Spot Safety Project Evaluation

Project Log # 200704303

Spot Safety Project # 05-01-205

Spot Safety Project Evaluation of the Installation of a Traffic Signal at the Intersection of SR 1321 (Avent Ferry Rd) and SR 1348 (Trailwood Dr)
Wake County

Documents Prepared By:

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

Principal Investigator

_____ 11/13/07
Brad Robinson, EI Date

Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 05-01-205 – The Intersection of SR 1321 (Avent Ferry Rd) and SR 1348 (Trailwood Dr) in Wake County.

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was to install a 3-phase traffic signal. The subject location is a three-leg intersection which was controlled by a stop sign on SR 1348 (Trailwood Dr) in the before period. Northbound SR 1348 is a two lane approach, with one left and one right turn lane. SR 1321 (Avent Ferry Rd) is a five lane roadway at the subject location, with the center left turn lane from the before period being used as a left turn lane for westbound traffic in the after period. The speed limits are 40 mph for SR 1321 and 45 mph for SR 1348.

The original statement of problem was that traffic volumes had increased to the point where motorists could not safely maneuver through the intersection. At the request of private citizens, a signal warrant investigation was conducted and it was determined that the intersection satisfied traffic signal warrants 1, 2, 8, 9, and 11.

The initial crash analysis was conducted from January 1, 1998 to December 31, 2000 with a total of 13 crashes, 6 of which were considered correctable by the chosen countermeasure. The final completion date for the improvements at the subject intersection was on July 20, 2002 with a total cost of $40,000.00.

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 May 1, 2002 to September 30, 2002. The before period consisted of reported crashes from September 1, 1997 through April 30, 2002 (4 years and 8 months) and the after period consisted of reported crashes from October 1, 2002 through May 31, 2007 (4 years and 8 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 crash types were the Target Crashes for the applied countermeasure. These crash types considered are 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	29	60	106.9
Total Severity Index	5.66	4.73	-16.4
Target Crashes	15	22	46.7
Target Crash Severity Index	8.03	4.36	-45.7
Volume	23,400	30,000	28.2
Crash Severity Summary			
Fatal Crashes	1	0	-100.0
Class A Crashes	0	1	N/A
Class B Crashes	1	6	500.0
Class C Crashes	7	14	100.0
PDO Crashes	20	39	95.0

The naive before and after analysis at the treatment location resulted in a 107 percent increase in Total Crashes, a 47 percent increase in Target Crashes, and a 28 percent increase in Average Daily Traffic (ADT). The before period ADT year was 1999 and the after period ADT year was 2005.

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 107 percent increase in Total Crashes and a 47 percent increase in Target Crashes. The Total Severity Index decreased by 16 percent and the Target Crash Severity Index decreased by 46 percent. 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.

There was a fatality at the intersection in the before period (crash #8). A vehicle made a left turn from SR 1348 (Trailwood Dr) without yielding. An eastbound driver on SR 1321 (Avent Ferry) swerved to avoid the turning vehicle, went out of control, and struck a westbound driver.

Referencing the *Collision Diagrams*, crash patterns at the intersection have either remained constant or increased at the intersection from the before to the after period. The most notable increase appears to be Left Turn-Same Roadway Crashes involving westbound traffic on SR 1321 (Avent Ferry) turning left onto SR 1348 (Trailwood). In the before period there were three crashes of this type, in the after period there were 12 such crashes, an increase of 300 percent. Although the left turn has protected-permitted phasing, it appears that most of these crash crashes appear to be the fault of the left turning driver (9 of 12, after).

Another notable increase is in Left Turn-Same Roadway crashes involving a left turning vehicle from SR 1348 (Trailwood) and an eastbound vehicle on SR 1321 (Avent Ferry). This pattern increased from two in the before period to seven in the after period, an increase of 250 percent. All

seven of the after period crashes appear to be the fault of the eastbound driver running the traffic signal. It is not clear why eastbound SR 1321 traffic is running the signal. The seven crashes took place at random times throughout the day, not following any noticeable pattern. There does not appear to be site distance issues.

