

# Spot Safety Project Evaluation

Order # 41000009122

Spot Safety Project # 11-04-205

**Spot Safety Project Evaluation of the Traffic Signal Installation  
US 221 (Linville Bypass) at NC 181 (Newland Hwy)  
Avery County, Town of Linville**

Documents Prepared By:

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

**Principal Investigator**



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Jason B. Schronce

11-08-2010

Date

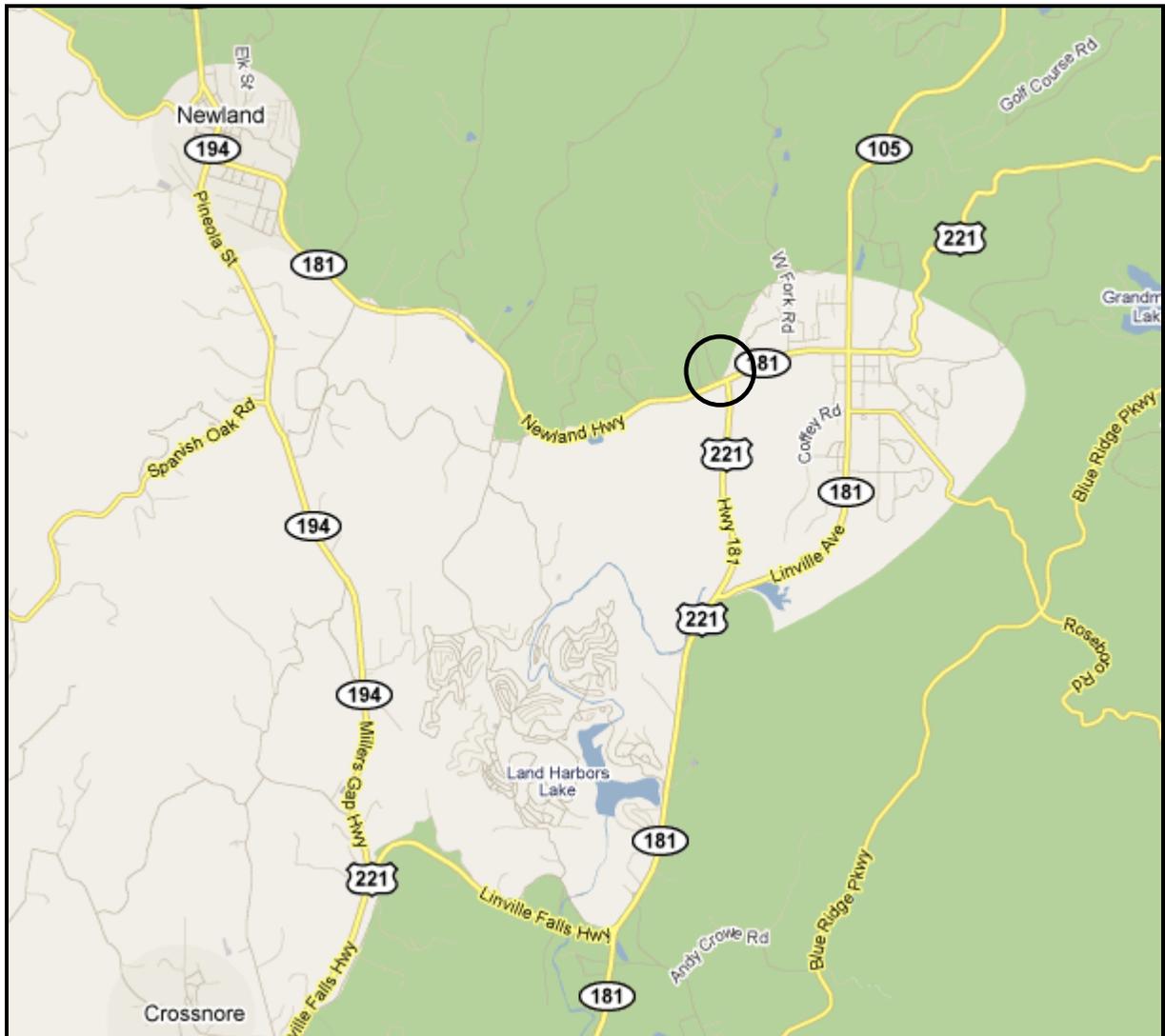
Traffic Safety Project Engineer

# Spot Safety Project Evaluation Documentation

## Subject Location

Evaluation of Spot Safety Project Number 11-04-205 located at the Intersection of US 221 (Linville Bypass) at NC 181 (Newland Highway) / Hughes Lane / Mountain View Apartments Lane in Avery County, near the Town of Linville.

The Sig ID is 11-1397 for this newly installed traffic signal.





