DelDOT Traffic Calming Design Manual

2025 EDITION



Delaware Department of Transportation

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According to Title 17 of Delaware Code, the Delaware Department of Transportation has jurisdiction and control of all state highways of the State of Delaware outside of the limits of incorporated cities and towns for the purpose of regulating traffic and for the use and operation of all vehicles thereover, and may adopt any and all rules and regulations respecting the use of such highways and the operation of all vehicles upon the same.

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CHAPTER 1
INTRODUCTION AND BACKGROUND

1A. INTRODUCTION

The Delaware Department of Transportation's (DelDOT's) *Traffic Calming Design Manual* represents an important milestone in the development of traffic calming in Delaware. Originally published in August 2000 and updated in 2012, this manual provides DelDOT personnel, local governments, community groups, and individual citizens with guidance regarding the appropriate use, design, and signing/marking of traffic calming measures on Delaware's roadways.

The Federal Highway Administration (FHWA) Traffic Calming ePrimer defines traffic calming as follows: "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] This manual follows FHWA's definition.

As indicated in the above definition, the reduction of traffic volume or speed is a means to other ends, such as improving the quality of life in residential areas, increasing pedestrian safety in residential and commercial areas, or making bicycling more comfortable. *As such, traffic calming supports Delaware's Strategic Highway Safety Plan[2], DelDOT's Complete Streets Policy[3], and FHWA's Safe System Approach Initiative[4].*

The FHWA definition covers a host of *engineered physical measures* to slow or divert traffic on low-speed collector roads, local roads, and subdivision streets. The FHWA definition, however, does not include *non-engineering measures* that may provide traffic calming and improve street appearance. For example, streetscaping, planting trees on a roadside to create a canopy, and enforcing traffic laws more intensively could all result in reduced travel speeds. However, they generally fall outside DelDOT's areas of responsibility.

Traffic calming is most appropriate on subdivision streets, local roads, and collectors that serve the primary purpose of providing access to properties at posted speed limits less than or equal to 35 MPH. At speeds greater than 35 MPH or on arterial roadways, careful consideration, planning and engineering studies must be conducted to determine if traffic calming measures are viable. Traffic calming is not appropriate on higher speed or functional classification highways, such as freeways and interstates that serve a primary purpose of conveying high volumes of traffic over long distances at higher speeds.

1A.1 PURPOSE

The purpose of the *DelDOT Traffic Calming Design Manual* is to provide the administrative procedures needed to evaluate and implement traffic calming measures, provide guidance on applications for traffic calming, and to provide guidance on geometric design, signing and pavement marking related to traffic calming measures.

To accomplish this purpose, DelDOT's *Traffic Calming Design Manual* provides a framework for the planning, design, and implementation of traffic calming measures. This manual seeks to promote consistency and predictability in the following areas, each of which is the subject of a subsequent chapter:

- Process and Procedures (Chapter 2)
- Horizontal Measures (Chapter 3)
- Vertical Measures (Chapter 4)
- Other Measures (Chapter 5)

While other measures such as gateway treatments, patterned pavements, aesthetic treatments, and other signage or striping improvements may have traffic calming benefits, they are not included in this manual because they fall outside of the Traffic Calming process. Projects that include these elements can be pursued through other DelDOT programs.

1A.2 RELATIONSHIP TO LONG RANGE TRANSPORTATION AND STRATEGIC HIGHWAY SAFETY PLANS

This manual is consistent with and furthers Delaware's Statewide Long-Range Transportation Plan (SLRTP)[2]. The SLRTP establishes transportation goals, strategies, actions, and performance measures. The intent of the SLRTP is to develop "a safe, reliable and efficient transportation system that will support a diverse economy, vibrant communities and viable transportation options for Delaware's citizens, visitors and customers."[2] This manual establishes policies to do just that: maintain a safe and reliable transportation system while improving quality of life and supporting diverse and vibrant communities via traffic calming.

In order to achieve Delaware's vision, eight action strategies are identified in the SLRTP. Traffic calming is integral to a number of these strategies, including traffic management; pedestrian transportation; and roads, bridges, & other assets.

This manual is also consistent and supports Delaware's Strategic Highway Safety Plan (SHSP)[5] which provides a framework for improving safety on all public roads. The SHSP supports the action items identified in the SLRTP. Traffic calming, and this manual, supports multiple SHSP emphasis areas.

1A.3 APPLICABILITY

This manual, and the guidelines it contains, applies to all state-maintained roadways and private roadways that have been dedicated to public use. This includes existing and new state-maintained roads, including subdivision streets maintained by DelDOT. While DelDOT maintains the majority of roadways within the state of Delaware (and, therefore, the majority of roads that this manual is intended for), the guidelines in this manual can also be used as a guide for local municipalities, private developers, and other agencies.

It is important to note that this manual does not *mandate* traffic calming on state-maintained roadways. However, if traffic calming is initiated by residents, local officials, or others, DelDOT will follow the guidelines contained herein with rare exceptions. While this manual does not mandate traffic calming on new subdivision streets, DelDOT prefers that new subdivision streets be designed and constructed with traffic calming measures to reduce the need for any post-construction modifications once the subdivision construction is complete. All traffic calming measures that developers install within subdivisions that will be accepted for maintenance by DelDOT, will be subject to the field application, geometric, and signing/marking guidelines contained in this manual.

The project development and funding processes described in this manual do not apply to streets under municipal control, or to private streets under the control of neighborhood associations. Traffic calming on these streets is the responsibility of the entities maintaining them. However, the field application and geometric design guidance included in this manual are appropriate to apply on any local streets and can be utilized by any local governing authority.

Even with standardization of traffic calming in Delaware, there is flexibility in design. The manual sets forth guidelines, rather than rigid policies. DelDOT reserves the right to deviate from these guidelines in special cases. The guidelines themselves provide flexibility as well, in that they offer options rather than dictating single design solutions.

1A.4 RELATED REFERENCES

DelDOT's *Development Coordination Manual (DCM)*[6] includes mobility-friendly subdivision street standards, which offer subdivision developers an alternative to conventional street design. Alternative standards have been established for local subdivision and minor collector subdivision streets. In return for narrower streets, subdivision developers are now required to build more interconnected street networks

and are encouraged to incorporate traffic calming measures to slow traffic in these residential networks. These standards must be applied in their entirety rather than selectively.

The *Manual on Uniform Traffic Control Devices (MUTCD)*[7] provides guidance and standards for appropriate application of signing, striping and the necessary evaluation and studies needed to support changes or implementation of them. The Federal Highway Administration (FHWA) publishes a Federal version of the MUTCD, and individual states have either adopted the Federal version or developed and adopted state-specific MUTCDs that are in substantial conformance with the Federal version. Where used throughout this manual, "MUTCD" refers to the latest version of the MUTCD adopted by DelDOT.

1A.5 SELECTION OF APPROPRIATE COUNTERMEASURE(S)

Selecting the appropriate traffic calming countermeasure first involves identifying the nature of the specific traffic concern on a given street or in a specific community. Once identified, the appropriate traffic calming measure(s) capable of addressing the concerns can be selected. There are a number of traffic calming measures in the traffic calming "toolbox" but not every measure is appropriate to address a specific issue or in the context of the area where it would be implemented. Much like a hammer would not be used to turn a screw, not all traffic calming measures are appropriate or will address a specific issue and may result in unintended outcomes. If the issue is cut-through traffic on local streets, one set of measures may be appropriate; whereas if the issue is speeding on local streets, another set may be more appropriate.

The process of selecting an appropriate traffic calming measure is described in Chapter 2, and individual countermeasures are outlined in Chapters 3, 4, and 5. Each chapter provides a menu of available traffic calming measures and provides guidance on their appropriateness for use based on the issue, context, and type of roadway(s) under study.

The traffic calming measures addressed in this manual are organized in three categories: Horizontal Measures (Chapter 3), Vertical Measures (Chapter 4) and Other Measures (Chapter 5). Horizontal measures physically alter the width of lanes or streets by narrowing or redirecting traffic to achieve the desired traffic calming results. Vertical measures alter the elevation or profile of a lane or street to achieve traffic calming. Other measures normally consist of signing and/or pavement marking solutions, including public awareness campaigns. Within each chapter, the measures are generally listed from the least complex and least expensive to the most complex and expensive. Each measure presented includes:

- a description of the measure,
- a sketch and photographic examples,
- guidance on appropriate use,

- expected impacts, and
- advantages and disadvantages.

For many traffic calming projects, a combination of measures from one or all three of these categories may be employed to address specific issues within a community. Signing and striping installation or alterations can be standalone but are often paired with vertical or horizontal measures.

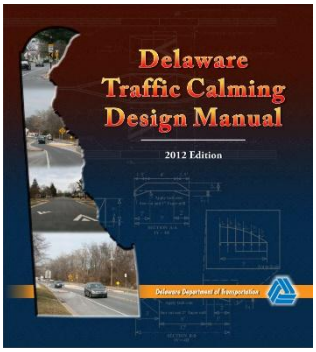
The traffic calming measures described in the following chapters constitute Delaware's traffic calming toolbox. The specific traffic calming guidance and geometric details included in this manual are meant to be advisory only and do not constitute a set of warrants or minimum requirements. Rather, they are a set of recommendations, which should be applied based on an engineering study and using sound engineering judgment.

1B. BACKGROUND

1B.1 PREPARATION AND REVISIONS TO THE MANUAL

Delaware's first *Traffic Calming Design Manual* was published in August of 2000. It was prepared under the supervision of both a Citizens Advisory Committee (CAC) and a Technical Review Team (TRT). Membership in these committees involved a broad cross section of stakeholders including members of the Legislature, county and municipal governments, the metropolitan planning organizations (MPOs), the fire service, police, the Delaware Department of Education, and various civic groups.

DelDOT updated the manual in the fall of 2012. The updates included modification and streamlining of the processes and procedures, changes in the funding mechanisms, inclusion of best practices based on the previous 10 years of experience, and changes in the state of practice and revised geometric standards. The updates were reviewed both internally and through a public process that included external review by the MPOs and interested Legislators and a public comment period.



The 2024 update further streamlines the traffic calming process, includes a name change to the *DelDOT Traffic Calming Design Manual*, and incorporates over twenty (20) years of local (Delaware) experience in addition to changes in the state of practice such as those in the FHWA Traffic Calming ePrimer[1].

1B.2 DELDOT TRAFFIC CALMING EXPERIENCE

Since adoption of the first *Traffic Calming Design Manual* in August of 2000, DelDOT has been working with citizen groups to successfully implement traffic calming solutions across the State. A sample of some of the successful projects follow:

1. **Statewide Speed Hump Installation**
   For many communities throughout Delaware, the installation of speed humps in strategic locations addresses speeding issues on community streets, especially where pedestrian traffic, particularly children, is high. Since the initiation of the traffic calming program within Delaware, numerous speed hump installations have successfully been completed in communities throughout the state.


Upper Snuff Mill Row, Hockessin


Meadowbrook Avenue, Wilmington

2. **Kirk Road (Major Collector), Montchanin – Edge Narrowing and Speed Hump**
   Kirk Road, between SR 100 and Rockland Road, is a one-way local road bisecting a commercial, historic inn. Guests must cross Kirk Road to travel between the guest houses, the central activity building, and the restaurant. Speeding traffic along this short stretch was creating a pedestrian safety concern that needed to be addressed. The implemented traffic calming solution was the installation of edge islands to narrow the road in combination with a speed hump before the crosswalk to slow traffic.


Before



After

3. **Wellington Drive (Local Roadway), Newark – Realigned Intersection**
   Residents on Wellington Drive expressed concerns about speeding on the wide subdivision collector road near its intersection with Curlew Drive. The intersection is on a curve and has a high volume of turning traffic. The implemented traffic calming solution was to realign the intersection and install all-way stop control. The project improved safety and resulted in a reduction of over 10 MPH along the segment of Wellington Drive that was realigned and over 5 MPH in the opposite direction.



Before



After

4. **Mallard Pointe (Local Roadway), New Castle – Realigned Intersection / Median Islands**
   Residents on Mallard Road expressed concerns about speeding on the wide subdivision collector road at the intersection with Brandt Drive. The high speeds were creating safety concerns not just for vehicular traffic, but also for pedestrians crossing Mallard Road at the intersection to access the local community playground. The implemented traffic calming solution included a realigned intersection, narrowing of the road by installing a median island and the provision of striped pedestrian crosswalks. The project improved pedestrian safety and resulted in a reduction in speeds in both directions on this segment of Mallard Road of approximately 8 MPH.



Before



After

5. **Stanton Road (Major Collector), Wilmington – Raised Crosswalk**
   Residents of subdivisions to the west of Stanton Road expressed safety concerns regarding speeding along Stanton Road, specifically for pedestrians crossing the street to access Powell Ford Park. The implemented traffic calming solution included a raised crosswalk and pedestrian warning signs. While the installation is still relatively new, initial results indicated an approximate 12% reduction in traffic and 10% reduction in the average speed on Stanton Road.



Before



After

6. **Independence Boulevard (Local Roadway), Dover – Realigned Intersection and Mini-Roundabout**
   Residents of Bicentennial Village and the surrounding area requested a mini-roundabout and other traffic calming measures along Independence Boulevard with the intent of slowing and reducing traffic on the roadway, which functions as the main road through the community.



Source: Google Maps

Before



Source: Google Maps

After

1C. TRAFFIC CALMING DESIGN MANUAL UPDATES

The information contained in this manual is current at the time of publishing. It is expected that the guidance contained in this document may be updated periodically. Interim guidance may be published by DelDOT and will be made available on DelDOT's website within the Design Resource Center (DRC). Proposed changes to this manual should be submitted to DelDOTTrafficCalming@delaware.gov and must be approved by DelDOT's Chief of Traffic Engineering.

CHAPTER 2
TRAFFIC CALMING PROCESS AND PROCEDURES

The process and procedures used by DelDOT in deciding when, where, and how to evaluate and implement a traffic calming project are outlined in this chapter. Where appropriate, optional streamlined procedures are also outlined.

2A. PROJECT DEVELOPMENT PROCESS

In general, a traffic calming project may make *spot* improvements, *corridor-wide* improvements, or may plan and implement improvements on an *areawide* basis, with multiple streets treated at the same time. Projects may be initiated within or outside of DelDOT. When feasible, DelDOT favors areawide approaches, so traffic problems do not simply spillover from one neighborhood street to another. Even for single-street requests, treatments may ultimately extend to parallel streets. DelDOT also encourages private developers to design street systems that don't require traffic calming, or to incorporate traffic calming measures into their developments when they are constructed, since it is easier and more cost-effective to design and construct traffic calming features into new subdivision streets rather than retrofitting streets that are already in place.

All traffic calming projects follow the same two first steps, Project Initiation and Project Classification, as outlined in the sections that follow and as shown in **Figure 2-1**. After a project has been initiated, and once a classification is determined, there are varying processes that reflect the complexity of the issue and potential solutions, and to ensure the appropriate studies, community input, and funding are accounted for.

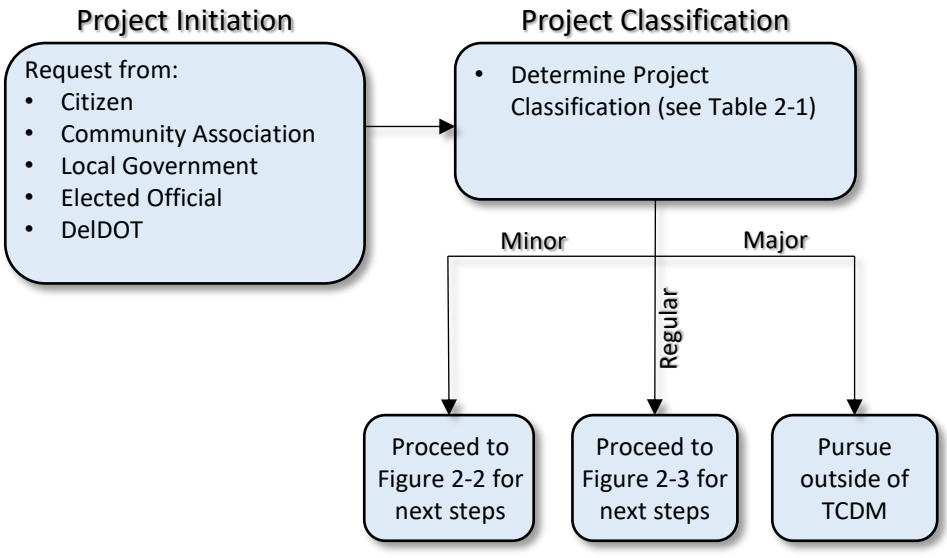


Figure 2-1. Project Initiation and Classification (All Projects)

2A.1 PROJECT INITIATION

Traffic Calming project requests may be initiated by local governments, community associations, elected officials, individual citizens, or from within DelDOT. The request must be made in writing to DelDOT (online at Report an Issue, through the DelDOT mobile app, by email to DelDOTTrafficCalming@delaware.gov, or by mail to **DelDOT Traffic Studies, 169 Brick Store Landing Road, Smyrna, DE 19977**) and should include the following information:

- Location / Corridor
- Subdivision (If applicable)
- Requestor Contact Information
- Associated elected officials
- Description of the issue(s) or concern
- The type of traffic calming countermeasure that is being requested for consideration

Most traffic calming requests should be initiated by either the local elected officials or representatives of a municipality who can forward the above information to DelDOT. Elected official involvement is needed to ensure public support. However, requests for All-Way Stop Control (AWSC) within subdivisions may be submitted directly to DelDOT by community associations, per the *AWSC Guidelines for Residential Streets*[8]. Additionally, individual citizens may request yard signs (see Section 5A) directly from DelDOT, without the involvement of elected officials.

DelDOT prefers that traffic calming requests come from associations representing the broad interests of the community or neighborhood. DelDOT encourages individuals to work through their community associations, where such associations exist, rather than filing requests on their own. If the community does not have an association, the individual seeking a traffic calming project should coordinate with their elected officials to further the request.

Similarly, requests for AWSC and Radar Speed Signs (RSS) should also involve the local legislators as the ASWC Guidelines requires their involvement in areas with no community association, and the installation of RSS shall follow DelDOT's latest RSS policy[9] which can be found on DelDOT's website.

2A.1.1 OPTIONAL COMMUNITY MEETING

DelDOT may hold a community meeting with those requesting traffic calming to better understand the traffic issues, and how the community perceives the issues may be resolved by the requested traffic calming project. Any initial data gathered by the community to support the request will be reviewed by DelDOT. DelDOT will explain to the community the process that will be followed to evaluate the need,

potential impacts, and the likelihood of success associated with the implementation of a traffic calming project. For some minor projects, needs and possible solutions may be well understood, and community meetings may not be necessary.

2A.2 PROJECT CLASSIFICATION

Each traffic calming project is classified as Minor, Regular, or Major. Projects that involve only non-construction measures are classified as **Minor** projects. Examples of Minor projects include yard signs, AWSC, and RSS. Projects that involve horizontal and vertical traffic calming measures, are within existing right-of-way, and do not have anticipated environmental or drainage impacts are classified as **Regular** projects. **Regular** projects typically follow DelDOT's "expedited" traffic calming design procedures (see Section 2C). Projects that require the need for new right-of-way, have environmental permits, or have changes to drainage are classified as **Major** projects. **Major** projects do not fall under the Traffic Calming Program outlined in this manual. Instead, a **Major** project will be initiated as a separate project and follow DelDOT's typical Project Development Process (see Section 2D). Each traffic calming measure and their assigned classification is outlined in **Table 2-1**.

Table 2-1. Project Classification

Project Classification	Project Type
Minor	Yard Signs (Section 5A) Radar Speed Signs (Section 5B) All-Way Stop Control (Section 5D)
Regular	All Horizontal Measures* (Chapter 3) All Vertical Measures* (Chapter 4) One-Way Restrictions* (Section 5C) Lane Narrowing (Section 5E) Speed Reduction Markings (Section 5F) **Projects that have Right-of-Way Impacts, require Environmental Permits, or have impacts to drainage are considered Major projects (see below)*
Major	Projects that require new right-of-way, environmental permits, or changes to drainage *These projects fall outside of the Traffic Calming Program and must be considered and prioritized through the TIP and CTP processes.*

2B. MINOR PROJECT PROCEDURE

Minor traffic calming projects include traffic calming measures such as RSSs, yard signs, and AWSC. The procedure for these projects is outlined in **Figure 2-2**.



Figure 2-2. Minor Project Procedure

2B.1 PROJECT SCOPING

For minor projects, which do not involve in-road construction, traffic studies are typically not required. If necessary, to help define the traffic issues and level of improvement, DelDOT may gather speed data, crash data and other traffic information at this stage. For All-Way Stop Control requests within a subdivision, a completed AWSC Nomination Form is required. This form can be found in Appendix A of DelDOT's *AWSC Guidelines for Residential Streets*[8].

2B.2 PROJECT APPROVAL

Minor projects that have legislator approval and funding do not need further community approval. For minor projects that include the installation of RSSs, legislator approval is required for both the number and location of RSS, because the legislator provides the funding, through their Community Transportation Funds (CTF), for the purchase and installation of the signs. More information about RSSs can be found in the DelDOT Radar Speed Sign Policy. For minor projects where there may not be consensus among the community, DelDOT may conduct an optional community ballot. If held, this community ballot process will be consistent with the process found in Section 2F.

2B.3 PROJECT IMPLEMENTATION

Once a minor project is approved, DelDOT will either deliver the requested yard signs or have the RSS or AWSC signs installed on state-maintained roadways outside of municipalities. On state-maintained roadways within municipalities, DelDOT will coordinate installation of RSS or AWSC signs with the municipality.

2C. REGULAR PROJECT PROCEDURE

Regular traffic calming projects include all other traffic calming measures listed in this manual that are not considered minor projects, including vertical and horizontal measures. The procedure typically utilized for Regular projects is outlined in **Figure 2-3**.

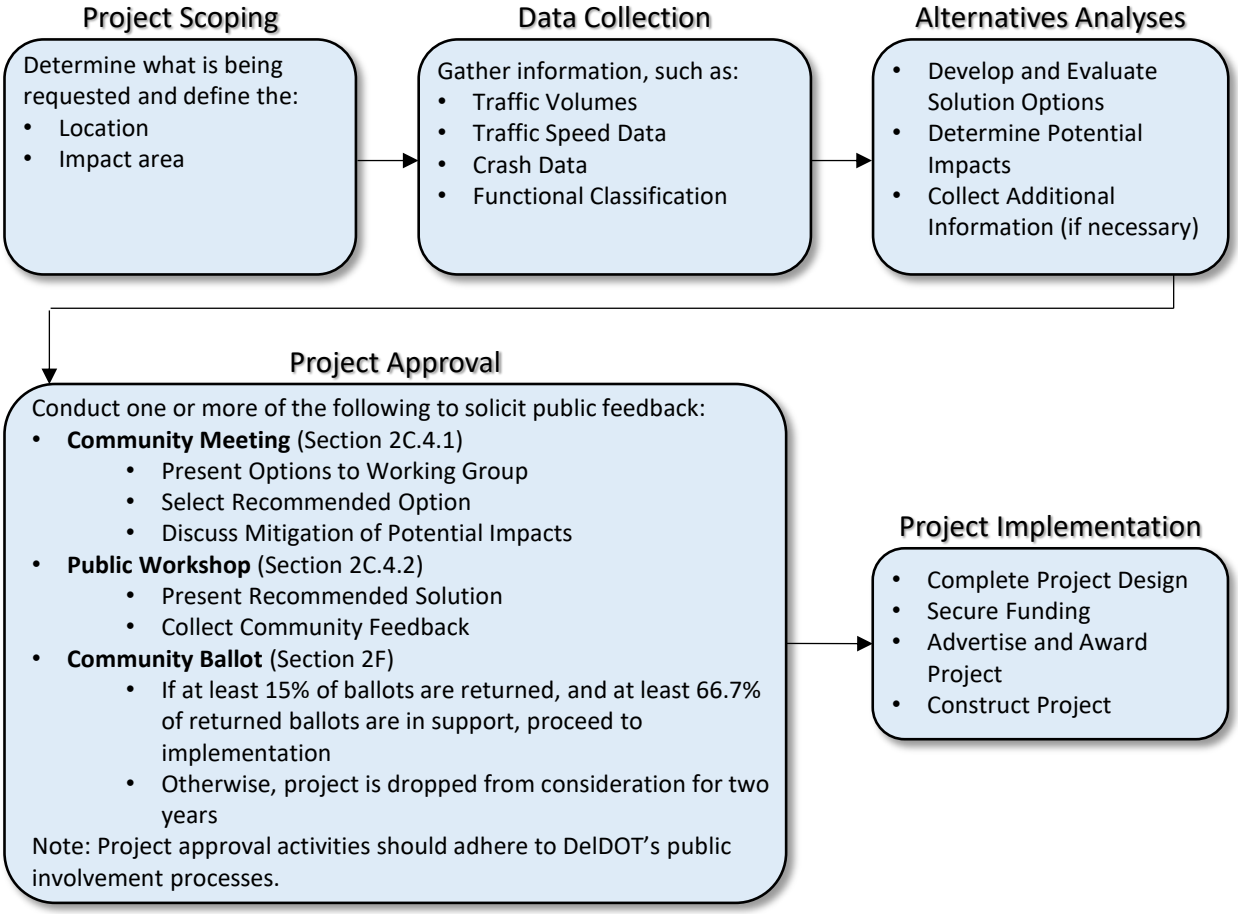


Figure 2-3. Regular Project Procedure

2C.1 PROJECT SCOPING

After the identification of a Regular traffic calming project, Project Scoping will begin with the determination of the impact area of the project for the purposes of plan development and public approval. This area shall encompass all streets for which traffic calming is proposed, all streets only accessible via those streets, and all streets likely to be impacted by diverted traffic.

The impact area for a Regular project will ordinarily be larger for volume control measures than for speed control measures. While in most cases the impact area will be apparent, when it is not, the impact area will be determined with the assistance of the area

legislators, members of a Working Group if one is established (see Section 2C.4.1), and DelDOT staff. Should consensus/agreement not be reached on the appropriate impact area, DelDOT will make the final decision on the impact area boundary.

2C.2 DATA COLLECTION

Once the impact area has been defined, DelDOT will collect the data necessary to support the planning and design of the appropriate traffic calming measures to resolve the identified traffic issues. Traffic volume and speed data will be gathered (if not already available) for the street(s) in question and the 85th percentile speed will be determined. Outside of subdivisions, the speed study must show that the street has an 85th percentile speed of 5 MPH or more above the posted speed limit for a street to be eligible for vertical or horizontal traffic calming measures. Projects within subdivisions may be pursued without a speed study if the community association demonstrates support for the project and legislators commit to providing CTF for the project. Although not required within subdivisions, if requested by the community association or legislator, DelDOT will perform a speed study to quantify the 85th percentile speed within a subdivision to provide information for decision-making purposes.

Crash information may also be gathered, as necessary. DelDOT may also collect data on pedestrian volumes, bicycle usage, bus routes, emergency services, parking facilities, and locations of schools, parks, senior housing, or other unique trip generators. In the event of limited project funding or multiple and competing requests, the volume, crash, and speed data collected at this stage will subsequently be used by DelDOT to determine funding priority (see Section 2G). The data collected during this stage may also be used during the development of traffic calming alternatives, the design of the selected alternative, and to provide “before” data for potential before-and-after studies.

2C.3 ALTERNATIVES ANALYSES

After all pertinent information has been collected, DelDOT will develop traffic calming alternatives for Regular projects from the toolbox of traffic calming measures identified in subsequent chapters of this manual. This typically includes the preparation of graphic displays for use in discussions with the community. Each alternative will be evaluated, and potential impacts will be identified. A summary of the advantages and disadvantages of each option may also be prepared. Additional information and data may be collected during the alternatives analyses, if needed. Preliminary cost estimates will be developed, and funding sources identified. A more detailed discussion of project funding follows in Section 2G. In addition, the need for any maintenance agreements associated with aesthetic measures or landscaping will be determined and responsible parties identified. Section 2I contains more detail related to maintenance responsibilities and maintenance agreements.

2C.4 PROJECT APPROVAL

All Regular projects should follow DelDOT's current public involvement processes. For Regular projects on roadways outside of or adjacent to residential neighborhoods, feedback received from the community through either a Working Group meeting, if a Working Group is established (see Section 2C.4.1), or a Public Workshop (see Section 2C.4.2) will form the basis for deciding if a project is able to move towards final design and implementation.

For Regular projects that are self-contained within a residential subdivision, a community ballot will be required, and DelDOT will send ballots to the affected residences. The ballot process is discussed in Section 2F.

For Regular projects on state-maintained roadways within a municipality, concurrence from the municipality is required for the project to move forward. Typically, this concurrence has taken the form of letters from the Town Manager or Mayor or ordinances or resolutions passed by Town/City Council.

2C.4.1 COMMUNITY AND WORKING GROUP MEETING(S)

For Regular projects within residential subdivisions, DelDOT will coordinate directly with the community and local elected officials to select a recommended alternative. DelDOT may attend a community meeting (at the community's request) to discuss the proposed project and answer any questions members of the community may have.

Outside of subdivisions, or for those traffic calming projects that involve more complex studies or potentially substantial impacts, DelDOT and/or local elected officials may establish a Neighborhood Traffic Calming Working Group (Working Group) to assist in the preparation of a traffic calming plan for the project impact area.

While DelDOT encourages involvement from residents and business owners within the project impact area, it is also important that there is equitable representation on the Working Group. The makeup of the Working Group will vary based upon whether the project is self-contained within a residential subdivision or a project on a street adjacent to a neighborhood, in which case the affected community is much broader. Membership may include the original petitioners for traffic calming, residents appointed by a community association, citizens volunteering, business owners within the impact area, and any other members deemed essential by DelDOT for balanced representation. State legislators, as well as local government officials, are encouraged to participate in Working Groups and offer input. Representatives of emergency services, the local school district, the bicycling community, and any transit providers may also be offered

membership on the Working Group if the proposed project affects their modes of transportation or activities.

The Working Group will be expected to meet and work with DelDOT, as necessary, in the evaluation of the identified traffic issues, the identification and evaluation of potential alternatives, and the recommendation of a preferred solution. The Working Group will be responsible for keeping their respective communities informed of their efforts and may also assist DelDOT in presenting the recommended solution and in answering questions at any Community Meeting or Public Workshop on the project.

