Chapter 1103 Design Control Selection

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1103.01 General Overview

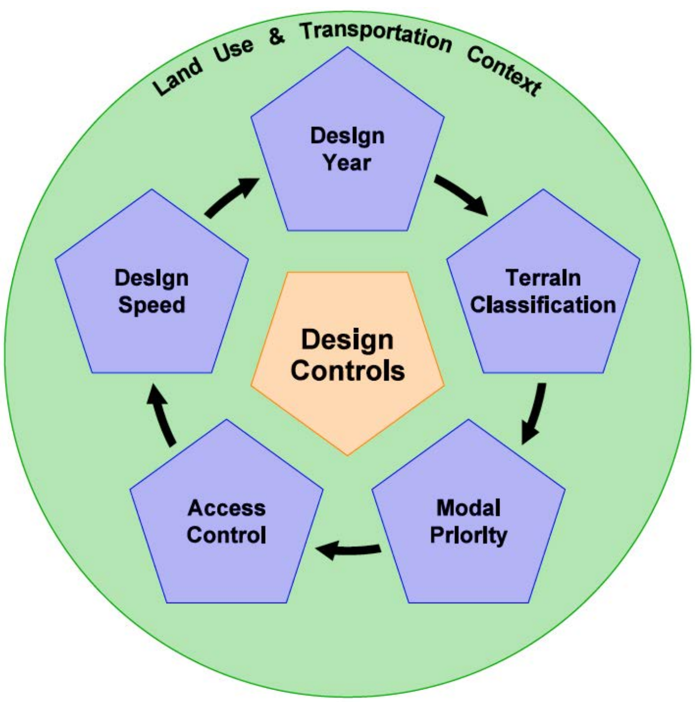
Design controls are specific design elements that directly influence or are used to assist in the selection of most other design elements and their dimensions. As such, design controls establish fundamental boundaries for design alternatives. This chapter provides guidance on the selection of design controls for state routes.

The five WSDOT design controls include:

- Design year
- Modal priority
- Access control
- Design speed
- Terrain Classification

Exhibit 1103-1 shows reciprocal connections between design controls and land use and transportation contexts.

Exhibit 1103-1 WSDOT Design Controls



1103.02 Control: Design Year

The **horizon year** for planning and design is typically considered to be 20 years from the year construction is scheduled to begin.

Design year is the forecast year used for design. Design year selection is dependent on a decision to design for the current or future context (see Chapter 1102). The specific baseline performance metric(s) being considered can also affect the design year selection. Design year can be any interim year selected between the current year up to the horizon year. Environmental documentation or federal-aid projects may require horizon year analysis of an alternative regardless of the selected design year.

Future scenarios are typically developed from predictive travel demand models. When evaluating future scenarios, verify that the modeling assumptions are reflective of planned land use, operations, and facility needs at the forecast year. Sensitivity analysis is sometimes used to test a range of assumptions, their values, and the model limitations. The decision to include or exclude horizon year alternatives and analyses for other transportation contexts other than those described in 1103.02(1) is documented through the Basis of Design (see Chapter 1100) document.

1103.02(1) Interstate Projects and Projects of Division Interest

All Interstate highway projects incorporating new construction are to evaluate alternatives for the horizon year to be compliant with 23 USC § 109. These Interstate projects are expected to provide satisfactory performance for the identified performance metric(s) in the horizon year. However, modification or reconstruction of the Interstate does not necessarily drive the need to evaluate alternatives for the horizon year, if the appropriate approvals have been obtained. For Interstate new and reconstruction projects or those deemed Projects of Division Interest (PoDI), obtain FHWA approval for design controls using the Basis of Design (see Chapter 1100) form. See Chapter 300 for guidance related to FHWA oversight and approvals.

1103.03 Control: Modal Priority

Modal priority is the recognition of multimodal capacity in relation to context. It acknowledges and incorporates modal compatibilities, design users, and intersection design vehicles. These are each discussed further below. Modal priorities are primarily selected based on the outputs from the modal compatibility assessment (see 1103.03(3)), the baseline and contextual performance need(s), community engagement, and identified planning strategies. This collaborative decision is an important milestone and is necessary to support the subsequent design control and design element analysis decisions. More than one modal priority may exist for a project based on variation in context.