**2005 Avery County GIS Map – Prior to Signal Installation  
Roadway Geometrics stayed the same with the 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. US 221 and NC 181 are both two-lane facilities at the subject intersection with speed limits of 55 mph on all approaches. The roadways widen at the intersection for auxiliary turn lanes including a northbound right turn lane, westbound left turn lane, and an eastbound left and right turn lane. The fourth leg of the intersection is a two dead-end road split with Mt. View Apartment Lane and Hughes Lane serving residential properties. The subject location was previously stop-controlled for the northbound US 221 approach.

The original statement of problem was the existence of congestion and delay issues at this location with a developing angle crash problem. The intended purposes of these improvements were to increase mobility and safety by assigning vehicular movement right-of-way.

The initial crash analysis was completed from August 1, 2000 to July 31, 2003 with four (4) correctable crashes including one angle and three left turn different roadway. The final completion date for the improvement at the subject intersection was on July 14, 2006 with a total cost of \$45,000.

## 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 were the months of June through July 2006. The before period consisted of reported crashes from May 1, 2002 through May 31, 2006 (4 years and 1 month); and the after period consisted of reported crashes from August 1, 2006 through August 31, 2010 (4 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, 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.

<b><u>Treatment Information</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Total Crashes	16	11	- 31.3 %
Total Severity Index	6.66	9.91	48.8 %
Target Crashes	5	4	- 20.0 %
Target Crash Severity Index	17.64	23.65	34.1 %
Volume (2004, 2008)	13,100	11,700	- 10.7 %

<b><u>Injury Crash Summary</u></b>	<b>Before</b>	<b>After</b>	<b>Percent Reduction (-) Percent Increase (+)</b>
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	1	1	0.0 %
Class B injury Crashes	1	0	- 100.0 %
Class C Injury Crashes	2	3	50.0 %
Total Injury Crashes	4	4	0.0 %

The naive before and after analysis at the treatment location resulted in a 31 percent decrease in Total Crashes, a 20 percent decrease in Target Crashes, but a 49 percent increase in the Total Severity Index. The before period ADT year was 2004 and the after period ADT year was 2008.

## Results and Discussion

Referencing the *Collision Diagrams*, the before period presented five (5) frontal impact collisions including two (2) angle and three (3) left turn different roadway crashes from vehicles traveling northbound choosing insufficient gaps. After the signal installation these patterns were eliminated but the intersection still had four (4) target crashes. The after period collisions included a right turn on red, two (2) left turn same roadway on permissive green, and one (1) A-injury red light run crash. With the after period A-injury collision, the benefit-cost for this project became a negative value for the target crashes.

Also, the predominant crash pattern at this location was the rear-end collisions occurring in the northbound right turn lane. This pattern reduced through the evaluation from eleven (11) collisions in the before period to seven (7) in the after period. These collisions appear to be low speed (20 mph or less) in nature and are likely occurring from vehicles attempting to turn right on red thinking the vehicle in front as already cleared. This movement has a protected-permissive right turn signal phase in the after period.

The calculated benefit to cost ratio for this project is **0.54 considering total crashes**. The benefit to cost ratio **considering only target crashes is (-0.28)**. 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 the three main 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 East on NC 181 (Newland Highway)



Traveling West on US 221 approaching intersection



Traveling North on US 221 (Linville Bypass)

**BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes**

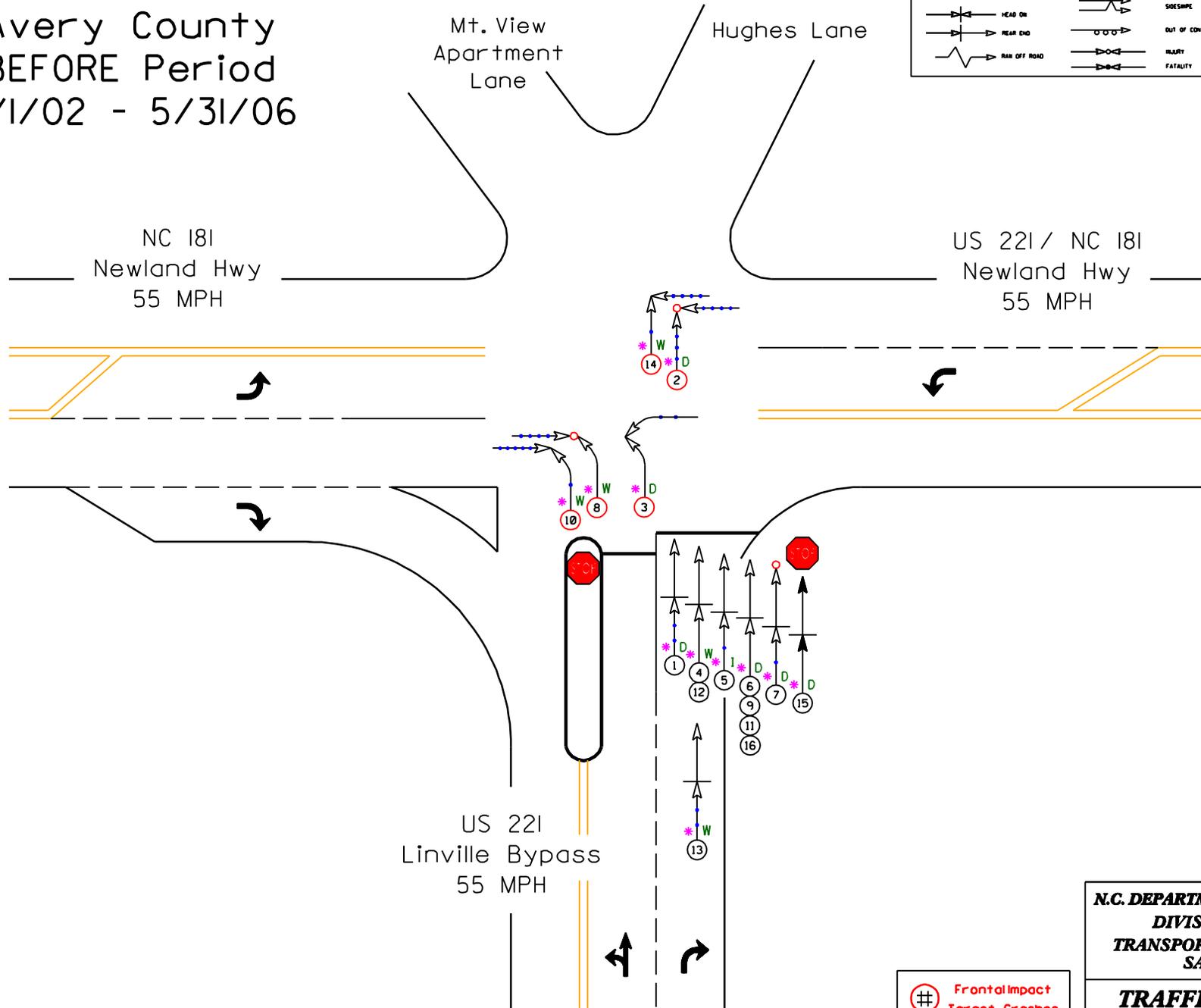
LOCATION: <b>US 221 at NC 181</b>		BY: <b>JBS</b>						
COUNTY: <b>Avery</b>		DATE: <b>11/8/2010</b>						
FILE NO.: <b>SS 11-04-205</b>								
DETAILED COST: TYPE IMPROVEMENT - <b>New Traffic Signal</b>								
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
Construction	\$45,000	10	0.149	\$6,706				
Right-of-Way	\$0	0	0.000	\$0				
TOTALS	\$45,000	10	0.149	\$6,706				
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$2,200				
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900				
TOTAL ANNUAL COST=				\$9,806				
TOTAL COST OF PROJECT=				\$45,000				
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	4.08	1	0.25	3	0.74	12	2.94	\$181,765
AFTER	4.08	1	0.25	3	0.74	7	1.72	\$176,495
Annual Benefits from Crash Cost Savings								\$5,270
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						= (\$4,537)		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						= 0.54		
TOTAL COST OF PROJECT		-	\$45,000	COMPREHENSIVE B/C RATIO		-	0.54	

**BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes**

LOCATION: <b>US 221 at NC 181</b>		BY: <b>JBS</b>						
COUNTY: <b>Avery</b>		DATE: <b>11/8/2010</b>						
FILE NO.: <b>SS 11-04-205</b>								
DETAILED COST: TYPE IMPROVEMENT - <b>New Traffic Signal</b>								
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
Construction	\$45,000	10	0.149	\$6,706				
Right-of-Way	\$0	0	0.000	\$0				
TOTALS	\$45,000	10	0.149	\$6,706				
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$2,200				
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900				
TOTAL ANNUAL COST=				\$9,806				
TOTAL COST OF PROJECT=				\$45,000				
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	4.08	1	0.25	1	0.25	3	0.74	\$162,475
AFTER	4.08	1	0.25	2	0.49	1	0.25	\$165,270
Annual Benefits from Crash Cost Savings								(\$2,794)
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST						= (\$12,600)		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST						= -0.28		
TOTAL COST OF PROJECT		-	\$45,000	COMPREHENSIVE B/C RATIO		-	-0.28	

