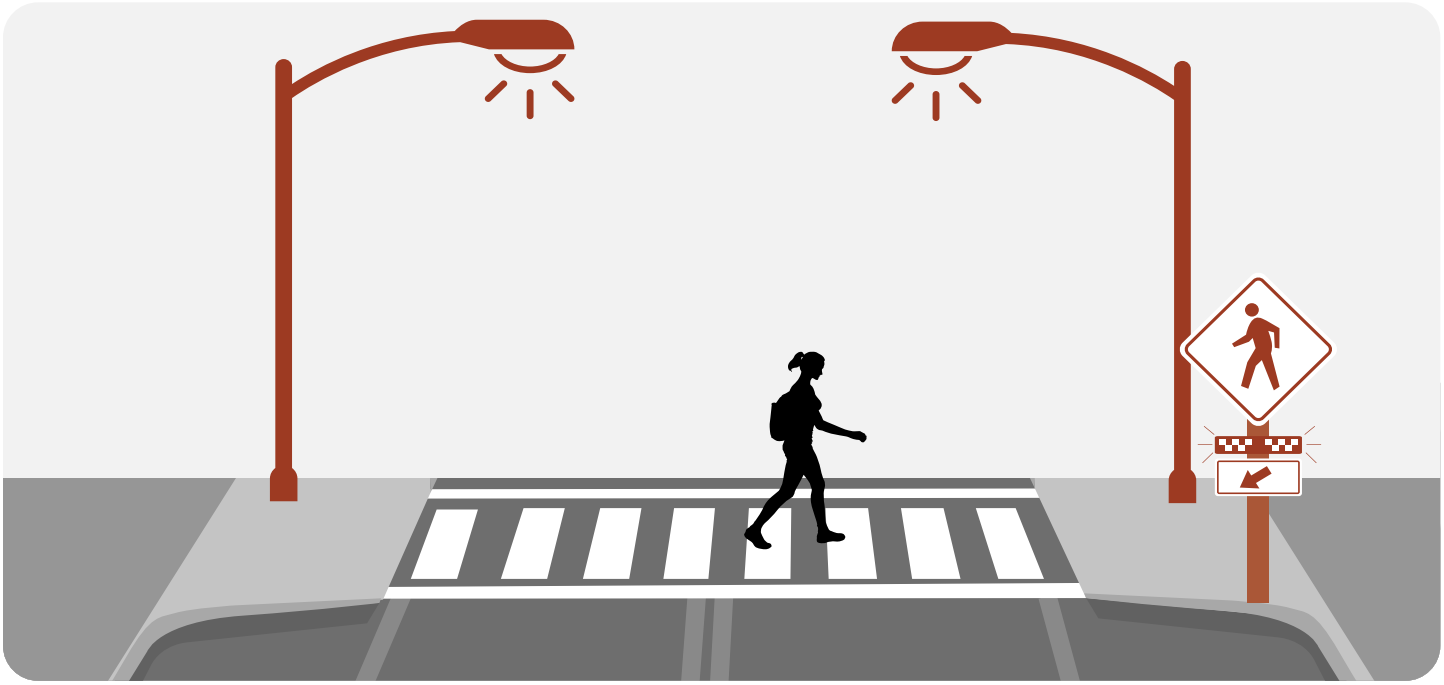
APPENDIX F. CASE STUDY INFORMATION SHEETS

CASE STUDY:
Enhanced Pedestrian and School Crossings



Crosswalk visibility enhancements include safety countermeasures that improve pedestrian safety when crossing roadways by shortening crossing distances, increasing visibility of pedestrians to motorists, and reducing vehicle speeds approaching the crossing. Countermeasures may include crosswalk striping, enhanced signage, lighting improvements, bulb outs and refuge islands. Other countermeasures may include Rectangular Rapid Flashing Beacon (RRFB) signage or a Pedestrian Hybrid Beacon (PHB) type crossings.

Components

- High-visibility paint patterns can be implemented for the crossing making the area and pedestrians more visible to motorists. Signage helps alert motorists of the crossing and potential pedestrians in the area. Lighting at the crossing increases nighttime visibility of pedestrians to motorists.
- Bulb outs on either one or both sides of the roadway shorten the required crossing distance for pedestrians, improve pedestrian visibility to motorists, and help reduce turning speeds for vehicles. Bulb outs can consist of either curb extensions or pavement markings/striping.
- Pedestrian refuge islands allow pedestrians a shorter crossing distance and the ability to cross only one direction of traffic at a time. Refuge islands are especially beneficial on multilane roadways where pedestrians are required to cross multiple lanes of traffic.
- Rectangular Rapid Flashing Beacon (RRFB) signage is activated by a pedestrian at a crossing and flash rectangular LEDs on the sign with alternating high frequency to help capture a motorist's attention and alert them to a crossing pedestrian. For multilane crossings, RRFBs may be mounted on either side of one direction of travel.
- Pedestrian Hybrid Beacons are overhead traffic signals activated by a pedestrian push button that stop vehicles and allows pedestrians to cross the roadway. PHBs, (sometimes called HAWKs) include a controller and operate as a traffic signal, typically accompanied by other high-visibility crossing countermeasures such as signage, striping, lighting, and refuge islands. PHBs help facilitate pedestrian crossings in high pedestrian areas, particularly at mid-block crossings.