For Regular projects that have established a Working Group, once the traffic calming alternatives have been developed and graphics for the available alternatives have been prepared, a meeting with the project Working Group can be scheduled for the Working Group to select a recommended alternative and identify any mitigation that may be required to offset adverse impacts. If necessary, more than one meeting may be held to establish the recommended alternative with the Working Group. Once agreement has been achieved, the recommended alternative can be presented at a Public Workshop or Community Meeting, or DelDOT may conduct a Community Ballot to gauge consensus. More information about the Public Workshop is provided below. The community ballot process is described in Section 2F.

2C.4.2 PUBLIC WORKSHOP

For Regular projects impacting larger areas where a Community Ballot would not capture the majority of roadway users, as determined by DelDOT, a Public Workshop may be scheduled either through virtual means or at a location as close to the affected community as is practical. The Public Workshop could take the form of a DelDOT scheduled event, a legislative community meeting, a municipal meeting, or other public information session. DelDOT staff and/or Working Group members, if one is established, will present the recommended alternatives and answer questions on the traffic calming plan and any expected impacts. Forms may be distributed at the workshop to collect community feedback. Following the Public Workshop, all feedback received will be evaluated by DelDOT, and the Working Group, if one is established, and any final adjustments to the recommended option will be made.

For Regular projects outside of residential subdivisions, once any revisions are made to the alternative(s), DelDOT will determine the need for a follow-up workshop or if the revised alternative(s) can be deemed acceptable to move towards implementation. Within a residential subdivision, once the revised alternatives are deemed acceptable, ballots may be sent by DelDOT to the residents of the impact area established for the project.

2C.4.3 COMMUNITY BALLOT

After a recommended alternative has been selected for a Regular project, DelDOT can gauge consensus by conducting a Community Ballot. The community ballot process is described in Section 2F.

2C.5 PROJECT IMPLEMENTATION

Once project approval has been gained for a Regular project, DelDOT will confirm project funding (See Section 2G), then design and construct the proposed traffic calming measures. Most Regular traffic calming projects consist of straightforward designs, which typically allows for an abbreviated design and advertisement process, similar to that followed by DelDOT's Community Transportation Contracts and DelDOT's Pavement and Rehabilitation Contracts.

The design of Regular traffic calming projects on state-maintained roadways will be overseen by DelDOT. Typically, construction will be completed through an existing open-end agreement, where possible. Traffic calming projects are usually constructed utilizing CTF contracts that are administered by DelDOT's Maintenance and Operation (M&O) Division. In rare occasions, the project may be advertised by DelDOT and construction will be managed by DelDOT. Through this streamlined and expedited process, traffic calming projects can be implemented in less time than the projects that follow DelDOT's more traditional Project Development Process needed for larger and usually more complex Capital Transportation Program projects.

The steps associated with the design for most Regular traffic calming projects are as follows:

- **Project Initiation** – All identified Regular traffic calming projects which have an approved plan, project estimate, and funding source, are grouped by the Traffic Calming Coordinator, and forwarded to in-house design staff or outside design consultants for final engineering and preparation of bid documents. Funding availability will also be confirmed at this stage.

- **Project Design** – Design plans are prepared for each location. Existing street plans usually serve as the base plan for the project plans supplemented by field surveys only when needed. At the beginning of the project design, the project design engineer conducts a field review (along with a utility locator firm, if necessary) to locate existing utility lines in the project area, so potential conflicts may be avoided. The designer also verifies all improvements will be within existing right-of-way and that no environmental permits are required.

- **Design Review and Plans, Specification & Estimate Package (PS&E)** – Near the end of the design period, the plan package is considered Semi-Final and is circulated for review by the appropriate Sections within DelDOT. If any location is found to have unavoidable

impacts necessitating permits, cultural resource approvals or the acquisition of right of way, the project is no longer considered a Traffic Calming project and cannot move further within the Traffic Calming Program. Rather, the project would need to be developed as a separate project through DelDOT's normal Project Development Process. Semi-Final Plans are also sent to the design support sections as a final check on the "no-impact" determination. A formal plan review meeting is not held and any comments on the plan package are provided within a two-week period. Once comments are received, the final plans, specifications, and estimates (PS&E) are prepared, funding is confirmed, and any needed maintenance agreements (See Section 2I) are signed. If the construction cannot be completed through an existing open-end agreement, the PS&E package is then submitted to the Contract Administration Section for advertisement.

- **Project Advertisement (if needed)** – Once the PS&E package is received by the Contract Administration Section it is publicly advertised for bids. Advertisement and receipt of bids for projects of this size is generally accomplished within a one-month time period.

- **Project Award (if needed)** – Once bids are submitted and publicly opened, they are reviewed by Contract Administration and the project designer to determine their acceptability within DelDOT's specifications and bid guidelines. Assuming there are no irregularities in the bid, the project is then awarded. Because the projects are typically small in scale the award is often able to be made within two weeks of the bid opening.

- **Notice to Proceed (if needed)** – By Delaware Code, the contractor has 20 days to execute the contract documents once it is awarded. Once the documents are signed, the responsible DelDOT Construction Section will schedule the Preconstruction Meeting. Assuming the contractor makes all of the required submittals for items such as the construction schedule and source of materials, the DelDOT Construction Section will issue the "Notice to Proceed" to the contractor. For traffic calming projects, this typically can occur within one month.

- **Construction** – Due to the relatively smaller size and scope of these Regular traffic calming projects, it is anticipated that most projects can be completed in a shorter duration than typical roadway construction projects. Construction is typically administered and inspected by DelDOT.

2D. MAJOR PROJECTS

Traffic calming projects that require the acquisition of new right-of-way or have impacts that require environmental permits or changes to drainage are classified as Major projects. Because of the regulations and laws governing the acquisition of property for project needs and environmental resource protection, Major projects are not able to follow the expedited traffic calming design process defined previously for Minor and Regular projects. These projects fall

outside of the Traffic Calming Program and must be considered and prioritized through the TIP and CTP processes before they are able to be initiated as a stand-alone project.

Although this manual describes the expedited traffic calming design processes for Minor and Regular projects, this does not preclude the inclusion of traffic calming elements in Major projects that must go through the TIP and CTP processes.

Due to the additional requirements associated with a Major project, careful consideration should be given to alternatives and concepts that can avoid this classification.

2E. DEMONSTRATION PROJECTS

In working with the community through the project development process, it may be determined that a demonstration project is warranted. In cases where a community and DelDOT may be uncertain of the potential results or effectiveness of one or more traffic calming measure(s), demonstration or trial projects can help define the appropriate measure(s) to install. Projects with complex area-wide plans whose traffic diversion potential is difficult to predict or those involving the installation of novel traffic calming measures, such as vertical measures with unconventional profiles may also be good candidates for a trial installation.

It should be noted that the installation of a traffic calming device on a trial basis does not mean that unsightly materials will be used. Notably, national experience suggests the importance of aesthetics for public acceptance of devices used on a trial basis.

A trial period will typically last six months to one year, at which time a decision on permanent installation will be made. The decision to install a demonstration project on a permanent basis is solely at DelDOT's discretion, and funding for the permanent installation must be agreed upon prior to the trial demonstration project being installed. An example of a demonstration or trial project is the temporary installation of prefabricated speed humps or tubular markers (see **Figure 2-4**). The prefabricated devices allow for the temporary installation of the measure for a pre-defined period of time, under which the traffic impacts can be measured and studied, and then the device can be easily removed, and potentially replaced by a permanent installation.



Figure 2-4. Examples of Demonstration Projects

2F. COMMUNITY BALLOTS

If it is determined that a Community Ballot is necessary, DelDOT will mail ballot information to each household and business located within the defined impact area. Each household and business, whether owning or renting property, shall have one vote on the implementation of the selected plan. Ballots can be returned via mail or electronically. The community ballot process is outlined in **Figure 2-5**.

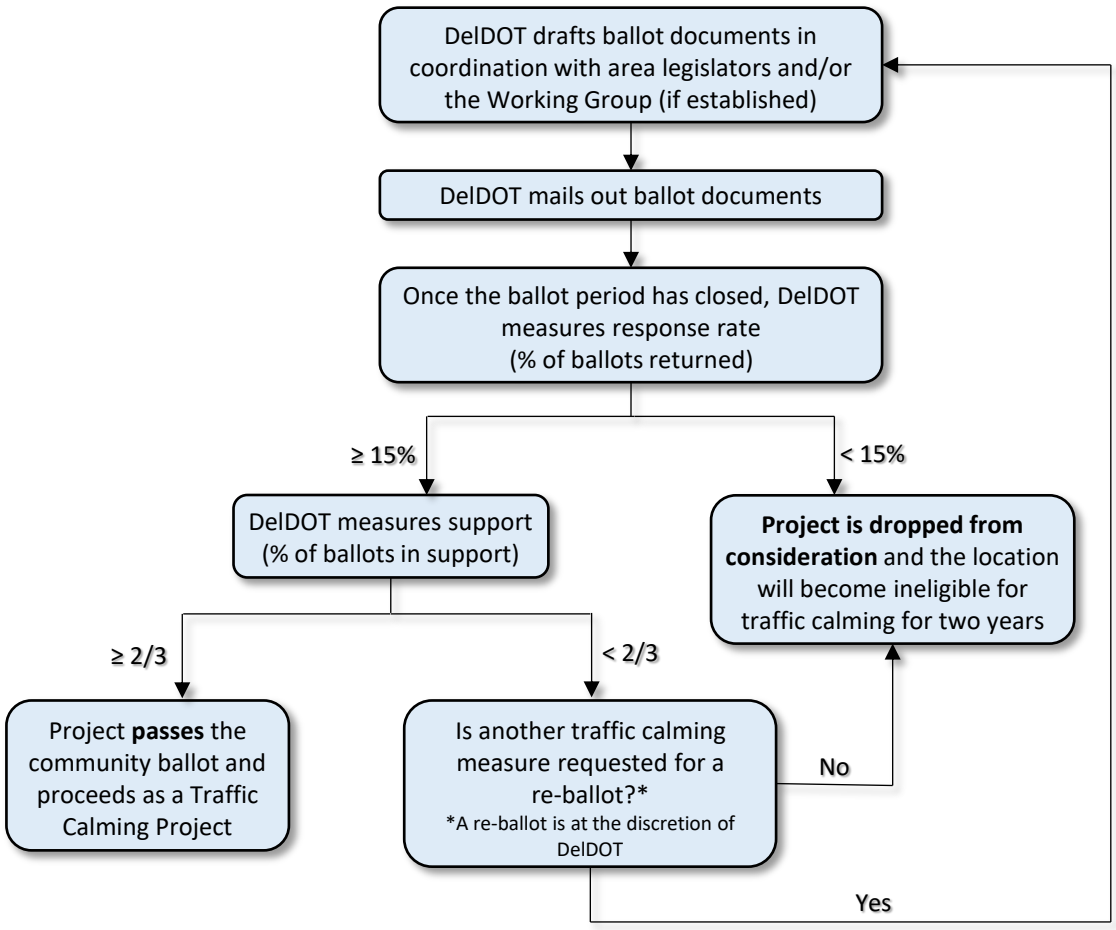


Figure 2-5. Community Ballot Process

For the permanent installation of a traffic calming device, at least fifteen percent (15%) of those receiving ballots must respond, by mail or electronically, for the vote to be considered a representative sample. After the assigned due date, if less than 15% of those receiving ballots have responded, DelDOT will drop consideration of the project due to lack of interest and the location will become ineligible for traffic calming for a period of two years. If 15% or more of those receiving ballots have responded, two-thirds (2/3) of those responses must be in support of the traffic calming measure(s) for the installation to be approved. Once approved, measures will be programmed for permanent installation.

If less than two-thirds (2/3) of respondents approve of a permanent installation, DelDOT may consider modifying the plans and offering them to the public for a second round of votes. A second ballot will be at the discretion of DelDOT and will be based upon the response rate and the level of community support. If plans are modified and submitted to the public a second time, they will be subject to the same 15% response rate and two-thirds (2/3) approval requirement. If the community does not demonstrate support of the plans, the project will be dropped from consideration and the location will become ineligible for traffic calming for two years.

2G. PROJECT FUNDING

As specific projects are being developed and are ready to proceed to design and construction, funding sources must be determined and secured by DelDOT for the projects to advance.

2G.1 FUNDING SOURCES

There are several possible funding sources available for Traffic Calming projects that include the following:

- Community Transportation Funds (CTF)
- Local/municipal funds
- Developer contributions
- Private/community contributions
- Federal and State Funds as appropriated through the DelDOT Capital Transportation Program
- Any combination of the above funding sources

The Capital Transportation Program (CTP) allocates some funding to traffic calming projects throughout the State. To the extent that funds exist in any given fiscal year, DelDOT will typically fund the study and possibly the design of traffic calming projects on roads of all classifications, including subdivision streets. Construction of traffic calming projects is typically funded through one or more other sources such as those listed above. Speed humps and RSSs must be funded using one of the non-DelDOT funding sources listed above.

Proposed traffic calming projects on subdivision streets must have local legislator support prior to consideration. Funding contributions from the local elected official's CTF allocation can be used to partially or fully fund traffic calming projects. In Delaware, CTF dollars are allocated to the State's legislators and normally used for transportation projects within their district. These funds are most often applied to repairs or improvement of subdivision streets. In new developments, developers may choose to incorporate traffic calming measures into the design of their projects, or traffic calming measures may be requested by DelDOT, through the review and approval process.

Counties and municipalities may also fund projects within their jurisdictions. Such funding may augment or be in lieu of State or Federal funding. Existing communities or individuals may also contribute private funds to assist in the construction of traffic calming measures in their communities.

Traffic calming projects proposed on state-maintained roadways within municipalities may require DelDOT and the municipality to complete a third-party agreement prior to implementation. A third-party agreement typically outlines whether DelDOT or the municipality is responsible for funding, construction, and maintenance once the traffic calming project is implemented.

2G.2 PRIORITY RATING

As noted in Section 2G.1, traffic calming projects can be funded with CTF or private dollars. All projects fully funded with these sources of funding will proceed through the design and construction phases as soon as they are determined eligible and obtain community approval. However, all traffic calming projects, even those privately funded, must meet all process and substantive requirements outlined in this manual.

To the extent that Traffic Calming funding exists, DelDOT may advance projects to design and construction in accordance with the procedures outlined in this chapter. However, should the number and cost of traffic calming projects exceed available Traffic Calming funding, DelDOT will review all eligible traffic calming projects that have obtained the necessary approvals on a fiscal year basis to determine priority. Eligibility and priority will be based on the order in which the projects were received and completion of all the necessary approvals but may also consider functional classification of the road(s), traffic volume, crash and speed data, and potential cost of the project.

2H. PROJECT MONITORING

After a traffic calming project is implemented, DelDOT may monitor the area to determine if the project has been effective. For most traffic calming projects, especially those that only contain speed humps or RSS, this is typically completed by conducting a before/after speed study near the completed project. If safety issues or unanticipated traffic diversions are observed, DelDOT will evaluate the traffic calming project further to determine if it should be removed.

2I. PROJECT MAINTENANCE

Project maintenance is an important consideration for any traffic calming project, especially those that incorporate aesthetic treatments or landscaping. It is important that traffic calming installations, like any other street improvement, receive proper maintenance to function as intended, safely, and to remain aesthetically pleasing. Because almost all traffic calming installations are on local residential or subdivisions streets, paying for the maintenance, repair,

and replacement of the facilities over time is a shared responsibility between the DelDOT District Maintenance Funds and the Community Transportation Fund (CTF). DelDOT is responsible for short-term emergency maintenance repairs on state-maintained roadways outside of municipalities, including items such as potholes and localized areas of breakup of the roadway pavement, curbs around islands or curb extensions, sidewalks within traffic islands, roadway striping, and MUTCD-compliant signing. Within municipalities, the maintenance responsibilities are governed by the Town Agreement for each roadway. Funding for major rehabilitation and replacement of traffic calming elements, as well as funding for special added aesthetic features is provided through CTF under DelDOT's Capital Program. The maintenance and replacement responsibilities for traffic calming installations on state-maintained roadways are determined on a case-by-case basis prior to implementation.

2J. MODIFICATION OR REMOVAL

If monitoring indicates there is a new and substantial safety or operational issue associated with a traffic calming measure, DelDOT may modify or remove the measure on its own initiative. In addition, citizens may petition DelDOT for modification or removal. Unless under very unusual conditions, DelDOT will consider such petitions only after a full year of experience with the traffic calming measure(s). The same procedural requirements that apply to initial installation will also apply to modification or removal of measures including the community ballot (see Section 2F) and securing funding for the modification or removal (see Section 2G).

CHAPTER 3
HORIZONTAL MEASURES

Horizontal traffic calming measures are designed to reduce vehicle speeds or volumes by either altering the vehicle's direction of travel, otherwise known as deflection, or reducing the width of the traveled way. Horizontal measures typically alter the overall street width, lane width, and/or lane alignment through the addition of intersection islands, edge islands, shifts in pavement markings, or the modification of curb lines. In some cases, physical islands and/or barriers are used to completely close a street to one direction of travel. Horizontal Measures can be used as standalone applications or as part of a series of traffic calming measures, including in combination with vertical traffic control measures.

This chapter presents specific traffic calming guidance, including geometric details, signing, and markings, for the use of Horizontal Measures. It should be noted that the guidance outlined in the latest version of the MUTCD adopted by DelDOT should always be considered. Additionally, proposed traffic calming measures that incorporate pedestrian facilities and existing pedestrian facilities that are impacted by a traffic calming project shall be designed and constructed in accordance with DelDOT's current accessibility standards.

3A. LATERAL SHIFT

A lateral shift is a single realignment of an otherwise straight roadway that causes travel lanes to shift in one direction. It is a variation of the chicane, outlined in Section 3B, which typically involves multiple realignments and is treated as a separate horizontal measure in this manual.

The typical lateral shift, as shown in **Figure 3-1**, separates opposing traffic by means of edge islands, curb extensions, and/or a center island. The center island prevents drivers from crossing the centerline into the opposing travel lane, whether unintentionally or intentionally to minimize the redirection in their travel path, which improves the safety and effectiveness of the lateral shift. Examples of lateral shifts are shown in **Figure 3-2**.

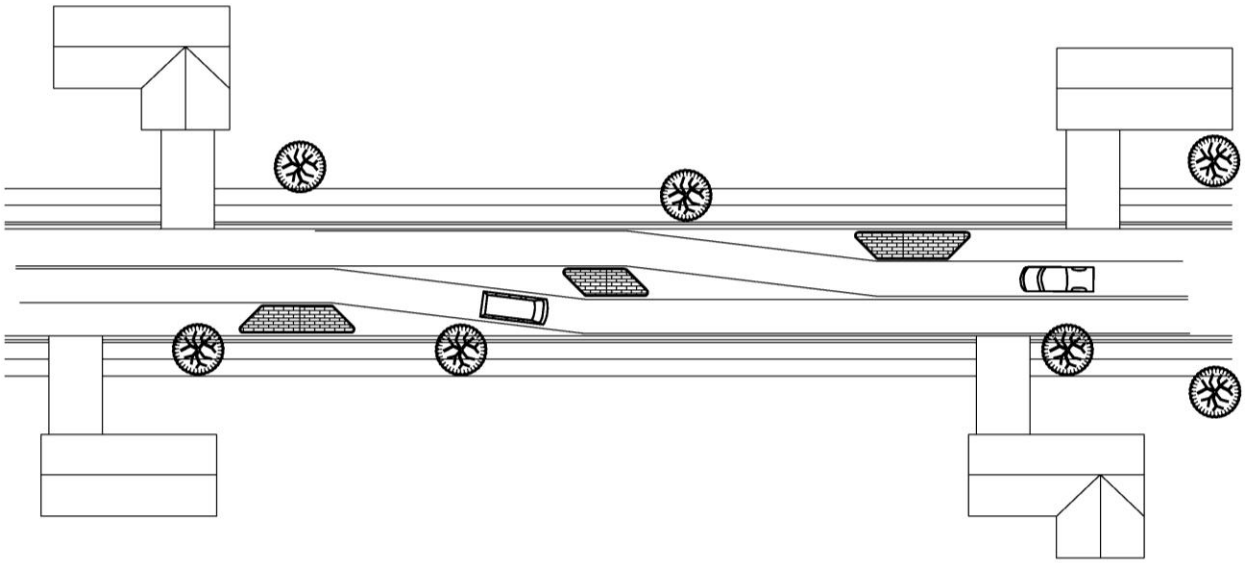
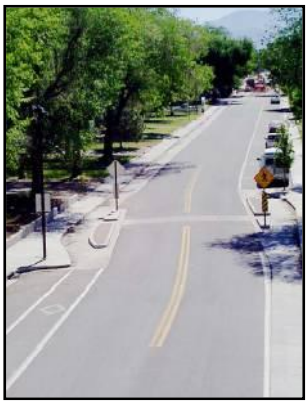


Figure 3-1. Diagram of a Lateral Shift



Source: ITE Traffic Calming State of the Practice, August 1999



Source: City of Alameda Traffic Calming Toolbox, February 18, 2003

Figure 3-2. Examples of Lateral Shifts

Application:

Types of Streets	• Appropriate for subdivision streets, local and collector roadways. May be appropriate on select arterial roadways (see Design Considerations) • Appropriate for use at mid-block locations on two-way streets with one lane in each direction or on single-lane one-way streets
Speed Limits	• Appropriate for roadways with posted speed limits of 35 MPH or less
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Speed reduction is obtained through the horizontal deflection due to edge islands, curb extensions, and/or a center island. The level of speed reduction is dependent on the extent of the alignment shift, the angle of deflection, as well as the volume and distribution of traffic. Because a lateral shift is a variation of a chicane where the roadway shifts only once, the speed reduction is typically less than that obtained through a series of chicanes.

Traffic Diversion: Lateral shifts, as a standalone measure, have little effect on the diversion of traffic from a street. Traffic diversion is highly dependent on the extent of speed reduction, increased travel time for non-local traffic, and the availability of a quicker, parallel route. The use of a lateral shift in combination with other traffic calming measures may be more effective in diverting unwanted traffic from a street than as a standalone treatment.

Advantages:

- Encourages speed reduction through horizontal deflection
- Accommodates large vehicles and has negligible effect on emergency response times
- Provides a visual break in the streetscape and reduces the “wide open” appearance of the street
- Provides landscaping opportunities

Disadvantages:

- May result in the loss of on-street parking
- May narrow pavement surface available for bicycles

Design Considerations:

- At speeds greater than 35 MPH or on arterial roadways, careful consideration, planning and engineering studies must be conducted to determine if lateral shifts are viable.
- Lateral shifts can be created by means of curb extensions or edge islands and/or the addition of a median island.
- The design of lateral shifts should consider the existing drainage patterns and drainage system because the flow path may be altered by the curb realignment.
- It is preferred that lateral shifts include a center island to separate opposing traffic. Without a center island, some motorists may simply cross the centerline to minimize deflection and to maintain higher travel speeds.

- Street lighting should be evaluated in accordance with DelDOT's Traffic Lighting Policy[10] near lateral shift locations.
- Edge line tapers should conform to the MUTCD. The curb extensions or edge islands should have 45-degree tapers to reinforce the edge lines.
- Curb extensions or edge islands that form lateral shifts should have vertical elements to draw attention to them. Signs and landscape materials must meet DelDOT standards/specifications. Additionally, if landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs.
- The approach edge of the curb extensions or edge islands that form lateral shifts should be depressed in accordance with DelDOT design standards to not create a hazard for plowing operations.
- Mountable curbs are preferred over barrier curbs for the islands that form lateral shifts because they are more forgiving to motorists, and the islands are not expected to serve as pedestrian refuges. Barrier curbs may be considered in specific instances and require additional design considerations. For low-speed street conditions, mountable curbs may be placed at the edge of a through lane rather than offset by the one-foot or more required for barrier curbs.
- The accommodation of bicyclists should be considered in the design of lateral shifts.
- The design details for lateral shifts are shown in **Figure 3-3**.

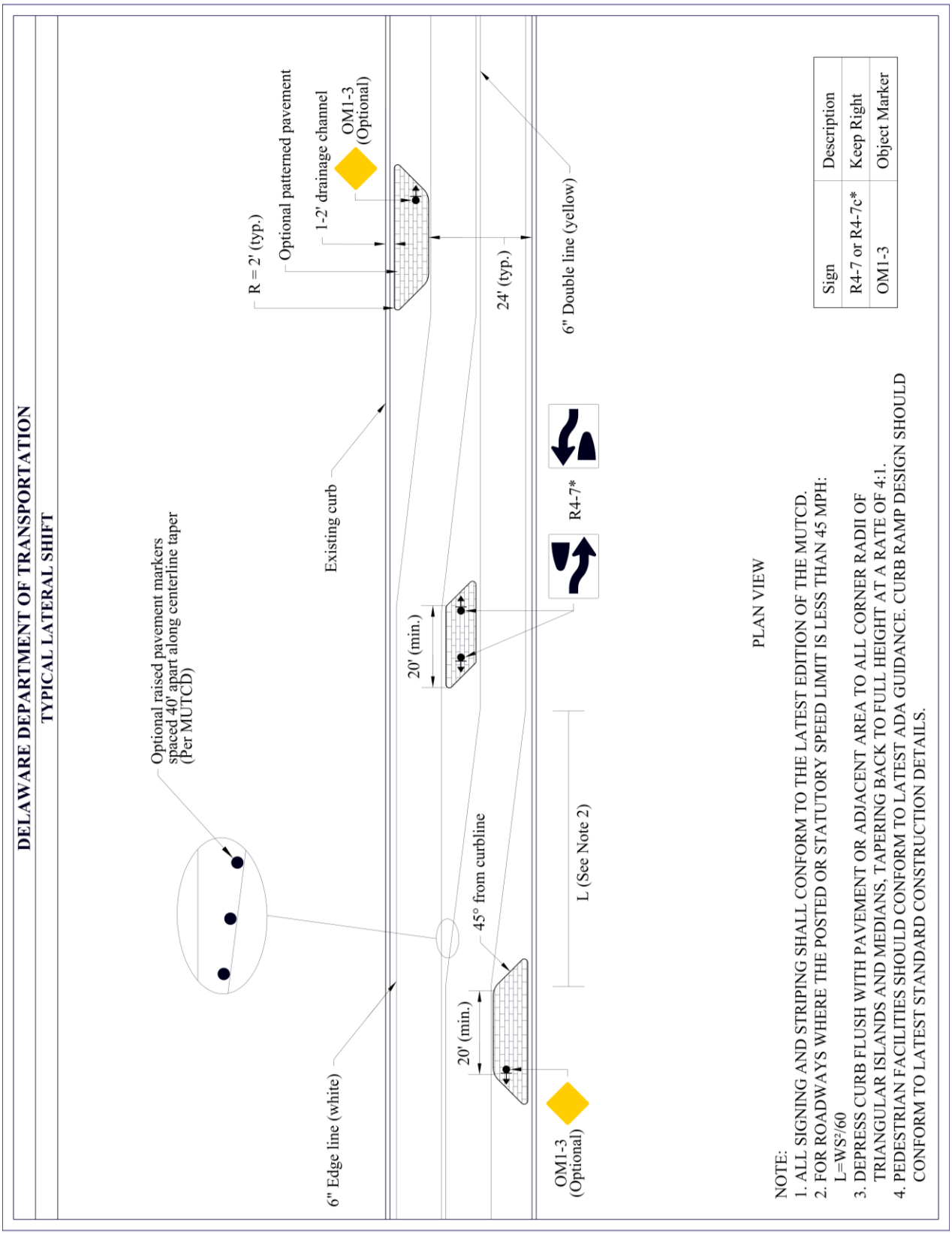


Figure 3-3. Design Details for Lateral Shift

3B. CHICANE

Chicanes, as shown in **Figure 3-4**, are a series of curb extensions, edge islands, and/or center islands that shift travel lanes from one side of the street to the other, forming an S-shaped, curvilinear roadway alignment. They are also referred to as deviations, serpentines, or reversing curves. The purpose of a chicane is to introduce horizontal curvature to the road, breaking up the appearance of wide and straight streets. Examples of chicanes are shown in **Figure 3-5**.

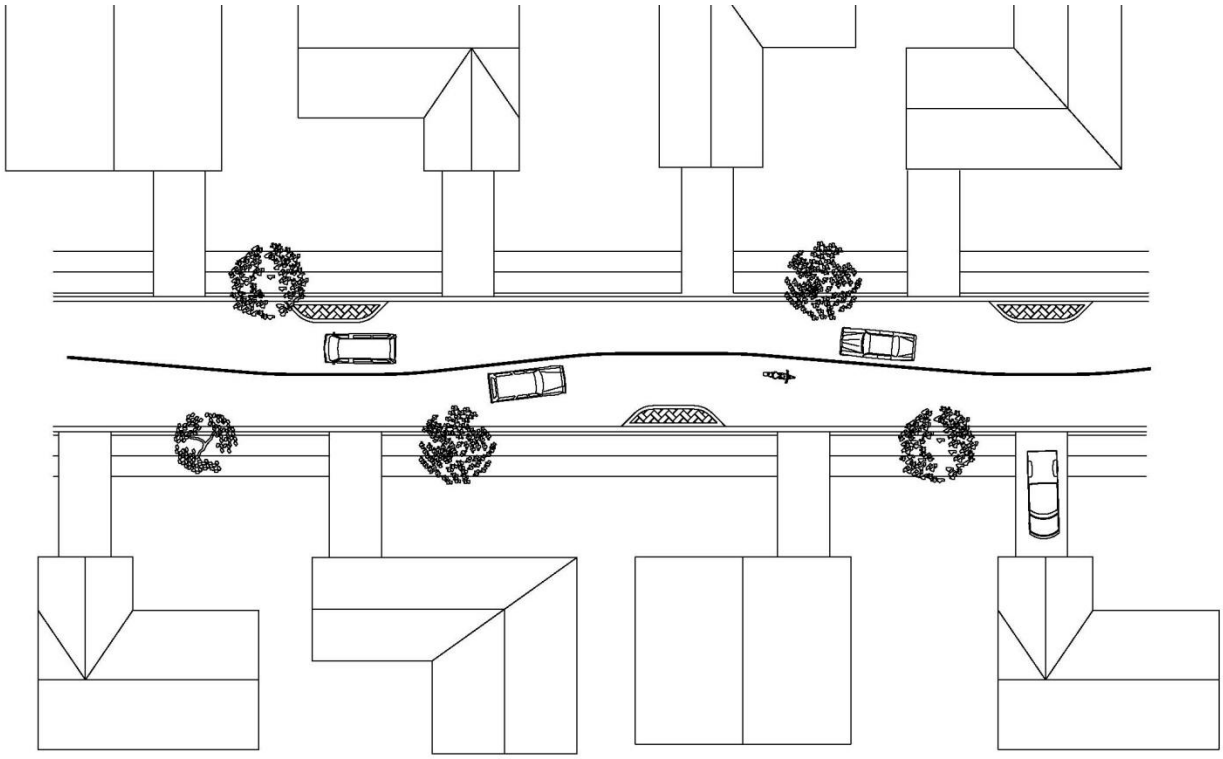


Figure 3-4. Diagram of a Chicane



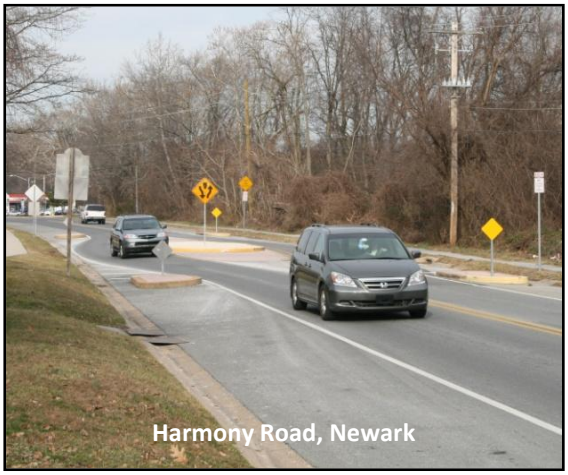


Figure 3-5. Examples of Chicanes

Application:

Types of Streets	• Appropriate for subdivision streets, local, and collector roadways • Appropriate for use at mid-block locations on two-way streets with one lane in each direction or on single-lane one-way streets
Speed Limits	• Appropriate for roadways with posted speed limits of 35 MPH or less
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Speed reduction is the primary function of a chicane, achieved through horizontal deflection. The level of speed reduction is dependent on the extent of the alignment curvature through the feature, as well as the volume and distribution of traffic. Chicanes are less effective when the volume of traffic is significantly higher in one direction than the other or when volumes are so low that the likelihood of a motorist encountering an opposing motorist within the chicane is low. Studies have shown that speed reductions in the vicinity of a chicane can be 3 to 9 MPH[3].

