

Estimates of Countermeasure Effectiveness Reduction (CRF) Factors

(September 1997, Revised July 2007)

ID	Description	All	PDO	INJ/FAT	Night	Wet	Pedestrian	Left	Right	Angle	Rear	Head	Side	Fixed	Ran
1	1 Upgrade pavement markings - general	0.1													
2	2 Install raised pavement markers, locations & sections	0.09													
3	3 Install plastic pavement markings	0.1													
4	4 De-slick pavement - sections [except wet pavement crashes]	0.2				0.5									
5	5 Resurface - rural sections - 2 lane	0.12		0.21											
6	5a Resurface - rural sections > 2 lane	0.44		0.59											
7	56 Resurface - urban section > 2 lane	0.42		0.46											
8	6 Upgrade signs - general	0.05													
9	7 Lane use signs - overhead										0.1		0.2		
10	8 Warning signs at intersection - rural	0.2		0.25											
11	9 Warning signs on section - rural 2 lane	0.36		0.32											
12	9a Warning signs on section - rural > 2 lane	0.18		0.03											
13	57 Install/improve warning signs on rural curves [curve crashes only]	0.2													
14	30 Install warning sign-mounted flasher	0.3													
15	31 Install PTSWF sign/flasher [for approach speeds > 45 mph]										0.6				
16	58 Install/improve warning signs on sections - rural 2 lane	0.36		0.32											
17	58a Install/improve warning signs on sections - rural > 2 lane	0.18		0.03											
18	59 Install/improve warning signs on sections - urban 2 lane	0.14		0.14											
19	59a Install/improve warning signs on sections - urban > 2 lane	0.26		0.2											
20	60 Install delineators at curve - rural [Curve crashes only]	0.16													
21	13 Install concrete median barrier [median and cross-median crashes only]			0.61											
22	14 Install painted median	0.12													
23	15 Install two-way left turn lane	0.083		0.2											
24	41 Flatten vertical curve	0.2		0.51											
25	16 Install left turn bay & extra pavement without signal							0.2			0.2				
26	17 Install left turn bay & extra pavement with signal							0.2			0.2				
27	37 Widen roadway, rural section, no additional lanes	0.38		0.3											
28	38 Widen roadway, rural section, including additional lanes	0.38		0.3											
29	39 Widen for left turn lane, including resurfacing							0.2			0.2		0.2		
30	40 Widen for right turn lane, including resurfacing								0.2		0.2		0.2		
31	42 Stabilize berms - rural section	0.38		0.3											
32	20 Upgrade existing flasher	0.2													
33	21 Install flasher	0.5													
34	22 Upgrade existing signal - general	0.2													
35	23 Reconstruct existing signal - major	0.27													
36	24 Install traffic signal - all types							0.1	0.1	0.8	-0.1		0.1		
37	25 Revise signal timing	0.1													
38	26 Add pedestrian heads						0.5								
39	27 Add left turn phase with new left turn lane							0.4			0.2				
40	28 Add left turn phase with existing left turn lane							0.3			0.1				
41	29 Add left turn phase without left turn lane							0.2							
42	32 Install optically programmed heads							0.1		0.1	0.1	0.2			
43	33 Remove existing, unwarranted signal														
44	61 Provide signal interconnection														
45	34 Install intersection lighting			0.75											
46	35 Install section lighting			0.5											
47	36 Upgrade existing lighting			0.5											
48	43 Replace culvert													0.6	
49	44 Replace bridge													0.62	
50	45 Widen bridge													0.43	
51	46 Widen culvert													0.25	
52	62 Install guard rail at bridge end [Injury-fatal crashes only]													0.2	
53	49 Install guard rail [Injury-fatal crashes only]													0.2	0.2
54	63 Improve guard rail [Injury-fatal crashes only]													0.2	
55	50 Remove or relocate fixed object to a safe distance from the roadway	0.38		0.38											
56	64 Make utility pole breakaway [Utility pole fatal crashes only]													0.3	
57	65 Relocate utility pole 3 0' from edge of pavement [Utility pole fatal crashes only]													0.32	
58	66 Remove utility pole [Utility pole fatal crashes only]													0.38	
59	67 Remove tree [Tree crashes only]													0.25	
60	68 Make sign support breakaway - all sizes [Sign injury-fatal crashes only]													0.24	
61	69 Install auto. prot. device at R/R grade crossing [Train-vehicle crashes only]	0.28													
62	48 Install impact attenuator device [Injury-fatal crashes only]													0.5	
63	47 Eliminate fixed objects													1	
64	55 Improve horizontal alignment - rural section	0.4													
65	70 Reconstruct curves on rural section - 2 lane [Curve crashes only]	0.88													
66	10 Eliminate parking														
67	11 Speed zone														
68	12 Prohibit turn	0.4													
69	18 Close median opening														
70	19 Relocate driveway entrance							0.1	0.1	0.1	0.2	0.2			
71	51 Relocate intersection	0.25													
72	52 Increase cross corner sight distance									0.5					
73	71 Prohibit right-turn-on-red								0.2						
74	53 Install rumble strips														
75	54 Provide proper super-elevation on curve - rural [curve crashes only]	0.5													

When using multiple countermeasures, the total reduction factor is:
 $R1 + (1-R1)R2 + (1-R1)(1-R2)R3 + (1-R1)(1-R2)(1-R3)R4 + \dots = RT$
Cost of crashes for determining ROR (Updated - 2006)

SYSTEM	PDO	INJ/FAT
Rural State Highways	\$9,960	\$82,224
Counties and Unincorporated Villages	\$7,430	\$59,234
Cities and Incorporated Villages	\$10,846	\$70,073