

North Carolina Project Development Crash Reduction Factor Information

Revised April 1, 2015

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs	NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
1. Traffic Signals						
1.1 Install a Traffic Signal	Total Angle Crashes	65	10	\$2,500 / \$475	\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<i>{Total Crashes}</i>	<i>{22}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 1, 2
	3-leg Urban Intersection (Injury includes fatality and injury crashes)					
	Total Right-Angle Injury Crashes	34	10	\$2,500 / \$475	\$4,544,000 / \$134,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 4
	Total Rear-End Injury Crashes	-50	10	\$2,500 / \$475	\$3,086,000 / \$113,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 4
	<i>{Total Injury Crashes}</i>	<i>{14}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 4
	4-leg Urban Intersection (Injury includes fatality and injury crashes)					
	Total Right-Angle Injury Crashes	67	10	\$2,500 / \$475	\$4,544,000 / \$134,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 4
	Total Rear-End Injury Crashes	-38	10	\$2,500 / \$475	\$3,086,000 / \$113,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 4
	<i>{Total Injury Crashes}</i>	<i>{23}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 4
3-Leg and 4-Leg Rural Intersection						
Total Angle Crashes	77	10	\$2,500 / \$475	\$4,544,000 / \$134,000 / \$6,700	November 09 -- CMF Web -- CMF ID 326 -- Reference 9	
Total Rear-End Crashes	-58	10	\$2,500 / \$475	\$3,086,000 / \$113,000 / \$6,700	November 09 -- CMF Web -- CMF ID 328 -- Reference 9	
<i>{Total Crashes}</i>	<i>{44}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 325 -- Reference 9	
1.2 Upgraded Traffic Signals	Total Fatal Crashes	38	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
	Total Non-Fatal Injury Crashes	22	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
	Total PDO Crashes	23	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
	<i>{Total Crashes}</i>	<i>{22}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
1.3 Add Protected Left-Turn Phase	Total Left-Turn Crashes	70	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<i>{Total Crashes}</i>	<i>{25}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 8
1.4 Add Protected Permissive Left-Turn Phase	Total Left-Turn Crashes	40	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<i>{Total Crashes}</i>	<i>{10}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 13
1.5 Change from Permitted or Permitted-Protected to Protected	Urban Total Left-Turn Crashes on Treated Approach	99	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	November 09 -- CMF Web -- CMF ID 333 -- Reference 9
1.6 Pretimed to Actuated	Total Crashes	20	10	\$300 / \$0	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 8
1.7 Closed Loop Signal System	Total Crashes	15	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
1.8 Improve Signal Timing	Total Crashes	15	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	March 05 -- WPRFC Email -- ITE Safety Briefs
1.9 Replace 8-inch Signal Heads with 12-inch Signal Heads	Total Angle Crashes	42	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	January 10 -- CMF Web -- CMF ID 2333 -- Reference 15
	<i>{Total Crashes}</i>	<i>{3}</i>	<i>na</i>	<i>na</i>	<i>na</i>	January 10 -- CMF Web -- CMF ID 2334 -- Reference 15
	Urban Total Angle Crashes	46	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1444 -- Reference 32
1.10 Long Vehicle Detection	Total Crashes	10*	10	\$250 / \$0	\$4,451,000 / \$117,000 / \$6,700	September 06 -- WPRFC Email -- Subjective based on 6 B&A analyses

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs	NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
1. Traffic Signals (continued)						
1.11 Provide Advanced Dilemma Zone Detection for Rural High Speed Approaches Major ADT 10900 to 43300	<u>Rural - 4-Leg</u> Total Injury Crashes (Injury includes fatality and injury crashes)	39	10	\$250 / \$0	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1379 -- Reference 30
1.12 Signal Back Plates	Total Right Angle Crashes	20	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<i>{Total Crashes}</i>	<i>{5*}</i>	<i>na</i>	<i>na</i>	<i>na</i>	September 06 -- WPRFC Email -- Subjective based on committee opinion
Add 3-Inch Yellow Reflective Sheeting	<u>Urban</u> Total Crashes	15	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1410 -- Reference 31
1.13 Queue Detection - Ramp Locations	Total Crashes	30*	10	\$100 / \$0	\$4,451,000 / \$117,000 / \$6,700	April 06 -- WPRFC Email -- Subjective based on committee opinion
1.14 Flashing Yellow Arrow <i>(Left Turn crash on approach treated with FYA)</i>	<u>Permissive Only to FYA Protected-Permitted</u> Target Injury Crashes (Injury includes fatality and injury crashes)	41	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	September 14 -- NCDOT Internal Evaluation
	<i>{Total Crashes}</i>	<i>{7}</i>	<i>na</i>	<i>na</i>	<i>na</i>	September 14 -- NCDOT Internal Evaluation
<i>(Left Turn crash on approach treated with FYA)</i>	<u>Protected Only to FYA Protected-Permitted</u> Target Injury Crashes (Injury includes fatality and injury crashes)	-378	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	September 14 -- NCDOT Internal Evaluation
	<i>{Total Crashes}</i>	<i>{-12}</i>	<i>na</i>	<i>na</i>	<i>na</i>	September 14 -- NCDOT Internal Evaluation
<i>(Left Turn crash on approach treated with FYA)</i>	<u>Protected Only to FYA Protected-Permitted with TOD</u> Target Injury Crashes (Injury includes fatality and injury crashes)	-137	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	September 14 -- NCDOT Internal Evaluation
	<i>{Total Crashes}</i>	<i>{10}</i>	<i>na</i>	<i>na</i>	<i>na</i>	September 14 -- NCDOT Internal Evaluation
<i>(Left Turn crash on approach treated with FYA)</i>	<u>"Doghouse" Protected-Permitted to FYA Protected-Permitted</u> Target Injury Crashes (Injury includes fatality and injury crashes)	25	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	September 14 -- NCDOT Internal Evaluation
	<i>{Total Crashes}</i>	<i>{7}</i>	<i>na</i>	<i>na</i>	<i>na</i>	September 14 -- NCDOT Internal Evaluation
<i>(Left Turn crash on approach treated with FYA)</i>	<u>Permissive Only to FYA Permissive Only</u> Target Injury Crashes (Injury includes fatality and injury crashes)	65	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	September 14 -- NCDOT Internal Evaluation
	<i>{Total Crashes}</i>	<i>{11}</i>	<i>na</i>	<i>na</i>	<i>na</i>	September 14 -- NCDOT Internal Evaluation
1.15 Install Shoulder Mounted "Be Prepared to Stop" Signs <i>(Mainline through vehicle ran red light)</i> <i>(Mainline through vehicle on approach)</i>	Target Frontal Impact Crashes	70	10	\$500 / \$100	\$4,544,000 / \$134,000 / \$6,700	October 10 -- NCDOT Internal Evaluation "Preliminary"
	Target Rear-End Crashes	-3	10	\$500 / \$100	\$3,086,000 / \$113,000 / \$6,700	October 10 -- NCDOT Internal Evaluation "Preliminary"
	<i>{Total Crashes}</i>	<i>{6}</i>	<i>na</i>	<i>na</i>	<i>na</i>	October 10 -- NCDOT Internal Evaluation "Preliminary"
1.16 Left Turn Yield Blank Out Sign	Total Crashes	15*	10	\$25 / \$100	\$4,451,000 / \$117,000 / \$6,700	December 07 -- WPRFC Email -- Subjective based on committee opinion
1.17 Signal Removal	None	None*	na	na	na	May 08 -- WPRFC Email -- Subjective based on committee opinion
1.18 Install Signalized Superstreet at Intersection that is currently Signal Control	Total Crashes	51*	20	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	June 10 -- WPRFC Email -- Subjective based on committee opinion
1.19 Split Side Street Signal Phasing	Total Left-Turn Crashes	70*	10	\$0 / \$0	\$4,544,000 / \$134,000 / \$6,700	May 11 -- WPRFC Email -- Subjective based on committee opinion
	<i>{Total Crashes}</i>	<i>{25*}</i>	<i>na</i>	<i>na</i>	<i>na</i>	May 11 -- WPRFC Email -- Subjective based on committee opinion
1.20 Install Dynamic Red Extension	Total Red Light Run Crashes	50*	10	\$125 / \$0	\$4,544,000 / \$134,000 / \$6,700	September 14 -- WPRFC Email -- Subjective based on committee opinion
1.21 Change from Permitted or Permitted-Protected to Protected	<u>Urban</u> Total Injury Crashes (Injury includes fatality and injury crashes)	17	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	July 10 -- CMF Web -- CMF ID 1415 -- Reference 51
	Total PDO Crashes	31	10	\$0 / \$0	\$4,451,000 / \$117,000 / \$6,700	July 10 -- CMF Web -- CMF ID 1416 -- Reference 51
1.22 Continuous Green T	Target Frontal Impact Crashes	75*	10	\$2,500 / \$475	\$4,544,000 / \$134,000 / \$6,700	February 15 -- WPRFC Email -- Subjective based on committee opinion and 2 simple before and after applications averaged