A project's legislative intent may override modal priority selection when it differs from modal compatibility (see 1103.03(3)) outputs. However, project teams are encouraged to work with program management staff if when there is a difference between modal priority outputs and legislative intent to explore change management opportunities.

1103.03(1) Design Users

"Design users" refers to users of all modes that may use and are legally permitted on a highway segment or node. The intent in identifying design users is to highlight all user needs, recognize modal interactions, and develop an integrated system for all users. List design users with sufficient descriptive detail, such as “commuter” and/or “recreational bicyclists” rather than just listing “bicyclists.”

Division III of the document Understanding Flexibility in Transportation Design – Washington (www.wsdot.wa.gov/research/reports/600/638.1.htm) is a key resource for understanding the needs and characteristics of various design users. This document also provides conceptual guidance for the application of context sensitive solutions in the project development process, and provides a compilation of issues for evaluation in highway design. The intent is to offer information and tools to increase understanding of how the different user issues are interrelated, and how understanding this interrelationship leads to better decision-making during the evaluation and optimization of trade-offs.

1103.03(2) Intersection Design Vehicle

An intersection design vehicle is a specific selection made at each intersection. The intent in selecting an intersection design vehicle is to allow the largest vehicles commonly encountered to adequately complete a required turning maneuver. Frequency of the design vehicle, impacts to other design users, and specifically pedestrian crossing distance and times are also considered. The objective is not necessarily to size the specific intersection curb radius (unless there is a baseline need associated with the larger vehicles), but rather to account for a reasonable path to accommodate the large vehicle turning maneuver. Use turn simulation software (such as AutoTURN®) to analyze and decide on what is necessary to support turning movements.

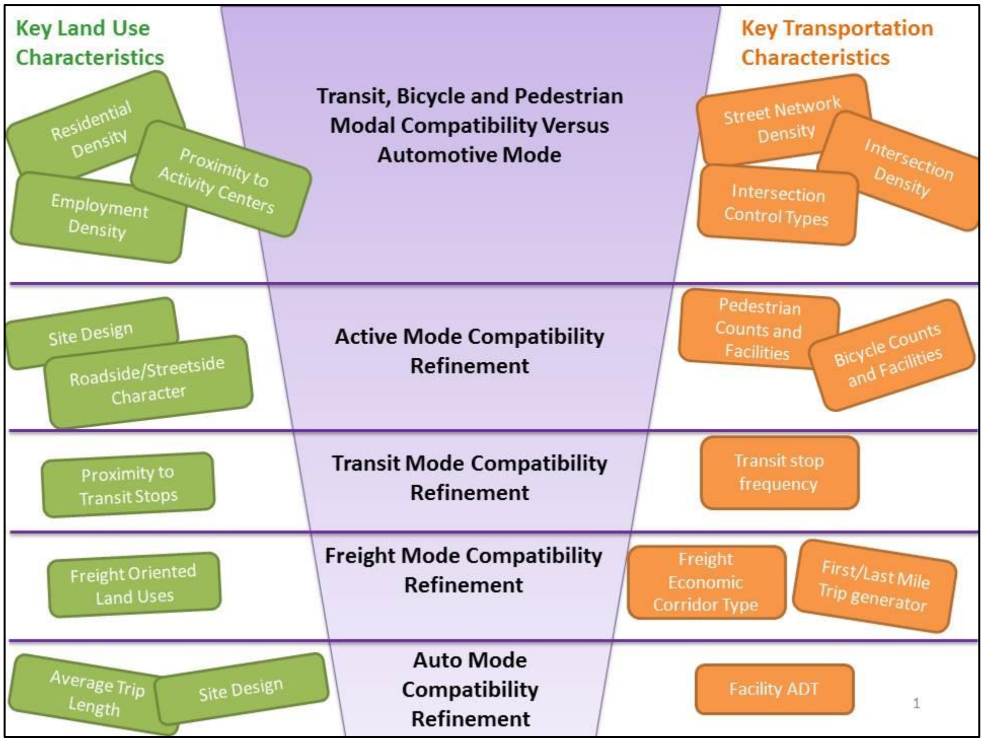
> **Example**: An intersection at a location identified as a pedestrian mode priority may experience infrequent turning movements by a WB-67. Because of the pedestrian priority and needs, a smaller curb radius would provide benefit with shorter crossing times and reduced exposure to vehicles. Using turn simulation software, a graphical display of the various turning movements is created. Based upon those turning movements, a practicable path for the larger vehicle can be identified, even though intrusion into the second same direction lane or painted median may be necessary. The infrequency of use by a WB-67 indicates that the intersection design may be appropriate given the pedestrian benefit.
>
> Conversely, if the crossroad was identified as a Connecting Freight Corridor, with frequent turning movements from larger vehicles, then it would be appropriate to size the intersection to prevent the second lane incursion.

