

Spot Safety Project Evaluation

Project Log # 200906136

Order # 41000000242

Spot Safety Project # 04-02-221

Spot Safety Project Evaluation of the Right Turn Lane Installation I-40 Eastbound Ramps (Exit 312) at NC 42 Johnston 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

8-25-2009

Date

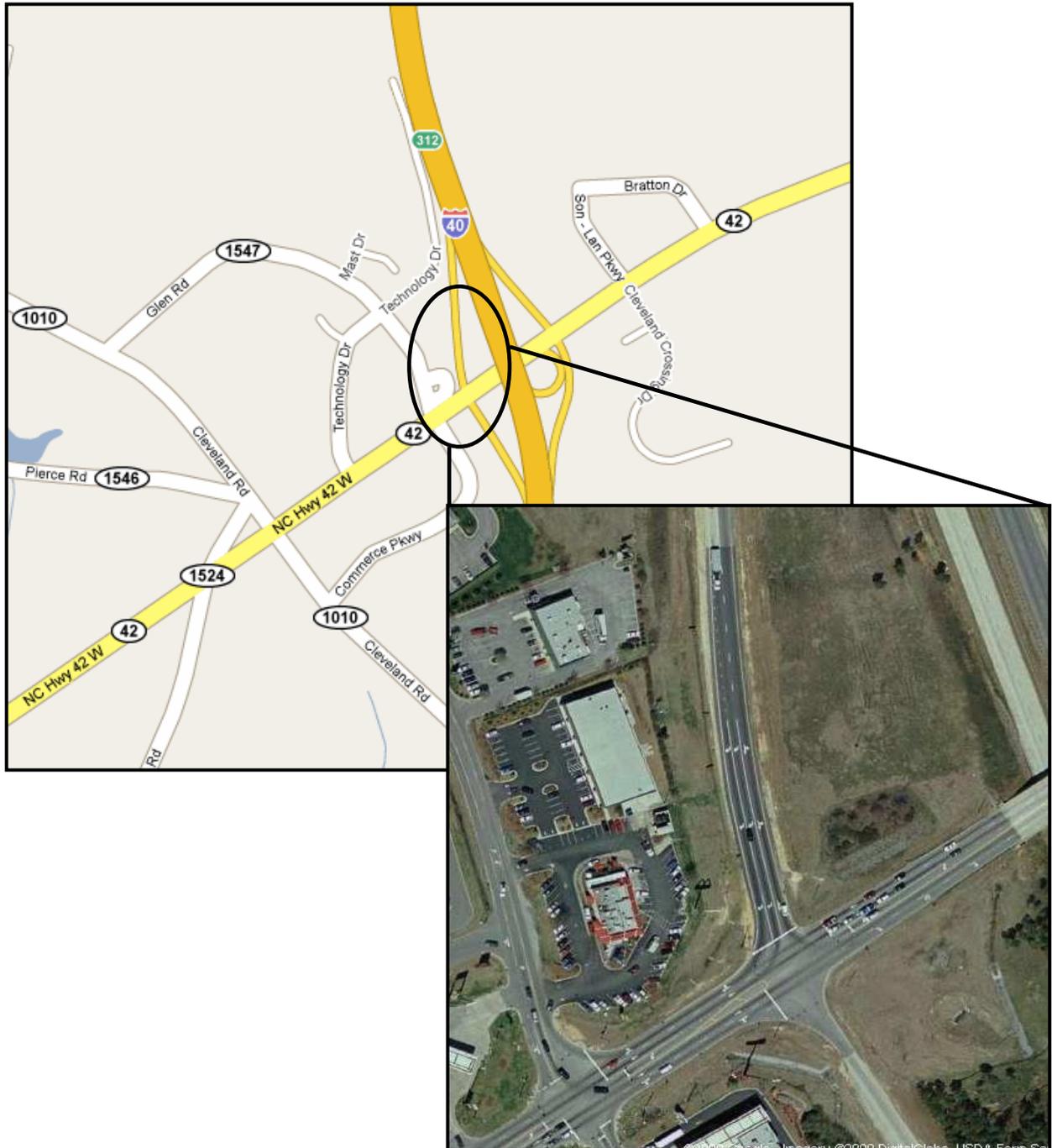
Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 04-02-221 located at the Intersection of I-40 Eastbound Ramp Terminal (Exit 312) and NC 42 in Johnston County, west of the City of Clayton.

