

Spot Safety Project Evaluation

Project Log # 200703099

Spot Safety Project # 10-97-033

**Spot Safety Project Evaluation of the Traffic Signal Installation
At the Intersection of NC 16 (Providence Rd) and I-485 Westbound Ramp
Mecklenburg County, City of Charlotte**

Documents Prepared By:

Safety Evaluation Group
Traffic Safety Systems Management Section
Traffic Engineering and Safety Systems Branch
North Carolina Department of Transportation

Principal Investigator

Jason B. Schronce

12-18-2007
Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 10-97-033 – The Intersection of NC 16 (Providence Rd) and I-485 Westbound Ramp (Exit 57) in Mecklenburg County.

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 actuated traffic signal. In the study period, NC 16 was a four-lane facility at the subject intersection with a dedicated northbound left turn lane and a southbound right turn lane for access to the I-485 acceleration ramp. The off ramp from I-485 westbound provides left and right turn lanes at the subject intersection. This location was controlled by stop signs at the off-ramp terminal and a speed limit of 45 mph on NC 16 (Providence Road).

In July of 2002, the geometry of the aforementioned interchange was altered by the addition of cloverleaf on-ramps for both directions of I-485. The subject intersection was altered by the removal of the northbound left turn lane, which was replaced with a dedicated right turn lane that becomes the cloverleaf on-ramp. Bike lanes were also added as part of this project. Please see the attached *Aerial Map* and *Condition Diagram* showing the existing intersection geometry.

The original statement of problem was the excessive delays experienced by northbound NC 16 motorists turning left onto the I-485 acceleration ramp and left turning vehicles from the I-485 westbound off-ramp traveling south on Providence Road. The signal was also designed to reduce the potential for frontal impact crashes. The intersection met signal volume warrants 1, 2, 9, and 11.

An initial crash analysis was not completed for this project since it originated before crash data was available from the September 1997 opening of this I-485 segment around Charlotte. The new traffic signal at the subject intersection was installed on September 22, 1999 with a total cost of \$20,000.00.

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 August 1, 1999 to November 30, 1999. The before period consisted of reported crashes from October 1, 1997 through July 31, 1999 (1 year and 10 months) and the matching after period consisted of reported crashes from December 1, 1999 through September 30, 2001 (1 year and 10 months). The beginning date and limiting factor for this analysis was determined by the opening of this segment of I-485 in September of 1997.

The complete after period consisted of crashes from December 1, 1999 through May 31, 2007 (7 years, 6 months). This secondary analysis can be seen in *Table 2 (Loop Analysis)* below, which is

separated by the addition of the cloverleaf on-ramps and redesign of the intersection geometry, as stated in the background section. The Before Loop period consisted of crashes from December 1, 1999 through July 20, 2002 (2 years, 7.70 months) and the After Loop period consisted of crashes from July 21, 2002 through May 31, 2007 (4 years, 10.3 months). The ending date of this analysis was determined by the date of available crash data at the time of analysis and is evaluated by crash type and crashes per year.

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 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.

Treatment Information – Signal Analysis			
	Before (1.83 yrs)	After (1.83 yrs)	Percent Reduction (-) Percent Increase (+)
Total crashes	14	14	0.00 %
Total Severity Index	5.76	3.64	- 36.81 %
Target Crashes	9	7	- 22.22 %
Target Crash Severity Index	3.81	4.17	9.45 %
Volume	28,100	36,700	30.60 %
<u>Injury Crash Summary</u>			
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	0	0	N/A
Class B injury Crashes	3	0	- 100.00 %
Class C Injury Crashes	6	5	- 16.67 %
Total Injury Crashes	9	5	- 44.44 %

The naive before and after analysis at the treatment location resulted in a 22 percent decrease in Target Crashes and a 37 percent decrease in Total Severity Index. The before period ADT year was 1998 and the after period ADT year was 2003.

Results and Discussion

The naive before and after analysis involving the comparison of treatment actual before data versus treatment actual after data resulted in zero change for Total Crashes and a 22 percent decrease in Target Crashes. The summary results above demonstrate that 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 (9 of 14) were the result of a vehicle taking an insufficient gap off the exit ramp attempting

to go south on Providence Road. After the signal installation, this pattern was significantly reduced to just two (2), which were the result of a northbound vehicle on NC 16 running the red light.