Traffic Diversion: Chicanes may result in modest diversion of traffic from a street, though the amount of traffic diversion is highly dependent on the level of speed reduction, increased travel times for non-local traffic, and the availability of alternate routes.

Advantages:

- Encourages speed reduction through multiple horizontal deflections
- Accommodates large vehicles and has little effect on emergency response times
- Provides a visual break in the streetscape and reduces the “wide-open” appearance of the street
- Provides landscaping opportunities

Disadvantages:

- May result in the loss of on-street parking
- May narrow pavement surface available for bicycles
- Some drivers may view chicanes as an “obstacle course,” leading to aggressive braking, cornering or acceleration

Design Considerations:

- The lateral shifts of a chicane can be created by means of curb extensions or edge islands and may also contain center median islands. Trapezoidal islands are preferred, and semi-circular shapes are permitted.
- The design of chicanes should consider the existing drainage patterns and drainage system because the flow path may be altered by the curb realignment.
- Edge line tapers should conform to the MUTCD. The curb extensions or edge islands should have 45-degree tapers to reinforce the edge lines.

- Curb extensions or edge islands that form chicanes should have vertical elements to draw attention to them. Signs and landscape materials must meet DelDOT standards/specifications. Additionally, if landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs.
- The approach edge of the curb extensions or edge islands that form chicanes should be depressed in accordance with DelDOT design standards to not create a hazard for plowing operations.
- Mountable curbs are preferred over barrier curbs for the curb extensions and edge islands that form chicanes because they are more forgiving to motorists and chicanes are not expected to serve as pedestrian refuges. Barrier curbs may be considered in specific instances and require additional design considerations.
- Chicanes may separate opposing traffic by means of double solid yellow lines with raised or recessed pavement markers. To discourage motorists from cutting across the centerline to minimize deflection, a raised median may be installed. The median may be narrow and mountable without landscaping or if right-of-way permits, the median may be wider with landscaping.
- The design details for chicanes are shown in **Figure 3-6**.

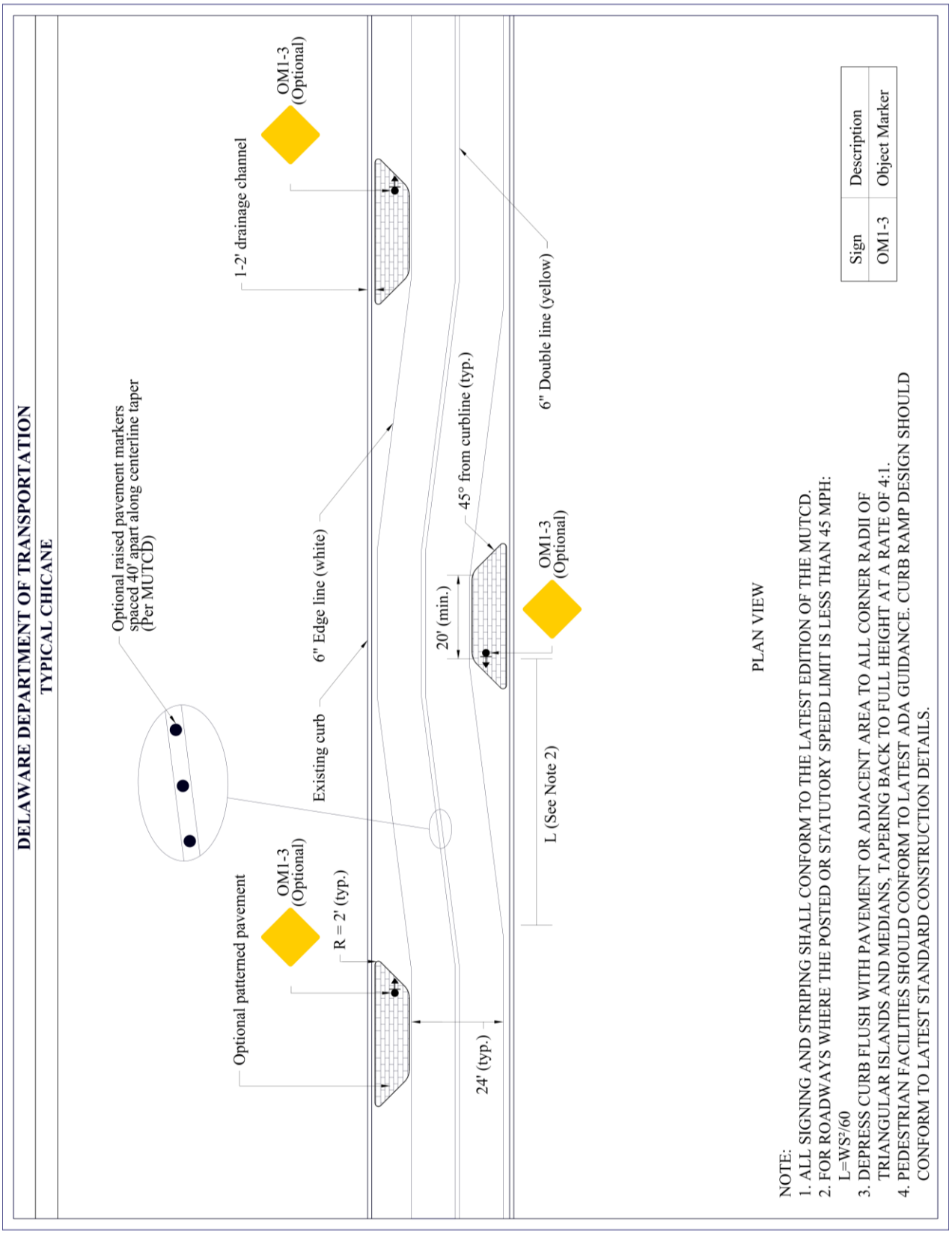


Figure 3-6. Design Detail for Chicanes

3C. REALIGNED INTERSECTION

Realigned intersections, as shown in **Figure 3-7**, involve changes in the horizontal alignment of the approaches to three-leg intersections. Curbed islands are typically used to convert the straight approaches of the through street into a curving street with all straight paths through the intersection removed. Examples are shown in **Figure 3-8**.

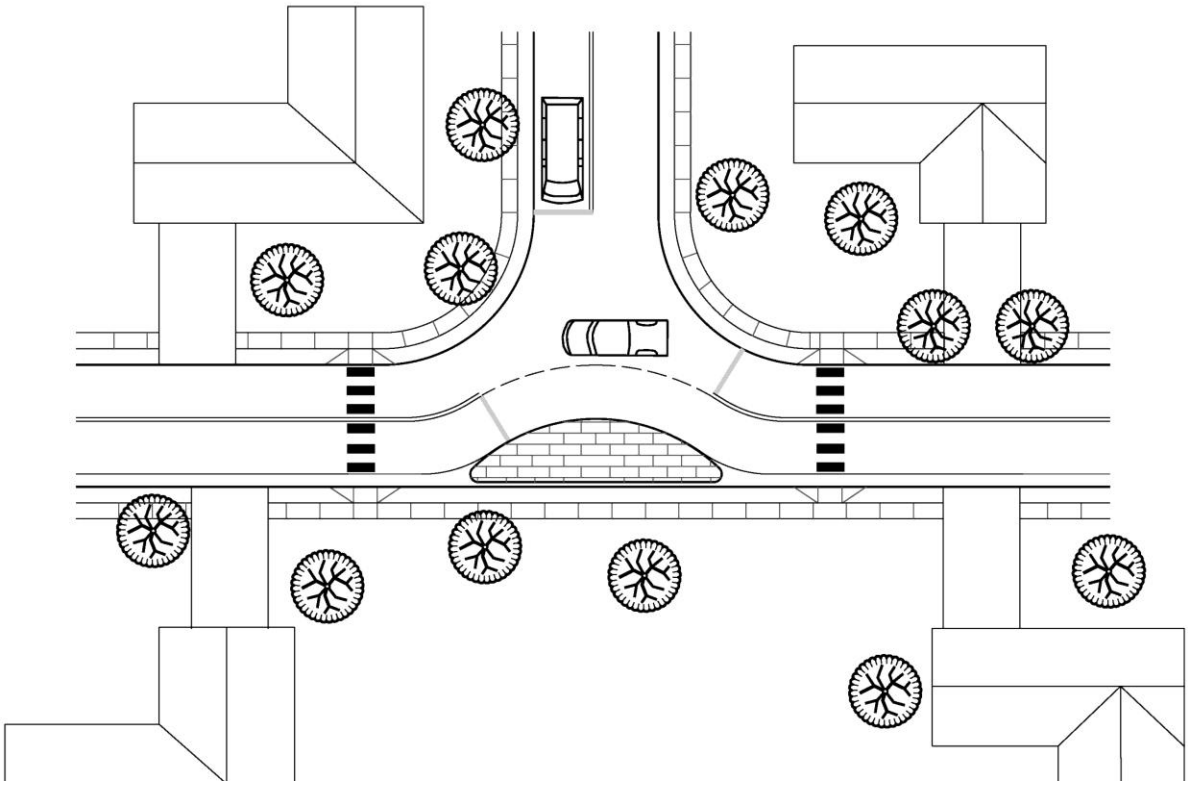


Figure 3-7. Diagram of a Realigned Intersection





Figure 3-8. Examples of Realigned Intersections

Application:

Types of Streets	• Appropriate for subdivision streets, local, and collector roadways • Appropriate for three-leg intersections
Speed Limits	• Appropriate for roadways with posted speed limits of 25 MPH
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Speed reduction is obtained through the horizontal deflection of the roadway approaches to the intersection. In locations where stop signs are also installed as part of the measure, the expected speed reductions are greater as vehicles stop. In some instances, increased speeds may be observed on either side of the realigned intersection as motorists attempt to recover lost time.

Traffic Diversion: As a standalone installation, a realigned intersection has a minor effect on the diversion of traffic from a street, unless the installation of stop signs on the major street creates queueing and delays. Traffic diversion is highly dependent on the amount of speed reduction, the increased travel time for non-local traffic, and the availability of alternate routes. Realigned intersections are most effective in reducing travel speeds and diverting traffic from a street when used in combination with other traffic calming measures.

Advantages:

- Encourages speed reduction through horizontal deflection
- May provide for reduced crossing distances for pedestrians
- Accommodates large vehicles and has negligible effect on emergency response times
- Provides a visual break in the streetscape
- Provides landscaping opportunities

Disadvantages:

- May result in the loss of on-street parking
- May narrow the pavement surface available for bicycles
- May increase intersection queuing and delay on the major street

Design Considerations:

- Prior to design, a traffic review and capacity analysis of the intersection should be performed to determine if other traffic controls, such as stop signs, should be implemented as part of the measure. Capacity analyses of the intersection should consider whether queuing or delays are significantly increased by the loss of any existing turn lanes and/or implementation of stop control.
- Design considerations of a realigned intersection should also include right of way and utilities, lighting, drainage, and bicycle access.
- Curb extensions used at the intersection should maintain adequate sight lines and minimize maintenance costs.
- **Figure 3-9** and **Figure 3-10** show the design details for realigned intersections with and without median islands.

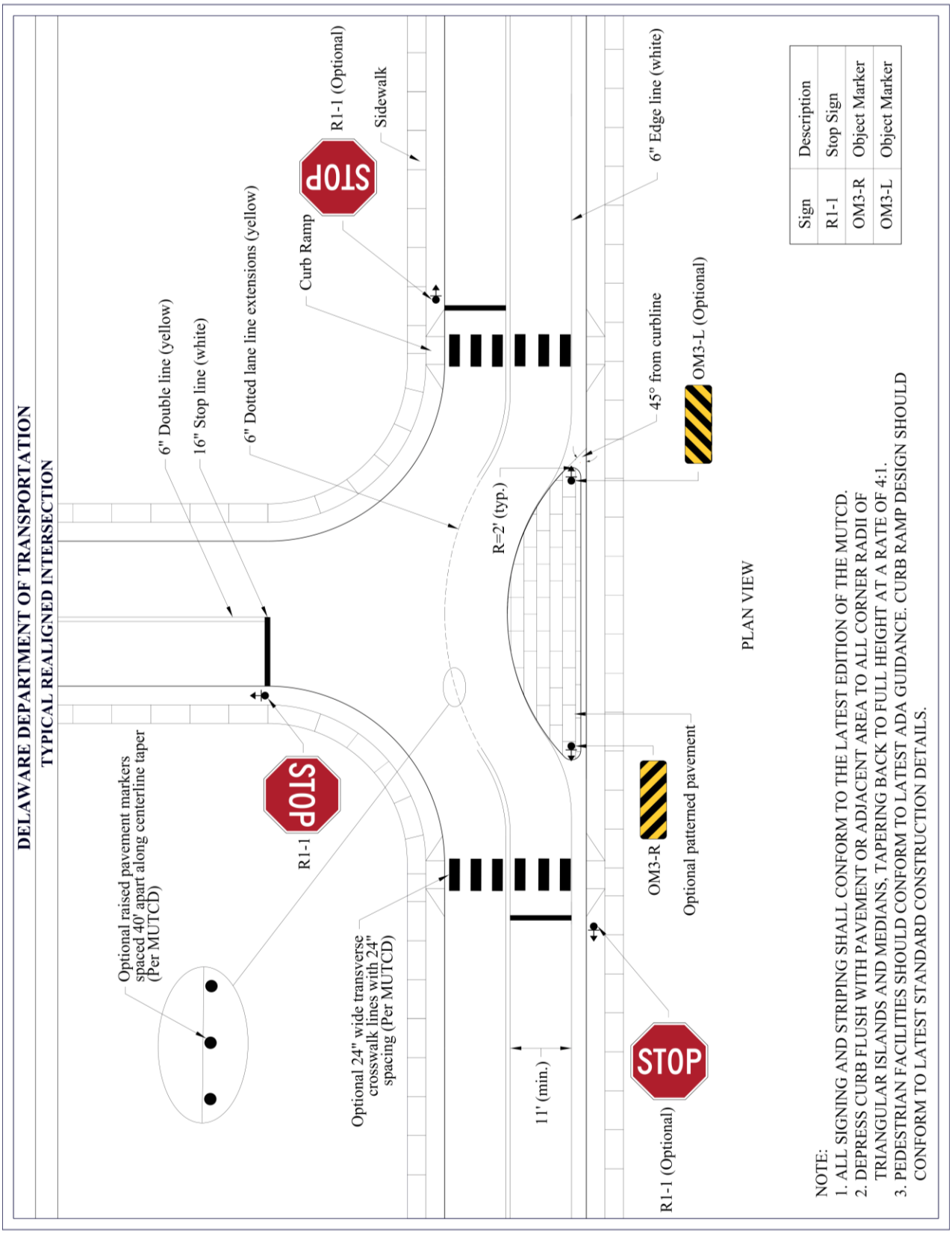


Figure 3-9. Design Details for Typical Realigned Intersection

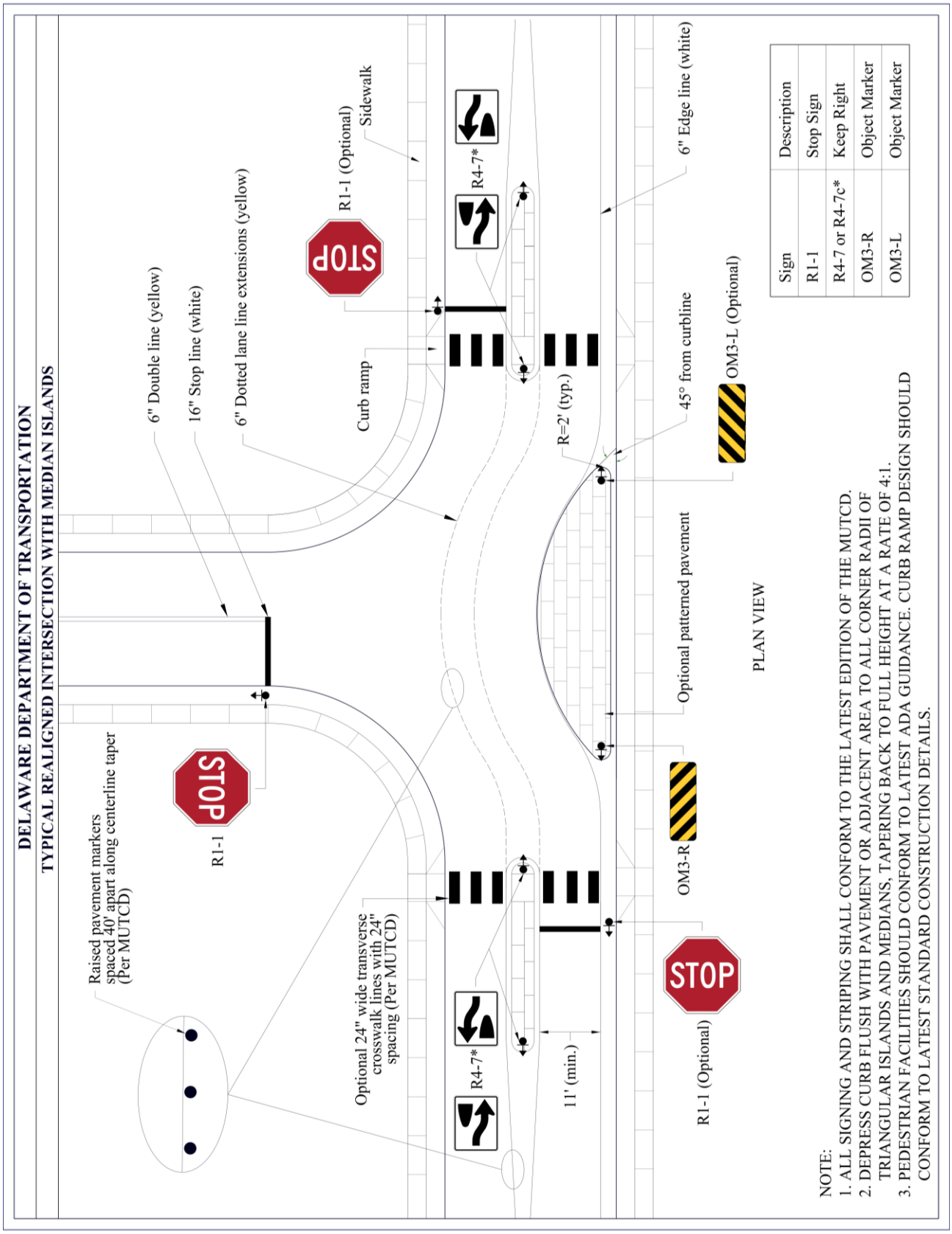


Figure 3-10. Design Details for Realigned Intersection With Median Islands

3D. NEIGHBORHOOD TRAFFIC CIRCLES & MINI-ROUNDABOUTS

Neighborhood traffic circles and mini-roundabouts, while similar in appearance, have some unique design differences. Neighborhood traffic circles are designed to fit within existing intersections. Neighborhood traffic circles typically do not have a raised central island or include diverter islands on the approaches to the intersection. Because of their size, most vehicles larger than a passenger car must travel over at least a portion of the central island to make a left turn; the central island in a neighborhood traffic circle is typically flush for this reason. By contrast, mini-roundabouts typically include diverter islands on the approaches, and a raised, traversable central island that includes mountable aprons, as shown in **Figure 3-11**. Depending on the width of the street approaches and intersection, mini-roundabouts may involve modification of the intersection. Full-size roundabouts have many of the same safety and operational benefits of neighborhood traffic circles and mini-roundabouts. However, due to their size, they generally have more impacts on drainage, right-of-way, and utilities. Therefore, full-size roundabouts are beyond the scope of the Traffic Calming Program but may be initiated as a separate project that follows DelDOT's typical Project Development Process. More information about full-size roundabouts, as well as design guidance, is available on DelDOT's website.



Figure 3-11. Examples of Mini-Roundabouts

Application:

Types of Streets	• Neighborhood traffic circles are appropriate for the junction of two subdivision streets • Mini-roundabouts are appropriate for the junction of two subdivision streets, local, or collector roadways
Speed Limits	• Neighborhood traffic circles are appropriate for roadways with posted speed limits of 25 MPH • Mini-roundabouts are appropriate for roadways with posted speed limits of 30 MPH or less
Design Vehicles	• The design vehicle for both neighborhood traffic circles and mini-roundabouts is a passenger car
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Safety: Both neighborhood traffic circles and mini-roundabouts may provide reduced conflict points and increased safety.

Speed: Neighborhood traffic circles result in modest speed reduction obtained through the horizontal deflection through the intersection. Because neighborhood traffic circles generally do not include diverter islands or a raised central island, motorists who choose to ignore the striping are able to drive over the central island as opposed to around it. Speed reduction through mini-roundabouts is largely dependent on the proper design of the approach lanes to deflect vehicles as they travel through the intersection. Without proper deflection, vehicles may be able to pass through the mini-roundabout without lowering their speed.

Traffic Diversion: Both neighborhood traffic circles and mini-roundabouts have little effect on the diversion of traffic from a street. Traffic diversion depends on the amount of speed reduction, the increased travel time for non-local traffic, and the availability of a faster, parallel route.

Advantages:

- Both neighborhood traffic circles and mini-roundabouts may improve the safety of the intersection by reducing the number of vehicle conflict points from 32 to 8 and the number of pedestrian conflict points from 24 to 8 (for a 4-leg intersection)
- Encourages speed reduction through horizontal deflection
- Typically, no right-of-way is required for the construction of a neighborhood traffic circle
- Provides traffic calming and traffic control for two streets simultaneously
- Neighborhood traffic circles have a relatively low implementation cost

Disadvantages:

- May result in an increase in emergency response times
- May result in the loss of on-street parking
- Snow removal operations may be more challenging

Design Considerations:

- While the majority of vehicles traveling through neighborhood traffic circles and mini-roundabouts are passenger cars, the design must account for larger vehicles such as buses and delivery trucks. Because neighborhood traffic circles do not typically include a raised central island, turns by any size vehicle can be accommodated to the same degree as the existing non-circular intersection. For mini-roundabouts, a single unit truck can pass through the intersection, but in most cases will need to mount the apron of the center island while larger trucks and buses may also have to traverse a portion of the center island when passing through the intersection.
- Neighborhood traffic circles, unlike mini-roundabouts, typically do not include a raised traversable central island. In both cases, however, the center island, whether flush or raised, should be constructed with a different pavement type than the surrounding roadways to increase visibility. Concrete or textured pavements are used most often to

distinguish the central island from surrounding (mostly hot-mix) pavements. Striping can be used for neighborhood traffic circles though it is not as aesthetic as other pavement options.

- The central island of mini-roundabouts are designed to slope away from the center island to provide positive drainage. Because neighborhood traffic circles maintain existing street grades, drainage is typically not an issue.
- The approach edge of the center island for a mini-roundabout should be depressed in accordance with DelDOT design standards to not create a hazard for plowing operations.
- Neighborhood traffic circles and mini-roundabouts are typically deployed at four-way intersections because this is where the greatest safety benefits are realized. If a mini-roundabout or neighborhood traffic circle is designed for a three-leg intersection, additional design of the approach curb lines is required to ensure adequate deflection of the vehicle path along the top of the T.
- Crosswalks at neighborhood traffic circles and mini-roundabouts should be constructed in accordance with the guidance provided in the MUTCD for roundabouts with the appropriate setback from the yield line.
- Design details for neighborhood traffic circles and mini-roundabouts are shown in **Figure 3-12** and **Figure 3-13**, respectively.

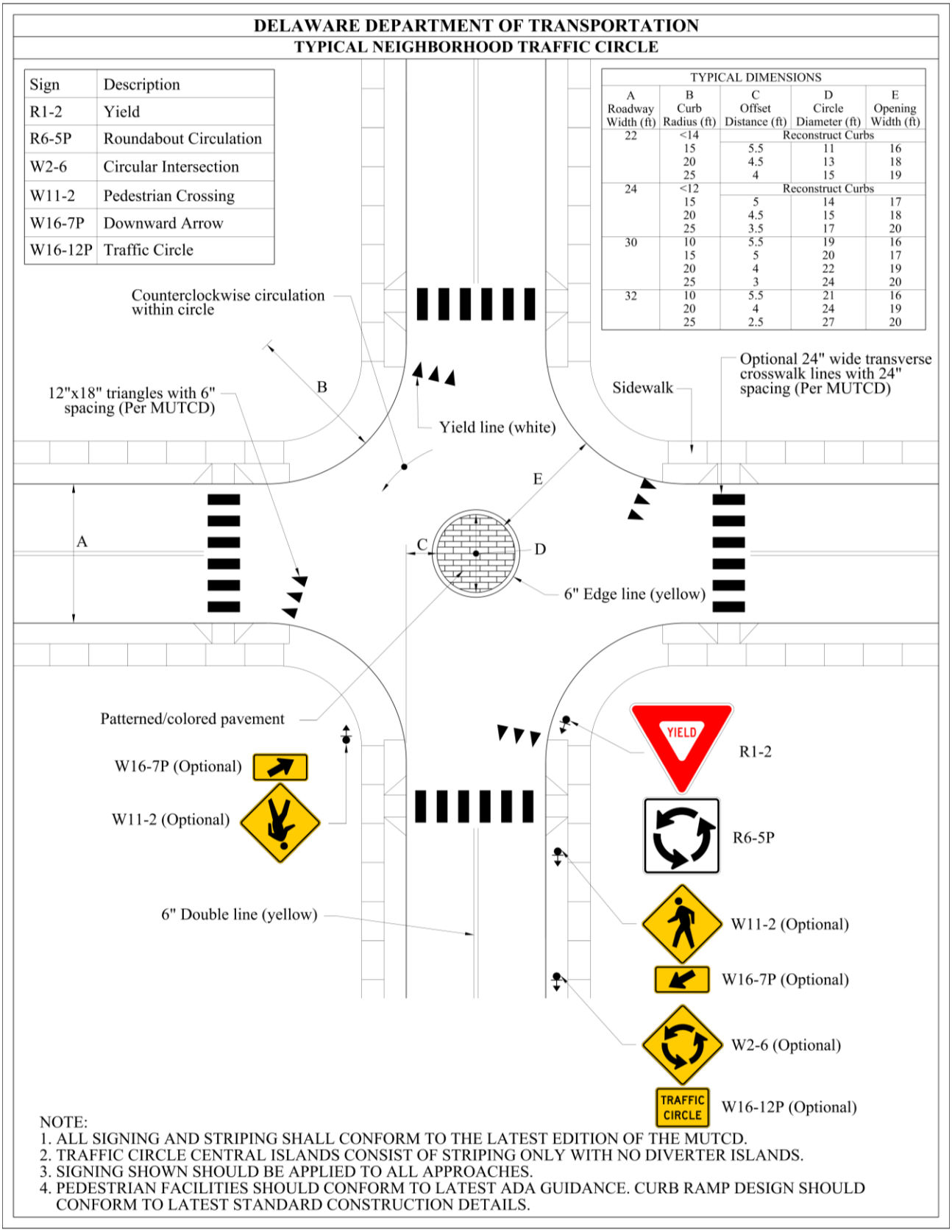


Figure 3-12. Design Details for Neighborhood Traffic Circle

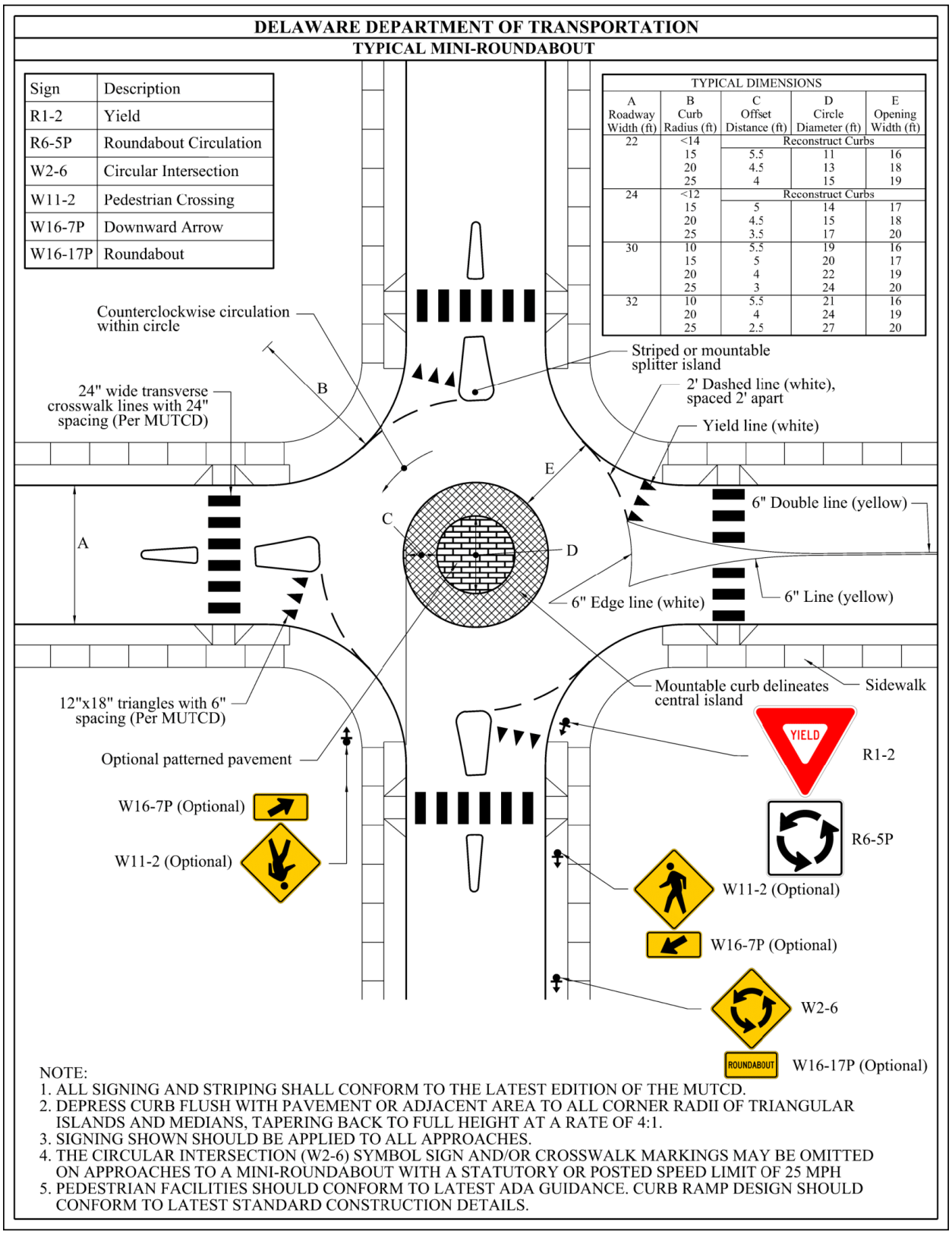


Figure 3-13. Design Details for Mini-Roundabout

3E. Corner Extension / Bulbout

Corner extensions, which are sometimes called curb extensions or bulbouts, provide both a physical and visual narrowing of an intersection. The extension of the curb line into the roadway narrows the travel way, decreases the distance pedestrians must cross, and increases pedestrian visibility, as shown in **Figure 3-14**. The reduced pavement width combined with tighter turning radii reduce both through and turning vehicle speeds. Because of the reduction in the pavement width and turning radii, an operational analysis should always be performed during the design phase to ensure that the intersection will operate acceptably with respect to queues, delays, and vehicle turning paths. Examples of corner extensions are shown in **Figure 3-15**.

