

Spot Safety Project Evaluation

Order # 41000007099

Spot Safety Project # 05-03-212

**Spot Safety Project Evaluation of the Monolithic Island Installation
On the South Leg at the Intersection of US 401 (Main Street)
and SR 1301 (Purfoy Road / Sunset Lake Road)
City of Fuquay Varina, In Wake County**

Documents Prepared By:

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

Principal Investigator



Chad J. Neilson

9-22-2010

Date

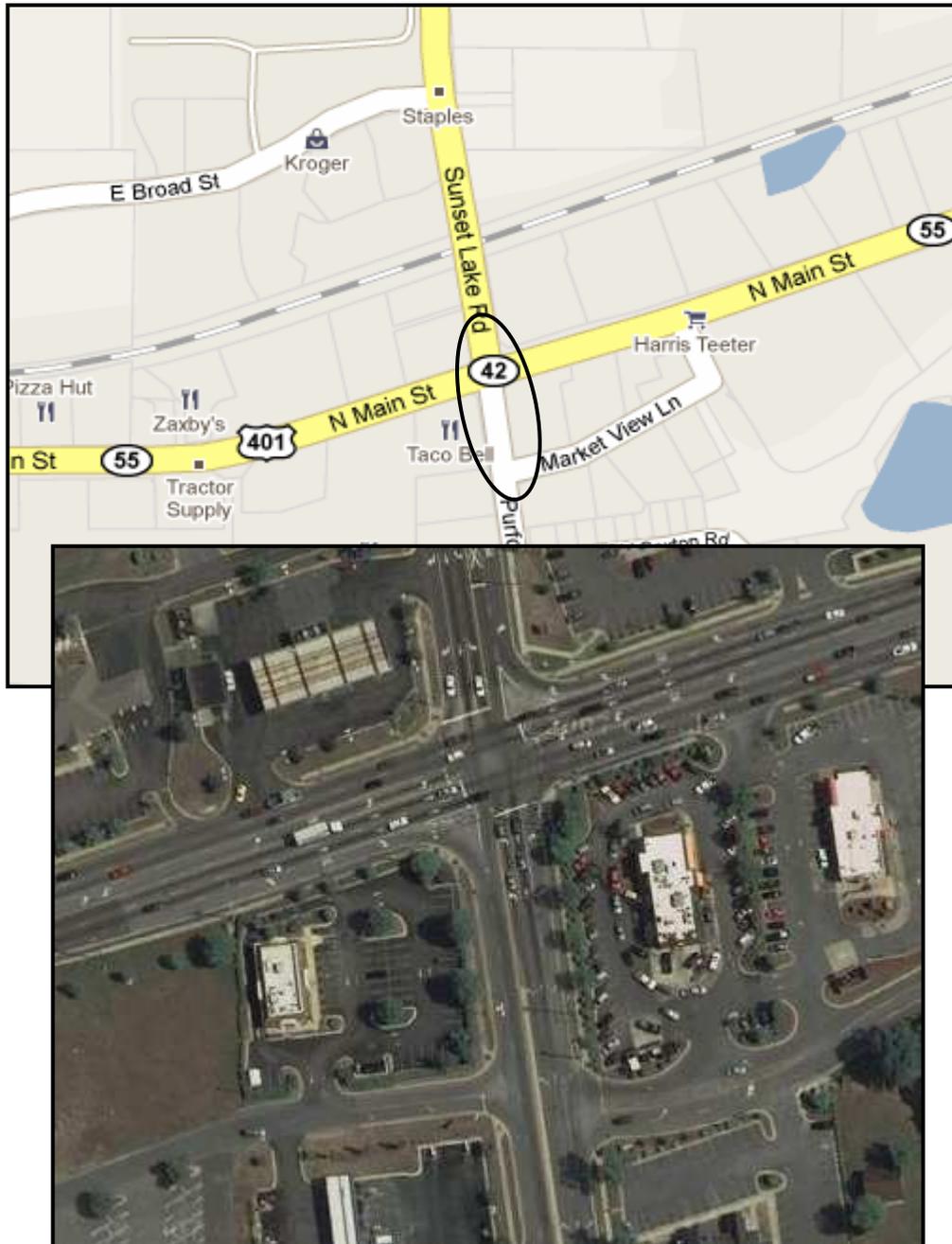
Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 05-03-212 located at the intersection of US 401 (Main Street) and SR 1301 (Purfoy Road / Sunset Lake Road) in the city of Fuquay Varina, in Wake County.

The Signal ID for this intersection is 05-0935.