A new pattern of Left Turn; Same Roadway collisions developed as vehicles on Providence attempted to access the I-485 westbound acceleration ramp. This pattern increased from zero to four (4) crashes in the after period. There was also a slight increase in Rear-End Crashes at the intersection (from 5 to 6).

The calculated benefit to cost ratio for this project is 5.07 considering total crashes. The benefit to cost ratio considering only target crashes is 4.50. 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 following table represents the complete after period of 7.50 years and is separated by crash type and analyzed in crashes per year.

Treatment Information – Loop Analysis		
	No Loops (2.64 yrs)	Loops (4.86 yrs)
Total crashes	25	62
Total Crashes / Year	9.47	12.76
Angle (Ran Red Light)	2	5
Angle Crashes / Year	0.76	1.03
Left Turn; Same Roadway (NB onto Ramp)	6	1
LTSR Crashes / Year	2.27	0.21
Mainline (NC-16) Rear-end	8	27
Mainline Rear-end Crashes / Year	3.03	5.55
Westbound Ramp Rear-end	5	23
Ramp Rear-end Crashes / Year	1.89	4.73
Other (Sideswipe, Pedestrian, Object)	4	6

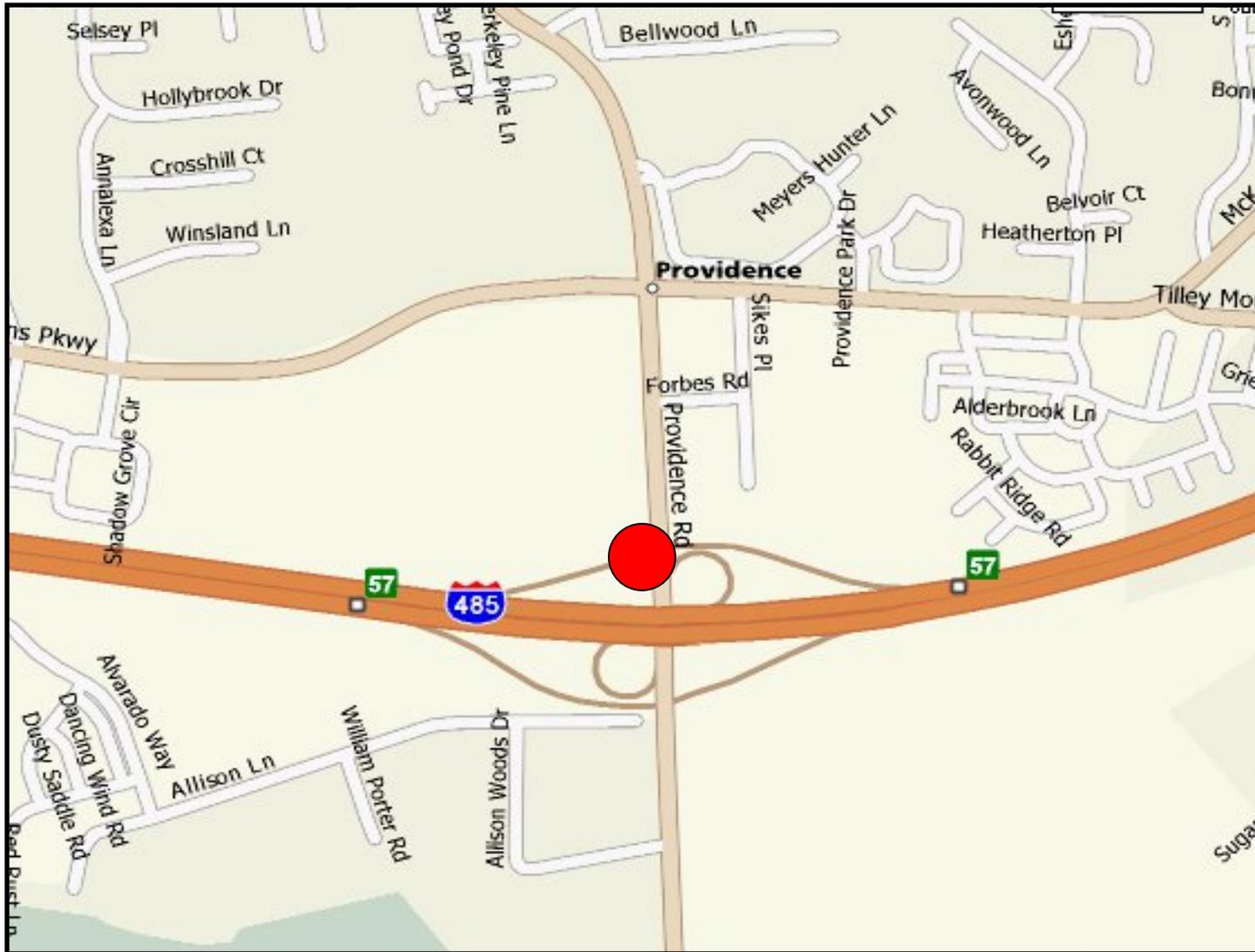
As seen from the table above, crashes per year have increased overall and significantly in the rear-end (mainline and ramp) categories. The cloverleaf ramps have nearly eliminated, from six (6) to one (1), the Left Turn; Same Roadway crash pattern that developed in the initial 1.83 year after period. The one crash of this type was the result of an illegal movement since left turns are no longer allowed.

