

Hazard Elimination Project Evaluation

Order # 41000021199

Hazard Elimination Project W-4806

**Evaluation of the Rumble Strip Installation on I-40
From the Johnston County Line to the Duplin County Line
Sampson County**

Documents Prepared By:

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

Principal Investigator



Brad Robinson, PE

1/4/2013

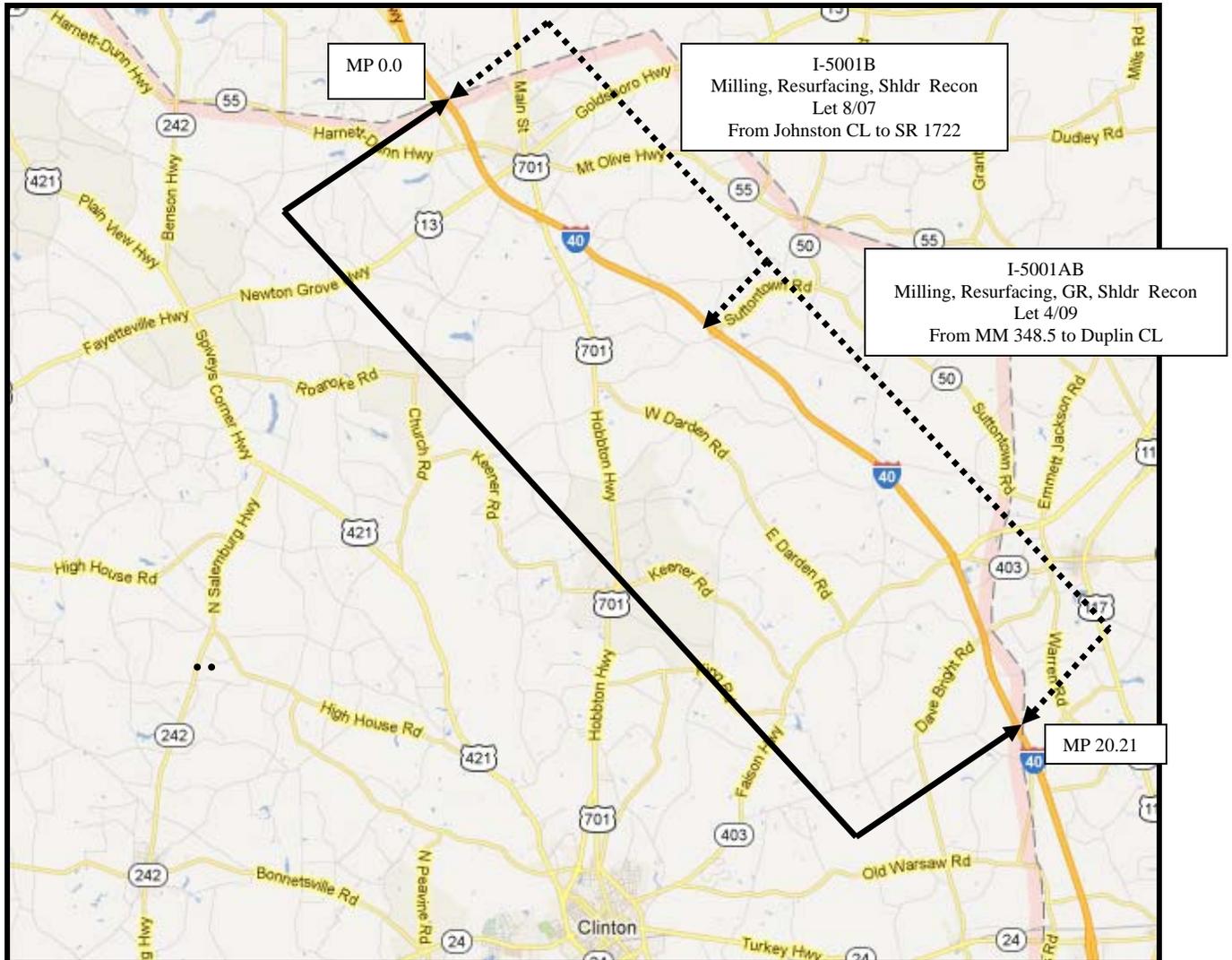
Date

Traffic Safety Project Engineer

Hazard Elimination Project Evaluation Documentation

Subject Location

I-40 in Sampson County from the Johnston County line to the Duplin County, a distance of approximately 20 miles. Two TIP projects were completed on this section of roadway during the analysis period for this evaluation. They are noted in the location map for your reference but are not accounted for in this evaluation.