Applications

Local or collector type roadways with intersections, mid-block crossings, or school zone crossings. Typically on roadways with speed limits 40 MPH or less.

PHBs may be applied on arterials or other multilane roadways with long crossing distances, more traffic, and higher speeds.

Crash Types

Costs

Low (for visibility enhancements only)
(Note: High for PHB signals.)

CASE STUDY:
Enhanced Pedestrian and School Crossings

Considerations

Not all countermeasures are applicable for each crossing location. The following are some considerations that should be evaluated in selecting safety countermeasures at crossing locations.

High-visibility crossings with signage or other enhancements should be placed in areas where pedestrians would normally not walk out of their way to cross at a typical intersection or crosswalk. Typically these improvements help enhance or create a mid-block crossing away from a standard intersection, however, some components are applicable at a typical unsignalized intersection. These countermeasures are also applicable to school areas or known areas of high pedestrian activity.

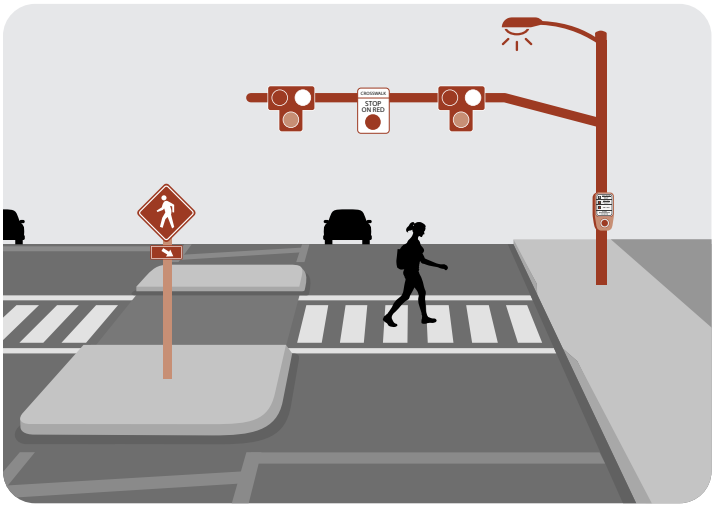
On-street parking must be restricted approaching bulb outs as to not block visibility of pedestrians to motorists. Bulb outs should not extend into the travel lanes. Bicycle lanes need to be considered in the roadway cross section, particularly at the bulb out locations. Drainage should also be considered, especially if bulb outs are extending or covering curb and gutter.

- Bulb outs are ideal on either side of the crossing, if only one side of the crossing is feasible, that may still be installed as an improvement to the crossing. Bulb outs reduce turning radii. Consider if the location serves high numbers of trucks or buses.

Refuge islands should be clear of sight obstructions such as landscaping or signage so that motorists and pedestrians have clear lines of sight. Median islands should be accompanied with signage or flashing signage.

RRFBs may be located on each side of the road or on both sides for a single direction travel lane. The signs may be solar powered in rural areas. Best practice includes RRFB signage on each side of the roadway and in the center median for both directions of travel, when feasible.