The volume at this intersection has increased by 30 percent from the before to the after periods, which has a defining role in low speed rear-end collisions approaching a traffic signal.

Please see the attached *Treatment Site Photos*. Photos are provided for all approaches to the treatment intersection, although the configuration of the existing interchange is different from the configuration that was analyzed for the initial study, as explained in the *Project Background* section.

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
Mecklenburg County, City of Charlotte
Evaluation of Spot Safety Project # 10-97-033



Treatment Location: NC-16 (Providence Road) at I-485 Westbound Off-Ramp

SS# 10-97-033 Aerial Map



TREATMENT SITE PHOTOS TAKEN 8/28/2007



Traveling South on NC 16 (Providence Rd)



Traveling North on NC 16 (Providence Rd)



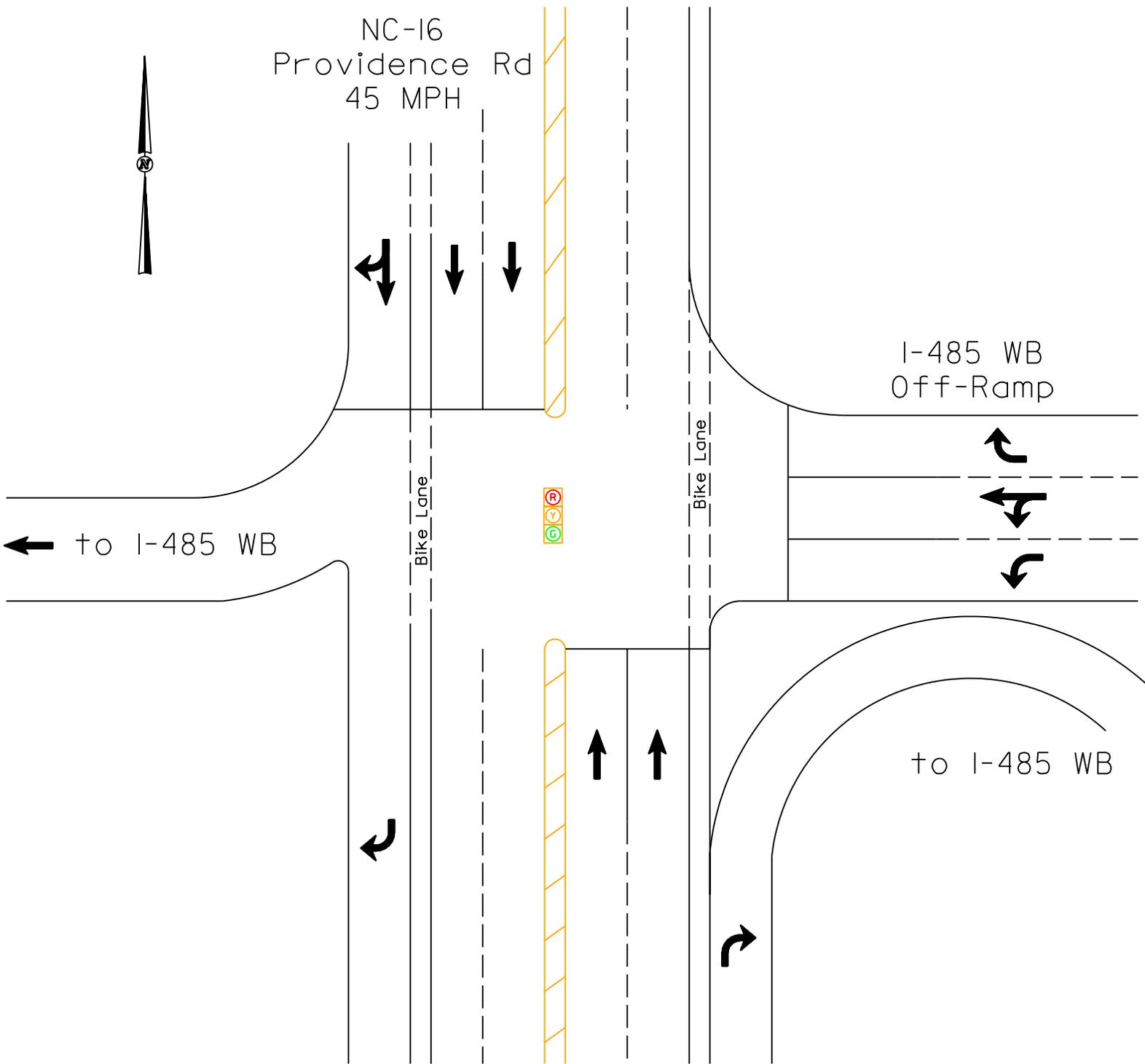
Traveling North on NC 16



Traveling West on I-485 Off Ramp

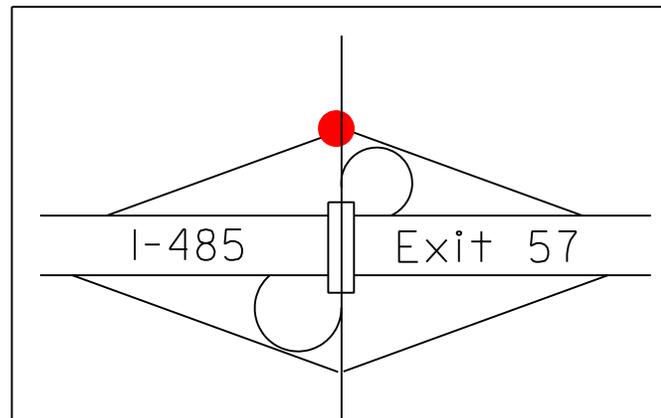