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs	NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
2. Flashing Beacons						
2.1 Intersection Warning Flasher	Total Crashes	30	10	\$300 / \$260	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 8, 13
	<u>2-lane at 2-lane Rural Intersection</u>					
	Injury Crashes (Injury crashes are B and C level)	9	10	\$300 / \$260	\$4,451,000 / \$117,000 / \$6,700	November 06 -- NCDOT Study
	Severe Injury Crashes (Severe injury crashes are K and A level)	40	10	\$300 / \$260	\$4,451,000 / \$117,000 / \$6,700	November 06 -- NCDOT Study
	"OR"					
	Frontal Impact Crashes	9	10	\$300 / \$260	\$4,544,000 / \$134,000 / \$6,700	November 06 -- NCDOT Study
	"OR"					
	"Ran Stop Sign" Crashes	26	10	\$300 / \$260	\$4,544,000 / \$134,000 / \$6,700	November 06 -- NCDOT Study
	<i>{Total Crashes}</i>	<i>{12}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 06 -- NCDOT Study
2.2 Actuated Vehicle Entering When Flashing (2-Lane at 2-Lane Intersections)	<u>Overhead Signs and Flashers on Major, Loop on Minor</u> Total Crashes	-6	10	\$500 / \$125	\$4,451,000 / \$117,000 / \$6,700	July 12 -- NCDOT Internal Evaluation
	<u>Overhead Signs and Flashers on Minor, Loop on Major</u> Total Crashes	5	10	\$500 / \$125	\$4,451,000 / \$117,000 / \$6,700	July 12 -- NCDOT Internal Evaluation
	<u>Post Mounted Signs and Flashers on Major, Loop on Minor</u> Total Crashes	32	10	\$500 / \$125	\$4,451,000 / \$117,000 / \$6,700	July 12 -- NCDOT Internal Evaluation
(Combination of countermeasure scenarios above)	<u>Combination of Signs and Flashers on Major/Minor, Loops on Major/Minor</u> Total Crashes	25	10	\$500 / \$125	\$4,451,000 / \$117,000 / \$6,700	July 12 -- NCDOT Internal Evaluation
(4-Lane at 2-Lane Intersections)	<u>All Potential Countermeasure Scenarios</u> Total Crashes	-7	10	\$500 / \$125	\$4,451,000 / \$117,000 / \$6,700	July 12 -- NCDOT Internal Evaluation

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				1 Approach	Both Approaches		
3. Turn Lanes							
3.1 Left Turn Lane at an Intersection							
	<u>Without Signal</u>						
	Total Left-Turn Crashes	50	20	\$250		\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	Total Crashes	35	20	\$250		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<u>With Signal</u>						
	Total Left-Turn Crashes	45	20	\$250		\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	Total Crashes	25	20	\$250		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<u>3-leg Rural Stop Sign controlled</u>						
	Total Left Turn-Same Road and Rear-End Slow or Stop Crashes						
	<i>{Total Crashes}</i>	<i>{44}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 2
	<u>3-leg Urban Stop Sign controlled</u>						
	Total Crashes	33	20	\$250		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
	<u>4-leg Rural Stop Sign controlled</u>						
	Total Left Turn-Same Road and Rear-End Slow or Stop Crashes	37	20	\$250	60	\$4,544,000 / \$134,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
	<i>{Total Crashes}</i>	<i>{28}</i>	<i>na</i>	<i>na</i>	<i>{48}</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 2
	<u>4-leg Urban Stop Sign controlled</u>						
	Total Left Turn-Same Road and Rear-End Slow or Stop Crashes	26	20	\$250	45	\$4,544,000 / \$134,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
	<i>{Total Crashes}</i>	<i>{27}</i>	<i>na</i>	<i>na</i>	<i>{47}</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 2
	<u>4-leg Urban Signal controlled</u>						
	Total Left Turn-Same Road and Rear-End Slow or Stop Crashes	13	20	\$250	24	\$4,544,000 / \$134,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
	<i>{Total Crashes}</i>	<i>{10}</i>	<i>na</i>	<i>na</i>	<i>{19}</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 2
	<u>3-leg Urban Signal controlled</u>						
	Total Crashes	7	20	\$250		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
	<u>3-leg Rural Signal controlled</u>						
	Total Crashes	15	20	\$250		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
	<u>4-leg Rural Signal controlled</u>						
	Total Crashes	18	20	\$250	33	\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 2
3.2 Right Turn Lane at an Intersection							
	Total Right-Turn Crashes	50	20	\$250		\$4,544,000 / \$134,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
	<i>{Total Crashes}</i>	<i>{25}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 13
	<u>4-leg Rural and Urban Stop Sign controlled</u>						
	Total Crashes	14	20	\$250	26	\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 3
	<u>4-leg Rural and Urban Signal controlled</u>						
	Total Crashes	4	20	\$250	8	\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 3
3.3 Dual Left Turn Lanes							
	Total Injury Crashes (Injury includes fatality and injury crashes)	29	20	\$250		\$4,451,000 / \$117,000 / \$6,700	February 06 -- WPRFC Email -- NCHRP 500
	Total PDO Crashes	26	20	\$250		\$4,451,000 / \$117,000 / \$6,700	February 06 -- WPRFC Email -- NCHRP 500
3.4 Increase Turn Lane Length							
	Total Crashes	15	20	\$100		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
3.5 Extend Acceleration Lane by approx. 98 ft (30 m)							
	Total Crashes	11	20	\$100		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 474 -- Reference 2
3.6 Extend Deceleration Lane by approx. 98 ft (30 m)							
	Total Crashes	7	20	\$100		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 475 -- Reference 2

