Appendix D: Traffic Calming Program

Introduction

This appendix describes a potential process for the Public Works Department to receive and address traffic calming requests from community members. To support a process like the one described below it is recommended Public Works determine if it can allocate or request a sustainable source of funds to support the program as described. If a budget is established, Public Works could use an annual dollar threshold to cap petitions and instruct interested parties to pursue funding in the next program cycle.

This appendix also describes how City staff will consider traffic calming requirements as part of the development application process.

What is Traffic Calming?

When referring to traffic calming, the City of Belgrade utilizes the Federal Highway Administration (FHWA) definition:

> *"The primary purpose of traffic calming is to support the livability and vitality of residential and commercial areas through improvements in non-motorist safety, mobility, and comfort. These objectives are typically achieved by reducing vehicle speeds or volumes on a single street or a street network. Traffic calming measures consist of horizontal, vertical, lane narrowing, roadside, and other features that use self-enforcing physical or psycho-perception means to produce desired effects"*[1]

Per this definition, only passive/self-enforcing infrastructure will be considered as traffic calming treatments in the City's traffic calming program. Self-enforcing treatments are physical alterations to the roadway that are engineered to alter a motorist's speed or direction of travel without the need for enforcement.

What is Not Traffic Calming?

By the definition presented above, measures like additional police enforcement, stop sign installation, traffic signal installation, speed limit reductions, and education campaigns are not considered traffic calming under this program. These measures require enforcement and while stop signs and traffic signals successfully indicate who has the right-of-way, they are not proven tools for slowing vehicle speeds along a corridor[2]. The Manual on Uniform Traffic Control Devices (MUTCD) specifies that "Yield or Stop signs shall not be used for speed control." (Section 2B.06). Requests of this nature will not be considered eligible for review under the City's traffic calming program.

1 Federal Highway Administration. (N.D.). Traffic Calming E-Primer. https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer

2 Portland Bureau of Transportation. N.d. Stop Sign Overview. https://www.portland.gov/transportation/traffic-operations/stop-sign-overview#:~:text=Do%20stop%20signs%20really%20reduce,speeding%20doesn't%20necessarily%20work.

Traffic Calming Measures the City Will Consider in This Program

Traffic calming measures the city will evaluate are broken down into the following categories:

Horizontal deflection

- **Definition:** creates a horizontal shift in the roadway, resulting in drivers slowing their vehicle in order to comfortably navigate the measure[3].
- **Examples:** lateral shift, traffic circle/mini-roundabout, chicane

Vertical deflection

- **Definition:** creates a change in the height of the roadway that forces a motorist to slow down in order to maintain an acceptable level of comfort[3].
- **Examples:** speed cushions, raised crosswalk, raised intersection

Street width reduction

- **Definition:** narrows the width of a vehicle travel lane. These measures can also reduce the distance a pedestrian walks to cross a street, reducing exposure to pedestrian/vehicle conflicts[3].
- **Examples:** choker, median island, curb extension

Routing restriction

- **Definition:** prevents particular vehicle movements at an intersection, thereby reducing cut-through traffic[3].
- **Examples:** partial closure, forced turn island, diagonal diverter

Attachment A contains a toolbox of traffic calming measures that will be considered by Public Works staff through this program, including their typical application, design considerations, benefits, and constraints. Public Works staff may choose to consider additional measures or add to this toolbox at their discretion.

Where Does this Program Apply?

Ownership

Only roadways under the ownership of the City of Belgrade are eligible for traffic calming review. Montana Department of Transportation (e.g., Jackrabbit Lane, Main Street) or Gallatin County roadways are not eligible for consideration in the traffic calming program.

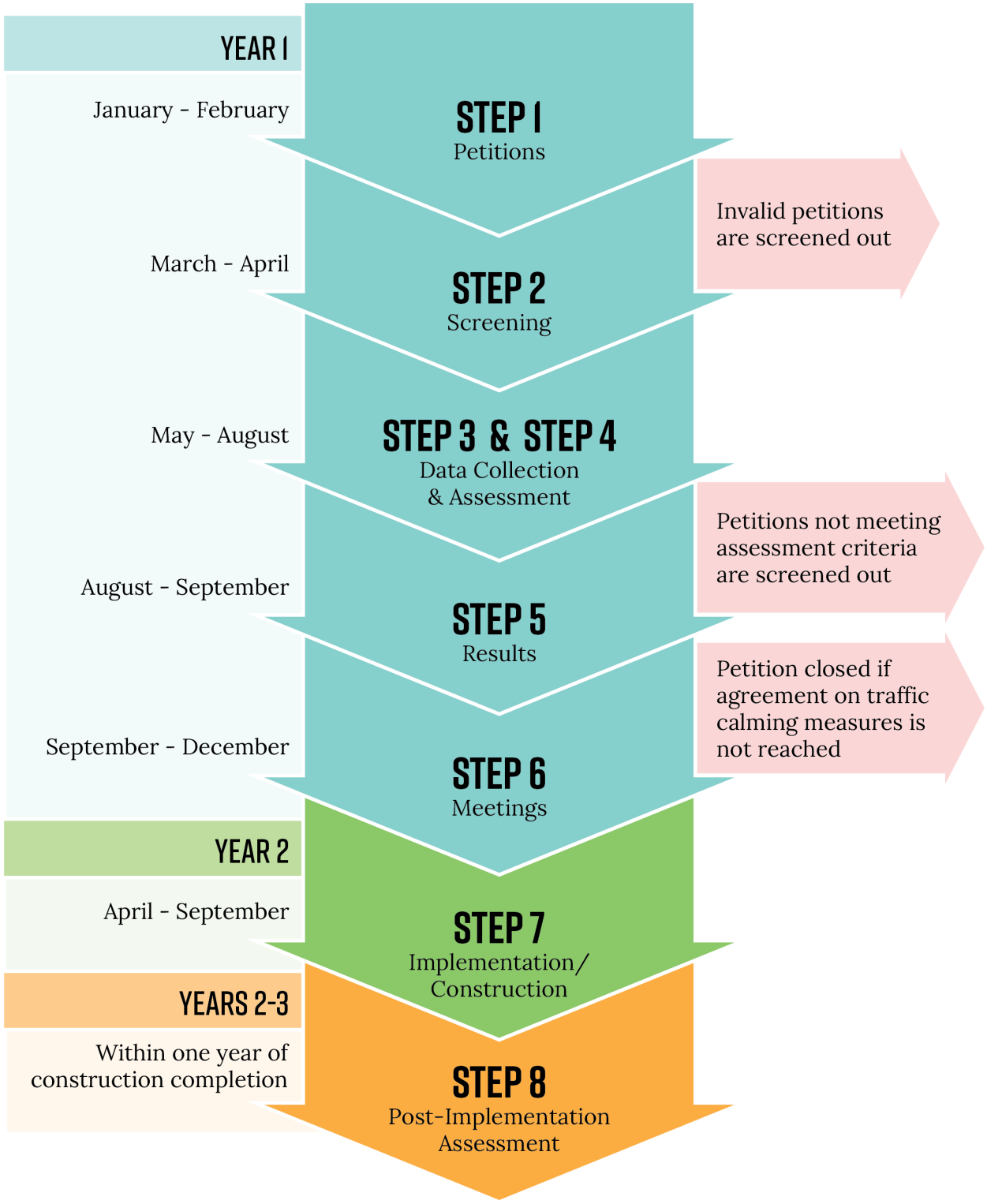
Classification

The roadway functional classification must be local or collector. Arterials are not eligible for traffic calming measures through this program. However, residents are encouraged to share concerns applying to arterial roadways with the city.

3 Federal Highway Administration. (N.D.). Traffic Calming E-Primer. https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer

Traffic Calming Request Process

The City will evaluate traffic calming treatments when requested by Belgrade community members in the manner highlighted in the figure below and explained in detail in this program document.



Step One: Petitions

The petition window opens for community members. Formal petitions are submitted to the City. All submissions must identify the primary location and concern (such as speed, crashes, heavy vehicles, etc.).

Valid petitions must be submitted by a group meeting one of the following criteria:

- 25% of the residents or property owners that abut the roadway segment in question.
- Greater than 15 community members with a "vested interest" in the location. Vested interest includes the following groups:
  - Parents whose children utilize the roadway as their route to school;
  - Employees of a business located on the street;
  - Neighborhood association, HOA, or community group representing a location specific demographic (e.g. downtown business association).
- Public Works Department Staff may suggest a location based on known of suspected issues.
  - Public Works Staff petitions will go through the same screening, data collection, assessment, and community meeting process that any our request would be subject to.

Timeframe
The petition window will be open for two months (January and February). Any application submitted after the closure date will be encouraged to apply in next year's application cycle.

Step Two: Screening

City staff will review petitions to ensure they align with the scope of the program.

These determinations will be based on a review of the guidance provided in the following sections and meets the petition requirements of Step One:

- What is Traffic Calming?
- What is Not Traffic Calming?
- Where Does this Program Apply?

Invalid petitions will be screened out and their petitioners notified of the results and reasoning. Invalid petitions will be granted two weeks from the notice of screening results to resubmit their application with any issues identified by city staff addressed. Only one request for reconsideration per petition is allowed per year.

Timeframe
This step will occur between March and April.

Step Three: Data Collection

Screened petitions deemed valid will move into the data collection phase.

City staff will either consolidate acceptable existing data or collect new data covering the following:

- Safety: *Gather recorded crashes in the study area*
- Vehicle speeds: *Conduct a speed study of the corridor*
- Vehicle volumes: *Average Annual Daily Traffic (AADT) volumes or 24-hour tube counts.*
- School and community destination proximity
- Land use context: Document whether the surrounding area is commercial, residential, industrial, agricultural, or other.

Timeframe
This is expected to occur May through August. Projects near school zones may have different assessment schedules to ensure data collection occurs when school is in session.

Step Four: Assessment

Following data collection, the petition will be evaluated using the criteria outlined in *Table 1*.

Assessment criteria were derived from a review of existing traffic calming programs across the country and modified to fit the Belgrade context. Traffic calming programs reviewed included:

- Burlington (VT) Traffic Calming Manual[4]
- Pleasant Ridge (MI) Traffic Calming Manual[5]
- San Diego (CA) Traffic Calming Guidelines[6]
- DDOT (DC) Traffic Calming Assessment Application[7]
- FHWA's Traffic Calming ePrimer[8]
- Ada County Highway District's (ID) Residential Traffic Calming Policy[9]

Timeframe
This is expected to occur May through August.

