

Spot Safety Project Evaluation

Order # 41000006283

Spot Safety Project # 10-02-207

**Spot Safety Project Evaluation of the
Installation of a Traffic Signal and SR 1394 Left Turn Lanes
SR 1394 (Poplar Tent Road) at SR 1449 (Harris Road)
Cabarrus 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

8-25-2010

Date

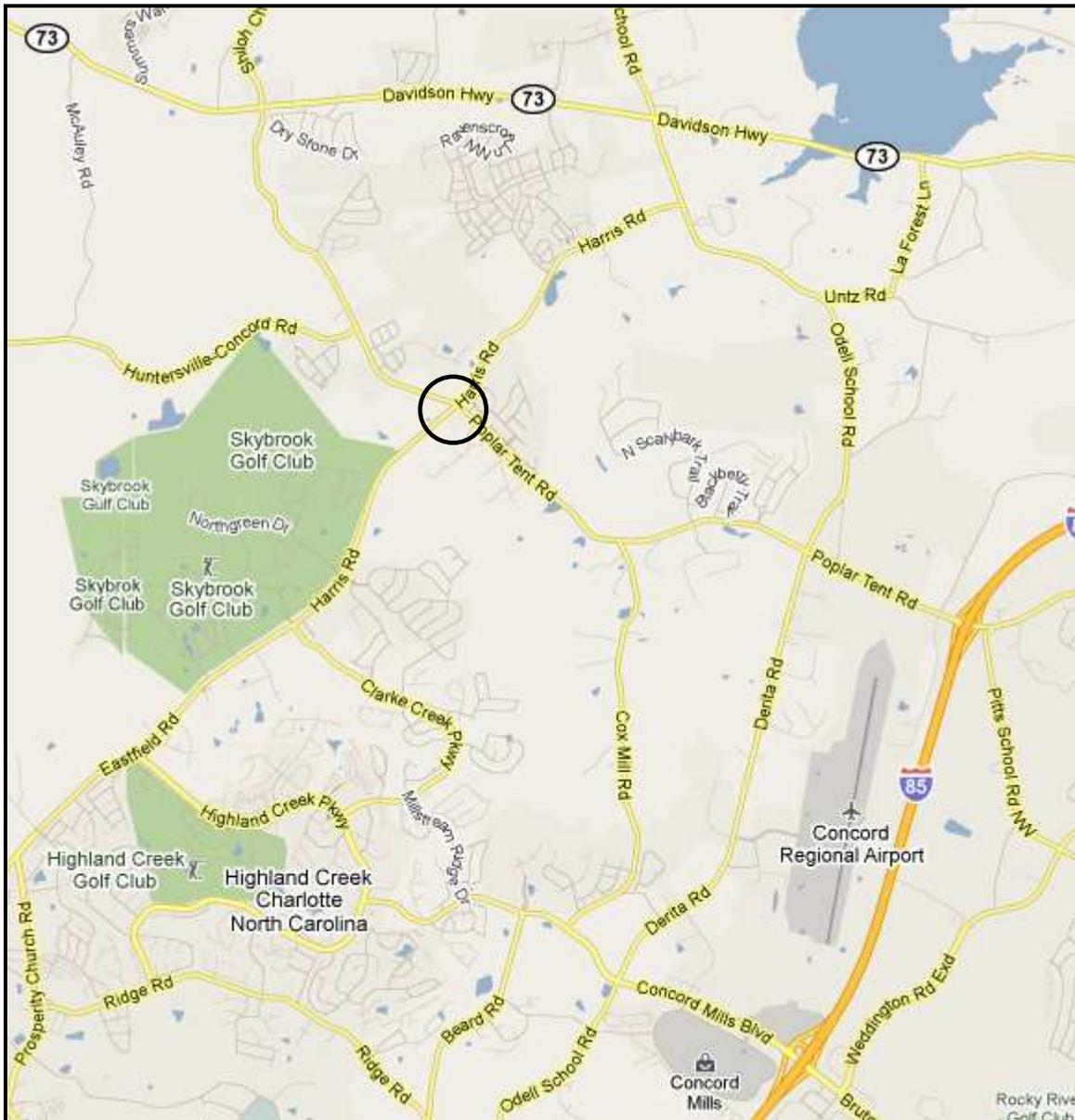
Traffic Safety Project Engineer

Spot Safety Project Evaluation Documentation

Subject Location

Evaluation of Spot Safety Project Number 10-02-207 located at the Intersection of SR 1394 (Poplar Tent Road) and SR 1449 (Harris Road) in Cabarrus County, near the City of Concord.