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				Maintenance / Utility Costs			
3. Turn Lanes (continued)							
3.7 Provide Long Ramp Instead of Shortramp	Total Crashes	38	20	\$500		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 477 -- Reference 4
3.8 Provide Short Ramp Instead of Directional Loop Ramp	Total Crashes	30	20	\$500		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 480 -- Reference 4
3.9 Provide Straight Ramp Instead of Cloverleaf Ramp	Total Crashes	45	20	\$500		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 478 -- Reference 4
3.10 Continuous Left Turn Lane	Total Crashes	30	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 3
	<u>Urban - 4-Lane</u>						
	Total Injury Crashes (Injury includes fatality and injury crashes)	51	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4092 -- Reference 50
	Total PDO Crashes	62	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4090 -- Reference 50
	<u>Suburban - 4-Lane</u>						
Total Injury Crashes (Injury includes fatality and injury crashes)	59	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4093 -- Reference 50	
Total PDO Crashes	49	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4091 -- Reference 50	
3.11 Install TWLTL (Two-Way Left Turn Lane) on Two Lane Road	Total Injury Crashes (Injury includes fatality and injury crashes)	26	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	January 10 -- CMF Web -- CMF ID 2346 -- Reference 20
	<i>{Total Rear End Crashes}</i>	<i>{39}</i>	<i>na</i>	<i>na</i>		<i>na</i>	January 10 -- CMF Web -- CMF ID 2351 -- Reference 20
	<i>{Total Crashes}</i>	<i>{20}</i>	<i>na</i>	<i>na</i>		<i>na</i>	January 10 -- CMF Web -- CMF ID 2341 -- Reference 20
3.12 Install TWLTL (Two-Way Left Turn Lane) on Two Lane Road	<u>Rural</u>						
	Total Non-Fatal Injury Crashes	35	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	January 10 -- CMF Web -- CMF ID 584 -- Reference 20
	<i>{Total Rear End Crashes}</i>	<i>{47}</i>	<i>na</i>	<i>na</i>		<i>na</i>	January 10 -- CMF Web -- CMF ID 585 -- Reference 20
<i>{Total Crashes}</i>	<i>{36}</i>	<i>na</i>	<i>na</i>		<i>na</i>	January 10 -- CMF Web -- CMF ID 583 -- Reference 20	
3.13 Positive Offset for New Left Turn Lanes	Total Crashes	10*	20	\$0		\$4,451,000 / \$117,000 / \$6,700	April 07 -- WPRFC Email -- Subjective based on November 2004
3.14 Positive Offset for Existing Left Turn Lanes	Total Crashes	37*	20	\$0		\$4,451,000 / \$117,000 / \$6,700	April 07 -- WPRFC Email -- Subjective based on 2 B&A analyses
3.15 Introducing Zero or Positive Offset Left-Turn Lane on Crossing Roadway	<u>Urban - Signalized</u> Total Angle Crashes	26	20	\$0		\$4,544,000 / \$134,000 / \$6,700	November 09 -- CMF Web -- CMF ID 276 -- Reference 7
3.16 Stripe for Turn Lane within Existing Roadway	Total Crashes	26*	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	March 05 -- WPRFC Email -- Subjective based on committee opinion
3.17 Introduce Painted Left-Turn Channelization	<u>Rural - Multilane - 4-Leg - Stop Controlled</u> Total Rearend and Sideswipe Crashes	39	5 Long Life, 1 Paint	\$0		\$3,086,000 / \$113,000 / \$6,700	November 09 -- CMF Web -- CMF ID 280 -- Reference 6
	<i>{Total Crashes}</i>	<i>{33}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 09 -- CMF Web -- CMF ID 281 -- Reference 6
3.18 Introduce Raised/Curb Left-Turn Channelization	<u>Rural - Multilane - 4-Leg - Stop Controlled</u> Total Rearend and Sideswipe Crashes	25	20	\$800		\$3,086,000 / \$113,000 / \$6,700	November 09 -- CMF Web -- CMF ID 278 -- Reference 6
	<i>{Total Crashes}</i>	<i>{13}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 09 -- CMF Web -- CMF ID 279 -- Reference 6
3.19 Install Offset Right Turn Lane with Raised Channelization	Total Crashes	25*	20	\$800		\$4,451,000 / \$117,000 / \$6,700	April 13 -- WPRFC Email -- Subjective based on committee opinion
3.20 Road Diet (4 Lane to 3 Lane)	Total Crashes	29	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 199 -- Reference 18

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance /		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference	
				Utility Costs				
4. Pavement Widening								
4.1 Widening for an Additional Lane	Total Crashes	10*	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	March 07 -- WPRFC Meeting -- Subjective based on committee opinion	
4.2 Pavement Widening	Total Fatal Crashes	40	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total Non-Fatal Injury Crashes	15	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total PDO Crashes	25	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	<i>{Total Crashes}</i>	<i>{22}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2	
4.3 Widen or Improve Shoulder	Total Fatal Crashes	22	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 2	
	Total Non-Fatal Injury Crashes	13	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 2	
	Total PDO Crashes	12	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 2	
	<i>{Total Crashes}</i>	<i>{8}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 1, 2	
	Rural 2-lane	Total Fatal Crashes	48	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2
	Total Non-Fatal Injury Crashes	8	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
Total PDO Crashes	23	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2		
<i>{Total Crashes}</i>	<i>{18}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2		
Urban 2-lane	Total Crashes	26	20	-\$500 per Mile		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
4.4 Remove or Relocate Fixed Objects Outside of Clear Zone	Total Injury Crashes (Injury includes fatality and injury crashes)	38	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1025 -- Reference 33	
	<i>{Total Crashes}</i>	<i>{38}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 09 -- CMF Web -- CMF ID 1024 -- Reference 33	
4.5 Increase Distance to Roadside Obstacle from around 1 m to around 5 m	Rural Total Crashes	22	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 35 -- Reference 2	
4.6 Increase Distance to Roadside Obstacle from around 5 m to around 9 m	Rural Total Crashes	44	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 36 -- Reference 2	
4.7 Flatten Sideslope from 1V:3H to 1V:4H	Rural Total Non-Fatal Injury Crashes	42	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 26 -- Reference 2	
	Total PDO Crashes	29	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 27 -- Reference 2	
4.8 Flatten Sideslope from 1V:4H to 1V:6H	Rural Total Non-Fatal Injury Crashes	22	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 29 -- Reference 2	
	Total PDO Crashes	24	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 30 -- Reference 2	
4.9 Add Passing Lanes (Two-Lane Roads)	One-Way (single direction of travel) Total Crashes	25	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 11	
	Two-Way (short four-lane sections) Total Crashes	35	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 11	
	Rural Total Injury Crashes (Injury includes fatality and injury crashes)	42	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4083 -- Reference 49	
	ADT 1655 to 7031							
ADT 1655 to 7031	Rural - Non-Intersection Total Injury Crashes (Injury includes fatality and injury crashes)	35	20	\$4000 per Mile		\$4,451,000 / \$117,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4082 -- Reference 49	

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs	NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
5. Pavement Enhancements						
5.1 Shoulder Rumble Strips	Total Crashes	29	10	\$0	\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 3
	<u>Rural and Urban Freeways</u> (Injury includes fatality and injury crashes) Total Injury Single-Vehicle Run-Off-Road Crashes	13	10	\$0	\$4,745,000 / \$110,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 17
	<i>{Total Single-Vehicle Run-Off-Road Crashes}</i>	<i>{18}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 17
	<u>Rural Freeways</u> (Injury includes fatality and injury crashes) Total Injury Single-Vehicle Run-Off-Road Crashes	7	10	\$0	\$4,745,000 / \$110,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 17
	<i>{Total Single-Vehicle Run-Off-Road Crashes}</i>	<i>{21}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 17
5.2 Implement Shoulder Widening in Conjunction with Shoulder Rumble Strip Installation on Freeways	<u>Principal Arterial Freeway or Expressway</u> Total Run Off Road Crashes	13	20	- \$500 per Mile	\$4,745,000 / \$110,000 / \$6,700	November 09 -- CMF Web -- CMF ID 123 -- Reference 27
	<i>{Total Crashes}</i>	<i>{19}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 122 -- Reference 27
5.3 Add Centerline Rumble Strips	<u>Rural 2-lane Roads</u> (Injury includes fatality and injury crashes) Total Injury Frontal/Opposing-Direction Sideswipe Crashes	25	10	\$0	\$4,745,000 / \$110,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 18
	<i>{Total Crashes}</i>	<i>{14}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 18
	<i>{Total Frontal/Opposing-Direction Sideswipe Crashes}</i>	<i>{21}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 18
	<i>{Total Injury Crashes}</i>	<i>{15}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 18
5.4 Centerline Rumble Strips on Rural 5-Lane Curb and Gutter Crossover	Total Crashes	29*	10	\$0	\$4,451,000 / \$117,000 / \$6,700	December 08 -- WPRFC Email -- Subjective based on committee opinion
5.5 Skid Treatments (overlay)	Total Wet Injury Crashes (Injury includes fatality and injury crashes)	57	10	\$0	\$4,745,000 / \$110,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 9
	<i>{Total Crashes}</i>	<i>{27}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
	<i>{Total Fatal Crashes}</i>	<i>{29}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
	<i>{Total Non-Fatal Injury Crashes}</i>	<i>{16}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
	<i>{Total PDO Crashes}</i>	<i>{32}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
	<i>{Total Wet Crashes}</i>	<i>{63}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 10
5.6 Increased Pavement Friction	Total Wet Road Crashes	57	10	\$0	\$4,745,000 / \$110,000 / \$6,700	November 09 -- CMF Web -- CMF ID 195 -- Reference 18
	<i>{Total Crashes}</i>	<i>{24}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 194 -- Reference 18
	<i>{Total Rear End Crashes}</i>	<i>{17}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 196 -- Reference 18
	<i>{Total Single Vehicle Crashes}</i>	<i>{30}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 198 -- Reference 18
5.7 Skid Treatments (groove pavement)	Total Wet Injury Crashes (Injury includes fatality and injury crashes)	61	10	\$0	\$4,745,000 / \$110,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 9
	<i>{Total Crashes}</i>	<i>{14}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
	<i>{Total Non-Fatal Injury Crashes}</i>	<i>{12}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
	<i>{Total PDO Crashes}</i>	<i>{15}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 2
5.8 Resurface Pavement with Groove Pavement (GP)	Total Wet Road Crashes	50	10	\$0	\$4,745,000 / \$110,000 / \$6,700	April 10 -- CMF Web -- CMF ID 2468 -- Reference 22
5.9 Safety Edge	None	None*	na	na	na	October 08 -- WPRFC Email -- Subjective based on committee opinion
5.10 Spot Specific Water Removal such as Drop Inlets, Drainage Grates, and Debris Removal	Total Wet Injury Crashes (Injury includes fatality and injury crashes)	57*	20	\$0	\$4,745,000 / \$110,000 / \$6,700	April 10 -- WPRFC Email -- Subjective based on committee opinion
	<i>{Total Wet Crashes}</i>	<i>{63*}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 10 -- WPRFC Email -- Subjective based on committee opinion
5.11 Open Graded Asphalt Concrete	Total Wet Crashes	41	10	\$0	\$4,745,000 / \$110,000 / \$6,700	April 10 -- CMF Web -- CMF ID 2467 -- Reference 22

