

Hazard Elimination Project Evaluation

Order # 41000019039

Hazard Elimination Project W-4805

**Evaluation of the Paved Shoulders Installation through 16 Curves
SR 1112 (Sunset Harbor Road) – Entire Route
Brunswick County**

Documents Prepared By:

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

Principal Investigator



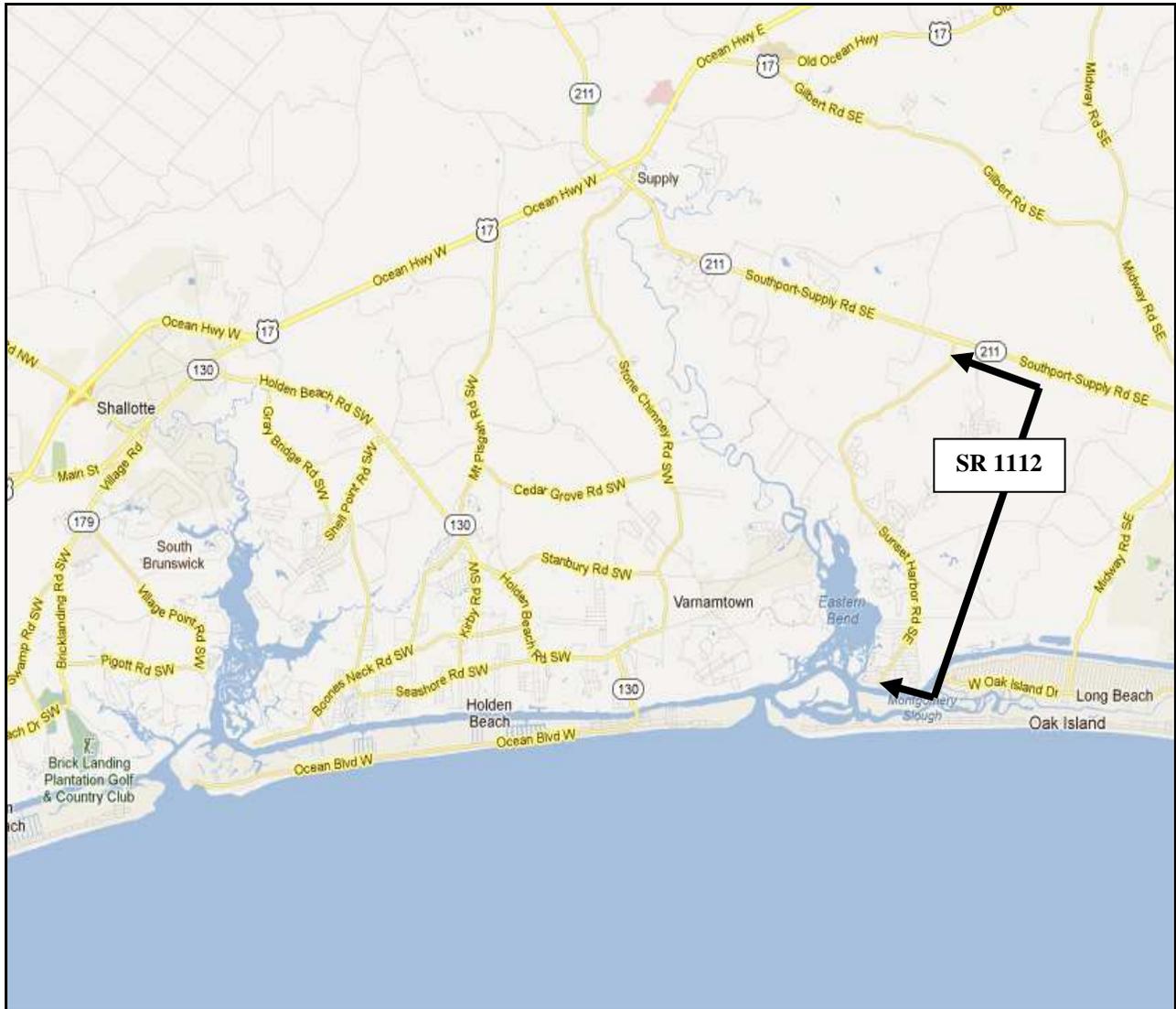
Jason B. Schronce
Traffic Safety Project Engineer

6-11-2012
Date

Hazard Elimination Project Evaluation Documentation

Subject Location

Evaluation of Hazard Elimination Project W-4805 located along the segment of SR 1112 (Sunset Harbor Road) from SR 1113 to NC 211 in Brunswick County. The entire route consists of sixteen (16) horizontal curves which were all improved. The sixteen curves have a combined total surface distance of 1.8 miles out of the 5.92 mile SR 1112 roadway.