The Sig ID is 10-1854 for this newly installed traffic signal.





Aerial Showing After-1 Period Design: New Signal with SR 1394 Left Turn Lanes



Aerial Showing After-2 Period Design: SR 1449 Left Turn Lanes and Two Right Turn Lanes

Project Information and Background from the Project File Folder

The spot safety project improvement countermeasures chosen for the subject location were the installation of an intersection traffic signal and widening for left turn lanes on both SR 1394 (Poplar Tent Road) approaches. SR 1394 and SR 1449 (Harris Road) are both two-lane facilities at the subject intersection with speed limits of 45 mph on all approaches. The subject location is a four-leg crossroads intersection, which was controlled by a stop condition on SR 1449 in the before period.

This intersection was additionally expanded by the developer of the northeast quadrant shopping center in the calendar year of 2007. The improvements included SR 1449 (Harris Road) left turn lanes and right turn lanes for the northbound and westbound intersection approaches. The traffic signal was also upgraded to match the roadway geometrics.

The original statement of problem explained that horizontal and vertical alignments were leading to sight distance limitations; therefore resulting in angle and rear-end collisions. Also, due to volume increase, this location was experiencing congestion and delay. The countermeasures were intended to alleviate the current crash patterns.

The initial crash analysis was completed from November 1, 1998 to November 1, 2001 with eighteen (18) reported crashes, fourteen (14) of which were deemed correctable. The final completion date, determined from crash data, for the improvements at the subject intersection was approximately mid-year 2004 with a total cost of \$220,000.

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 May through September 2004 (Signal) and April through October 2007 (additional turn lanes). The analysis was divided into the following time frames:

Before Period:	May 1, 1999 to April 30, 2004	(5 Years)
After 1 Period (Signal):	October 1, 2004 to March 31, 2007	(2 Years, 6 Months)
After 2 Period (Turn Lanes):	November 1, 2007 to June 30, 2010	(2 Years, 8 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. *Please see attached location map, aerial maps, and photos for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment location shown in crashes per year form. Please note that Frontal Impact Crashes were the Target Crash 1 (Signal) 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; Angle; and Ran-off Roadway (avoidance). Also, SR 1394 (Poplar Tent Road) Rear-End Crashes and Ran-off Roadway (avoidance) were selected as the Target Crash 2 (Left Turn Lanes) for this evaluation.

<u>Treatment Information</u>	Before 5.0 Yrs	After 1 2.50 Yrs	After 2 2.67 Yrs
Total Crashes	46	14	14
Total Severity Index	3.57	4.17	4.17
Total Crashes per Year	9.20	5.60	5.24
Volume (2001, 2005, 2009)	11,500	18,100	21,800

<u>Target Crash Information</u>	Before 5.0 Yrs	After 1 2.50 Yrs	After 2 2.67 Yrs
Target Crash 1: Frontal (Signal)	24	3	6
Target Crash 1 Severity Index	4.70	3.47	5.93
Target 1 Crashes per Year	4.80	1.20	2.25
Target Crash 2: SR 1394 Rear-End (Lefts)	10	4	4
Target Crash 2 Severity Index	1.74	6.55	2.85
Target 2 Crashes per Year	2.00	1.60	1.50

<u>Injury Crash Summary</u>	Before 5.0 Yrs	After 1 2.50 Yrs	After 2 2.67 Yrs
Fatal injury Crashes	0	0	0
Class A injury Crashes	0	0	0
Class B injury Crashes	2	0	2
Class C Injury Crashes	14	6	4
Total Injury Crashes	16	6	6
Injury Crashes per Yr	3.20	2.40	2.25

The naive before and after analysis at the treatment location resulted in a 39 percent decrease in Total Crashes per year from the Before Period to the After-1 Period. The before period ADT year was 2001 and the after period ADT years were 2005 and 2009.

Results and Discussion

Referencing the *Collision Diagrams*, the before period presented a strong pattern of frontal impact crashes including thirteen (13) angle, one (1) avoidance of an angle collision, three (3) left turn different roadway, one (1) right turn, and six (6) left turn same road. These frontal impact crashes resulted in 4.80 crashes per year. After the signal installation, this pattern reduced to 1.20 crashes per year with two (2) left turn same road and one (1) right turn crash in the After-1 Period. The signal installation appears to have successfully assigned intersection right-of-way and eliminated the sight distance issues.

