In addition to the reduction in conflicts, it is possible that locating driveways outside of the intersection functional area also provides more time and space for vehicles to turn or merge across lanes (21). It is generally accepted that access points located within 250 ft upstream or downstream of an intersection are undesirable (34).

14A.3.1.2. Provide Corner Clearance

Corner clearances are the minimum distances required between intersections and driveways along arterials and collector streets. *"Driveways should not be situated within the functional boundary of at-grade intersections* (1)." Corner clearances vary greatly, from 16 ft to 350 ft, depending on the jurisdiction.

It is generally accepted that driveways that are located too close to intersections result in an increase in crashes, and as many as one half of crashes within the functional area of an intersection may be driveway-related (17).

14A.4. INTERSECTION DESIGN ELEMENTS

14A.4.1. General Information

The material below provides an overview of considerations related to shoulders/sidewalks and roadside elements at intersections. These two categories of intersection design elements are integral parts of intersection design; however, crash effects are not known to a statistically reliable and/or stable level to include as CMFs, or to identify trends within this edition of the HSM.

14A.4.1.1. Shoulders and Sidewalks

Shoulders are intended to perform several functions. Some of the main functions are: to provide a recovery area for out-of-control vehicles, to provide an emergency stopping area, and to improve the structural integrity of the pavement surface (23).

The main purposes of paving shoulders are: to protect the physical road structure from water damage, to protect the shoulder from erosion by stray vehicles, and to enhance the control of stray vehicles.

Motorized vehicle perspective and considerations

Some concerns when increasing shoulder width include:

- Wider shoulders on the approach to an intersection may result in higher operating speeds through the intersection which, in turn, may impact crash severity;
- Steeper side or backslopes may result from wider roadway width and limited right-of-way; and
- Drivers may choose to use the wider shoulder as a turn lane.

Geometric design standards for shoulders are generally based on the intersection setting, amount of traffic, and right-of-way constraints (23).

Shoulders at mid-block or along roadway segments are discussed in Chapter 13.

14A.4.1.2. Roadside Elements

The roadside is defined as the "area between the outside shoulder edge and the right-of-way limits. The area between roadways of a divided highway may also be considered roadside (4)". The AASHTO *Roadside Design Guide* is an invaluable resource for roadside design, including clear zones, geometry, features, and barriers (4).

The following sections discuss the general characteristics and considerations related to roadside geometry and roadside features.

Roadside geometry
Roadside geometry refers to the physical layout of the roadside, such as curbs, foreslopes, backslopes, and transverse slopes.

AASHTO's *Policy on Geometric Design of Highways and Streets* states that a "a curb, by definition, incorporates some raised or vertical element (1)." Curbs are used primarily on low-speed urban highways, generally with a design speed of 45 mph or less (1).

Designing a roadside environment to be clear of fixed objects with stable flattened slopes is intended to increase the opportunity for errant vehicles to regain the roadway safely or to come to a stop on the roadside. This type of roadside environment, called a "forgiving roadside," is also designed to reduce the chance of serious consequences if a vehicle leaves the roadway. The concept of a "forgiving roadside" is explained in AASHTO's *Roadside Design Guide* (4).

Chapter 13 includes information on clear zones, forgiving roadsides, and roadside geometry for roadway segments.

Roadside Elements—Roadside Features
Roadside features include signs, signals, luminaire supports, utility poles, trees, driver-aid call boxes, railroad crossing warning devices, fire hydrants, mailboxes, bus shelters, and other similar roadside features.

The AASHTO *Roadside Design Guide* contains information about the placement of roadside features, criteria for breakaway supports, base designs, etc (4). It is generally accepted that the best treatment for all roadside objects is to remove them from the clear zone (35). Because removal is not always possible, the objects may be relocated farther from the traffic flow, shielded with roadside barriers, or replaced with breakaway devices (35).

Roadside features on roadway segments are discussed in Chapter 13.

14A.4.2. Intersection Design Elements with No CMFs—Trends in Crashes and/or User Behavior

14A.4.2.1. Provide bicycle lanes or wide curb lanes at intersections
Bicycle lane is defined as a part of the roadway that is designated for bicycle traffic and separated by pavement markings from motor vehicles in adjacent lanes. Most often, bicycle lanes are installed near the right edge or curb of the road, although they are sometimes placed to the left of right-turn lanes or on-street parking (3). An alternative to providing a dedicated bicycle lane is to provide a wide curb lane. A wide curb lane is defined as a shared-use curb lane that is wider than a standard lane and can accommodate both vehicles and bicyclists.