Project Information and Background from the Project File Folder

The hazard elimination project improvements chosen for the subject location were the paving of two-foot shoulders throughout the sixteen (16) horizontal curves on SR 1112 (Sunset Harbor Road) on both sides of the roadway.

SR 1112 is a two-lane roadway with a winding horizontal alignment that provides access to the Sunset Harbor Community near Oak Island in rural Brunswick County. The roadway extends from NC 211 to Lockwood Folly Road with a speed limit of 55-mph. The route of SR 1112 consists of approximately thirty (30) intersections, multiple private residential driveways, and one bridge.

The project background information simply stated that this segment was experiencing a significant pattern of lane departure collisions caused by severe rutting along the pavement edges in the curves. The countermeasure was aimed at giving motorists more travel lane flexibility and additional paved recovery space in order to increase safety.

The initial crash analysis was completed from July 31, 2000 to July 31, 2003 with 30 total reported crashes and 10 deemed correctible lane departure collisions. The improvement was completed on May 2, 2008 with a total cost of \$200,000. The projected B/C Ratio was 14.00.

Naive Before and After Analysis

After reviewing the 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 from March through May 2008. The before period consisted of reported crashes from June 1, 2004 through February 29, 2008 (3 years, 9 months); and the after period consisted of reported crashes from June 1, 2008 through February 29, 2012 (3 years, 9 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 along SR 1112 with a zero (0) foot y-line from 150 feet north of SR 1113 (Lockwood Folly Road) to 150 feet south of NC 211. The study was from milepost 0.028 to 5.892 with a total length of 5.864 miles. *Please see attached location map for further details.*

The following data table depicts the Naive Before and After Analysis for the treatment segment. Please note that Lane Departure Crashes were the target crashes for the applied countermeasure. The Lane Departure Crash types considered are as follows: Ran-Off Road (Right, Left, Straight), Fixed Object, Overturn/Rollover, Sideswipe (Opposite Direction), and Head-On. Each Lane Departure target crash was verified by the crash report for this evaluation.

<u>Treatment Information</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	57	52	- 8.8 %
Total Severity Index	5.61	4.17	- 25.7 %
Lane Departure Crashes - Straight & Curve	33	22	- 33.3 %
All Lane Departure Severity Index	8.51	4.70	- 44.8 %
Lane Departure Crashes – Involving Curve	25	16	- 36.0 %
Curve Lane Departure Severity Index	10.32	4.24	- 58.9 %

The naive before and after analysis at the treatment location resulted in a 9 percent reduction in the Total Crashes, a 33 percent decrease in Lane Departure Target Crashes, and a 26 percent decrease in the Total Severity Index. The before period ADT year was 2006 and the after period ADT year was 2010.

SR 1112: MP 0.028 – 5.892	Before	After	Percent Reduction (-)/ Percent Increase (+)
Volume (2006, 2010)	1,900	1,700	- 10.5 %
Total Crash Rate (per 100 Million Miles)	373.70	381.03	2.0 %
Injuries			
Fatal Injury Crashes	1	0	- 100.0 %
Class-A Injury Crashes	1	1	0.0 %
Class-B Injury Crashes	4	3	- 25.0 %
Class-C Injury Crashes	11	9	- 18.2 %
Property Damage Only Crashes	40	39	- 2.5 %
Contributing Factors			
Night Crashes	26	34	30.8 %
Wet Road Crashes	7	7	0.0 %
Alcohol / Drug Related	8	3	- 62.5 %
Animal Crashes	17	23	35.3 %
Lane Departure Crash Types			
Fixed Object	25	17	- 32.0 %
Head On	1	1	0.0 %
Overturn / Rollover	6	3	- 50.0 %
Ran-Off Roadway - Right	0	1	100.0 %
Sideswipe, Opposite Direction	1	0	- 100.0 %

Results and Discussion

Overall, Total Crashes on this roadway segment remained constant through the evaluation periods with only a nine (9) percent reduction. There was however a 33 percent reduction in the lane departure crashes with the complete elimination of severe injury (fatal and A-injury) lane departure crashes in the after period; from one (1) fatal and one (1) A-injury in the before period. The total crashes were consistent because of an increase in Animal related collisions which were up 35 percent in the after period.