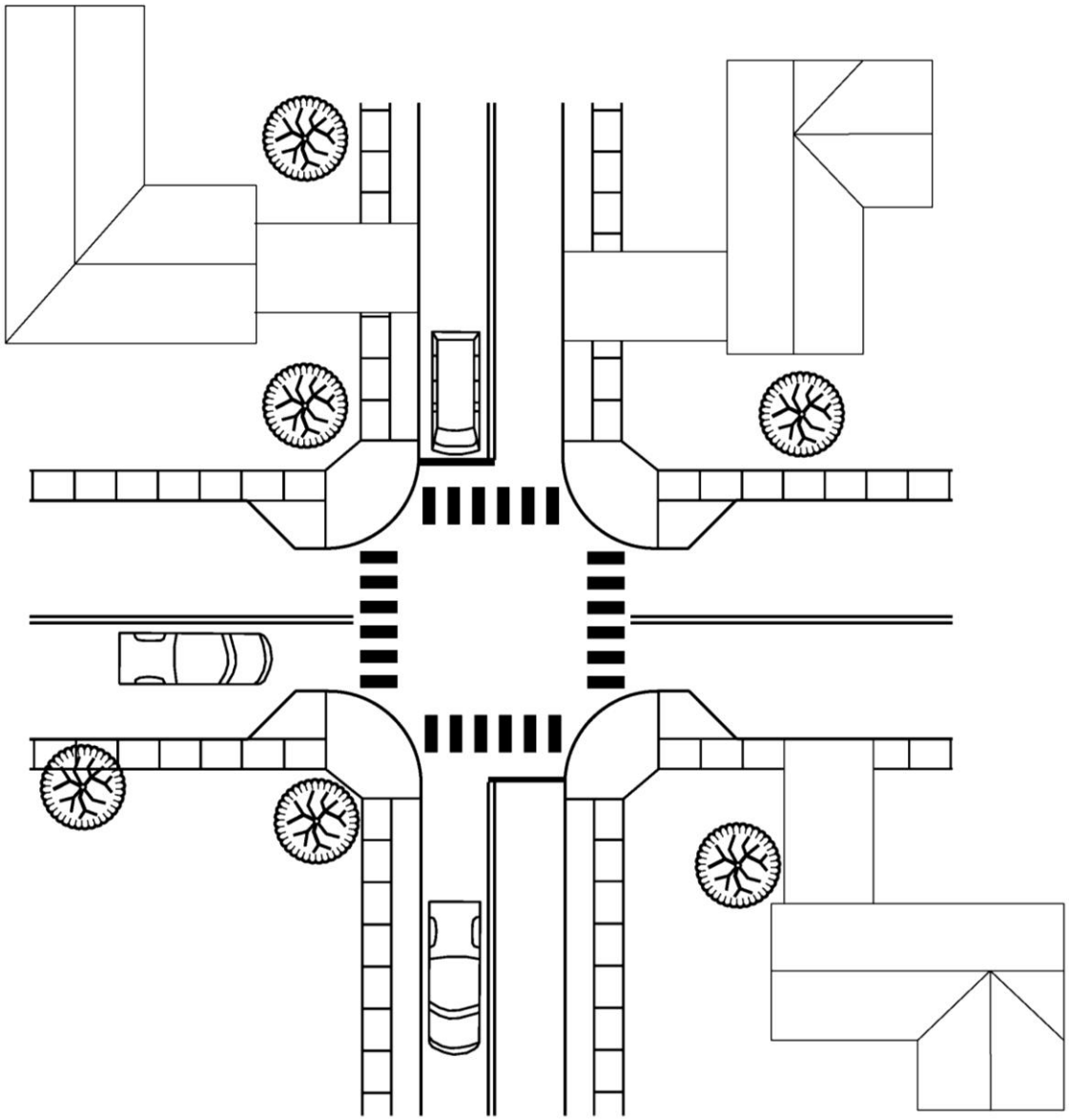


Figure 3-14. Diagram of a Corner Extension





Figure 3-15. Examples of Corner Extensions

Application:

Types of Streets	• Appropriate for the intersection of two local, collector, and arterial roadways • Not appropriate within subdivisions
Speed Limits	• Appropriate for roadways with posted speed limits of 35 MPH or less
Design Vehicles	• Same design vehicles used in the original street design to ensure sufficient turning radii for buses and large trucks can be maintained
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: Speed reduction is obtained through the narrowing of the roadway and reduced turning radii. The overall speed reduction is dependent on the degree of narrowing, curb radii, and the volume and distribution of traffic.

Traffic Diversion: Corner extensions as a standalone measure have little effect on the diversion of traffic from a street.

Advantages:

- Reduces speeds through the immediate intersection area
- Reduces crossing distances and increases visibility for pedestrians
- Provides landscaping opportunities
- Minimal impact to emergency vehicle response times

Disadvantages:

- May result in the loss of on-street parking
- May impact street sweeping operations
- May require bicyclists to use the travel lanes at intersections

- May make right turns by large vehicles more difficult
- May impact or require drainage and utility systems

Design Considerations:

- A typical corner extension is designed such that a single unit truck or bus can stay to the right of the centerline when making a right turn. However, depending on the site, designs might also need to consider accommodating larger vehicles (fire trucks, garbage trucks, etc.), as well as street lighting and bicycle access.
- Curb extensions that form corner extensions should have vertical elements to draw attention to them. Signs and landscape materials must meet DelDOT standards/specifications. Additionally, if landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs.
- The design of corner extensions should consider the existing drainage patterns and drainage system because the flow path may be altered by the curb realignment.
- The design of corner extensions should also consider existing utilities to avoid utility relocations.
- Intersection corner extensions may be designed in conjunction with vertical traffic calming measures, such as raised intersections or raised pedestrian crosswalks, to increase the likelihood of lower vehicle speeds and to help visually define the intersection.
- Turning vehicle template analyses should be performed as part of the design process to ensure adequate operations can be maintained.
- Design details for corner extensions are shown in **Figure 3-16**.

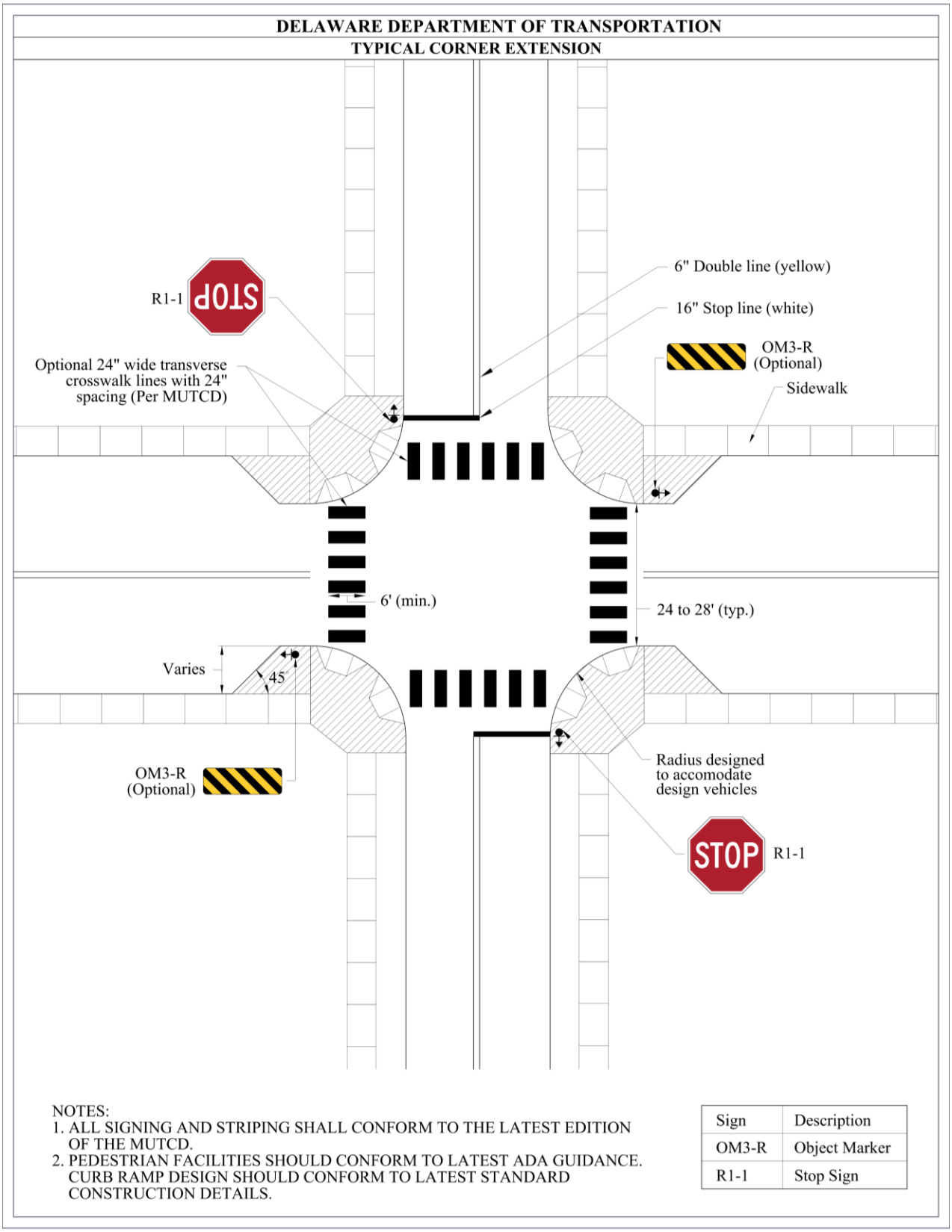


Figure 3-16. Design Details for Corner Extension

3F. CHOKER

Chokers, as shown in **Figure 3-17**, narrow the travel lanes of a roadway by pulling the existing curb line closer to the centerline of the road. The typical two-lane road width at a choker is 20 feet wide (curb-to-curb) at its most narrow point and the curb line should extend toward the centerline beyond any parking lanes, where possible.

The length of a choker can vary depending on the location of adjacent driveways and on-street parking. Chokers provide a favorable opportunity to install a mid-block crosswalk (either raised or flush with the roadway) because pedestrian crossing distances are reduced, motor vehicle speeds are lower, and the combination of design elements draw greater visual attention to the crossing location.

Chokers can be constructed either by realigning the curb or constructing new edge islands adjacent to the existing curb line. Edge islands are less aesthetic but leave existing drainage channels open. They also make it possible to provide bicycle bypass lanes on streets without curbside parking if the distance between the island and the curb line can be made wide enough based on site conditions. Chokers may be hazardous to bicyclists, especially on roadways with high traffic volumes if cyclists are forced into the travel lanes with motorists. In such cases, bicycle bypass lanes should be considered. Examples of chokers are shown in **Figure 3-18.**

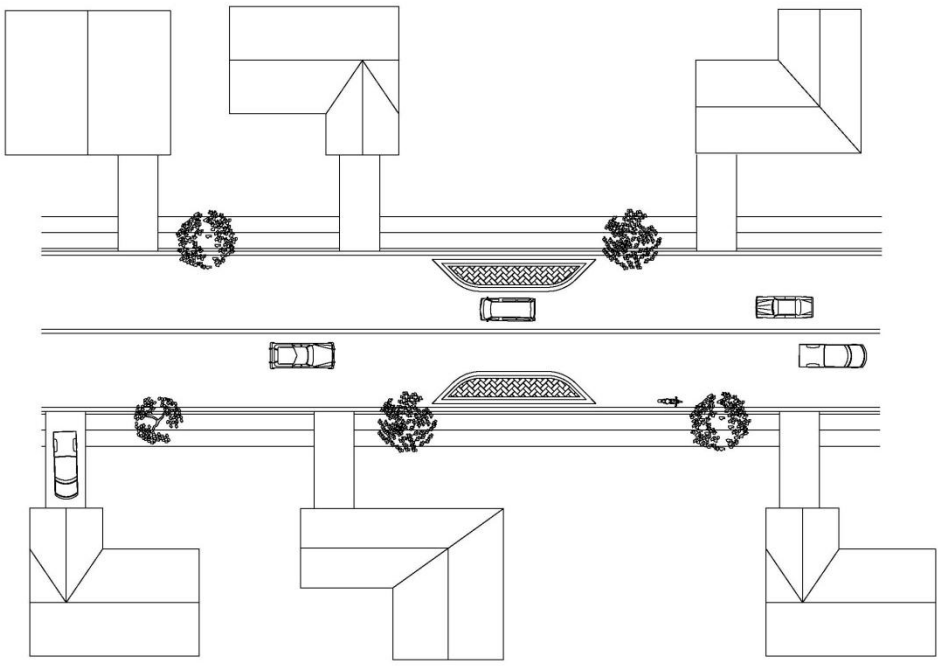


Figure 3-17. Diagram of a Choker



Figure 3-18. Examples of Chokers

Application:

Types of Streets	• Appropriate for subdivision streets, local, collector, and arterial roadways • Appropriate for two-way streets with one lane in each direction or on one-way streets
Speed Limits	• Appropriate for roadways with posted speed limits of 35 MPH or less
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: Speed reduction is obtained by both a visual and physical narrowing of the roadway. The narrowing encourages motorists to reduce their speeds as they approach and travel through the choker. The amount of speed reduction is dependent on the degree of narrowing, as well as the volume and distribution of traffic. Chokers as a standalone element are less effective when the volume of traffic is significantly higher in one direction than the other or when volumes are so low that the likelihood of a motorist encountering an opposing motorist within the narrowed area is low.

Traffic Diversion: Chokers as standalone elements may have a modest diversion of traffic from a street. Traffic diversion is highly dependent on the amount of speed reduction, the increased travel time for non-local traffic, and the availability of a quicker, alternative route. A choker in combination with other traffic calming measures will be more effective in diverting traffic from a street.

Advantages:

- Reduces speeds in the area of a choker
- Reduces crossing distances and increases visibility for pedestrians
- Provides opportunities for landscaping
- Accommodates emergency vehicles

Disadvantages:

- May result in the loss of some on-street parking
- May impact existing drainage flow lines and systems

Design Considerations:

- Where possible, mid-block locations near streetlights are preferred.
- The design of the clear width between choker islands should consider emergency vehicle access.
- On streets with low bicycle traffic and/or low motor vehicle volumes, the probability of vehicles and bicycles meeting at the choker is sufficiently low enough to require no special accommodation of bicycles. On wider streets with higher volumes, bypass lanes for bicycles, separated from the main travel lanes by the curb extensions, may be considered.
- Edge line tapers should conform to the MUTCD taper formulas.
- Curb extensions that create a choker should have vertical elements to draw attention to them. Signs and landscape materials must meet DelDOT standards/specifications. Additionally, if landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs.
- The length of a choker island should be at least 20 feet, the length of a typical passenger car.
- Chokers are generally located in mid-block locations and often provide the opportunity for mid-block pedestrian crossings. The narrowing of the traveled way provides a reduced crossing distance. However, along with these benefits of a mid-block crossing, motorists do not normally expect to encounter a pedestrian crossing at a mid-block location that may be far away from an intersection. For this reason, the MUTCD has established a marking convention for mid-block pedestrian crossings. If a crossing is established as part of a traffic calming project, the markings and signing of the crosswalk shall meet the standards established in the MUTCD.
- Design details for chokers are shown in **Figure 3-19**.

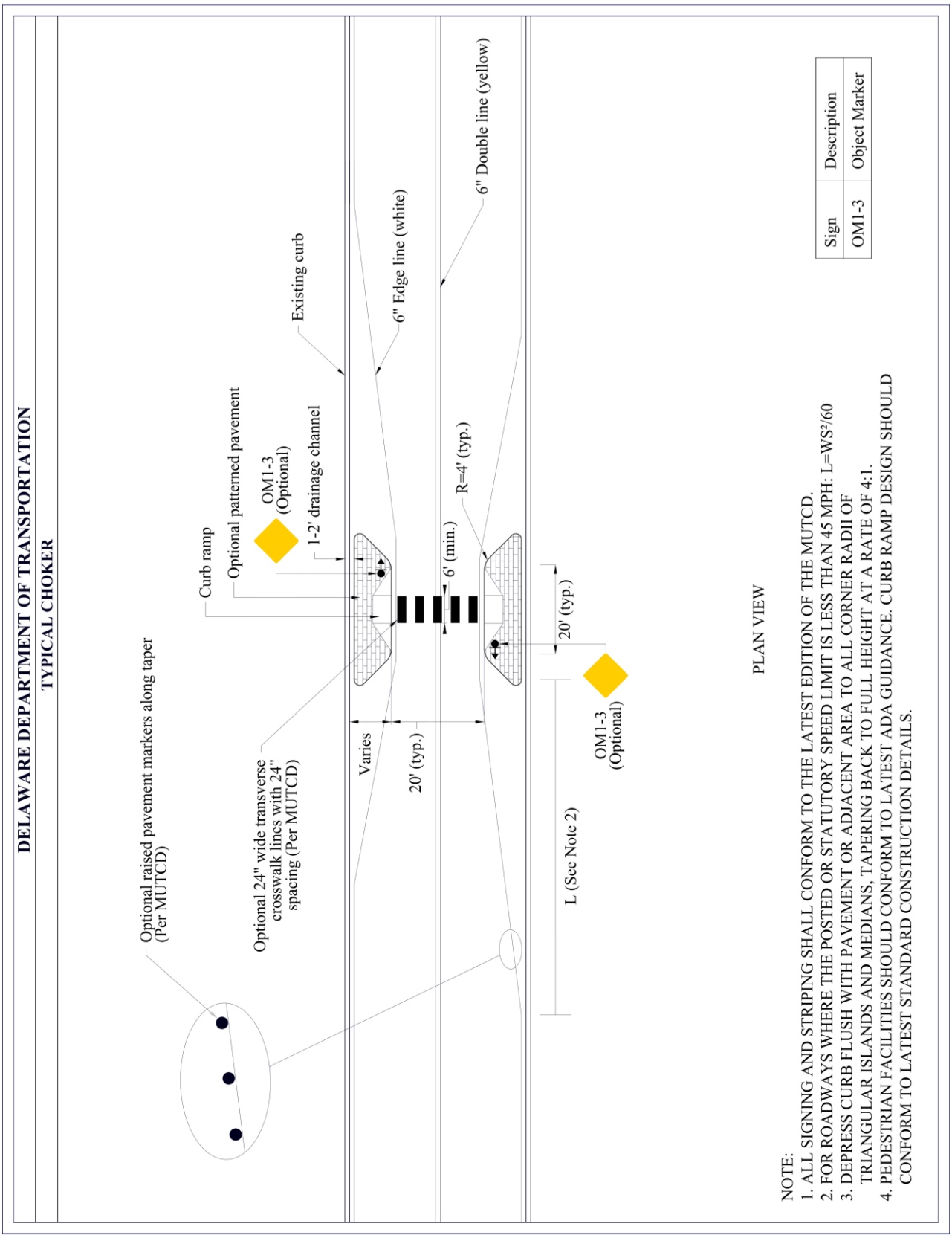


Figure 3-19. Design Details for Chokers

3G. MEDIAN ISLAND

Median islands, as shown in **Figure 3-20**, narrow the roadway by placing an island in the center of the roadway, resulting in a narrowing of the lane widths on either side of the island. The visual appearance of narrowed lanes encourages drivers to slow down as they shift their travel path. Under some conditions, the center island can provide opportunities for pedestrian refuge or landscaping. To be most effective, median islands should be raised and often incorporate textured surfaces. For median islands that are flush with the existing roadway, textured concrete or pavement is essential in helping draw attention to the island. Examples are shown in **Figure 3-21**.

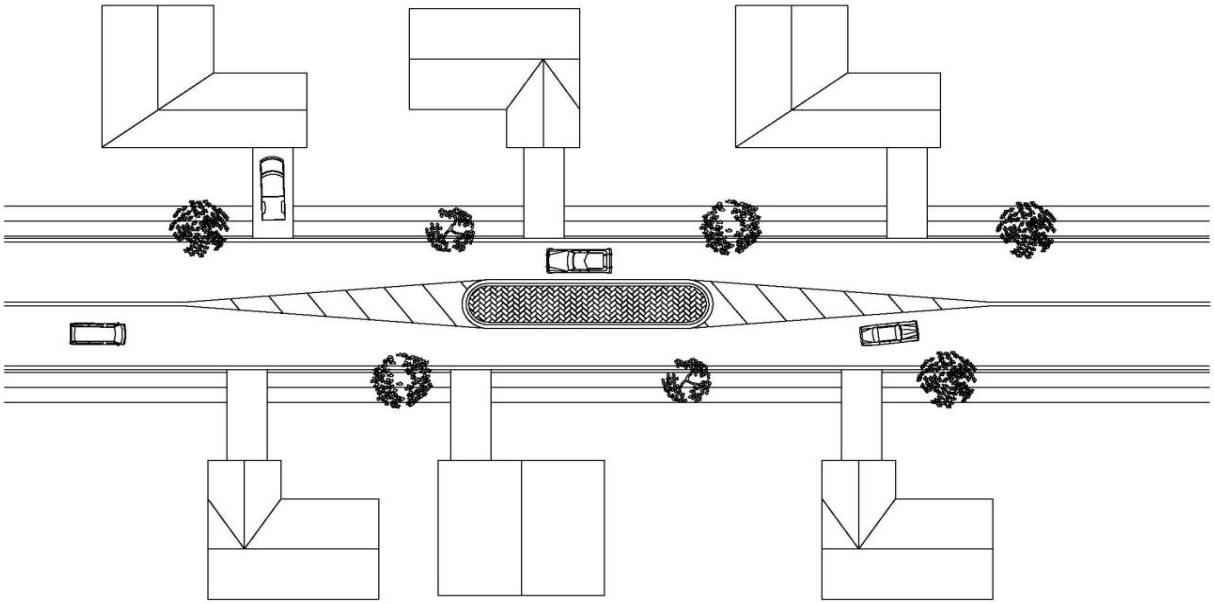


Figure 3-20. Diagram of Median Island

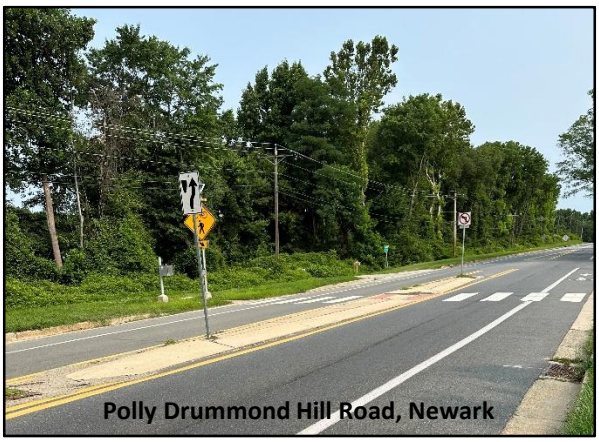




Figure 3-21. Examples of Median Islands

Application:

Types of Streets	• Appropriate for subdivision streets, local, collector, and arterial roadways
Speed Limits	• Appropriate for roadways with posted speed limits of 35 MPH or less. May be considered on roadways with higher posted speed limits with adequate sight distances and advance warning.
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Speed reduction is obtained through horizontal deflection as motorists travel around the median island. The amount of speed reduction is highly dependent on the extent of deflection, the reduced width of the travel lanes, and traffic volumes.

Traffic Diversion: Median islands have little effect on the diversion of traffic from a street.

Advantages:

- Encourages speed reduction through horizontal deflection
- If sufficiently wide enough (6 feet minimum), median islands can provide a refuge area for pedestrians in middle of roadway and reduce crossing distances
- Provides a visual break in the streetscape and reduces the “wide-open” appearance of the street
- Results in little impact on emergency vehicle response

Disadvantages:

- May result in only a modest speed reduction
- May result in the loss of on-street parking
- May force bicyclists to share travel lanes at the lane narrowing points

Design Considerations:

- A center island that is six feet or wider may be used to incorporate pedestrian crossing and refuge areas. The wider islands minimize crossing distances and allow pedestrians to cross only one direction of traffic at a time. If used, the pedestrian crossings can be flush with the existing pavement (with a corresponding break in the median island), or raised, such that the pedestrian crossing is level with the sidewalk.
- Center islands may incorporate vertical traffic calming measures, such as raised crosswalks, which may result in greater speed reductions and improved pedestrian crossing visibility. Additional information on vertical traffic calming measures can be found in Chapter 4.
- Skewed center islands encourage motorists to move towards the outside edge of the roadway.

- The approach edge of the center islands should be depressed in accordance with DelDOT design standards to not create a hazard for plowing operations.
- On streets with low bicycle traffic and/or low motor vehicle volumes, the probability of vehicles and bicycles meeting at the median island is sufficiently low enough to require no special accommodation of bicycles. However, at higher volumes, narrower travel lanes and at least 4-foot-wide bike lanes may need to be provided. While providing this much width is contrary to the goal of narrowing the traveled way, other visual features can be incorporated into the edge design, such as pavement striping to separate the bike lane from the travel lane, giving the appearance of a narrower cross section.
- Median islands should not be placed in front of driveways.
- On major streets and highways, markings for the islands within the roadway must meet the requirements of the MUTCD.
- Design details for median islands are shown in **Figure 3-22**.

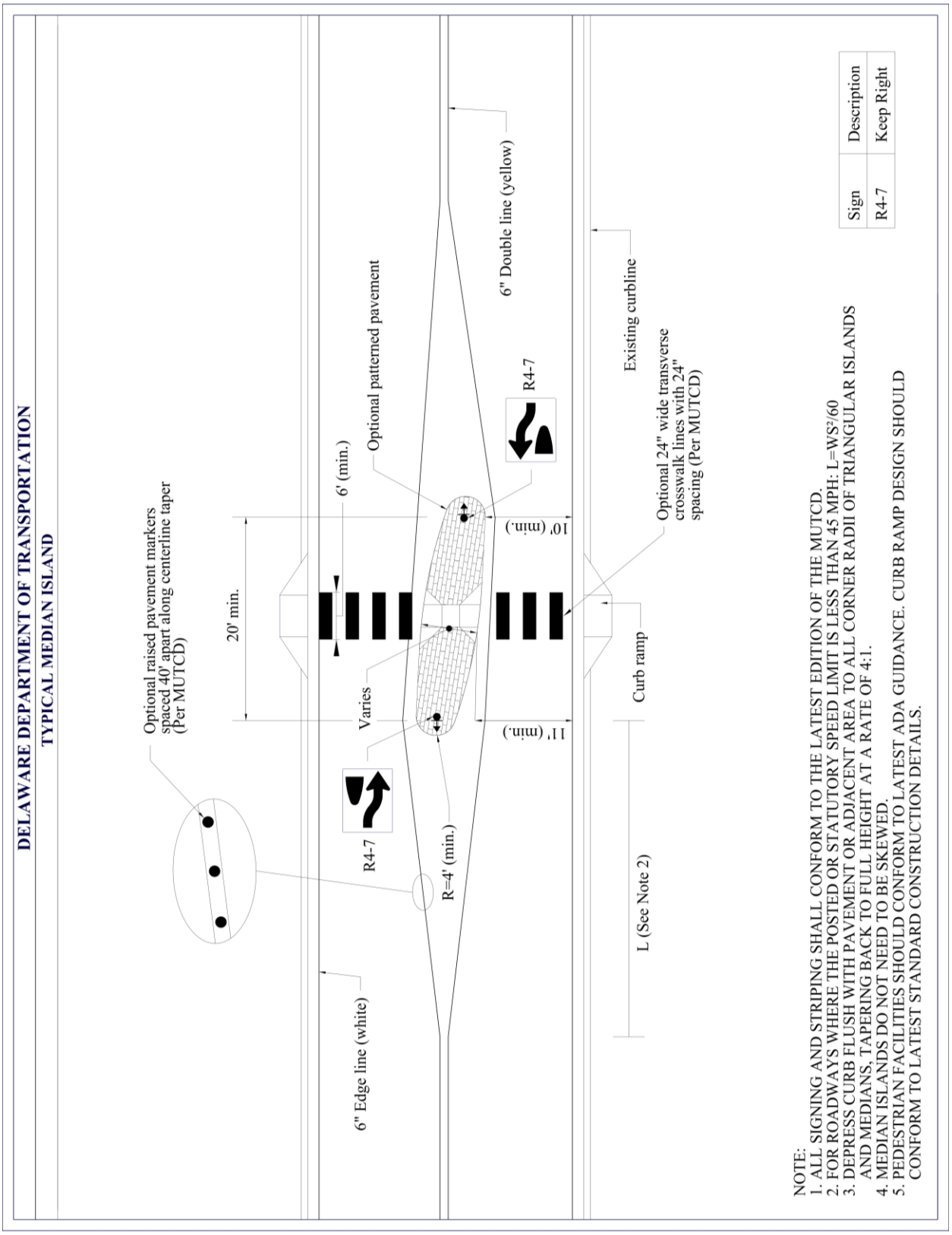


Figure 3-22. Design Details for Median Islands

3H. PARTIAL CLOSURE

Partial closures, sometimes referred to as one-way or half closures, use curb extensions or islands to block travel in one direction for a short distance on an otherwise two-way street, as shown in **Figure 3-23**. Typically, DelDOT installs partial closures primarily on subdivision streets and local roads, either restricting traffic from entering or exiting those streets (i.e., limiting the volume of traffic using the traffic calmed street). When two partial closures are placed across from one another at an intersection, the result is a semi-diverter that blocks through movement on a cross street. When islands are used to create the partial closure, a path can sometimes be constructed to accommodate bicycle and pedestrian traffic and separate them from vehicular traffic. Partial closures are not appropriate for streets that serve as transit routes in the closed direction. Care must also be taken to minimize wrong way driving through the device and studies should be undertaken to understand where diverted traffic is most likely to go to avoid secondary issues on the adjacent roadway network. Examples are shown in **Figure 3-24**.