Project Information and Background from the Project File Folder

The spot safety project improvement countermeasure chosen for the subject location was the installation of a monolithic island on the south leg and updated signal phasing at US 401 (Main Street) and SR 1301 (Purfoy Road / Sunset Lake Road). The signal phasing changes from this spot safety project included northbound and southbound protected left-turn phases. Independently of this spot safety project, there was a change made to alter the mainline left turn phasing to protected only. US 401 (Main Street) is a five-lane facility with a center two-way-left-turn-lane and has a speed limit of 45 mph. SR 1301 (Purfoy Road / Sunset Lake Road) is a four-lane facility with designated turn lanes at US 401 (Main Street) and a speed limit of 45 mph. For the purpose of this study the intersections will be referred to as the following:

- Location 1 - SR 1301 (Purfoy Road) and Market View Lane / Sunset Plaza Shopping Center
- Location 2 - US 401 / NC 42 / NC 55 (Main Street) and SR 1301 (Purfoy Road / Sunset Lake Road).

The original statement of problem was the concern for crashes due to insufficient gaps along SR 1301 (Purfoy Road) for vehicles attempting to enter the roadway at Location 1. The intended purpose of the new monolithic island is to prevent vehicles from turning left into and out of Market View Lane and the Sunset Plaza Shopping Center and prevent eastbound and westbound through movements.

The initial crash analysis was completed from December 1, 1999 to November 30, 2002 with fifty-six (56) reported crashes, eight (8) of which were deemed correctable. The final completion date for the improvement at the subject intersection was on April 25, 2005 with a total cost of \$74,600.00.

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 were the months of April 2005 and May 2005. The before period consisted of reported crashes from April 1, 2000 through March 31, 2005 (5 years); and the after period consisted of reported crashes from June 1, 2005 through May 31, 2010 (5 years). The ending date for this analysis was determined by the date of available crash data at the time of analysis.

The treatment data consists of crashes that occurred on SR 1301 (Purfoy Road) where the monolithic island was installed, at Location 1. The data also consisted of all crashes within 150 feet of Location 2. *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 locations. Please note that Frontal Impact Crashes were the target crashes for the applied countermeasure at Location 1. The Frontal Impact Crash types considered are as follows: Left turn, same roadway; Left turn, different roadways; Head on; and Angle. At location 2, Left turn, same roadway; and Left turn, different roadways for the northbound and southbound movements are considered as target crashes.

Treatment Information		Before	After	Percent Reduction (-) Percent Increase (+)
Total Crashes		123	176	43.09 %
Total Crash Severity Index		3.54	1.97	- 44.35 %
Location 1	Total Crashes	24	26	8.33 %
	Target Crashes	19	2	- 89.47 %
	Target Crash Severity Index	2.17	4.70	116.59 %
	Volume (2002, 2007)	13,000	13,000	0.00 %
Location 2	Total Crashes	99	150	51.52 %
	Target Crashes	7	14	100.00 %
	Target Crash Severity Index	5.23	1.00	- 81.88 %
	Volume (2002, 2007)	31,900	35,000	9.72 %

The naive before and after analysis at the treatment location resulted in a forty-three (43) percent increase in Total Crashes and a forty-four (44) percent decrease in the Total Severity Index. At Location 1, Target Crashes were reduced by eighty-nine (89) percent. At Location 2, Target Crashes were increased by one – hundred (100) percent. The before period ADT year was 2002 and the after period ADT year was 2007.

Location 1 Injury Crash Summary	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal Injury Crashes	0	0	N/A
Class A Injury Crashes	0	0	N/A
Class B Injury Crashes	0	1	N/A
Class C Injury Crashes	3	1	- 66.67 %
Total Injury Crashes	3	2	- 33.33 %

The total number of injury crashes at Location 1 was reduced by thirty-three (33) percent.

Location 2 Injury Crash Summary	Before	After	Percent Reduction (-) Percent Increase (+)
Fatal Injury Crashes	0	0	N/A
Class A Injury Crashes	1	0	N/A
Class B Injury Crashes	8	2	- 75.00 %
Class C Injury Crashes	21	19	- 9.52 %
Total Injury Crashes	30	21	- 30.00 %

The total number of injury crashes at Location 2 was reduced by thirty (30) percent.

Results and Discussion

Referencing the *Collision Diagrams*, the before period angle crash pattern at Location 1 consisted of eleven (11) collisions, and the left-turn crash pattern consisted of eight (8) collisions. After the monolithic island installation, the angle crash pattern was completely eliminated and the left-turn crash pattern was reduced to two (2) collisions. There were two crash patterns that occurred in the after period at Location 1. A right-turn, same roadway pattern accounts for fourteen (14) crashes and there were 6 (six) U-turn collisions at the ends of the monolithic island.

The before period left-turn crash pattern (northbound and southbound movements combined) at Location 2 consisted of seven (7) target crashes. After the signal phasing was altered, the left-turn crash pattern increased to fourteen (14) target crashes.

The following table illustrates the crash patterns that either significantly increased or decreased at both Location 1 and Location 2.

