of 2002 based on police crash reports and the signal design file and had a total cost of \$56,000.

Naive Before and After Analysis

After reviewing the spot safety project file folder, the signal diagrams, and all the crashes at the subject location, the crash data omitted from this analysis to consider for an adequate construction period were the months of July through October 2002. The before period consisted of reported crashes from November 1, 1995 through June 30, 2002 (6 years and 8 months); and the after period consisted of reported crashes from November 1, 2002 through June 30, 2009 (6 years and 8 months). 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, aerial map, and photos for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location. Please note that Frontal Impact Crashes were the target crashes for the applied countermeasure. The Frontal Impact Crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Right turn, same roadway; Right turn, different roadways; Head on; and Angle.

<u>Treatment Information</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Total crashes	17	14	- 17.6 %
Total Severity Index	17.42	14.47	- 16.9 %
Target Crashes	11	8	- 27.3 %
Target Crash Severity Index	25.04	23.65	- 5.6 %
Volume	13,800	16,300	18.1 %

<u>Injury Crash Summary</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	3	2	- 33.3 %
Class B injury Crashes	3	1	- 66.7 %
Class C Injury Crashes	4	4	0.0 %
Total Injury Crashes	10	7	- 30.0 %

The naive before and after analysis at the treatment location resulted in an 18 percent decrease in Total Crashes, a 27 percent decrease in Target Crashes, and a 17 percent decrease in the Total Severity Index. The before period ADT year was 1999 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 an 18 percent decrease in Total Crashes and a 27 percent decrease in Target Crashes. The summary results above demonstrate that both Total and Target Crashes appear to have decreased at the treatment location from the before to the after period.

Referencing the *Collision Diagrams*, the before period observed eleven (11) frontal impact collisions. Of these crashes, eight (8) were left turn same roadway collisions, which include one avoidance ran-off roadway collision, from vehicles on westbound NC 280 attempting to access SR 1316. After the signal installation, this left turn same roadway pattern remained with six (6) collisions from the permissive green signal phase.

The SR 1316 (Ray Hill Road) rear-end crash pattern also increased slightly from three (3) crashes in the before period to four (4) collisions in the after period. This project did slightly reduce crashes and created a positive benefit-cost ratio with the reduction of A-injury collisions from three (3) to two (2) through the analysis.

The calculated benefit to cost ratio for this project is **7.02 considering total crashes**. The benefit to cost ratio **considering only target crashes is 6.84**. 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 from Google Street View for all four 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



Looking West / Southwest on NC 280 approaching intersection



Looking East / Northeast on NC 280 approaching intersection



Looking North on SR 1316 (Ray Hill Road) nearing intersection



Looking South on SR 1422 (Forge Mtn Road) nearing intersection

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: NC 280 at SR 1316 / 1422		BY: JBS						
COUNTY: Henderson		DATE: 10/7/2009						
FILE NO.: SS 14-01-212		NOTES: Total Crashes						
DETAILED COST:	TYPE IMPROVEMENT - New Traffic Signal							
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
Construction	\$56,000	10	0.149	\$8,346				
Right-of-Way	\$0	0	0.000	\$0				
TOTALS	\$56,000	10	0.149	\$8,346				
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$2,200				
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900				
TOTAL ANNUAL COST=				\$11,446				
TOTAL COST OF PROJECT=				\$56,000				
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	6.67	3	0.45	7	1.05	7	1.05	\$247,871
AFTER	6.67	2	0.30	5	0.75	7	1.05	\$167,511
Annual Benefits from Crash Cost Savings								\$80,360
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$68,914		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	7.02		
TOTAL COST OF PROJECT		-	\$56,000	COMPREHENSIVE B/C RATIO		-	7.02	

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: NC 280 at SR 1316/1422		BY: JBS						
COUNTY: Henderson		DATE: 10/7/2009						
FILE NO.: SS 14-01-212		NOTES: Target Crashes - Frontal Impact						
DETAILED COST:	TYPE IMPROVEMENT - New Traffic Signal							
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
Construction	\$56,000	10	0.149	\$8,346				
Right-of-Way	\$0	0	0.000	\$0				
TOTALS	\$56,000	10	0.149	\$8,346				
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$2,200				
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900				
TOTAL ANNUAL COST=				\$11,446				
TOTAL COST OF PROJECT=				\$56,000				
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	6.67	3	0.45	5	0.75	3	0.45	\$240,135
AFTER	6.67	2	0.30	4	0.60	2	0.30	\$161,889
Annual Benefits from Crash Cost Savings								\$78,246
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$66,800		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	6.84		
TOTAL COST OF PROJECT		-	\$56,000	COMPREHENSIVE B/C RATIO		-	6.84	