The Sig ID is 04-1064 for the existing traffic signal at this location.



Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the widening of the eastbound exit ramp for an additional right turn lane. The existing before period Exit 312 off-ramp consisted of a two lane approach to NC 42 that extended approximately half the ramp length. NC 42 is a four-lane facility with an additional westbound left turn lane for access to the I-40 eastbound entrance ramp. The intersection was already protected by a traffic signal.

The original statement of problem was that afternoon peak traffic queues on this ramp routinely stack beyond the gore area and back up onto the right through lane of Interstate 40. The intended purpose of this project was to add capacity to the off-ramp and remove the I-40 traffic queue.

There was no initial crash analysis completed at this location since this project was proposed around a congestion issue. The final completion date for the improvement at the subject intersection was on October 14, 2003 with a total cost of \$200,000.

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 October through December 2003. The before period consisted of reported crashes from May 1, 1998 through September 30, 2003 (5 years and 5 months); and the after period consisted of reported crashes from January 1, 2004 through May 31, 2009 (5 years and 5 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 on NC 42 and 0.1 on the I-40 Off-Ramp from NC 42. *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 Rear-End Crashes on the Off-Ramp were the target crashes for the applied countermeasure.

<u>Treatment Information</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Total crashes	79	79	0.0 %
Total Severity Index	4.96	3.44	- 30.6 %
Target Crashes	50	28	- 44.0 %
Target Crash Severity Index	4.40	3.11	- 29.3 %
Volume	21,900	26,600	21.5 %

<u>Injury Crash Summary</u>	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal injury Crashes	0	0	N/A
Class A injury Crashes	1	0	- 100.0%
Class B injury Crashes	2	6	200.0 %
Class C Injury Crashes	30	20	- 33.3 %
Total Injury Crashes	33	26	- 21.2 %

The naive before and after analysis at the treatment location resulted in no change of Total Crashes, but a 44 percent decrease in Target Crashes and a 31 percent decrease in the Total Severity Index. The before period ADT year was 2000 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 no change of Total Crashes and an 44 percent decrease in Target Crashes. The summary results above demonstrate that both Target Crashes and Crash Severity appear to have decreased at the treatment location from the before to the after period.

The target crashes for this evaluation were selected as ramp rear-end collisions due to the capacity issues on this approach. Referencing the *Collision Diagrams* it appears that rear-end collisions have decreased significantly, especially for right turning motorists (47 to 19 crashes), with the addition of the extra ramp turn lane. The Safety Evaluation Group could not complete a full capacity analysis for this location due to the lack of before period data collection.

Overall, the intersection experienced the same number of collisions from the before to the after period but the traffic volume did increase by over 20 percent. Intersection frontal impact collisions increased slightly from eleven (11) in the before period to thirteen (13) in the after period.

The calculated benefit to cost ratio for this project is **5.16 considering total crashes**. The benefit to cost ratio **considering only target crashes is 2.64**. 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 by Google Street-View 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.