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				Maintenance / Utility Costs			
6. Curves and Sight Distance							
6.1 Horizontal Realignment	Total Fatal Crashes	66	20	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1
	Total Non-Fatal Injury Crashes	43	20	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1
6.2 Vertical Realignment	Total Crashes	40	20	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
6.3 Improve Skew Angle	Total Crashes	40	20	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
6.4 Improve Sight Distance Triangles - Remove Objects	Total Fatal Crashes	66	20	\$0		\$4,451,000 / \$117,000 / \$6,700	February 2005 -- WPRFC Phone Call -- Low Cost Workshop
	Total Non-Fatal Injury Crashes	20	20	\$0		\$4,451,000 / \$117,000 / \$6,700	February 2005 -- WPRFC Phone Call -- Low Cost Workshop
	<i>{Total Crashes}</i>	<i>{25}</i>	<i>na</i>	<i>na</i>		<i>na</i>	February 2005 -- WPRFC Phone Call -- Low Cost Workshop
6.5 Increase Triangle Sight Distance	Total Fatal Crashes	56	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1637 -- Reference 34
	Total Non-Fatal Injury Crashes	37	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1638 -- Reference 34
	4-Leg						
	Total Non-Fatal Injury Crashes	48	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 307 -- Reference 2
	Total PDO Crashes	11	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 308 -- Reference 2
6.6 Channelization - Parking Area Sight Distance Issues	Total Crashes	25*	20	\$800		\$4,451,000 / \$117,000 / \$6,700	April 06 -- WPRFC Email -- Subjective based on committee opinion
6.7 Improve Superelevation through a Curve	Total Crashes	40*	20	\$0		\$4,451,000 / \$117,000 / \$6,700	March 10 -- WPRFC Email -- Subjective based on committee opinion
6.8 Flatten Crest Vertical Curve	Total Injury Crashes	51	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 721 -- Reference 33
	<i>{Total Crashes}</i>	<i>{20}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 09 -- CMF Web -- CMF ID 720 -- Reference 33
6.9 Flatten Horizontal Curve	Principal Arterial - 2-Lane Total Crashes	67	20	\$0		\$4,451,000 / \$117,000 / \$6,700	October 10 -- CMF Web -- CMF ID 2826 -- Reference 35

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference	
				Maintenance / Utility Costs				
7. Guardrail								
7.1 New or Upgraded Guardrail	Total Injury Crashes (Injury includes fatality and injury crashes)	47	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 19	
	Total PDO Crashes	-50*	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	March 06 -- WPRFC Email -- Subjective based on committee opinion	
	Rural 2-lane							
	Total Fatal Crashes	50	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total Non-Fatal Injury Crashes	12	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total PDO Crashes	18	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Rural 4-lane Undivided							
	Total Fatal Crashes	44	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total Non-Fatal Injury Crashes	23	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total PDO Crashes	44	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Rural 4-lane Divided							
	Total Fatal Crashes	46	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	Total Non-Fatal Injury Crashes	13	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
	7.2 New Median Barrier	Total Fatal Crashes	63	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1
Total Non-Fatal Injury Crashes		10	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1	
Total PDO Crashes		-25*	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting -- Subjective based on committee opinion	
Rural 4-lane Divided								
Total Fatal Crashes		93	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
Rural								
Total Fatal Crashes		75	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
Urban 4-lane Undivided								
Total Non-Fatal Injury Crashes		63	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
Urban 4-lane Divided								
Total Fatal Crashes		84	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
Urban								
Total Fatal Crashes		72	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 2	
Principal Arterial - Divided Highway								
Total Fatal Injury Crashes	43	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 42 -- Reference 2		
Total Non-Fatal Injury Crashes	30	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 43 -- Reference 2		
Total PDO Crashes	-24	15	See Example Below		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 44 -- Reference 2		
7.3 Bridge Guardrail	Bridge Approach Guardrail							
	Total Fatal Crashes	55	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 4	
	Total Non-Fatal Injury Crashes	20	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 4	
	Total PDO Crashes	-50	10	See Example Below		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 4	
7.4 Bridge Replacements	Total Injury Crashes per Year (Injury includes fatality and injury crashes)	32	50	\$0		\$4,451,000 / \$117,000 / \$6,700	November 02 -- NCDOT Study	
	PDO Crashes per Year	13	50	\$0		\$4,451,000 / \$117,000 / \$6,700	November 02 -- NCDOT Study	
	<i>{Total Crashes per Year}</i>	<i>{22}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 02 -- NCDOT Study	

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				Maintenance / Utility Costs	(F+A / B+C / PDO)	
7. Guardrail (continued)						

Guardrail	400	x After Period Ran-Off-Road Crashes Per Year Per Mile
Median Barrier	200	

Guardrail Improvement Example:

20 crashes over 5 years (5 Fatal, 10 Injury, 5 PDO)
 Average per year: 1 Fatal, 2 Injury, 1 PDO

CRFs for "New or Upgraded Guardrail": 35% Fatals, 4% Injury, 7% PDO

Fatal Crashes Remaining (per year): $1 - (1)(0.35) = 0.65$
 Injury Crashes Remaining (per year): $2 - (2)(.04) = 1.92$
 PDO Crashes Remaining (per year): $1 - (1)(.07) = 0.93$
 Total Crashes Remaining (per year): $0.65 + 1.92 + 0.93 = 3.5$

