Washington State Department of Transportation — Publications Transmittal

Transmittal Number PT 12-064	Date July 2012
Publication Distribution To: Design Manual holders	
Publication Title Design Manual – July 2012	Publication Number M 22-01.09
Originating Organization WSDOT Development Division, Design Office – Design Policy, Standards, and Safety Research Section	

Remarks and Instructions

What's changed in the Design Manual for July 2012?

For a summary of the 2012 Substantial Revisions, Incorporated Supplements, and Minor Revisions and Technical Errata, see page 3.

How do you stay connected to current design policy?

It's the designer's responsibility to apply current design policy when developing transportation projects at WSDOT. The best way to know what's current is to reference the manual online.

Download the current electronic WSDOT *Design Manual,* the latest revision package, and separate chapters at: www.wsdot.wa.gov/publications/manuals/m22-01.htm

We're ready to help. If you have comments or questions about the Design Manual, please don't hesitate to contact us:

Area of Practice	Your Contacts		
Geometric Design	Chris Workman	360-705-7272	WORKMAC@wsdot.wa.gov
Roadside Safety and Traffic Barriers	Rod Erickson	360-705-7246	ERICKSR@wsdot.wa.gov
	Dave Olson	360-705-7952	OLSONDA@wsdot.wa.gov
General guidance and support	Chris Schroedel	360-705-7299	SCHROEC@wsdot.wa.gov

To get the latest information on individual WSDOT publications:

Sign up for e-mail updates at: www.wsdot.wa.gov/publications/manuals/

HQ Design Office Signature **/s/ Pasco Bakotich III**	Phone Number 360-705-7952

Remove/Insert instructions for those who maintain a printed manual. Note: In addition to the following pages, please also replace your Title Page, Foreword, and Comment Form. They have been revised.

VOLUME 1		
CHAPTER	**REMOVE PAGES**	**INSERT PAGES**
Contents/Exhibits	1–32	1–12
130 Project Development Sequence	130-5–8	130-5–8
210 Public Involvement and Hearings	210-1–6, 13–18, 23–28, 33–36	210-1–6, 13–18, 23–28, 33–36
300 Design Documentation, Approval, and Process Review	300-13&14, 17&18	300-13&14, 17&18
310 Value Engineering	310-1–8	310-1–12
320 Traffic Analysis	320-3&4	320-3&4
510 Right of Way Considerations	510-1–4, 7&8	510-1–4, 7&8
520 Access Control	520-3–6	520-3–6
530 Limited Access Control	530-1–4, 7–12, 17–20	530-1–4, 7–12, 17–20
550 Interchange Justification Report	550-5&6, 13&14, 19&20	550-5&6, 13&14, 19&20
560 Fencing	560-1&2	560-1&2
720 Bridges	720-1–12	720-1–14
730 Retaining Walls and Steep Reinforced Slopes	730-13&14	730-13&14
740 Noise Barriers	740-5&6	740-5&6
1010 Work Zone Safety and Mobility	1010-1–44	1010-1–42
1020 Signing	1020–5&6	1020–5&6
1040 Illumination	1040-9&10, 15&16, 39&40	1040-9&10, 15&16, 39&40
VOLUME 2		
CHAPTER	**REMOVE PAGES**	**INSERT PAGES**
Contents/Exhibits	1–32	1–20
1100 Design Matrix Procedures	Remove 18-page Supplement dated March 2012	1100-1–16
1110 Minor Operational Enhancement Projects	1110-1&2, 5&6	1110-1&2, 5&6
1120 Basic Design Level	Remove 4-page Supplement dated March 2012	1120-1–4
1130 Modified Design Level	1130-13&14	1130-13&14
1140 Full Design Level	1140-1–4, 15–22	1140-1–4, 15–22
1310 Intersections at Grade	1310-23&24	1310-23&24
1320 Roundabouts	1320-19&20	1320-19&20
1420 HOV Direct Access	1420-13&14, 17–20, 31–34	1420-13&14, 17–20, 31–34
1515 Shared-Use Paths	1515-1–18	1515-1–24
1610 Traffic Barriers	1610-13&14, 21–42	1610-13&14, 21–42
1620 DMS incorporation	Remove 24-page Supplement dated August 2011	1620-1–24
1710 Safety Rest Areas	1710-1–6	1710-1–14