From the GIS Plots, lane departure collisions appear to have decreased in every curve except for the final curve near the NC 211 intersection (located near milepost 5.70). Before and After Collision Diagrams are provided for the roadway from milepost 5.52 through 5.82 on SR 1112 (Sunset Harbor Road). Referencing the diagrams, total crashes increased from ten (10) collisions to thirteen (13) crashes through the study over this 0.3 mile breakout segment. Lane Departure Target Crashes increased from six (6) in the before period to eleven (11) in the after period. The after period collisions highlight seven (7) night crashes but only one (1) wet roadway condition crash.



Google Aerial of the Curve approaching NC 211 intersection (Milepost 5.70)

The calculated benefit to cost ratio for the project is **9.17** considering Total Crashes. The benefit to cost ratio considering only Lane Departure Target Crashes is **17.57**. 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 costs when applicable.

As the Safety Evaluation Group completes additional 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 treatment.

BENEFIT-COST ANALYSIS WORKSHEET - Total Crashes

LOCATION: SR 1112 (Sunset Harbor Road)		BY: JBS						
COUNTY: Brunswick		DATE: 4/30/2012						
FILE NO.: W-4805								
DETAILED COST:	TYPE IMPROVEMENT -	Widen Roadway in 16 Curves						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$200,000	20	0.102	\$20,370			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$200,000	20	0.102	\$20,370			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				(\$180)			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$20,190			
	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	3.75	2	0.53	15	4.00	40	10.67	\$461,867
AFTER	3.75	1	0.27	12	3.20	39	10.40	\$276,720
							Annual Benefits from Crash Cost Savings	\$185,147
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$164,956		
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	9.17		
	TOTAL COST OF PROJECT	-	\$200,000		COMPREHENSIVE B/C RATIO	-		9.17

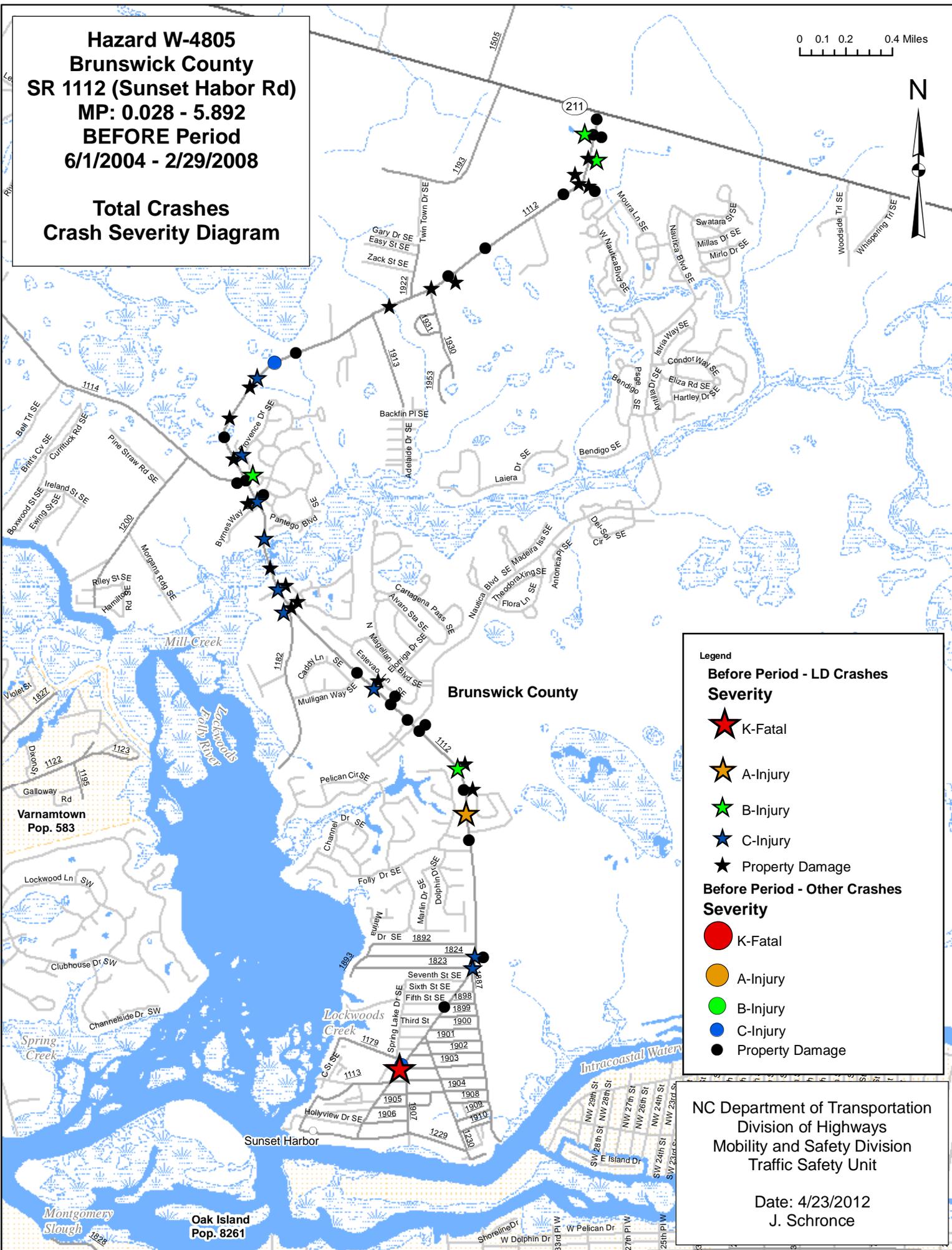
BENEFIT-COST ANALYSIS WORKSHEET - Target Crashes