TREATMENT SITE PHOTOS



Looking South on I-40 Exit 312 Eastbound Off-Ramp – Start of New Lane



Looking South on I-40 Exit 312 Eastbound Off-Ramp – at Intersection



Looking East on NC 42 at Eastbound Ramp Intersection



Looking West on NC 42 at Eastbound Ramp Intersection

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

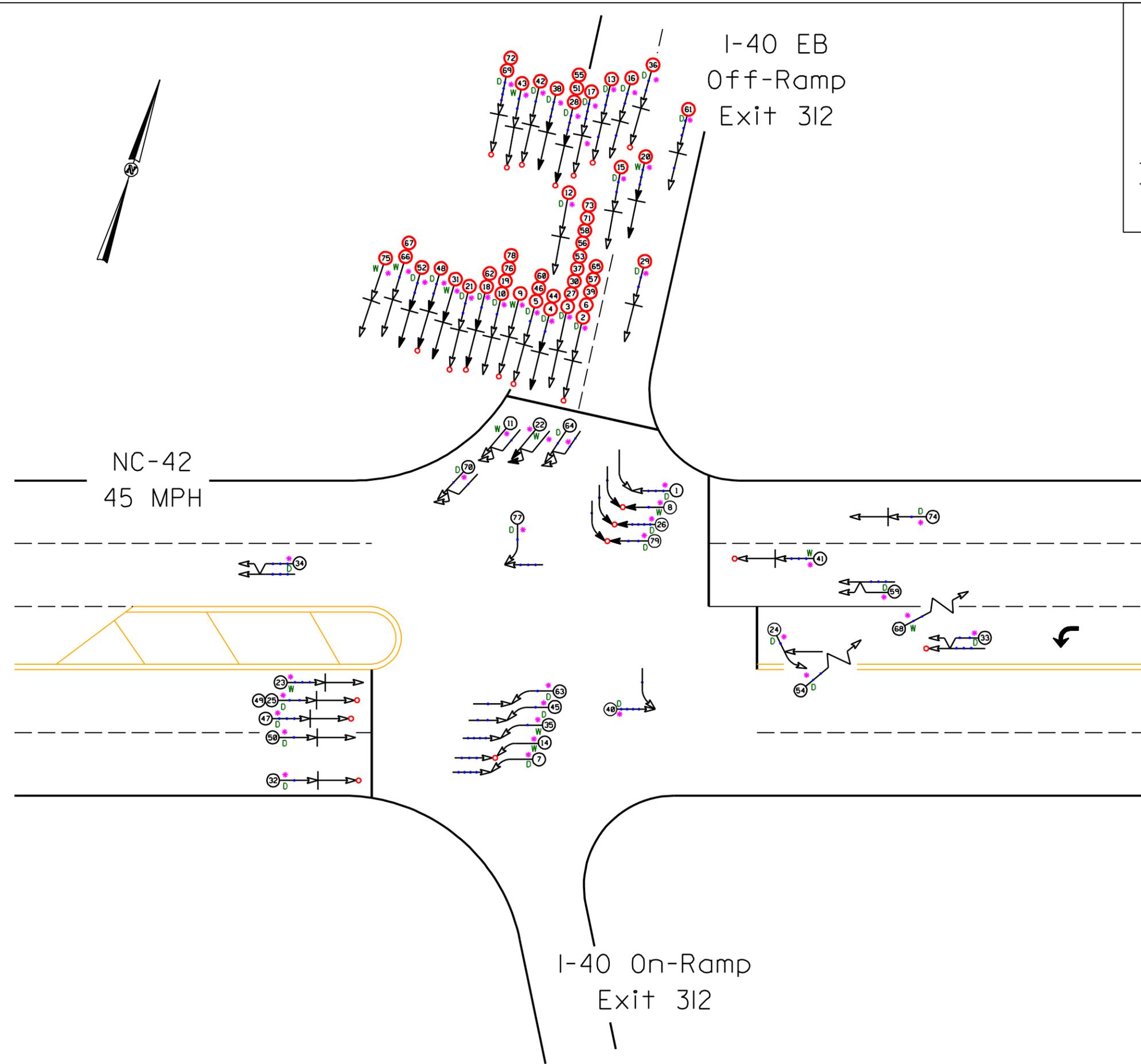
LOCATION: NC 42 at I-40 EB Ramps Exit 312		BY: JBS						
COUNTY: Johnston		DATE: 8/19/2009						
FILE NO.: SS 04-02-221		NOTES: Total Crashes						
DETAILED COST:	TYPE IMPROVEMENT - Widen Ramp for Additional Right Turn Lane							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$200,000	20	0.102	\$20,370			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$200,000	20	0.102	\$20,370			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$400			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$20,770			
	TOTAL COST OF PROJECT=				\$200,000			
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	5.42	1	0.18	32	5.90	46	8.49	\$231,624
AFTER	5.42	0	0.00	26	4.80	53	9.78	\$124,483
						Annual Benefits from Crash Cost Savings		\$107,140
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$86,370		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	5.16		
TOTAL COST OF PROJECT		-	\$200,000	COMPREHENSIVE B/C RATIO		-	5.16	

BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: NC 42 at I-40 EB Ramps (Exit 312)		BY: JBS						
COUNTY: Johnston		DATE: 8/19/2009						
FILE NO.: SS 04-02-221		NOTES: Target Crashes - Ramp Rear-Ends						
DETAILED COST:	TYPE IMPROVEMENT - Widen Ramp for Additional Right Turn Lane							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$200,000	20	0.102	\$20,370			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$200,000	20	0.102	\$20,370			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$400			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$20,770			
	TOTAL COST OF PROJECT=				\$200,000			
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	5.42	0	0.00	23	4.24	27	4.98	\$95,812
AFTER	5.42	0	0.00	8	1.48	20	3.69	\$40,959
						Annual Benefits from Crash Cost Savings		\$54,852
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$34,082		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	2.64		
TOTAL COST OF PROJECT		-	\$200,000	COMPREHENSIVE B/C RATIO		-	2.64	



I-40 EB
Off-Ramp
Exit 312



NC-42
45 MPH

I-40 On-Ramp
Exit 312

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# 04-02-221
Johnston County
BEFORE Period
5/1/98 - 9/30/03



Existing
Traffic Signal
Sig ID 04-1064



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 4	AREA:
	STUDY PERIOD: 5/1/1998 - 9/30/2003	
	DISTANCE: Y-LINE = 150/500FT	
ANALYSIS PREPARED BY: JBS		
ANALYSIS CHECKED BY: BR		
DIAGRAM PREPARED BY: JBS		
DIAGRAM REVIEWED BY: ST		
SCALE: NOT TO SCALE		
DATE: 8-17-2009		
LOG NUMBER: SS# 04-02-221 BEFORE		