Table 14A-1 below summarizes the crash effects and other observations known, at this time, related to bicycle lanes and wide curb lanes.

Table 14A-1. Summary of Bicycle Lanes and Wide Curb Lanes Crash Effects

Application	Crash Effect	Other Comments
Bicycle lanes at signalized intersections	Appears to have no crash effect on bicycle-motor vehicle crashes or overall crashes (29).	None
Bicycle lanes at minor-road stop-controlled intersections	May increase bicycle-motor vehicle crashes (29).	Magnitude of increase is uncertain.
Wide curb lane greater than 12 ft	Appears to improve the interaction between bicycles and motor vehicles in the shared lane (33).	There is likely a lane width beyond which safety may decrease due to misunderstanding of shared space (33).
Bicycle lane versus wide curb lane	No trends indicating which may be better than the other in terms of safety.	Bicyclists appear to ride farther from the curb in bike lanes that are 5.2-ft wide or greater compared to wide curb lanes under the same traffic volume (28).
		Bicyclist's compliance at traffic signals does not appear to differ between bicycle lanes and wide lanes (33).
		More bicyclists may comply at stop signs with bike lanes compared to wide curb lanes (33).
		At wide curb lane locations, bicyclists may perform more pedestrian style left- and right-turns (i.e., dismounting and use crosswalk) compared to bike lanes (33). At this time, it is not clear which turning maneuver (as a car or a pedestrian) is safer.

14A.4.2.2. Narrow Roadway at Pedestrian Crossing

Narrowing the roadway width using curb extensions, sometimes called chokers, curb bulbs, neckdowns, or nubs, extends the curb line or sidewalk out into the parking lane, and thus reduces the street width for pedestrians crossing the road. Curb extensions can also be used to mark the start and end of on-street parking lanes.

Reducing the street width at intersections appears to reduce vehicle speeds, improve visibility between pedestrians and oncoming motorists, and reduce the crossing distance for pedestrians (24).

14A.4.2.3. Install Raised Pedestrian Crosswalk

Common locations of crosswalks are at intersections on public streets and highways where there is a sidewalk on at least one side of the road. Marked crosswalks are typically installed at signalized intersections, school zones, and stop-controlled intersections (14). The specific application of raised pedestrian crosswalks most often occurs on local, urban, two-lane streets in residential or commercial areas. They may be applied at intersections or midblock.

Raised pedestrian crosswalks are often considered as a traffic calming treatment to reduce vehicle speeds at locations where vehicle and pedestrian movements conflict with each other.

On urban and suburban two-lane roads, this treatment appears to reduce injury crashes (13). It is reasonable to conclude that raised pedestrian crosswalks have an overall positive effect on crash frequency because they are designed to reduce vehicle operating speed (13). However, the magnitude of the crash effect is not certain at this time. The manner in which the crosswalks were raised is not provided in the original study from which the above information was gathered.

14A.4.2.4. Install Raised Bicycle Crossing

Installing a raised bicycle crossing can be considered a form of traffic calming as a means to slow vehicle speeds and create a defined physical separation of a bicycle crossing relative to the travel way provided for motor vehicles.

Installing raised bicycle crossings at signalized intersections appears to reduce bicycle-motor vehicle crashes (29). However, the magnitude of the crash effect is not certain at this time.

14A.4.2.5. Mark Crosswalks at Uncontrolled Locations (Intersection or Midblock)

Common locations of crosswalks are at intersections on public streets and highways where there is a sidewalk on at least one side of the road. Marked crosswalks are typically installed at signalized intersections, school zones, and stop-controlled intersections (14). This section discusses the crash effects of providing marked crosswalks at uncontrolled locations – the uncontrolled approaches of stop-controlled intersection or uncontrolled midblock locations.

Table 14A-2 summarizes the effects on crash frequency and other observations related to marking crosswalks at uncontrolled locations.

