Menlo Park Vision Zero Action Plan

Appendix D: Countermeasure Toolbox

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Countermeasure Toolbox

Summary of Countermeasures

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- Protected Intersection
- Neighborhood Traffic Circle
- Directional Median Openings to Restrict Left Turns
- Road Diet
- Roundabout/Mini Roundabout
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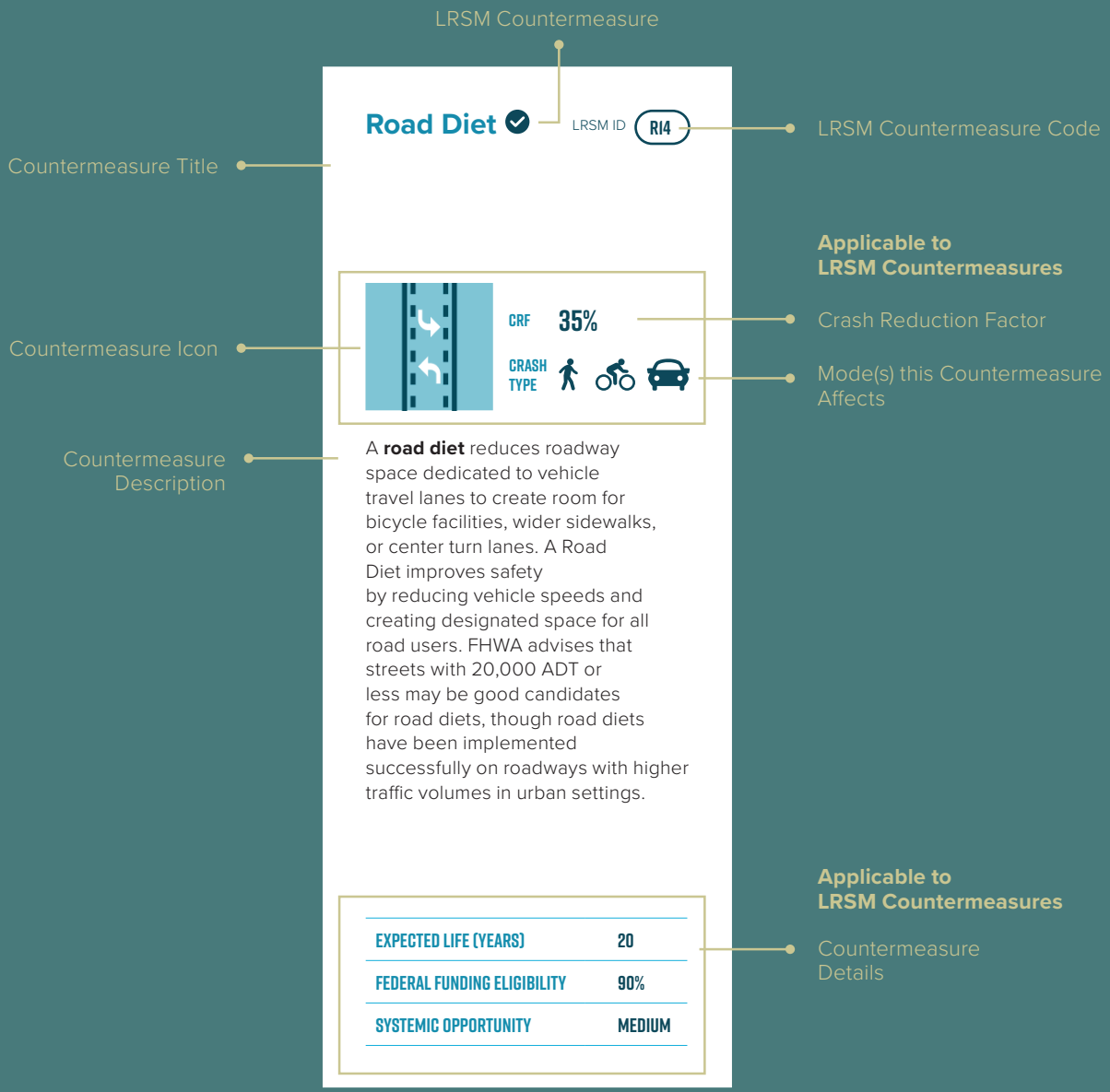
- Speed Hump or Speed Table
- Raised Median/Refuge Island
- Raised Crosswalk
- Rectangular Rapid Flashing Beacon
- Separated Bikeway
- Landscape Buffer
- Straighten Crosswalk
- Bicycle Boulevard
- Pedestrian Countdown Timer
- Widen Sidewalk

