New Jersey 2020 Strategic Highway Safety Plan

Emphasis Area

INTERSECTIONS

Team Leader: Kimberly Singleton
Room 104

Safety Summit #2

Emphasis Area Breakout Session (90 minutes)

Agenda

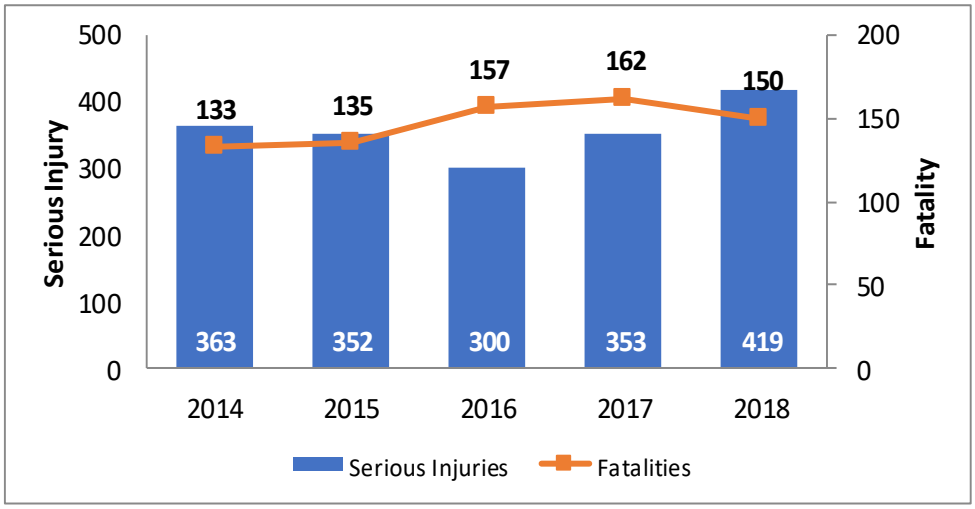
1. Review Goals of the Session (5 minutes)
2. Review Data and Identify Key Data Questions (20 minutes)
3. Review Existing Strategies (20 minutes)
4. Identify Additional Potential Strategies (15 minutes)
5. Discuss Prioritization of Strategies (30 minutes)

Intersections Crash Data Sheet

Summit #2 **January 21, 2020**

Summary

This fact sheet provides many details of intersection crash fatalities and serious injuries (FSI). It also provides suggested strategies to reduce fatalities and serious injuries in NJ.