Table 14A-2. Potential Crash Effects of Marked Crosswalks at Uncontrolled Locations (Intersections or Midblock)

Application	Crash Effect	Other Comments
Two-lane roads and multilane roads with < 12,000 AADT	A marked crosswalk alone, compared to an unmarked crosswalk, appears to have no statistically significant effect on pedestrian crash rate (pedestrian crashes per million crossings) (45).	The magnitude of the crash effect is not certain at this time.
Approaches with a 35 mph speed limit on recently resurfaced roads	No specific crash effects are apparent or known.	Marking pedestrian crosswalks appears to slightly reduce vehicle approach speeds (10,31). Drivers at lower speeds are generally more likely to stop and yield to pedestrians than higher-speed drivers (10).
Two- or three-lane roads with speed limits from 35 to 40 mph and AADT < 12,000 veh/day	Marking pedestrian crosswalks appears to have no measurable negative crash effect on either pedestrians or motorists (32).	Crosswalk usage appears to increase after markings are installed (32).
		Pedestrians walking alone appear to stay within marked crosswalk lines (32).
		Pedestrians walking in groups appear to take less notice of markings (32).
		There is no evidence that pedestrians are less vigilant or more assertive in the crosswalk after markings are installed (32).
Multilane roads with AADT > 12,000 veh/day	A marked crosswalk alone appears to result in a statistically significant increase in pedestrian crash rates compared to uncontrolled sites with unmarked crosswalks (45).	None.

When deciding whether to mark or not mark crosswalks, the results summarized in Table 14A-2 indicate the need to consider the full range of elements related to pedestrian needs when crossing the roadway (45).

14A.4.2.6. Provide a Raised Median or Refuge Island at Marked and Unmarked Crosswalks

Table 14A-3 summarizes the crash effects known related to the crash effects of providing a raised median or refuge island at marked or unmarked crosswalks.

Table 14A-3. Potential Crash Effects of Providing a Raised Median or Refuge Island at Marked and Unmarked Crosswalks

Application	Crash Effect	Other Comments
Multilane roads marked or unmarked intersection and midblock locations	Treatment appears to reduce pedestrian crashes (45).	None.
Urban or suburban multilane roads (4 to 8 lanes) with marked crosswalks and an AADT of 15,000 veh/day or greater	Pedestrian crash rate is lower with a raised median than without a raised median (45).	The magnitude of the crash effect is not certain at this time.
Unsignalized four-leg intersections across streets that are two-lane with parking on both sides and use zebra crosswalk markings	No specific crash effect known.	Refuge islands appear to increase the percentage of pedestrians who cross in the crosswalk and the percentage of motorists who yield to pedestrians (24).

14A.5. TRAFFIC CONTROL AND OPERATIONAL ELEMENTS

14A.5.1. Traffic Control and Operational Elements with No CMFs—Trends in Crashes or User Behavior

14A.5.1.1. Place Transverse Markings on Roundabout Approaches

Transverse pavement markings are sometimes placed on the approach to roundabouts that are preceded by long stretches of highway (18). One purpose of transverse markings is to capture the motorists attention of the need to slow down on approach to the intersection. In this sense, transverse markings can be considered a form of traffic calming. Transverse pavement markings are one potential calming measure; in this section, the crash effect of its application to roundabout approaches is discussed.

This treatment appears to reduce all speed-related injury crashes, during wet or dry conditions, daytime and nighttime (18). However, the magnitude of the crash effect is not certain at this time.

14A.5.1.2. Install Pedestrian Signal Heads at Signalized Intersections

Pedestrian signal heads are generally desirable at certain types of locations, including school crossings, wide streets, or places where the vehicular traffic signals are not visible to pedestrians (14).

Providing pedestrian signal heads, with a concurrent or standard pedestrian signal timing pattern, at urban signalized intersections with marked crosswalks appears to have no effect on pedestrian crashes compared with traffic signals without pedestrian signal heads for those locations where vehicular traffic signals are visible to pedestrians (43,44).

14A.5.1.3. Modify Pedestrian Signal Heads

Pedestrian signal heads may be modified by adding a third pedestrian signal head with the message DON’T START, or by changing the signal displays to be steady or flashing during the pedestrian “don’t walk” phase. Table 14A-4 summarizes the crash effects known regarding modifying pedestrian signal heads.

Table 14A-4. Potential Crash Effects of Modifying Pedestrian Signal Heads

Application	Specific Modification to Pedestrian Signal Heads	Crash Effect and/or Resulting User Behavior
Urban signalized intersections with moderate to high pedestrian volumes	Add a third pedestrian signal head—a steady yellow DON'T START to the standard WALK and flashing DON'T WALK signal heads.	Treatment appears to reduce pedestrian violations and conflicts (43).
Signalized intersections	Use a steady or flashing DON'T WALK signal display during the clearance and pedestrian prohibition intervals.	No difference in pedestrian behavior (43). Pedestrians may not readily understand the word messages.
Signalized intersections	Use a steady or a flashing WALK signal display during the pedestrian WALK phase.	No difference in pedestrian behavior (4). Pedestrians may not readily understand the word messages.
Signalized intersections	Use of symbols on pedestrian signal heads, such as a walking person or upheld hand.	Shown to be more readily comprehended by pedestrians than word messages (10).

