Spot Safety Project Evaluation

Order # 41000012519

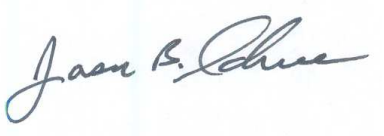
Spot Safety Project # 05-05-015

Spot Safety Project Evaluation of the Signal Phase Changes
SR 1009 (Lake Wheeler Road) at I-40 Eastbound Ramps (Exit 297)
Wake County, City of Raleigh

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

Traffic Safety Project Engineer

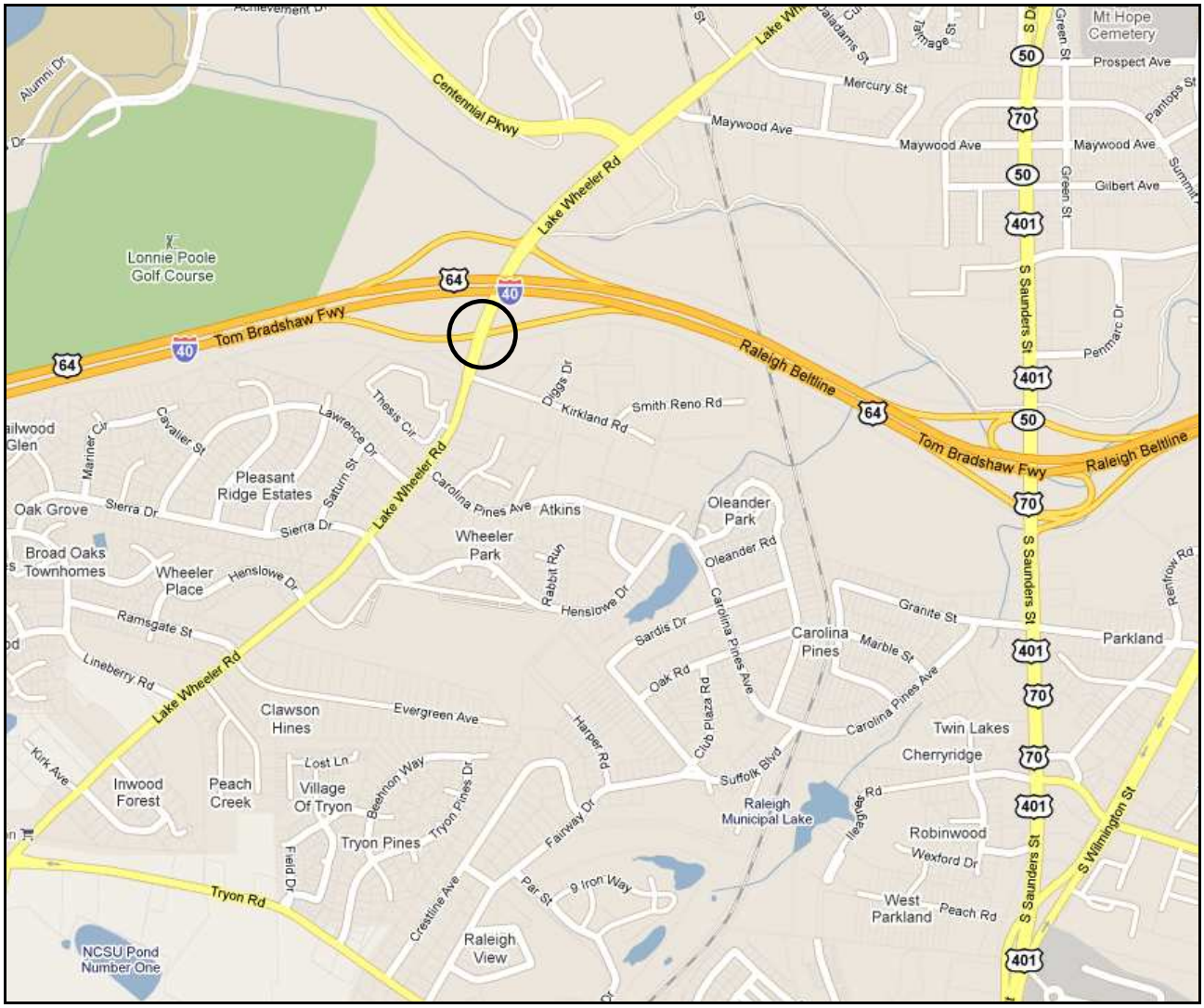
7-14-2011
Date

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 05-05-015 located at the Intersection of SR 1009 (Lake Wheeler Road) and the I-40 (formally I-440 Outer Beltline) Eastbound Ramp Terminal (Exit 297) in Wake County, City of Raleigh.

The Sig ID is 05-1575 for the modified traffic signal at this intersection.



Aerial Photograph provided by BING Maps

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the signal modification to Protected-Permitted Left Turns on southbound SR 1009 (Lake Wheeler Road). I-40 intersects SR 1009 with a standard diamond-style interchange with both ramp terminals signalized. Lake Wheeler Road at the Eastbound Ramp Terminal presents two through lanes in both directions, a southbound left turn lane, and a northbound right turn lane with a speed limit of 35-mph. The existing traffic signal operated under permissive only left turns in the before period.

The original statement of problem was the existing crash pattern of vehicles travelling southbound on Lake Wheeler Road unable to safely negotiate left turns onto the I-40 eastbound entrance ramp due to insufficient gaps in traffic. The intended purpose was to provide right-of-way for the left turn movement and therefore enhance safety performance of the intersection.

The initial crash analysis was completed from April 1, 2000 to March 31, 2005 with ten (10) reported left-turn same roadway correctable crashes. The final completion date for the improvement at the subject intersection was on March 28, 2007 with a total cost of $28,000.

Location Photographs (Field Visit 7-6-2011)

Looking Southbound on SR 1009 at EB Ramp Terminal