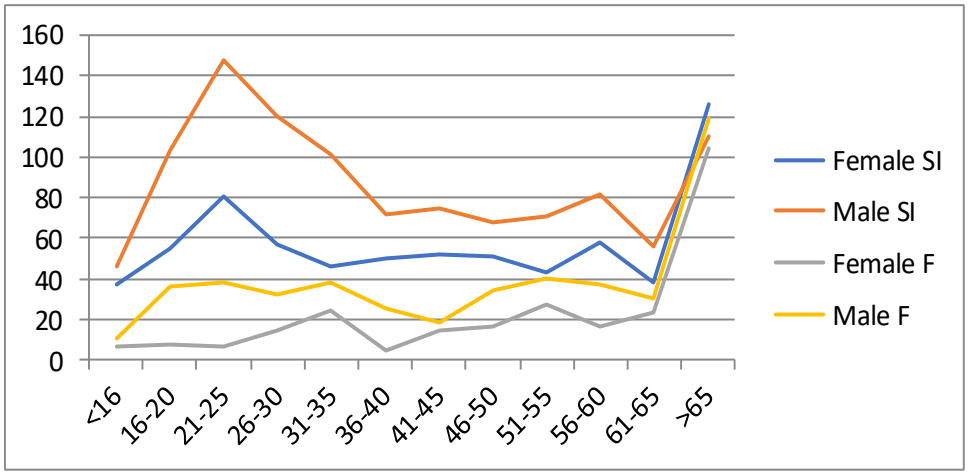


Intersection Crash Quick Facts

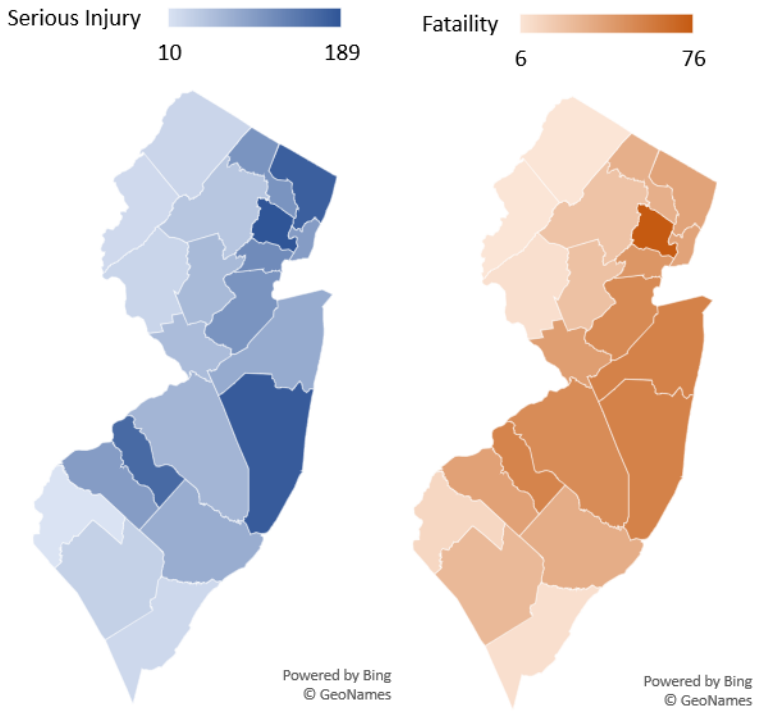
- Accounts for 30% of all NJ fatalities and serious injuries.
- 737 fatalities
- Increase of 1% from 2015 SHSP
- 1,787 serious injuries
- Decrease of 23% from 2015 SHSP
- 37%—At Signalized
- 39%—At Unsignalized

Who Was Involved?

Male and female drivers aged 21-25 years old are involved in the most intersection serious injuries. The most fatalities for both genders is in the 65 and over age group.



Where Did Crashes Occur?



Sixty-eight percent (68%) of fatalities and serious injuries (FSI) as a result of intersection crashes occurred in the NJTPA region.

FSI by Roadway Type

Roadway	Rural		Urban	
Interstate	1	0%	3	0%
State	30	1%	726	29%
County	45	2%	899	36%
City	2	0%	250	10%
Other	0	0%	0	0%
Total	78		1,878	

23% FSI - Unknown Roadway Type

FSI by Functional Class

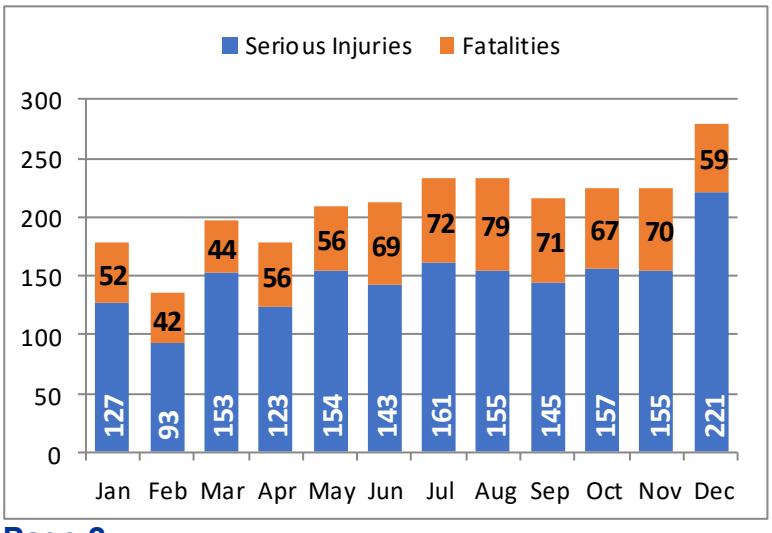
Functional Class	<=25 mph	30-45mph	45+ mph
Interstate	0	1	3
Freeways	2	8	13
Principal Arterial	128	469	304
Minor Arterial	225	350	66
Major Collector	93	90	46
Minor Collector	3	4	3
Local	42	18	19
Other	332	179	27

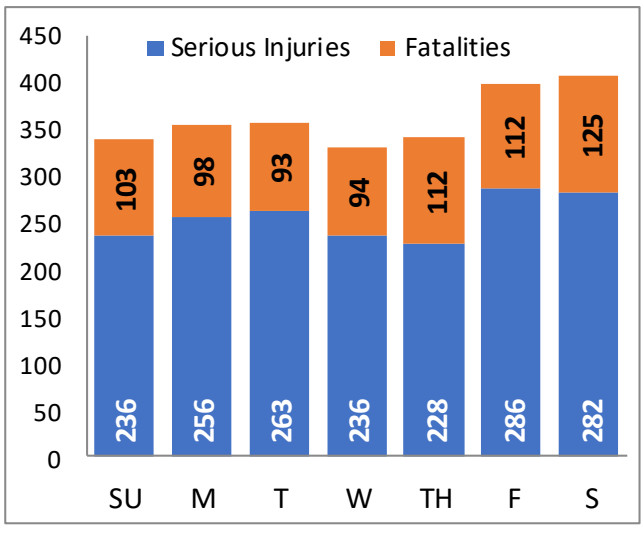
FSI by County (top) and MPO (bottom)

MPO	Fatality		Serious Injury	
DVRPC	188	26%	389	22%
NJTPA	465	63%	1253	70%
SJTPO	84	11%	145	8%

When Did Crashes Occur?