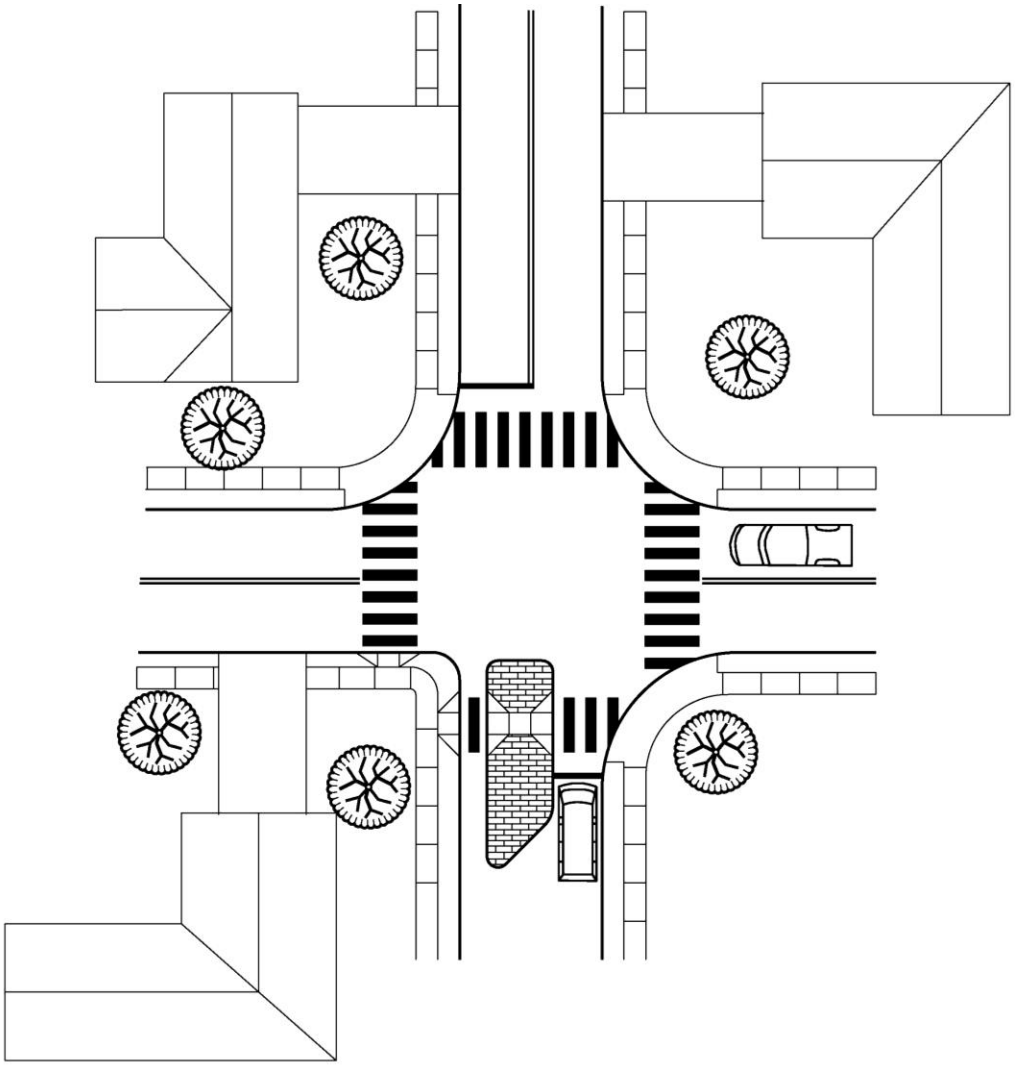


Figure 3-23. Diagram of a Partial Closure


East Loockerman Street, Dover



Source: ITE Traffic Calming State of the Practice, August 1999

Figure 3-24. Examples of Partial Closures

Application:

Types of Streets	• Appropriate for subdivision streets and local streets
Speed Limits	• Appropriate for roadways with posted speed limits of 25 MPH. May be considered on roadways with higher posted speed limits with adequate sight distances and advance warning.
Design Vehicles	• Same design vehicle used in the original street design • Not appropriate for streets that serve transit routes in the closed direction
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: Partial closures, as a standalone measure, have little effect on travel speeds.

Traffic Diversion: The primary purpose of partial closures is volume reduction, usually of cut-through vehicles. All through traffic in one direction is prevented from using the street and is diverted to parallel streets on the surrounding roadway network. Research has shown that a 40 to 60% reduction in daily traffic volume may result from the installation of diagonal diverters or partial closures[1]. Care must be taken to determine where the diverted traffic is likely to go, and analysis needs to be undertaken to ensure the resulting traffic impacts to nearby streets do not create secondary issues.

Advantages:

- Reduces volumes and cut-through traffic
- Narrows the pavement width through the closure island, which may minimally reduce speeds in the open direction
- Reduces crossing distance for pedestrians
- Provides landscaping opportunities

Disadvantages:

- May restrict access by increasing travel distance and time to some properties
- Will divert traffic to other streets and potentially through adjacent neighborhoods
- Can restrict emergency vehicle access and impact response times
- May create the potential for wrong-way travel

Design Considerations:

- Partial closures can be created by curb extensions or edge islands, and are typically used at an intersection to restrict traffic from entering a roadway, as closures placed on exiting lanes can trap vehicles and require they turn around. In cases where partial closures are placed on an exiting lane, Dead End signs should be placed far enough in advance to allow vehicles to turn at the nearest intersecting roadway.
- A full lane width should be provided in the open direction of travel and there should be sufficient curb and turning radii to allow design vehicles to make turns without encroaching onto curbs or islands.
- A 4-foot wide (typical) opening on the curb side of the closure island allows for drainage flow and permits bicyclists and pedestrians, but not motorists, to pass through the barrier in the closed direction.
- For enhanced aesthetics, the curb extension or edge island may be landscaped but must meet DelDOT standards and specifications. If landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs.
- Curb extensions or edge islands should have barrier-type curbs to discourage unauthorized vehicles from traversing them.
- Signing and pavement markings, consistent with the MUTCD, should be used at closures and diverters.
- For curb extensions or edge islands designed to deflect the path of traffic, pavement marking is required. In most cases, tapered edge striping will be sufficient to guide vehicles in the desired path around the island. However, if the curb extensions or edge islands are constructed in areas that fall outside the lane of travel, such as curb extensions within the designated shoulder or parking lane, no special pavement marking or supplemental signing will typically be required.
- Design details for partial closures are shown in **Figure 3-25**.

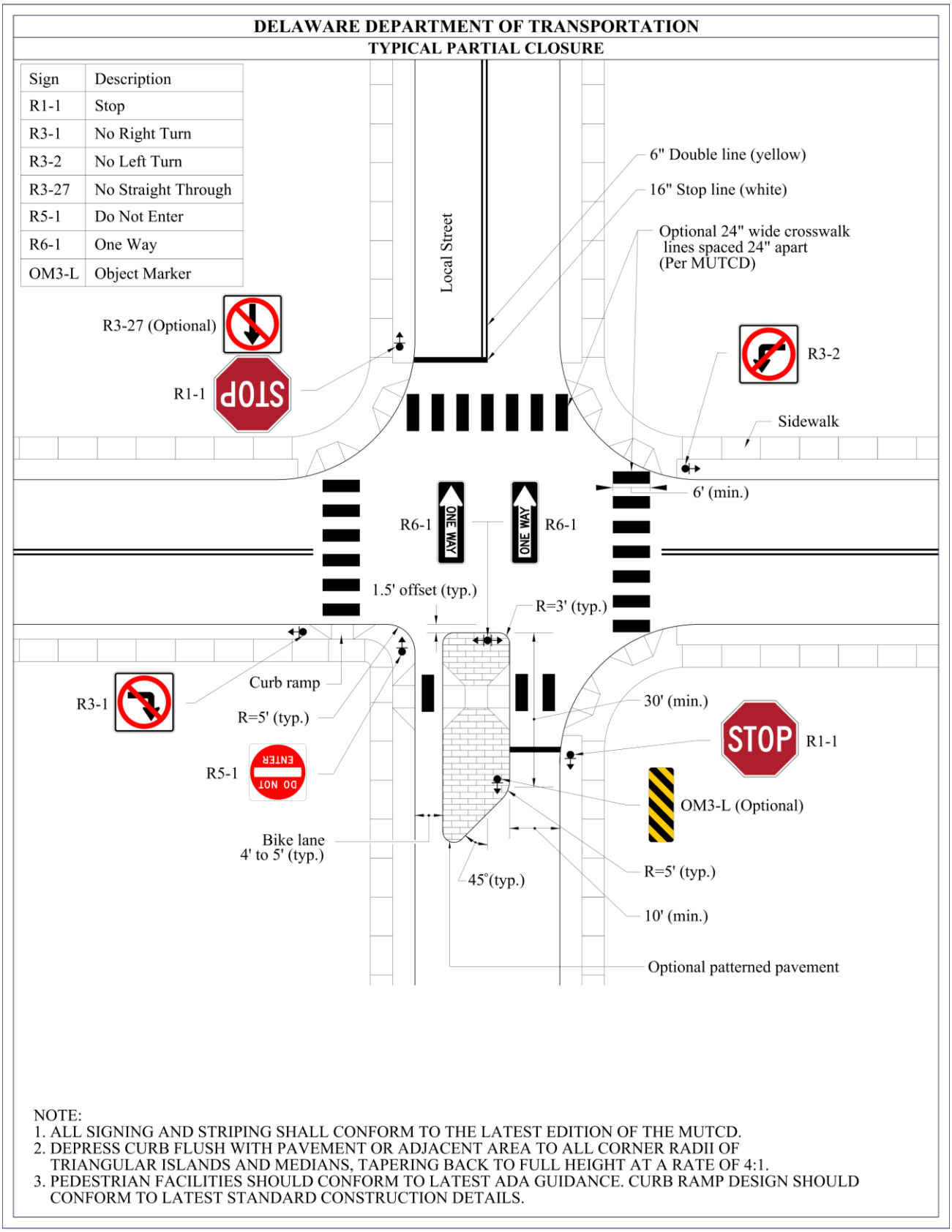


Figure 3-25. Design Details for Partial Closures

3I. ROAD DIET (ROADWAY RECONFIGURATION)

A road diet, also known as a roadway reconfiguration, is a modification of the cross section of an existing roadway, through signing and pavement markings to reduce the number of vehicular travel lanes. Bicycle facilities, dedicated turn lanes, and/or parking may be added. A typical application is the conversion of a four-lane roadway (two travel lanes in each direction) to a roadway with one travel lane in each direction, a center two-way left-turn lane, and the potential for bicycle and parking facilities. Other applications include the conversion from two travel lanes to a single lane on a one-way street to provide dedicated on-street parking and bicycle facilities. Examples of road diets are shown in **Figure 3-26**.

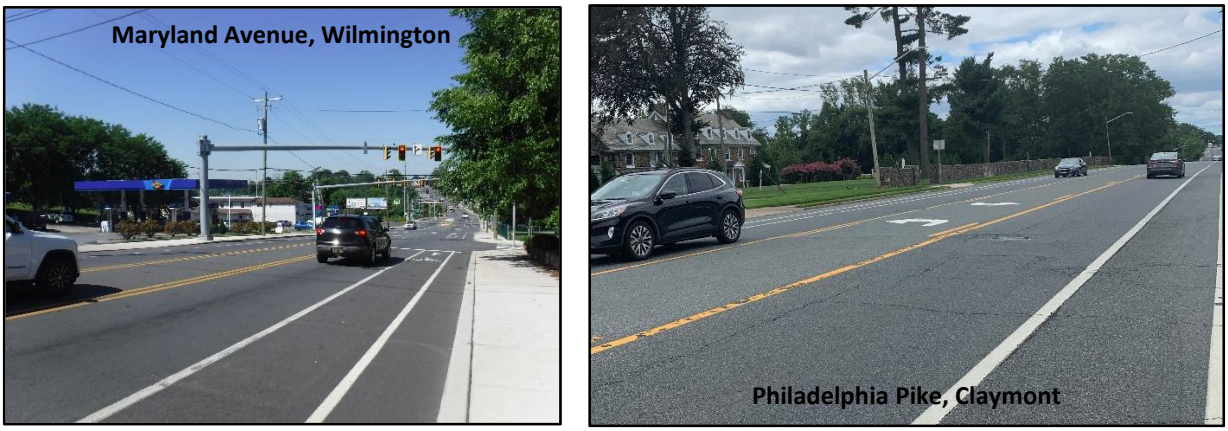


Figure 3-26. Examples of Road Diets

Application:

Types of Streets	• Appropriate for multi-lane local, collector, and arterial roadways
Speed Limits	• Appropriate for roadways with varying speed limits
Design Vehicles	• Same design vehicle as used in the original street design
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: While crash reduction and enhanced complete street environments are the primary advantages of road diets, speed reduction can also be anticipated as a result of the implementation of a road diet.

Traffic Diversion: Implementation of a road diet may result in some diversion of traffic to other parallel routes. However, a traffic review and analysis should be performed to ensure adequate capacity on the reconfigured roadway, which will likely minimize the extent of traffic diversion.

Advantages:

- Encourages reduced operating speeds through the corridor
- Increases mobility and safety for pedestrians and bicyclists

- May provide for turning lanes in the reconfigured cross section of the roadway
- May result in fewer and less severe crashes
- May provide enhanced livability and complete street opportunities

Disadvantages:

- May result in the loss of some capacity and increased congestion on the roadway
- May impact parking availability based on the cross section selected

Design Considerations:

- Per Federal Highway Administration's *Road Diet Informational Guide*[11], roadways with an AADT of 20,000 vehicles per day or less may be good candidates for consideration of a road diet, though hourly trends (peak hours) may impact the ability to implement one.
- Detailed operational studies should be undertaken prior to the design of the new cross section to ensure the needs of all users are considered and that the roadway will function at acceptable levels for all users.
- The reconfiguration of the cross section must consider defined objectives for the corridor and should include a detailed understanding of the community, traffic volumes, and needs of all motor vehicles, bicycles, and pedestrians.
- Each roadway must be considered individually as the cross section must be based upon the unique characteristics of the reconfigured roadway; therefore, there is not a singular design applicable to all road diets.
- Any loss of existing on-street parking should be carefully considered.
- Turn volumes and patterns must be assessed to determine the appropriate left turn treatments, such as two-way left turn lanes or dedicated turn lanes, to be included in the cross section.
- The transition to the modified cross section should not occur at or near major intersections or at locations where drivers must focus their attention on other complex actions.
- Design details for road diets can be found in the FHWA's *Road Diet Informational Guide*[11].

3J. DIAGONAL DIVERTERS

Diagonal diverters, as shown in **Figure 3-27**, are curb extensions or islands placed diagonally across an intersection that block through and some turning movements, creating two disconnected intersections. Diagonal diverters are sometimes referred to as full diverters and diagonal road closures. Diagonal diverters may incorporate an at-grade pass through that allows bicycles and pedestrians to navigate along the original street alignment. The islands should be signed or landscaped with vertical elements to draw motorist's attention, so that they see the measure on their approach. An example of a diagonal diverter is shown in **Figure 3-28**.

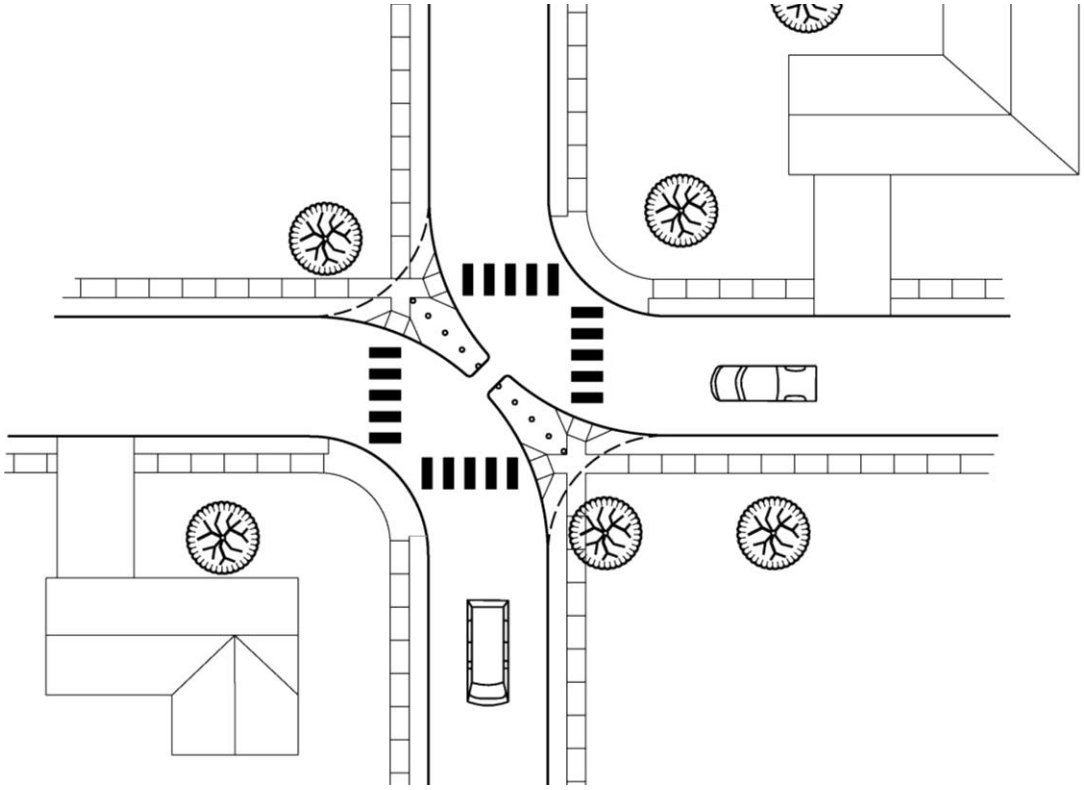


Figure 3-27. Diagram of Diagonal Diverter



Source: ITE Traffic Calming State of the Practice, August 1999

Figure 3-28. Example of Diagonal Diverter

Application:

Types of Streets	• Appropriate for subdivision, local, and collector roadways
Speed Limits	• Appropriate for roadways with posted speed limits of 25 MPH
Design Vehicles	• Same design vehicle used in the original street design • Not appropriate for streets that serve transit routes in the closed directions
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: Speed reduction may result as vehicles are forced to slow to negotiate the turns required at the intersection. The reduced speeds are expected as far as 300' on the approach and departure side of the diverter[1].

Traffic Diversion: The primary goal of a diagonal diverter is volume reduction as through vehicles are forced to take an alternate path and are redirected to parallel streets in the vicinity of the intersection. A reduction in daily traffic volume may result from the installation of diagonal diverters or partial closures and care must be taken to determine where the diverted traffic is likely to go, and what secondary impacts may result on the nearby streets and roadway network.

Advantages:

- Results in reduced volumes and cut-through traffic
- May result in reduced speeds approaching and through the intersection
- May provide landscaping opportunities

Disadvantages:

- May result in negative secondary impacts on roadways used by the diverted traffic
- Can restrict emergency vehicle access and impact response times
- Can increase travel distance and time for some trip patterns

Design Considerations:

- Diagonal diverters should maintain full lane widths, sufficient for the design vehicle throughout the diversion curves.
- Diagonal diverters should include openings (4 to 5 ft wide, typical), sufficient for bicyclists and pedestrians but not motor vehicles, to pass through.
- Diagonal diverters can be landscaped but must meet DelDOT's standards and specifications. If landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs. Where traversal by emergency vehicles is anticipated, a clear width of at least ten feet should be left free of landscaping and the traversable area should be clearly signed for emergency vehicles only. Some vertical deflection should also be used on the island to further discourage use by non-emergency personnel.
- Diagonal diverters should have barrier-type curbs to discourage unauthorized vehicles

from traversing them.

- Analysis should be undertaken to determine the impact of diverted traffic on nearby streets.
- Design details for diagonal diverters are shown in **Figure 3-29.**

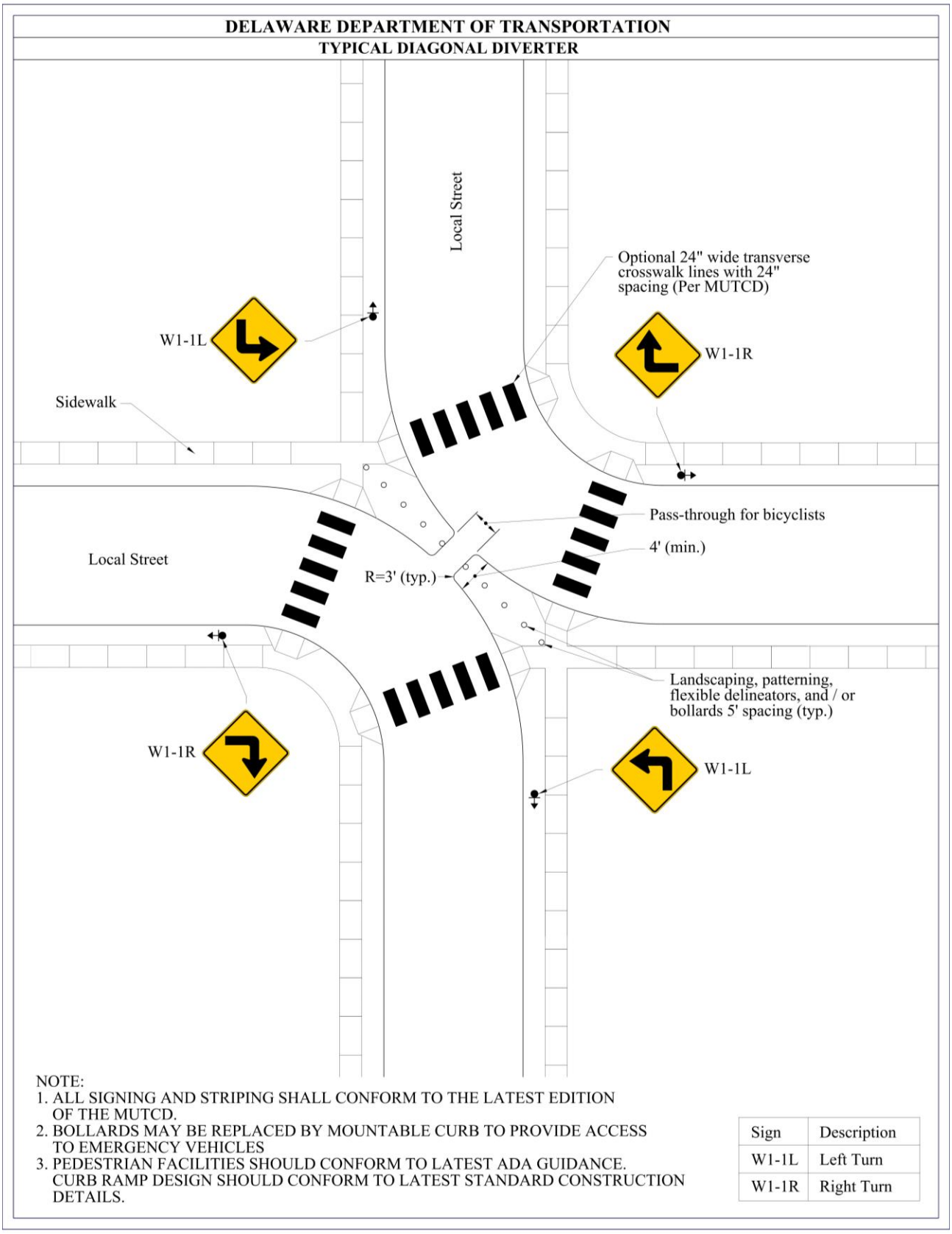


Figure 3-29. Design Details for Diagonal Diverter

3K. INTERSECTION BARRIERS

Intersection barriers, sometimes referred to as median barriers, are raised islands located along the centerline of a roadway that continue through an intersection, blocking left turn movements from the main street as well as through and left turn movements from the side streets, as shown in **Figure 3-30**. Intersection barriers differ from median islands in that they are intended to prevent turning or through movements at an intersection. Examples of intersection barriers are found in **Figure 3-31**.

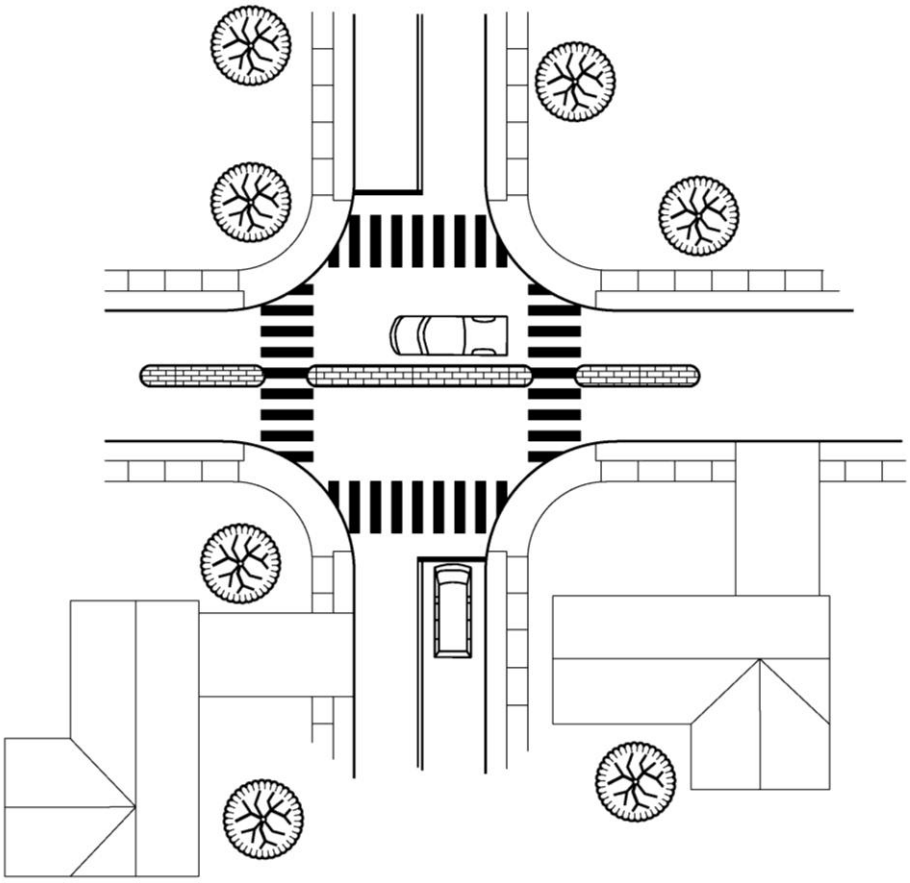


Figure 3-30. Diagram of an Intersection Barrier



Source: ITE Traffic Calming State of the Practice, August 1999



Source: ITE Traffic Calming State of the Practice, August 1999

Figure 3-31. Examples of Intersection Barrier

Application:

Types of Streets	• Appropriate for restricting access to and from subdivision streets, local and collector roadways
Speed Limits	• Appropriate for restricting access to and from roadways with posted speed limits of 35 MPH or less. May be installed along roadways with higher posted speed limits as long as adequate sight distance and advance warning is provided.
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: Speed reduction is not anticipated with the implementation of an intersection barrier.

Traffic Diversion: The primary purpose of intersection barriers is volume reduction as some through and turn movements are restricted and are redirected to surrounding streets and roadways. As such, care must be taken to determine where the diverted traffic is likely to go, and to understand if there will be secondary impacts on surrounding roadways.

Advantages:

- May reduce volumes and cut-through traffic
- May improve intersection safety by reducing the number of conflicts points (eliminating left turn and angle crashes at the intersection)

Disadvantages:

- May create secondary impacts on other streets due to the diverted traffic
- May increase travel distance and time for access to some properties
- May increase emergency response times

Design Considerations:

- Intersection barriers should take into account turning radii for the design vehicle.
- Intersection barriers should include openings of sufficient width (typically 8 feet) to allow for bicycles and pedestrians (on marked crosswalks) to pass through the barriers yet still restrict vehicles.
- Intersection barriers may be landscaped but must meet DelDOT's standards and specifications. If landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs. Where it is anticipated that emergency vehicles may traverse the barrier, a clear width of at least ten feet in width should be kept free of landscaping, and the design should include both emergency vehicles only signage and vertical deflection to further discourage use by non-emergency personnel.
- The approach edge of the center islands should be depressed in accordance with DelDOT design standards so to not create a hazard for plowing operations.