Revision marks

- A new date appears on the footer of each page that has changes or new/different pagination.
- Revision marks (underlines/sidebars) are used as a convenience to show designers what has changed.
- When a chapter is new or substantially rewritten (like 1515 or 1710), no revision marks are applied.

Summary of *Design Manual* Changes – July 2012

(Revisions merit careful study beyond this summary)

Highlights of the More Substantial Revisions

Chapter 310 – Value Engineering

- Chapter rewritten based on federal policy. Cost triggers for a VE Analysis remain the same: $20 million bridge project; any project $25 million.

Chapter 720 – Bridges

- Revised guidance on safety considerations for bridge medians on divided highways.
- Updated section on pedestrian and bicycle considerations.
- Updated guidance on screening for highway structures.
- Revised various pages in Chapters 1130 and 1140 based on these changes.

Chapter 1010 – Work Zone Safety and Mobility

- Traffic Office made clarifications to this chapter.
- No new policy has been added.

Chapter 1040 – Illumination

- Traffic Office and Bridge Office updated guidance on bridge inspection lighting.
- Addressed bridge inspection lighting covered in 1040.05(21) and Exhibit 1040-22.

Chapter 1420 – HOV Direct Access

- Added guidance to mitigate wrong-way freeway movements using new Exhibit 1420-21.
- Updated some photos in exhibits.
- Added color to signing exhibits where called for.

Chapter 1515 – Shared-Use Paths

- Added a design speed and minimum curve radius for approaching intersections.
- Updated the path landing requirements.
- Updated exhibits, including new Stopping Sight Distance graphs.
- Made general clarifications and revisions throughout.

Chapter 1610 – Traffic Barriers

- Updated text and exhibits to help clarify WSDOT barrier policy on high-tension cable barrier placement, concrete barrier usage, and curb placement in relation to barrier.
- Some pages re-dated to July 2012 due to changes in pagination.

Chapter 1710 – Safety Rest Areas

- Capital Facilities Office updated guidance on safety rest area design procedures. This replaces the June 2009 chapter in the *Design Manual*; the *Roadside Manual* SRA chapter has been withdrawn and now refers readers to the *Design Manual*.

Incorporated Design Manual Supplements (DMS)

The following Supplements are retired and incorporated as chapters dated July 2012:

March 2012 DMS: Chapters 1100, Design Matrices, and 1120, Basic Design Level

- Chapter 1100 has been further revised: A link has been provided to WSDOT's National Highway System list of routes, which allowed the removal of the static list we maintained in the DM: http://wsdot.wa.gov/mapsdata/grdo_home.htm
- Chapter 1120 is incorporated without any other changes.

August 2011 DMS: Chapter 1620, Attenuators

- This Supplement clarified use and selection options for low-maintenance attenuators.
- Incorporated without change July 2012.

Note: There are no other Supplements in effect as of July 2012 (remove letters lists if you keep a printed manual).

Minor Revisions and Technical Errata

Chapter 130, Project Development Sequence

- Updated links to Executive Orders and Project Management Online Guide.

Chapter 210, Public Involvement and Hearings

- Updated titles of approval authorities.

Chapter 300, Design Documentation, Approval, and Process Review

- Updated titles of approval authorities, updated office name, and clarified proprietary item approval with note.

Chapter 320, Traffic Analysis

- Updated office name.

Chapter 510, Right of Way Considerations

- Updated titles of approval authorities.

Chapter 520, Access Control

- Updated titles of approval authorities.

Chapter 530, Limited Access Control

- Updated titles of approval authorities.