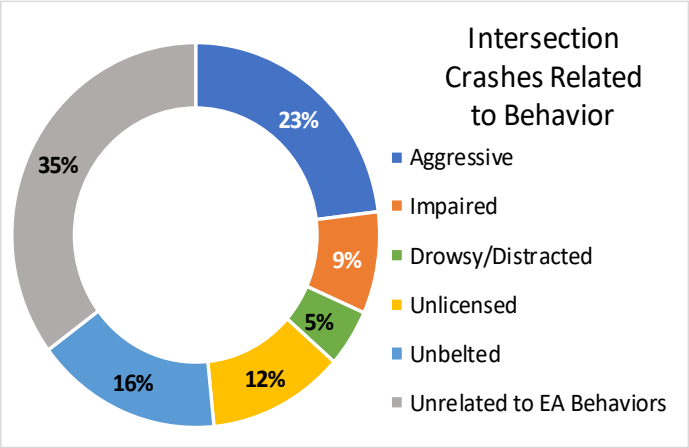
Both fatalities and serious injuries occurred mostly during the weekend. The most fatalities and serious injuries also happened primarily in December.

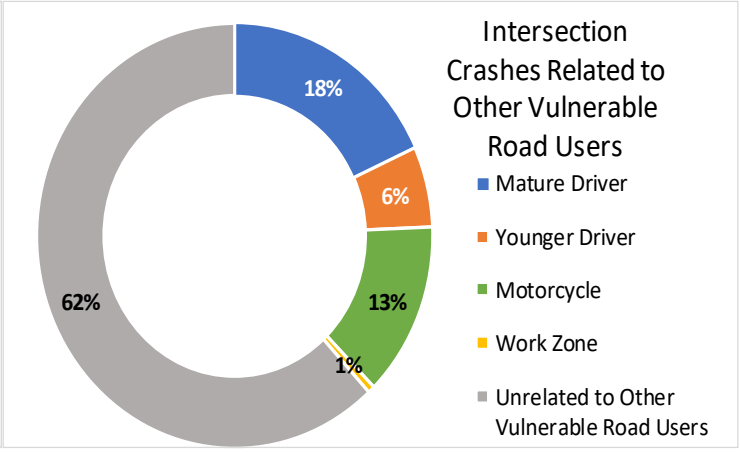




Contributing Factors

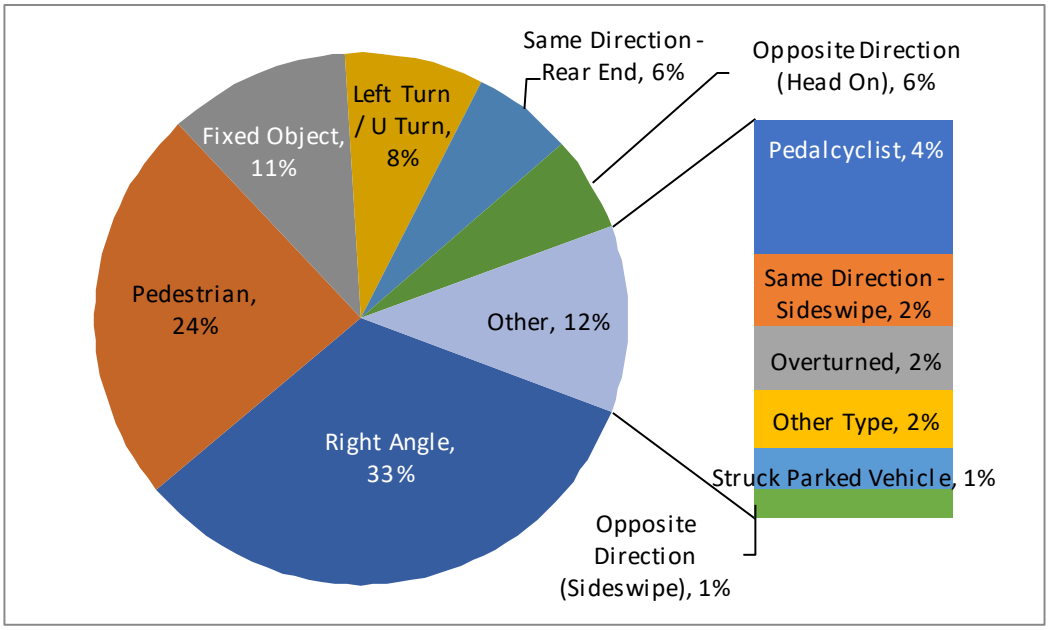
Relationship to Other SHSP Emphasis Areas