Project Information and Background from the Project File Folder

The hazard elimination project improvement chosen for the subject location was the installation of rumble strips along both the inside and outside shoulders of I-40.

I-40 is four lane divided facility with full access control. There are 10' paved outside shoulders and 4' paved median shoulders in each direction. The median is protected by cable barrier through the entire county. The intended purpose of the improvement was to alleviate the frequency of run-off-road crashes.

The initial crash analysis was completed from July 31, 2000 to July 31, 2003 with 197 total reported crashes, 124 of which were deemed correctable ran off road crashes. The improvement was completed on April 4, 2008 with a total cost of \$175,000. The projected B/C ratio was 9.72.

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 from March 1, 2008 through April 30, 2008. The before period consisted of reported crashes from January 1, 2004 through February 29, 2008 (4.16 years); and the after period consisted of reported crashes from May 1, 2008 through June, 2012 (4.16 years). The ending date for this analysis was determined by the date of available crash data at the time of analysis. The before period ADT year was 2006 and the after period ADT year was 2010.

The treatment data consisted of all mainline crashes on I-40 from the Johnston County line to the Duplin County line. The analysis was completed with a 0' y-line.

The following data tables depict the Naïve Before and After Analysis for the treatment location. Please note that lane departure crashes were the target crashes for the applied countermeasure. The lane departure crash types on fully controlled access facilities are considered as follows: Angle, Fixed Object, Head-On, Overturn/Rollover, Parked Motor Vehicle, Ran-Off Roadway (Right, Left, and Straight), and Sideswipe (Same and Opposite Direction).

<u>Treatment Information</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Crashes – Both Directions	328	388	18.3
Total Severity Index	4.61	2.90	-37.1
Lane Departure Crashes – Both Directions	220	244	10.9
Lane Departure Severity Index	5.25	3.51	-33.1
Volume (2006, 2010)	18,600	17,800	-4.3
Total Crash Rate (100 Million Vehicle Miles)	57.37	70.86	23.5

<u>I-40 Target Crashes Both Directions</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
Injury Crashes			
Fatal Injury Crashes	2	1	-50.0
Class-A Injury Crashes	4	2	-50.0
Class-B Injury Crashes	21	20	-4.8
Class-C Injury Crashes	44	32	-27.3
Property Damage Only Crashes	149	189	26.8
Contributing Factors			
Night Crashes	87	72	-17.2
Wet Road Crashes	34	83	144.1
Alcohol Related	11	11	0.0
Lane Departure Crash Types			
Angle	3	3	0.0
Fixed Object	174	198	13.8
Head On	1	0	-100.0
Jackknife	0	1	
Overturn / Rollover	15	18	20.0
Parked Motor Vehicle	1	1	0.0
Ran Off Road	11	3	-72.7
Sideswipe, Opposite Direction	0	0	
Sideswipe, Same Direction	15	20	33.3

<u>I-40 Eastbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
EB Total Crashes	190	192	1.1
EB Total Severity Index	4.43	3.06	-30.9
EB Lane Departure Crashes	126	127	0.8
EB Lane Departure Severity Index	4.55	3.71	-18.5

<u>I-40 Westbound Only</u>	Before	After	Percent Reduction (-)/ Percent Increase (+)
WB Total Crashes	138	196	42.0
WB Total Severity Index	4.86	2.75	-43.4
WB Lane Departure Crashes	94	117	24.5
WB Lane Departure Severity Index	6.19	3.29	-46.8

Results and Discussion

Using naïve before and after analysis, Total Crashes have increased by 18 percent and Target Crashes have increased by 11 percent in the subject area. Looking at the crashes by direction,

Target Crashes in the eastbound lanes remained relatively constant while Target Crashes in the westbound lanes experienced a 25 percent increase from the before to the after period. The total severity index decreased by 37 percent and the target crash severity index decreased by 33 percent.

Wet road crashes increased significantly from the before to the after period, with total wet road crashes increasing by 150 percent and wet road target crashes increasing by 144 percent. Maps showing the location of wet road target crashes are attached for both the before and the after periods.

The following table summarizes the weather data for the area during the two time periods. The weather data was obtained from the State Climate Office of North Carolina from the Horticultural Crops Research Station in Clinton, NC.

Weather Data	Before	After	Percent Reduction (-)/ Percent Increase (+)
Total Weather Event Days	411	471	14.6
Total Rainfall (Inches)	146.47	164.15	12.1
Average Rainfall per Event (Inches)	0.36	0.35	-2.8

There was a 15 percent increase in total days with rainfall and a 12 percent increase in total rainfall from the before to the after period.

Maps showing the location of wet road target crashes are attached for both the before and the after periods.