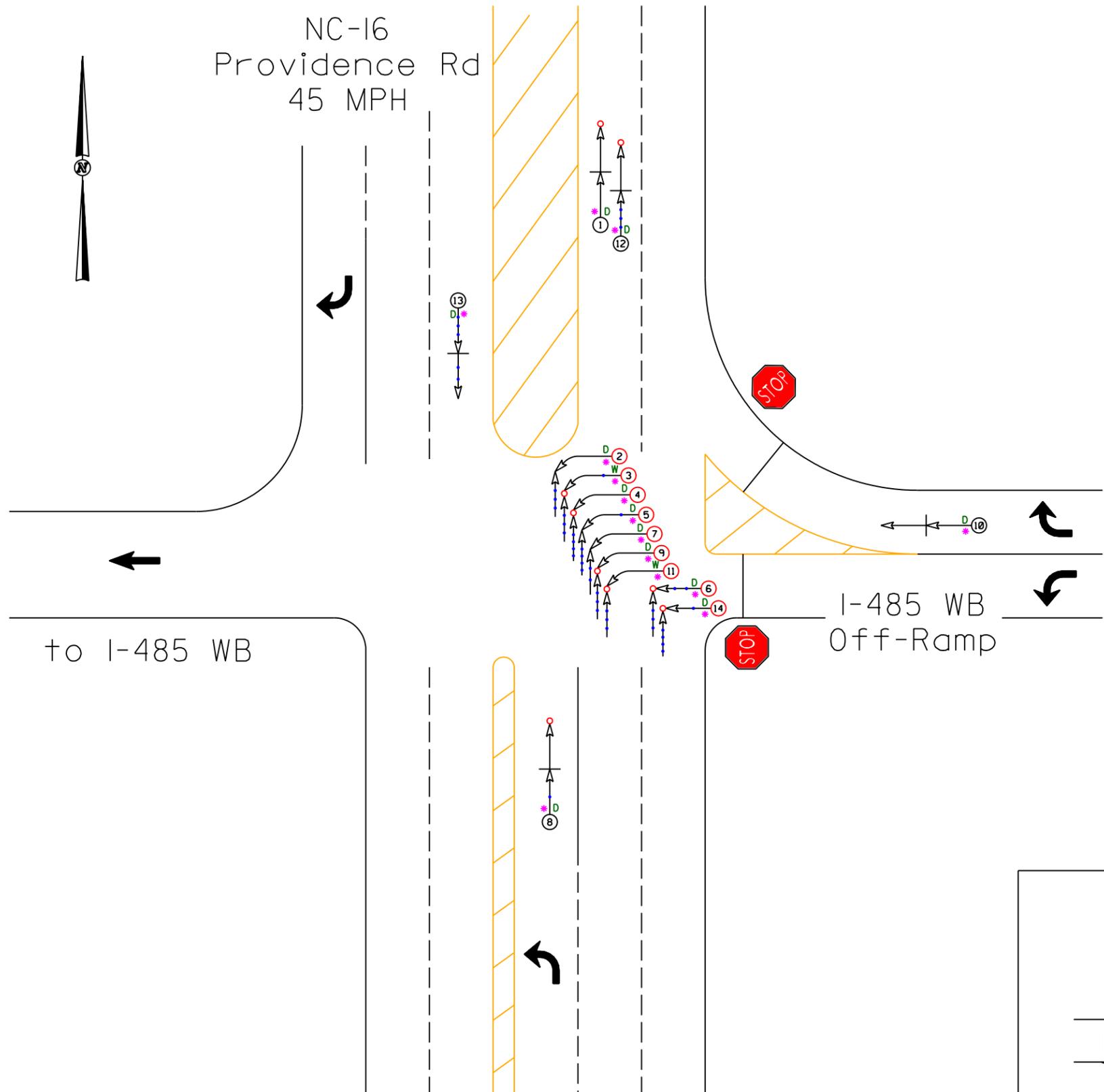
Traveling West on I-485 Off Ramp



SS# 10-97-033
 Mecklenburg County
 I-485 WB at NC-16
 Current Geometry

Cloverleaf Ramps
 added in July 2002



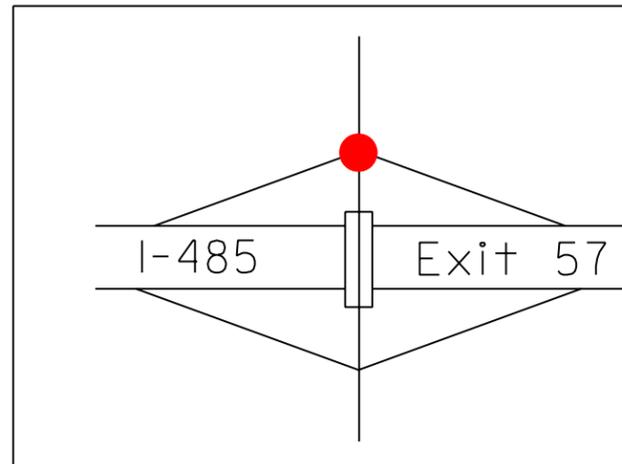


LEGEND

	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		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		0 OILY
	RAN OFF ROAD				70 AND UP		

SS# 10-97-033
 Mecklenburg County
 BEFORE Period
 10/1/97 - 7/31/99
 I-485 WB at NC-16