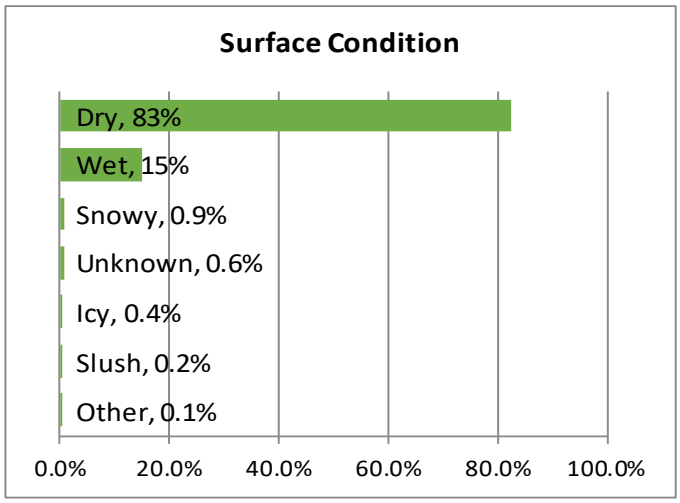
Crash Type

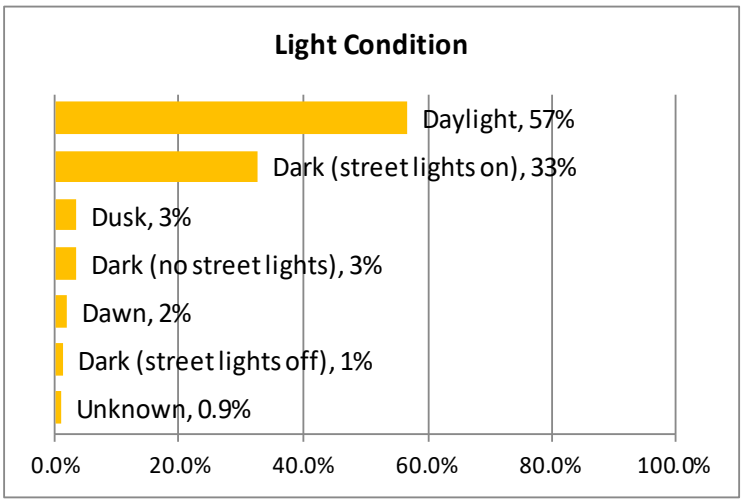
Intersection fatalities and serious injuries resulted in right angle and pedestrian crashes as the top crash types.



Surface and Light Conditions

Intersection fatalities and serious injuries mainly occurred during the day and in dry pavement conditions.





Strategies

The 2015 NJ SHSP identified several strategies that have the greatest potential to reduce intersection fatalities and serious injuries. They are grouped under each main category (bold blue) by crash types that would be the most improved. Other strategies are also noted.

Signalized Intersections

Reduce Frequency and Severity of Intersection Conflicts through Traffic Control and Operational Improvements

Right Angle & Left/U Turn Crashes

- Employ multiphase signal operation. Optimize clearance intervals.★
- Restrict or eliminate turning maneuvers (including right turns on red).

All Crashes

- Employ signal coordination along a corridor or route.
- Employ emergency vehicle preemption.
- Remove unwarranted signal.

Pedestrian and Bicyclist Crashes

- Improve operation of pedestrian and bicycle facilities at signalized intersections.

Reduce Frequency and Severity of Intersection through Geometric Improvements

Right Angle & Left/U Turn Crashes

- Provide/improve left-turn channelization.
- Provide/improve right-turn channelization.

Pedestrian and Bicyclist Crashes

- Improve geometry of pedestrian and bicycle facilities.

Improve Sight Distance at Signalized Intersections

Right Angle & Left/U Turn Crashes

- Clear sight triangles.
- Redesign intersection approaches.

Improve Driver Awareness of Intersections and Signal Control

All Crashes

- Improve visibility of signals (overhead indications, 12-inch lenses, ight-emitting diodes, background shields (backplates★) and signs (mast-arm-mounted street names) at intersections.