It is important to determine the local origins and destinations of large vehicles to strategically plan to accommodate their uses at specific intersection locations, and also to consider alternatives that may help lower turning speeds and pedestrian exposure. Planners and designers need to work with stakeholders, businesses, and service providers to understand their needs (like school bus and emergency vehicle movements) in order to define the frequency of use at specific intersections. Municipalities may have established truck routes or specific restrictions that govern local freight patterns or time of day delivery narrowing the possible locations that will focus on larger intersection design vehicles. The purpose of providing flexibility related to the intersection design vehicle is to balance the design for the users and modes of the corridor, as well as to avoid the unnecessary expense of oversizing intersections.

1103.03(3) Modal Compatibility

Modal compatibility is the identification of modes most compatible within an identified context environment. Compatibility is a function of the combination of land use and transportation characteristics, as well as an understanding of the performance needs at a location. Exhibit 1103-2 shows the association of context characteristics with different design user groups.

Exhibit 1103-2 Key Context Characteristics and Modal Compatibility



Modal compatibility is not only determined based on the volume of a given modal user group existing on a corridor segment. Modal compatibility may change over time, as land use and transportation characteristics change, so it is critical to identify whether the existing context or a future vision of that context is the basis for the design.

WSDOT's goal is to optimize existing system capacity through better interconnectivity of all transportation modes. Consideration of modal compatibility over time allows different investment scenarios in a particular mode for a given context to be evaluated. Exhibit 1103-3 is an example of a modal compatibility assessment for a specific context.

Exhibit 1103-3 Modal Compatibility Assessment Example

Land Use Characteristic	Modal Compatibility
High proximity to activity centers	Pedestrian, Transit, Bicycle
Large number of industrial and commercial land uses in surrounding area	Freight
High densities of both residential and employment	Bicycle, Pedestrian, Transit
No or minimal building setbacks adjacent to roadway	Pedestrian
Human scale architecture present	Pedestrian, Transit
Transportation Characteristic	**Modal Compatibility**
Large number of accesses	Auto
Well-established grid network	Bicycle, Pedestrian, Transit, Auto
T-2 freight route	Freight
Streetside elements present	Pedestrian, Transit
Frequent signalized intersections along route	Auto, Transit, Pedestrian

1103.04 Control: Access Control

Access is a critical component informed by an understanding of the contextual characteristics. Access is the primary connection between the land use and transportation contexts. The type of access control selected (see Chapter 520) affects accessibility and impacts the types of activities and functions that can occur on a segment. It is important for mobility and economic vitality projects to consider whether the current access classification and/or planned access classification conforms to the context selected for design (see Chapter 1102).

During development of the state highway system, access management functioned to preserve the safety and efficiency of regional highways. However, the level of access management can also significantly affect accessibility to land uses and, in turn, the various modal mobility needs and economic vitality of a place. It is necessary to select the appropriate type of access during planning and design. However, if access control has been acquired by purchase of access rights, this evaluation and selection is not necessary.

A choice to change the current or planned access control is a major decision and is to be consistent with the contextual information, desired performance targets, and modal priorities for a location.

> **Example:** A managed access Class 2 route has incurred significant development in adjacent and surrounding parcel uses, increasing the number of local trips made on a segment of the route. Over time, additional intersections and access connection permits were granted. In this situation, it may be more appropriate to consider selecting managed access Class 4 or 5 because of the alteration in functions and activities along that segment over time.
>
> Conversely, a route may have a need oriented around improving motor vehicle travel time performance, and managed access Class 1 is selected to assist in achieving that modal priority performance need. In this situation, the access helps to control features within the design consistent with the need, context, and modal priority.

If an alteration to current or planned access is determined necessary, consult the Development Services and Access Manager for preliminary approval for the selection, and document on the Basis of Design form (see Chapter 1100). For additional information on access control and access management, see Chapters 520, 530, and 540.