Chapter 550, Interchange Justification Report

- Fixed incorrect chapter reference from 940 to 1360.
- Updated titles of approval authorities.

Chapter 560, Fencing

- Updated title of approval authority.

Chapter 730, Retaining Walls and Steep Reinforced Slopes

- Updated title of approval authority.

Chapter 740, Noise Barriers

- Updated titles of approval authorities.

Chapter 1020, Signing

- Updated references to state route milepost markers, including the *Traffic Manual*.

Chapter 1110, Minor Operational Enhancement Projects

- Provided link to determine if a route is on the National Highway System, since the exhibit list in Chapter 1100 has been withdrawn.

Chapter 1130, Modified Design Level

- Revised Note [8] in Exhibit 1130-10 pertaining to bridge median guidance. (Related to changes made in Chapter 720.)

Chapter 1140 – Full Design Level

- Clarified guidance in Geometric Design Data tables related to shoulder widths on divided highway/freeway: auxiliary lane does not count as a through lane when determining shoulder widths.
- Corrected a link to the functional classification website.
- Added the definition for auxiliary lane.
- Revised several exhibit notes pertaining to Chapter 720 and bridge medians.

Chapter 1310, Intersections at Grade

- Fixed two cells in table in Exhibit 1310-14, where data was misaligned.

Chapter 1320, Roundabouts

- Corrected text reference from Chapter 1520 to Chapter 1515 in regard to shared-use paths.

Washington State Department of Transportation

Design Manual

Volume 1 – Procedures

M 22-01.09

July 2012

Division 1 – General Information
Division 2 – Hearings, Environmental, and Permits
Division 3 – Project Documentation
Division 4 – Surveying
Division 5 – Right of Way and Access Control
Division 6 – Soils and Paving
Division 7 – Structures
Division 8 – Hydraulics
Division 9 – Roadside Development
Division 10 – Traffic Safety Elements

Engineering and Regional Operations
Development Division, Design Office

Americans with Disabilities Act (ADA) Information

This material can be made available in an alternate format by e-mailing the Washington State Department of Transportation (WSDOT) Diversity/ADA Compliance Team at wsdotada@wsdot.wa.gov or by calling toll free, 855-362-4ADA (4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

Title VI Notice to Public

It is WSDOT's policy to ensure no person shall, on the grounds of race, color, national origin, or sex, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its federally funded programs and activities. Any person who believes his/her Title VI protection has been violated may file a complaint with WSDOT's Office of Equal Opportunity (OEO). For Title VI complaint forms and advice, please contact OEO's Title VI Coordinator at 360-705-7082 or 509-324-6018.

To get the latest information on individual WSDOT publications, sign up for e-mail updates at:
www.wsdot.wa.gov/publications/manuals

Foreword

The *Design Manual* is for use by Washington State Department of Transportation engineering personnel. It provides policies, procedures, and methods for developing and documenting the design of improvements to the transportation network in Washington. It has been developed for state facilities and may not be appropriate for all county roads or city streets that are not state highways.

The *Design Manual* supplements the engineering analyses and judgment that must be applied to Improvement and Preservation projects. It provides uniform procedures for documenting and implementing design decisions.

The Federal Highway Administration has agreed to approve designs that follow the guidance in the *Design Manual*; therefore, following the guidance is mandatory for state highway projects. When proposed designs meet the requirements contained in the *Design Manual*, little additional documentation is required.

The design environment changes rapidly, often without warning to the practitioner. To track every change, and to make improvements based upon each change, is not feasible. The intent of this manual is to provide recommended values for critical dimensions. Flexibility is permitted to encourage independent design tailored to individual situations. However, when flexibility is applied to a proposed design and the critical dimensions do not meet *Design Manual* criteria, additional documentation is required to record the decision-making process.

The addition of new or modified design criteria to the *Design Manual* through the revision process does not imply that existing features are deficient or inherently dangerous. Nor does it suggest or mandate immediate engineering review or initiation of new projects.