4 City of Burlington. October 2020, *Traffic Calming Manual*. https://www.burlingtonvt.gov/DocumentCenter/View/3111/View-the-2020-Traffic-Calming-Manual-PDF?bidId=

5 City of Pleasant Ridge. Februrary 2019. Traffic Calming Manual. https://cityofpleasantridge.org/wp-content/uploads/2019/01/Traffic-Calming-Manual.pdf

6 City of San Diego. N.d. Traffic Calming Guidelines. https://www.sandiego.gov/sites/default/files/2024-08/104_san_diego_traffic_calming_guidelines.pdf

7 District Department of Transportation. April 2012. https://www.sandiego.gov/sites/default/files/2024-08/104_san_diego_traffic_calming_guidelines.pdf

8 Federal Highway Administration. n.d. *Traffic Calming ePrimer*. https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer

9 Ada County Highway District. n.d. *Residential Traffic Calming Policy*. https://www.achdidaho.org/home/showpublisheddocument/1716/638804140039600000

Table 1. Assessment Criteria Evaluation

Assessment Criteria	Threshold	Location Performance
Group 1		
Safety	Located on the SAP's High Injury Network	Yes / No
	One or more fatal or serious injury crashes in the past two years	Yes / No
	Ten or more minor injury or property damage crashes in the past two years	Yes / No
Vehicular Speeds	50th percentile speed measurement at the location is greater than the posted speed limit for the location	Yes / No
Vehicular Volumes	Local roads: >100 vehicles during the weekday peak hour Collector roads: >300 vehicles during weekday peak hour Heavy Vehicles: >5% of traffic is heavy vehicles	Yes / No
Group 2		
Schools	Along a designated reduced speed zone or walking route to school (up to 1.5 miles away from a school)	Yes/No
Community Destinations	Within 0.25-miles of one or more of the following: • Park • Library • Community Center • City Hall	Yes / No
Land Use Context	Located within a residential or local commercial zone	Yes / No

Step Five: Results

Determining if criteria has been met.

Following the assessment in step four, one of two pathways are possible:

- If assessment criteria are not met, City staff will notify the petitioners of the assessment results.
- If assessment criteria are met, City staff will schedule a community meeting to discuss traffic calming options and notify the petitioners of said meeting.

A petition **must satisfy at least two of the Group 1 assessment criteria** and **one of the Group 2 assessment criteria in Table 1** to move onto Step Six.

Timeframe
This is expected to occur August through September.

Step Six: Community Meeting

City staff will organize and facilitate a community meeting.

City staff will organize and facilitate a community meeting between September and December. The community meeting will be used to inform the petitioner, and interested parties of the potential traffic calming treatments deemed appropriate for the petitioned location.

- If the petitioners and city staff cannot agree on potential traffic calming treatments, the petition will be closed.
- If the petitioners agree with the potential traffic calming treatments, City staff will provide an estimated construction schedule and cost for the petitioned location and agreed-upon traffic calming treatment(s).

Timeframe
This is expected to occur September through December.

Step Seven: Implementation/Construction

Application of traffic calming measures.

The next construction season when funds are available, traffic calming measures will be installed.

Timeframe
This is expected to take place between April and September of year two

Step Eight: Post-Implementation Assessment

Evaluation of successes and challenges.

City staff will evaluate the traffic calming location to inform future traffic calming petitions. Post-implementation evaluation includes reviewing:

- Assessment criteria that validated the original request: Document if there has been a recordable change
- Speed data (even if not one of the assessment criteria that validated the original request): Document if there has been a recordable change
- Infrastructure conditions: Determine any design or material changes for future implementation
- Vehicle and/or volume data: Document if there has been a recordable change

Timeline
Within one year of construction completion

New Development Traffic Calming Requirements

City of Belgrade Public Works Department staff will evaluate proposed developments to determine whether traffic calming measures may be required based on the development's impact on planned (Group 1) or existing (Group 2) roadways. Staff's assessment will be based on the criteria identified in ***Table 2*** and applies in the following scenarios:

- Where new development is proposing to construct new roadways:
  - New roadways are assessed using Group 1 criteria
  - Existing roadways are assessed using Group 2 criteria
- Where new development will not construct new roadways (excluding site accesses):
  - Existing roadways are assessed using Group 2 criteria

City of Belgrade Public Works Department staff may require traffic calming elements from new development based on the following:

- For new roadways: All Group 1 thresholds are met
- For existing roadways: If Group 2 Vehicular Volumes and Land Use criteria are met, plus at least one of either the Schools or Community Destinations criteria are met

Attachment A contains a toolbox of treatment options that Public Works staff may require of new development if the thresholds above are met. Public Works staff may also identify measures not included in this toolbox.

Assessment practices for new development detailed here only apply to collector and local roadways. Development impacts to arterial roadways will not be evaluated for traffic calming.

Table 2. New Development Traffic Calming Assessment Criteria

Assessment Criteria	Threshold	Location Performance
New Roadways (Group 1)		
New Roadway Design	New roadway constructed is longer than 750-feet	Yes / No
	Proposed roadway design speed is 30 mph or less	Yes / No
	Is the proposed roadway missing passive design elements needed to discourage excessive speed?	Yes / No
Vehicular Volumes	Are new roadways constructed with this development expected to carry vehicle volumes exceeding any of the following: • Local roads: >100 vehicles during the weekday peak hour • Collector roads: >300 vehicles during weekday peak hour • Heavy Vehicles: >5% heavy vehicle percentages	Yes / No
Existing Roadways (Group 2)		
Vehicular Volumes	Are the proposed development's assigned vehicle trips expected to make any existing roadways exceed one of the following (where they were not originally): • Local roads: >100 vehicles during the weekday peak hour • Collector roads: >300 vehicles during weekday peak hour • Heavy Vehicles: >5% heavy vehicle percentages	Yes/No
Schools	Will the new development assign new vehicle trips exceeding 25 vehicles in the peak hour along a designated reduced speed zone or walking route to school (up to 1.5 miles away from a school)	Yes/No
Community Destinations	Will the new development assign new vehicle trips exceeding 25 vehicles in the peak hour on roadways within 0.25-miles of one or more of the following: • Park • Library • Community Center • City Hall	Yes / No
Land Use Context	Is the proposed development located within a residential or local commercial zone?	Yes / No

Attachment A

Traffic Calming Toolbox

Potential Traffic Calming Program:

Traffic Calming Toolbox

This document provides a compilation of traffic calming treatments that could be considered for implementation within the scope of the City of Belgrade Traffic Calming Program. This toolbox provides illustrative examples of design elements, as well as benefits and considerations for use, typical applications, factors to consider in design, and resources for additional guidance.

Traffic Calming Treatments

The treatments are organized into the following categories:

Horizontal Deflection

- Mini-roundabout
- Traffic Circle
- Lateral Shift
- Chicane
- Realigned Intersection

Vertical Deflection

- Speed Hump
- Speed Cushion
- Raised Crosswalk
- Raised Intersection

Street Width Reduction

- Curb Extension/Bulbout
- Choker
- Median Island
- On-street Parking
- Bike Lanes

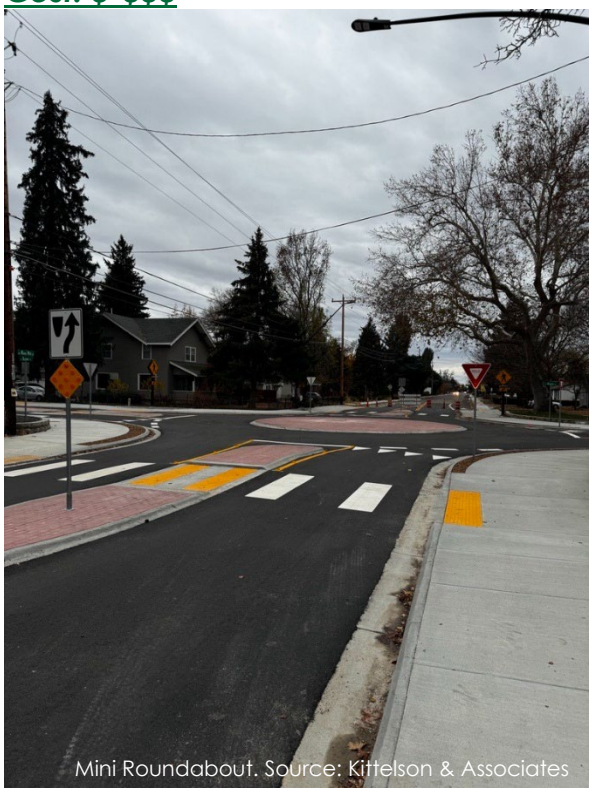
Routing Restriction

- Full Closure
- Partial Closure
- Diagonal Diverter
- Median Barrier and Forced Turn Island

Horizontal Deflection

Mini-Roundabout or Traffic Circle

Cost: $-$$$



Mini Roundabout. Source: Kittelson & Associates

Traffic Circle. Source: FHWA Traffic Calming ePrimer

Mini roundabouts are compact roundabouts that operate similar to a single lane roundabout with raised central islands in the center and splitter islands to direct traffic but have smaller intersection footprints in comparison with full-size roundabouts. Traffic circles operate similar to roundabouts, however they are typically not designed to accommodate all vehicle types, do not have splitter islands, and require minimal changes to existing intersection right-of-way (ROW).

Benefits

- Slows vehicles along all approaches.
- Reduces conflict points between vehicles at intersection.
- Typically less costly to build than standard roundabouts and require less right-of-way (particularly traffic circles).
- Mini roundabouts may have a fully traversable center island for heavy vehicles.
- Central island can be used as a landscaping or color/texture treatment opportunity to create a gateway feel.

Considerations

- Speed reduction largely dependent on geometric design.
- May cause truck traffic to divert to other routes.
- Mini-roundabouts may require more ROW than a stop-controlled intersection.
- Speed reduction effect is limited to the intersection area.