LOCATION: SR 1112 (Sunset Harbor Road)		BY: JBS						
COUNTY: Brunswick		DATE: 4/30/2012						
FILE NO.: W-4805		Lane Departure Target Crashes						
DETAILED COST:	TYPE IMPROVEMENT -	Widen Roadway in 16 Curves						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$200,000	20	0.102	\$20,370			
		\$0	0	0.000	\$0			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$200,000	20	0.102	\$20,370			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				(\$180)			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$20,190			
	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	3.75	2	0.53	13	3.47	18	4.80	\$425,973
AFTER	3.75	0	0.00	11	2.93	11	2.93	\$71,280
							Annual Benefits from Crash Cost Savings	\$354,693
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$334,503		
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	17.57		
	TOTAL COST OF PROJECT	-	\$200,000		COMPREHENSIVE B/C RATIO	-		17.57

**Hazard W-4805
Brunswick County
SR 1112 (Sunset Harbor Rd)
MP: 0.028 - 5.892
BEFORE Period
6/1/2004 - 2/29/2008**

**Total Crashes
Crash Severity Diagram**

0 0.1 0.2 0.4 Miles



Legend

Before Period - LD Crashes Severity

- ★ K-Fatal
- ★ A-Injury
- ★ B-Injury
- ★ C-Injury
- ★ Property Damage

Before Period - Other Crashes Severity

- K-Fatal
- A-Injury
- B-Injury
- C-Injury
- Property Damage

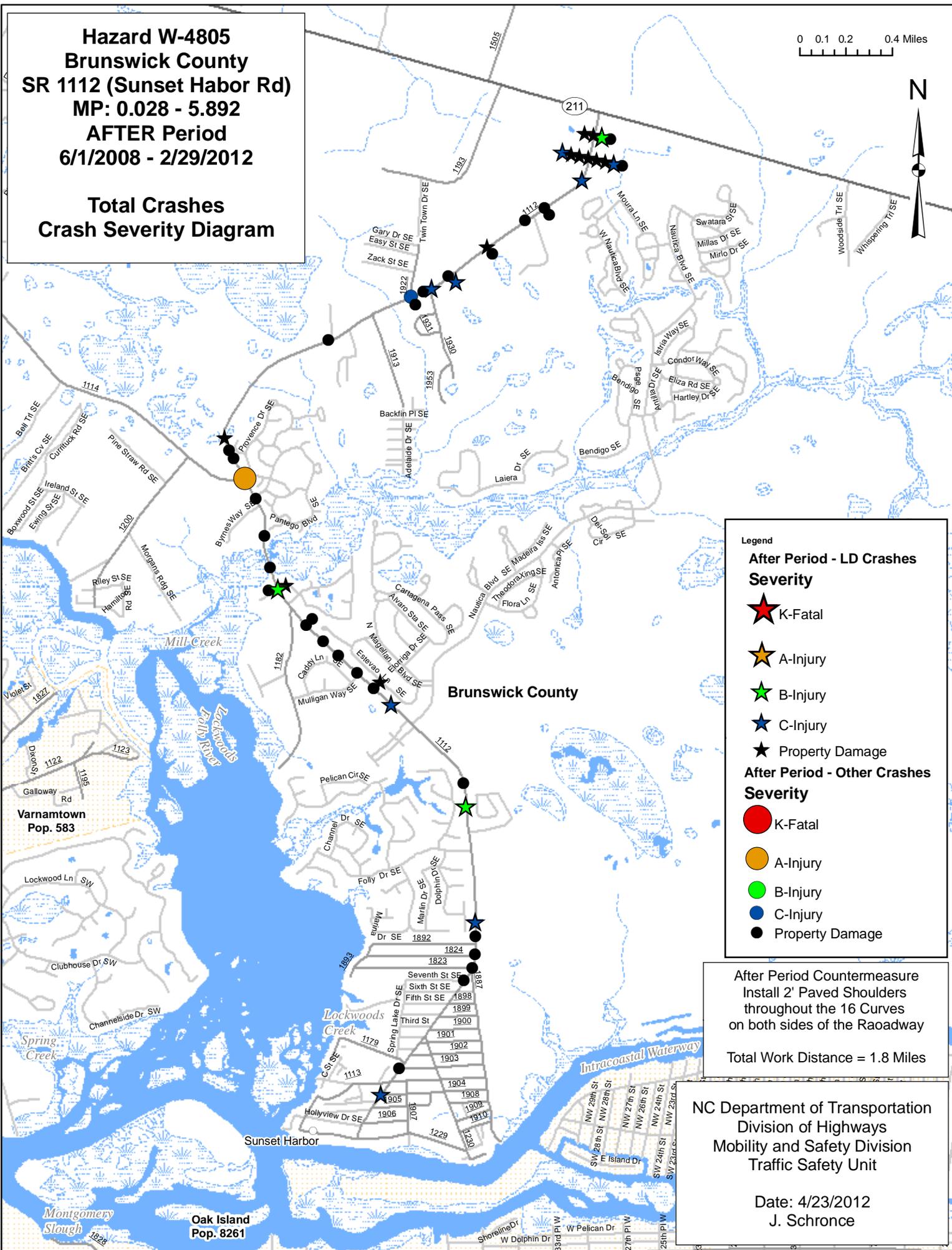
NC Department of Transportation
Division of Highways
Mobility and Safety Division
Traffic Safety Unit

Date: 4/23/2012
J. Schronce

Hazard W-4805
Brunswick County
SR 1112 (Sunset Harbor Rd)
MP: 0.028 - 5.892
AFTER Period
6/1/2008 - 2/29/2012

Total Crashes
Crash Severity Diagram

0 0.1 0.2 0.4 Miles



Legend

After Period - LD Crashes Severity

- ★ K-Fatal
- ★ A-Injury
- ★ B-Injury
- ★ C-Injury
- ★ Property Damage

After Period - Other Crashes Severity

- K-Fatal
- A-Injury
- B-Injury
- C-Injury
- Property Damage

After Period Countermeasure
 Install 2' Paved Shoulders
 throughout the 16 Curves
 on both sides of the Roadway