1103.05 Control: Design Speed

WSDOT uses a target speed approach for determining design speed. The objective of the target speed approach is to establish the design speed at the desired operating speed. The target speed selection is derived from all other design controls presented within this chapter, as well as transportation and land use context characteristics. The target speed approach exercises the connection that's been found in research and through experience between operating speed, design controls, and context characteristics.

Engage the public and local agency staff and officials prior to selecting the target speed. Once the target speed is selected, it becomes the design speed for the project. The goal of the target speed approach is that the speed ultimately posted on the completed project is the same as the design and ultimately the operating speed. In order to achieve this outcome, consider the impact of existing or proposed contextual characteristics, modal priorities, access control selection, performance need(s), and contributing factors analyses that have been developed for the project (see 1103.03(3), 1103.04, and Chapters 1101, 1102, and either 530 or 540, as appropriate).

When selecting a target speed that is lower than the existing posted speed, or where excessive operating speeds were identified from contributing factors analysis of the baseline performance need, consider the use of roadway treatments that will help achieve the selected target speed (see 1103.05(2)) during alternatives formulation. When selecting a target speed in excess of the existing posted speed, measures such as greater restriction of access control and segregation of modes may be necessary to reduce conflicts in activities and modal uses. Use caution when basing a target speed on one or more contextual characteristics that are proposed to take place after project opening, as the goal of ending up with a posted speed equal to the design speed at opening may be jeopardized.

Concurrence of the Region Traffic Engineer is required when speed management treatments are proposed to accomplish a desired target speed operation. When a design speed is proposed and assumed for a project or project segment that is lower than the existing posted speed, the approval of the State Traffic Engineer is also required.

The region Traffic Engineer is responsible for setting the posted speed on the highway once the project is completed. Because target speed is only one of the considerations used when establishing posted speed, and achieving a posted speed that is equal to the design speed is critical to project success, engage and include the region Traffic Engineer and Traffic Office staff in key decision-making that will affect the design speed selection.

1103.05(1) Low, Intermediate, and High Speeds

To provide a general basis of reference between target speed and geometric design, three classifications of target speed have been established:

1. **Low Speed is 35 mph and below**. A low target speed selection is ideal for pedestrian and bicycle modal oriented environments. Transportation contexts that include frequent transit stops, intermodal connections, moderate to high intersection density, or moderate to high

access densities may also benefit from lower speed environments. Land use contexts compatible with these modes or serving commercial and/or residential densities may also benefit from a low target speed selection.

2. **Intermediate Speeds are 40 mph and 45 mph**. Intermediate target speed selection is ideal for speed transitions between high and low target speed environments. Transportation environments with low access densities and few at-grade intersections are also examples of where intermediate speed may be appropriate. Consider a higher degree of modal segregation between non-motorized and motorized modes.

   Example: Separated buffer between the traveled way and bicycle lanes. Land use contexts such as rural commercial or suburban connector contexts may benefit from intermediate speed selection, whereas higher-density suburban residential or commercial contexts may not be appropriate for intermediate target speeds.

3. **High Speed is 50 mph and above**. High-speed environments are ideal for Interstate and expressway transportation contexts oriented to motorized vehicular modes, and regional or longer-distance local trips. Consider the highest level of segregation and protection between motorized and non-motorized modal users in multimodal environments with a high target speed selection. Rural connector land use contexts with infrequent farm or residential accesses are consistent with the use of high target speeds.

Corridors with inconsistent land uses occurring in close succession may benefit from selecting a single target speed that will limit the speed variance between vehicles, providing for reliable, adequate mobility while limiting potential undesirable impacts to other modes. Selection of target speed provides for optimization of different modes of travel while providing adequate mobility throughout a given location. This selection will avoid repeated changes to driver expectations and multiple speed transition segments in close succession. Speed management treatments may be necessary to provide driver information that maintains a constant target speed within these corridors.

1103.05(2) Speed Management

Speed management is necessary within many highways to achieve an optimal multimodal transportation environment that will support the land use and transportation contexts. Speed management may also be necessary to maintain consistent or desired speeds between adjacent roadway segments. Design speed transition segment(s) as necessary to achieve desired speeds. Identify the appropriate milepost limits that include potential speed transition segments when scoping the project.