- Intersection barriers should have barrier-type curbs to discourage unauthorized vehicles from traversing them.
- Design details for intersection barriers are shown in **Figure 3-32**.

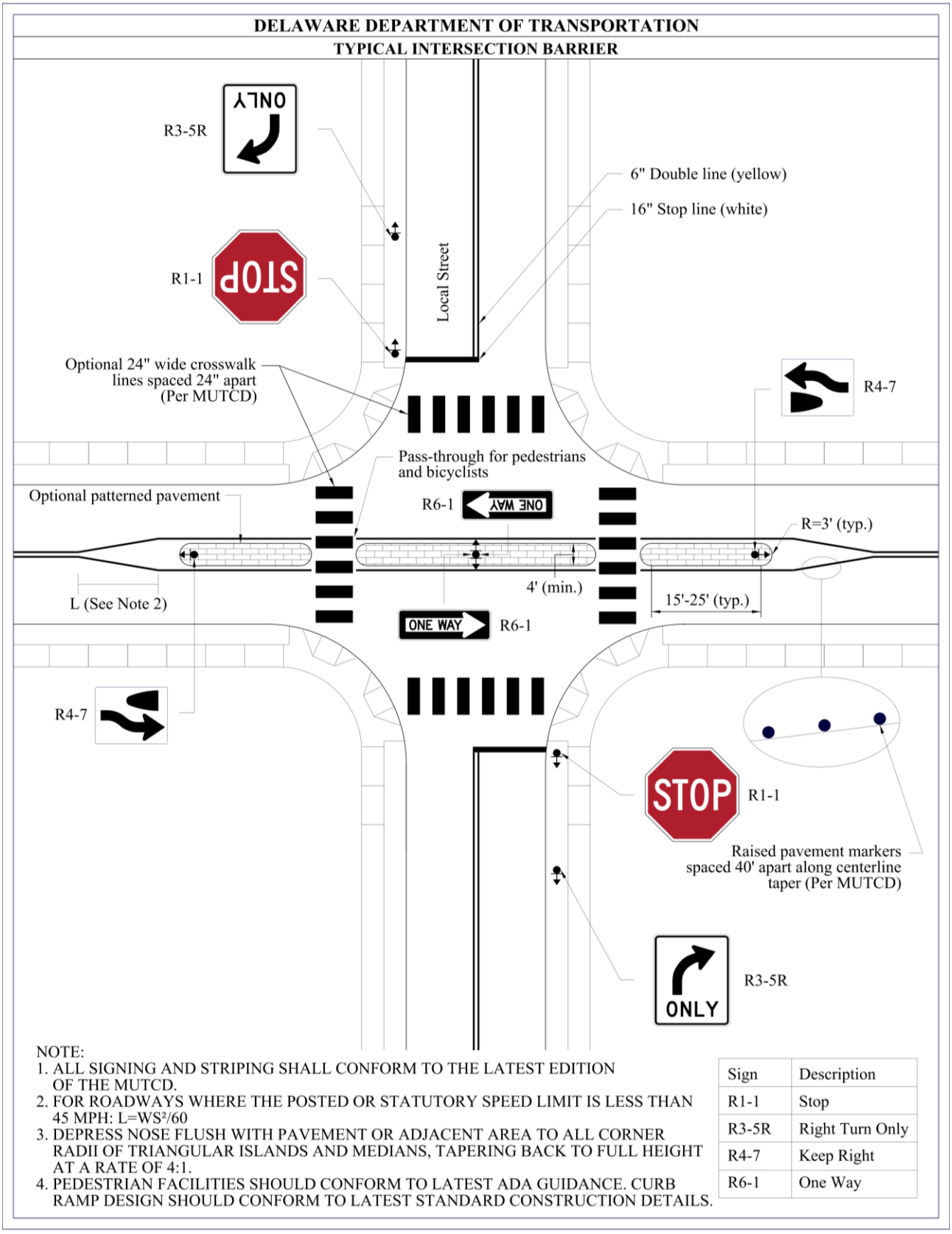


Figure 3-32. Design Details of Intersection Barrier

3L. FORCED TURN ISLANDS

Forced turn islands, as shown in **Figure 3-33**, are typically triangular shaped raised islands installed on an approach to an intersection that restricts left turn and through movements. The installation limits movements that can enter the roadway and forces all side street traffic on the approach where the island is installed to turn right. An example of a forced turn island is shown in **Figure 3-34**.

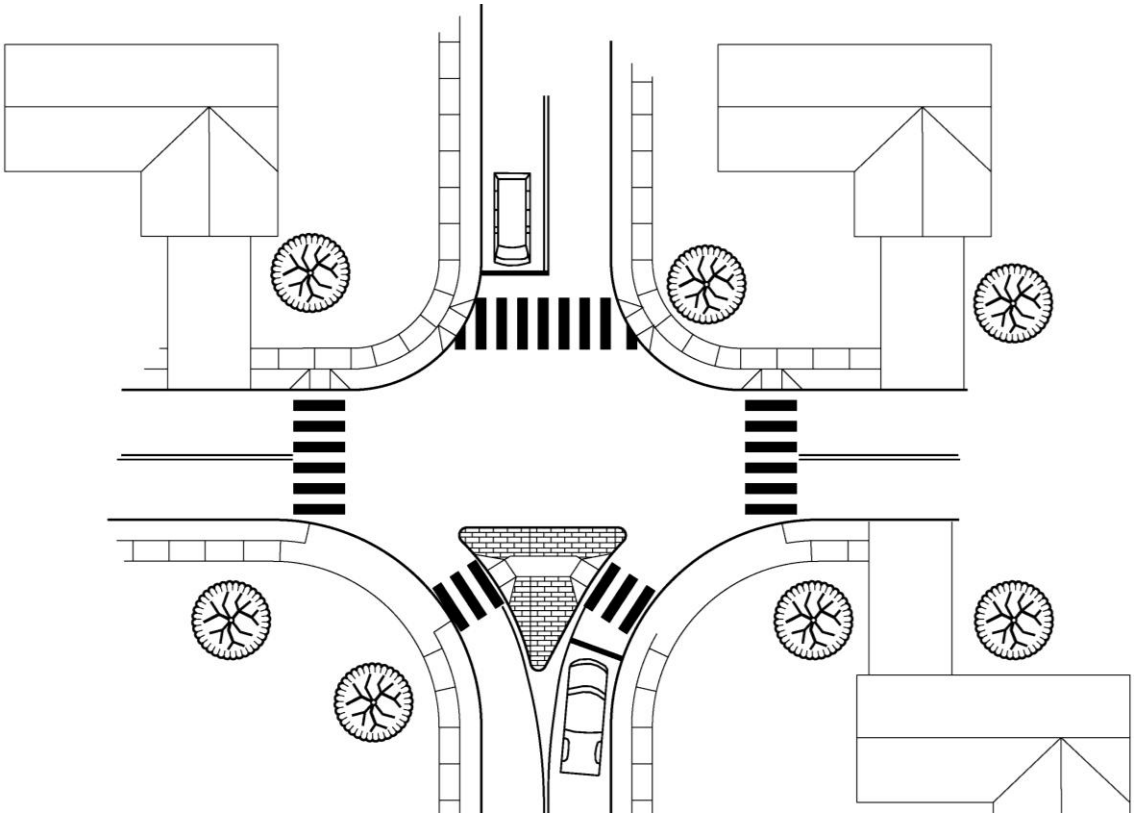


Figure 3-33. Diagram of Forced Turn Islands



Source: ITE Traffic Calming State of the Practice, August 1999

Figure 3-34. Example of Forced Turn Island

Application:

Types of Streets	• Appropriate for restricting access to and from subdivision streets, local and collector roadways
Speed Limits	• Appropriate for restricting access to and from roadways with posted speed limits of 35 MPH or less. May be installed along roadways with higher posted speed limits as long as adequate offset is provided to the forced turn island.
Design Vehicles	• Same design vehicle as used in the original street design
Street Grades	• Grades are not typically a controlling factor, as long as adequate stopping sight distance is provided

Anticipated Impacts:

Speed: Speed reduction is not the primary purpose of the forced turn island, though some minor speed reduction may be achieved as vehicles slow to navigate the right turn movements.

Traffic Diversion: The primary goal of a forced turn island is volume reduction, usually of cut-through vehicles by restricting certain movements and redirecting traffic to other routes. Analysis must be undertaken to determine where this diverted traffic is likely to go in order to understand the potential impacts to nearby streets.

Advantages:

- May reduce volumes and cut-through traffic
- May provide pedestrian refuge and reduced crossing distances for the approach with the forced turn island
- Reduces the number of potential conflict points; may improve overall intersection safety

Disadvantages:

- May result in increases to travel distance and time for some properties
- May negatively impact emergency response times
- May result in secondary impacts to other streets as a result of the diverted traffic

Design Considerations:

- Forced turn islands should take into account vehicle turning radii to accommodate the design vehicle.
- The design of forced turn islands should incorporate input from responding fire and emergency medical service providers.
- Forced turn islands may be landscaped but must meet DelDOT's standards and specifications. If landscaping is used, preference should be given to low-lying, slow growing, hardy plants to maintain adequate sight lines and minimize maintenance costs.
- Forced turn islands should be designed with sufficient area and deflection to discourage wrong-way movements.
- Design details for forced turn islands are shown in **Figure 3-35**.

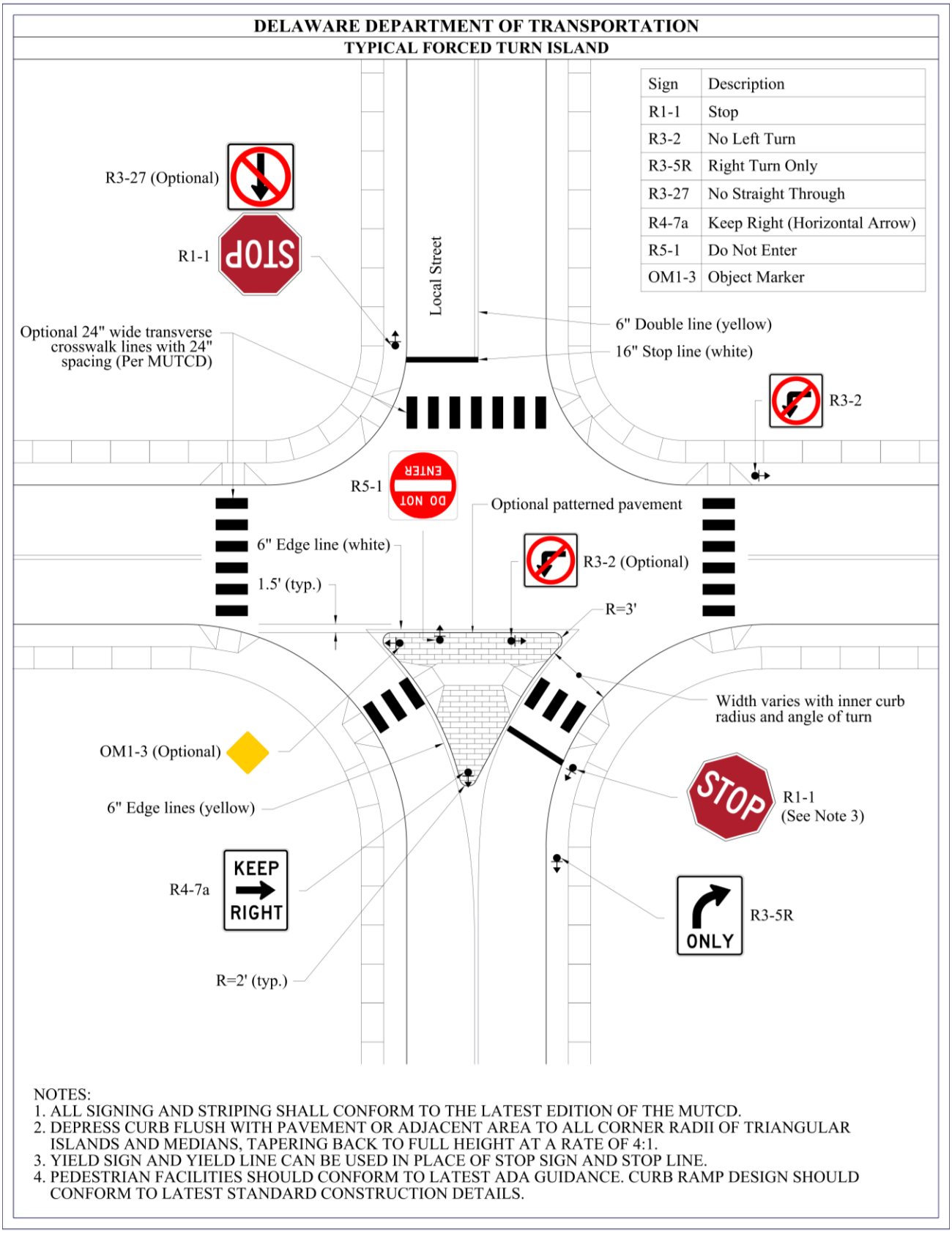


Figure 3-35. Design Details of Forced Turn Island

CHAPTER 4
VERTICAL MEASURES

Vertical traffic calming measures are designed to reduce vehicle speeds by altering the pavement elevation, or profile, over short distances to cause a degree of discomfort for motorists if they travel at speeds higher than the speed for which the vertical measure was designed. Vertical measures are typically less than 6 inches in height at the centerline of the roadway, and most are between 3 inches and 4 inches high. Vertical measures are typically between 12 and 30 feet in length in the direction of travel, and often span the full width of the roadway. Depending on the length over which the vertical change is made, some low-profile vehicles may "bottom out" when crossing the vertical measure at an excessive speed. In locations used by transit, emergency vehicles, bicycles, and other vulnerable users (people walking, biking, or rolling; as well as highway workers on foot in a work zone), care needs to be taken during the planning and design process to ensure that all users are adequately accommodated. Vertical measures can be used as standalone applications or as part of a series of traffic calming measures, including in combination with horizontal traffic calming measures.

The selection of appropriate vertical traffic calming measures is based on multiple criteria, as outlined in the eligibility flow chart shown in **Figure 4-1**. The evaluation criteria include snow removal route responsibility and designation, functional classification, AADT, posted speed limit, prevalence of speeding, and pedestrian/bicyclist safety. Where vulnerable road user connections exist, raised crosswalks, and raised intersections should be prioritized over speed humps, speed tables, and speed cushions. Future traffic volumes and truck percentages should also be considered during the selection and design of vertical measures.

The remainder of this chapter presents specific guidance on the selection, geometric details, signing, and pavement markings, for a wide variety of vertical traffic calming measures. All vertical traffic calming measures outside of subdivisions should be clearly marked with signage and pavement markings so that roadway users are alerted to their presence and reduce their speeds appropriately. On subdivision streets, advance pavement markings shall not be used, and warning signs should not be installed. It should be noted that the guidance outlined in the latest version of the MUTCD adopted by DelDOT should always be considered. Additionally, proposed traffic calming measures that incorporate pedestrian facilities and existing pedestrian facilities that are impacted by a traffic calming project shall be designed and constructed in accordance with DelDOT's current accessibility standards.

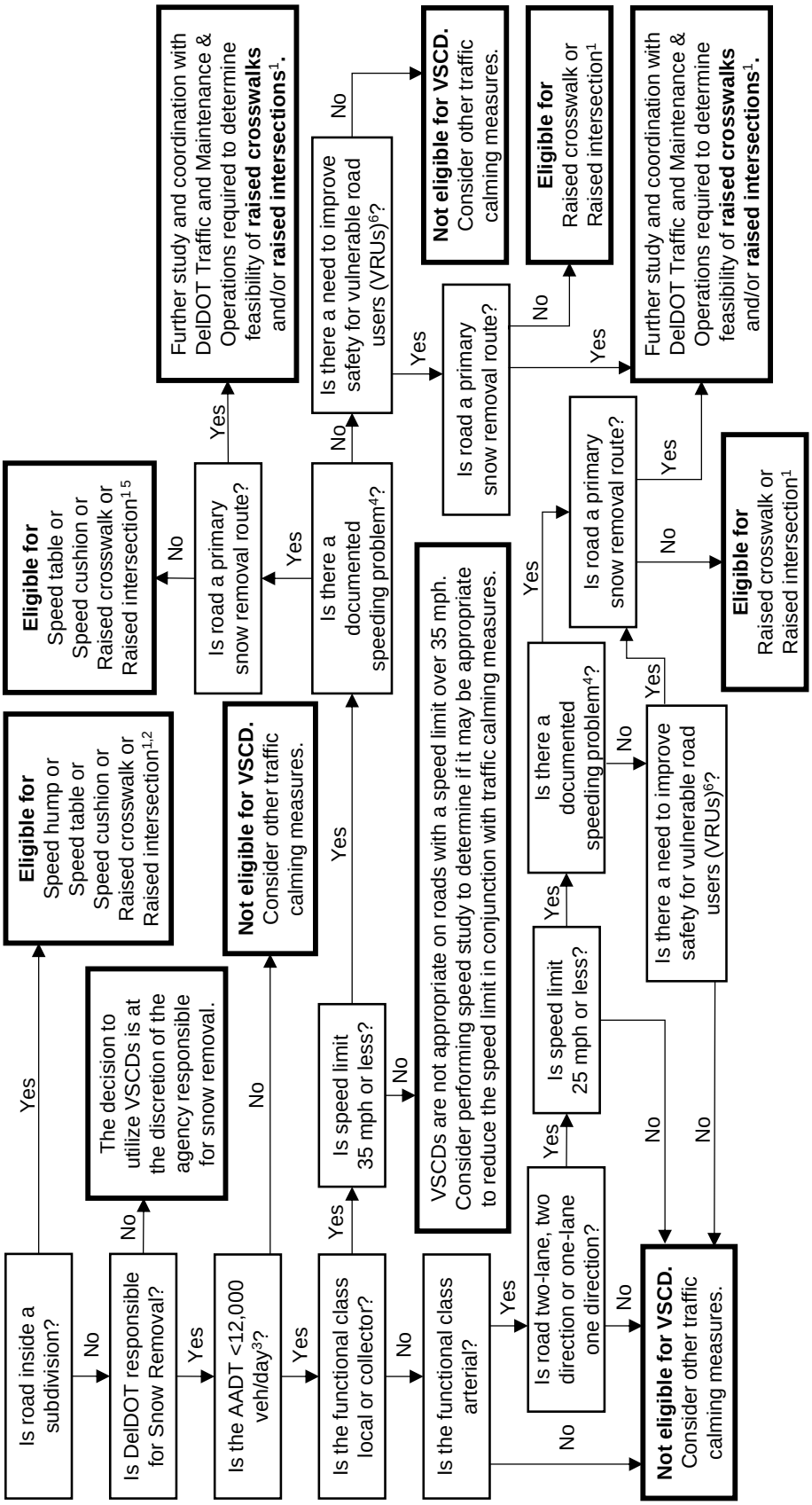


Figure 4-1. Vertical Speed Control Devices Eligibility Flow Chart

4A. SPEED HUMP

Speed humps, as shown in **Figure 4-2**, are elongated mounds installed across the travel way, perpendicular to the direction of travel. Typically, speed humps are 3-to-4 inches high, parabolic in shape, 12 feet in length (in the direction of travel) and span the full width of the traveled way. Speed humps differ from speed bumps, which are typically 6 inches in height, and 1 to 2 feet in length[1]. Speed bumps are not installed on state-maintained roadways. To reduce speeds over a longer distance, a series of speed humps can be installed. ITE's *A Guide to Vertical Deflection Speed Reduction Techniques* recommends a spacing of 250' to 500' for a series of speed humps to be effective[13]. The guidelines further recommend that speed humps should not be installed on "horizontal curves with less than a 200-foot centerline radius or with less than the minimum stopping sight distance"[13]. More information about the installation and maintenance of Speed Humps is found in the Speed Hump FAQs on DelDOT's website. Examples of speed humps are shown in **Figure 4-3**.

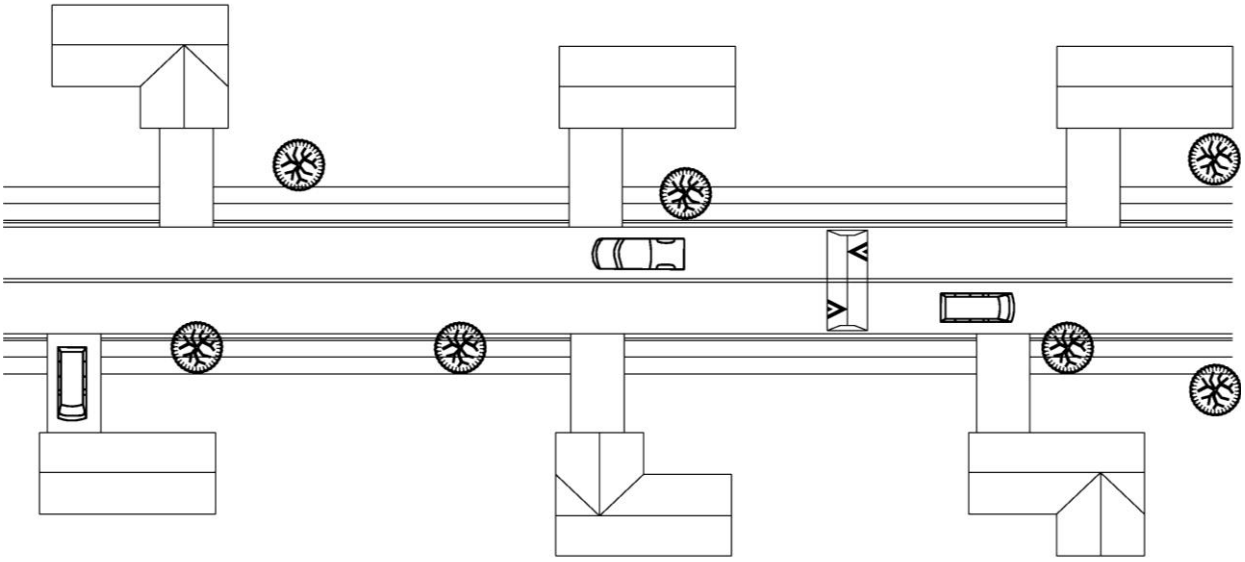


Figure 4-2. Diagram of a Speed Hump

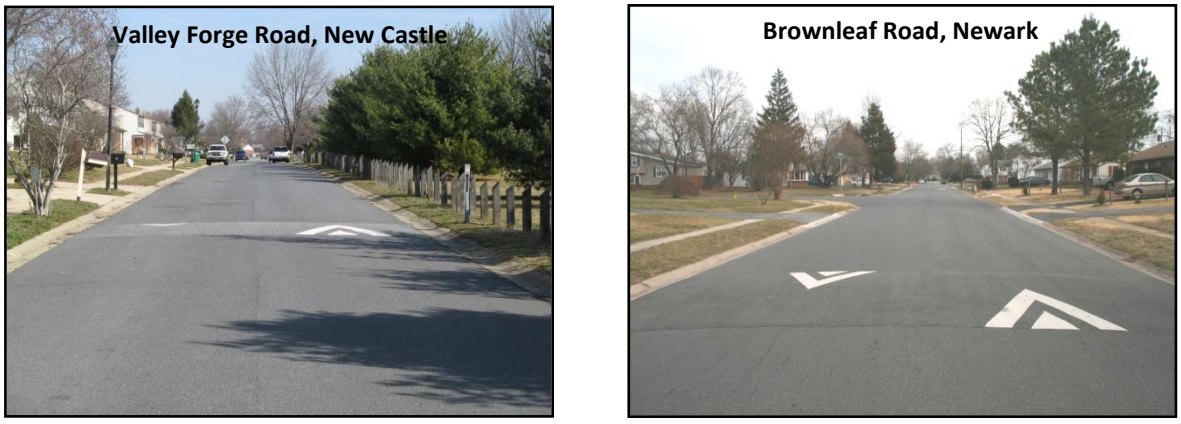


Figure 4-3. Examples of Speed Humps

Application:

Types of Streets	• Appropriate for subdivision streets and local roads inside subdivisions
Speed Limits	• Appropriate on roadways with posted speed limits of 25 MPH
Design Vehicles	• Same design vehicle used in the original street design
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Safety: Crash reductions between 33 and 48 percent were reported in a meta-study summarizing five field studies, which collectively included 51 sites[14].

Speed: Vertical deflection encourages motorists to reduce their speeds through the sections of the street where speed humps are located. Speed humps generally have a design crossing speed of 15 to 20 MPH for automobiles, while larger vehicles, including emergency service vehicles, typically cross at lower speeds[1]. Before and after data from previous studies show a 6 to 13 MPH reduction in the 85th percentile speed as a result of speed humps[3]. However, speed reduction effects decline at approximately 0.5 to 1 MPH for every 100 feet beyond the 200-foot approach and exit of a speed hump[1]. Installation of a series of speed humps along several blocks tends to yield the greatest speed reduction benefits.

Traffic Diversion: Individual speed humps are not expected to contribute to traffic diversion. However, a series of speed humps may contribute to the diversion of traffic from a street. Data from previous studies show an average drop in traffic volume of approximately 20 percent following the construction of a series of speed humps[1]. The amount of traffic diversion will depend on the amount of speed reduction, the increased travel time for non-local traffic, and the availability and attractiveness of alternative routes.

Advantages:

- Documented speed reduction for passenger vehicles
- May reduce cut-through traffic volumes
- Relatively low implementation cost

Disadvantages:

- Emergency response time may be affected. Approximate delay of between 3 and 5 seconds per hump for fire trucks and up to 10 seconds for an ambulance with a patient[1]
- Potential increased noise due to vehicle braking and accelerating and the vibration of loose items in truck beds or trailers
- May divert traffic to other streets
- May impact snow plowing operations
- May result in some motorists speeding between speed humps to make up for perceived lost time

Design Considerations:

- A single speed hump installed in isolation reduces speeds locally; however, the speed reduction typically diminishes beyond the hump. Therefore, to reduce speeds over a longer distance, multiple speed humps should be installed, with a typical spacing of 250 to 500 feet[13].
- Speed humps should not be installed on steep grades or horizontal curves with less than a 200-foot centerline radius or with less than the minimum stopping sight distance[13].
- Speed humps are typically designed with sides that taper off at the gutter for drainage. This design may be modified to end the taper further from the gutter to create a bypass bicycle lane. This design has the advantage of providing a wide, flat surface for bicyclists, but may encourage other vehicles to encroach on the bicycle lane at the speed hump to ride with one wheel on and one wheel off the speed hump.
- Pavement markings (striping, arrows, etc.) should be added to increase visibility of the speed hump in accordance with the MUTCD, providing a warning to drivers of their presence.
- White object markers or delineators should be installed at each speed hump. These devices are useful in identifying the traffic calming measure for snowplows and for motorists when the road is covered with snow. White object markers and delineators are also useful on road sections without curbs to prevent motorists from veering off the roadway to avoid the vertical traffic calming measure.
- Prefabricated speed humps should not be used as a permanent device. Prefabricated speed humps may be used as a temporary implementation or trial measure only if the outside entity requesting them agrees to maintain them through a Right-Of-Way Use Agreement. Any temporary or trial measure should match permanent design characteristics.
- This manual outlines the current speed hump design. However, the current Standard Construction Details should also be referenced.
- **Figure 4-4** shows design details for speed humps, including advance markings which may be used as a supplement to pavement markings and signs, object markers, or delineators at the speed hump.

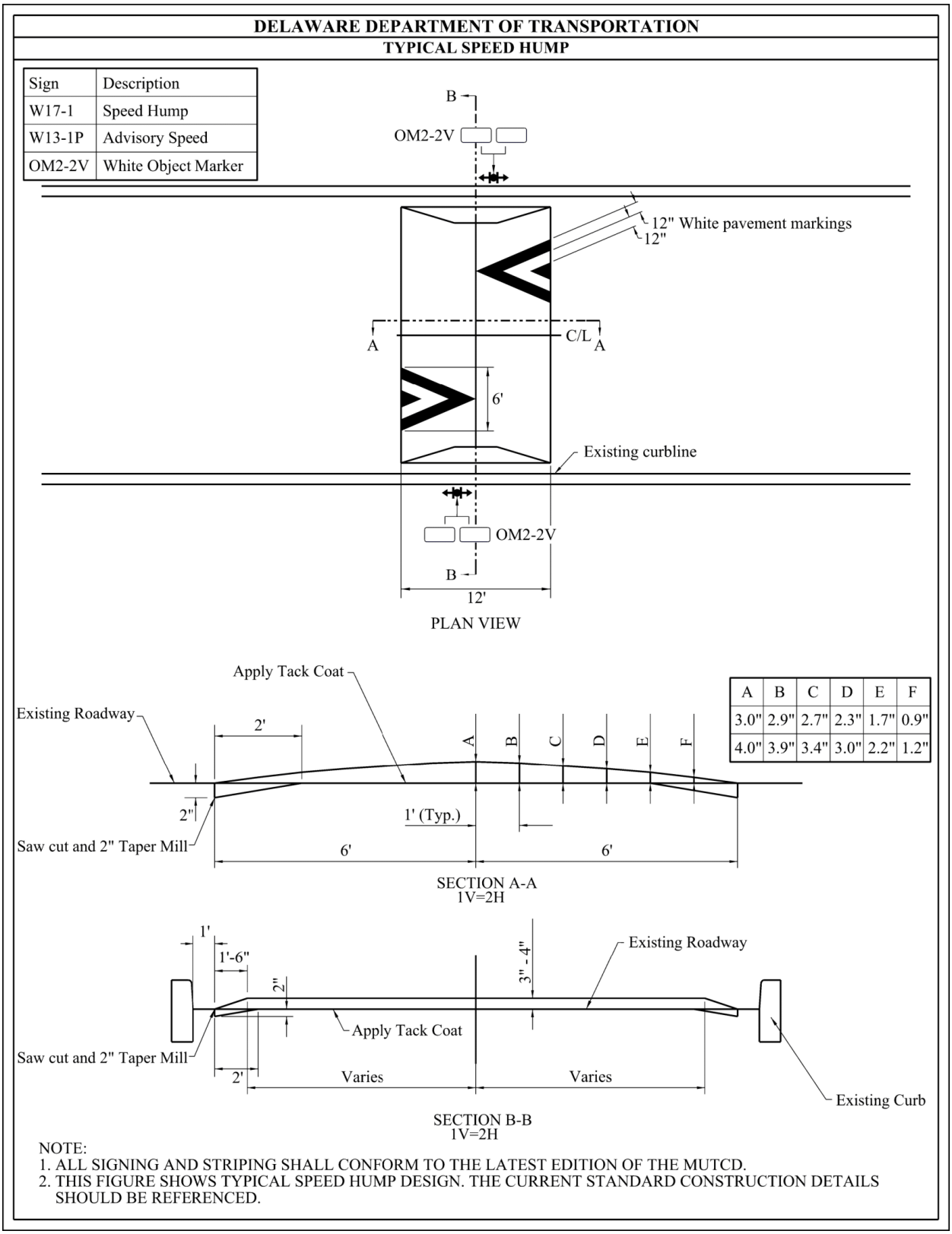


Figure 4-4. Design Details for Speed Humps

4B. SPEED CUSHION

Speed cushions are similar to speed humps, except that they have gaps, often referred to as "cutouts," that allow some vehicles with wide axles (primarily emergency vehicles and transit vehicles) and bicycles to pass by without any vertical deflection. The cutouts in the speed cushions are positioned such that a passenger vehicle cannot pass it without traveling over a portion of the raised pavement, while bicycles and wider vehicles such as emergency vehicles and transit vehicles can pass relatively unimpeded. Like speed humps, speed cushions are typically parabolic in shape, 3 inches high, and 12 feet long, but unlike speed humps they contain a level area on top of the cushion. The profile of a speed cushion is gentle enough to provide a comfortable ride when traversed at a speed of approximately 15 to 20 MPH[1]. At higher speeds, it becomes more uncomfortable for motorists to drive over the speed cushion. To reduce speeds over a longer distance, a number of speed cushions should be installed, with a typical spacing of 250 to 500 feet[13]. An example of a speed cushion is shown in **Figure 4-5**.



