SMART SCALE Planning Level CMFs – Round 6

Project Extent	Improvement Type/Features	CMF Value
Freeway	Implement ITS for incident management	0.85
	Implement hard shoulder running lanes	0.68
	Implement ramp metering	0.86
	Implement variable speed limits	0.87
	Add auxiliary lanes between ramps	0.77*
	Widen on directional basic freeway segment (2 to 3 lanes – rural)	0.90*
	Widen on directional basic freeway segment (4 to 5 lanes – urban)	0.92*
	Widen on directional basic freeway segment (other scenarios)	No benefit*
	Widen on directional merge segment	0.80*
	Widen on directional weave and diverge segments	No benefit*
	Install lighting	Targeted
Arterial	Install adaptive traffic signal	0.642
	Retime or optimize signals	0.958
	Install flashing yellow arrow at signalized intersection	Targeted
	Add median (along roadway segment)	0.74
	Convert intersection to right-in, right-out	0.20*
	Reconstruct roadway alignment	0.85*
	Add two-way left turn lane (four to five lane conversion)	0.758
	Add two-way left turn lane (two to three lane conversion)	0.739
	Convert a 4-lane road to a 2-lane road and install a center two-way left turn lane	0.53
	Install traffic calming measures	0.89*
	Widen arterial outside influence area of signalized intersection	No benefit*
	Add through lanes at signalized intersection	Function*
	Widen travel lanes – rural	Function
	Widen travel lanes – urban	Function
	Improve shoulder/clear zone/roadside	Targeted*
	Add truck climbing or passing lane	Targeted*

*Additional guidance on implementation is provided in safety scoring training slides
@Do not pair CMF with CMFs listed in Unapplicable CMF Pairs list

Project Extent	Improvement Type/Features	CMF Value
Arterial	Install lighting	Targeted
	Convert stop/yield control to signal	0.65[@]
	Convert stop/yield control to roundabout	0.18[@]
	Convert two-way stop control to unsignalized RCUT	0.37*[@]
	Convert signal to roundabout	0.22[@]
	Convert signal to signalized RCUT	0.78*[@]
	Convert signal to continuous green T (CGT) intersection	0.85[@]
	Convert signal to partial displaced left turn (DLT) intersection	0.81[@]
	Convert signal to median U-turn (MUT) intersection	0.77*[@]
	Convert signal to bowtie intersection	0.77[@]
	Convert signal to thru-cut	0.958*[@]
	Convert signal to quadrant roadway	Design Dependent[@]
	Convert unsignalized intersection to median acceleration lane (unsignalized CGT)	0.88
	Convert pedestal to mast arm	0.56
	Convert span wire to mast arm	0.98
	Add retroreflective backplates to existing signal heads	0.85
	Install lighting	Targeted
	Install conflict warning system – intersection of 4-lane road and 2-lane road	0.80
	Install conflict warning system – intersection of 2-lane road and 2-lane road	0.70
	Add turn lane (none present on approach)	Function*[@]
	Add turn lane (to existing)	0.97*[@]
	Extend turn lane	0.85*[@]
	Construct channelized right turn at 3-legged intersection	0.98*
	Construct channelized right turn at 4-legged intersection	0.87*
	Improve angle of channelized right-turn lane	0.564*
	Improve intersection skew angle	Function
	Increase intersection radii	0.95
	Install pedestrian or bicyclist accommodations	Targeted

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Project Extent	Improvement Type/Features	CMF Value
Interchange	Convert at-grade intersection to interchange	0.43
	Convert diamond interchange to DDI	0.558[@]
	Convert diamond interchange to SPUI	0.62[@]
	Convert full cloverleaf interchange to partial cloverleaf interchange	Volume Based*
	Add collector-distributor roads	0.90
	Extend ramp acceleration lane length	Function*
	Extend ramp deceleration lane length by 100 feet up to 700 feet in total length	0.93*
	Change number of entrance or exit ramps at interchange	Targeted

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Targeted CMF Short List

CMF Type	Improvement Type/Feature	Targeted Crash Type	CMF Value	Application Notes
Pedestrian and Bicycle	Add new sidewalk	Pedestrian[6]	0.598*	
	Add bicycle lane on roadway (not separated)	Bicyclist[5],	0.42	
	Add separated bicycle facility	Bicyclist[5]; Not Intersection[7]	Function	
	Add shared-use path or mixed-use trail	Pedestrian[6]	0.598*@	
		Bicyclist[5]; Not Intersection[7]	0.41*@	
	Add high-visibility crosswalk	Pedestrian[6]	0.60*@	Applies for new crosswalk or upgrades from low-visibility crosswalk.
	Install countdown pedestrian timer	Pedestrian[6]	0.30@	If a countdown pedestrian timer is installed in coordination with a new or upgraded crosswalk, apply only this CMF.
		N[1]	0.85@	
	Construct median pedestrian refuge island	Pedestrian[6]	0.69	Do not combine with other pedestrian signal improvements.
	Install leading pedestrian interval (LPI)	Pedestrian[6]	0.81	
	Install HAWK/PHB	Pedestrian[6]	0.45	
		Rear End and Sideswipe[1]	0.876	
	Install RRFB	Pedestrian[6]	0.53	
Intersection	Convert protected left-turn phasing to flashing yellow arrow (FYA)	Angle[1]	2.24	
	Convert protected/permissive left-turn phasing to flashing yellow arrow (FYA)	Angle[1]	0.81	
	Convert permissive left-turn phasing to flashing yellow arrow (FYA)	Angle[1]	0.63	