The *Design Manual* emphasizes cost-effective, environmentally conscious, and context sensitive design. Designers are encouraged to view the highway corridor beyond the vehicular movement context, so guidance regarding the use of the highway corridor by transit, pedestrians, and bicyclists is included. To accommodate multimodal use, the criteria provided for one mode is to be appropriately adapted to individual locations.

The complexity of transportation design requires the designer to make fundamental trade-off decisions that balance competing considerations. Although this adds to the complexity of design, it acknowledges the unique needs of specific projects and the relative priorities of various projects and programs. Improvements must necessarily be designed and prioritized in light of finite transportation funding.

Updating the *Design Manual* is an ongoing process and revisions are issued regularly. Comments, questions, and improvement ideas are welcomed. Use the comment form on the following page, or the online version at the Design Policy Internet Page: www.wsdot.wa.gov/design/policy

/s/ Pasco Bakotich III

Pasco Bakotich III, P.E.
Director & State Design Engineer,
Development Division

Comment Form

From: ______________________ Date: ______________

______________________ Phone: ______________

____

To: WSDOT Headquarters
Development Division, Design Office
Attn: Policy, Standards, and Research Section
PO Box 47329
Olympia, WA 98504-7329

Subject: *Design Manual* Comment

Comment (marked copies attached):

Volume 1 – Procedures Contents

Division 1 – General Information

Division 2 – Hearings, Environmental, and Permits

Division 6 – Soils and Paving

Division 9 – Roadside Development

Division 10 – Traffic Safety Elements

Executive Order E 1028.02 directs the department to adopt the principle of context sensitive solutions as a method that allows planners, programmers, and designers to best optimize the conditions and resources in the project vicinity. Planners, programmers, and designers are directed to:

- Engage with representatives of the affected communities from the project's inception.
- Ensure transportation objectives are clearly described and discussed with local communities in a process that encourages communication.
- Pay attention to and address community and citizen concerns.
- Ensure the project is a safe facility for both users and the community.

The following sections discuss the project development sequence.

(1) Washington State Highway System Plan (HSP)

The HSP is the modal element of the Washington Transportation Plan (WTP) that addresses the state highway system. The HSP, managed by the HQ Systems Analysis and Program Development (SA&PD) Section of the HQ Strategic Planning and Programming Division, includes a comprehensive assessment of existing and projected 20-year needs of the state highway system. Preservation of existing assets and safety, mobility, freight, bicycle, and pedestrian issues are among the 20-year needs. The HSP also lists potential solutions addressing these needs.

The SA&PD Section has the lead role in identifying state highway needs through coordination with WSDOT Headquarters, various technical groups, and region planning offices that coordinate with external Regional Transportation Planning Organizations (RTPOs) and Metropolitan Planning Organizations (MPOs). The SA&PD Section develops a 20-year plan of construction needs.

The HSP identifies the following four major programs used to manage the state-owned transportation system:

- Maintenance Program (M)
- Traffic Operations Program (Q)
- Preservation Program (P)
- Improvement Program (I)

You can access the HSP at: www.wsdot.wa.gov/planning/hsp.htm

(2) Highway Construction Program

In every odd-numbered year, the Legislature meets to consider and pass a Transportation Budget. One piece of this budget is funding for the Highway Construction Program. In order to control expenditures and track budget dollars and commitments, WSDOT groups capital projects into programs, subprograms, and categories based on the action strategies, objectives, and goals in the HSP. The department has identified three subprograms within the Preservation Program and six subprograms within the Improvement Program, four of which are shown in Exhibit 130-2.

(a) **Prioritizing Project Needs and Solutions**

Based on the Strategic Plan, WSDOT uses the following elements for future investments in Washington's transportation system:

- Preservation of existing assets
- Safety
- Mobility, including special needs transportation
- Economic vitality
- Environment quality and health
- Stewardship

With the Highway System Plan, WSDOT has developed an incremental tiered approach to address project needs. This approach separates strategies into three investment tiers to be implemented incrementally over the life of the 20-year plan, to maximize performance improvement for every dollar invested.