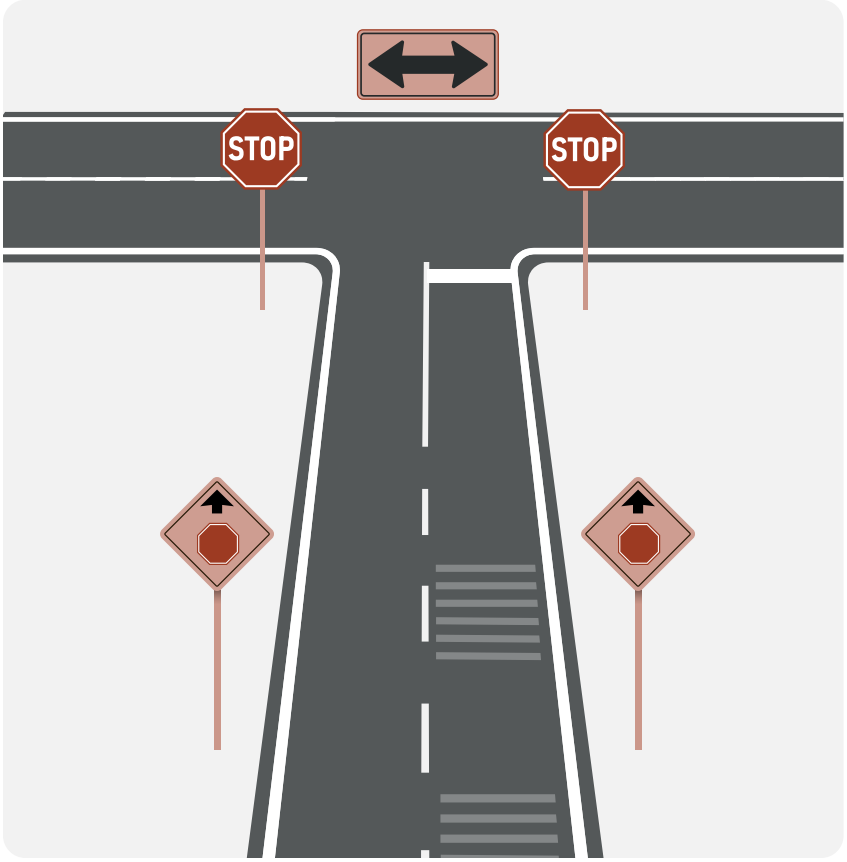
PHBs and RRFBs should be installed in high-pedestrian areas. Consider the spacing and proximity of locations, so that motorists do not discount flashing signs or become accustomed to them.



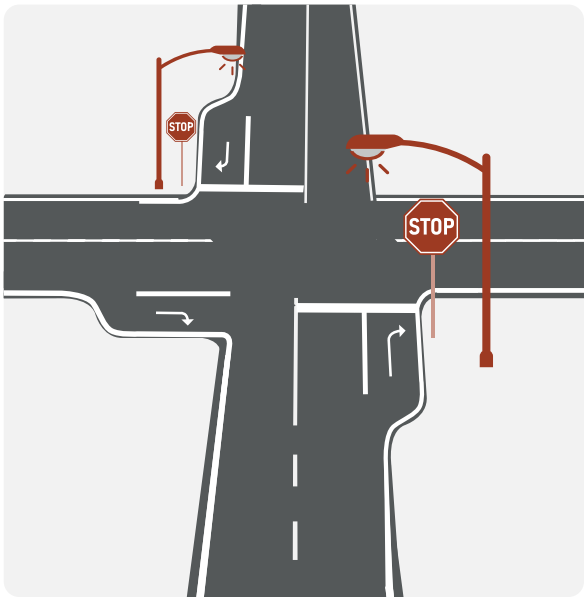
Potential Locations

- SUU Loop (SR 289), Cedar City
- 1925 North, Cedar City
- 600 South, Cedar City
- 860 West, Cedar City
- Center Street (SR 14), Cedar City
- Main Street (SR 274), Parowan City
- 200 South (SR 143), Parowan City
- SR 143, Brian Head Town
- Main Street, Paragonah Town
- Old Highway 91, Enoch City, Kanarraville Town
- Midvalley Road, Enoch City
- Existing crossing locations with only a signed or marked crossing
- School crossings

CASE STUDY:
Unsignalized Intersections



A combination of several low-cost safety countermeasures may be installed to improve safety at unsignalized intersections. Countermeasures may include installing turn lanes, upgraded signage, and improved striping. Intersection lighting and rumble strips may also be incorporated.



Components

- Left- or right-turn lanes provide separation of movements and speeds at an intersection.
- Signage improvements may include 'stop ahead' or 'intersection ahead' signage or stop sign improvements such as an additional sign, larger sign, or signage with flashing beacons.
- Striping improvements may include installing new or refreshing old pavement striping, installing retroreflective striping, or widening the striping beyond typical lane line widths to help delineate the roadway or stop bar locations.
- Intersection lighting may also be considered to help address nighttime visibility and crashes.
- Transverse rumble strips on the minor intersection approaches help alert motorists of an upcoming intersection, stop sign, or stopped vehicles.

Applications

Unsignalized intersections of minor roads (to either other minor roadways or more major roadways).

Crash Types

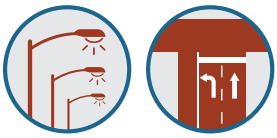
Costs

Low

CASE STUDY:
Unsignalized Intersections

Considerations

Not all countermeasures are applicable for each unsignalized intersection. The following are some considerations that should be evaluated in selecting safety countermeasures at unsignalized intersections.