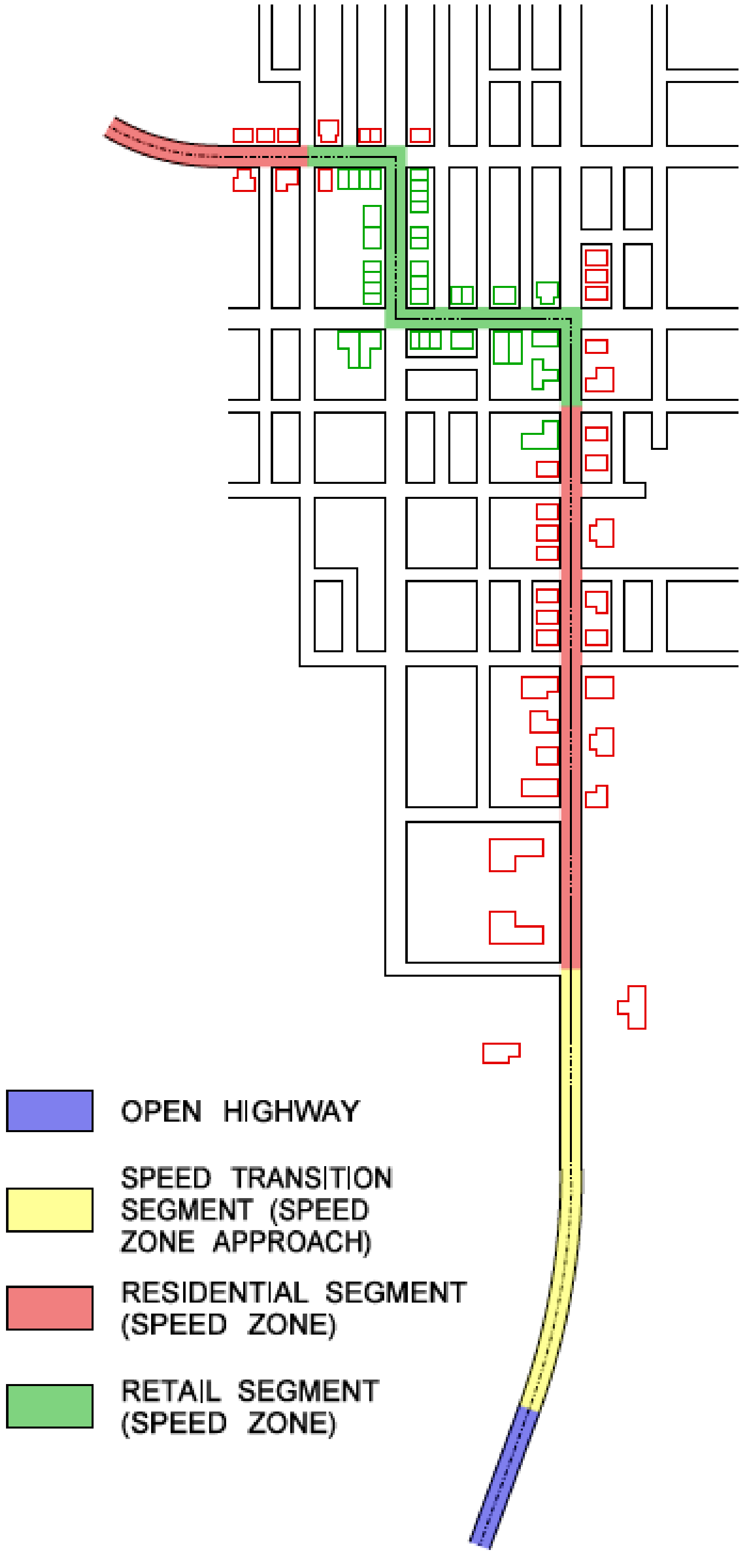
1103.05(2)(a) Speed Transition Segments

Include a speed transition segment where there is a need to obtain a target speed lower than the existing operating speed. A speed transition segment is not needed where existing operating speeds are within 5 mph of the target speed for a given location. Carefully locate the speed transition segment. The transition segment may not always directly precede the speed zone segment as shown in Exhibit 1103-4.

Example: A residential segment could benefit from introducing a speed transition segment farther upstream to increase the likelihood that approaching vehicles operate at the desired speed, for both segments.

The speed transition segment may incorporate a variety of treatments that alert motorists to a changing roadway environment. These treatments are intended to narrow driver focus and/or affect driver decision-making on that segment. Consider the transition segment location and length when providing multiple treatments in a short distance.