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For CMF Functions, reference the SMART SCALE CMF Calculator in Excel. Refer to the following fields when identifying the targeted crashes:

- (1) – Collision Type
- (2) – Light Condition
- (3) – Roadway Departure Type
- (4) – Single- or Multiple-Vehicle
- (5) – Bike or Not Bike
- (6) – Ped or Not Ped
- (7) – Intersection Analysis

CMF Type	Improvement Type/Feature	Targeted Crash Type	CMF Value	Application Notes
Lighting	Install lighting at intersection	Darkness – Road Not Lighted$_2$	0.881	
	Install lighting at interchange	Darkness – Road Not Lighted$_2$	0.50	Apply to merge/diverge areas and ramps. Apply intersection CMF to ramp terminals.
	Install lighting on segment	N/A	N/A	
Segment	Install centerline rumble strips	Head On$_1$	0.55	
		Roadway Departure – Left$_3$	0.55	
		Sideswipe – Opposite Direction$_1$	0.55	
	Install edge rumble strips	Roadway Departure – All$_3$	0.84	
	Install truck climbing lane	Head On$_1$	0.66*	
		Sideswipe – Same Direction$_1$	0.66*	
		Sideswipe – Opposite Direction$_1$	0.66*	
		Roadway Departure – All$_3$	0.66*	
	Widen paved inside shoulder on freeway from X to Y feet	Roadway Departure – Left$_3$	Function*	
	Widen paved outside shoulder on freeway from X to Y feet	Roadway Departure – Right/Unknown$_3$	Function*	Separate functions for horizontal curve and tangent segments.
	Widen average shoulder width on non-freeway from X to Y feet	Roadway Departure – All$_3$	Function*	
	Improve roadside hazard rating (RHR)	Roadway Departure – All$_3$	Function*	
	Change driveway density along segment	Multiple-Vehicle$_4$	Function*	Must remove two driveways on same roadway.
Interchange	Add entrance ramp lane (1 to 2 lanes)	Multiple-Vehicle$_4$	1.60	
	Add exit ramp lane (1 to 2 lanes)	Multiple-Vehicle$_4$	1.65	

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For CMF Functions, reference the SMART SCALE CMF Calculator in Excel. Refer to the following fields when identifying the targeted crashes:

(1) – Collision Type
(2) – Light Condition
(3) – Roadway Departure Type

(4) – Single- or Multiple-Vehicle
(5) – Bike or Not Bike
(6) – Ped or Not Ped

Unapplicable CMF Pairs

Main CMF	CMFs That Should Not Be Paired
Install countdown pedestrian timer	Add high-visibility crosswalk Construct median pedestrian refuge island
Add high-visibility crosswalk	Construct median pedestrian refuge island
Add shared-use path or mixed-use trail	Add new sidewalk Add bicycle lane
Convert stop/yield control to signal	Retime or optimize signals
Convert stop/yield control to roundabout	Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane Add high-visibility crosswalk Construct median pedestrian refuge island
Convert two-way stop control to unsignalized RCUT (at main intersection)	Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signal to roundabout	Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane Add high-visibility crosswalk Construct median pedestrian refuge island
Convert signal to signalized RCUT (at main intersection)	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signal to signalized green T (CGT) intersection	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane Convert unsignalized intersection to median acceleration lane (unsignalized CGT)
Convert signal to displaced left turn (DLT) intersection (at main intersection)	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane

Main CMF	CMFs That Should Not Be Paired
Convert signal to partial displaced left turn (PDLT) intersection (at main intersection)	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signal to median U-turn (MUT) intersection (at main intersection)	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signal to bowtie intersection (at main intersection)	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane Convert stop/yield control to roundabout Convert signal to roundabout
Convert signal to thru-cut (at main intersection)	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signal to quadrant roadway	Retime or optimize signals
Convert stop-controlled diamond interchange to DDI	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signalized diamond interchange to DDI	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert diamond interchange to SPUI	Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Add turn lane (none present on approach)	Add turn lane (to existing) Extend turn lane
Extend turn lane	Add turn lane (none present on approach) Add turn lane (to existing)
Add turn lane (to existing)	Add turn lane (none present on approach) Extend turn lane