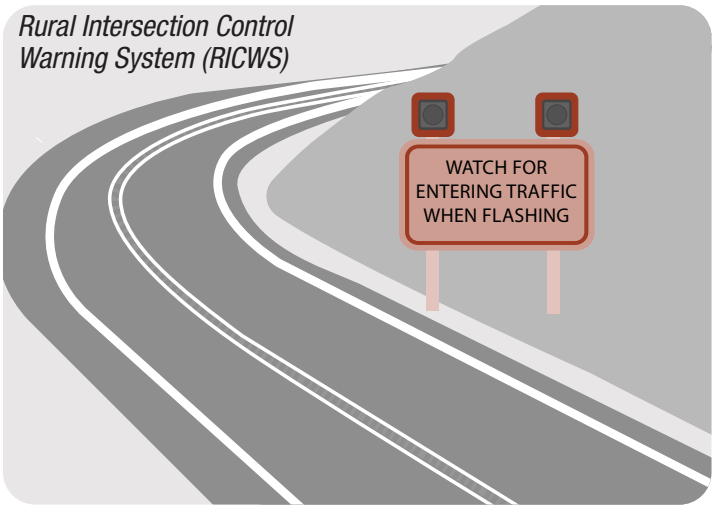
Ensure sight distances are maintained with the addition of signage, turn lanes, or lighting. For lighting to be included in low-cost measures the availability of power needs to be evaluated.

Ensure signing complies with the MUTCD guidelines on traffic control devices or local jurisdiction standards.

Consider striping enhancements or installation during regularly scheduled maintenance, resurfacing or reconstruction of the roadway.

An all-way stop-control, signal warrant, or intersection control evaluation study may be required if traditional countermeasures may not be feasible or effective for a particular location.

RICWS are a much higher cost countermeasure that may be considered at intersections with high major street traffic and low, infrequent minor street traffic.

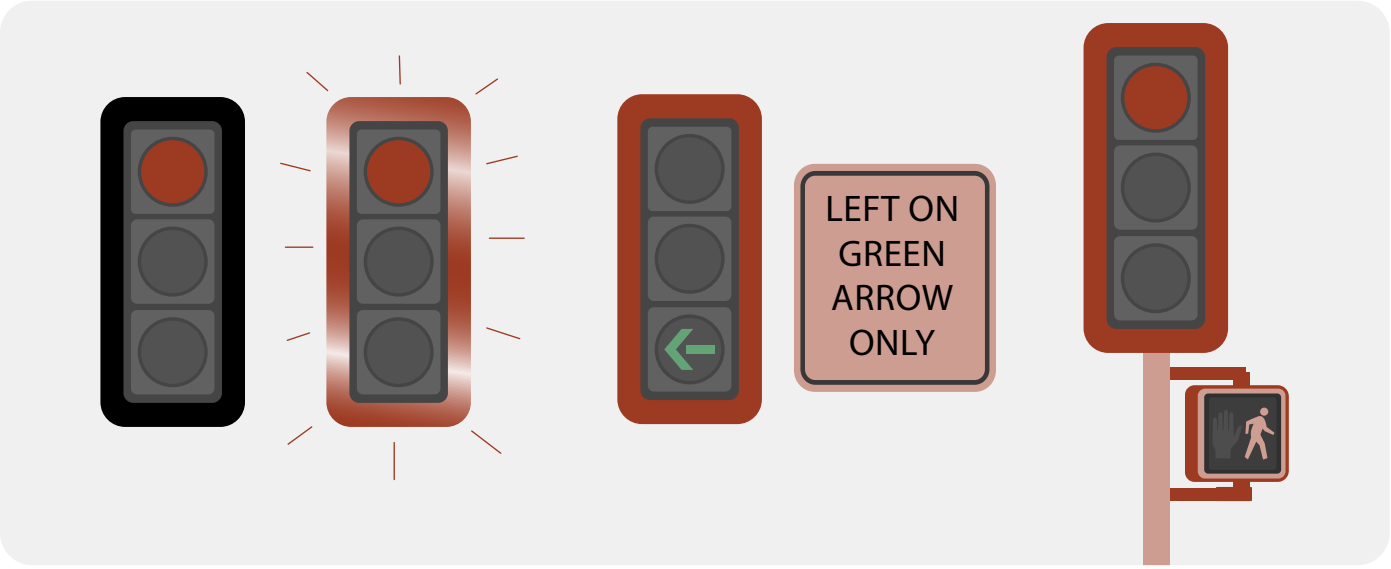


Rural Intersection Control Warning System (RICWS)

Potential Locations

- Berly Junction (SR 18 & SR 56)
- Main Street and SR 56, Newcastle
- Midvalley Road intersections
- Lund Highway intersections
- Old Highway 91 intersections

CASE STUDY:
Signalized Intersections



Various safety countermeasures may be applied at signalized intersections. Countermeasures may include signal timing adjustments, signal infrastructure components such as signal heads or lighting, and lane geometries at the intersection.