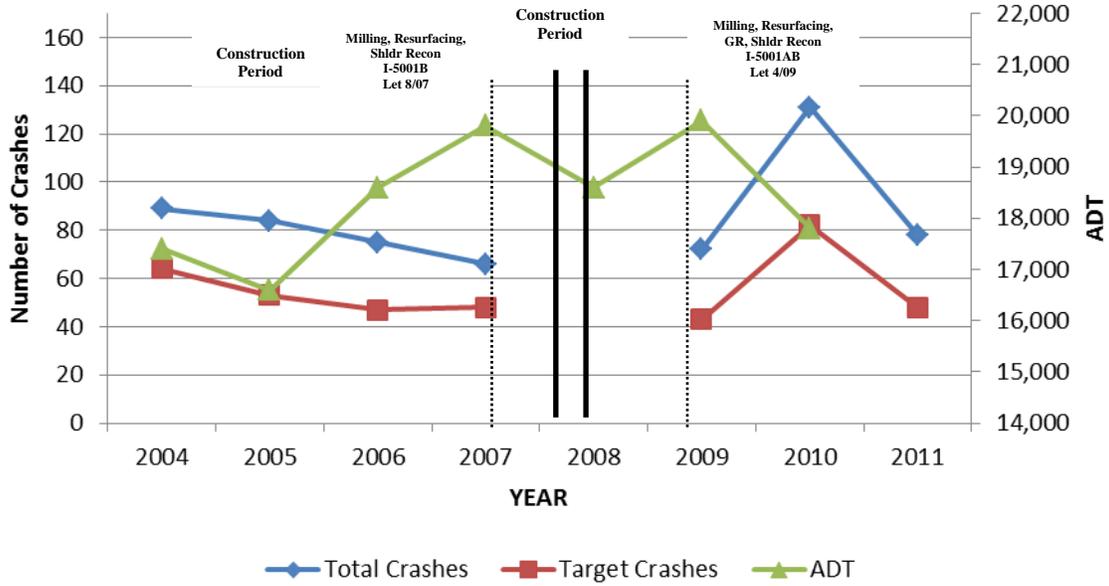
The calculated benefit to cost ratio for the project is 27.76 considering Total Crashes. The benefit to cost ratio considering only Target Crashes is 18.23. The benefits are calculated using the change in annual crash costs from the before to the after period. Operational and other benefits related to 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.

The following chart depicts the crash trends along this segment of I-40. The number of Total and Target Crashes per year are plotted in the before and after periods, along with the ADT. We typically show the dates of other projects that occurred in the analysis periods on this chart, but as explained in the *Subject Location* section there are currently issues with the NCDOT website, making this information inaccessible.