Along with the signal, left turn lanes were installed on the SR 1394 approaches. There were seven (7) rear-end crashes while vehicles were waiting to turn left onto Harris Road and three (3) avoidance collisions in the before period; resulting in 2.0 crashes per year. In the After-1 Period,

SR 1394 rear-end crashes reduced to 1.60 crashes per year with all four (4) collisions occurring in the through movement lane.

The After-2 Period does indicate a slight increase in frontal impact collisions to 2.25 crashes per year. There were two (2) red-light run crashes and three (3) left turn same road collisions during this period. The frontal impact severity index nearly doubled during this period as well. However, overall crashes per year were still slightly reduced from 5.60 in the After-1 Period to 5.24 in the After-2 Period.

The calculated benefit to cost ratio for this project is **0.76 considering total crashes**. The benefit to cost ratio **considering only target crashes is 0.90**. The benefits are calculated using the change in annual crash costs from the Before Period to the After-1 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 from Google Street View for all four 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 / Southwest on SR 1449 (Harris Rd)



Looking North / Northeast on SR 1449 (Harris Rd)



Traveling East on SR 1394 (Poplar Tent Road)



Traveling West / Northwest on SR 1394 (Poplar Tent)

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: SR 1394 at SR 1449		BY: JBS						
COUNTY: Cabarrus		DATE: 8/24/2010						
FILE NO.: SS 10-02-207								
DETAILED COST:	TYPE IMPROVEMENT - New Signal & 2 SR 1394 Left Turn Lanes							
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
Construction	\$220,000	10	0.149	\$32,786				
Right-of-Way	\$0	0	0.000	\$0				
TOTALS	\$220,000	10	0.149	\$32,786				
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$3,000				
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900				
TOTAL ANNUAL COST=				\$36,686				
TOTAL COST OF PROJECT=				\$220,000				
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	5.00	0	0.00	16	3.20	30	6.00	\$89,800
AFTER	2.50	0	0.00	6	2.40	8	3.20	\$61,760
Annual Benefits from Crash Cost Savings								\$28,040
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	(\$8,646)		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	0.76		
TOTAL COST OF PROJECT		-	\$220,000	COMPREHENSIVE B/C RATIO		-	0.76	