Components

- Retroreflective traffic signal backplates that border signal heads improve the visibility of the signal heads to motorists. Retroreflective backplates, different signal head types, and lighting may all help address poor visibility or distracted driving issues.
- Traffic signal timing and phasing improvements such as Leading Pedestrian Intervals (LPI) or left-turn priority phasing help facilitate pedestrians in crosswalks and improve pedestrian visibility to motorists. LPIs allow pedestrians to enter crosswalks before vehicles are allowed to make the turning movement.
- Left- or right-turn lanes provide separation of movements and speeds at an intersection.

Applications

Signalized intersections

Crash Types

Costs

Low
(Medium if lighting or turn lanes are involved.)

CASE STUDY:
Signalized Intersections

Considerations

Each signalized intersection should be carefully evaluated for which types of safety concerns are present. Some considerations to evaluate before applying identified countermeasures include:

Backplates may be a systemic one-time improvement for traffic signal heads at relatively low costs compared to other improvements or infrastructure changes.

- Signal timing for coordinated signals, or signals along a corridor may need to be revisited when LPIs or changes to left-turn phases are implemented. Implementing left-turn phase changes or LPIs will require signal retiming and evaluation.

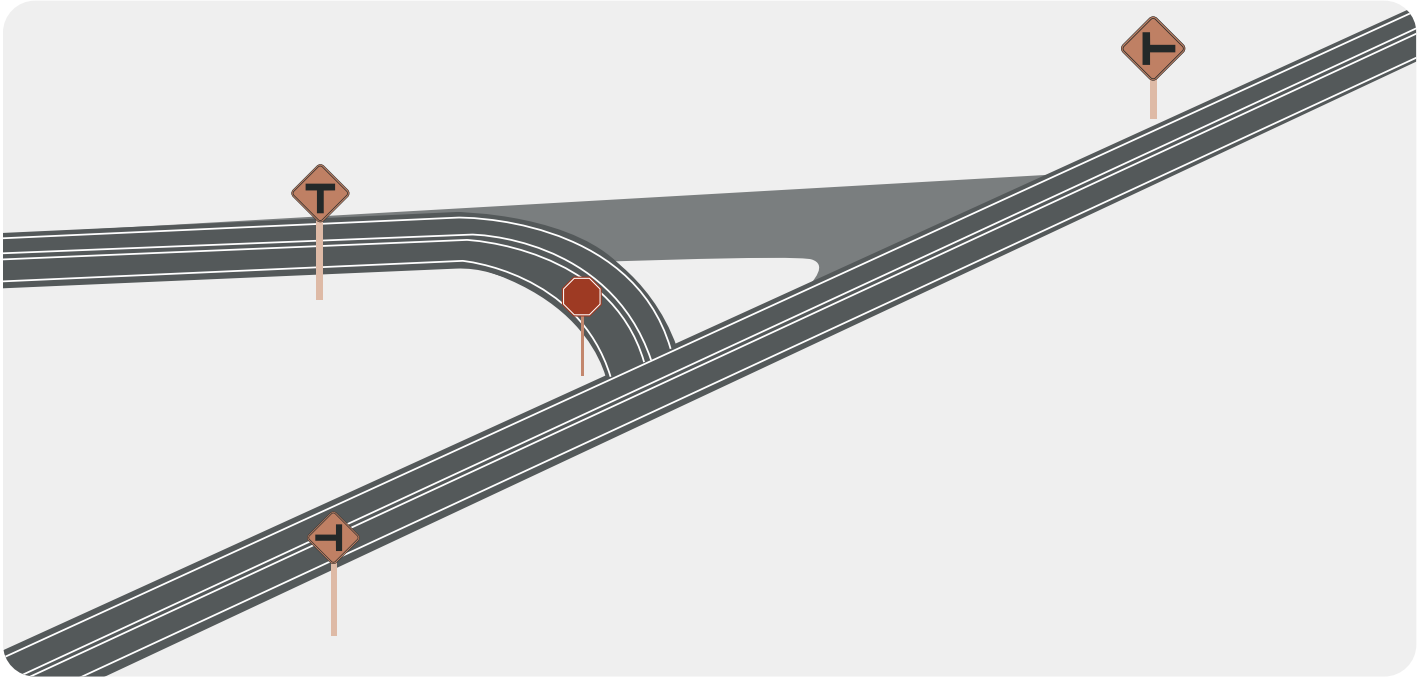
Audible pedestrian signals should be considered at all signalized crossings.