Looking Northbound on SR 1009 at EB Ramp Terminal

Looking Eastbound on the Exit 297 Ramp from I-40

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 January through March 2007. The before period consisted of reported crashes from January 1, 2003 through December 31, 2006 (4 years); and the after period consisted of reported crashes from April 1, 2007 through March 31, 2011 (4 years). 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 Left Turn-Same Roadway Crashes on the southbound approach of SR 1009 were the target crashes for the applied countermeasure.

Treatment Information	**Before**	**After**	**Percent Reduction (-) Percent Increase (+)**
Total Crashes	37	31	- 16.2 %
Total Severity Index	5.25	2.43	- 53.7 %
Target Crashes	15	8	- 46.7 %
Target Crash Severity Index	4.95	2.85	- 42.4 %
Volume (2004, 2009)	17,800	17,600	- 1.1 %

Injury Crash Summary	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal injury Crashes	1	0	- 100.0 %
Class A injury Crashes	0	0	N/A
Class B injury Crashes	4	1	- 75.0 %
Class C Injury Crashes	7	5	- 28.6 %
Total Injury Crashes	12	6	- 50.0 %

The naive before and after analysis at the treatment location resulted in a 16 percent decrease in Total Crashes, an 47 percent decrease in Target Crashes, and a 54 percent decrease in the Total Severity Index. The before period ADT year was 2004 and the after period ADT year was 2009.

Results and Discussion

Referencing the *Collision Diagrams*, the before period presented a strong pattern of fifteen (15) left turn crashes from vehicles choosing the wrong gap while attempting to access the I-40 entrance ramp. With the assignment of right-of-way using the new protected-permitted phasing in the after period, this pattern was reduced by almost half with seven (7) southbound vehicles choosing the wrong gap and one (1) northbound vehicle running the red light. However, the intersection did experience an increase in southbound SR 1009 through vehicles running the red light from zero (0) to four (4) crashes from the before to the after periods.