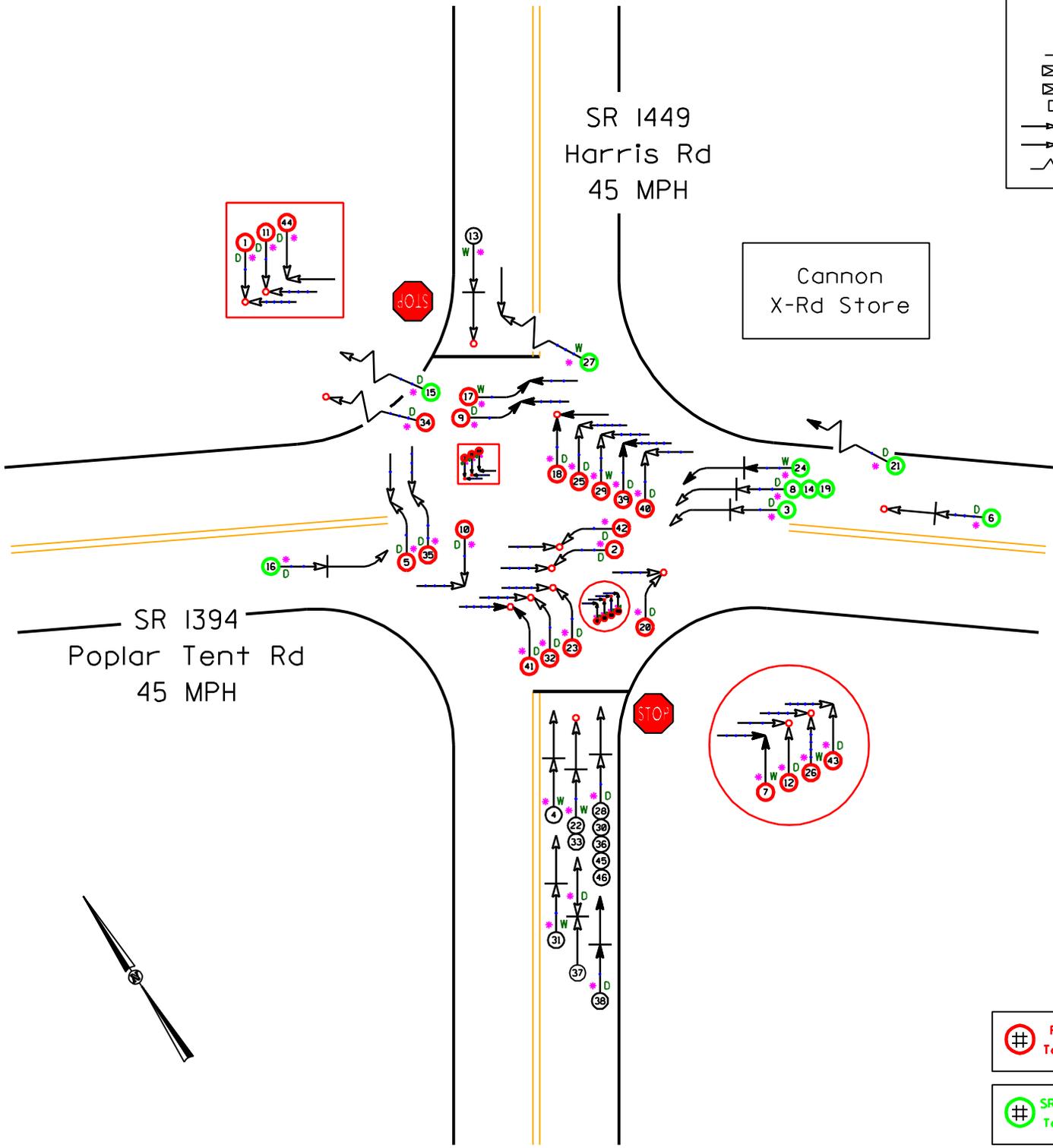
BENEFIT-COST ANALYSIS WORKSHEET - Combined Target Crashes

LOCATION: SR 1394 at SR 1449		BY: JBS						
COUNTY: Cabarrus		DATE: 8/24/2010						
FILE NO.: SS 10-02-207								
DETAILED COST:	TYPE IMPROVEMENT - New Signal & 2 SR 1394 Left Turn Lanes							
ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST				
Construction	\$220,000	10	0.149	\$32,786				
Right-of-Way	\$0	0	0.000	\$0				
TOTALS	\$220,000	10	0.149	\$32,786				
ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$3,000				
ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$900				
TOTAL ANNUAL COST=				\$36,686				
TOTAL COST OF PROJECT=				\$220,000				
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	5.00	0	0.00	13	2.60	21	4.20	\$70,060
AFTER	2.50	0	0.00	4	1.60	3	1.20	\$37,160
Annual Benefits from Crash Cost Savings								\$32,900
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST					=	(\$3,786)		
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST					=	0.90		
TOTAL COST OF PROJECT		-	\$220,000	COMPREHENSIVE B/C RATIO		-	0.90	

LEGEND

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

SS# 10-02-207
 Order# 41000006283
 Cabarus County
 BEFORE Period
 5/1/99 - 4/30/04
 5.0 Years