14A.5.1.4. Install Pedestrian Countdown Signals

Pedestrian countdown signals are a form of pedestrian signal heads that displays the number of seconds pedestrians have to cross the street; this information is provided in addition to displaying WALK and DON'T WALK information in the form of either word messages or symbols.

Installing pedestrian countdown signals appears to reduce pedestrian-motor vehicle conflicts at intersections (12). There appears to be no effect on vehicle approach speeds during the pedestrian clearance interval (i.e., the flashing DON'T WALK) with the countdown signals (12).

14A.5.1.5. Install Automated Pedestrian Detectors

Automated pedestrian detection systems can sense the presence of people standing at the curb waiting to cross the street. The system activates the WALK signal without any action from the pedestrian. The detectors in some systems can monitor slower walking pedestrians in the crossing so that clearance intervals can be extended until the pedestrians reach the curb. Infrared and microwave sensors appear to provide similar results. Fine tuning of the detection equipment at the location is required to achieve an appropriate detection level and zone.

Installing automated pedestrian detectors at signalized intersections appears to reduce pedestrian-vehicle conflicts as well as the percentage of pedestrian crossings initiated during the "don't walk" phase (26).

14A.5.1.6. Install Stop Lines and Other Crosswalk Enhancements

Installing pedestrian crossing ahead signs, a stop line, and yellow lights activated by pedestrians at marked intersection crosswalks appears to reduce the number of conflicts between motorists and pedestrians. This treatment also appears to increase the percentage of motorists that yield to pedestrians (11).

At marked intersection crosswalks, other treatments such as installing additional roadway markings and signs, providing feedback to pedestrians regarding compliance, and police enforcement, appear to increase the percentage of motorists who yield to pedestrians (11).

14A.5.1.7. Provide Exclusive Pedestrian Signal Timing Pattern

An exclusive pedestrian signal timing pattern provides a signal phase in which pedestrians are permitted to cross while motorists on the intersection approaches are prohibited from entering or traveling through the intersection.

At urban signalized intersections with marked crosswalks and pedestrian volumes of at least 1,200 people per day, this treatment appears to reduce pedestrian crashes when compared with concurrent timing or traffic signals with no pedestrian signals (43,44). However, the magnitude of the crash effect is not certain at this time.

14A.5.1.8. Provide Leading Pedestrian Interval Signal Timing Pattern

A leading pedestrian interval (LPI) is a pre-timed allocation to allow pedestrians to begin crossing the street in advance of the next cycle of vehicle movements. For example, pedestrians crossing the western leg of an intersection are traditionally permitted to cross during the north-south vehicle green phase. Implementing an LPI would provide pedestrians crossing the western leg of the intersection a given amount of time to start crossing the western leg after the east-west vehicle movements and before the north-south vehicle movements. The LPI provides pedestrians an opportunity to begin crossing without concern for turning vehicles (assuming right-on-red is prohibited).

Providing a three-second LPI at signalized intersections with pedestrian signal heads and a one-second, all-red interval appears to reduce conflicts between pedestrians and turning vehicles (40). In addition, a three-second LPI appears to reduce the incidence of pedestrians yielding the right-of-way to turning vehicles, making it easier for pedestrians to cross the street by allowing them to occupy the crosswalk before turning vehicles are permitted to enter the intersection (40).

14A.5.1.9. Provide Actuated Control

The choice between actuated or pre-timed operations is influenced by the practices and standards of the jurisdiction. Intersection-specific characteristics such as traffic flows and intersection design also influence the use of actuated or pre-timed phases.

For the same traffic flow conditions at an actuated signal and pre-timed signal, actuated control appears to reduce some types of crashes compared with pre-timed traffic signals (7). However, the magnitude of the crash effect is not certain at this time.

14A.5.1.10. Operate Signals in “Night-Flash” Mode

Night-flash operation or mode is the use of flashing signals during low-volume periods to minimize delay at a signalized intersection.

Research indicates that replacing night-flash with regular phasing operation may reduce nighttime and nighttime right-angle crashes (19). However, the results are not sufficiently conclusive to determine a CMF for this edition of the HSM.