Installing turn lanes extend required pedestrian crossing times. Bulb outs or median refuge islands may be considered in these locations to help shorten the required pedestrian crossing distances.

Potential Locations

- Signalized Intersections with SR 56 (200 North) including: Airport Road, Aviation Way, Cove Drive, Ramp Intersections, 800 West, 300 West.
- Signalized intersections with Main Street (SR 130) in Cedar City: Old Highway 91, 800 South, 600 South, 200 South, Center Street, 200 North, Coal Creek Road, 1045 North, 1925 North, 3000 North.

CASE STUDY:
Skewed Intersections with Major Roadways



A misaligned or skewed roadway approach (typically a more minor local or collector type roadway to a larger collector or arterial type roadway) creates sight issues for motorists and increases crash risk to all roadway users, including pedestrians and bicyclists. Realignment countermeasures including repaving, striping, signage, and roadway configurations provide better sight distance and visibility at the intersection for all users.

Components

- Realignment of a roadway approach should include new pavement, signage, and striping for the minor roadway approach.
- Other countermeasures may be paired with realignment such as intersection lighting, turn lanes, crosswalk visibility enhancements or other unsignalized intersection improvements.

Applications

Skewed minor road approaches and intersections with major roads.

Crash Types

Costs

Medium
(Note, ROW acquisition may be required making this improvement a high cost)

CASE STUDY:
Skewed Intersections with Major Roadways

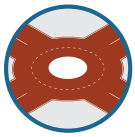
Considerations

Each intersection is unique and will require evaluation of existing conditions. The following should be considered before applying identified safety countermeasures.

Right-of-way may need to be acquired for the realignment of a roadway approach. Evaluate potential impacts to existing utilities or required utility relocations if the roadway was to be realigned.

Adequate curve radii and tangential approach lengths of the minor roadways need to be included or maintained in the realigned roadway approach.

For some minor intersection approaches where rerouting is available and the transportation network is connected in the area, consider terminating the minor road connection to the major road as part of access management.