The tiered approach was developed to address emerging congestion and provide interim relief when funding for major improvement work is limited. The three tiers include:

1. **Tier I**

   Focuses on low-cost projects that deliver a high return on capital investment and have short delivery schedules. These include incident management, Intelligent Transportation Systems, access management projects, ramp modifications, turn lanes, and intersection improvements.

2. **Tier II**

   Focuses on moderate- to higher-cost projects that deliver potential network benefits to both highways and local roads. These include improvements to parallel corridors (including local roads) and adding auxiliary lanes and direct access ramps.

3. **Tier III**

   Focuses on highest-cost projects that can deliver corridor-wide benefits. These include commuter rail, HOV/HOT lanes, and interchange modifications. (See the Highway System Plan online for more information.)

This tiered approach is consistent with legislative direction provided in RCW47.05.010.

(b) **Background Information**

The HQ Systems Analysis and Program Development (SA&PD) Section begins the prioritization process for a category of work, as required by state law, by identifying the potential benefit(s) associated with solving the needs. There are insufficient resources of time and money to analyze the benefits and costs of all needs in each category of the Highway System Plan each biennium, so an initial ranking system is used to reduce the effort. Because the primary objective of WSDOT's prioritization process is to provide the most beneficial improvement for the least possible cost, needs in each category are ranked based on their potential to provide a benefit. The process is as follows:

1. The HQ SA&PD Section works with the technical experts at Headquarters to develop the ranked lists and forwards them to the region program managers for their actions. They also place the lists of needs on the department's internal website with instructions on what to do with the ranked lists.
2. The regions scope projects to address the identified needs. The biennial programming instructions provide guidance to the regions on how far down the ranked "needs lists" to go.

   To obtain a consistent approach and eligibility for federal funding, WSDOT has developed a set of design matrices. Each design matrix sets forth the level of development for a given type of need that would be automatically approved by the department and FHWA (see Chapters 1100 and 1110).

   WSDOT has also developed a tool using GIS called the Transportation Analysis Business Area of the GIS Workbench. This tool provides users a common source of consistent data statewide.
   http://wwwi.wsdot.wa.gov/gis/supportteam/gis_workbench/default.asp

   Design teams and managers are encouraged to use the WSDOT *Project Management Online Guide* to map out the direction and the expectations for the project (www.wsdot.wa.gov/projects/projectmgmt/pmog.htm). They are also encouraged to make use of GIS and the Transportation Analysis Business Area of the GIS Workbench to analyze transportation and environmental resource data in the project area.
3. The regions prepare a cost estimate for the approved scope of work and compare the cost to the potential benefit in order to determine which projects are the most beneficial to construct.

In order to minimize disruptions to the public and take advantage of cost savings, the department may adjust priorities by combining solutions to HSP-identified needs into a single contract. However, adjusting priorities is generally limited to a six-year period.

(c) Building the Program

The basic building blocks for the Highway Construction Program are the project phases in the Capital Improvement and Preservation Program (CIPP).

1. Carry-Forward Projects

"Carry-forward" project commitments typically represent job phases that will continue into the next biennium.

The "book-building process," which includes a list of projects that will be started, continued, or completed in the next biennium, starts with carry-forward projects.

The regions need to review carry-forward projects and determine the potential for project delays and cost overruns in the current biennium that could affect the next biennium. Maintain close coordination between the region, the HQ Project Control and Reporting Office, the HQ SA&PD Section, the Project Development Engineer, and the Construction Engineer to ensure projects under development and under construction are accomplished as planned.

2. **New Improvement Projects**

    New Improvement project phase starts are proposed based on improvement(s) in system performance and the cost-effectiveness of the proposed project. These new project starts represent needs that are identified in the Highway System Plan (HSP). The HQ SA&PD Section determined the needs the regions will develop projects to solve. Once Headquarters has established the level of needs to scope, the regions will begin scoping projects for the Highway Construction Program. Note: Regions cannot propose a project unless a need has been identified in the HSP.