Typical Applications

- Intersections involving local or collector roadways.
- One- or two-way streets
- Lower traffic volumes than a single lane roundabout

Design Considerations

- Stormwater runoff should drain away from center island
- Traffic circles may not be traversable by heavy vehicles, depending on design.
- Redesign/relocation of existing utilities
- Potential need for additional street lighting

Additional Guidance

- FHWA Traffic Calming ePrimer
- FHWA Mini-Roundabouts Technical Summary
- NCHRP Report 1043: A Guide for Roundabouts

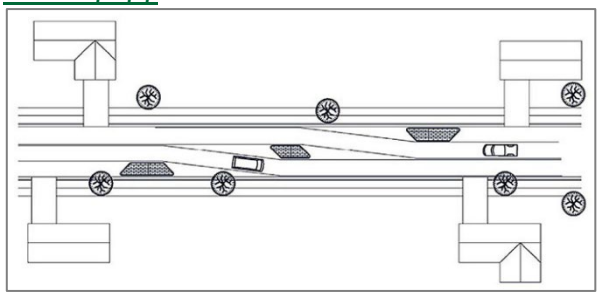
Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a mini-roundabout or traffic circle if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

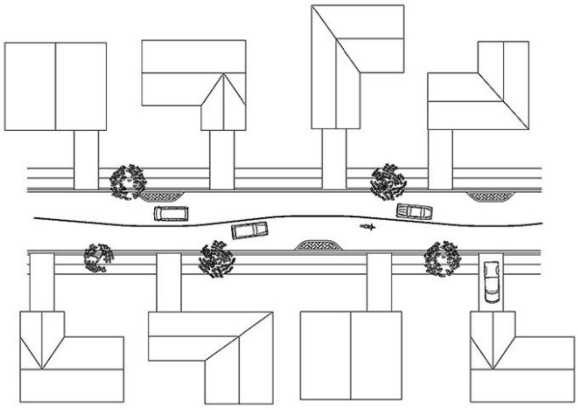
Horizontal Deflection

Lateral Shift/Chichane

Cost: $-$$



Lateral Shift. Source: FHWA Traffic Calming ePrimer



Chicane. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a lateral shift/chicane if it is covered by snow. Flexposts or landscape features can be placed on the feature to improve visibility.

Lateral shifts are a realignment of an otherwise straight travel lane. Lateral shifts are typically paired with median islands to discourage motorists crossing the roadway centerline. Similarly, chicanes introduce curvature to straight roadways. The primary difference between the two is that a chicane shifts alignments more than once (e.g. S-curves). Chicanes can be achieved with curb extensions, on-street parking, raised/landscape medians, etc.

Benefits

- Heightens driver awareness and forces drivers to steer/drive slower.
- Creates opportunities for street landscaping.

Considerations

- May not be as effective when traffic volumes are higher in one direction or when traffic volumes are low enough that opposing vehicles rarely interact.
- Not a preferred location for crosswalks as drivers should be focusing on curvature.

Typical Applications

- Local streets or low-volume collectors.
- Either applied midblock or for entire blocks.
- Roadways with infrequent driveways and side street accesses.

Design Considerations

- Design to avoid relocating drainage features (e.g., catch basins, concrete channels, valley gutters, inlets, and trench drains) if possible.
- May require the removal of on-street parking where implemented.
- Should not require relocation of above- and below-ground utilities.

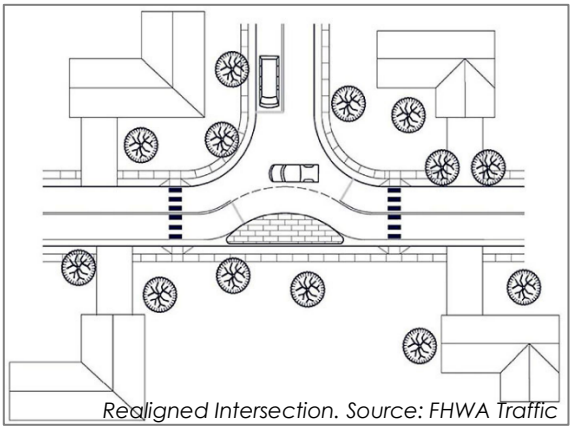
Additional Guidance

- FHWA Traffic Calming ePrimer

Horizontal Deflection

Realigned Intersection

Cost: $-$$$



Realigned Intersection. Source: FHWA Traffic

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a realigned intersection if it is covered by snow. Flexposts or landscape features can be placed on the feature to improve visibility.

The reconfiguration of an intersection with perpendicular angles to have curvilinear travel paths through the intersection.

Benefits

- Slows straight through and turning speeds through horizontal deflection.
- Can provide opportunities for landscaping.
- Can be installed on routes that carry buses and emergency vehicles if appropriate turning radii can be provided.

Considerations

- Not applicable to four leg intersections (use traffic circles or roundabouts instead).
- If cut-through traffic concerns are present on roadway consider additional traffic calming measures.

Typical Applications

- T-intersection with perpendicular approaches.
- Collector and local roads with speed limits under 30 mph.

Design Considerations

- Design to avoid relocating drainage features if possible.
- Should not require relocation of above- and below-ground utilities.

Additional Guidance

- FHWA Traffic Calming ePrimer

Vertical Deflection

Speed Hump/Speed Cushion

Cost: $

Speed Hump. Source: FHWA Traffic Calming ePrimer


Speed Cushions. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a speed hump or speed cushion if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

Speed humps utilize a larger vertical radius than a typical speed bump which results in wider widths and a gentler crossing by vehicles. Speed cushions break a hump into individual sections that allow for emergency vehicles to pass through them with minimal disruptions.

Benefits

- Relatively inexpensive.
- Effectively slows vehicle speeds.
- Easily navigated by bicyclists.

Considerations

- May be considered noisy by nearby residents.
- May require emergency vehicles to slow down.
- Inappropriate on streets with bus traffic due to rider comfort and reduced travel speeds.

Typical Applications

- Local and collector roadways.
- Where focused speed reductions are desired (e.g. approach to a school, change in land use context, etc.).
- Where a diversion in traffic volumes along a road segment are desired (requires successive humps along the full length of the segment).

Design Considerations

- Emergency vehicle access and drainage needs should be accommodated.
- Used midblock, not at intersections (unless used as a raised crossing).
- Advance signing and pavement markings on the treatment should be provided (Signage is necessary for snow removal vehicles to locate under snow).
- Typically preferred for treatment to not extend into bike lane

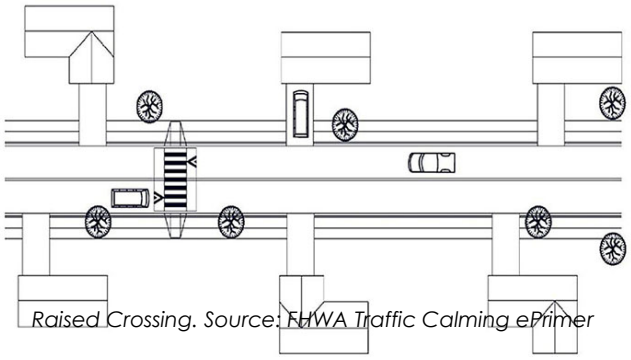
Additional Guidance

- FHWA Traffic Calming ePrimer
- ITE Traffic Calming Measures
- ITE Guidelines for the Design and Application of Speed Humps

Vertical Deflection

Raised Pedestrian Crossing

Cost: $-$$



Raised Crossing. Source: FHWA Traffic Calming ePrimer

Raised Crossing. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a raised crosswalk if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

Raised pedestrian crossings bring the level of the roadway even with the sidewalk, providing a level pedestrian path and requiring vehicles to slow. Raised crossings can be used at midblock crosswalks or intersections.

Benefits

- Improves visibility of and for pedestrians and motorists
- Slows down motorists.
- Can eliminate the need for curb ramps.

Considerations

- May be considered noisy by nearby residents.
- May require emergency vehicles to slow down.
- Inappropriate on streets with bus traffic due to rider comfort and reduced travel speeds.

Typical Applications

- Local and collector roadways.
- Midblock crossings on two-lane roads where pedestrian volumes are high and speed control is needed.
- Intersections where low-volume streets intersect with high-volume streets or where a roadway changes character (such as from commercial to residential).

Design Considerations

- Raised crosswalks should be even with the sidewalk in height and at least as wide as the crossing.
- Provide detectable warnings for pedestrians where they cross from the sidewalk into the crossing area.
- Consider drainage needs and provide appropriate treatments.
- Avoid the use of brick or decorative surface materials to make the crossing smoother for those with mobility impairments.
- Advance signing and pavement markings on the treatment should be provided.

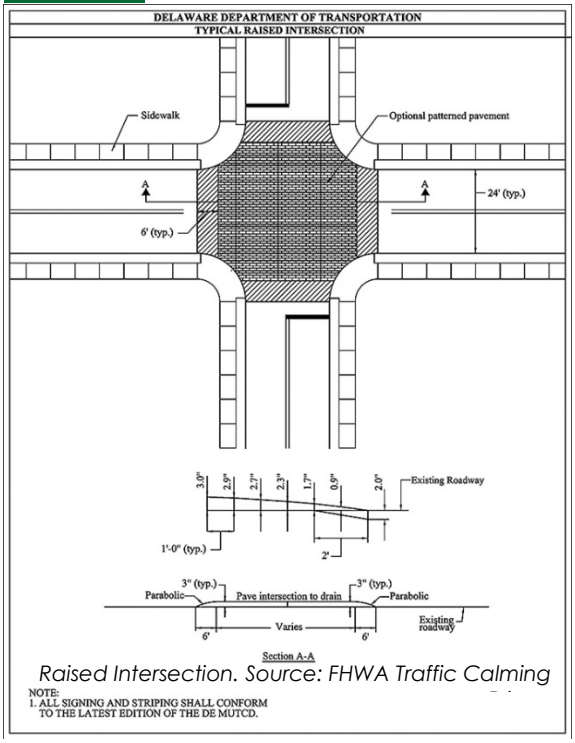
Additional Guidance

- ITE/FHWA Report Traffic Calming: State of the Practice
- FHWA Designing Sidewalks and Trails for Access *Part II of II: Best Practices Design Guide*

Vertical Deflection

Raised Intersection

Cost: $$$



Raised Intersection. Source: FHWA Traffic Calming

Raised Intersection. Source: Salt Lake City, UT.

A flat, raised area covering an entire intersection with ramps on all approaches. It is essentially a speed table that covers an entire intersection, including the crosswalks.

Benefits

- Slows speeds at all intersection approaches.
- Improves visibility of and for pedestrians and motorists
- Can remove the need for curb ramps.
- Easily navigated by bicyclists.