SIGNAL MODIFICATIONS

- Accessible Signal Interconnectivity and Coordination (Green Wave)
- Extend Yellow and All-Red Time
- Leading Pedestrian Intervals and Pedestrian Recall
- New Signal
- Protected Left Turn
- Shorten Cycle Length
- Speed Sensitive Rest in Red Signal

Many of the countermeasures in this toolbox are included in the 2022 Caltrans Local Roadway Safety Manual (LRSM) and can be advantageous for use in Caltrans Highway Safety Improvement Program (HSIP) grant funding applications. The toolbox identifies a Caltrans-approved Crash Reduction Factor (CRF) as outlined in the LRSM. The higher the CRF, the greater the expected reduction in collisions. There are many effective safety countermeasures beyond those listed in the LRSM, and several are included in this toolbox.

WHAT YOU'LL SEE IN THIS TOOLBOX



GEOMETRIC MODIFICATIONS

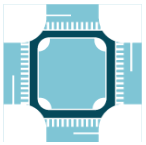
Diverter

A **diverter** is a roadway treatment that restricts through vehicle movements using physical diversion while allowing bicyclists and pedestrians to proceed through an intersection in all directions.

Driveway Consolidation

Reducing the number of driveways through consolidation limits the exposure of pedestrians to vehicles entering or exiting driveways, reducing conflicts.

Protected Intersection



A **protected intersection** provides separate paths for vehicles, bikes and pedestrians each to cross the intersection. One key design element is the corner refuge island. This island forces drivers to turn a full 90 degrees before intersecting a crosswalk when making a right turn and makes the intersection smaller overall, shrinking the distance pedestrians, as well as bikers, have to traverse.

Neighborhood Traffic Circle

Mini circles use paint and soft hit posts to replace stop-controlled intersections with a circular design that slows traffic and eliminates left turns, also reducing conflict points with pedestrians. Also helps traffic flow more efficiently.

GEOMETRIC MODIFICATIONS

Directional Median Openings to Restrict Left Turns

CRF 50%

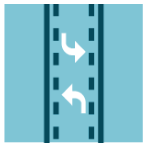
CRASH TYPE

Access control and turn restrictions balances traffic safety and efficiency with reasonable property access. Installing a raised median can restrict turning movements and reduce head-on collisions by number of vehicles that cross the centerline.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Road Diet

LRSM ID R14



CRF 35%

CRASH TYPE

A **road diet** reduces roadway space dedicated to vehicle travel lanes to create room for bicycle facilities, wider sidewalks, or center turn lanes. A Road Diet improves safety by reducing vehicle speeds and creating designated space for all road users. FHWA advises that streets with 20,000 ADT or less may be good candidates for road diets, though road diets have been implemented successfully on roadways with higher traffic volumes in urban settings.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Roundabout/ Mini Roundabout

LRSM ID NS05MR /NS04 /NS05

CRF 30%/VARIES

CRASH TYPE

A **roundabout** is a type of circular intersection in which road traffic is permitted to flow in one direction around a central island, and priority is typically given to traffic already in the junction. The types of conflicts that occur at roundabouts are different from those occurring at conventional intersections; namely, conflicts from crossing and left-turn movements are not present in a roundabout. The geometry of a roundabout keeps the range of vehicle speed narrow, which helps reduce the severity of crashes when they do occur. Pedestrians only have to cross one direction of traffic at a time at roundabouts, thus reducing their potential for conflicts.

See CA MUTCD Chapter 3C for details

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Transit Island

Where there is a protected or buffered bike lane and there is a bus stop, an island between the vehicle lane and the bike lane creates a safe place for pedestrians to wait for the bus. Adding the **transit island** narrows the vehicle lane and has a traffic calming effect on vehicle traffic, encouraging slower speeds which creates less risk for pedestrians.

LIGHTING

Segment Lighting

LRSM ID ROI

CRF 35%

CRASH TYPE

Providing **segment lighting** improves safety during nighttime conditions by making drivers more aware of the surroundings, which improves drivers' perception-reaction times; enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change; and improving nonmotorist's visibility and navigation. Upgrading to LED lighting also has a documented safety benefit. Pedestrian-scale lighting, which can be used in addition to roadway and intersection lighting, is lower in height than standard street lighting and is spaced closer together.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Upgrade to LED Lighting

Upgrading existing street lights to **LED lighting** can increase the visibility of pedestrians in crosswalks, providing for a whiter light, greater color contrast and larger areas of light distribution, when compared to existing high-pressure sodium lighting of the same or higher wattage.