Total Work Distance = 1.8 Miles

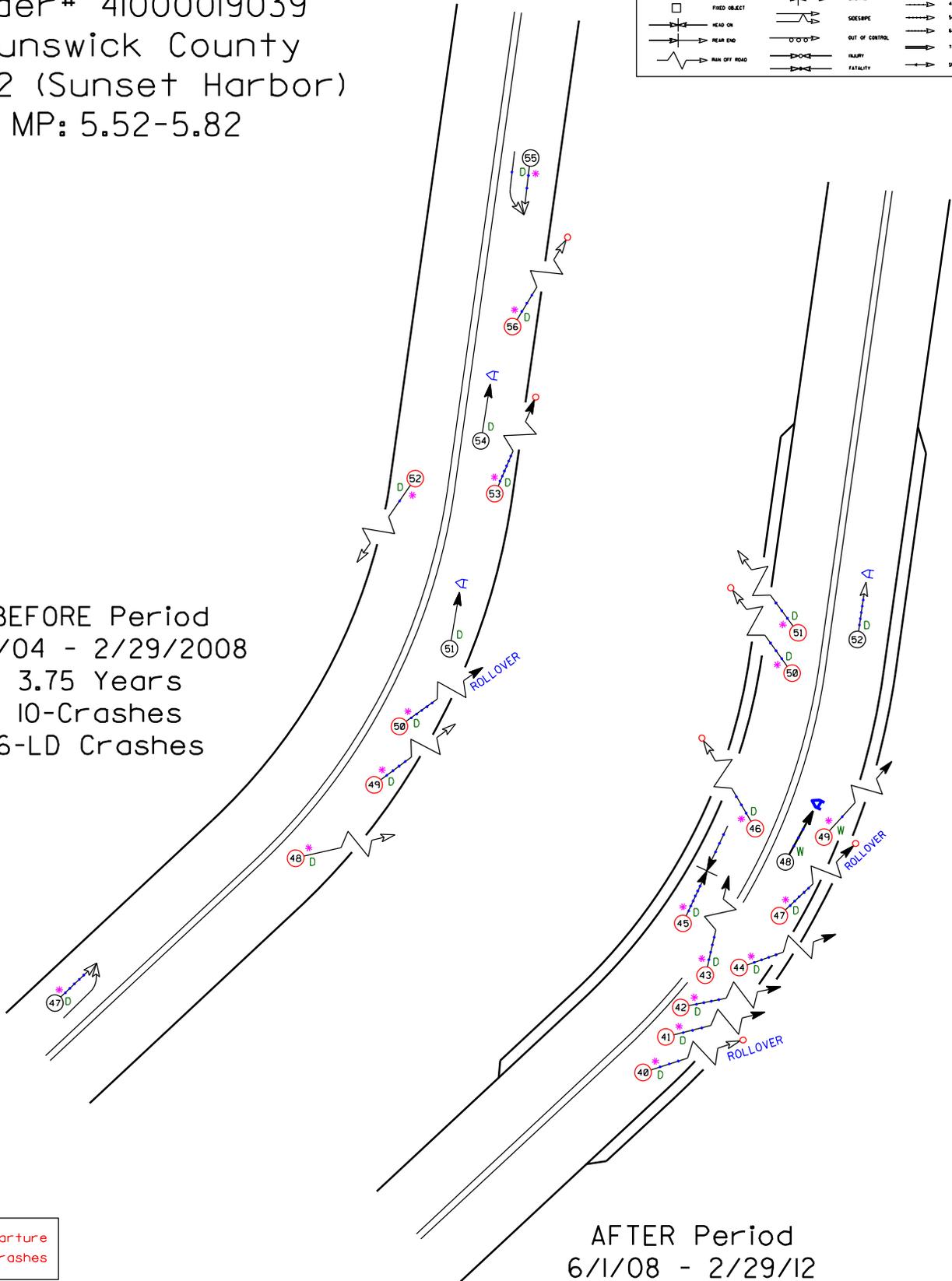
NC Department of Transportation
 Division of Highways
 Mobility and Safety Division
 Traffic Safety Unit

Date: 4/23/2012
 J. Schronce

Hazard W-4805
 Order# 41000019039
 Brunswick County
 SR 1112 (Sunset Harbor)
 MP: 5.52-5.82

LEGEND							
	MOVING VEHICLE		ANGLE		9 MPH OR LESS		PEDESTRIAN
	PEDESTRIAN		TURNING		10 MPH TO 19		TRAIN
	PAIRED VEHICLE		BACKING		20 MPH TO 29		DRIVER AT FAULT
	PAIRED VEHICLE		SIDESWIPE		30 MPH TO 39		DRY
	FIXED OBJECT		OUT OF CONTROL		40 MPH TO 49		WET
	HEAD ON		ROLLOVER		50 MPH TO 59		100 FT OR SHORTER
	REAR END		HIT AND RUN		60 MPH TO 69		SPEED UNKNOWN
	RAN OFF ROAD		FUGITIVE		TO AND UP		FATAL
	RAN OFF ROAD		FATALITY		TO AND UP		ONLY

BEFORE Period
 6/1/04 - 2/29/2008
 3.75 Years
 10-Crashes
 6-LD Crashes



Lane Departure
 Target Crashes

AFTER Period
 6/1/08 - 2/29/12
 3.75 Years
 13-Crashes
 11-LD Crashes

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

TRAFFIC SAFETY UNIT

Date: 4-30-2012

Prepared By: J. Schronce