Exhibit 1103-4 Speed Transition Segment Example



1103.05(2)(b) Speed Reduction Traffic Calming Treatments

Traffic calming treatments can serve a variety of purposes, from deterring higher volumes of motorized traffic to providing speed management. This section presents traffic calming treatment options to increase the reliability of reducing vehicular speed. Speed reduction traffic calming treatments applied independently or in combination may be beneficial depending on the type and use of the treatments. Many speed management treatments have demonstrated varied effectiveness for single applications. Multiple treatments in series and parallel that build upon the context characteristics are more effective. Contact the Headquarters Design and Traffic offices for any project implementing a speed transition segment, for assistance on selection and monitoring of treatments.

Speed management techniques vary and have different results depending on the speed and types of users at a given location. The following subsections present different options for speed-reducing traffic calming treatments.

1103.05(2)(b)(1) Geometric Treatments

Geometric treatments can include overall changes of the horizontal or vertical geometry to introduce features that will support maintaining the targeted speed. Exhibit 1103-5 shows geometric traffic calming treatments and potential considerations when selecting these types of treatments.

1103.05(2)(b)(2) Roadside and Pavement Treatments

There are a number of treatments that create an environment that influences human factors and perception. Many successful roadside treatments use landscaping in an attempt to achieve the desired behavioral effect. It is important to coordinate with project partners to evaluate landscaping features and provide for traveled way operations and sight lines. The introduction of roadside features like trees, parking, and/or bicycle lanes to alert travelers to a change in conditions may be appropriate. Applying features like vegetated medians or trees is appropriate at some locations and contexts. In landscaping discussions, include Traffic Engineers, Maintenance, Urban Forestry, Landscape Architects, and Human Factors and Safety Experts. If the landscaping proposed is in a managed access segment with local jurisdiction responsibility for the roadside, coordinate to understand the jurisdictions’ capabilities to sustain the landscaping and that it meets their clear zone goals.

Pavement-related treatments can also produce undesirable impacts on other users. For pavement treatments, include Materials Engineers, Maintenance, and ADA Compliance Experts to review what sustainable and effective treatments can be employed.

Exhibit 1103-6 lists roadside and pavement-oriented traffic calming treatments and considerations to evaluate when selecting the appropriate treatments.

Exhibit 1103-5 Geometric Traffic Calming Treatments and Considerations

Treatment	Considerations
Taper for Narrow Lanes	Narrowing the lane width can be achieved by restriping lane lines. A decision to taper in or out may depend on other treatments planned, such as introducing a median or chicanes. Base taper rates on the target speed entering the context or speed transition segment, as appropriate. It is recommended that this be the first treatment employed.
Chicanes/Lane Shifts	This treatment may be achieved with curbed features, like planter strips or striping combined with additional fixed delineators. These treatment types are more appropriate when reducing speeds from an initial intermediate speed or less. When introducing this treatment with initial high speeds, the treatment should utilize paint striping, in addition to using other treatments preceding the chicane/lane shift, rather than constructing hardscape features.
Pinch Points	Applies on intermediate to low target speed situations unless completed with striping or other pavement markings. This treatment uses striping, roadside features, or curb extensions to temporarily narrow the vehicle lane. It is likely more appropriate for maintaining a desired target speed within a segment than as part of a speed transition segment. Pinch points are not appropriate for high-speed segments. Use of pinch-point treatments on intermediate speed segments requires concurrence from the Region Traffic Engineer.
Speed Cushion/Humps/Tables	On state highways, this treatment will likely have limited application, but should not be excluded from consideration. Impacts to freight, transit, and emergency service vehicles need to be evaluated prior to selecting these vertical types of treatments. These treatments may only be used when maintaining a 25 mph target speed within a segment.
Raised Intersections	Raised intersections, similar to other vertical treatments, will have limited application on state highways. This treatment typically has higher costs to construct due to the pavement needs. This treatment may be a good option when a roundabout cannot be accommodated at a narrow intersection. It can also be considered where there is a need to improve visibility of the intersection and modal conflicts, especially at problematic stop control intersections planned to remain in place. This treatment may only be used when maintaining a 25 mph target speed within a segment.
Roundabouts	Roundabouts can be a unique feature, providing reduced serious injury collision potential, traffic calming, and gateway functions. (See Chapter 1320 and the *Roadside Policy Manual* for details on roundabout design,) Roundabouts are effective from a collision reduction and operational perspective, and they provide reduced driver workload, lower speeds, and limited conflict points. They can assist with access management or when turning movements are limited or restricted on a segment. To determine if a roundabout is appropriate at a specific location, follow the Intersection Control Analysis process described in Chapter 1300.