OPERATION/WARNING

All-Way Stop Control

LRSM ID NS02

CRF 50%

CRASH TYPE

An all-way stop-controlled intersection requires all vehicles to stop before crossing the intersection. An all-way stop controlled intersection improves safety by removing the need for motorists, bicyclists, and pedestrians on a side-street stop-controlled intersection to cross free-flowing lanes of traffic, which reduces the risk of collision. An "ALL WAY" sign should be placed under the octagonal stop sign at all-way stop-controlled intersections as required by the California Manual on Uniform Traffic Control Devices (MUTCD).

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	100%
SYSTEMIC OPPORTUNITY	HIGH

Upgrade to Larger Warning Signs

LRSM ID NS06

CRF 15%

CRASH TYPE

The visibility of intersections and, thus, the ability of approaching drivers to perceive them can be enhanced by **installing larger regulatory and warning signs** at or prior to intersections. A key to success in applying this strategy is to select a combination of regulatory and warning sign techniques appropriate for the conditions on a particular unsignalized intersection approach.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	VERY HIGH

Remove Obstructions for Sightlines

LRSM ID NS11

CRF 20%

CRASH TYPE

Remove objects that may prevent drivers and pedestrians from having a **clear sightline**. May include installing red curb at intersection approaches to remove parked vehicles (also called "daylighting"), trimming or removing landscaping, or removing or relocating large signs.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	HIGH

Prohibit Left Turn or U-Turn

Prohibits left turns at locations where a turning vehicle may conflict with pedestrians in the crosswalk or where opposing traffic volume is high. Reduces pedestrian interaction with vehicles when crossing.

OPERATION/WARNING

Lane Narrowing

A **reduction in lane width** produces a traffic calming effect by encouraging motorists to travel at slower speeds, lowering the risk of collision with bicyclists, pedestrians, and other motorists.

Prohibit Right-Turn-on-Red

Restricts right turns during the pedestrian crossing phase at locations where a turning vehicle may conflict with pedestrians in the crosswalk. This restriction may be displayed with a blank-out sign. This may be implemented in conjunction with a Leading Pedestrian Interval.

Retroreflective Borders on Signals

LRSM ID S02

CRF 15%

CRASH TYPE

Retroreflective borders enhance the visibility of traffic signals for aging and color vision impaired drivers enabling them to understand which signal indication is illuminated. Retroreflective borders may also alert drivers to signalized intersections during periods of power outages when the signals would otherwise be dark, and non–reflective signal heads and backplates would not be visible.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	VERY HIGH

Striping Through Intersections

LRSM ID S09

CRF 10%

CRASH TYPE

Adding clear **pavement markings** (i.e. “cat track”) can guide motorists through complex intersections. Intersections where the lane designations are not clearly visible to approaching motorists and/or intersections noted as being complex and experiencing crashes that could be attributed to a driver’s unsuccessful attempt to navigate the intersection can benefit from this treatment.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	VERY HIGH

OPERATION/WARNING

Advanced Stop Bar

LRSM ID S20PB

CRF 15%

CRASH TYPE

An **advance stop bar** is a horizontal stripe painted ahead of the crosswalk at stop signs and signals to indicate where drivers should stop. An advanced stop bar improves safety by reducing instances of vehicles encroaching on the crosswalk. Creating a wider stop bar or setting the stop bar further back may be appropriate for locations with known crosswalk encroachment issues. See CA MUTCD Section 3B.16 for more information.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	VERY HIGH

Bike Box

LRSM ID S20PB

CRF 15%

CRASH TYPE

A **bike box** is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	VERY HIGH

Curb Extensions

LRSM ID NS2IPB

CRF 35%

CRASH TYPE

A **curb extension** widens the sidewalk for a short distance to reduce the crossing distance and to improve pedestrians and drivers' visibility that would otherwise be limited by parked vehicles. Curb extensions also slow vehicles around turns by forcing drivers to make turns at a smaller radius. Paint, surface-mounted flexible guide posts, raised lane separators, delineators posts, and plastic curb barriers are quick build options.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Speed Limit Reduction

Setting speed limits to reflect the surrounding context of the roadway and that meet with driver expectations can help improve driver respect for speed limits. **Speed limits** that appear inconsistent may be ignored by the majority of drivers and this may contribute to lack of respect for speed limit and other traffic laws.