Improve Driver Compliance with Traffic Control

Right Angle & Left/U Turn Crashes

- Consider the use of red-light confirmation lights to reduce red-light running. These lights, when coordinated with the signal timing and added to the back of a traffic signal, allow law enforcement to see red light violators.

Improve Access Management Near Signalized Intersections

Right Angle & Left/U Turn Crashes

- Restrict access to properties using driveway closures or turn restrictions.
- Restrict cross-median access near intersections.

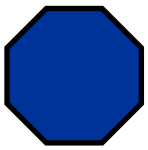
Improve Safety through other Infrastructure Treatments

All Crashes

- Restrict or eliminate parking on intersection approaches.

★ *FHWA Proven Safety Countermeasure*

Strategies (Con't)



Unsignalized Intersections

Improve Management of Access near Unsignalized Intersections

Right Angle & Left/U Turn Crashes

- Implement driveway closures/relocations.
- Implement driveway turn restrictions.
- Provide left-turn acceleration lanes at divided highway intersections.
- Provide right-turn lanes at intersections.★
- Provide offset right-turn lanes at intersections.
- Provide right-turn acceleration lanes at intersections.
- Restrict or eliminate turning maneuvers by providing channelization or closing median openings.
- Close or relocate high-risk intersections.
- Convert four-legged intersections to two T-intersections.
- Realign intersection approaches to reduce or eliminate intersection skew.
- Use indirect left-turn treatments to minimize conflicts at divided highway intersections.★

Pedestrian and Bicyclist Crashes

- Improve pedestrian and bicycle facilities to reduce conflicts between motorists and non-motorists.

Improve Sight Distance at Unsignalized Intersections

Right Angle & Left/U Turn Crashes

- Clear sight triangle on stop- or yield-controlled approaches to intersections, including snow removal.
- Clear sight triangles in the medians of divided highways near intersections, including snow removal.

All Crashes

- Change horizontal and/or vertical alignment of approaches to provide more sight distance.
- Eliminate parking that restricts sight distance.

Improve Availability of Gaps in Traffic and Assist Drivers in Judging Gap Sizes at Unsignalized Intersections

Right Angle & Left/U Turn Crashes

- Provide an automated real-time system to inform drivers of suitability of available gaps for making turning and crossing maneuvers.

Improve Driver Awareness of Intersections as Viewed from the Intersection Approach

Right Angle & Left/U Turn Crashes

- Improve visibility of intersections by providing enhanced signing and delineation.
- Improve visibility of intersections by providing lighting.
- Provide a stop bar (or provide a wider stop bar) on minor-road approaches.
- Install larger regulatory and warning signs at intersections, including the use of dynamic warning signs at appropriate intersections.
- Call attention to the intersection by installing rumble strips on the intersection approaches.
- Provide dashed markings (extended left edge lines) for major-road continuity across the median opening at divided highway intersections.
- Provide pavement markings with supplemental messages, such as STOP AHEAD.
- Install flashing beacons at stop-controlled intersections.

★ *FHWA Proven Safety Countermeasure*

Strategies (Con't)

Choose Appropriate Intersection Traffic Control to Minimize Crash Frequency and Severity

Right Angle & Left/U Turn Crashes

- Avoid signalizing through roads.
- Provide all-way stop control at appropriate intersections.
- Provide roundabouts at appropriate locations.★

Guide Motorists More Effectively through Complex Intersection

Right Angle & Left/U Turn Crashes

- Provide turn-path pavement markings.

Additional Considerations

Enhanced Corridor Enforcement and Education

All Crashes

- Target areas with concentrations of intersection crashes resulting from other factors (e.g. aggressive, impairment, or unbelted).
- Dedicated and sustain funding for driver education for all ages and abilities, especially where new technologies are employed.

★ *FHWA Proven Safety Countermeasure*

Overview of the Intersection Crash Query

- NJDOT Crash Records Database (100% of records)
- Crash location noted in NJTR-1
  - At Intersection

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Federal Highway Administration

Backplates with Retroreflective Borders

Source: FHWA

SAFETY BENEFIT:

15%
Reductions in total crashes

Source: CMF Clearinghouse, CMF ID 1410.

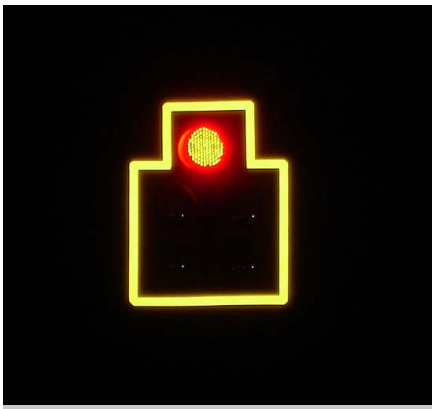
Backplates added to a traffic signal indication improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a retroreflective border. Signal heads that have backplates equipped with retroreflective borders are more visible and conspicuous in both daytime and nighttime conditions.