SS# II-04-205  
 Order# 41000009122  
 Avery County  
 BEFORE Period  
 5/1/02 - 5/31/06

LEGEND			
	MOVING VEHICLE		ANGLE
	PEDESTRIAN		TURNING
	PAKED 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 SNOW
			O ONLY



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

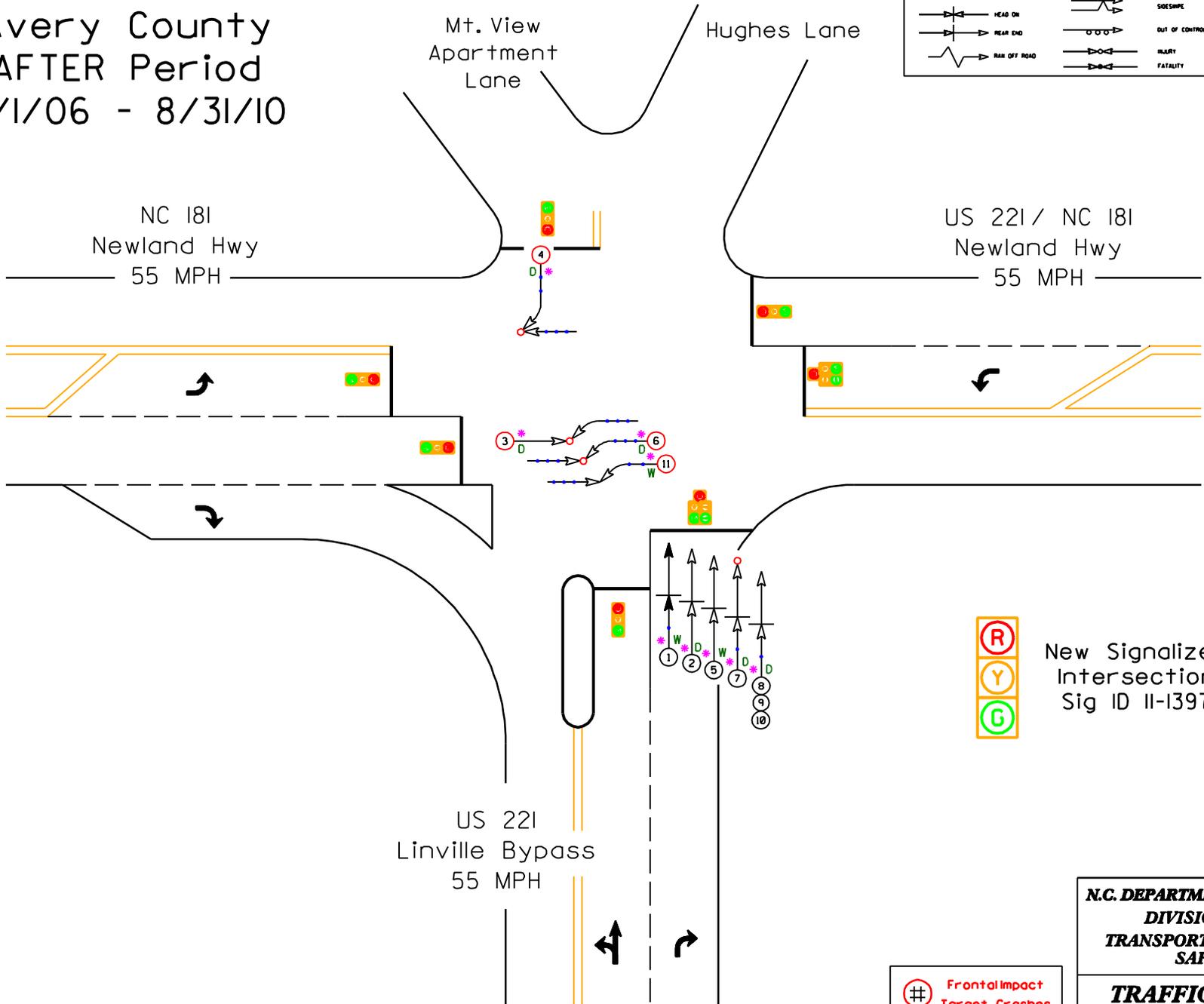
**TRAFFIC SAFETY UNIT**

Date: 11-3-2010  
 Prepared By: J. Schronce

SS# II-04-205  
 Order# 41000009122  
 Avery County  
 AFTER Period  
 8/1/06 - 8/31/10

**LEGEND**

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



New Signalized Intersection  
 Sig ID II-1397

Frontal Impact  
 Target Crashes

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

**TRAFFIC SAFETY UNIT**

Date: 11-3-2010 Prepared By: J. Schronce