Considerations

- Drainage requirements may impact the ability to achieve impactful vertical deflection.
- May require emergency vehicles to slow down.
- Minimal change to traffic volumes.

Typical Applications

- At intersections (four legged or T), in particular those with high pedestrian activity and crosswalks or identified needs for crosswalks.
- Where maximum roadway speed at approaches is 30 mph or less.

Design Considerations

- Likely requires changes in access to below-ground utilities.
- Requires redesign of surface drainage structures that serve the intersection and approach legs.

Additional Guidance

- FHWA Traffic Calming ePrimer

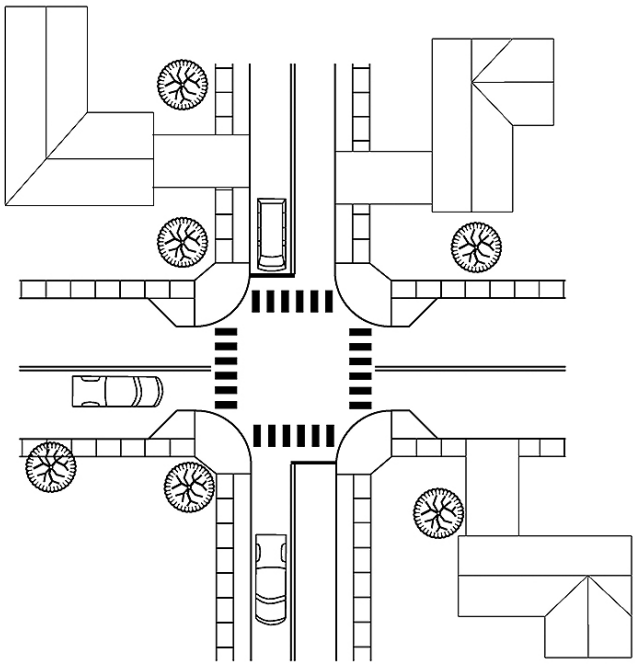
Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a raised intersection if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

Street Width Reduction

Curb Extension/Bulbout

Cost: $-$$



Curb Extension. Source: FHWA Traffic Calming ePrimer

Curb Extension. Source: FHWA Traffic Calming ePrimer

An extension of the curb or the sidewalk into the street, usually at an intersection or mid-block crossing, that narrows the vehicle path, slows turning vehicles, and shortens the crossing distance for pedestrians.

Benefits

- Shortens crossing distances for pedestrians.
- Reduces motorist turning speeds.
- Increases visibility between motorists and pedestrians.
- Enables tree and landscape planting and water runoff treatment.

Considerations

- Impacts turning radii.
- May not be appropriate if there is a far side bus stop.
- Drainage may be impacted.

Typical Applications

- Mid-block or intersection pedestrian crossings on streets with or without on-street parking.
- Streets with on-street parking where there is significant pedestrian activity.

Design Considerations

- Evaluate drainage needs with the changing curbline.
- Avoid intruding into a bike lane.
- Provide accessible curb ramps and detectable warnings.
- Consider landscaping or other treatment to differentiate path for pedestrian travel, especially for pedestrians with vision impairments.

Additional Guidance

- ITE/FHWA Report Traffic Calming: State of the Practice
- FHWA Designing Sidewalks and Trails for Access *Part II of II: Best Practices Design Guide*

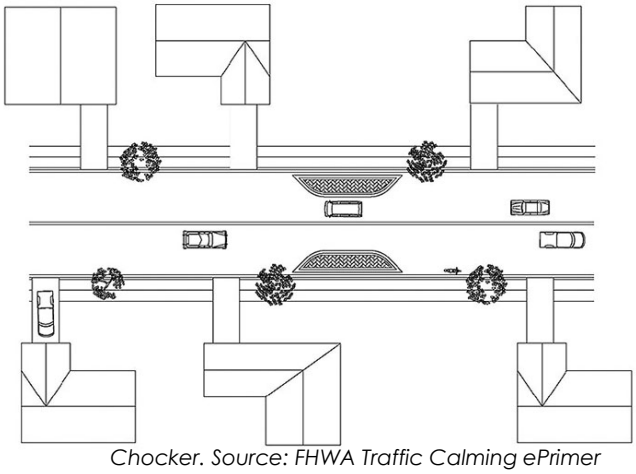
Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a curb extension if it is covered by snow. Flexposts or crosswalk signage can be placed on the curb to improve visibility.

Street Width Reduction

Choker

Cost: $-$$



Chocker. Source: FHWA Traffic Calming ePrimer

Choker. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a choker if it is covered by snow. Flexposts or crosswalk signage can be placed on the curb to improve visibility.

An extension of the curb or the sidewalk into the street, not at an intersection, that narrows the vehicle path.

Benefits

- Reduces motorist speeds.
- Can provide space for tree and landscape planting and water runoff treatment.
- Can provide protected parking bay for on street parking.

Considerations

- May force bicycles into center of vehicle travel lanes.
- Drainage may be impacted.

Typical Applications

- Local and collector roadways.
- Mid-block along a roadway segment that is under 40 mph provided there is adequate shy distance between the travel lane and choker curb.

Design Considerations

- Relocation of curbing may require relocation of drainage features.
- May require relocation of above- and below-ground utilities
- On a street with a bicycle lane or on a street with higher volumes, a bypass lane for a bicyclist separated from the main travel lane by a curb extension or shared lane markings and "bike may use full lane" signage are needed.

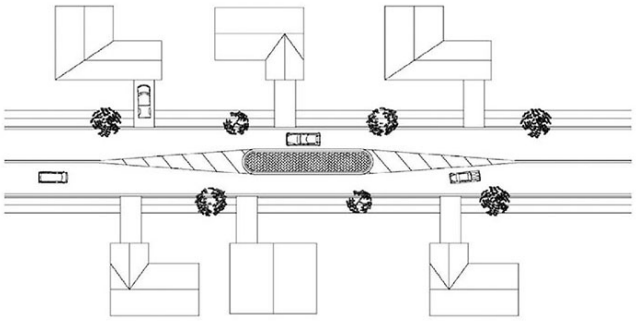
Additional Guidance

- FHWA Traffic Calming ePrimer.

Street Width Reduction

Median Island

Cost: $-$$



Median Island. Source: FHWA Traffic Calming ePrimer

Median Island. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a median island if the driver is unaware of its presence. Design, warning signage, and flexosts may mitigate this concern.

Physical medians constructed in the center of the roadway providing a barrier between travel directions. These features can be installed corridor-wide or as individual median islands for site specific locations.

Benefits

- Physically narrows the pavement width and reduces the open feel of the street.
- Can facilitate pedestrian crossing refuge areas and increase pedestrian visibility.
- Changes visual and physical context of the roadway.
- Can include landscaping or monument sign and serve as a gateway treatment.

Considerations

- Insufficient roadway width or right-of-way can prevent installation.
- May impact access to driveways or side streets if placed near/at them.

Typical Applications

- Two-way streets with one or more lanes in each direction.
- All roads are eligible for a median if safe travel lane widths can be maintained.
- Midblock locations, intersection approaches, or through intersections. If through an intersection, see median barrier section below.

Design Considerations

- Adequate roadway width and/or right-of-way for installation.
- Can impact adjacent driveways access point(s).

Additional Guidance

- AASHTO Green Book
- FHWA Traffic Calming ePrimer

Street Width Reduction

Bike Lanes

Cost: $

Bike Lane. Source: Kittelson & Associates

Bike Lane. Source: Kittelson & Associates

Winter Maintenance Considerations:

Likely no or limited effect on winter maintenance operations.

A standard bike lane is an on-street facility that provides space designated for bicyclists, separated from vehicles by pavement markings.

Benefits

- Provides a designated facility for bicyclists using the minimum pavement width, encouraging bicycle activity and increasing driver awareness.
- Can be used to reallocate pavement space and narrow travel lanes for vehicles.
- Provides increased visibility for bicyclists.
- Relatively inexpensive treatment when pavement width is available.

Considerations

- Can position bicyclists in the "door zone" if located adjacent to parked vehicles without a buffer.
- Motorists may illegally park in the lane if not adequately signed and enforced.
- Does not provide physical protection or horizontal buffer from vehicles and therefore may not attract bicyclists of all levels.
- Does not physically narrow the pavement width on the road.

Typical Applications

- See Pedestrian and Bicycle Facility Selection Guidance for application based on speeds and volumes.
- Streets without sufficient right-of-way or pavement width for buffered bike lanes or separated bike lanes (SBLs).

Design Considerations

- Typical bike lane width is 6 feet, with 5 feet in constrained locations. A minimum 4-foot width can be used on constrained segments where on-street parking is not present.
- Green pavement markings or striping can add visibility and awareness in "conflict areas" or intersections where bicycle and vehicle travel paths cross.

Additional Guidance

- AASHTO Guide for the Development of Bicycle Facilities
- NACTO Urban Bikeway Design Guide

Street Width Reduction

On-Street Parking

Cost: $

On-Street Parking. Source: FHWA Traffic Calming ePrimer

On-Street Parking. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Likely no or limited effect on winter maintenance operations.

On-street parking can effectively narrow the roadway travel lanes by adding side friction to the traffic flow. Whether on-street parking can be an appropriate traffic calming measure is a direct function of its occupancy with parked vehicles during the time when traffic calming is desired.

Benefits

- Generally low cost provided necessary pavement width is already present.
- Can be protected with chokers or curb extensions.

Considerations

- If cars are not parked for portions of the day, traffic calming benefits are not realized.
- The door zones may present conflicts for cyclists in the roadway.
- If vehicles are parked too closely to intersections or crossings they can restrict visibility.

Typical Applications

- Local or collector roadways with unused pavement right-of-way.
- Can be applied to collector or local roadways, and roadways with or without a bicycle lane.

Design Considerations

- Depending on available right-of-way parking can be parallel and front-in or back-in angled.
- For a bicycle lane placed between the parking lane and the travel lane, the preferred bicycle lane width is 6 feet, with a minimum of 5 feet. A width of up to 7 feet may be desirable if adjacent to a narrow parking lane with high parking turnover.

Additional Guidance

- FHWA Traffic Calming ePrimer

Routing Restriction

Full Closure

Cost: $-$$$

Full Closure. Source: FHWA Traffic Calming ePrimer

Full Closure. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Requires turnaround for snowplows if the road is to be plowed. If the closure is designed to be accessible for emergency vehicles, sign to avoid snow storage at the access point.