This treatment is recognized as a human factors enhancement of traffic signal visibility, conspicuity, and orientation for both older and color vision deficient drivers. This countermeasure is also advantageous during periods of power outages when the signals would otherwise be dark, providing a visible cue for motorists.

Example of a signal backplate framed with a retroreflective border.

Source: FHWA

Transportation agencies should consider backplates with retroreflective borders as part of their efforts to systemically improve safety performance at signalized intersections. Adding a retroreflective border to an existing signal backplate is a very low-cost safety treatment. The most effective means of implementing this proven safety countermeasure is to adopt it as a standard treatment for signalized intersections across a jurisdiction.



Retroreflective borders are highly visible during the night.

Source: South Carolina DOT

➔ For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.

FHWA-SA-17-051

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Corridor Access Management

This intersection design restricts left-turn movements to improve safety.

Source: FHWA

SAFETY BENEFITS:

5-23%
Reduction in total crashes along 2-lane rural roads

25-31%
Reduction in injury and fatal crashes along urban/ suburban arterials

Source: *Highway Safety Manual*

Access management refers to the design, application, and control of entry and exit points along a roadway. This includes intersections with other roads and driveways that serve adjacent properties. Thoughtful access management along a corridor can simultaneously enhance safety for all modes, facilitate walking and biking, and reduce trip delay and congestion.

A raised median reduces conflict points along this roadway.

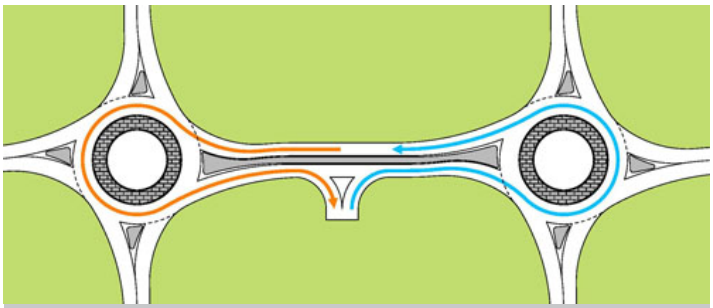
Source: Missouri DOT

Every intersection, from a signalized intersection to an unpaved driveway, has the potential for conflicts between vehicles, pedestrians, and bicycles. The number and types of conflict points—locations where the travel paths of two users intersect—influence the safety performance of the intersection or driveway.

The following access management strategies can be used individually or in combination with one another:

- Driveway closure, consolidation, or relocation.
- Limited-movement designs for driveways (such as right-in/right-out only).
- Raised medians that preclude across-roadway movements.
- Intersection designs such as roundabouts or those with reduced left-turn-conflicts (such as J-turns, median U-turns, etc.).
- Turn lanes (i.e., left-only, right-only, or interior two-way left).
- Lower speed one-way or two-way off-arterial circulation roads.

Successful corridor access management involves balancing overall safety and corridor mobility for all users along with the access needs of adjacent land uses.



Use of roundabouts, raised median, and right-in/right-out driveways can be an effective access management plan.

Sour:e: FHWA-SA-15-005

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Left and Right Turn Lanes at Two-Way Stop-Controlled Intersections

SAFETY BENEFITS:

LEFT-TURN LANES

28-48%

Reduction in total crashes

RIGHT-TURN LANES

14-26%

Reduction in total crashes

Source: *Highway Safety Manual*

Example of left-turn lanes.

Source: FHWA

Auxiliary turn lanes—either for left turns or right turns—provide physical separation between turning traffic that is slowing or stopped and adjacent through traffic at approaches to intersections. Turn lanes can be designed to provide for deceleration prior to a turn, as well as for storage of vehicles that are stopped and waiting for the opportunity to complete a turn.

While turn lanes provide measurable safety and operational benefits at many types of intersections, they are particularly helpful at two-way stop-controlled intersections. Crashes occurring at these intersections are often related to turning maneuvers. Since the major route traffic is free flowing and typically travels at higher speeds, crashes that do occur are often severe. The main crash types include collisions of vehicles turning left across opposing through traffic and rear-end collisions of vehicles turning left or right with other vehicles following closely behind. Turn lanes reduce the potential for these types of crashes.