Annual Maintenance Cost: $(3.5)(\$400) = \1400

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				Maintenance / Utility Costs			
8. Signing and Delineation							
8.1 Markings & Delineation	Total Fatal Crashes	15	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 2
	Total Non-Fatal Injury Crashes	6	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 2
	Total PDO Crashes	26	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 1, 2
	<i>{Total Crashes}</i>	<i>{21}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 01 -- WPRFC Meeting Handout -- Reference 1, 2
8.2 Introduce Stop Ahead Pavement Markings	<u>Rural - 3-Leg</u> Total Crashes	60	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 402 -- Reference 21
	<u>Rural - Unspecified</u> Total Crashes	56	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 404 -- Reference 21
8.3 Apply Converging Chevron Pattern Markings on Roadway Segments	<u>Rural</u> Total Crashes	32	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 112 -- Reference 28
8.4 Warning Signs - General	Total Crashes	25	6	\$0		\$4,451,000 / \$117,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
8.5 Advance Static Curve Warning Signs	Total Non-Fatal Injury Crashes	30	6	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 71 -- Reference 2
	Total PDO Crashes	8	6	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 72 -- Reference 2
8.6 Provide Static Combination Horizontal Alignment / Advisory Speed Signs	Total Non-Fatal Injury Crashes	13	6	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 73 -- Reference 2
	Total PDO Crashes	29	6	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 74 -- Reference 2
8.7 Install a Solar Powered Flasher on an existing Curve Warning Sign with Advisory Speed Plate	Total Crashes	5*	10	\$100		\$4,451,000 / \$117,000 / \$6,700	June 07 -- WPRFC Email -- Subjective based on committee opinion
8.8 Changeable Curve Speed Warning Signs	<u>Rural Principal Arterial</u> Total Truck Crashes	71	10	\$500 / \$100		\$6,059,000 / \$106,000 / \$6,700	November 09 -- CMF Web -- CMF ID 70 -- Reference 3
8.9 Install Changeable Speed Warning Signs for Individual Drivers	Total Crashes	46	10	\$500 / \$100		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 78 -- Reference 2
8.10 Changeable Queue Warning Signs	<u>Principal Arterial Freeway and Expressway</u> Total Rear-End Non-Fatal Injury Crashes	16	10	\$500 / \$100		\$3,086,000 / \$113,000 / \$6,700	November 09 -- CMF Web -- CMF ID 76 -- Reference 2
	Total Rear-End PDO Crashes	-16	10	\$500 / \$100		\$3,086,000 / \$113,000 / \$6,700	November 09 -- CMF Web -- CMF ID 77 -- Reference 2
8.11 Installing Long Vehicle Detection that would Actuate Flashers on Several Truck Warning Signs that are currently Installed	Total Crashes	10*	10	\$500 / \$100		\$4,451,000 / \$117,000 / \$6,700	July 07 -- WPRFC Email -- Subjective based on committee opinion
8.12 Install a Detection Warning System with CCTV's, Warning Signs with Flashers, and DMS's	Total Crashes	25*	10	\$2000 / \$1000		\$4,451,000 / \$117,000 / \$6,700	May 08 -- WPRFC Email -- Subjective based on committee opinion
8.13 Reduce Regulatory Speed Limit in Curve	None	None*	na	na		na	May 08 -- WPRFC Email -- Subjective based on committee opinion
8.14 Replace Engineer Grade Signs with High Intensity Signs along a Corridor	Total Crashes	5*	6	\$0		\$4,451,000 / \$117,000 / \$6,700	July 08 -- WPRFC Email -- Subjective based on committee opinion
8.15 "Watch for Slow or Stopped Traffic" Signs	Total Crashes	25*	6	\$0		\$4,451,000 / \$117,000 / \$6,700	October 08 -- WPRFC Email -- Subjective based on committee opinion
8.16 Regulatory Sign to Enforce Truck Network Restrictions	Total Crashes	15*	6	\$0		\$4,451,000 / \$117,000 / \$6,700	March 10 -- WPRFC Email -- Subjective based on committee opinion
8.17 Actuated Advanced Flasher at Official Use Crossover	Public Use Crossover Crashes	75*	10	\$500 / \$100		\$4,544,000 / \$134,000 / \$6,700	March 10 -- WPRFC Email -- Subjective based on committee opinion
8.18 Transversable Delineator Posts at Official Use Crossover	Public Use Crossover Crashes	80*	3	\$0		\$4,544,000 / \$134,000 / \$6,700	March 10 -- WPRFC Email -- Subjective based on committee opinion
8.19 Install Warning Signs on Waterway To Prevent Distracted Drivers	Total Crashes	25*	6	\$0		\$4,451,000 / \$117,000 / \$6,700	June 10 -- WPRFC Email -- Subjective based on committee opinion

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				Maintenance / Utility Costs			
8. Signing and Delineation (continued)							
8.20 Speed Reduction Pavement Markings	Total Crashes	21*	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	March 11 -- WPRFC Email -- Subjective based on committee opinion
8.21 Overhead Lane Use/Guidance Signs	Total Rearend Crashes	10*	15	\$0		\$3,086,000 / \$113,000 / \$6,700	July 11 -- WPRFC Email -- Subjective based on committee opinion
	Total Sideswipe Crashes	20*	15	\$0		\$4,745,000 / \$110,000 / \$6,700	July 11 -- WPRFC Email -- Subjective based on committee opinion
8.22 Supplemental Warning Pavement Marking	Total Crashes	6*	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	November 11 -- WPRFC Email -- Subjective based on committee opinion
8.23 Vibraline Pavement Markings	Total Crashes	29*	5	\$0		\$4,451,000 / \$117,000 / \$6,700	March 12 -- WPRFC Email -- Subjective based on committee opinion
8.24 Overhead Lighting/Street Lighting	Non-Freeway and Non-Intersection						
	Total Night Injury Crashes	46	15	\$1000 / \$0		\$4,451,000 / \$117,000 / \$6,700	October 10 -- CMF Web -- CMF ID 2845 -- Reference 36
	<i>{Total Night Fatal Crashes}</i>	<i>{49}</i>	<i>na</i>	<i>na</i>		<i>na</i>	October 10 -- CMF Web -- CMF ID 2844 -- Reference 36
	Intersection Related						
Total Injury Crashes (Injury includes serious and minor (A, B, and C))	38		15	\$1000 / \$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 433 -- Reference 2
Total PDO Crashes	31		15	\$1000 / \$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 434 -- Reference 2
8.25 Install New Fluorescent Curve Signs or Upgrade Existing Curve Signs to Fluorescent Sheeting	Rural - 2-Lane - Non-Intersection						
	Total Nighttime Head-On, Run-Off-Road, and Sideswipe Crashes	34	6	\$0		\$4,745,000 / \$110,000 / \$6,700	April 10 -- CMF Web -- CMF ID 2435 -- Reference 37
	<i>{Total Crashes}</i>	<i>{18}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 10 -- CMF Web -- CMF ID 2431 -- Reference 37
	<i>{Total Head-On, Run-Off-Road, and Sideswipe Crashes}</i>	<i>{18}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 10 -- CMF Web -- CMF ID 2432 -- Reference 37
<i>{Total Nighttime Crashes}</i>	<i>{35}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 10 -- CMF Web -- CMF ID 2434 -- Reference 37	
8.26 Install Chevron Signs on Horizontal Curves	Rural - 2-Lane - Non-Intersection						
	Total Nighttime Head-On, Run-Off-Road, and Sideswipe Crashes	22	6	\$0		\$4,745,000 / \$110,000 / \$6,700	April 10 -- CMF Web -- CMF ID 2440 -- Reference 37
	<i>{Total Crashes}</i>	<i>{4}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 10 -- CMF Web -- CMF ID 2436 -- Reference 37
	<i>{Total Head-On, Run-Off-Road, and Sideswipe Crashes}</i>	<i>{6}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 10 -- CMF Web -- CMF ID 2437 -- Reference 37
<i>{Total Nighttime Crashes}</i>	<i>{25}</i>	<i>na</i>	<i>na</i>		<i>na</i>	April 10 -- CMF Web -- CMF ID 2439 -- Reference 37	
8.27 Install Static Signs and Flashers "Truck Speed too Fast when Flashing"	Total Crashes	25*	10	\$500 / \$100		\$4,451,000 / \$117,000 / \$6,700	August 12 -- WPRFC Email -- Subjective based on committee opinion
8.28 Install Wider Edgelines (4" to 6")	Total Fatal Crashes	15*	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	January 14 -- WPRFC Email -- Subjective based on committee opinion
	Total Non-Fatal Injury Crashes	6*	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	January 14 -- WPRFC Email -- Subjective based on committee opinion
	Total PDO Crashes	26*	5 Long Life, 1 Paint	\$0		\$4,451,000 / \$117,000 / \$6,700	January 14 -- WPRFC Email -- Subjective based on committee opinion
8.29 Replace Standard Stop Sign with Flashing Flashing LED Stop Sign	Total Angle Crashes	41	10	\$500 / \$100		\$4,745,000 / \$110,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4074 -- Reference 47
8.30 Install Actuated Flasher on Stop Sign	Total Crashes	5*	10	\$500 / \$100		\$4,451,000 / \$117,000 / \$6,700	December 12 -- WPRFC Email -- Subjective based on committee opinion
8.31 Install Supplemental Advance Guide Sign	Total Crashes	15*	15	\$0		\$4,451,000 / \$117,000 / \$6,700	February 13 -- WPRFC Email -- Subjective based on committee opinion
8.32 Install Sequential Lighted Chevron System	Total Crashes	25*	10	\$100		\$4,451,000 / \$117,000 / \$6,700	March 13 -- WPRFC Email -- Subjective based on committee opinion
8.33 Mandatory Motorcycle Pull Off Area with Roadway Informational Signing	Total Crashes	20*	6	\$0		\$4,451,000 / \$117,000 / \$6,700	November 13 -- WPRFC Email -- Subjective based on committee opinion
8.34 Install Chevrons on Outside of Urban 4 Lane Road Curve	Total Crashes	25*	6	\$0		\$4,451,000 / \$117,000 / \$6,700	February 14 -- WPRFC Email -- Subjective based on committee opinion
8.35 Actuated "Prepare to Stop when Flashing" signs in advance of intersection with sight distance issues	Total Crashes	32*	10	\$500 / \$125		\$4,451,000 / \$117,000 / \$6,700	November 14 -- WPRFC Email -- Subjective based on committee opinion