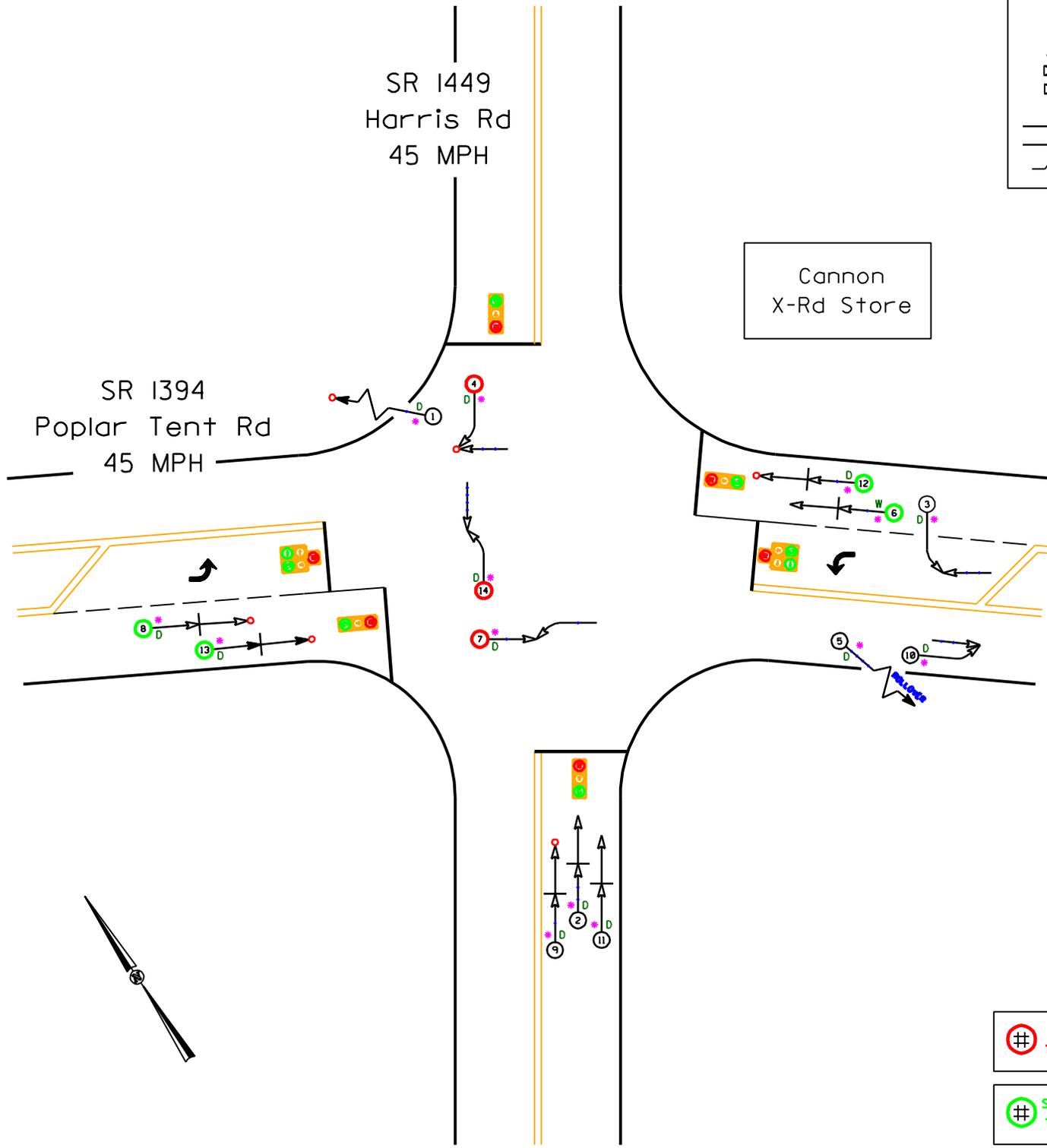


- Frontal Impact Target Crashes
- SR 1394 Rear-End Target Crashes

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DIVISION of HIGHWAYS
TRANSPORTATION MOBILITY and SAFETY DIVISION

TRAFFIC SAFETY UNIT

Date: 8-23-2010 Prepared By: J. Schronce



LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PAKED VEHICLE		TURNING		10 MPH TO 19		TRAIN
	PARKING VEHICLE		BACKING		20 MPH TO 29		DRIVER AT FAULT
	FIXED OBJECT		SIDESWIPE		30 MPH TO 39		D DRY
	HEAD ON		OUT OF CONTROL		40 MPH TO 49		W WET
	REAR END		HURT		50 MPH TO 59		I ICY OR SNOW
	RAN OFF ROAD		FATALITY		60 MPH TO 69		1 TO AND UP
			SPEED UNKNOWN		70 AND UP		O ONLY

SS# 10-02-207
 Order# 41000006283
 Cabarus County
 AFTER I Period
 10/1/04 - 3/31/07
 2.50 Years