LEGEND

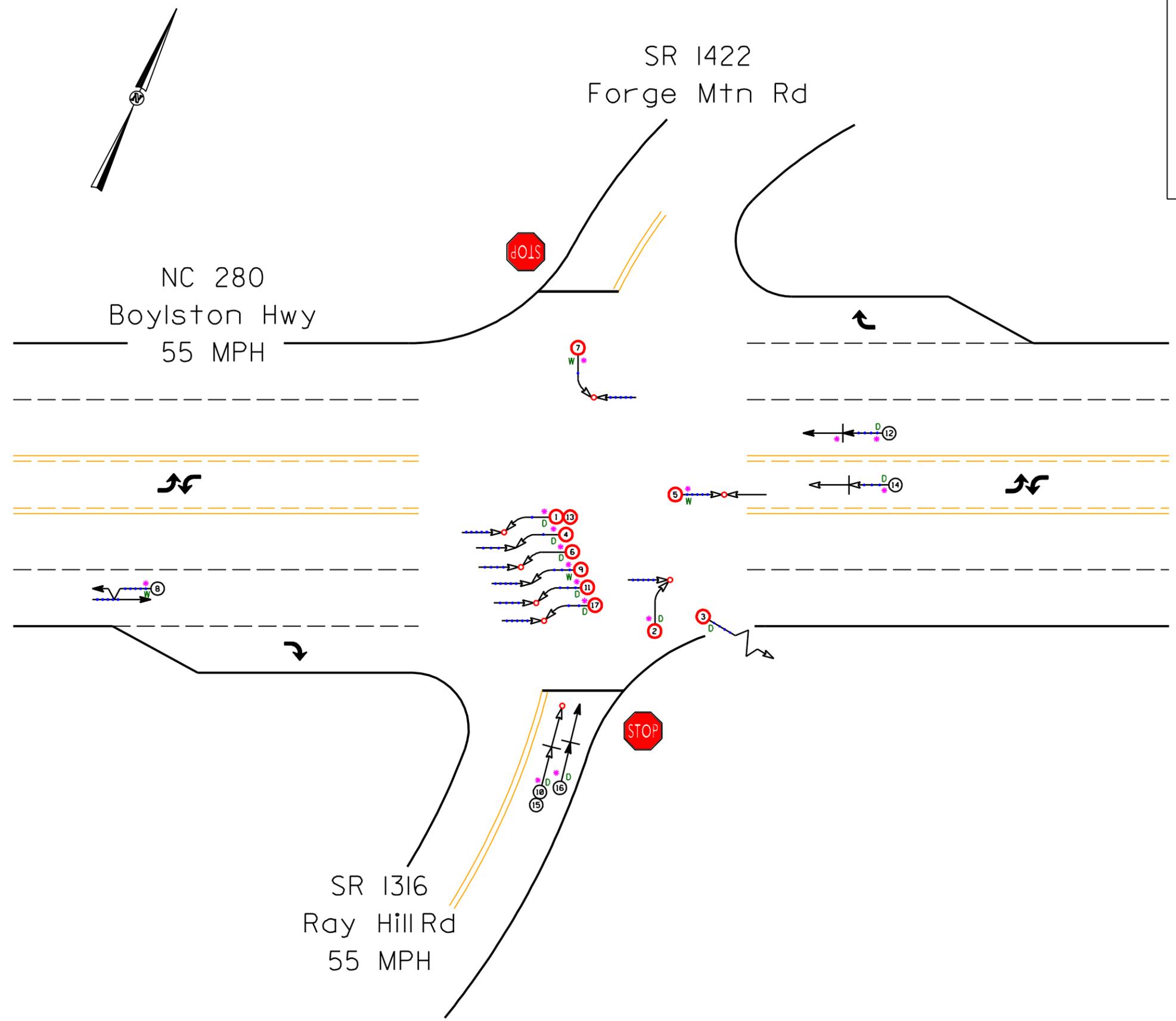
	MOVING VEHICLE		ANGLE		9 MPH OR LESS		P PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		T TRAIN
	PARKED VEHICLE		BACKING		20 MPH TO 29		* DRIVER AT FAULT
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		D DRY
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		W WET
	HEAD ON		INJURY		50 MPH TO 59		I ICY OR SNOWY
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

SR 1422
Forge Mtn Rd

NC 280
Boylston Hwy
55 MPH

SS# 14-01-212
Henderson County
BEFORE Period
11/1/95 - 6/30/02

SR 1316
Ray Hill Rd
55 MPH



Frontal Impact
Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 14	AREA:
	STUDY PERIOD: 11/1/1995 - 6/30/2002	
	DISTANCE: Y-LINE = 150 FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: N/A		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 10-7-2009		
EVAL NUMBER: Or der 4100000051 BEFORE		