PEDESTRIAN & BICYCLE

Green Conflict Striping

Green conflict striping is green markings painted in a dashed pattern on bike lanes approaching an intersection and/or going through an intersection. Green conflict striping highlights potential conflict points and communicates the expected trajectory of bicyclists through those conflict points.

High-Visibility Crosswalk Striping

LRSM ID SI8PB

CRF 25%

CRASH TYPE

A **high-visibility crosswalk** has a striped pattern with markings made of high-visibility material, such as thermoplastic tape, instead of paint. A high-visibility crosswalk improves safety with a clearly marked pedestrian crossing so motorists exercise caution and yield to pedestrians. The crash reduction factor noted here only applies to locations currently without a marked crosswalk, but high-visibility crosswalk upgrades can be implemented at existing marked crosswalks. See Section 3B.18 of the CA MUTCD for more detail.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	HIGH

Install Sidewalk

LRSM ID R34PB

CRF 80%

CRASH TYPE

Adding **sidewalks** provides a separated and continuous facility for people to walk along the roadway. Adding sidewalks also improves safety by minimizing the risk of vehicle and bicycle collisions with pedestrians.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Shared-Use Path

LRSM ID R34PB

CRF 80%

CRASH TYPE

Installing a **mixed-use path** provides a completely separate right of way that is designated for the exclusive use of people riding bicycles and walking with minimal cross-flow traffic.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

PEDESTRIAN & BICYCLE

Pedestrian Signal

LRSM ID NS23PB

CRF 55%

CRASH TYPE

Corridors should also be assessed to determine if there are adequate safe opportunities for non-motorists to cross and if a **pedestrian signal** is needed to provide an active warning to motorists when a pedestrian is in the crosswalk.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	LOW

Speed Hump or Speed Table

These traffic calming devices use vertical defection to raise the entire wheelbase of a vehicle and encourage motorists to travel at **slower speeds** to avoid damage to the undercarriage of an automobile.

Raised Median/ Refuge Island

LRSM ID NS19PB /SI2 /R08

CRF 45%/25%

CRASH TYPE

A **raised median/refuge island** is raised curb in the center of the roadway that can restrict certain turning movements and provide a place for pedestrians to wait if they are unable to finish crossing the intersection. A Raised Median can improve safety by reducing the number of potential conflict points with designate zones for vehicles to turn, and a pedestrian refuge island improves safety by reducing the exposure time for pedestrians crossing the intersection.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Raised Crosswalk

LRSM ID R36PB

CRF 35%

CRASH TYPE

A **raised pedestrian crossing** at an intersection or on a segment provides a formalized location for people to cross the street, reducing the risk of people crossing outside crosswalks where drivers are not expecting them. Raising the crossing increases the visibility of the crosswalk and pedestrian to the driver and encourages slower driving.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

PEDESTRIAN & BICYCLE

Rectangular Rapid Flashing Beacon

LRSM ID NS22PB /R37PB

CRF 35%

CRASH TYPE

A **rectangular rapid flashing beacon (RRFB)** is a pedestrian-activated flashing light with additional signage to alert motorists of a pedestrian crossing. An RRFB improves safety by increasing motorist yield compliance at uncontrolled locations.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	MEDIUM

Separated Bikeway

LRSM ID R33PB

CRF 45%

CRASH TYPE

A **separated bikeway** provides dedicated street space with physical separation from vehicle traffic, designated lane markings, pavement legends, and signage. Physical separation may consist of plastic posts, parked vehicles, or a curb. Separated bikeways improve safety by reducing conflicts between bicycles and vehicles and by creating a road-narrowing effect which may reduce vehicle speeds. Raised lane separators, delineator and flexible guide posts, planters, and curb barriers a re quick build options.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	HIGH

Landscape Buffer

Separating vehicles from pedestrians using **landscaping** provides more space between the modes and can produce a traffic calming effect by encouraging motorists to drive at slower speeds, lowering the risk of collision.

Straighten Crosswalk

Straightening crosswalks improves sight lines, making pedestrians more visible to oncoming motorists, and may shorten the crossing distance, reducing the length of time required for pedestrians to cross an intersection.