A physical barrier placed in the street that fully closes vehicular access to through traffic. This closure can be designed to still allow pedestrians and bicyclists to pass through.

Benefits

- Stops vehicular through traffic and will divert traffic to other routes.
- Largest expected traffic volume reduction of traffic calming measures.
- Can enable tree and landscape planting and water runoff treatment.

Considerations

- Not appropriate for one-way streets.
- Not appropriate where emergency vehicle or bus through access concerns are present.
- Not applicable where no alternative access routes for diverted vehicles can be provided.
- Causes the need for circuitous routing from affected properties.

Typical Applications

- Applicable at an intersection or midblock.
- Local roadways where cut-through traffic is occurring, and diversions to collectors or other local streets are desirable.

Design Considerations

- Closure can be modified to include removable delineators, breakaway or lockable bollards, lockable gates, low landscaping, or a mountable curb apron along with a passable area wide enough for an emergency vehicle.
- Signage needed to indicate that a street is a dead end.

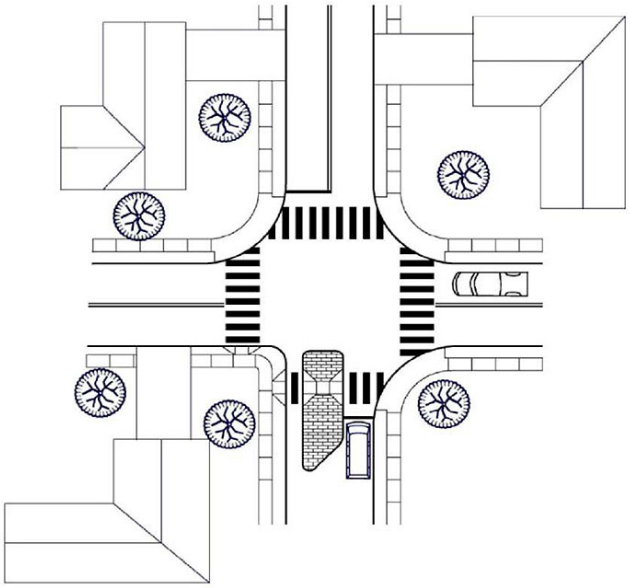
Additional Guidance

- FHWA Traffic Calming ePrimer

Routing Restriction

Partial Closure

Cost: $-$$



Partial Closure. Source: FHWA Traffic Calming ePrimer

A partial closure is a physical barrier that blocks travel in one direction for a short distance on an otherwise two-way street. This normally takes place at an intersection to obstruct a particular traffic movement from occurring.

Benefits

- Removes conflict points from an intersection.
- Can be used to remove a traffic movement perceived to be dangerous or problematic.
- Its implementation can accommodate pedestrians, bicyclists, and emergency vehicles.
- Reduces cut-through traffic.

Considerations

- Not applicable at midblock as motorists may try to bypass the measure.
- Not applicable where no alternative access routes for diverted vehicles can be provided.
- Causes the need for circuitous routing from affected properties.

Partial Closure. Source: FHWA Traffic Calming ePrimer

Typical Applications

- The most common application of a half closure blocks entry to the side street from the main street and permits side street traffic to enter the main street.
- An entrance-only half closure is less common because it can trap side street traffic attempting to access the main street. The potential safety problem is that a motorist may use the short wrong-way section adjacent to the half closure.

Design Considerations

- A half closure should provide a full lane width in the open direction and sufficient curb radii at the entrance intersection to permit the design vehicle to make a turn at the treated intersection without encroaching onto a curb or island.
- For an exit-only half closure, movement prohibition and DO NOT ENTER signs are needed to advise approaching traffic of the closure. One-Way signs should be used to advise traffic on the main street that a turn into the closed street is not permitted.

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking partial closure infrastructure if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

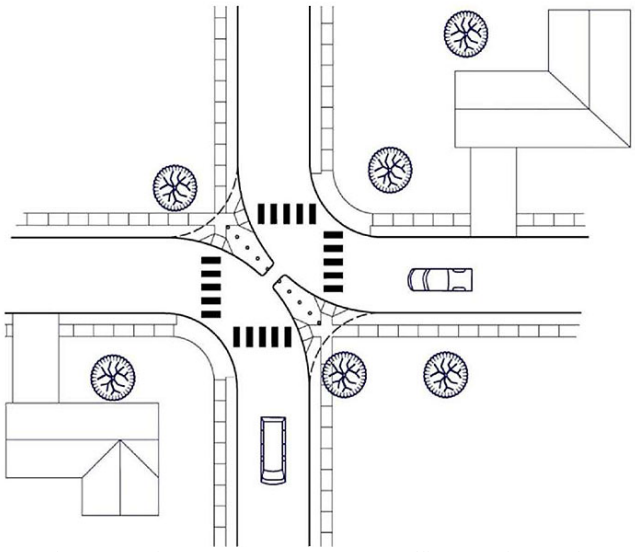
Additional Guidance

- FHWA Traffic Calming ePrimer

Routing Restriction

Diagonal Diverter

Cost: $-$$



Diagonal Diverter. Source: FHWA Traffic Calming ePrimer

Diagonal Diverter. Source: FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a diagonal diverter if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

A physical barrier placed diagonally across a four legged intersection. This creates two unconnected intersections and traffic approaching the intersection only has access to one receiving leg rather than three.

Benefits

- Reduces potential for cut-through traffic by preventing straight through movements.
- Can still allow for pedestrian, bicycle and emergency vehicle access.
- Removes conflict points from an intersection.

Considerations

- Not applicable where no alternative access routes for diverted vehicles can be provided.
- Causes the need for circuitous routing from affected properties.

Typical Applications

- Four legged intersections with neighborhood connectivity that can accommodate this diversion.
- Where local street cut-through traffic can be discouraged or funneled to nearby collectors.

Design Considerations

- The design for a diagonal diverter should maintain full lane widths.
- A diagonal diverter is designed for accessibility, not mobility. The radius should be the minimum needed to allow the design vehicle through.
- Appropriate signs and markings need to be in place to help the motorist be aware of and see the diagonal diverter. Painted curbs, delineation, streetlights, and advance warning directional arrow signs (e.g., Single Curve signs) should be considered. Parking Prohibited signs may also be required along the diverter.

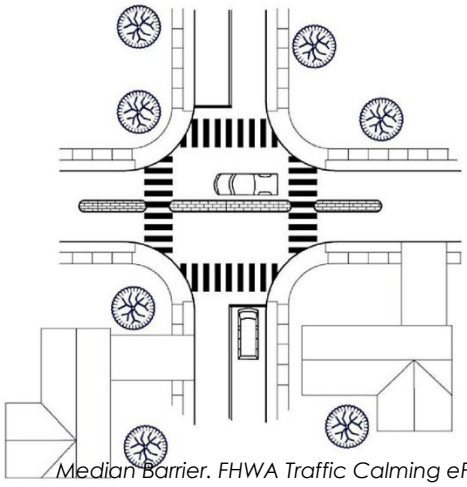
Additional Guidance

- FHWA Traffic Calming ePrimer

Routing Restriction

Median Barrier and Forced Turn Island

Cost: $-$$ Safety Benefit: Medium



Median Barrier. FHWA Traffic Calming ePrimer

Forced Turn Island. FHWA Traffic Calming ePrimer

Median Barrier. FHWA Traffic Calming ePrimer

Winter Maintenance Considerations:

Snow clearance methods (plowing) may risk striking a median barrier or forced turn island if the driver is unaware of its presence. Design and warning signage may mitigate this concern.

A median barrier is a raised island placed through an intersection, along the centerline of a roadway (often the higher-order roadway), preventing a motorist from traveling straight through the intersection on the side street. A median barrier can be designed to allow turns to and from the main street, while preventing through traffic from the side street from crossing the main roadway.

A forced turn island is a raised island that blocks certain movements on approaches to an intersection. It can force a motorist to turn right from the side street (by blocking left-turn and through movements).

Benefits

- Reduces conflict points.
- Reduces volumes by restricting access from certain approaches.
- Can still accommodate pedestrians and bicyclists to make all movements.
- Median barrier can slow speeds on main street by narrowing lanes.

Considerations

- Not appropriate on primary emergency vehicle routes.
- Likely will not slow speeds on minor leg approach

Typical Applications

- Can be installed anywhere provided alternative routes provide system connectivity.

Design Considerations

- The design of a median barrier or forced turn island should consider the right turn curb radii needed for a design vehicle unless the median is traversable.
- The median barrier should extend a sufficient distance beyond the intersection to discourage a main street motorist from attempting to drive to the left of the median.

Additional Guidance

- FHWA Traffic Calming ePrimer

Appendix E: Main Street Demonstration Project

Appendix E:
Main Street Demonstration Project

Executive Summary

The City of Belgrade installed a temporary demonstration project on Main Street in downtown in the summer of 2025. The purpose of this project was to pilot treatments that could improve safety and the pedestrian experience in downtown Belgrade, particularly for people crossing Main Street. Treatments included enhanced pedestrian crossing signage, crosswalk markings, and curb extensions delineated by paint and flexposts.

The project team evaluated the performance of the demonstration project. Key findings from this evaluation include that after the demonstration project treatments were installed:

- Drivers were more likely to yield to pedestrians crossing Main Street, especially at the Davis Street intersection.
- People crossing Main Street near Davis Street were more likely to cross at the Davis Street intersection.
- People reported feeling safer walking, biking, and driving along Main Street and walking across Main Street.
- Average motor vehicle speeds decreased slightly.

The primary challenges experienced with the Demonstration Project were people feeling that it was difficult to make certain turning movements with large vehicles and disliking the aesthetic of the flexposts.

If these treatments are to be made permanent, the City should work with the Montana Department of Transportation (MDT) to:

- Design the curb extensions to accommodate the appropriate design vehicle at each location.
- Consider how the curb extensions can improve the aesthetic of downtown Belgrade and help with placemaking on Main Street.
- Consider installing high visibility crosswalk markings.

Installed features at the Weaver Street intersection

Introduction

The City of Belgrade received Safe Streets and Roads for All (SS4A) Demonstration Grant funding to install a temporary pilot project along Main Street. The pilot project involved installing quick-build safety treatments at seven intersections, shown in Figure 1. Treatments included enhanced pedestrian crossing signage, crosswalk markings, and curb extensions delineated by paint and flexposts.