This location also experienced one (1) fatal crash in the before period that was random in nature. The collision occurred when a vehicle travelling in excess of 80-mph (double the posted speed limit) went left of center and struck a northbound motorist head-on. This crash yields the project with a significant Total Benefit-Cost calculation.

The calculated benefit to cost ratio for this project is **40.35 considering total crashes**. The benefit to cost ratio **considering only target crashes is 6.87**. 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 *Location Photographs*. Photos are provided from our field visit on July 7, 2011 for the three 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.

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: Lake Wheeler at I-40 EB Ramps BY: JBS
COUNTY: Wake DATE: 7/7/2011
FILE NO.: SS 05-05-015

DETAILED COST: TYPE IMPROVEMENT - Protected-Permitted Phasing

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$28,000	10	0.149	$4,173
	$0	0	0.000	$0
Right-of-Way	$0	0	0.000	$0
TOTALS	$28,000	10	0.149	$4,173

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $200
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $150

TOTAL ANNUAL COST= $4,523
TOTAL COST OF PROJECT= $28,000

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	4.00	1	0.25	11	2.75	25	6.25	$239,375
AFTER	4.00	0	0.00	6	1.50	25	6.25	$56,875

Annual Benefits from Crash Cost Savings $182,500

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $177,977

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 40.35

TOTAL COST OF PROJECT - $28,000 COMPREHENSIVE B/C RATIO - 40.35

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: Lake Wheeler at I-40 EB Ramps BY: JBS
COUNTY: Wake DATE: 7/7/2011
FILE NO.: SS 05-05-015 SB Left Turn-Same Roadway Crashes

DETAILED COST: TYPE IMPROVEMENT - Protected-Permitted Phasing

ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	$28,000	10	0.149	$4,173
	$0	0	0.000	$0
Right-of-Way	$0	0	0.000	$0
TOTALS	$28,000	10	0.149	$4,173

ESTIMATED INCREASE IN ANNUAL MAINT. COST = $200
ESTIMATED INCREASE IN ANNUAL UTILITY COST = $150

TOTAL ANNUAL COST= $4,523
TOTAL COST OF PROJECT= $28,000

COMPREHENSIVE COST REDUCTION:

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

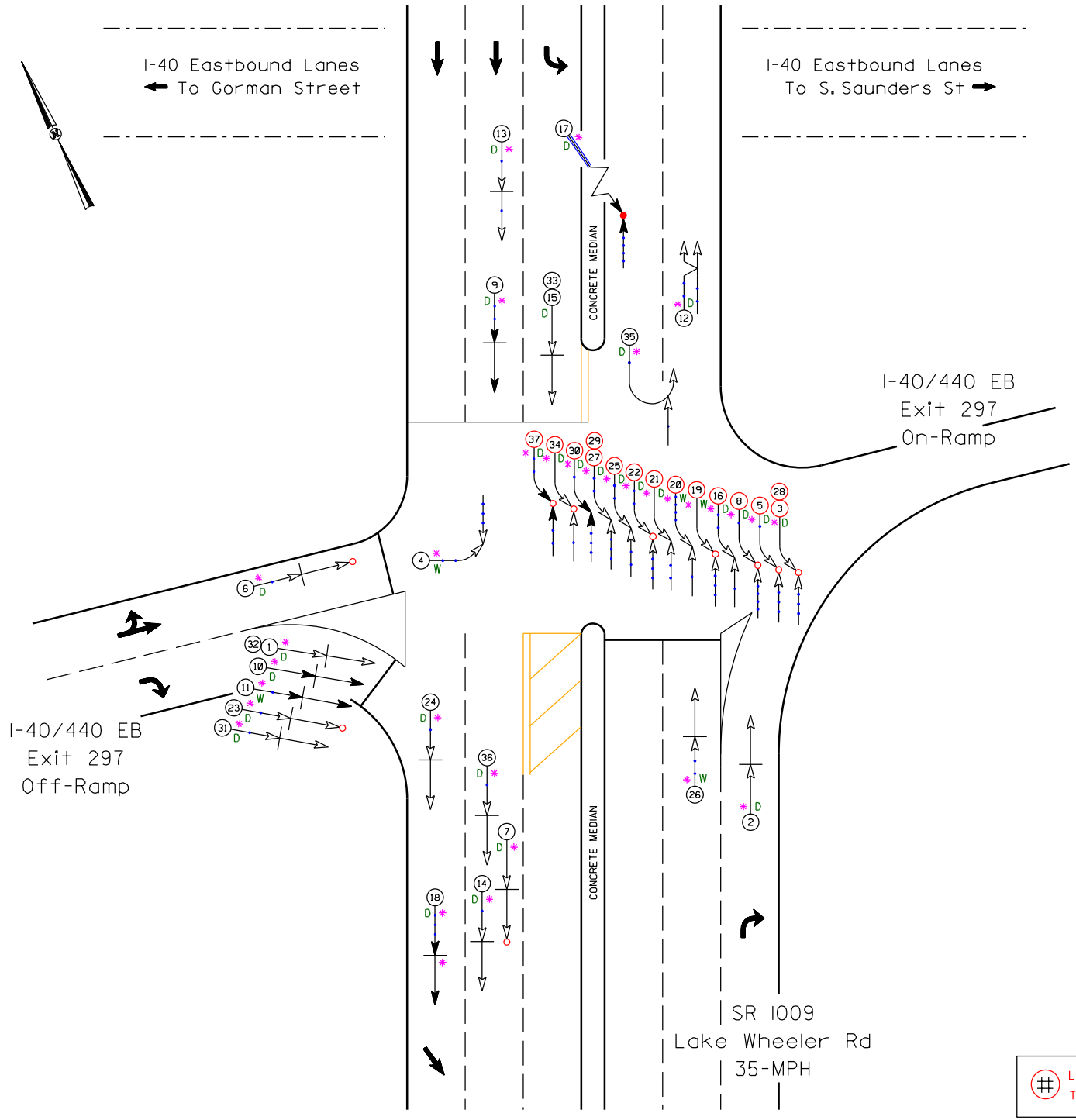
TIME PERIOD	YEARS	K & A CRASHES	K & A CRASHES PER YR	B & C CRASHES	B & C CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	ANNUAL COSTS
BEFORE	4.00	0	0.00	8	2.00	7	1.75	$47,525
AFTER	4.00	0	0.00	2	0.50	6	1.50	$16,450