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs	NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
9. Intersection Enhancements						
9.1 Unsignalized Superstreets (NC Data) (Old Designation - Limited Movement Crossovers)	<u>Rural - Principal Arterial</u> Total Crashes	46	20	\$800	\$4,451,000 / \$117,000 / \$6,700	December 2010 -- NCDOT Research Project 2009-06
	<u>Rural - Principal Arterial</u> Total Injury Crashes (Injury includes fatality and injury crashes)	63	20	\$800	\$4,451,000 / \$117,000 / \$6,700	January 2013 -- CMF Web -- CMF ID 4884 -- Reference 46
9.2 Create Directional Median Openings to Allow Left-Turns and U-Turns (Old Designation - Install Concrete Island to Prohibit Left Turns from Side Street, but Allow Left Turns from Mainline)	Total Crashes	51	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 2009 -- CMF Web -- CMF ID 1516 -- Reference 34
9.3 Replace Direct Left-Turns with Right-Turn/U-Turn	<u>Principal Arterial</u> Total Crashes	20	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 351 -- Reference 8
9.4 Install J-Turn Intersection 4-Leg - Major ADT 10670 to 11240, Minor ADT 1450 to 17	<u>Rural - 4-lane Divided Principal Arterial at Undivided Major Collector Two-Way Stop Controlled</u> Total Crashes	92	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 2033 -- Reference 5
	4-Leg - Major ADT 45000 to 47600, 55 MPH <u>4-lane Divided Principal Arterial Freeway or Expressway at Two-Way Stop Controlled</u> Total Angle Crashes	92	20	\$800	\$4,745,000 / \$110,000 / \$6,700	November 09 -- CMF Web -- CMF ID 2060 -- Reference 5
	<i>{4-Leg - Major ADT 45000 to 47600, 55 MPH}</i> <i>{Total PDO Crashes}</i>	<i>{64}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 2059 -- Reference 5
	4-Leg - Major ADT 16900 to 20000, 55 MPH <u>4-lane Divided Principal Arterial Freeway or Expressway at Two-Way Stop Controlled</u> Total Non-Fatal Injury Crashes	80	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 2045 -- Reference 5
	<i>{4-Leg - Major ADT 16900 to 20000, 55 MPH}</i> <i>{Total Crashes}</i>	<i>{61}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 2043 -- Reference 5
	4-Leg - Major ADT 28600 to 29200, 55 MPH <u>Suburban - 4-lane Divided Principal Arterial Freeway or Expressway at Two-Way Stop Controlled</u> Total Angle Crashes	64	20	\$800	\$4,745,000 / \$110,000 / \$6,700	November 09 -- CMF Web -- CMF ID 2077 -- Reference 5
<i>{4-Leg - Major ADT 28600 to 29200, 55 MPH}</i> <i>{Total Crashes}</i>	<i>{70}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 2067 -- Reference 5	
4-Leg - Major ADT 45000 to 47600, 55 MPH <u>4-lane Divided Principal Arterial at Two-Way Stop Controlled</u> Total Crashes	50	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 2056 -- Reference 5	
9.5 Concrete Island - Channelization	Total Crashes	25	20	\$800	\$4,451,000 / \$117,000 / \$6,700	March 07 -- NCDOT Project Development Webpage -- Reference 13
9.6 Install Raised Median ADT 10000 to 55000	Total Fatal and Serious Injury	36	20	\$0	\$4,451,000 / \$117,000 / \$6,700	March 2011 -- CMF Web -- CMF ID 3035 -- Reference 40
	<i>{ADT 10000 to 55000}</i> <i>{Total Crashes}</i>	<i>{25}</i>	<i>na</i>	<i>na</i>	<i>na</i>	March 2011 -- CMF Web -- CMF ID 3034 -- Reference 40
	ADT 1390 to 51200 <u>Urban - Principal Arterial</u> Total Angle Crashes	55	20	\$0	\$4,745,000 / \$110,000 / \$6,700	December 09 -- CMF Web -- CMF ID 2220 -- Reference 23
<i>{ADT 1390 to 51200}</i> <i>{Total Crashes}</i>	<i>{71}</i>	<i>na</i>	<i>na</i>	<i>na</i>	December 09 -- CMF Web -- CMF ID 2219 -- Reference 23	

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				Maintenance / Utility Costs			
9. Intersection Enhancements (continued)							
9.7 Replace TWLTL with Raised Median ADT 4883 to 96080, 30-45 MPH 4-Lane, ADT 18340 to 50925 6-Lane, ADT 26224 to 57000	<u>Urban</u>						
	Total Angle Crashes	36	20	\$0	\$4,745,000 / \$110,000 / \$6,700	April 2010 -- CMF Web -- CMF ID 2515 -- Reference 39	
	Total Rear-End Crashes	19	20	\$0	\$3,086,000 / \$113,000 / \$6,700	April 2010 -- CMF Web -- CMF ID 2516 -- Reference 39	
	Total Sideswipe Crashes	21	20	\$0	\$4,745,000 / \$110,000 / \$6,700	April 2010 -- CMF Web -- CMF ID 2517 -- Reference 39	
	Total Head-On Crashes	47	20	\$0	\$4,745,000 / \$110,000 / \$6,700	April 2010 -- CMF Web -- CMF ID 2518 -- Reference 39	
	<u>Urban and Suburban - Principal Arterial</u>						
	Total Fatal Crashes	47	20	\$0	\$4,451,000 / \$117,000 / \$6,700	August 2013 -- CMF Web -- CMF ID 5093 -- Reference 43	
	Total Non-Fatal Injury Crashes	3	20	\$0	\$4,451,000 / \$117,000 / \$6,700	August 2013 -- CMF Web -- CMF ID 5092 -- Reference 43	
	Total PDO Crashes	6	20	\$0	\$4,451,000 / \$117,000 / \$6,700	August 2013 -- CMF Web -- CMF ID 5091 -- Reference 43	
	<u>Urban and Suburban - Principal Arterial</u>						
	Total Fatal Crashes	21	20	\$0	\$4,451,000 / \$117,000 / \$6,700	August 2013 -- CMF Web -- CMF ID 5113 -- Reference 43	
	Total Non-Fatal Injury Crashes	42	20	\$0	\$4,451,000 / \$117,000 / \$6,700	August 2013 -- CMF Web -- CMF ID 5112 -- Reference 43	
Total PDO Crashes	32	20	\$0	\$4,451,000 / \$117,000 / \$6,700	August 2013 -- CMF Web -- CMF ID 5111 -- Reference 43		
9.8 Provide a Median	<u>Urban Principal Arterial</u>						
	Total Non-Fatal Injury Crashes	22	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 22 -- Reference 2	
	Total PDO Crashes	-9	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 23 -- Reference 2	
	<u>Rural Principal Arterial</u>						
	Total Non-Fatal Injury Crashes	12	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 24 -- Reference 2	
	Total PDO Crashes	18	20	\$800	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 25 -- Reference 2	
9.9 Remove Crossover	Total Crashes	90*	20	\$0	\$4,451,000 / \$117,000 / \$6,700	March 07 -- WPRFC Meeting on 030107 -- Subjective based on committee opinion	
9.10 Roundabout Installation (NC Data)	Total Injury Crashes (Injury includes fatality and injury crashes)	75	25	\$2,500	\$4,451,000 / \$117,000 / \$6,700	June 2011 -- NCDOT Internal Evaluation	
	<i>{Total Crashes}</i>	<i>{46}</i>	<i>na</i>	<i>na</i>	<i>na</i>	June 2011 -- NCDOT Internal Evaluation	
	<i>{Total Frontal Impact Crashes}</i>	<i>{76}</i>	<i>na</i>	<i>na</i>	<i>na</i>	June 2011 -- NCDOT Internal Evaluation	
9.11 Convert High-Speed Rural Intersection to Roundabout 3 to 5-Leg - ADT 6030 to 13456, 40-65 MPH <i>{3 to 5-Leg - ADT 6030 to 13456, 40-65 MPH}</i>	<u>Rural</u>						
	Total Injury Crashes (Injury includes fatality and injury crashes)	89	25	\$2,500	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1980 -- Reference 12	
	<i>{Total Crashes}</i>	<i>{67}</i>	<i>na</i>	<i>na</i>	<i>na</i>	November 09 -- CMF Web -- CMF ID 1975 -- Reference 12	
9.12 Convert Signalized Intersection to Roundabout ADT 5300 to 52500, 15-35 MPH ADT 5300 to 52500, 15-35 MPH	Total Crashes	48	25	\$0 / - \$500	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 225 -- Reference 11	
	<u>Urban</u>						
	Total Injury Crashes (Injury includes fatality and injury crashes)	55	25	\$0 / - \$500	\$4,451,000 / \$117,000 / \$6,700	June 2012 -- CMF Web -- CMF ID 4189 -- Reference 46	
	<u>Suburban</u>						
	Total Injury Crashes (Injury includes fatality and injury crashes)	42	25	\$0 / - \$500	\$4,451,000 / \$117,000 / \$6,700	June 2012 -- CMF Web -- CMF ID 4186 -- Reference 46	
	<u>Rural - 4-Leg</u>						
9.13 Convert Two-Way Stop-Controlled Intersection to Roundabout	Total Crashes	71	25	\$2,500	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 237 -- Reference 11	
	<u>Suburban - 4-Leg</u>						
	Total Crashes	78	25	\$2,500	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 238 -- Reference 11	
<u>Urban - 4-Leg</u>							
Total Crashes	29	25	\$2,500	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 231 -- Reference 11		
9.14 Splitter Island with Additional Stop Sign	Total Right Angle Crashes	36	20	\$800	\$4,745,000 / \$110,000 / \$6,700	April 05 -- WPRFC Email -- Low Cost Workshop	
	<i>{Total Crashes}</i>	<i>{11}</i>	<i>na</i>	<i>na</i>	<i>na</i>	April 05 -- WPRFC Email -- Low Cost Workshop	
9.15 Transverse Rumble Strips	Total Crashes	30	10	\$0	\$4,451,000 / \$117,000 / \$6,700	May 05 -- WPRFC Email -- Low Cost Workshop	