A pattern of Rear-End Crashes involving eastbound vehicles that had just cleared the intersection also developed in the after period. In the before period there was only 1 crash of this type, while in the after period there were 11. Some of the crash reports sited backed up traffic on SR 1321 to be the cause of the Rear-Ends. It is possible that the driveway on the northern side of SR 1321 just east of the intersection might be the reason for some of these crashes. The driveway is right next to the westbound stop bar, and the left turn lane for westbound vehicles is still clearly defined across from the driveway. In the before period there was a center turn lane in this area, so any eastbound vehicle turning into the driveway could use the center turn lane. In the after period vehicles might be stopping in the travel lane to make a left turn into the driveway instead of using the center lane, which as stated above is marked as a left turn lane for the opposite direction. Nine of the 11 crashes occurred between 1:00 p.m. and 9:00 p.m., a time period when people might be coming home to the apartment complex. It should be noted that during the field investigation no vehicles were observed making this movement.

The calculated benefit to cost ratio for this project is –7.41 considering total crashes. The benefit to cost ratio considering only target crashes is 9.88. 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.

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 roadway.

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: SR 1321 at SR 1348 BY: Brad Robinson
COUNTY: Wake DATE: 10/26/2007
FILE NO.: SS 05-01-205

DETAILED COST: TYPE IMPROVEMENT - Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$40,000	10	0.149	$5,961
	$0	0	0.000	$0
Right-of-Way	$0	0	0.000	$0
TOTALS	$40,000	10	0.149	$5,961

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,000
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $900

TOTAL ANNUAL COST= $8,861
TOTAL COST OF PROJECT= $40,000

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	4.66	1	0.21	8	1.72	20	4.29	$163,948
AFTER	4.66	1	0.21	20	4.29	39	8.37	$229,592

Annual Benefits from Crash Cost Savings ($65,644)

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = ($74,505)

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = -7.41

TOTAL COST OF PROJECT - $40,000 COMPREHENSIVE B/C RATIO - -7.41

BENEFIT-COST ANALYSIS WORKSHEET

LOCATION: SR 1321 at SR 1348 BY: Brad Robinson
COUNTY: Wake DATE: 10/26/2007
FILE NO.: SS 05-01-205 Target

DETAILED COST: TYPE IMPROVEMENT - Signal

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$40,000	10	0.149	$5,961
	$0	0	0.000	$0
Right-of-Way	$0	0	0.000	$0
TOTALS	$40,000	10	0.149	$5,961

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $2,000
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $900

TOTAL ANNUAL COST= $8,861
TOTAL COST OF PROJECT= $40,000

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	4.66	1	0.21	4	0.86	10	2.15	$138,841
AFTER	4.66	0	0.00	10	2.15	12	2.58	$51,330

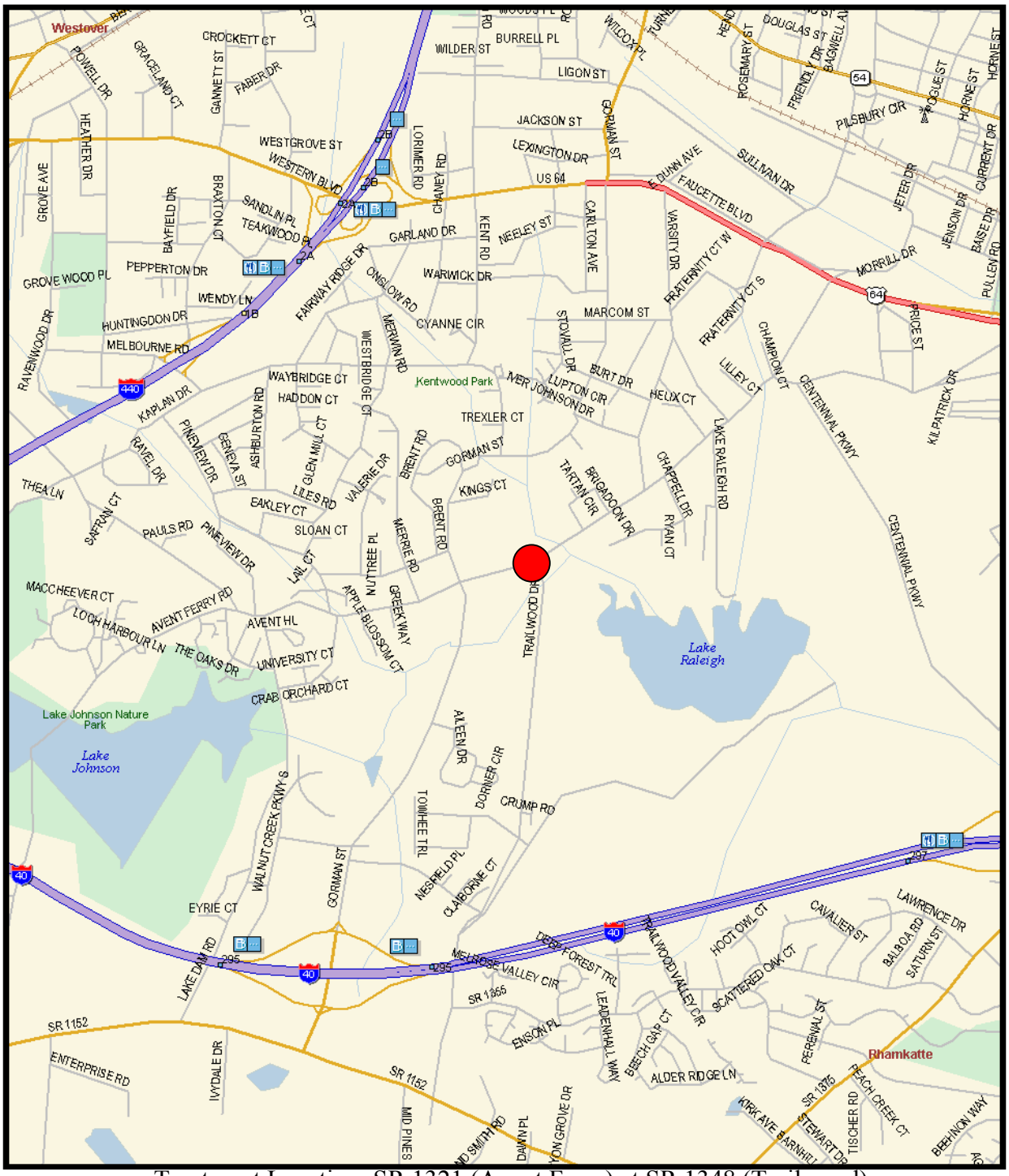
Annual Benefits from Crash Cost Savings $87,511