PEDESTRIAN & BICYCLE

Bicycle Boulevard

Bicycle boulevards are roads that encourage low automobile traffic volumes and speeds through signing and striping while giving bicyclists priority and encouraging non-motorized travel. This can be accomplished through traffic calming, which includes measures that encourage slower speeds to bring automobile speeds closer to those of bicyclists.

Pedestrian Countdown Timer

Displays "**countdown**" of seconds remaining on the pedestrian signal. Countdown indications improve safety for all road users, and are required for all newly installed traffic signals where pedestrian signals are installed.

Widen Sidewalk

Wide sidewalks can provide a more comfortable space for pedestrians. They are particularly helpful at locations with high volumes of pedestrians, and for providing space to accommodate people in wheelchairs.

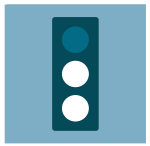
SIGNAL MODIFICATIONS

Accessible Signal Interconnectivity and Coordination (Green Wave)

Certain timing, phasing, and control strategies can produce multiple safety benefits. Sometimes capacity improvements come along with the safety improvements and other times adverse effects on delay or capacity occur. The emphasis of improving **signal coordination** for this countermeasure is to provide an opportunity for slow speed signal coordination. Coordinating signals to allow for bicyclist progression, also known as a 'green wave,' gives bicyclists and pedestrians more time to safely cross through the 'green wave' intersections.

Extend Yellow and All-Red Time

LRSM ID S03



CRF 15%

CRASH TYPE

Extending yellow and all red time increases the time allotted for the yellow and red lights during a signal phase. Extending yellow and red time improves safety by allowing drivers and bicyclists to safely cross through a signalized intersection before conflicting traffic movements are permitted to enter the intersection. See CA MUTCD Section 4D.26 for more detail.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	50%
SYSTEMIC OPPORTUNITY	VERY HIGH

Leading Pedestrian Intervals and Pedestrian Recall

LRSM ID S2IPB

CRF 60%

CRASH TYPE

At intersection locations that have a high volume of turning vehicle and have high pedestrian vs. vehicle crashes, a **leading pedestrian interval** gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left or right. **Pedestrian recall** timing automatically provides a pedestrian crossing phase, without having to press the pedestrian call button.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	VERY HIGH

New Signal

LRSM ID NS03

CRF 30%

CRASH TYPE

Traffic signals at intersections control the flow of traffic. Traffic signals have the potential to reduce the most severe type crashes but will likely cause an increase in rear-end collisions. A reduction in overall injury severity is likely the largest benefit of traffic signal installation.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	LOW

SIGNAL MODIFICATIONS

Protected Left Turn

LRSM ID S06/S07

CRF 30/55%

CRASH TYPE

A **protected left turn** can be implemented at signalized intersections (with existing left turns pockets) that currently have a permissive left-turn or no left-turn protection and a high frequency of angle crashes involving left turning movements. Left turns are widely recognized as the highestrisk movements at signalized intersections. Providing protected left-turn phases significantly improves the safety for left-turn maneuvers by removing the need for the drivers to navigate through gaps in oncoming through vehicles.

EXPECTED LIFE (YEARS)	20
FEDERAL FUNDING ELIGIBILITY	90%
SYSTEMIC OPPORTUNITY	LOW/HIGH

Shorten Cycle Length

LRSM ID S03

CRF 15%

CRASH TYPE

Traffic signal cycle lengths have a significant impact on the quality of the urban realm and consequently, the opportunities for bicyclists, pedestrians, and transit vehicles to operate safely along a corridor. Long signal cycles, compounded over multiple intersections, can make crossing a street or walking even a short distance prohibitive and frustrating. Short cycle lengths of 60–90 seconds are ideal but must be balanced with the time it akes for a pedestrian to cross the street, especially at wide intersections.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING A	50%
SYSTEMIC OPPORTUNITY	VERY HIGH

Speed Sensitive Rest in Red Signal

LRSM ID S03

CRF 15%

CRASH TYPE

vAt certain hours (e.g. late night) a signal will **rest-in-red** for all approaches or certain approaches until a vehicle arrives at the intersection. If the vehicle is going faster than the desired speed, the signal will not turn green until after vehicle stops. If the vehicle is going the desired speed the signal will change to green before the vehicle arrives. This signal timing provides operational benefit to drivers traveling at the desired speed limit. Can be paired with variable speed warning signs.

EXPECTED LIFE (YEARS)	10
FEDERAL FUNDING ELIGIBILITY	50%
SYSTEMIC OPPORTUNITY	VERY HIGH