New Signalized
 Intersection
 Sig ID 10-1854

- Frontal Impact Target Crashes
- SR 1394 Rear-End Target Crashes

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New Shopping Center

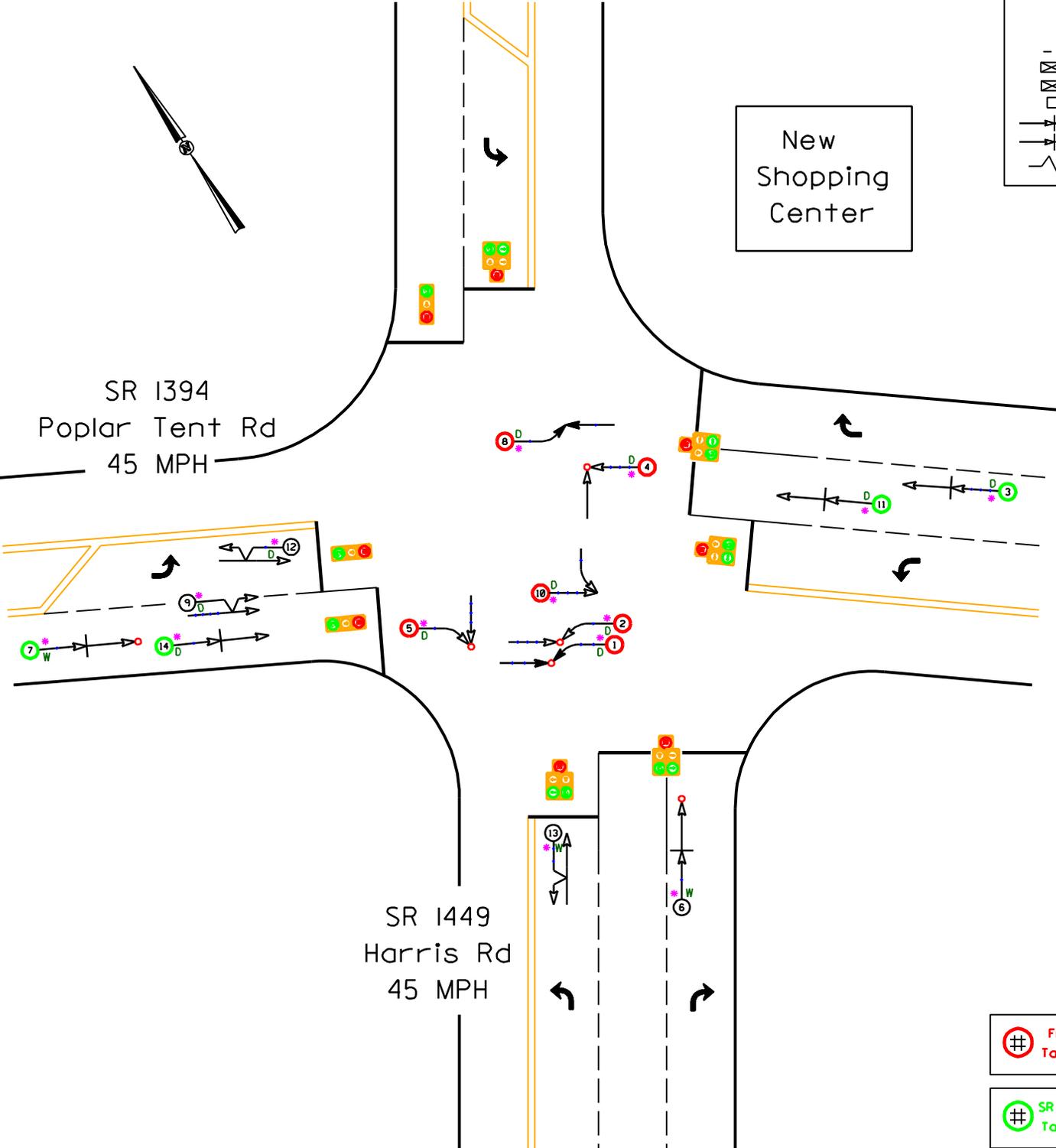
LEGEND

	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PAKED 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 SHOTY
	REAR END		FATALITY		60 MPH TO 69		ICY OR SHOTY
	RAN OFF ROAD		SPEED UNKNOWN		70 AND UP		ONLY

SS# 10-02-207
 Order# 41000006283
 Cabarus County
 AFTER 2 Period
 11/1/07 - 6/30/10
 2.67 Years

SR 1394
 Poplar Tent Rd
 45 MPH

SR 1449
 Harris Rd
 45 MPH



Modified
 Traffic Signal
 Sig ID 10-1854

- Frontal Impact Target Crashes
- SR 1394 Rear-End Target Crashes

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TRANSPORTATION MOBILITY and SAFETY DIVISION

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