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



I-40 EB
Off-Ramp
Exit 312

LEGEND

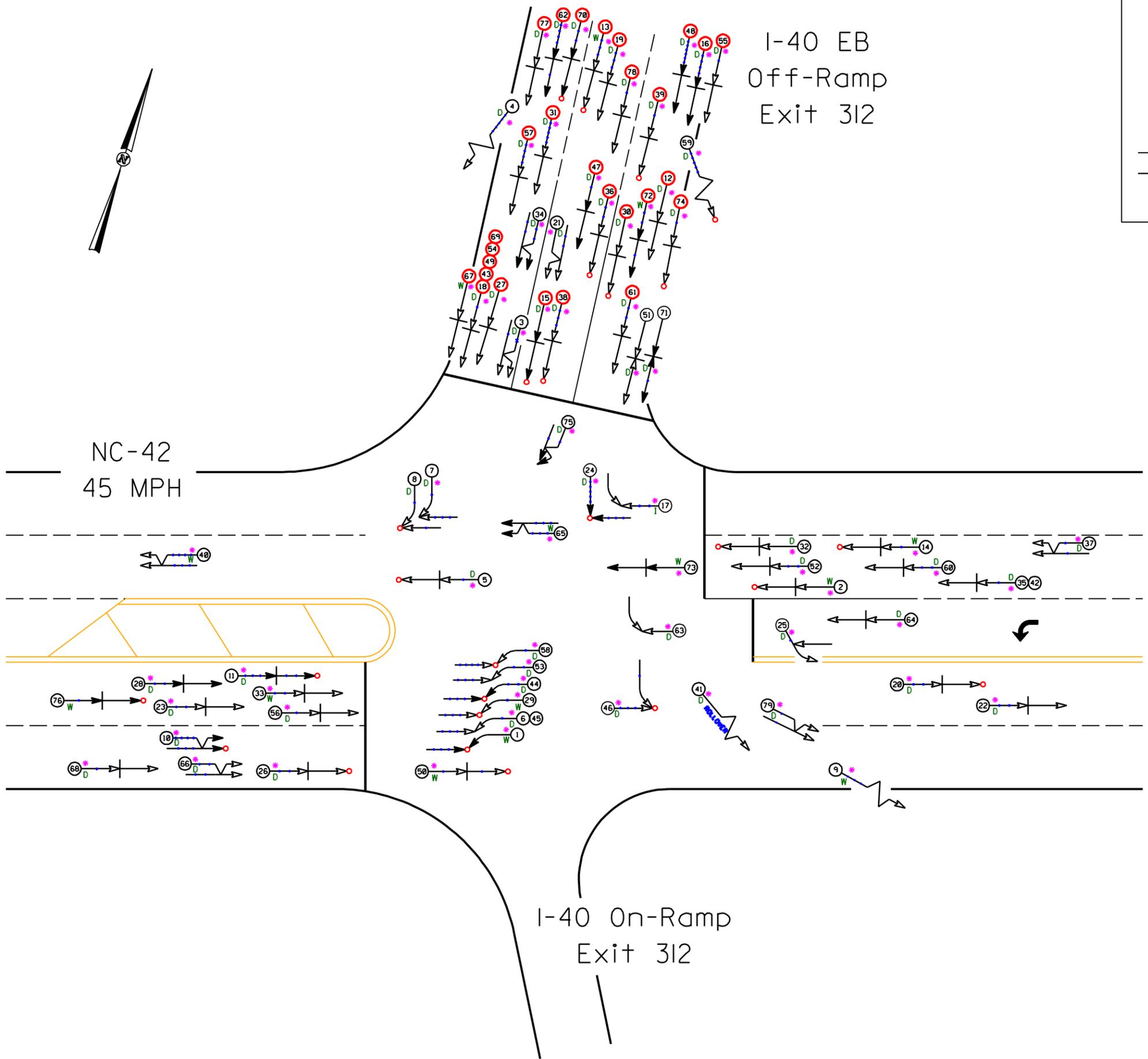
	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PARKED VEHICLE		BACKING		20 MPH TO 29		DRIVER AT FAULT
	PARKING VEHICLE		SIDESWIPE		30 MPH TO 39		DRY
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		WET
	HEAD ON		INJURY		50 MPH TO 59		ICY OR SNOWY
	REAR END		FATALITY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

SS# 04-02-221
Johnston County
AFTER Period
1/1/04 - 5/31/09



Existing
Traffic Signal
Sig ID 04-1064

NC-42
45 MPH



I-40 On-Ramp
Exit 312



TRAFFIC SAFETY SYSTEMS MANAGEMENT UNIT

	COLLISION DIAGRAM	
	DIVISION: 4	AREA:
	STUDY PERIOD: 1/1/2004 - 5/31/2009	
	DISTANCE: Y-LINE : 150/500FT	
	ANALYSIS PREPARED BY: JBS	
	ANALYSIS CHECKED BY: BR	
	DIAGRAM PREPARED BY: JBS	
	DIAGRAM REVIEWED BY: ST	
	SCALE: NOT TO SCALE	
	DATE: 8-18-2009	
	LOG NUMBER: SS* 04-02-221AFTER	

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