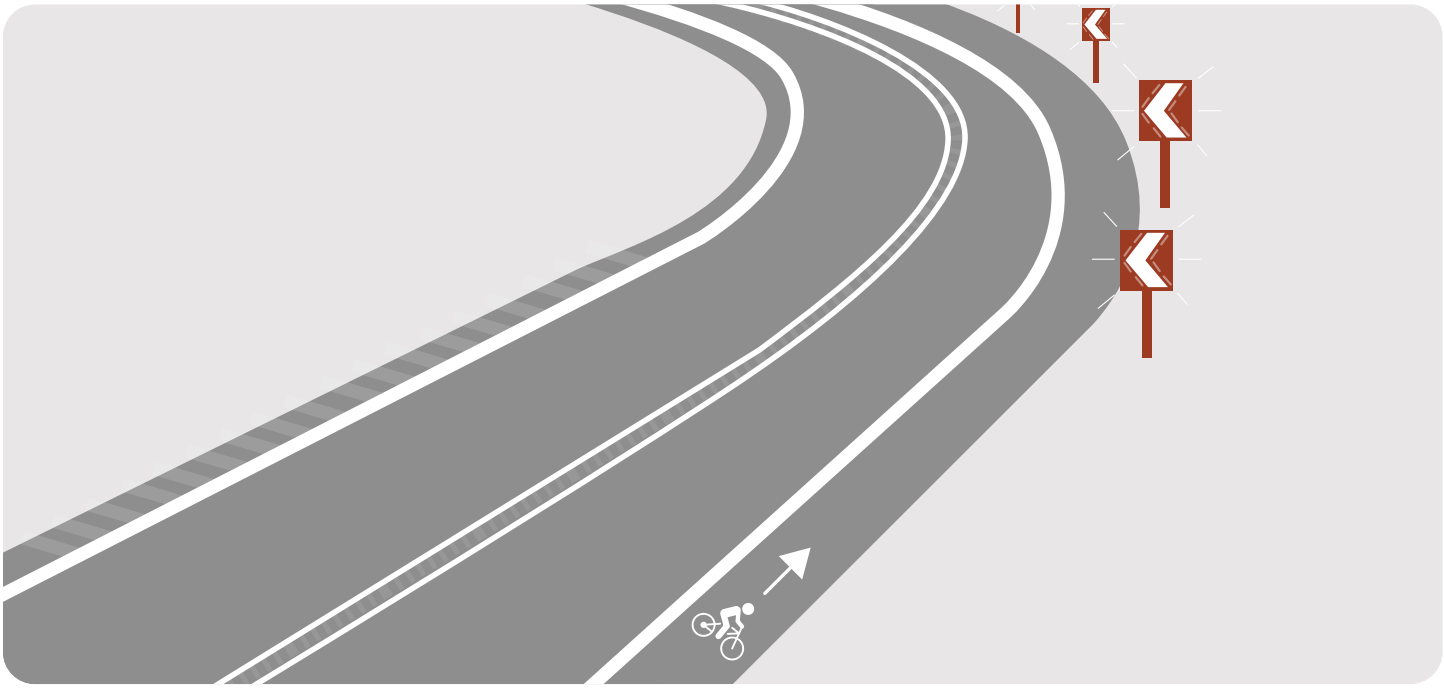


Roundabouts or alternative intersection layouts may be considered in certain situations to help resolve skewed approaches, particularly if multiple legs of the intersection approach at odd angles.

Potential Locations

- Intersections with SR 56 including 7700 West, Comstock Road, and Pinto Road.
- Intersections with Lund Highway such as 5400 North, 6000 North, and 6400 North
- Intersections with Old Highway 91 in Enoch City such as Midvalley Road, Enoch Road, and Heather Hue Road
- Intersections with Old Highway 91 between Parowan City and Summit.
- Intersections with Iron Springs Road such as 6300 West and 1600 North
- Various locations in Iron County where the minor road approach to an intersections is at a skewed angle.

CASE STUDY:
Two-Lane Highways



Two-lane, high-speed highways are common in Iron County and in rural areas. Various safety countermeasures may be applicable for different settings, but mostly directed towards addressing single-vehicle crashes such as run-off the road or crossover type crashes that are common on these types of roadways.

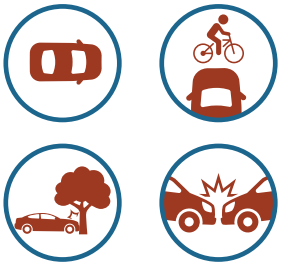
Components

- Shoulder widening provides additional recovery space for vehicles, emergency areas, and provides space for bicyclists, wider edge line striping, or edge line rumble strips.
- Striping may include refreshing existing striping, installing edge line striping if not present, converting to more retroreflective striping, or installing wider striping.
- Rumble strips may be implemented on the edge lines and/or centerline of the roadway. Rumble strips may be either the typical grooved style or a sinusoidal style (sometimes called “mumble” strips since they are quieter to the driver, typically used in more residential areas. Rumble strips provide physical indicators to motorists of lane or roadway departures or crossovers.
- These roadway types often navigate curves or slopes. Installing, or enhancing existing signage to help delineate the roadway and curves provide additional guidance and captures motorist’s attention. Countermeasures may include installing signage, enhancing existing signage with flashing beacons or retroreflecitvity, reflective delineators, guardrail, or striping improvements.

Applications

Two-lane roadways or corridors with typically higher-speeds in a more rural setting.

Crash Types



Costs

Medium

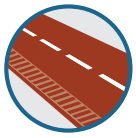
CASE STUDY:
Two-Lane Highways

Considerations

Not all of the countermeasures detailed may be applicable to each location. Consider the context of the roadway and surrounding conditions, including the prevalent crash types historically experienced at the location.

Consider striping enhancements or installation at regularly scheduled maintenance, resurfacing, or reconstruction of the roadway.

Consider required width of shoulders accounting for potentially wider striping, rumble strips, and bicycle lanes.



Consider installing sinusoidal rumble strips (or "mumble" strips) in lieu of typical grooved rumble strips where noise is a concern (near residential or recreation areas). If the area experiences high on-roadway bicycle users, the use of rumble strips needs to be evaluated.

In bicycling areas, ensure shoulder widening includes adequate width for striping, rumble strips (if applicable) and a bicycle lane.