Installing left-turn lanes and/or right-turn lanes should be considered for the major road approaches for improving safety at both three- and four-leg intersections with two-way stop control on the minor road, where significant turning volumes exist, or where there is a history of turn-related crashes. Pedestrian and bicyclist safety and convenience should also be considered when adding turn lanes at an intersection.

Example of a right-turn lane.

Source: FHWA

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Reduced Left-Turn Conflict Intersections

Example of MUT intersection.

Source: FHWA

SAFETY BENEFITS:

RCUT

50%

Reduction in injury and fatal crashes[1]

MUT

30%

Reduction in intersection-related injury crash rate[2]

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn (RCUT) and the median U-turn (MUT).

Example of RCUT intersection.

Source: FHWA

Restricted Crossing U-turn (RCUT)

The RCUT intersection modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location – either signalized or unsignalized – to continue in the desired direction.

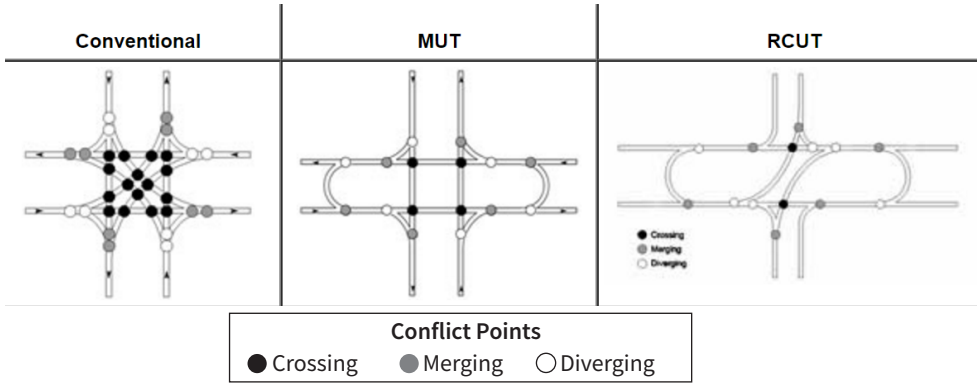
The RCUT is suitable for a variety of circumstances, including along rural, high-speed, four-lane, divided highways or signalized routes. It also can be used as an alternative to signalization or constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections.

Median U-turn (MUT)

The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for modifying the cross-street left turns.

The MUT is an excellent choice for heavily traveled intersections with moderate left-turn volumes. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.

MUT and RCUT Can Reduce Conflict Points by 50%



Source: FHWA

[1] Edara et al., "Evaluation of J-turn Intersection Design Performance in Missouri," December 2013.

[2] FHWA, *Median U-Turn Intersection Informational Guide*, FHWA-SA-14-069 (Washington, DC: 2014), pp. 41-42.

➔ For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.

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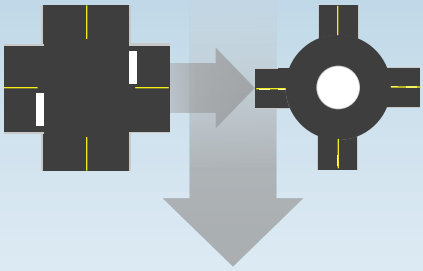
PROVEN SAFETY COUNTERMEASURES

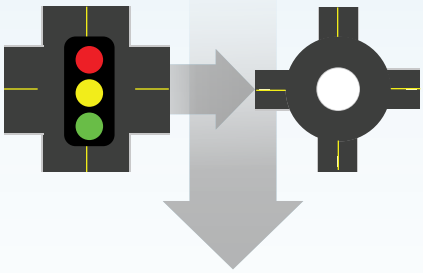
Roundabouts

TWO-WAY STOP-CONTROLLED INTERSECTION TO A ROUNDABOUT



82%
Reduction in severe crashes

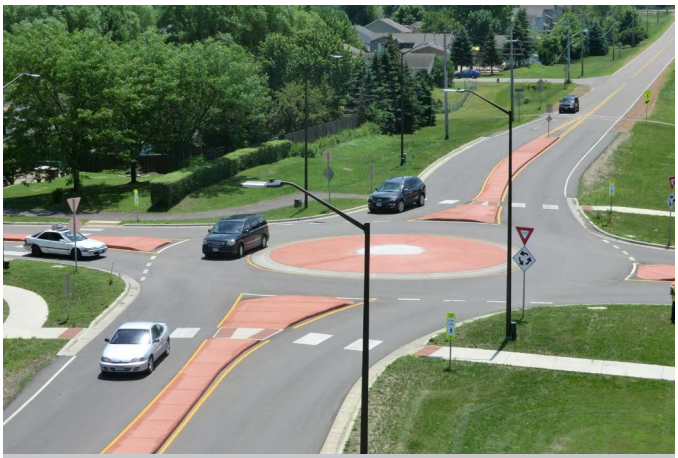
SIGNALIZED INTERSECTION TO A ROUNDABOUT



78%
Reduction in severe crashes

Source: *Highway Safety Manual*

The modern roundabout is a type of circular intersection configuration that safely and efficiently moves traffic through an intersection. Roundabouts feature channelized approaches and a center island that results in lower speeds and fewer conflict points. At roundabouts, entering traffic yields to vehicles already circulating, leading to improved operational performance.