Source: City of Alameda Traffic Calming Toolbox, February 18, 2003

Figure 4-5. Example of Speed Cushion (Without Required Striping)

Application:

Types of Streets	• Appropriate for subdivision streets, local, and collector roadways
Speed Limits	• Appropriate on roadways with posted speed limits of 35 MPH or less • Typically installed on roadways with a posted speed limit of 25 MPH
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Speed reduction is the goal in the construction of speed cushions. Vertical deflection encourages motorists to reduce their speeds through the sections of the street where there are speed cushions. Speed cushions have a design crossing speed of 15 to 20 MPH for automobiles, while emergency vehicles can straddle the speed cushions at higher speeds[1].

Traffic Diversion: Speed cushions may contribute to the diversion of traffic from a street. The amount of traffic diversion will depend on the amount of speed reduction, the increased travel time for non-local traffic, and the availability and attractiveness of alternative routes. As with other traffic calming applications, using speed cushions in a series along several blocks, or as one measure within a series of traffic calming measures, will likely be more effective in diverting unwanted traffic from a street.

Advantages:

- Documented speed reduction for passenger vehicles
- Minimal impact to emergency response compared to other vertical traffic calming measures
- Transit and bicycle friendly
- May reduce cut-through traffic volumes

Disadvantages:

- Speed reductions for passenger cars may not be quite as high as with speed humps because the speed cushion allows motorists to drive over them with one wheel up and one wheel down
- Potential increased noise due to vehicle braking and accelerating and the vibration of loose items in truck beds or trailers
- May divert traffic to other streets
- May impact snow plowing operations
- May cause some motorists to speed up between speed cushions

Design Considerations:

- Speed cushions may be an appropriate speed reduction treatment on roadways where there are concerns about emergency vehicle access and/or transit vehicles, as an alternative to speed humps.
- Speed cushions are typically designed with sides that taper off at the gutter for drainage. This design may be modified to end the taper further from the gutter to create a wide, flat surface for a bicycle bypass lane, if desired.
- Pavement markings (striping, arrows, etc.) should be added to the speed cushion to increase visibility and warn drivers of their presence.
- Pavement markings approaching and on the vertical traffic calming measure itself should be supplemented with signs, white object markers, or delineators. These devices are useful in identifying the traffic calming measure for snowplows and for motorists when the road is covered with snow. Signs, white object markers, or delineators are also useful on road sections without curbs to prevent motorists from veering off the roadway to avoid the vertical traffic calming measure. Alternatively, for some installations the location of the vertical traffic calming measure may be marked with appropriate landscaping or decorative bollards.
- Advance markings may be used to supplement the marking on the vertical traffic calming measure; however, advance pavement markings shall not be installed within subdivisions.

- Outside subdivisions, all speed cushions should include advance W17-1 “Speed Hump” signs in addition to an advisory speed plaque. However, if installed in a series, the advisory speed plaque may be omitted on all but the first W17-1 sign in the series.
- Within subdivisions, advance warning signs and advisory speed plaques should not be installed. However, object markers should be installed at all speed cushion locations.
- A “Raise Plow” plaque may be used to warn vehicles equipped with a snowplow of a hazard in the roadway. If used, the “Raise Plow” plaque shall be used in conjunction with other vertical measure signs; it shall not be mounted or displayed alone.
- Typical construction material for a speed cushion is asphalt, although prefabricated speed cushions are available.
- Prefabricated speed cushions should not be used as a permanent device. Prefabricated speed cushions may be used as a temporary implementation or trial measure only if the outside entity requesting them agrees to maintain them through a Right-Of-Way Use Agreement. Any temporary or trial measure should match permanent design characteristics.
- **Figure 4-6** and **Figure 4-7** show design details for speed cushions, including advance markings which may be used as a supplement to pavement markings and signs, object markers, or delineators at the speed cushion.

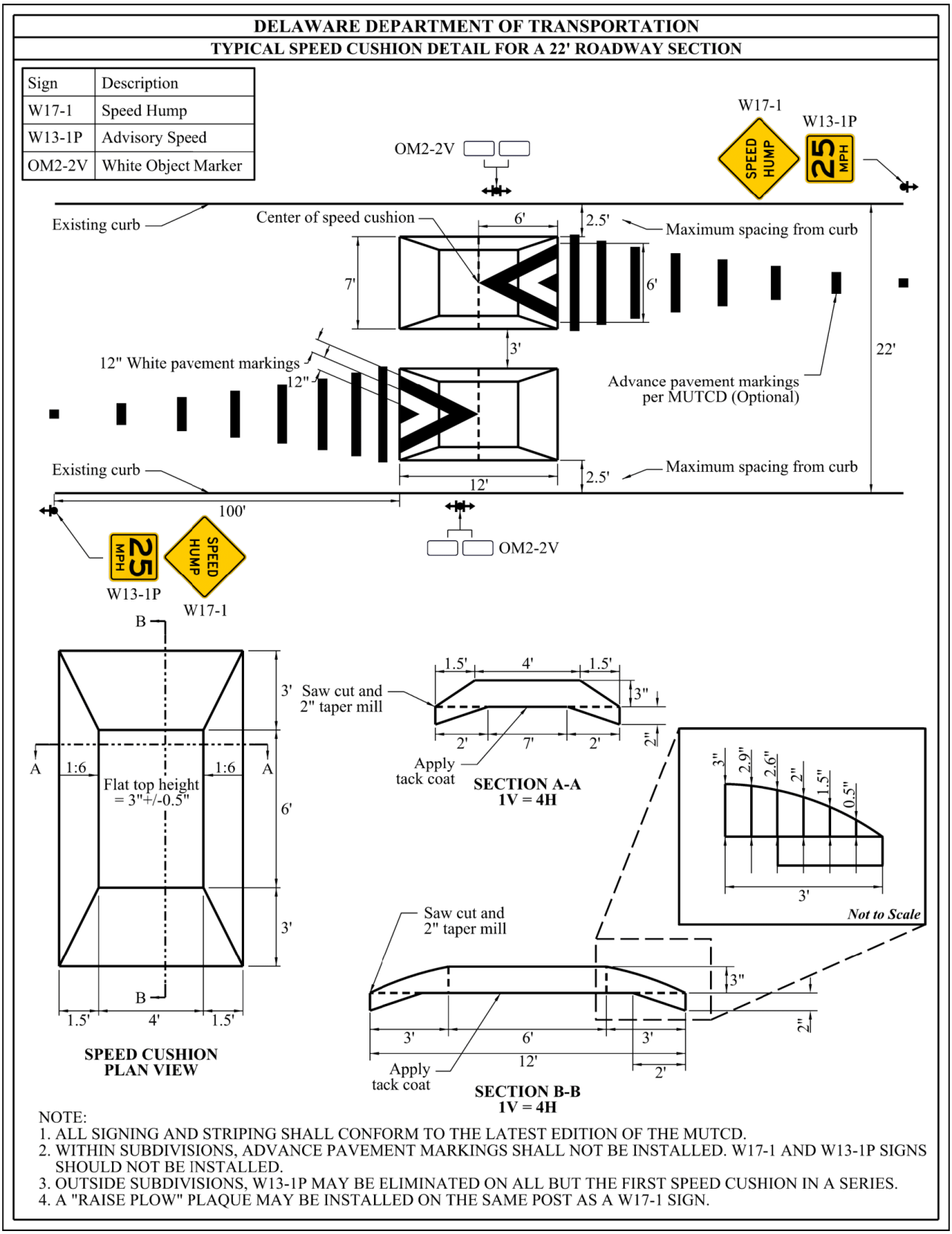
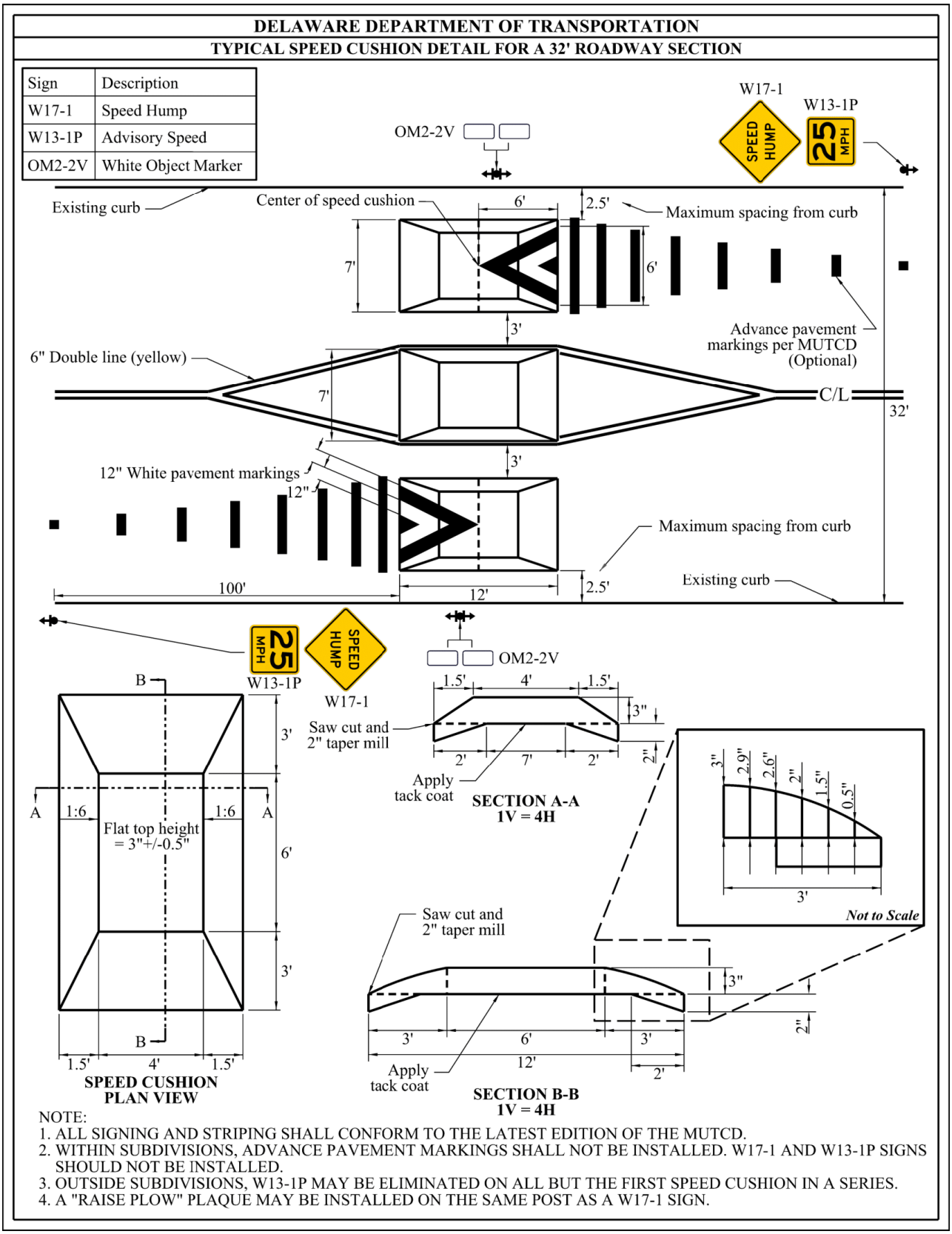


Figure 4-6. Design Details for Speed Cushions On 22' Roadway



NOTE:
1. ALL SIGNING AND STRIPING SHALL CONFORM TO THE LATEST EDITION OF THE MUTCD.
2. WITHIN SUBDIVISIONS, ADVANCE PAVEMENT MARKINGS SHALL NOT BE INSTALLED. W17-1 AND W13-1P SIGNS SHOULD NOT BE INSTALLED.
3. OUTSIDE SUBDIVISIONS, W13-1P MAY BE ELIMINATED ON ALL BUT THE FIRST SPEED CUSHION IN A SERIES.
4. A "RAISE PLOW" PLAQUE MAY BE INSTALLED ON THE SAME POST AS A W17-1 SIGN.

Figure 4-7. Design Details for Speed Cushions On 32' Roadway

4C. SPEED TABLE / RAISED CROSSWALK

Speed tables/raised crosswalks, as shown in **Figure 4-8**, are similar in nature to speed humps. In contrast to speed humps, speed tables/raised crosswalks are typically 22-feet long (in the direction of travel) and include a 10-foot long flat section on top in the middle of the device.

When a speed table is designated as a crosswalk through the use of striping or pavers, it is known as a raised crosswalk. While a 3-inch height is preferable, raised crosswalks can be higher than a speed hump, to ensure that they are level with the adjacent sidewalk/curb. Raised mid-block crosswalks may be an appropriate treatment to lower vehicle travel speeds and prioritize vulnerable road users over other modes where vulnerable users enter the street. It should be noted that mid-block crossings should only be considered when the nearest intersection is a considerable distance away. Examples of raised crosswalks are shown in **Figure 4-9**.

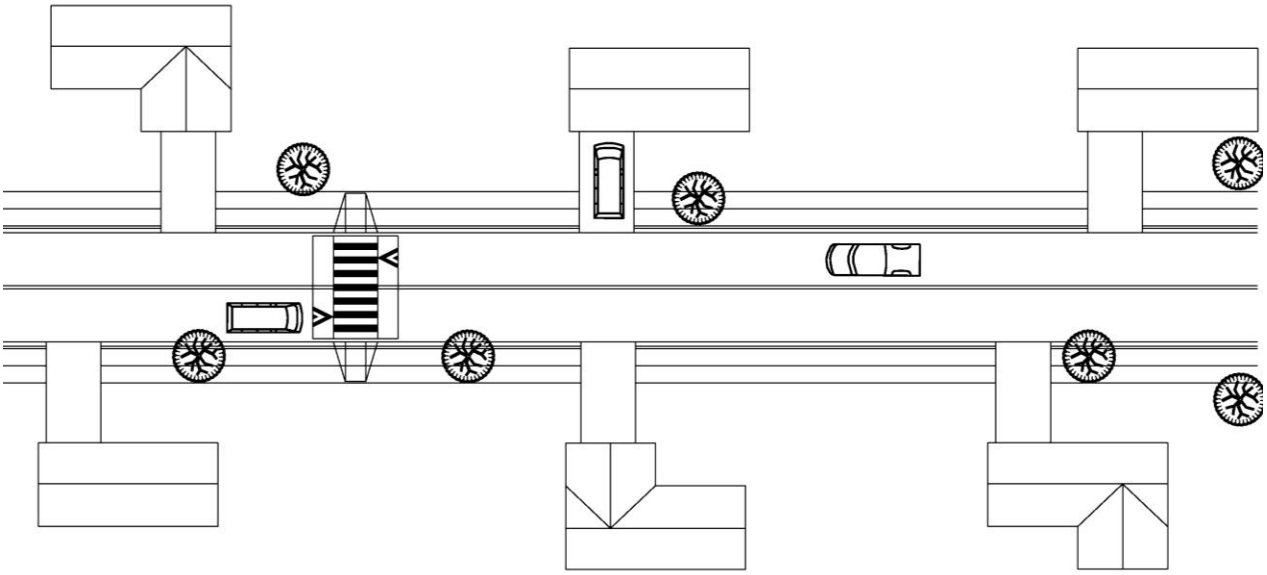


Figure 4-8. Diagram of a Raised Crosswalk





Figure 4-9. Examples of Raised Crosswalks

Application:

Types of Streets	• Appropriate for subdivision streets, local, and collector roadways • May be considered on single-lane arterial roadways with speed limits of 25 MPH or less
Speed Limits	• Appropriate for roadways with posted speed limits of 35 MPH or less
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Speed tables/raised crosswalks have a design crossing speed of 25 to 35 MPH for automobiles, while larger vehicles typically cross at lower speeds[1]. Before and after data from previous studies show a 4 to 11 MPH reduction in the 85th percentile speed as a result of speed humps, raised crosswalks and speed tables[3]. However, studies also indicate that travel speeds generally increase by approximately 0.5 to 1 MPH for every 100 feet of additional spacing between speed humps, raised crosswalks and speed tables (beyond 200 feet)[1].

Traffic Diversion: Speed tables/raised crosswalks may cause traffic to divert to other routes, especially when used in a series or in combination with other traffic calming devices.

Advantages:

- Documented speed reduction for passenger vehicles
- May reduce cut-through traffic volumes
- Improves safety for vulnerable road users, facilitates crossing by elderly/persons in wheelchairs, increases visibility of vulnerable road users, and prioritizes vulnerable road users over other modes

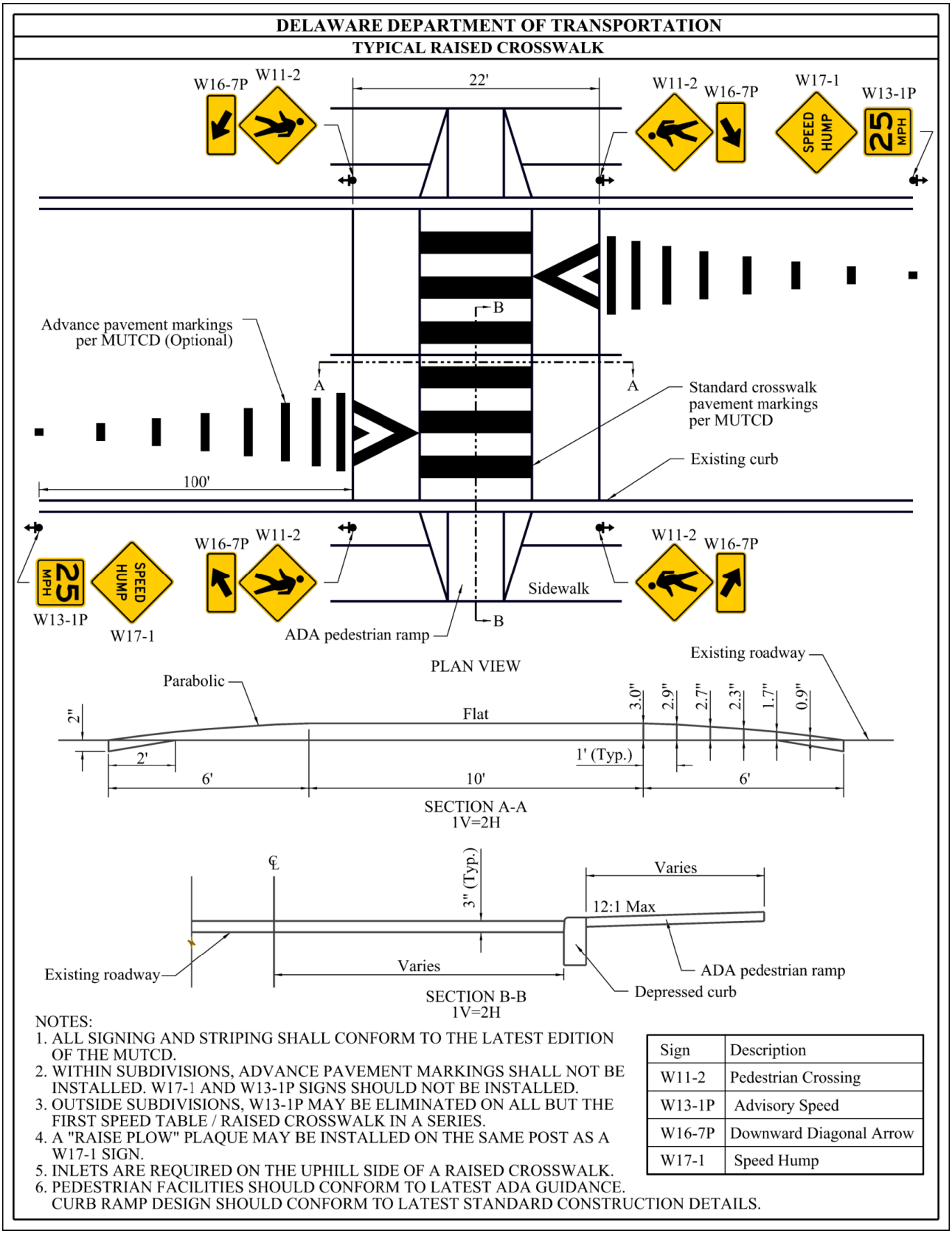
Disadvantages:

- Emergency response time may be affected; however, there is typically less delay than for a speed hump and a less jarring effect on emergency vehicles
- Potential increased noise due to vehicle braking and accelerating and the vibration of loose items in truck beds or trailers
- May impede bicyclists due to the changes in vertical grades
- May divert traffic to other streets
- May impact snow plowing operations

Design Considerations:

- Speed tables/raised crosswalks should not be installed on steep grades or on sharp curves.
- Where possible, raised crosswalks are preferred to speed tables to provide vulnerable road user connectivity. Outside of subdivisions, speed tables/raised crosswalks should incorporate existing or future pedestrian facilities.
- DelDOT should coordinate with transit and emergency service providers to ensure the speed table/raised crosswalk will not substantially impact their operations.

- For raised crosswalks, the longitudinal drainage taper should be eliminated to form a level crossing. As a result, drainage needs to be accommodated near curbed edges using devices such as a trench drain with accessible grates.
- Color contrasts and detectable warning truncated domes should be used at transitions to enable vulnerable road users with vision impairments to detect the crossing.
- Pavement markings approaching and on the vertical traffic calming measure itself should be supplemented with signs, white object markers, or delineators. These devices are useful in identifying the traffic calming measure for snowplows and for motorists when the road is covered with snow. Signs, white object markers, or delineators are also useful on road sections without curbs to prevent motorists from veering off the roadway to avoid the vertical traffic calming measure. Alternatively, for some installations the location of the vertical traffic calming measure may be marked with appropriate landscaping or decorative bollards.
- A "Raise Plow" plaque may be used to warn vehicles equipped with a snowplow of a hazard in the roadway. If used, the "Raise Plow" plaque shall be used in conjunction with other vertical measure signs; it shall not be mounted or displayed alone.
- Advance markings may be used to supplement the marking on the vertical traffic calming measure; however, advance markings shall not be installed within subdivisions.
- Outside subdivisions, all speed tables/raised crosswalks should include advance W17-1 "Speed Hump" signs in addition to an advisory speed plaque. However, if installed in a series, the advisory speed plaque may be omitted on all but the first W17-1 sign in the series.
- If speed tables are installed outside of subdivisions, they must be installed in a series of two or more.
- Within subdivisions, advance warning signs and advisory speed plaques should not be installed. Object markers should be installed at all speed table/raised crosswalk locations.
- Speed tables are generally located in mid-block locations and often provide the opportunity for mid-block crossings, as they slow traffic speeds and, in some cases, narrow the width of the travelled way providing a much shorter crossing of the street. However, along with these benefits of a mid-block crossing, motorists may not expect to encounter a vulnerable road user crossing at a mid-block location that may be far away from an intersection. For this reason, the MUTCD has established a marking convention for mid-block crossings. If these crossings are established as part of a traffic calming project, the markings and signing of the crosswalk shall meet the standards established in the MUTCD. In a low-speed context, such as a traditional main street, colored and patterned surfaces of brick or concrete paver materials may be considered if an outside entity agrees to maintain it through a Right-Of-Way Use Agreement. In those cases, transverse lines should still be used to delineate the crosswalk.
- **Figure 4-10** shows design details for speed tables/raised crosswalks, including advance markings which may be used as a supplement to pavement markings and signs, object markers, or delineators at the speed table/raised crosswalk.



NOTES:
1. ALL SIGNING AND STRIPING SHALL CONFORM TO THE LATEST EDITION OF THE MUTCD.
2. WITHIN SUBDIVISIONS, ADVANCE PAVEMENT MARKINGS SHALL NOT BE INSTALLED. W17-1 AND W13-1P SIGNS SHOULD NOT BE INSTALLED.
3. OUTSIDE SUBDIVISIONS, W13-1P MAY BE ELIMINATED ON ALL BUT THE FIRST SPEED TABLE / RAISED CROSSWALK IN A SERIES.
4. A "RAISE PLOW" PLAQUE MAY BE INSTALLED ON THE SAME POST AS A W17-1 SIGN.
5. INLETS ARE REQUIRED ON THE UPHILL SIDE OF A RAISED CROSSWALK.
6. PEDESTRIAN FACILITIES SHOULD CONFORM TO LATEST ADA GUIDANCE. CURB RAMP DESIGN SHOULD CONFORM TO LATEST STANDARD CONSTRUCTION DETAILS.

Sign	Description
W11-2	Pedestrian Crossing
W13-1P	Advisory Speed
W16-7P	Downward Diagonal Arrow
W17-1	Speed Hump

Figure 4-10. Design Details for A Raised Crosswalk

4D. RAISED INTERSECTION

A raised intersection (as shown in **Figure 4-11**) is similar to a raised crosswalk, except that the raised section covers an entire intersection, including crosswalks. Approach ramps are provided on all street approaches, resulting in calming of traffic on both intersecting roadways. Raised intersections are more appropriate in dense urban areas, where installation of mid-block vertical measures would result in a larger loss of on-street parking. Raised intersections are typically installed at locations with high pedestrian volumes that are controlled by a traffic signal or all-way stop control. Raised intersections reinforce the stop condition, or in the case of signalized intersections, the need to slow down and watch for vulnerable road users. Raised intersections often have major impacts to drainage systems and utilities and are therefore more costly to implement than other vertical traffic calming measures. Examples of raised intersections are shown in **Figure 4-12**.

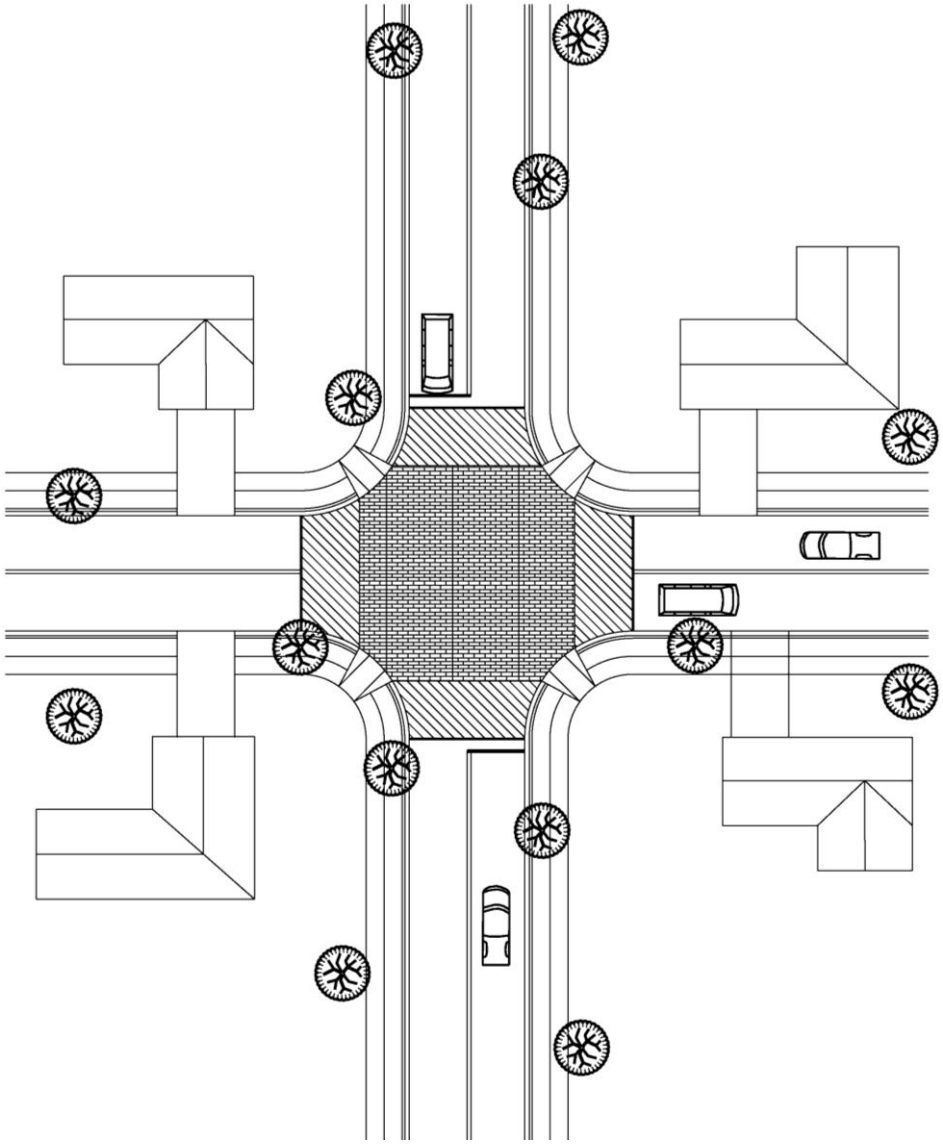


Figure 4-11. Diagram of a Raised Intersection

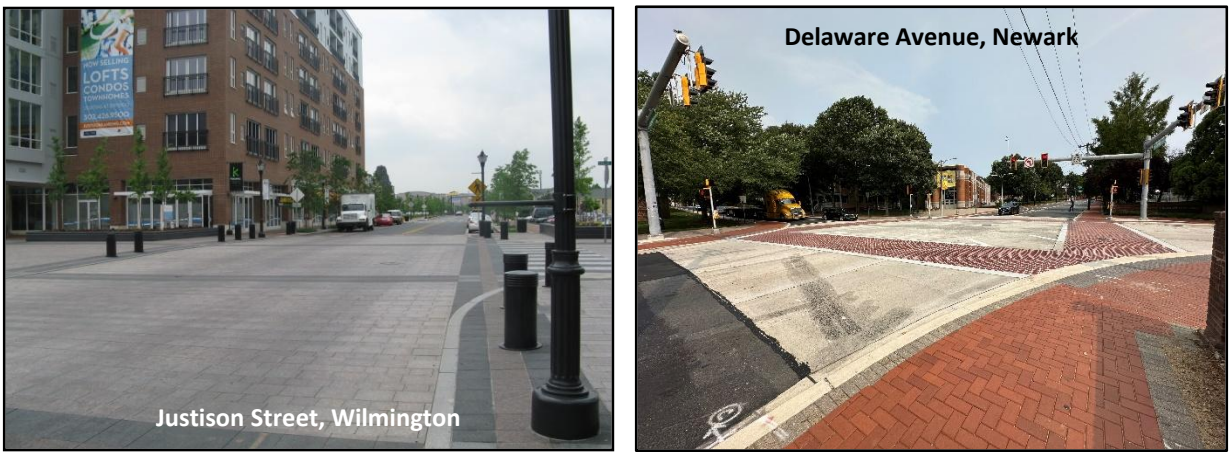


Figure 4-12. Examples of Raised Intersections

Application:

Types of Streets	• Appropriate for the junction of subdivision streets, local, and collector roadways • May be considered on single-lane arterial roadways with speed limits of 25 MPH or less
Speed Limits	• Appropriate for the junction of roadways with posted speed limits of 35 MPH or less
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Maximum recommended grade is 6%

Anticipated Impacts:

Speed: Vehicle speeds may be reduced through the raised intersection to a range of 25 to 35 MPH[1]. However, upstream and downstream of the intersection, raised intersections are unlikely to have an impact on vehicle speeds.