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $78,650

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 9.88

TOTAL COST OF PROJECT - $40,000 COMPREHENSIVE B/C RATIO - 9.88

Location Map
Wake County
Evaluation of Spot Safety Project #05-01-205



Treatment Location: SR 1321 (Avent Ferry) at SR 1348 (Trailwood)

Treatment Site Photos Taken October 19, 2007

Driving Westbound on SR 1321 (Avent Ferry Rd)

Driving Eastbound on SR 1321 (Avent Ferry Rd)

Driving Northbound on SR 1348 (Trailwood Dr)

Driving Northbound on SR 1348 (Trailwood Dr)

Wake County
SR 1321(Avent Ferry) at
SR 1348 (Trailwood)
Before Period From 9/1/1997-4/30/2002

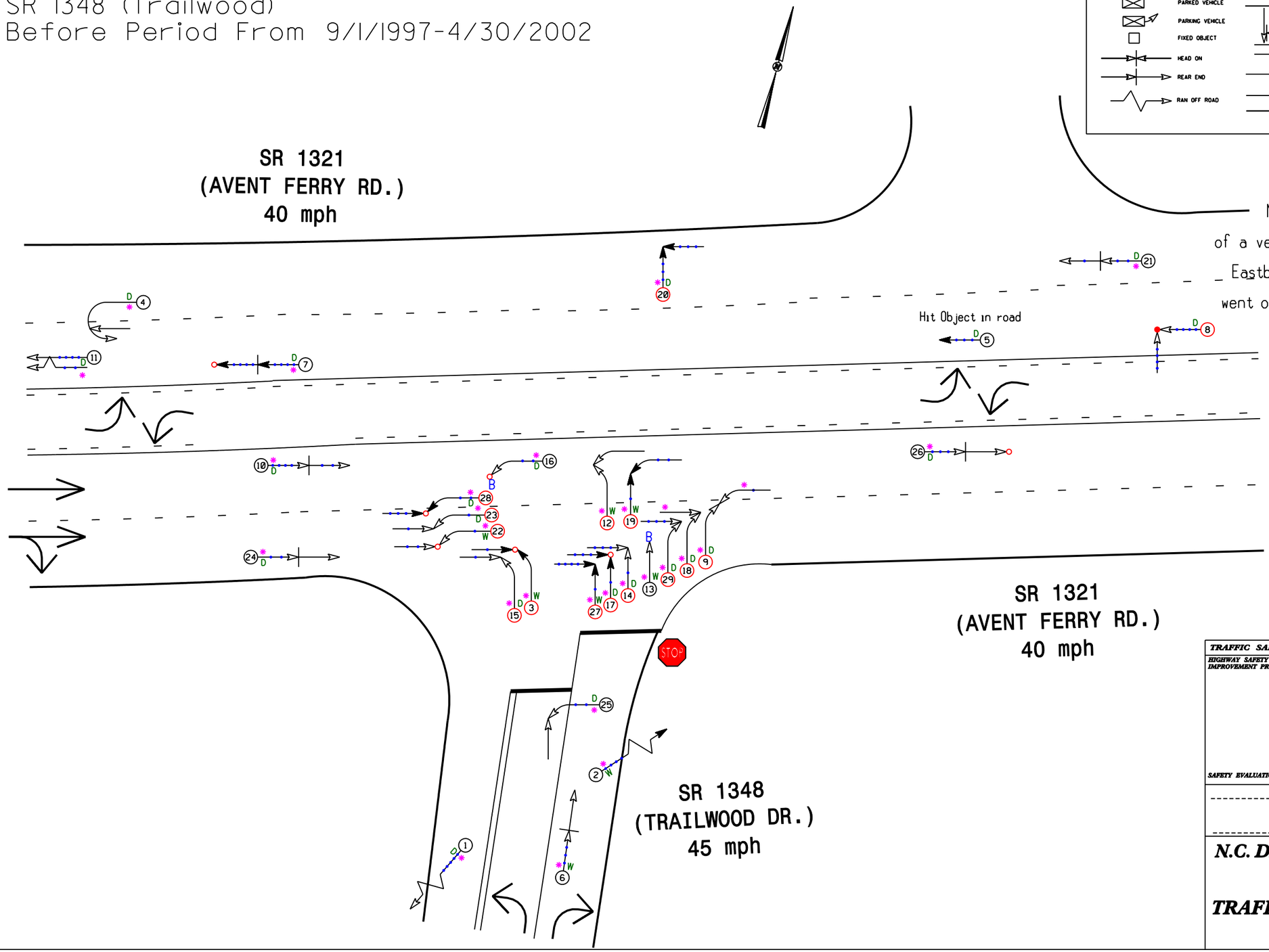
LEGEND

MOVING VEHICLE
PEDESTRIAN
PARKED VEHICLE
PARKING VEHICLE
FIXED OBJECT
HEAD ON
REAR END
RAN OFF ROAD

ANGLE
TURNING
BACKING
SIDESWIPE
OUT OF CONTROL
INJURY
FATALITY

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
DAYLIGHT CRASH
DARK CRASH

P PEDESTRIAN
B BICYCLE
T TRAIN
A ANIMAL
* DRIVER AT FAULT
D DRY
W WET
I ICY OR SNOWY



Note: Crash #8 occured as a result of a vehicle making a left-turn from trailwood. Eastbound driver swerved to avoid vehicle, went out of control and hit westbound vehicle.

Target Crashes

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT
HIGHWAY SAFETY IMPROVEMENT PROGRAM
SAFETY INFORMATION MANAGEMENT AND SUPPORT
STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION •
SAFETY EVALUATION
TRAFFIC SAFETY

BEFORE

COLLISION DIAGRAM

DIVISION: 5	AREA: ..
STUDY PERIOD: 9/1/97 TO 4/30/02	
DISTANCE:	Y-LINE: 150 FT
ANALYSIS PREPARED BY: B.Robinson	
DIAGRAM PREPARED BY: B.Robinson	
DIAGRAM REVIEWED BY: _____	
SCALE:	NOT TO SCALE
DATE:	October 2007
LOG NUMBER:	200704303

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

Wake County
SR 1321(Avent Ferry) at
SR 1348 (Trailwood)
After Period From 10/1/2002-5/31/2007

