

SMART SCALE Planning Level CMFs – Round 5

Project Extent	Improvement Type/Features	CMF Value
Freeway Segment	Implement ITS for incident management	0.85
	Implement ITS for ATM	0.80
	Implement ITS for variable speed limits	0.49
	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
Non-Freeway Segment	Retime or optimize signals	0.91
	Close driveway	0.70*
	Add median or close median opening (convert to right-in/right-out)	0.40*
	Reconstruct roadway alignment	0.85*
	Convert two-way road to one-way road	0.45
	Add two-way left turn lane (four to five lane conversion)	0.45
	Add two-way left turn lane (two to three lane conversion)	0.75
	Reutilize pavement (road diet)	0.55
	Install traffic calming measures	0.85*
	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*
Install lighting	Targeted	

*Additional guidance on implementation is provided in training slides

@Do not pair CMF with CMFs listed in Unapplicable CMF Pair list

Project Extent	Improvement Type/Features	CMF Value
Intersection	Retime or optimize signals	0.91
	Convert stop control to yield control (when warranted)	0.45
	Convert stop/yield control to signal	0.65 [@]
	Convert stop/yield control to roundabout	0.20 [@]
	Convert two-way stop control to unsignalized RCUT	0.37* [@]
	Convert signal to roundabout	0.25 [@]
	Convert signal to signalized RCUT	0.78* [@]
	Convert signal to continuous green T (CGT) intersection	0.85 [@]
	Convert signal to displaced left turn (DLT) intersection	0.80 [@]
	Convert signal to partial displaced left turn (PDLT) intersection	0.85 [@]
	Convert signal to median U-turn (MUT) intersection	0.70* [@]
	Convert signal to bowtie intersection	0.70 [@]
	Convert signal to thru-cut	0.91* [@]
	Convert signal to quadrant roadway	Design Dependent [@]
	Convert unsignalized intersection to median acceleration lane (unsignalized CGT)	0.85
	Convert pedestal to mast arm	0.55
	Convert span wire to mast arm	0.98
	Add retroreflective backplates to existing signal heads	0.85
	Install lighting	Targeted
	Convert unsignalized intersection warning beacons from static to dynamic	0.95
	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 through lanes at signalized intersection	Function*
	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*
	Install traffic calming measures	0.85*
	Add median or close median opening (convert to right-in/right-out)	0.40*
Improve intersection skew angle	Function	
Increase intersection radii	0.95	

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Project Extent	Improvement Type/Features	CMF Value
Interchange	Convert at-grade intersection to interchange	0.50
	Convert stop-controlled diamond interchange to DDI	0.30 [@]
	Convert signalized diamond interchange to DDI	0.37 [@]
	Convert diamond interchange to SPUI	0.60 [@]
	Convert full cloverleaf interchange to partial cloverleaf interchange	Volume Based*
	Replace arterial turns with loops or directional ramps	0.65
	Add collector-distributor roads	0.90
	Extend ramp acceleration lane length	Function*
	Extend ramp deceleration lane length by 250-500 feet up to 700 feet in total length	0.85*
	Implement ramp metering	0.65
Pedestrian and Bicycle	<i>Refer to Targeted CMF Short List for other pedestrian and bicycle CMFs</i>	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 ₁	0.12*	Does not apply for upgrades or widening
	Add bicycle lane	Bicyclist ₅	0.42	
	Add shared-use path or mixed-use trail	Pedestrian ₁	0.12* [@]	
		Bicyclist ₅	0.41* [@]	
	Add high-visibility crosswalk	Pedestrian ₁	0.70* [@]	Applies for new crosswalk or upgrades from low-visibility crosswalk
	Install countdown pedestrian timer	Pedestrian ₁	0.30 [@]	If a countdown pedestrian timer is installed in coordination with a new or upgraded crosswalk, apply only this CMF
		All Others ₁	0.85 [@]	
	Construct median pedestrian refuge island	Pedestrian ₁	0.75	Apply only if this is the only improvement. Do not combine with other pedestrian signal improvements.
	Install leading pedestrian interval (LPI)	Pedestrian ₁	0.413	
	Install HAWK	Pedestrian ₁	0.45	
Rear End and Sideswipe ₁		0.876		
Install RRFB	Pedestrian ₁	0.53		
	Rear End ₁	0.93		
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

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	0.62	
	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*	
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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- (3) – Roadway Departure Type
- (4) – Single- or Multiple-Vehicle
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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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert signal to quadrant roadway	<ul style="list-style-type: none"> Retime or optimize signals
Convert stop-controlled diamond interchange to DDI	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Retime or optimize signals Add turn lane (none present on approach) Add turn lane (to existing) Extend turn lane
Convert diamond interchange to SPUI	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> Add turn lane (to existing) Extend turn lane
Extend turn lane	<ul style="list-style-type: none"> Add turn lane (none present on approach) Add turn lane (to existing)
Add turn lane (to existing)	<ul style="list-style-type: none"> Add turn lane (none present on approach) Extend turn lane