The demonstration project was installed in June 2025. It is planned to remain in place through September 2025.

The project team has completed a before-after evaluation of the Main Street Demonstration project. This evaluation was completed using a range of quantitative and qualitative metrics. This appendix summarizes this evaluation and includes recommendations for how this demonstration project could inform a potential future permanent installation of the features.

Figure 1. Main Street Demonstration Project Treatment Locations

Performance Evaluation

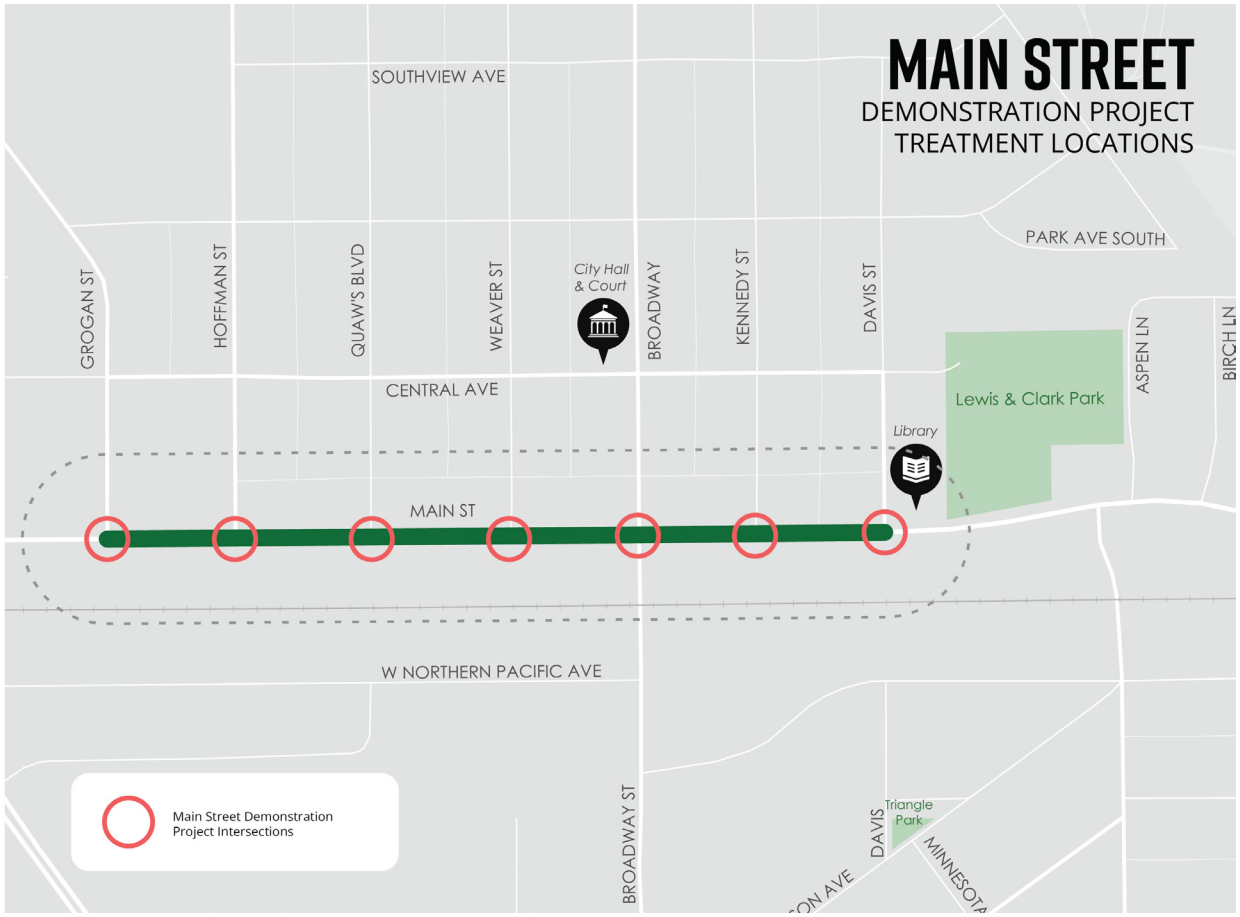
To evaluate the effectiveness of the Main Street Demonstration project, the project team evaluated four different performance measures. The team evaluated the measures prior to demonstration project installation and following implementation, allowing time for users to acclimate to the new conditions. These performance measures were selected to capture changes in actual user behavior and safety perceptions.

The four Main Street Demonstration Project performance metrics are:

- Motor Vehicle Speeds
- Driver Yielding Rates to Crossing Pedestrians
- Near Misses
- Community Safety Perceptions

Most performance metrics were evaluated at two select intersections along Main Street, shown in Figure 2, Weaver Street and Davis Street. The exception was "Community Safety Perceptions."

Figure 2. Main Street Demonstration Project Study Intersections



The following subsections detail the evaluation for the "pre-demonstration" and "post-demonstration" conditions for each metric.

Motor Vehicle Speeds

Higher motor vehicle speeds bring more kinetic energy into a crash, which in turn increases the risk of fatal and serious injury crashes. Therefore, reducing motor vehicle speeds can enhance traffic safety for all road users. It can also improve the feel of Main Street for people walking and biking to and from businesses and other destinations on the street. The current posted speed on the study section of Main Street is 25 miles per hour (mph).

Data Collection

Motor vehicle speed data was collected by the City of Belgrade continuously over a five-day period in both directions at each of the two study intersections in the pre- and post-demonstration periods. Pre-demonstration data was gathered at the Davis Street intersection May 1–5, 2025, and at the Weaver Street intersection May 8–12, 2025. Post-demonstration data was collected during the following periods: July 16-21, 2025, at the Davis Street intersection and July 24-28, 2025, at the Weaver Street intersection.

Analysis Methodology

The 85th percentile speed and average speed in both directions were provided by the City at the two study intersections.

Analysis Results

Table 1 summarizes the motor vehicle speed data collected at the Davis Street and Weaver Street intersections during the pre- and post-demonstration periods.

Table 1. Pre- and Post-Demonstration Motor Vehicle Speeds

Main Street Intersection	Direction	Metric	Pre-Demonstration (May 2025)	Post-Demonstration (July 2025)	Change in Speed
Davis Street	Northwest-bound	85th percentile	29 mph	29 mph	No change
		Average	25.5 mph	24.9 mph	- 0.6 mph
	Southeast-bound	85th percentile	30 mph	30 mph	No change
		Average	26.3 mph	26.4 mph	+ 0.1 mph
Weaver Street	Northwest-bound	85th percentile	28 mph	27 mph	- 1 mph
		Average	24.8 mph	24.0 mph	- 0.8 mph
	Southeast-bound	85th percentile	27 mph	27 mph	No change
		Average	22.6 mph	22.5 mph	- 0.1 mph

In the pre-demonstration data, all 85th percentile speeds exceeded the posted 25 mph speed limit. Additionally, average speeds at the Davis Street intersection exceeded the posted speed limit in both directions.

In the post-demonstration data, average speeds slightly decreased in the northwest-bound direction at both intersections. The 85th percentile speed for northwest-bound traffic also decreased at Weaver Street. Otherwise, speeds generally remained similar to pre-demonstration data.

Driver Yielding Rates

Driver yield rates capture how motorists respond to the presence of a pedestrian or bicyclist[1] at a marked crosswalk. Lower yield rates indicate that pedestrians must wait longer to cross the street.

Data Collection

The City of Belgrade collected 120 hours of video footage over five days at each study intersection. Data at the Davis Street intersection during the pre-demonstration study was collected between May 1-5, 2025, and the camera was positioned at the southeast corner of the intersection, angled northwest. Data at the Weaver Street intersection was collected between May 8-12, 2025, and the camera was positioned at the northwest corner of the intersection, angled southeast.

The cameras were placed in similar locations during the post-demonstration study. Data was collected at the Davis Street intersection between July 16-21, 2025, and at the Weaver Street intersection between July 24-28, 2025.

Drivers yielding to pedestrians at Weaver Street in the pre-demonstration period

Analysis Methodology

The project team analyzed video data during daylight hours (5:30 am – 9:00 pm) to assess driver yielding behavior during pedestrian crossings. A crossing was noted when a pedestrian or cyclist crossed Main Street onto/from the targeted side street. The project team reviewed the footage to collect the following key metrics:

- **Number of Crossings**[2]
  - A crossing was noted when a person walking or biking crossed Main Street at the study intersection, not when they crossed away from the intersection or on other side streets. The number of crossing events were counted, meaning a group of people crossing together would only count as a single crossing.
- **Whether a Vehicle was Present**
  - A vehicle was deemed to be present if it was travelling on Main Street and interacted with the crosswalk when a pedestrian was approaching or waiting. Vehicles turning from side streets onto Main Street were not counted in this analysis.
- **Yielding Behavior of Vehicles to Pedestrian**
  - A yield occurred when a vehicle slowed/stopped to allow a pedestrian to cross, and a no yield occurred when a vehicle drove through the crosswalk when a pedestrian was already waiting or approaching the curb ramp. Equations 1, 2, and 3 below show the yield rate calculation for vehicles present in one direction, two directions, and overall, respectively.

[1] For clarity purposes and due to the low observed volume of bicyclists, "pedestrian" refers to pedestrians and bicyclists for the remainder of this section.

[2] A group of pedestrians crossing together was treated as a single pedestrian crossing event.

- **Equation 1: Yield Rate with Vehicles Present in One Direction**

$$\text{Yield Rate} = \frac{\text{\# of vehicles yielding when vehicles are only present in one direction}}{\text{\# of crossings when vehicles are only present in one direction}}$$

- **Equation 2: Yield Rate with Vehicles Present in Both Directions**

$$\text{Yield Rate} = \frac{\text{\# of vehicles yielding when vehicles are present in both directions}}{2\times\text{\# of crossings when vehicles are present in both directions)}}$$

- **Equation 3: Overall Yield Rate**

$$\text{Yield Rate} = \frac{\text{total \# of vehicles with the opportunity to yield)}}{\text{total \# of vehicles yielding}}$$

There is a gravel parking lot on the south side of Main Street west of Davis Street. The project team also observed whether crossings occurred at this parking lot frontage or at the intersection itself.

Analysis Results

Table 2 summarizes the driver yield rate data for the two study intersections in the pre- and post-demonstration periods.