Exhibit 1103-6 Roadside, Streetside, and Pavement-Oriented Traffic Calming Treatments

Treatment	Considerations
Landscaping	Landscaping can be used in conjunction with other treatments to reinforce the surrounding context and the driver's perception of the context. It can also provide width for modal separation. Annual maintenance impacts need to be considered, weighed, and documented prior to selecting types of vegetation to be included.
Raised Vegetated Medians	Introduce a raised vegetated median following other treatments that prepare the driver for this feature. Appropriate for low to intermediate target speed locations and transition segments.
Transverse Rumble Strips	These in-lane rumble strips are intended to alert drivers to a condition change. They are likely placed in conjunction with and prior to traffic signing revisions or in advance of other speed-reducing traffic calming treatments. Appropriate for high, intermediate, or low target speed locations and transition segments.
Optical Speed Markings	This treatment is intended to influence a driver's perception. The treatment consists of 8-inch transverse paint strips within the vehicular lane extending from lane markings (or curb). The striping intervals sequentially decrease, providing the perception of increasing speed, an indication to drivers to slow their operating speed. Optical Speed Markings are ideal for speed transition segments, and are recommended to be applied in conjunction with lane narrowing. Appropriate for high or intermediate target speed locations and transition segments.
Dynamic Warning Systems	This treatment consists of actively alerting motorists about their operating speed. There are many different systems that accomplish this, including portable radar trailers and post-mounted systems. These can be either permanent or temporary installations. Appropriate for all speeds.
Gateways	The intent of a gateway feature is to alert travelers to a context change. A gateway feature is typically found on the edge of cities or towns, but can be used to highlight specific segments within cities or towns. The gateway can be anything from a banner/structure spanning the facility, to artistic work, landscaping, and/or a roundabout at the first intersection approaching a defined environment context. The gateway feature should be developed by the community. It may be of interest to design a gateway feature fitting the cultural and historic character of the location. Consideration for potential fixed object collisions is an important aspect of gateway design. Gateway features that span or are placed within state right of way will need specific approvals, as identified in Chapter 950. Appropriate for low to intermediate target speed locations and transition segments.

1103.06 Control: Terrain Classification

Terrain may limit operational and safety performance for particular modes. While terrain impacts may be addressed at specific locations, it is not cost beneficial to modify terrain continually throughout a corridor. The type of terrain, context, and speed influence the potential operating conditions of the highway, and should be a consideration when selecting mobility performance targets (See Chapter 1101). For more information on grades, see Chapter 1220.

To provide a general reference between terrain and geometric design, three classifications of terrain have been established:

1. **Level:** Level to moderately rolling, this terrain offers few or no obstacles to the construction of a highway having continuously unrestricted horizontal and vertical alignment.
2. **Rolling:** Hills and foothills, with slopes that rise and fall gently; however, occasional steep slopes might offer some restriction to horizontal and vertical alignment.
3. **Mountainous:** Rugged foothills; high, steep drainage divides; and mountain ranges.

Designate terrain as it pertains to the general character along the alignment of a corridor. Roadways in valleys or passes in mountainous areas might have the characteristics of roads traversing level or rolling terrain and are usually classified as level or rolling, rather than mountainous. See the Highway Log for terrain classification.

1103.07 Documentation

Document selections for design controls in Section 3 of the Basis of Design (BOD. For interstate new/reconstruction projects or Projects of Division Interest (PoDI), obtain FHWA approval on the Basis of Design, in addition to other approvals noted in Chapter 300.

1103.08 References

1103.08(1) Federal/State Directives, Laws, and Codes

Secretary's Executive Order 1090 – Moving Washington Forward: Practical Solutions

Secretary's Executive Order 1096 – WSDOT 2015-17: Agency Emphasis and Expectations

Secretary's Executive Order 1028 – Context Sensitive Solutions

1103.08(2) Supporting Information

Designing Walkable Thoroughfares: A Context Sensitive Approach, Institute of Transportation Engineers, Washington D.C., 2010 www.ite.org

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO, Washington, D.C., Current Edition www.transportation.org/Pages/Default.aspx

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