Traffic Diversion: A single raised intersection is unlikely to result in traffic diversion. However, when used in a series or in combination with other traffic calming devices, raised intersections may cause traffic to divert to other routes.

Advantages:

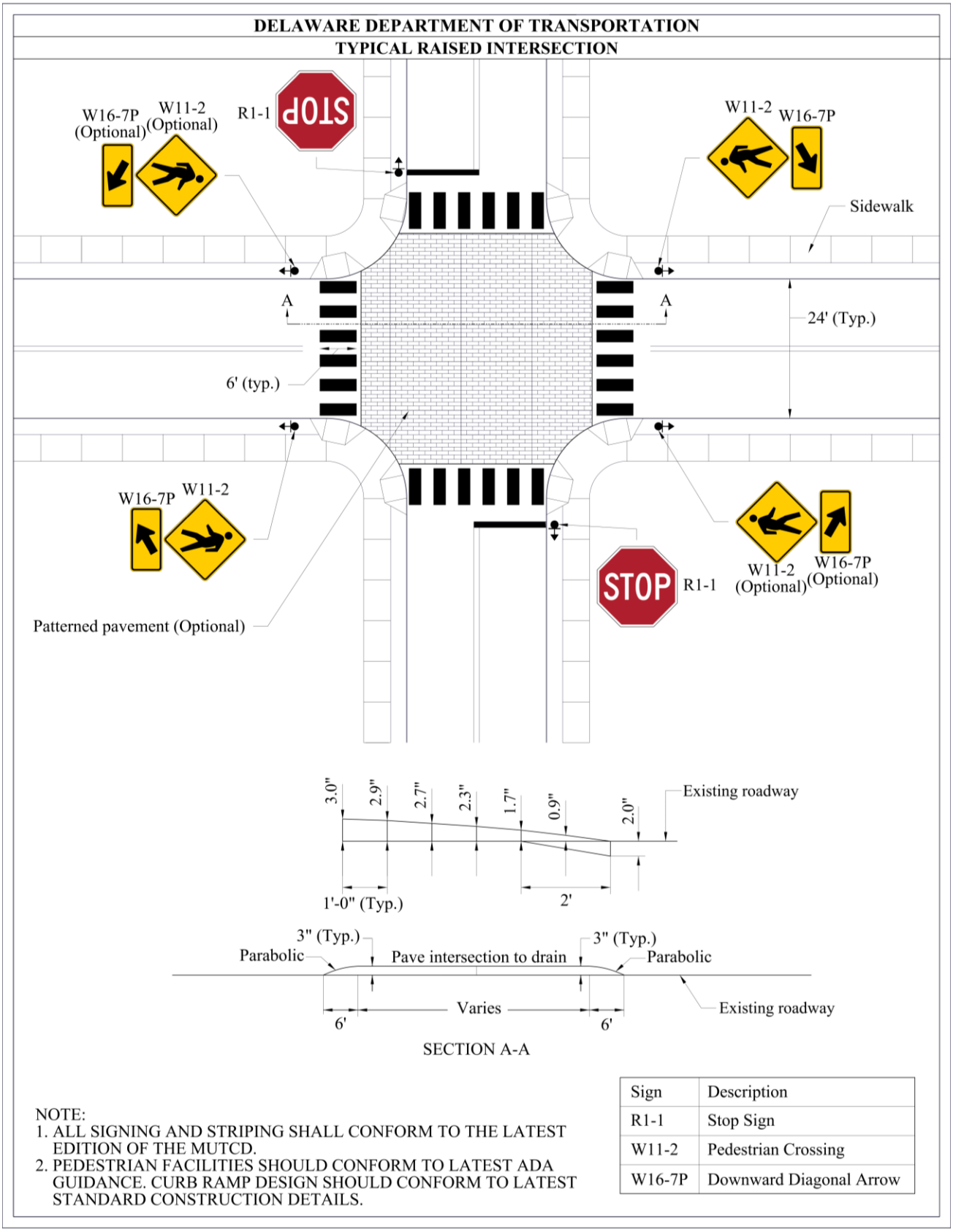
- Documented speed reduction for passenger vehicles
- May be used as an alternative to speed humps and speed cushions, especially in urban areas where parking space is limited
- Improves safety for vulnerable road users, facilitates crossing by the disabled and elderly, increases visibility of vulnerable road users, and prioritizes vulnerable road users over other modes
- Can serve as a form of a gateway treatment at or near the entrance to a development, shopping area, or other attraction

Disadvantages:

- Emergency response time may be affected; although, if installed at an intersection that is all-way stop controlled or signalized under existing conditions, the difference in response time is negligible
- Often requires major and costly redesign of both drainage and utility systems
- May make turning movements more difficult for larger vehicles
- High design and construction cost

Design Considerations:

- The design of a raised intersection should pay close attention to the existing drainage and utility systems because the grade of the entire intersection will be raised. Additional drainage inlets and/or utility relocations will likely be required.
- DelDOT should coordinate with transit and emergency service providers to ensure the raised intersection will not substantially impact these operations.
- The volume of emergency service and larger vehicles that turn at the intersection should be considered.
- Aesthetic treatments such as textured pavement surfaces may help reinforce the concept of a "calmed" area and may help promote lower speeds; however, they can have increased installation and maintenance costs. Aesthetic treatments may only be used if an outside entity agrees to maintain them through a Right-Of-Way Use Agreement.
- Pavement treatments should be skid resistant, particularly on inclines.
- It is important to correctly identify the pedestrian crossings accompanying the raised intersection and alert motorists to the fact that the traffic calming measure requires attention not only to reduce speed but also to the potential for vulnerable road users crossing the intersection. The MUTCD shall be followed when marking these locations.
- Color contrasts and detectable warning truncated domes should be used at transitions to enable vulnerable road users with vision impairments to detect the crossing.
- **Figure 4-13** shows design details for raised intersections.



Sign	Description
R1-1	Stop Sign
W11-2	Pedestrian Crossing
W16-7P	Downward Diagonal Arrow

Figure 4-13. Design Details for a Raised Intersection

CHAPTER 5
OTHER TRAFFIC CALMING MEASURES

Other Traffic Calming Measures that can increase safety, reduce speeds, or divert unwanted traffic include, but are not limited to, yard signs, Radar Speed Signs (RSSs), one-way closures, All-Way Stop Control (AWSC), and pavement marking applications. These measures typically do not require construction or reconstruction of the roadway and are generally less expensive than horizontal or vertical traffic calming measures.

5A. YARD SIGNS

Yard Signs, an example of which is shown in **Figure 5-1**, are temporary signs, typically made out of plastic, that may be placed on private property and serve as a vivid reminder to drive 25 MPH within neighborhoods. The sign is typically installed using metal stakes, similar to an advertisement sign or political candidate's sign, and can be located at the discretion of the property owner. As long as they are not installed within the right-of-way of the adjacent street, yard signs are compliant with the Delaware Outdoor Advertising Law and the MUTCD, which regulates the types and designs of signs installed above or adjacent to all roads in Delaware.





Figure 5-1. Example of Neighborhood Yard Sign
Note: Actual sign may vary from example shown above.

Application:

Types of Streets	• Appropriate for local roads within subdivisions; however, must be placed on private property
Speed Limits	• Appropriate for roadways with posted speed limits of 25 MPH
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Appropriate for all street grades

Anticipated Impacts:

Safety: Promotes safety by constantly reminding neighborhood residents of the dangers of excessive speed.

Speed: The primary purpose of yard signs is speed reduction, which may be achieved by reminding community residents of the dangers of speeding.

Advantages:

- May result in reduced speeds within the community

Disadvantages:

- Impact may be reduced over time unless regularly reinforced

Implementation Considerations:

- Yard signs are most effective when a community is supportive and promotes the need for speed reduction through other community educational efforts.
- Yard signs may lose their effectiveness if left in the same location for an extended period of time. Relocating yard signs from one location to another may increase conspicuity.
- Yard signs may not be placed within public right-of-way. Rather, they may be placed on private property, at the owner's discretion.

5B. RADAR SPEED SIGNS

RSSs, as shown in **Figure 5-2**, use electronic radar speed detection equipment to display the speed of passing vehicles. They are typically installed adjacent to a regulatory speed limit sign. The signs are placed along a road to increase motorists' awareness of their own speed. RSSs measure an approaching car's speed and display the speed in large, lighted numbers. The changeable message portion of RSSs may be capable of displaying numbers only (standard RSS) or a full matrix display (pictorial RSS). They do not record the license plate number or take pictures of violators. DelDOT only installs RSSs if funded through Community Transportation Funds (CTF) or other outside sources. More information about installation and maintenance of RSSs is found in the DelDOT Radar Speed Sign Policy[9] and in the Radar Speed Sign (RSS) FAQs on DelDOT's website.



Figure 5-2. Examples of Radar Speed Signs

Application

Types of Streets	• Appropriate for all streets, except freeways, expressways, and interstates
Speed Limits	• Appropriate for all speed limits
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Appropriate for all street grades

Anticipated Impacts:

Speed: A 2022 DelDOT study showed that RSSs may result in a minor (typically less than 2 mph) reduction in vehicle speeds which is likely to diminish as vehicles proceed further past the sign. The 2022 study also found that RSSs are slightly more effective at reducing speed and/or improving speed uniformity at sites where drivers understand the need to reduce their speeds, such as school zones, parks, and speed transition zones.

Advantages:

- May be effective in reducing vehicle speeds

- Relatively low implementation cost

Disadvantages:

- Impact on speeds may be minimal and may be reduced over time unless regularly enforced by local police

Implementation Considerations:

- The design and location of radar speed signs shall be approved by DelDOT Traffic prior to installation within right-of-way.
- The radar speed signs should not be installed within a curve.
- A pictorial radar speed sign may be used in conjunction with a regulatory speed limit sign. The pictorial radar speed signs shall have a full matrix display that have 12” or 18” digits.
- The majority of studies on the effectiveness of RSSs have shown negligible speed reductions.
- Local law enforcement agencies may be able to provide an RSS that is mounted on a trailer to allow the technology to be used as a temporary or short-term installation.

5C. ONE-WAY RESTRICTION

A one-way restriction limits the direction of travel on a street to one direction using only regulatory signage. As a result, motorists traveling in the restricted direction must use other parallel routes to reach their destination, impacting both the one-way street and the surrounding street network. Therefore, an engineering study is required to document existing operational and safety concerns, as well as the expected impacts due to the implementation of the one-way restriction. The engineering study should quantify the expected impacts on both the one-way road and the parallel routes, including the traffic volumes and the types of vehicles being diverted, any geometric or operational deficiencies, and any necessary mitigation measures.

The geometric design features of the parallel routes should have similar or higher design features than the one-way restricted street to properly accommodate the diverted traffic. Within subdivisions, one-way restrictions that divert traffic from higher volume collector streets, which are typically wider and have fewer driveways, to local streets, which are narrower and have many driveways, should be avoided.





Application:

Types of Streets	• Appropriate for all streets, except freeways, expressways, and interstates
Speed Limits	• Appropriate for all speed limits
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Appropriate for all street grades

Anticipated Results:

Safety: Previous studies have found that one-way streets may have fewer crashes than two-way streets because motorists do not have to contend with opposing motorized traffic. However, the streets that receive the diverted traffic may experience an increase in crashes due to the increase in volume.

Speed: One-way restrictions may cause traffic speeds to increase on the one-way street when traffic volumes decrease, and motorists no longer need to contend with opposing traffic.

Traffic Diversion: Implementation of a one-way restriction is generally expected to result in reduced traffic volumes on the road that is converted from two-way to one-way. However, the parallel routes that serve the restricted direction of travel are expected to experience an increase in volume due to the traffic that is diverted. The resulting traffic volumes on each of the roadways

in the network may be lower than the traffic volume carried by the original two-way street that is converted to one-way. In some cases, where motorists use the roadway as a cut-through to avoid congestion on adjacent routes, the creation of a one-way street system may discourage drivers from using the roadway as a cut-through. Due to the potential impacts, an engineering study is required prior to the implementation of a one-way street system.

Advantages:

- One-way restrictions generally reduce the traffic volume on the roadway that is converted from two-way to one-way
- One-way streets may discourage cut-through traffic from using subdivision streets to avoid congestion on the adjacent roadway network
- Relatively low implementation cost

Disadvantages:

- A one-way street system diverts traffic (to be estimated by an engineering study) to parallel routes and increases the traffic volume on the parallel routes
- Residents on the parallel routes may be opposed to the increase in traffic on their roadways created by the one-way restriction
- Residents and businesses on the one-way street may be opposed to the one-way restriction due to the limited access to their property
- Traffic speeds may increase as traffic volumes decrease on the one-way street

Implementation Considerations:

- One-way restrictions impact both the roadway that is converted from two-way to one-way road and the surrounding network. An engineering study should be performed prior to the implementation of a one-way street system.
- Consideration should be given to the geometric design features (roadway width, design vehicle, turning radii, etc.) of the parallel routes to ensure that diverted vehicles can utilize the parallel routes.
- All signage should conform to the latest version of the MUTCD.

5D. ALL-WAY STOP CONTROL (AWSC)

AWSC, also known as multi-way stop control, is when all approaches of an intersection are controlled by a stop sign. AWSC is not meant to reduce vehicle speeds, but rather to address cut-through traffic. *DelDOT's All-Way Stop Control (AWSC) Guidelines for Residential Streets*[8] discusses the process to request AWSC at intersections within subdivisions in further detail. Outside of subdivisions, more analysis is needed to determine whether AWSC is appropriate, in accordance with Part 2 of the MUTCD. Drivers must recognize the need for AWSC, or they may eventually begin to disregard the stop signs, potentially posing a risk to other motorists or pedestrians. More information about the implementation of AWSC is included in the All Way Stop Control (AWSC) FAQs on DelDOT's website.



Application:

Types of Streets	• Appropriate at most intersections within subdivisions • Intersections outside of subdivisions require further evaluation
Speed Limits	• Appropriate for all speed limits
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Appropriate for all street grades

Anticipated Results:

Safety: Research has shown that AWSC can reduce the total number, type, and severity of crashes[15].

Speed: AWSC should not be used for speed control, as studies have shown that drivers may increase their speed between stop signs to make up for lost time.

Traffic Diversion: AWSC may contribute to the diversion of traffic from a street. The amount of traffic diversion will depend on the increased travel time for non-local traffic and the availability of alternate route(s).

Advantages:

- Possible reduction in non-local traffic
- Relatively low implementation cost
- Provides a method for managing the circulation of traffic within a community

Disadvantages:

- May increase emergency response times
- May increase noise levels due to vehicles braking and accelerating
- May result in the loss of on-street parking at or near the intersection
- Drivers may speed up between stop-controlled intersections to make up for lost time
- Overuse of AWSC intersections may lead to low compliance

Implementation Considerations:

- Adequate sight distance approaching the stop signs is required.
- Supplemental temporary solar powered flashing beacons may be used outside of subdivisions to draw motorists' attention to the new AWSC condition.
- All signage should conform to the latest version of the MUTCD.

5E. LANE NARROWING (PAVEMENT MARKINGS)

Lane narrowing can be accomplished by restriping the edge lines and/or centerline of a roadway to reduce lane widths. Lane widths are typically reduced from a 12-foot travel lane to an 11- or 10-foot travel lane.

Application:

Types of Streets	• Appropriate for local, collector, and arterial roadways outside subdivisions
Speed Limits	• Appropriate for all speed limits
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Appropriate for all street grades

Anticipated Results:

Safety: Bicyclist safety can be improved if bike facilities are included.

Speed: Lane narrowing may reduce speeds on streets by reducing driver comfort.

Advantages:

- Increased shoulder widths can provide a larger buffer between vehicles and pedestrians or bicyclists
- Relatively low implementation cost
- May provide opportunities to accommodate bicycle facilities or parking lanes

Disadvantages:

- Removing existing striping may cause scarring of the roadway surface and may lead to premature failure of the pavement
- Wider vehicles may overhang outside the width of narrowed lanes
- Pavement markings may fade more quickly and require more frequent maintenance because vehicles may be more likely to travel on the markings
- Pavement markings may lose their effectiveness in reducing speed over time as regular users of the street become more comfortable with the narrowed lanes

Implementation Considerations:

- The widths of emergency vehicles, school buses, and large trucks must be considered when reducing lane widths.
- The age and remaining life of the existing pavement surface should also be considered. If lane narrowing is implemented in conjunction with regular pavement maintenance activities (mill and overlay or reconstruction), scarring of the roadway surface and premature failure may be avoided.
- Where possible, bicycle facilities and/or parking lanes should be included in the design.
- All striping should conform to the latest version of the MUTCD.

5F. SPEED REDUCTION MARKINGS

Speed reduction markings, as shown in **Figure 5-3**, are short, transverse stripes spaced at gradually decreasing distances where advance deceleration is needed. The markings can encourage drivers to reduce their speeds by giving them the illusion of traveling faster than their actual speed.



Figure 5-3. Example of Speed Reduction Marking

Application:

Types of Streets	• Appropriate for local, collector, and arterial roadways with edge lines and centerlines, and which are outside subdivisions
Speed Limits	• Appropriate for all speed limits
Design Vehicles	• Appropriate for all vehicles
Street Grades	• Appropriate for all street grades

Anticipated Results:

Speed: Speed reduction markings may reduce speeds between 0 MPH and 5 MPH upstream and downstream of curves[16].

Advantages:

- Relatively low implementation cost
- May be effective in reducing vehicle speeds

Disadvantages:

- Speed reduction markings may require more frequent maintenance than edge lines or centerlines because vehicles may be more likely to travel over the markings
- Speed reduction markings may lose their effectiveness in reducing speed over time

Design Considerations:

- Speed reduction markings should only be used in locations where advance deceleration is needed, such as in advance of horizontal or vertical curves or where there is a change in

roadway character and speed limit.

- Speed reduction markings should not be used on roadways where there is no need to change speed.
- Speed reduction markings should not be used in place of appropriate warning signs or other traffic control devices. However, speed reduction markings may be used to supplement other traffic control devices.
- All striping should conform to the latest version of the MUTCD.

APPENDIX A
References

1. *Traffic Calming ePrimer,* U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA).
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3. *State of Delaware Complete Streets Policy,* Governor Executive Order #6, Effective 1/6/2010.
4. *Safe System Approach,* U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA).
5. *DELAWARE 2021-2025 Strategic Highway Safety Plan: Toward Zero Deaths,* Delaware Department of Transportation (DelDOT). December 2020.
6. *DelDOT Development Coordination Manual*, Delaware Department of Transportation (DelDOT). November 2019.
7. *Delaware Manual on Uniform Traffic Control Devices (MUTCD)*, Delaware Department of Transportation (DelDOT). 2011.
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11. *Road Diet Informational Guide – FHWA Safety Program*, FHWA-SA-14-028, U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA). November 2014.
12. *Engineering Speed Management Countermeasures: A Desktop Reference of Potential Effectiveness in Reducing Speed,* U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA). July 2014.
13. *A Guide to Vertical Deflection Speed Reduction Techniques: Planning and Design of Speed Humps, Speed Tables and Other Related Measures,* Institute of Transportation Engineers (ITE). December 2022.
14. *Engineering Speed Management Countermeasures: A Desktop Reference of Potential Effectiveness in Reducing Crashes,* U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA). July 2014.
15. *Crash Trends at New All-Way Stop Control (AWSC) Locations – 2022 Crash Data Update,* RK&K. July 2023.
16. *Low-Cost Treatments for Horizontal Curve Safety 2016,* U.S. Department of Transportation (USDOT) Federal Highway Administration (FHWA). February 2017.

APPENDIX B
Frequently Asked Questions

1. What can I do to control speeding and/or a high volume of cut-through traffic in my community?

Sometimes local communities and subdivisions experience speeding or a high volume of cut-through traffic that can create real or perceived safety issues and quality of life concerns on certain neighborhood streets. In many cases, posted speed limits and appropriate warning signs are already in place, and enforcement can ensure compliance and correct the problem. Because enforcement cannot always be present, communities may seek more permanent, physical measures to ensure adherence to local traffic regulations. In response to this need, DelDOT has developed a Traffic Calming Program to install physical measures and other traffic controls to slow traffic and/or discourage neighborhood cut-through traffic. Traffic Calming projects generally begin with an engineering study to assess the magnitude of the issue, then identify potential solutions. The DelDOT Traffic Calming Design Manual provides guidance on the appropriate application of traffic calming measures, including identification of appropriate measures, geometric design, signing and pavement markings.

2. What is traffic calming?

The Federal Highway Administration's (FHWA) Traffic Calming ePrimer states that "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." DelDOT follows the FHWA definition.

3. What are some of the Traffic Calming measures that can be constructed?

The measures outlined in the DelDOT Traffic Calming Design Manual in Chapters 3 through 5 include:

Horizontal Measures
Lateral Shift
Chicane
Realigned Intersection
Traffic Circle
Mini Roundabout
Corner Extension / Bulbout
Choker
Median Island
Partial Closure
Road Diet / Roadway Reconfiguration
Diagonal Diverter
Intersection Barrier
Forced Turn Island

Vertical Measures
Speed Humps
Speed Cushions
Raised Crosswalks / Speed Tables
Raised Intersections

Other Measures
Yard Signs
Radar Speed Signs
One-Way Restrictions
All-Way Stop Control (AWSC)
Lane Narrowing
Speed Reduction Markings

4. **How do I request a Traffic Calming project for my community?**

   Traffic calming requests should be initiated by either the local elected officials or representatives of a municipality who can forward the applicable information to DelDOT. Elected official involvement is needed to ensure public support. However, requests for AWSC may be submitted directly to DelDOT by community associations, per the AWSC Guidelines for Residential Streets. Additionally, individual citizens may request yard signs directly from DelDOT, without the involvement of elected officials. See section 2A.1 for more details. Requests can be made online at Report an Issue, through the DelDOT mobile app, by email to DelDOTTrafficCalming@delaware.gov, or by mail to DelDOT Traffic Studies, ***169 Brick Store Landing Road, Smyrna, DE 19977****.*

5. **How long does it take for a Traffic Calming project to be funded and constructed?**

   The time frame for a Traffic Calming project, from the initial request to construction of the improvement, can vary depending on the complexity of the concerns and potential solutions, the time needed for the public outreach process to achieve consensus on appropriate solutions, and available funding. DelDOT has developed an expedited and streamlined process for most Traffic Calming projects so that Traffic Calming projects can be implemented in less time than projects that follow the more traditional Project Development process necessary for larger, and usually more complex, Capital Transportation Program projects.

6. **Who pays for a Traffic Calming project?**

   There are several possible funding sources available for Traffic Calming projects:

   a. *Community Transportation Funds (CTF)*
   b. *Local/municipal funds*
   c. *Developer contributions*
   d. *Private/community contributions*
   e. *Federal and State Funds as appropriated through the DelDOT Capital Improvement Program*
   f. *Any combination of the above funding sources*

7. **Can speeding and/or cut-through traffic be controlled by simply lowering the speed limits on the street?**

   Speed limits are established either by Delaware Code (statutory speed limits) or on the basis of an engineering study that has been performed in accordance with traffic engineering practices. The engineering study considers many factors including traffic volumes, crash trends, observed speed data, and other roadway characteristics that capture the surrounding area, such as roadside development, on-street parking, and pedestrian and bicycle activity. Posted speed limits that are set artificially low can encourage violations by many drivers and lead to less safe conditions. In some cases, it may be appropriate to reduce the posted speed limit in conjunction with physical traffic calming measures, if supported by an engineering study.

8. **Can speeding be controlled by All-Way Stop Control (AWSC) at various intersections?**

   AWSC is not meant to address speeding. Other traffic calming measures, such as vertical and horizontal traffic calming measures, have been found to better address speeding. AWSC can reduce cut-through traffic, reduce conflict points, address near-miss crashes, and reduce sight-distance related issues.

9. **Can trucks be restricted on a roadway to control speeding and/or cut-through traffic?**

   A truck restriction is a complex effort that may deter cut-through truck traffic on some roadways. However, truck restrictions fall outside of the Traffic Calming toolbox and require a larger study to evaluate the effects of such restriction.

10. **Where can speed humps be installed?**

    Speed humps are appropriate for subdivision streets and local roads inside subdivisions with speed limits of 25 MPH. They are typically placed on a straight and level section of roadway not near any intersection, driveway, or drainage inlet. Spacing of 250' to 500' is recommended for a series of speed humps to be effective, according to the Institute of Transportation Engineers (ITE).

11. **Can subdivision streets be closed or made one-way to control speeding and/or cut-through traffic?**

    A full closure of a local street is a complex effort that can result in increased emergency response times and additional traffic on adjacent streets. Full closures are outside of the Traffic Calming toolbox and require a larger study. Partial closures and one-way restrictions are within the Traffic Calming toolbox and may help address cut-through traffic. Partial closures use curb extensions or islands to block travel in one direction for a short distance on an otherwise two-way street. A one-way restriction uses only signing and pavement markings to convert a two-way street to a one-way street for a predetermined distance. Partial closures and one-way restrictions are not appropriate on streets that serve as transit routes in the closed direction. Care must also be taken to minimize wrong way driving through the restricted area and studies should be undertaken to understand where diverted traffic is most likely to go to avoid secondary issues on the adjacent roadway network.

12. **Can traffic signals be installed at intersections along subdivision streets to discourage cut-through traffic?**

    Traffic signals are not appropriate to control speed and/or cut-through traffic. Traffic signals are designed for specific situations and for specific purposes. When used in unexpected or inappropriate locations, numerous studies have shown that traffic signals can have negative impacts, such as increasing speed, increasing delay, increasing rear-end and/or red-light running crashes, and potentially excessive disobedience of the signal indications. The Federal Highway Administration (FHWA) developed the Manual of Uniform Traffic Control Devices (MUTCD) to uniformly govern the use of traffic signals. Traffic signals have specific traffic warrants, which must be met before they are installed. Adding traffic signals is never the standalone solution for speeding and/or cut-through traffic issues. More information on the use of traffic signals is available on ITE's Unsignalized Intersection Improvement Guide.

13. **How do I request a Radar Speed Sign (RSS) on a roadway?**

    Please contact your elected officials to request a Radar Speed Sign. RSSs are funded through elected officials' Community Transportation Funds (CTF). DelDOT will coordinate with the elected officials to determine an appropriate location for the RSS. A RSS will typically be placed on a straight and level section of roadway not near any intersection, driveway, or existing traffic calming device. The RSSs use solar energy, and thus should also be placed away from buildings, trees, and other shaded areas.

14. Who can I contact to learn more about various Traffic Calming options?

Requests to learn more about Traffic Calming projects can be made online at Report an Issue, through the DelDOT mobile app, by email to DelDOTTrafficCalming@delaware.gov, or by mail to DelDOT Traffic Studies, ***169 Brick Store Landing Road, Smyrna, DE 19977****.*

APPENDIX C
Cost Estimates

Traffic Calming Measure	Cost (2023 Dollars)
Horizontal Measures	
Lateral Shift	$125,000 - $175,000 *each*
Chicane	$125,000 - $175,000 *each*
Realigned Intersection	$35,000 - $45,000 *each*
Traffic Circle	$25,000 - $35,000 *each*
Mini-Roundabout	$450,000 - $550,000 *each*
Corner Extension / Bulbout	$350,000 - $400,000 *each*
Choker	$25,000 - $35,000 *each*
Median Island	$100,000 - $150,000 *each*
Partial Closure	$75,000 - $125,000 *each*
Road Diet / Roadway Reconfiguration	$225,000 - $275,000 *per mile*
Diagonal Diverter	$250,000 - $300,000 *each*
Intersection Barrier	$100,000 - $150,000 *each*
Forced Turn Island	$125,000 - $175,000 *each*
Vertical Measures	
Speed Humps	$10,000 - $15,000 *each*
Speed Cushions	$8,000 - $12,000 *each*
Raised Crosswalks / Speed Tables	$40,000 - $50,000 *each*
Raised Intersections	$150,000 - $200,000 *each*
Other Measures	
Yard Signs	DelDOT funds
Radar Speed Signs	$3,500 - $6,000 *each*
One-Way Restrictions	DelDOT funds
All-Way Stop Control (AWSC)	DelDOT funds
Lane Narrowing	$50,000 – $75,000 *per mile*
Speed Reduction Markings	$8,000 - $12,000 *per application*

Above cost estimates include materials, labor, installation, mobilization, construction inspection, and maintenance of traffic during construction. Above cost estimates do not account for inflation over time.