W-4806: I-40 in Sampson County from Johnson CL to Dublin CL

Rumble Strips Completed 4/08



BENEFIT-COST ANALYSIS WORKSHEET - TOTAL

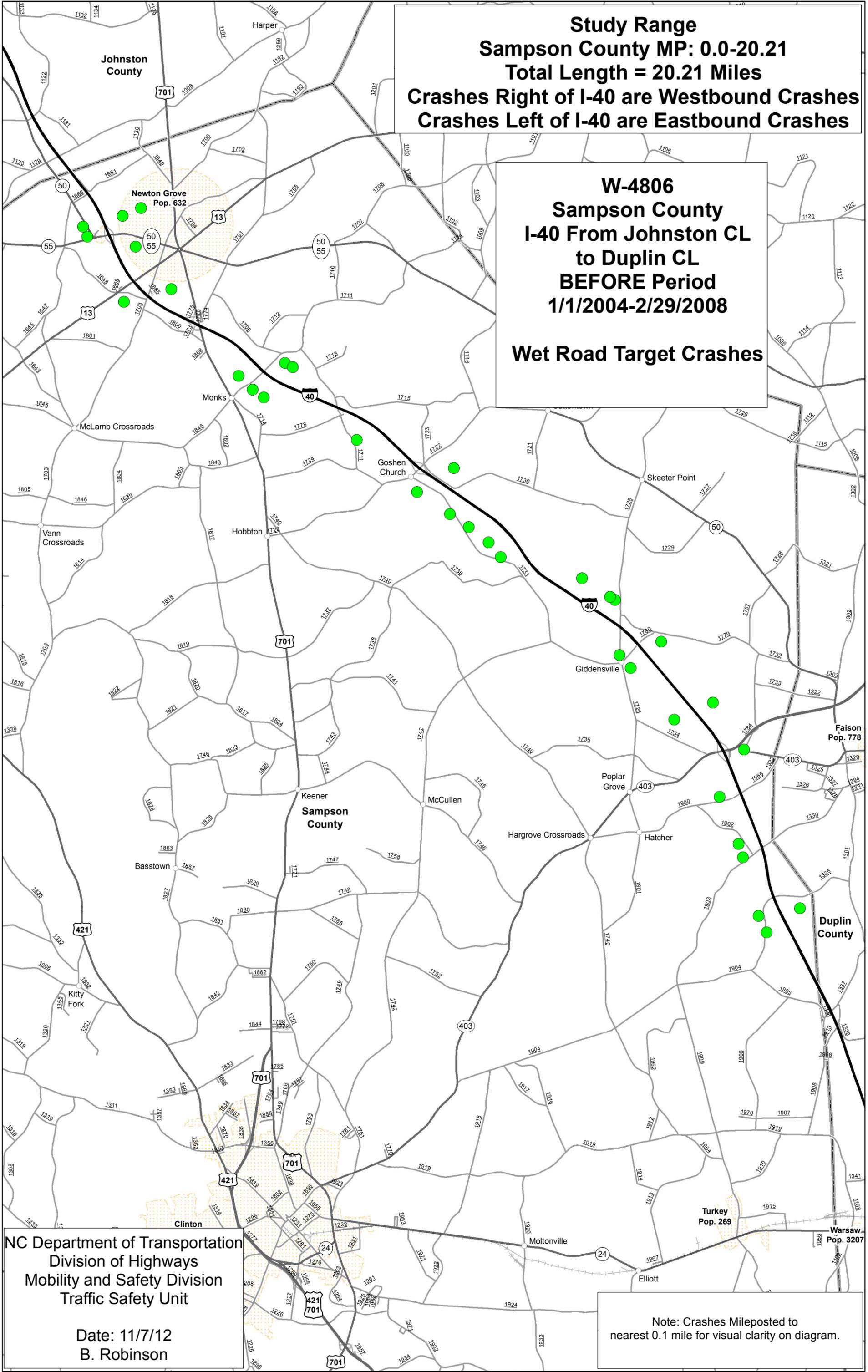
LOCATION: I-40 from Johnston CL to Pender CL		BY: bdr						
COUNTY: Sampson		DATE: 9/5/2012						
FILE NO.: W-4806								
DETAILED COST:	TYPE IMPROVEMENT -	Rumble Strips						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$0	0	0.000	\$0			
		\$175,000	10	0.149	\$26,080			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$175,000	10	0.149	\$26,080			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$26,080			
	TOTAL COST OF PROJECT=				\$175,000			
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	4.16	8	1.92	78	18.75	242	58.17	\$1,836,683
AFTER	4.16	3	0.72	69	16.59	316	75.96	\$1,112,692
							Annual Benefits from Crash Cost Savings	\$723,990
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$697,910		
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	27.76		
	TOTAL COST OF PROJECT	-	\$175,000	COMPREHENSIVE B/C RATIO	-			27.76

BENEFIT-COST ANALYSIS WORKSHEET - TARGET

LOCATION: I-40 from Johnston CL to Pender CL		BY: bdr						
COUNTY: Sampson		DATE: 9/5/2012						
FILE NO.: W-4806								
DETAILED COST:	TYPE IMPROVEMENT -	Rumble Strips						
	ITEMS	TOTAL	SERVICE	CRF	ANNUAL COST			
	Construction	\$0	0	0.000	\$0			
		\$175,000	10	0.149	\$26,080			
	Right-of-Way	\$0	0	0.000	\$0			
	TOTALS	\$175,000	10	0.149	\$26,080			
	ESTIMATED INCREASE IN ANNUAL MAINT. COST =				\$0			
	ESTIMATED INCREASE IN ANNUAL UTILITY COST =				\$0			
	TOTAL ANNUAL COST=				\$26,080			
	TOTAL COST OF PROJECT=				\$175,000			
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	4.16	6	1.44	65	15.63	149	35.82	\$1,375,168
AFTER	4.16	3	0.72	52	12.50	189	45.43	\$899,688
							Annual Benefits from Crash Cost Savings	\$475,481
	NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST				=	\$449,401		
	BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST				=	18.23		
	TOTAL COST OF PROJECT	-	\$175,000	COMPREHENSIVE B/C RATIO	-			18.23

Study Range
Sampson County MP: 0.0-20.21
Total Length = 20.21 Miles
Crashes Right of I-40 are Westbound Crashes
Crashes Left of I-40 are Eastbound Crashes

W-4806
Sampson County
I-40 From Johnston CL
to Duplin CL
BEFORE Period
1/1/2004-2/29/2008
Wet Road Target Crashes