Table 2. Pre- and Post-Demonstration Driver Yielding Rates

Intersection	Period	# of crossings with a vehicle present	Yield rate with a vehicle present in one direction	Yield rate with vehicle present in both directions	Overall Yield Rate
Davis Street*	Pre	25	13%	6%	9%
	Post	91	43%	37%	40%
Weaver Street	Pre	185	40%	43%	42%
	Post	172	59%	49%	53%

**Most crossings of Main Street at Davis Street did not occur at the intersection, but west down Main Street between the Bar 3 Bar-B-Q restaurant and gravel parking lot next to New Day Bakery. These crossings were not recorded in the analysis.*

Driver yield rates increased at both locations across all metrics after the demonstration project was put in place. The most significant increase occurred at Davis Street, where the overall yield rate more than quadrupled from about 9% to approximately 40% after the demonstration project was installed. Prior to the demonstration project, there was not a crosswalk painted across Main Street at Davis Street.

The overall yielding rate increased by about 25% at Weaver Street. Weaver Street did have a marked and signed crosswalk prior to the demonstration project, which may explain why yielding rates were higher than at Davis Street in the pre-demonstration period and increases were not as significant.

Crossings Away from Davis Street

As noted previously, most crossings of Main Street near Davis Street occur at the gravel parking lot's frontage on Main Street and not at the Davis Street intersection. The project team also evaluated a sample of the footage at Davis Street in the pre- and post-demonstration periods to evaluate whether the proportion of pedestrian crossings occurring at the intersection changed after the project was installed. In the pre-demonstration period, across a two-day sample, 17 of 242 observed crossings occurred at Davis Street (i.e., 7% of observed crossings occurred at the intersection). In the post-demonstration period, also across a two-day period, 86 of 187 observed crossings occurred at Davis Street, indicating the proportion of people crossing at Davis Street had increased to about 46%.

Near Misses

Near miss analysis involves using video analytics software to identify when potential conflicts may have occurred between different roadway users. This analysis was completed by a traffic data collection and analytics provider, Quality Counts (QC).

Data Collection

The near-miss analysis uses the same video data collected for the driver yield rate analysis, described in the previous section.

Analysis Methodology

QC uses their DataLens software to generate near miss reports. The software analyzed the video data to assess the post encroachment time (PET) between road users. PET measures the lapsed time from when a road user leaves a specific location, or conflict point, to when another user arrives at that location. The software flags a near miss when the PET is 3 seconds or less. The potential conflict points were separated out by the type of road user (i.e., bike-vehicle, pedestrian-vehicle, and vehicle-to-vehicle). Due to the small number of bike conflicts, the bike and pedestrian values have been combined in this analysis.

As part of the analysis, Kittelson reviewed all pedestrian and bicycle near miss events identified by QC to determine whether each represented a likely potential conflict (e.g., a motor vehicle crossing the path of a crossing pedestrian after yielding to the pedestrian would not be considered a likely potential conflict). Detections occurring outside of the study intersections were also excluded from further consideration.

Analysis Results

Bike-Vehicle and Pedestrian-Vehicle Events

No likely potential conflicts involving bikes or pedestrians were identified during the pre-demonstration or post-demonstration periods. These events identified by the software were either not in the study intersection, had a pedestrian cross right after a vehicle passed, or had a vehicle yield to a pedestrian before crossing.

Vehicle-Vehicle Events

Table 3 summarizes the near miss events in the pre- and post-demonstration periods. These events were not manually reviewed because the limited scope of the video viewing area and the speed of motor vehicles does not allow for the viewer to see all vehicle actions prior to the potential event.
The data in Table 3 do not indicate a clear trend in vehicle-vehicle near-miss events following the Main Street demonstration project. At the Davis Street intersection, the number of near-miss events increased by 24 during the post-demonstration period; however, this coincided with an increase of roughly 400 additional vehicles. Conversely, the Weaver Street intersection experienced 18 fewer near-miss events, but traffic volumes there were approximately 200 vehicles lower. Given these limited sample sizes, variations in traffic volumes, and inability to see vehicle actions in all directions on the intersection approaches, it is difficult to draw definitive conclusions about changes in vehicle-vehicle near-miss rates.

Table 3. Pre and Post Demonstration Vehicle-Vehicle Events

Main Street Intersection	Pre-Demonstration Events (May 2025)	Post-Demonstration Events (July 2025)
Davis Street	9	23
Weaver Street	34	16

Community Safety Perceptions

Community safety perceptions offer insight into how roadway users feel about safety and comfort along Main Street. While objective performance measures provide valuable information regarding changes in road user behavior, perception-based data helps identify how the Main Street corridor is experienced by people walking, biking, driving, and accessing transit or local businesses.

Data Collection

To assess community perceptions of safety on Main Street, the project team administered a public survey available through print and digital formats. The survey was hosted on the Be Heard Belgrade platform and was also distributed at public engagement events. Respondents were asked a series of questions related to their perceptions of transportation safety along the Main Street corridor. The survey also contained an open-ended question allowing respondents to provide additional feedback on the project.

The pre-demonstration survey was available from April 23 through May 12, 2025. The post-demonstration survey was open from June 23 through August 8, 2025.

Analysis Methodology

Survey respondents were asked to rate how safe they feel moving through the Main Street corridor using a variety of transportation modes using a four-point scale where 1 is "very unsafe" and 4 is "very safe." Respondents were also asked to indicate their agreement with a variety of Main Street safety-related statements on a similar four-point scale, where 1 is "disagree" and 4 is "agree." The mean scores were calculated for each question in both the pre- and post-demonstration survey responses to identify any shifts in public perception.

The responses from the open-ended survey question were also analyzed to identify key trends and themes.

Analysis Results

Table 4 presents the results from the two community surveys in both the pre- and post-demonstration periods.

Table 4. Pre and Post Demonstration Evaluation for Community Safety Perceptions

Question		Pre-Demonstration Conditions (April – May 2025)	Post-Demonstration Conditions (July 2025)
Thinking about Main Street in downtown Belgrade, rate how safe you feel while doing the following: Responses range from 1.0 ("Very unsafe") to 4.0 ("Very safe")	Walking	Average score of 64 responses: **2.7**	Average score of 273 responses: **3.5**
	Mobility Device	Average score of 26 responses: **1.9**	Average score of 87 responses: **2.9**
	Responses range from 1.0 ("Very unsafe") to 4.0 ("Very safe")	Average score of 55 responses: **1.8**	Average score of 188 responses: **2.9**
	Driving	Average score of 62 responses: **2.9**	Average score of 280 responses: **3.4**
	Riding the Bus	Average score of 23 responses: **3.5**	Average score of 72 responses: **3.4**
	Riding a Motorcycle	Average score of 25 responses: **2.3**	Average score of 93 responses: **3.1**
Select your agreement with the following statements: Responses range from 1.0 ("Disagree") to 4.0 ("Agree")	I feel safe when accessing businesses on Main Street	Average score of 65 responses: **2.8**	Average score of 278 responses: **3.5**
	Traffic moves at a safe speed on Main Street.	Average score of 64 responses: **2.8**	Average score of 279 responses: **3.3**
	I feel safe crossing Main Street.	Average score of 65 responses: **2.2**	Average score of 276 responses: **3.3**
	Drivers do a good job of stopping for me to cross Main Street.	Average score of 62 responses: **2.3**	Average score of 272 responses: **3.1**
	I feel safe accessing the Streamline bus stops on and near Main Street.	Average score of 17 responses: **2.7**	Average score of 42 responses: **3.4**
	Main Street is a family-friendly place.	Average score of 62 responses: **2.3**	Average score of 271 responses: **3.2**

Across nearly all survey questions, responses indicated an increase in perceived safety in the post-demonstration period. The greatest increases in average perceived safety score were for people biking and using mobility devices, where scores increase an average of at least 1 point. Walking, driving, and riding a motorcycle received increases in perceived safety of at least 0.5 points.
Respondents in the post-demonstration period also displayed increased agreement with general statements about safety on Main Street compared with respondents in the pre-demonstration period. This was particularly marked for the "I feel safe crossing Main Street" statement, which saw an increase of 1.1 points.

While the quantitative results from the safety perception questions indicate increased feelings of safety across modes, responses to the open-ended survey focused more on the aesthetic and functional impacts of the Main Street demonstration project and raised questions about the safety benefits of the quick-build installations. Respondents primarily noted that the white flexposts were visually unappealing and expressed concerns about their effect on large vehicle maneuverability. Several comments also described the posts as distracting or unnecessary, suggesting that some users viewed them as introducing new challenges rather than improving safety.

Performance Metrics Summary

Each performance metric assessed as part of this project contributes to a narrative surrounding the perceived and objective effectiveness of the treatments installed as part of this demonstration project. Table 5 summarizes the performance metrics and their corresponding outcomes assessed as part of this project.

Table 5. Main Street Demonstration Project Performance Metrics Summary

Performance Metric	Overall Outcome
Motor Vehicle Speeds	+
Driver Yielding Rates	+
Near Misses	o
Community Safety Perceptions	+

There was sometimes variability in the data within a specific category (e.g., some speed measures were unchanged and one slightly increased), but overall, outcomes were positive for nearly every metric in the post-demonstration period. The one exception was the near-miss data, which did not show any pedestrian or bicycle conflicts in the before or after periods.

The strongest results were seen in the driver yielding rates and community safety perceptions metrics. These metrics measure actions and perceptions that are most likely directly affected by the project. In this regard, the demonstration project has been successful at improving the experience of people crossing Main Street.

Other Evaluations

The project team also worked with the City to evaluate:

- 1) Materials performance, with respect to where and how flexposts were damaged.
- 2) The ability of large vehicles to complete turns with the installed curb extensions.

The purpose of these evaluations was to help inform potential future installations using hardscape materials and not the effectiveness of the project.

Materials Performance

The performance of the flexposts that were used to demarcate the curb extensions were monitored to understand how the treatments fared from a maintenance and operations perspective. As the demonstration project progressed, it became clear that the curb radii (about 15') used to originally implement the flexible posts was challenging for some drivers. As such, there were vehicle strikes and some posts needed to be replaced. As part of these replacement efforts, the City of Belgrade adjusted the placement of the posts to increase the radii of the curb extensions.

The photos in Table 6, taken throughout the month of July, show the performance of the materials used in the installations at the intersections of Broadway and Weaver Street.