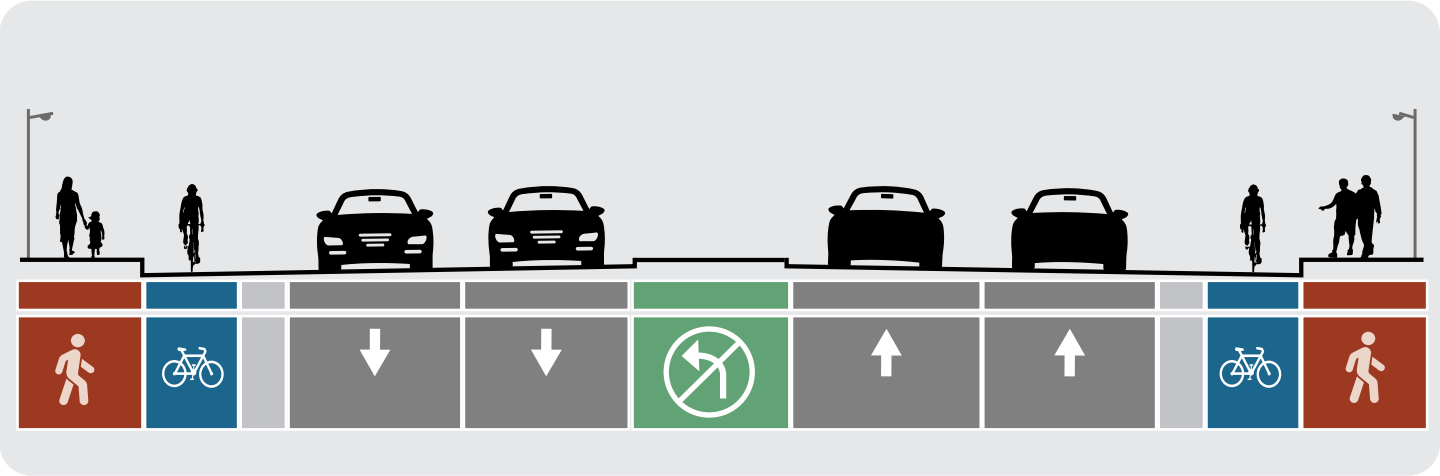
Ensure all signage complies with the MUTCD guidelines on traffic control devices.

Minersville Highway (SR 130)

Potential Locations

- SR 56
- SR 130
- Lund Highway
- Old Highway 91
- Iron Springs Road
- Westview Drive
- SR 143
- SR 271

CASE STUDY:
Three-or Five-Lane Roadways



Roadways with three to five lanes of travel present several safety risks for all roadway users. These types of roadways typically have higher traffic volumes, limited active transportation space, and signalized intersections or access driveways creating conflict points for all roadway users. Dedicated pedestrian and bicyclist space and access management strategies help reduce the number of conflict points on a roadway.

Components

- Bicycle lanes and sidewalks help create a safer space for non-motorized users and contribute to a more connected active transportation network. Buffered bike lanes may be striping only, a physical barrier, or separated pathways or trails. Shoulder widening may also help accommodate the bicycle lanes, striping, and signage.
- Access management strategies include the design, location, and density of ingress and egress points along a roadway or corridor and includes intersections with other roadways and access driveways. Reducing, restricting, and strategically planning accesses on the roadway helps reduce the number of conflict points, especially left-turn conflicts, for all roadway users.
- Center curbed medians is an infrastructure countermeasure that separates directional traffic and helps manage other vehicle movements such as left-turns. Medians may also serve non-motorized users by creating refuge islands for crossings and provide space for enhanced signage at crossings.

Applications

Suburban or urban multilane roadways with higher traffic volumes, many access driveways or intersections, and typically a center two-way left-turn lane.

Crash Types

Costs

High

CASE STUDY:
Three-or Five-Lane Roadways

Considerations

Existing conditions and land use context should be considered before implementing safety countermeasures. Applicable consideration include:

Widening the roadway or shoulders may require right-of-way acquisition and relocation of existing infrastructure or utilities. In bicycling areas, ensure shoulder widening includes adequate width for a buffered bicycle lane.

Consider connections to trails or other active transportation network components when installing bicycle lanes or sidewalks.

Prioritize separated, buffered, and then traditional painted bicycle lanes, especially on high traffic volume and higher speed roadways. Separation may be completed by curbing, barrier, or striping. Buffered bike lanes may be accomplished with posts or painting.

- Separated or buffered bicycle lanes should consider interactions with access driveways, on-street parking, and maintenance (particularly winter maintenance, including snowplows and snow removal operations).

Consider striping enhancements or installation during regularly scheduled maintenance, resurfacing, or reconstruction of the roadway.

When medians are proposed, consider implementing additional improvements such as refuge islands for pedestrian crossings or enhanced signage for crosswalks using the medians.

Evaluate access types, density, and locations along the entire corridor and implement restrictions or consolidation when applicable.

Cedar City Main Street (SR 130)

Potential Locations

- Main Street (SR 130), Cedar City and Enoch City
- 200 North (SR 56)
- SR 56
- Midvalley Road
- Cross Hollow Road
- Westview Drive
- Main Street (SR 274) Parowan City
- SR 143 Brian Head