Example of a single-lane roundabout.

Source: FHWA

Roundabouts provide substantial safety and operational benefits compared to other intersection types, most notably a reduction in severe crashes.

Roundabouts can be implemented in both urban and rural areas under a wide range of traffic conditions. They can replace signals, two-way stop controls, and all-way stop controls. Roundabouts are an effective option for managing speed and transitioning traffic from high-speed to low-speed environments, such as freeway interchange ramp terminals, and rural intersections along high-speed roads.

Example of a multi-lane roundabout.

Source: FHWA

FHWA encourages agencies to consider roundabouts during new construction and reconstruction projects as well as for existing intersections that have been identified as needing safety or operational improvements.

➔ **For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.**

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PROVEN SAFETY COUNTERMEASURES

Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections

Example of countermeasures on the stop approach.

Source: South Carolina DOT

SAFETY BENEFITS:

10%
Reduction in injury and fatal crashes

15%
Reduction in nighttime crashes

This systemic approach to intersection safety involves deploying a group of multiple low-cost countermeasures, such as enhanced signing and pavement markings, at a large number of stop-controlled intersections within a jurisdiction. It is designed to increase driver awareness and recognition of the intersections and potential conflicts.

Example of countermeasures on the through approach.

Source: South Carolina DOT

Average Benefit-Cost Ratio

12:1

The systemic approach to safety has three components: (1) analyze systemwide data to identify a problem, (2) look for similar risk factors present in severe crashes, and (3) deploy on a large scale low-cost countermeasures that address the risk factors contributing to crashes.

The low-cost countermeasures for stop-controlled intersections generally consist of the following treatments:

On the Through Approach

- Doubled up (left and right), oversized advance intersection warning signs, with street name sign plaques.
- Enhanced pavement markings that delineate through lane edge lines.

On the Stop Approach

- Doubled up (left and right), oversized advance “Stop Ahead” intersection warning signs.
- Doubled up (left and right), oversized Stop signs.
- Retroreflective sheeting on sign posts.
- Properly placed stop bar.
- Removal of any vegetation, parking, or obstruction that limits sight distance.
- Double arrow warning sign at stem of T-intersections.

Source: T. Le et al, “Safety Effects of Low-Cost Systemic Safety Improvements at Signalized and Stop-Controlled Intersections,” 96th Annual Meeting of the Transportation Research Board, Paper Number 17-05379, January 2017.

➔ For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.

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Yellow Change Intervals

SAFETY BENEFITS OF WELL-TIMED YELLOW CHANGE INTERVALS:

36-50%
Reduction in red light running

8-14%
Reduction in total crashes

12%
Reduction in injury crashes

Properly-timed yellow change intervals can reduce red-light running and improve overall intersection safety.

Source: FHWA

At a signalized intersection, the yellow change interval is the length of time that the yellow signal indication is displayed following a green signal indication. The yellow signal confirms to motorists that the green has ended and that a red will soon follow.

Since red-light running is a leading cause of severe crashes at signalized intersections, it is imperative that the yellow change interval be appropriately timed. Too brief an interval may result in drivers being unable to stop safely and cause unintentional red-light running, while too long an interval may result in drivers treating the yellow as an extension of the green phase and invite intentional red light running. Factors such as the speed of approaching vehicles, driver perception-reaction time, vehicle deceleration rates, intersection width, and roadway approach grades should all inform the timing calculation.

Transportation agencies can improve signalized intersection safety and reduce red-light running by reviewing and updating their traffic signal timing policies and procedures concerning the yellow change interval. Agencies should institute regular evaluation and adjustment protocols for existing traffic signal timing. Refer to the *Manual on Uniform Traffic Control Devices* for basic requirements and further recommendations about yellow change interval timing.

Source: NCHRP Report 731, *Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections.*

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FHWA-SA-17-057

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Notes

Name _____ Email _____ Zip Code _____

Please leave this form with project staff. To provide comments online, please email us at info@SafeRoadsForAllNJ.com or visit the project website at www.SafeRoadsForAllNJ.com.

Please provide comments on SHSP Emphasis Areas by January 31, 2020.