Table 6. Materials Performance at Broadway and Weaver Street

Main Street Intersection	July 1, 2025	July 7, 2025	July 21, 2025
Broadway (looking NW)			
Weaver Street (looking SW)			

Heavy Vehicle Turning Analysis

The projected team completed an AutoTurn analysis to inform potential future permanent installations of the curb extensions. This analysis used an SU-30 as the design vehicle (i.e., a vehicle that frequently uses a facility and should be designed for to avoid encroaching into adjacent and opposing traffic lanes) and a WB-40 as the control vehicle (i.e., a vehicle that infrequently uses a facility, but encroachment into opposing traffic lanes, multiple-point turns, or minor encroachment into the roadside is acceptable). The results of this analysis are shown in Figure 3 and Figure 4.

This analysis found that both vehicles can make the turns analyzed without striking the Demonstration Project curb extensions; however, they would likely need to encroach into opposing or adjacent lanes to avoid striking the extensions. This may be acceptable for the WB-40, which in some cases may need to do this even without the curb extensions, but it may not be acceptable for this to be the case for an SU-30 in some cases.

To better accommodate heavy vehicle turning movements, the City should consider the following when designing hardscape curb extensions:

- Confirming the appropriate design and control vehicles at each intersection. The vehicles used in this analysis may be appropriate for most intersections on Main Street, but different vehicles may be considered for the Broadway intersection. School buses may also need to be considered if they are regularly turning at any of the intersections.
- Designing curb radii to allow the SU-30, or other chosen design vehicle, to avoid encroaching into opposing travel lanes when turning from its lane. In certain cases, a small increase from a 15' radius to an 18' radius may be able to accomplish this for an SU-30, but a larger radius may be needed in other cases.
- Designing curb radii to allow the WB-40, or other chosen control vehicle, to be able to make turns with tolerable encroachment into adjacent or opposing lanes without striking the curb extensions.
- Setting stop bars further back on side streets can also provide a larger turning area for heavy vehicles and may reduce how much the curb radius needs to be expanded from the Demonstration Project design.

Figure 3. AutoTurn Analysis with WB-40 Design Vehicle

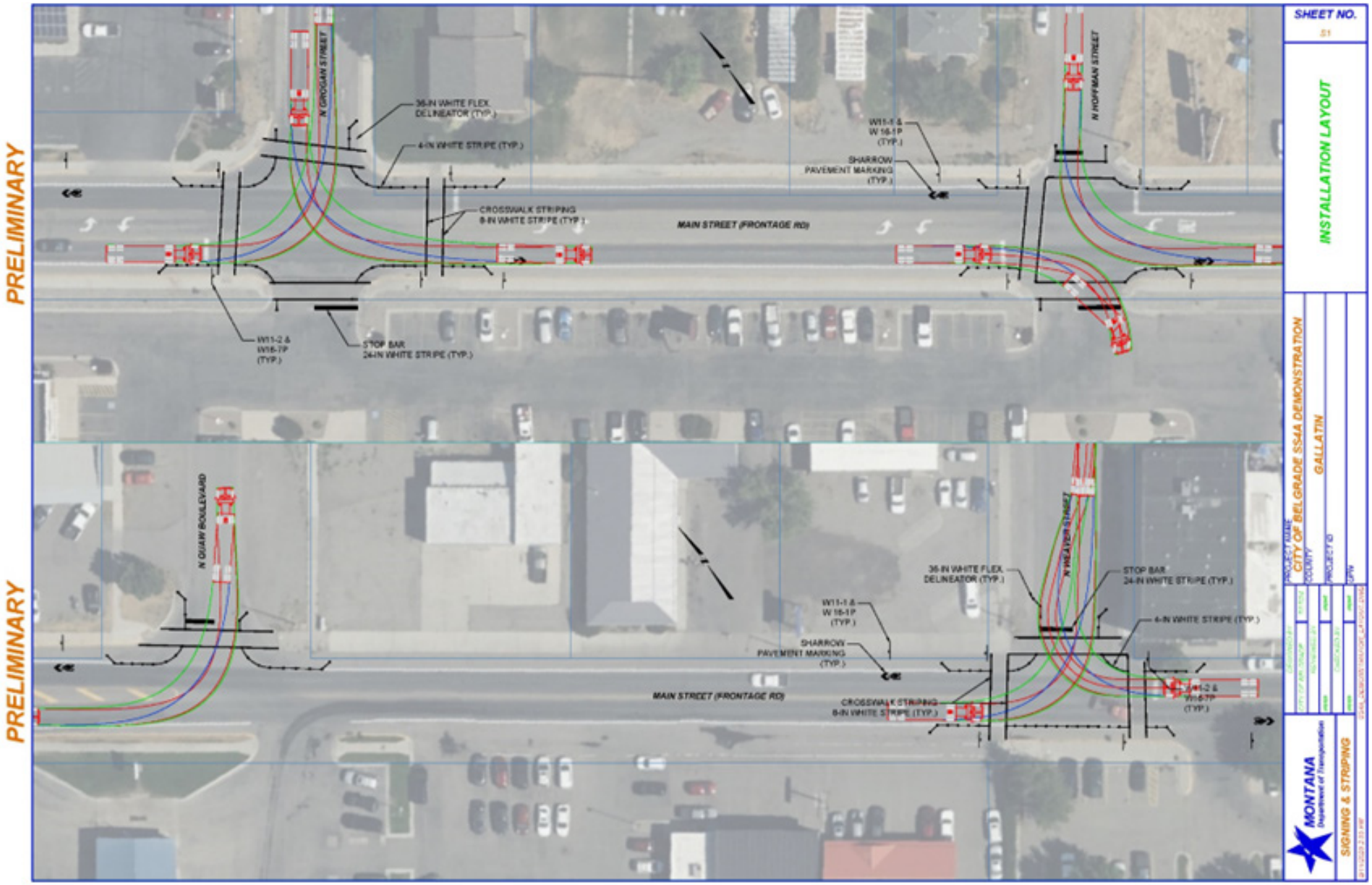
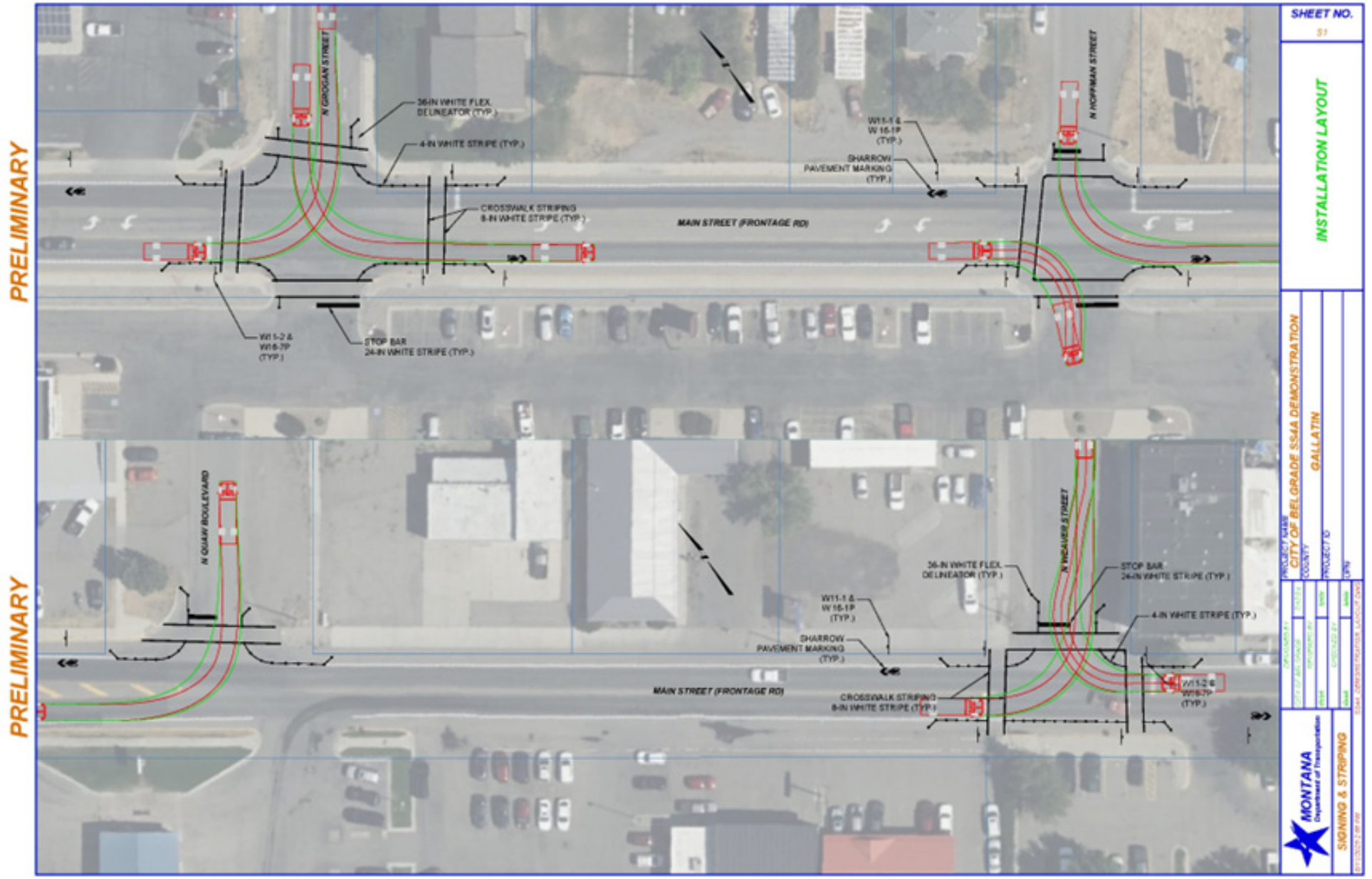


Figure 4. AutoTurn Analysis with SU-30 Design Vehicle



Recommendations Related to Permanent Installation

If these treatments are to be made permanent, the City should work with the Montana Department of Transportation (MDT) to:

- Design the curb extensions to accommodate the appropriate design vehicle at each location.
- Consider how the curb extensions can improve the aesthetic of downtown Belgrade and help with placemaking on Main Street.
- Consider installing high visibility crosswalk markings, instead of the transverse markings that were used in the demonstration project.