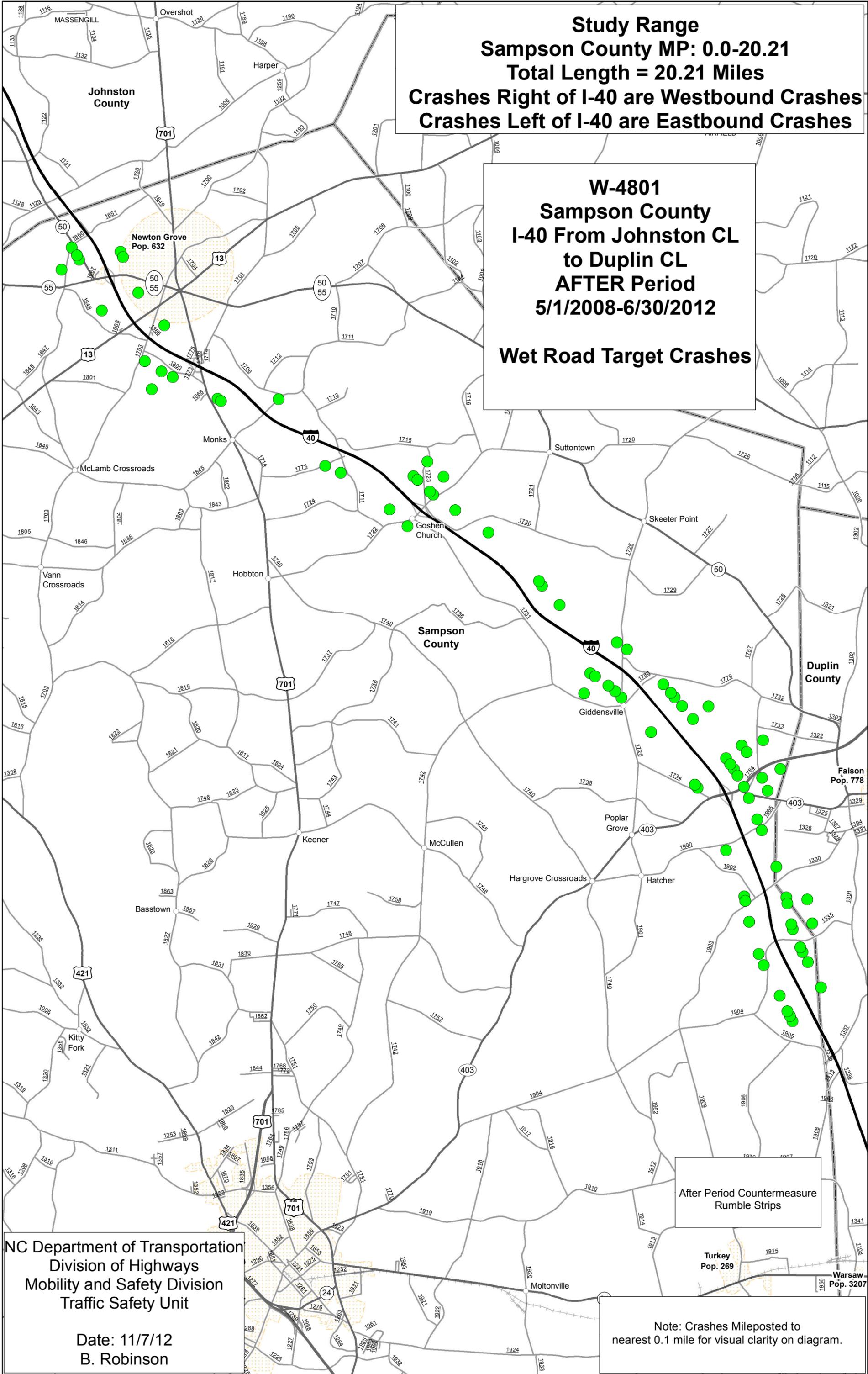
NC Department of Transportation
Division of Highways
Mobility and Safety Division
Traffic Safety Unit

Date: 11/7/12
B. Robinson

Note: Crashes Mileposted to nearest 0.1 mile for visual clarity on diagram.

Study Range
Sampson County MP: 0.0-20.21
Total Length = 20.21 Miles
Crashes Right of I-40 are Westbound Crashes
Crashes Left of I-40 are Eastbound Crashes

W-4801
Sampson County
I-40 From Johnston CL
to Duplin CL
AFTER Period
5/1/2008-6/30/2012
Wet Road Target Crashes



After Period Countermeasure
Rumble Strips

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

Date: 11/7/12
B. Robinson

Note: Crashes Mileposted to
nearest 0.1 mile for visual clarity on diagram.