Annual Benefits from Crash Cost Savings $31,075

NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST = $26,552

BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST = 6.87

TOTAL COST OF PROJECT - $28,000 COMPREHENSIVE B/C RATIO - 6.87



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

P PEDESTRIAN
T TRAIN
* DRIVER AT FAULT
D DRY
W WET
I ICY OR SNOWY
O OILY

SS# 05-05-015
Order# 41000012519
Wake County
BEFORE Period
1/1/03 - 12/31/06

R Y G
Existing
Traffic Signal
Sig ID 05-1575

All Approaches are Permissive

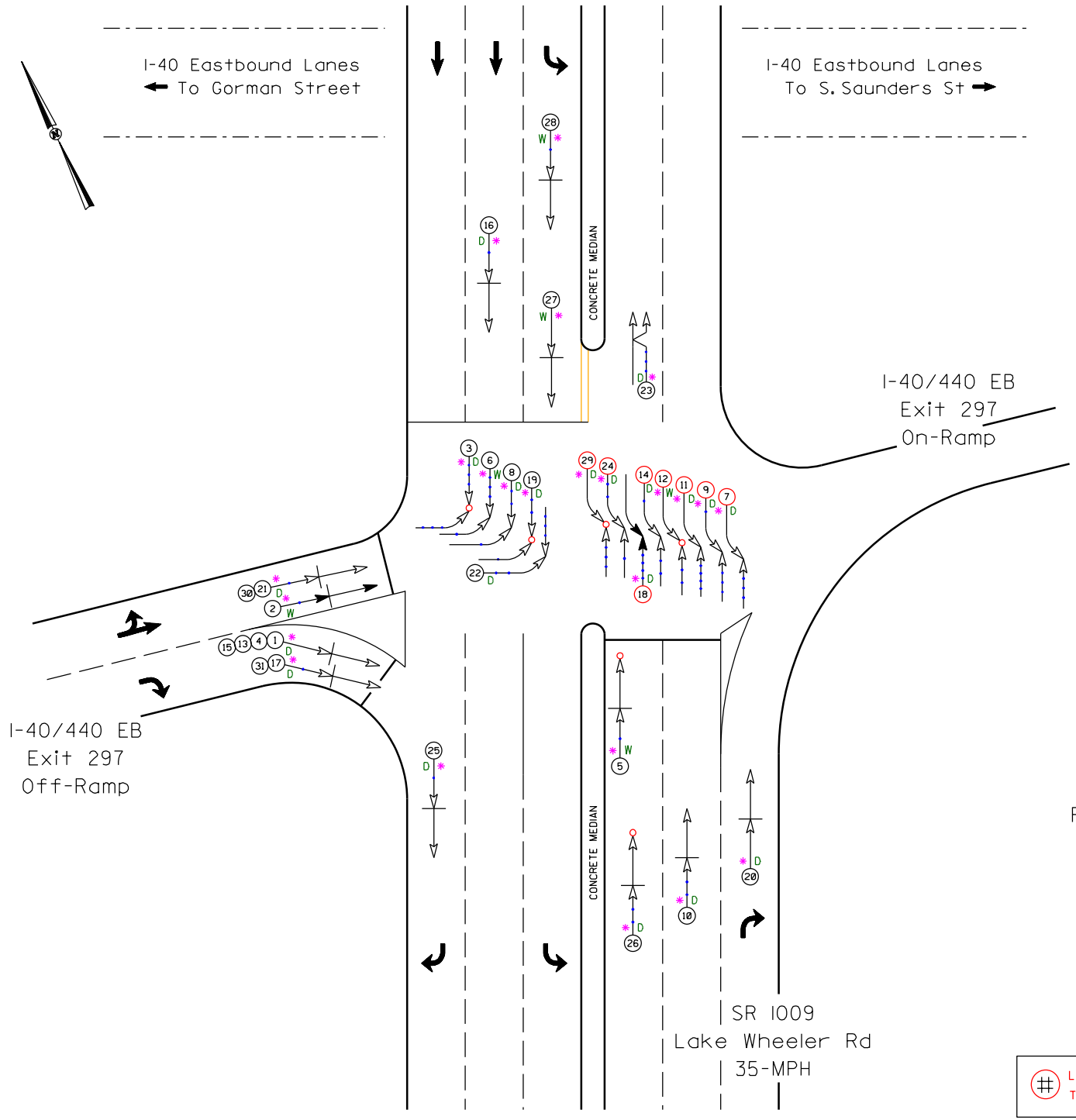
(#) Left Turn; Same Target Crashes

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

TRAFFIC SAFETY UNIT

Date: 7-1-2011

Prepared By: J. Schronce



LEGEND

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P PEDESTRIAN
T TRAIN
* DRIVER AT FAULT
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W WET
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O OILY

SS# 05-05-015
Order# 41000012519
Wake County
AFTER Period
4/1/07 - 3/31/11

R
Y
G

Modified
Traffic Signal
Sig ID 05-1575

SB Left turn onto I-40 EB:
Protected-Permitted Phasing

(#) Left Turn; Same Target Crashes

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

TRAFFIC SAFETY UNIT

Date: 7-5-2011

Prepared By: J. Schronce