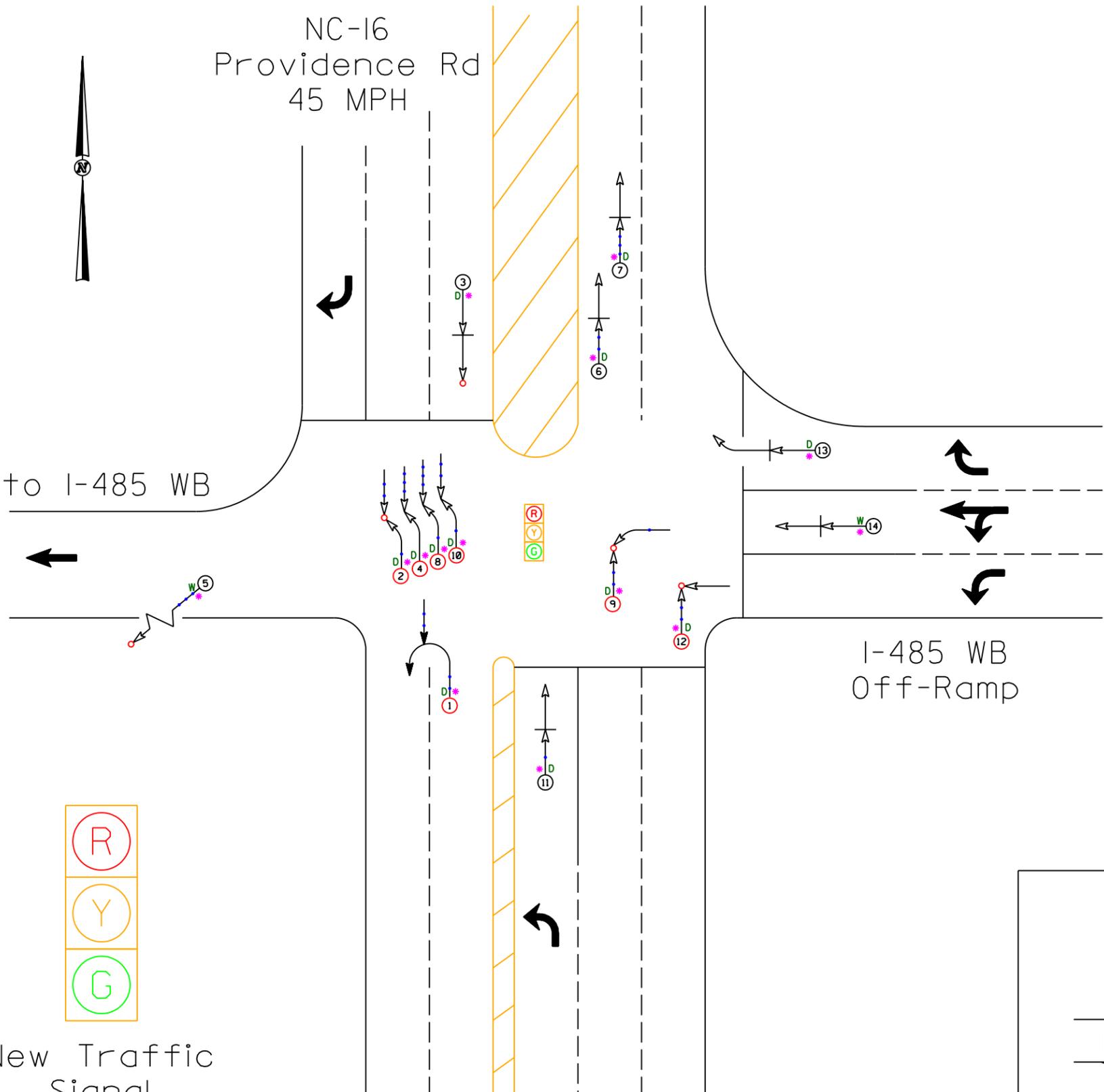
Target Crashes
 Frontal Impact



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 10	AREA:
STUDY PERIOD: 10/1/1997 TO 7/31/1999	
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: 12-11-2007	
LOG NUMBER: SS* 10-97-033	

N.C. DEPARTMENT of TRANSPORTATION
DIVISION of HIGHWAYS
TRAFFIC ENGINEERING AND SAFETY
SYSTEMS BRANCH



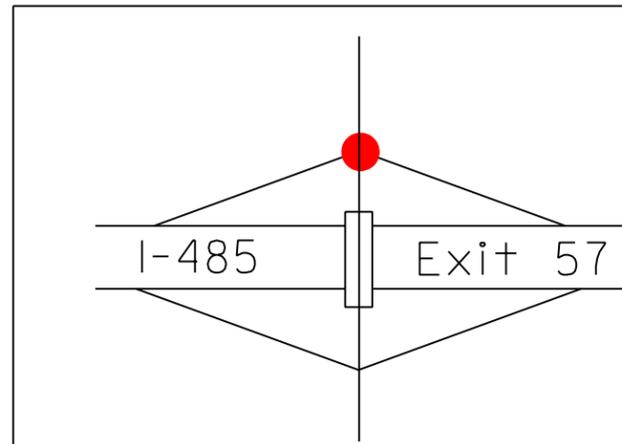
LEGEND

	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		SPEED UNKNOWN
	RAN OFF ROAD				70 AND UP		OILY

SS# 10-97-033
 Mecklenburg County
 AFTER Period
 12/1/99 - 9/30/01
 I-485 WB at NC-16

Target Crashes
 Frontal Impact

R
 Y
 G
 New Traffic Signal



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

COLLISION DIAGRAM	
DIVISION: 10	AREA: 1
STUDY PERIOD: 12/1/1999 TO 9/30/2001	
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: 12-11-2007	
LOG NUMBER: SS* 10-97-033	

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SYSTEMS BRANCH