	Crash Pattern	Type	Before	After	Percent Reduction (-) Percent Increase (+)
Location 1	Market View Lane WB Approach	Right turn	1	12	1100.00 %
	U-turn (ends of monolithic island)	U-turn	N/A	6	N/A
Location 2	US 401 WB Approach	Rear-end	11	25	127.27 %
	SR 1301 SB Approach	Rear-end	3	14	366.67 %
	US 401 EB Approach	Rear-end	3	14	366.67 %
	SR 1301 NB Approach	Rear-end	2	13	550.00 %
	US 401 WB (west of study intersection)	Rear-end	0	17	N/A
	US 401 WB Approach	Left turn, same road	11	0	N/A
	US 401 EB Approach	Left turn, same road	16	1	- 93.75 %

The before period left turn, same roadway crash pattern that existed for both mainline approaches at Location 2 was reduced to one (1) crash in the after period. All approaches at Location 2 had significant increases in rear end crashes. There is a newly developed crash pattern in the after period which involves rear end crashes occurring on westbound US 401 (Main Street) west of Location 2.

The calculated benefit to cost ratio for this project is **11.15 considering total crashes**. The benefit to cost ratio **considering only target crashes is 2.20**. The benefits are calculated using the change in annual crash costs from the before to the after period. It should be noted, there is one Type A Injury crash in the before period that occurred at Location 2 that affects the total crash benefit to cost ratio. 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 all four approaches to the treatment intersection and monolithic island. 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
US 401 (Main Street) at SR 1301 (Purfoy Road / Sunset Lake Road)



Looking South on SR 1301(Sunset Lake Road)



Looking West on US 401 (Main Street)



Looking North on SR 1301 (Purfoy Road)



Looking East on US 401 (Main Street)

TREATMENT SITE PHOTOS
SR 1301 (Purfoy Road) - Monolithic Island



Looking South on SR 1301(Purfoy Road)



Looking West on SR 1301 (Purfoy Road) turned towards Market View Lane

BENEFIT-COST ANALYSIS WORKSHEET - TOTAL CRASHES

LOCATION: US 401 (MAIN ST.) at SR 1301 (PURFOY RD / SUNSET LAKE RD)		BY: C Neilson						
COUNTY: Wake		DATE: 8/9/2010						
FILE NO.: SS 05-03-212								
DETAILED COST:	TYPE IMPROVEMENT - Monolithic Island							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$74,600	15	0.117	\$8,715			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$74,600	15	0.117	\$8,715			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$800			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$9,515			
	TOTAL COST OF PROJECT=				\$74,600			
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	5.00	1	0.20	32	6.40	90	18.00	\$331,400
AFTER	5.00	0	0.00	23	4.60	155	31.00	\$225,300
							Annual Benefits from Crash Cost Savings	\$106,100
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$96,585		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	11.15		
TOTAL COST OF PROJECT		-	\$74,600	COMPREHENSIVE B/C RATIO		-	11.15	

BENEFIT-COST ANALYSIS WORKSHEET - TARGET CRASHES

LOCATION: US 401 (MAIN ST.) at SR 1301 (PURFOY RD / SUNSET LAKE RD)		BY: C Neilson						
COUNTY: Wake		DATE: 8/9/2010						
FILE NO.: SS 05-03-212								
DETAILED COST:	TYPE IMPROVEMENT - Monolithic Island							
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$74,600	15	0.117	\$8,715			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$74,600	15	0.117	\$8,715			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$800			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$9,515			
	TOTAL COST OF PROJECT=				\$74,600			
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	5.00	0	0.00	3	0.60	16	3.20	\$25,760
AFTER	5.00	0	0.00	1	0.20	1	0.20	\$4,860
							Annual Benefits from Crash Cost Savings	\$20,900
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	\$11,385		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	2.20		
TOTAL COST OF PROJECT		-	\$74,600	COMPREHENSIVE B/C RATIO		-	2.20	

GAS STATION

SR 1301 (SUNSET LAKE ROAD)

WALGREENS

US 401 / NC 42 / NC 55 (MAIN ST)

US 401 / NC 42 / NC 55 (MAIN ST)

TACO BELL

BOJANGLES'

SS# 05-03-212
Order# 41000007099
Wake County
BEFORE Period
4/01/00 - 3/31/05

SUNSET PLAZA SHOPPING CENTER

MARKET VIEW LANE

SR 1301
(PURFOY ROAD)

Location 1
Target Crashes
Location 2
Target Crashes

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		O OILY
	RAN OFF ROAD				70 AND UP		
					SPEED UNKNOWN		

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

TRAFFIC SAFETY UNIT

Date: 8-9-2010

Prepared By: C Neilson

GAS STATION

WALGREENS

US 401 / NC 42 / NC 55 (MAIN ST)

45 MPH

45 MPH

US 401 / NC 42 / NC 55 (MAIN ST)

BOJANGLES'

TACO BELL

SR 1301 (PURFOY ROAD)

SS# 05-03-212
Order# 41000007099
Wake County
AFTER Period
6/01/05 - 5/31/10

SUNSET PLAZA SHOPPING CENTER

MARKET VIEW LANE

45 MPH

SR 1301 (PURFOY ROAD)

LEGEND

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

 Location 1
Target Crashes

 Location 2
Target Crashes

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