The crash effect of providing “night-flash” operations appears to be related to the number of approaches to the intersection (8).

14A.5.1.11. Provide Advance Static Warning Signs and Beacons

Traffic signs are typically classified into three categories: regulatory signs, warning signs, and guide signs. As defined in the *Manual on Uniform Traffic Control Devices* (MUTCD) (14), regulatory signs provide notice of traffic laws or regulations, warning signs give notice of a situation that might not be readily apparent, and guide signs show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information. The MUTCD provides standards and guidance for signage within the right-of-way of all types of highways open to public travel. Many agencies supplement the MUTCD with their own guidelines and standards. This section discusses the crash effects of providing advance static warning signs with beacons.

Providing advance static warning signs with beacons prior to an intersection appears to reduce crashes (9). This treatment may have a larger crash effect when drivers do not expect an intersection or have limited visibility to the intersection ahead (5). However, the magnitude of the crash effect is not certain at this time.

14A.5.1.12. Provide Advance Warning Flashers and Warning Beacons

An advance warning flasher (AWF) is a traffic control device that provides drivers with advance information on the status of a downstream traffic signal. AWFs may be responsive (i.e., linked to the signal timing mechanism) or continuous. Continuous AWFs are also called warning beacons.

The crash effects of responsive AWFs appear to be related to entering traffic flows from minor- and major-road approaches (38).

14A.5.1.13. Provide Advance Overhead Guide Signs

The crash effect of advance overhead directional or guide signs appears to reduce crashes. However, the magnitude of the crash effect is not certain at this time (9).

14A.5.1.14. Install Additional Pedestrian Signs

Additional pedestrian signs include YIELD TO PEDESTRIAN WHEN TURNING signs for motorists and PEDESTRIANS WATCH FOR TURNING VEHICLES signs for pedestrians.

In general, additional signs may reduce conflicts between pedestrians and motorists. However, it is generally accepted that signage alone does not have a substantial effect on motorist or pedestrian behavior without education and enforcement (25).

Table 14A-5 summarizes the known and/or apparent crash effects or changes in user behavior as the result of installing additional pedestrian signs.

Table 14A-5. Potential Crash Effects of Installing Additional Pedestrian Signs

Application	Specific Pedestrian Signs	Crash Effect and/or Resulting User Behavior
Intersections permitting pedestrians crossings	Install a red and white triangle YIELD TO PEDESTRIAN WHEN TURNING sign (36″ x 36″ x 36″)	Reduces conflicts between pedestrians and turning vehicles (44).
Intersections permitting pedestrians crossings	Provide a black-on-yellow PEDESTRIANS WATCH FOR TURNING VEHICLES sign	Decreases conflicts between turning vehicles and pedestrians (44).
Intersections with a history of pedestrian violations such as crossing against the signal	Install a sign explaining the operation of pedestrian signal	Appears to increase pedestrian compliance and reduce conflicts with turning vehicles (44).
Signalized intersections permitting pedestrian crossings	Provide a three-section signal that displays the message WALK WITH CARE during the crossing interval to warn pedestrians about turning vehicles or potential red-light running vehicles	Reduces pedestrian signal violations and reduces conflicts with turning vehicles (44).
Marked crosswalks at unsignalized locations	Provide an overhead CROSSWALK sign	Increases the percentage of motorists that stop for pedestrians (25).
Narrow low-speed roadways, unsignalized intersections	Install overhead, illuminated CROSSWALK sign with high-visibility ladder crosswalk markings	Increases the percentage of motorists who yield to pedestrians (36).
		Increases the percentage of pedestrians who use the crosswalk (36).
Marked crosswalks at unsignalized locations	Install pedestrian safety cones reading STATE LAW – YIELD TO PEDESTRIANS IN CROSSWALK IN YOUR HALF OF ROAD	Increases the percentage of motorists that stop for pedestrians (25).

14A.5.1.15. Modify Pavement Color for Bicycle Crossings

Modifying the pavement color at locations where bicycle lanes cross through an intersection is intended to increase the bicycle lanes conspicuity to motorists turning through or across the bicycle lane that is passing through the intersection. Increasing the conspicuity of the bicycle lane is intended to increase awareness of the presence of bicyclists, thereby reducing the number of vehicle-bicycle crashes.

Modifying the pavement color of bicycle path crossing points at unsignalized intersections (e.g., blue pavement) increases bicyclist compliance with stop signs and crossing within the designated area (28). In addition, there is a reduction in vehicle-bicycle conflicts (27).