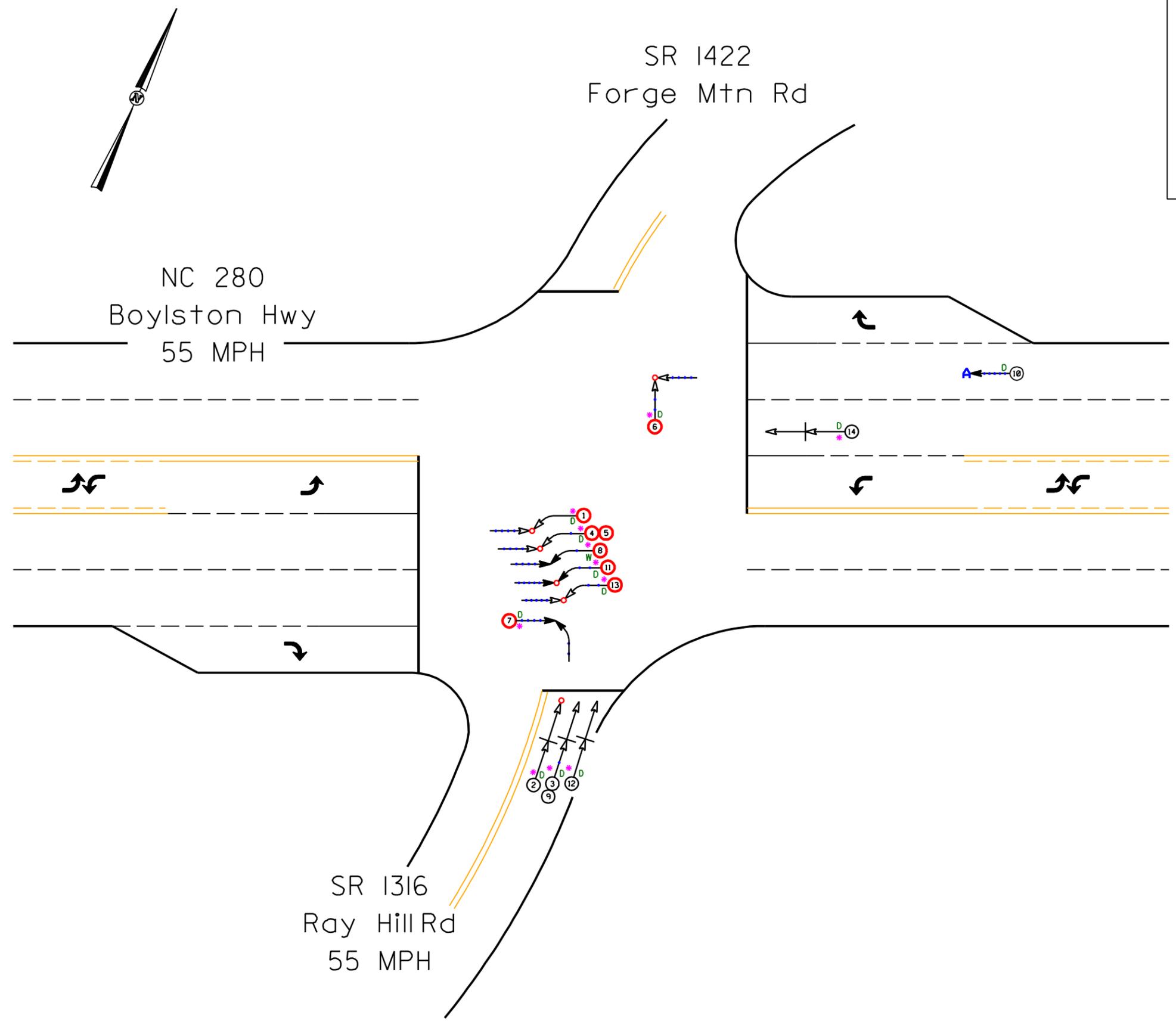
N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRANSPORTATION MOBILITY and SAFETY DIVISION

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# 14-01-212
 Henderson County
 AFTER Period
 11/1/02 - 6/30/09

New Signalized
 Intersection
 Sig ID 14-1137



Frontal Impact
 Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 14	AREA:
	STUDY PERIOD: 11/1/2002 - 6/30/2009	
	DISTANCE: Y-LINE = 150 FT	
	ANALYSIS PREPARED BY: JBS	
	ANALYSIS CHECKED BY: N/A	
	DIAGRAM PREPARED BY: JBS	
	DIAGRAM REVIEWED BY: ST	
SCALE: NOT TO SCALE		
DATE: 10-7-2009		
EVAL NUMBER: Order 4100000051 AFTER		

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SAFETY DIVISION