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				Maintenance /	Utility Costs		
9. Intersection Enhancements (continued)							
9.16 4-Way Stop Installation (NC Data) Without Overhead Flashers	Total Injury Crashes (Injury includes fatality and injury crashes)	71	6	\$0		\$4,451,000 / \$117,000 / \$6,700	March 2011 -- CMF Web -- CMF ID 3131 -- Reference 41
	<i>{Total Crashes}</i>	<i>{61}</i>	<i>na</i>	<i>na</i>		<i>na</i>	March 2011 -- CMF Web -- CMF ID 3130 -- Reference 41
	<i>{Total Frontal Impact Crashes}</i>	<i>{72}</i>	<i>na</i>	<i>na</i>		<i>na</i>	March 2011 -- CMF Web -- CMF ID 3132 -- Reference 41
4-Way Stop Installation (NC Data) With Existing Overhead Flashers	Total Injury Crashes (Injury includes fatality and injury crashes)	87	6	\$0		\$4,451,000 / \$117,000 / \$6,700	March 2011 -- CMF Web -- CMF ID 3134 -- Reference 41
	<i>{Total Crashes}</i>	<i>{80}</i>	<i>na</i>	<i>na</i>		<i>na</i>	March 2011 -- CMF Web -- CMF ID 3133 -- Reference 41
	<i>{Total Frontal Impact Crashes}</i>	<i>{84}</i>	<i>na</i>	<i>na</i>		<i>na</i>	March 2011 -- CMF Web -- CMF ID 3135 -- Reference 41
4-Way Stop Installation (NC Data) With Overhead Flashers Installed	Total Injury Crashes (Injury includes fatality and injury crashes)	87	10	\$300 / \$260		\$4,451,000 / \$117,000 / \$6,700	March 2011 -- CMF Web -- CMF ID 3137 -- Reference 41
	<i>{Total Crashes}</i>	<i>{82}</i>	<i>na</i>	<i>na</i>		<i>na</i>	March 2011 -- CMF Web -- CMF ID 3136 -- Reference 41
	<i>{Total Frontal Impact Crashes}</i>	<i>{86}</i>	<i>na</i>	<i>na</i>		<i>na</i>	March 2011 -- CMF Web -- CMF ID 3138 -- Reference 41
All-Way Stop Installation (62% of Sample On One Way Streets)	Total Injury Crashes (Injury includes fatality and injury crashes)	71	6	\$0		\$4,451,000 / \$117,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 7
	<i>{Total Crashes}</i>	<i>{47}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 7
	<i>{Total Right-Angle Crashes}</i>	<i>{72}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 7
	<i>{Total Rear-End Crashes}</i>	<i>{13}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 7
	<i>{Total Left-Turn Crashes}</i>	<i>{20}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 7
	<i>{Total Pedestrian Crashes}</i>	<i>{39}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 05 -- NCHRP Digest 299 -- Study 7
9.17 Grade Separation - No Interchange	Total Crashes	90*	50	\$0		\$4,451,000 / \$117,000 / \$6,700	March 06 -- WPRFC Email -- Subjective based on committee opinion
9.18 Convert At-Grade Intersection to Grade-Separated Interchange	Total Non-Fatal Injury Crashes	57	50	\$0		\$4,451,000 / \$117,000 / \$6,700	November 2009 -- CMF Web -- CMF ID 460 -- Reference 4
	Total PDO Crashes	36	50	\$0		\$4,451,000 / \$117,000 / \$6,700	November 2009 -- CMF Web -- CMF ID 461 -- Reference 4
	<i>{Total Crashes}</i>	<i>{42}</i>	<i>na</i>	<i>na</i>		<i>na</i>	November 2009 -- CMF Web -- CMF ID 459 -- Reference 4
9.19 Realign Intersection to Change Stop Condition and Install Turn Lanes	Total Fatal Crashes	66*	20	\$250		\$4,451,000 / \$117,000 / \$6,700	June 10 -- WPRFC Email -- Subjective based on committee opinion
	Total Non-Fatal Injury Crashes	43*	20	\$250		\$4,451,000 / \$117,000 / \$6,700	June 10 -- WPRFC Email -- Subjective based on committee opinion
9.20 Conversion of Four-Leg or Cross Intersections into Two T-Intersections	Total Crashes	57	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 1628 -- Reference 34
	<u>Urban</u>						
	Total Non-Fatal Injury Crashes	25	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 201 -- Reference 2
	Total PDO Crashes	10	20	\$0		\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 205 -- Reference 2
	<u>Rural Principal Arterial - 4-Lane Divided</u>						
Total Crashes	53	20	\$0		\$4,451,000 / \$117,000 / \$6,700	October 10 -- CMF Web -- CMF ID 2731 -- Reference 38	
9.21 Remove a Leg from an Intersection	Total Crashes	40*	20	\$0		\$4,451,000 / \$117,000 / \$6,700	January 11 -- WPRFC Email -- Subjective based on committee opinion
9.22 Installation of Foilage to Block Sight Distance of Downstream Intersection	Total Crashes	50*	20	\$0		\$4,451,000 / \$117,000 / \$6,700	September 14 -- WPRFC Email -- Subjective based on committee opinion

Note: Items in *{Italics Text}* are for Historical purposes only and should not be used in the Benefit Cost analysis

(Revised April 1, 2015)

* Subjective data agreed upon by the Crash Reduction Factor Committee until empirical data is established. The subjective data is based off of small samples of Simple Before and After Analyses or are compiled from the experiences and opinions of the Crash Reduction Factor Committee members.

Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual Maintenance / Utility Costs	NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
10. Pedestrian and Bicycle Enhancements						
10.1 Pedestrian Structure	Pedestrian	85	50	\$0	\$5,077,000 / \$99,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 12
10.2 Crosswalk	Total Pedestrian Crashes	25	5 Long Life, 1 Paint	\$0	\$5,077,000 / \$99,000 / \$6,700	April 01 -- WPRFC Meeting Handout -- Reference 13
10.3 Crosswalk - Multiple Improvements	Total Pedestrian Crashes	50*	5 Long Life, 1 Paint	\$0	\$5,077,000 / \$99,000 / \$6,700	March 06 -- WPRFC Email -- Subjective based on committee opinion
10.4 Install Raised Medians at Crosswalks	<u>Urban and Suburban Multilane Roads - Marked Crosswalks</u> Total Pedestrian Crashes	46	20	\$800	\$5,077,000 / \$99,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 20
	<u>Urban and Suburban Multilane Roads - Unmarked Crosswalks</u> Total Pedestrian Crashes	39	20	\$800	\$5,077,000 / \$99,000 / \$6,700	November 05 -- NCHRP Digest 299 -- Study 20
10.5 Change Out Standard Pedestrian Heads to Countdown Pedestrian Heads	None	None*	na	na	na	April 08 -- WPRFC Email -- Subjective based on committee opinion
10.6 Hawk Pedestrian Crossing Beacon	<u>Rural 2-lane</u> Total Crashes	12	10	\$500 / \$100	\$4,451,000 / \$117,000 / \$6,700	November 09 -- CMF Web -- CMF ID 2109 -- Reference 1
	<u>Urban and Rural</u> Total Vehicle/Pedestrian Crashes	65	10	\$500 / \$100	\$5,077,000 / \$99,000 / \$6,700	October 10 -- CMF Web -- CMF ID 2922 -- Reference 42
	<i>{Total Crashes}</i>	<i>{29}</i>	<i>na</i>	<i>na</i>	<i>na</i>	October 10 -- CMF Web -- CMF ID 2911 -- Reference 42
10.7 Install Bike Lanes	None	None*	na	na	na	August 12 -- WPRFC Email -- Subjective based on committee opinion
	<u>Urban</u> Total Injury Crashes (Injury includes fatality and injury crashes)	5	5 Long Life, 1 Paint	\$0	\$4,451,000 / \$117,000 / \$6,700	January 2013 -- CMF Web -- CMF ID 4660 -- Reference 45
10.8 Install High Visibility Crosswalk	<u>Urban</u> Total Vehicle/Pedestrian Crashes	40	5 Long Life, 1 Paint	\$0	\$5,077,000 / \$99,000 / \$6,700	September 2012 -- CMF Web -- CMF ID 4123 -- Reference 48
10.9 Installation of Sidewalks	Total Pedestrian Crashes	72*	20	\$0	\$5,077,000 / \$99,000 / \$6,700	January 13 -- WPRFC Email -- Subjective based on committee opinion
10.10 Installation of Pedestrian Countdown Heads Where No Pedestrian Heads Exist	Total Pedestrian Injury Crashes (Injury includes fatality and injury crashes)	25*	10	\$200 / \$0	\$5,077,000 / \$99,000 / \$6,700	January 13 -- WPRFC Email -- Subjective based on committee opinion
10.11 Actuated Overhead Flasher for a Pedestrian Location	Total Pedestrian Crashes	20*	10	\$300 / \$260	\$5,077,000 / \$99,000 / \$6,700	February 15 -- WPRFC Email -- Subjective based on committee opinion

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(Revised April 1, 2015)

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Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Service Life	Annual		NCDOT Crash Costs - 2013 (F+A / B+C / PDO)	Date -- Study -- Reference
				Maintenance / Utility Costs			
11. Railroad Crossing							
11.1 Grade Separation	Total Crashes	90*	50	\$0		\$6,582,000 / \$138,000 / \$60,000	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.2 Add Lights and Bells	Total Crashes	50	18	\$1016 / \$0		\$6,582,000 / \$138,000 / \$60,000	November 09 -- CMF Web -- CMF ID 482 -- Reference 2
11.3 Add Lights, Bells, and Gates	Total Crashes	84	18	\$1532 / \$0		\$6,582,000 / \$138,000 / \$60,000	November 09 -- CMF Web -- CMF ID 482/488 Combo -- Reference 2
11.4 Add Vehicle Detection	Total Train/Vehicle or Vehicle/Gate Crashes	20*	10	\$100 / \$0		\$6,582,000 / \$138,000 / \$60,000	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.5 Switch Legs of Stop Sign Control	None	None*	na	na		na	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.6 Relocate Rail Equipment on Shoulder	Total Crashes	22*	20	\$0		\$6,582,000 / \$138,000 / \$60,000	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.7 Median Barriers	Total Crashes	77*	20	\$800		\$6,582,000 / \$138,000 / \$60,000	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.8 Four Quadrant Gates	Total Crashes	86*	18	\$1532 / \$0		\$6,582,000 / \$138,000 / \$60,000	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.9 Four Quadrant Gates and Median Barriers	Total Crashes	98*	20	\$1532 / \$0		\$6,582,000 / \$138,000 / \$60,000	May 12 -- WPRFC Email -- Subjective based on committee opinion
11.10 Close an Existing At-Grade Crossing	Total Crashes	90*	30	\$0		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.11 Improve Vertical Alignment to Remove Sag / Hump	Total Vehicle Hang-Up Crashes	80*	10	\$0		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.12 Improve Approach Sight Distance For Active Crossings	Total Crashes	5*	10	\$0		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.13 Improve Approach Sight Distance For Passive Crossings	Total Crashes	25*	10	\$0		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.14 Widen Pavement at Crossing to Provide Shoulders and/or Walkway	Total Crashes	8*	20	- \$500 per Mile		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.15 Improve Crossing Surface Traversability	Total Crashes	24*	10	\$0		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.16 Install New Traffic Signal with Preemption	Total Crashes	22*	10	\$3000 / \$500		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.17 Install Traffic Signal Preemption at an Adjacent Intersection	Total Crashes	15*	10	\$500 / \$100		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.18 Install Train Actuated "Second Train Approaching" Sign	Total Crashes	6*	10	\$500 / \$100		\$6,582,000 / \$138,000 / \$60,000	July 12 -- WPRFC Email -- Subjective based on committee opinion
11.19 Installing Gates at Crossings with Flashing Lights and Sound Signals	Total Crashes	45	18	\$516 / \$0		\$6,582,000 / \$138,000 / \$60,000	November 09 -- CMF Web -- CMF ID 494 -- Reference 2
11.20 Installing Overhead Cantilever with Flashing Lights that has Existing Lights and Gates	Total Train/Vehicle Crashes <i>{Total Crashes}</i>	42* <i>{3*}</i>	18 <i>na</i>	\$1016 / \$0 <i>na</i>		\$6,582,000 / \$138,000 / \$60,000 <i>na</i>	December 12 -- WPRFC Email -- Subjective based on committee opinion December 12 -- WPRFC Email -- Subjective based on committee opinion
11.21 Replacing Tubular Markers with Concrete Medians	Total Crashes	None*	na	na		na	December 12 -- WPRFC Email -- Subjective based on committee opinion

Notes:

Please use all crashes of the correctable type occurring at the location unless otherwise noted.

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Revised April 1, 2015

References:

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April 01 -- WPRFC Handout -- Reference 2
April 01 -- WPRFC Handout -- Reference 3
April 01 -- WPRFC Handout -- Reference 4
April 01 -- WPRFC Handout -- Reference 8
April 01 -- WPRFC Handout -- Reference 9
April 01 -- WPRFC Handout -- Reference 10
April 01 -- WPRFC Handout -- Reference 11
April 01 -- WPRFC Handout -- Reference 12
April 01 -- WPRFC Handout -- Reference 13

(WPRFC -- W-Project Reduction Factor Committee)

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November 05 -- NCHRP Digest 299 -- Study 2
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November 05 -- NCHRP Digest 299 -- Study 7
November 05 -- NCHRP Digest 299 -- Study 11
November 05 -- NCHRP Digest 299 -- Study 17
November 05 -- NCHRP Digest 299 -- Study 18
November 05 -- NCHRP Digest 299 -- Study 19
November 05 -- NCHRP Digest 299 -- Study 20

November 09 -- CMF Web -- Reference 1
November 09 -- CMF Web -- Reference 2
November 09 -- CMF Web -- Reference 3
November 09 -- CMF Web -- Reference 4
November 09 -- CMF Web -- Reference 5
November 09 -- CMF Web -- Reference 6
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Install a Traffic Signal -- McGee, Taori, and Persaud; 2003
Convert to All-Way Stop Control -- Lovell and Hauer; 1986
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Add Shoulder Rumble Strips -- Griffith; 1999
Add Centerline Rumble Strips -- Persaud, Retting, and Lyon; 2003
Install/Upgrade Guardrail -- Elvik and Vaa; 2004
Install Raised Medians at Crosswalk -- Zegeer, Stewart, Huang, and Lagerwey; 2001

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