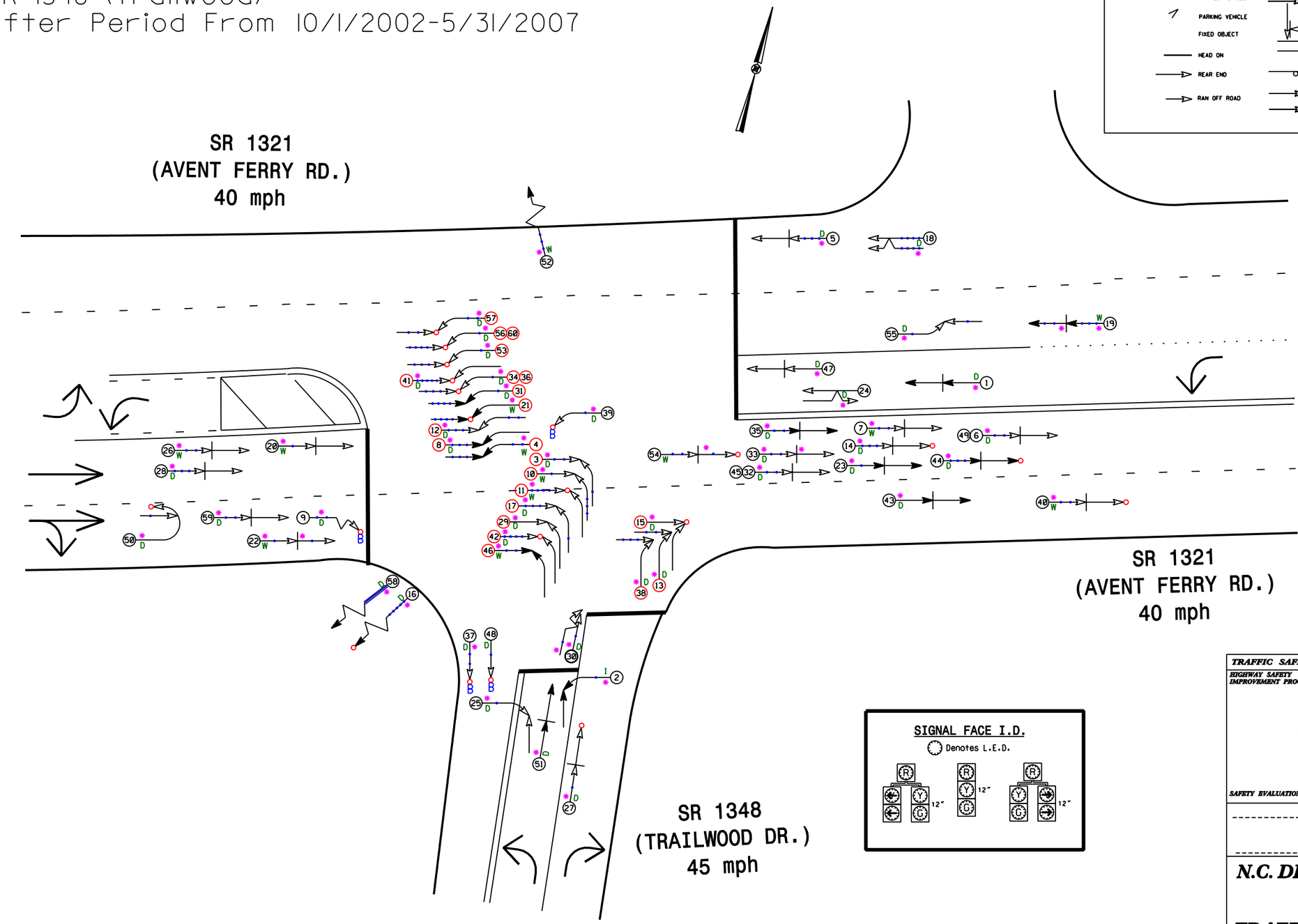
LEGEND

MOVING VEHICLE
PEDESTRIAN
PARKED VEHICLE
PARKING VEHICLE
FIXED OBJECT
HEAD ON
REAR END
RAN OFF ROAD

ANGLE
TURNING
BACKING
SIDESWIPE
OUT OF CONTROL
INJURY
FATALITY

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
DAYLIGHT CRASH
DARK CRASH

P PEDESTRIAN
B BICYCLE
T TRAIN
A ANIMAL
* DRIVER AT FAULT
D DRY
W WET
I ICY OR SNOWY



Target Crashes

SIGNAL FACE I.D.
Denotes L.E.D.

TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT
HIGHWAY SAFETY IMPROVEMENT PROGRAM
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STATE OF NORTH CAROLINA • DEPARTMENT OF TRANSPORTATION •
SAFETY EVALUATION
TRAFFIC SAFETY

AFTER

COLLISION DIAGRAM

DIVISION: 5	AREA: ..
STUDY PERIOD: 10/1/02 TO 5/31/07	
DISTANCE:	Y-LINE: 150 FT
ANALYSIS PREPARED BY: B.Robinson	
DIAGRAM PREPARED BY: B.Robinson	
DIAGRAM REVIEWED BY: _____	
SCALE:	NOT TO SCALE
DATE:	October 2007
LOG NUMBER:	20070303

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