Modifying the pavement color of bicycle lanes at exit ramps, right-turn lanes, and entrance ramps has the following effects:

- Increases the proportion of motorists yielding to cyclists;
- Increases bicyclists' use of the designated area;
- Increases the incidence of motorists slowing or stopping on the approach to conflict areas;
- Decreases the incidence of bicyclists slowing on the approach to conflict areas;
- Decreases motorists' use of turn signals; and
- Decreases hand signaling and head turning by bicyclists (27).

14A.5.1.16. Place "Slalom" Profiled Pavement Markings on Bicycle Lanes

Placing profiled pavement markings on the pavement between bicycle lanes and motor vehicles lanes is intended to increase the lateral distance between bicyclists and motorists on intersection approaches, and to increase the attentiveness of both types of road users (27). Profiled pavement markings can be applied to create a "slalom" effect, first directing bicyclists closer to the vehicle lane and then diverting bicyclists away from the vehicle lanes close to the stop bar.

Placing "slalom" profiled pavement markings at four-leg and T-intersections appears to regulate motorist speed to that of the bicyclists (27). These markings also result in more motorists staying behind the stop line at the intersection and reduce the number of motorists who turn right in front of a bicyclist (27).

14A.5.1.17. Install Rumble Strips on Intersection Approaches

Transverse rumble strips (also called "in-lane" rumble strips or "rumble strips in the traveled way") are installed across the travel lane perpendicular to the direction of travel to warn drivers of an upcoming change in the roadway. They are designed so that each vehicle will encounter them. Transverse rumble strips have been used as part of traffic calming or speed management programs, in work zones, and in advance of toll plazas, intersections, railroad-highway grade crossings, bridges, and tunnels. They are also considered a form of traffic calming that can be used with the intent of capturing motorists' attention and slowing speeds sufficiently enough to provide drivers additional time for decision-making tasks.

There are currently no national guidelines for applying transverse rumble strips. There are concerns that drivers will cross into opposing lanes of traffic in order to avoid transverse rumble strips. As in the case of other rumble strips, there are concerns about noise, motorcyclists, bicyclists, and maintenance.

On the approach to intersections of urban roads with unspecified traffic volumes, this treatment appears to reduce all crashes of all severities (13). However, the magnitude of the crash effect is not certain at this time.

14A.6. TREATMENTS WITH UNKNOWN CRASH EFFECTS

14A.6.1. Treatments Related to Intersection Types

- Convert stop-control intersection to yield-control intersection (not a roundabout)
- Convert uncontrolled intersection to yield, minor-road, or all-way stop control
- Remove unwarranted signals on two-way streets
- Close one or more intersection legs
- Convert two three-leg intersections to one four-leg intersection
- Install right-left or left-right staggering of two three-leg intersections
- Convert intersection approaches from urban two-way streets to a couplet or vice versa

14A.6.2. Treatments Related to Intersection Design Elements

Approach Roadway Elements

- Eliminate through vehicle path deflection
- Increase shoulder width
- Provide a sidewalk or shoulder at an intersection
- Increase pedestrian storage at intersection via sidewalks, shoulders, and/or pedestrian refuges
- Modify sidewalk width or walkway width
- Provide separation between the walkway and the roadway (i.e., buffer zone)
- Change the type of walking surface provided for pedestrians on sidewalks and/or crosswalks
- Modify sidewalk cross-slope, grade, curb ramp design
- Provide a left-turn bypass lane or combined bypass right-turn lane
- Modify lane width
- Provide positive offset for left-turn lanes
- Provide double or triple left-turn lanes
- Provide median left-turn acceleration lane
- Provide right-turn acceleration lanes
- Change length of left-turn and right-turn lanes
- Change right-turn curb radii
- Provide double right-turn lanes
- Provide positive offset for right-turn lanes
- Provide shoulders or improve continuity at intersections
- Provide sidewalks or increase sidewalk width at intersections
- Provide a median, or change median shape or change length of median opening
- Provide a flush median at marked and unmarked crosswalks
- Modify pedestrian refuge island design (e.g., curb extensions, refuge island width)
- Presence of utility poles and vegetation on medians
- Provide grade separation for bicyclists
- Improve continuity of bicycle lanes

Roadside Elements

- Increase intersection sight triangle distance
- Flatten sideslopes
- Modify backslopes
- Modify transverse slopes