    After the new projects have been selected and the carry-forward projects identified and their planned expenditures and schedules verified, the program of projects is developed and the project data is inputted into CPMS for balancing to the projected revenue—for both dollars and workforce (FTEs). Project summaries are then developed to document the proposed scope. The program of projects is shared with region executives and their input is incorporated. Adjustments are made to ensure the program can be accomplished within the constraints of the available workforce and facilities in the region.

(d) **Roles and Responsibilities Within WSDOT for Developing the Highway Construction Program**

WSDOT regions, working with support offices such as Environmental, Utilities, Right of Way, and Construction, develop and design the projects that deliver the transportation program. Designers have a tool called the *Project Management Online Guide* to assist with the process:
www.wsdot.wa.gov/projects/projectmgmt/pmog.htm

Executive Order 1032.01 directs the department to ensure capital projects are consistent with the principles of the project management process.

Executive Order 1028.02 directs the department to use the principles of context sensitive solutions (CSS), which includes public outreach, coordination, and collaborative decision making. Designers are encouraged to consider the public outreach process in the project work plan. WSDOT has developed a website resource to assist designers:
www.wsdot.wa.gov/design/policy/csdesign.htm

The HQ Budget and Financial Analysis Office and various offices in the HQ Strategic Planning and Programming Division share responsibility for developing a capital investment plan. The plan includes a forecast of available revenue by fund source and recommends investment levels based on the Washington Transportation Plan. The HQ Systems Analysis and Program Development (SA&PD) Section issues programming instructions, based on the preliminary budget targets, which assist the regions as they begin scoping highway projects.

Once a ten-year plan has been determined and the proposed projects scoped, the SA&PD Section finalizes a budget request, including a project list for submittal to the Legislature. The Legislature sets funding levels for the different programs within WSDOT that will deliver the project list for the funding amount identified in the scoping document.

Chapter 210 Public Involvement and Hearings

210.01 General

The Washington State Department of Transportation (WSDOT) strives to keep the public informed about transportation issues, involve the public in transportation decision making, and make transportation decisions based on the public's best interests.

One of the best ways to achieve WSDOT's goals is to collaborate with the public, community groups, and various agencies. These participants often have differing, and sometimes conflicting, perspectives and interests. In addition, many participants and organizations are not able to spend the time and effort required to fully engage in transportation decision making. Despite these challenges, active collaboration:

- Gives WSDOT access to important information and new ideas.
- Puts us in a position to help solve problems and resolve conflicts.
- Creates a sense of community.
- Fosters greater acceptance of projects.
- Helps us build and sustain a credible and trusting relationship with the public.
- Ultimately leads to transportation improvements that better meet the public's needs and desires.

When collaborating with the public about transportation projects or issues, WSDOT uses more formal techniques like public hearings, direct mail, and presentations to city councils and legislators; as well as less formal but equally important techniques, like telephone and e-mail discussions, meetings with community groups, media relations, and project Internet pages.

Law requires that many types of capital transportation projects go through a formal public hearing process; thus, the legal procedures necessary for public hearings is the primary focus of this chapter. Public involvement plans are briefly discussed, and referrals to WSDOT's communications resources are included to further guide their development and implementation.

210.02 References

(1) Federal/State Laws and Codes

United States Code (USC) Title 23, Highways, Sec. 128, Public hearings

USC Title 23, Highways, Sec. 771.111, Early coordination, public involvement, and project development

23 Code of Federal Regulations (CFR) 200.7, FHWA Title VI Policy

23 CFR 200.9(b)(4), Develop procedures for the collection of statistical data of participants and beneficiaries of state highway programs

23 CFR 200.9(b)(12), Develop Title VI information for dissemination to the general public

23 CFR 450.212, Public involvement

28 CFR Part 35, Nondiscrimination on the basis of disability in state and local government services

49 CFR Part 27, Nondiscrimination on the basis of disability in programs or activities receiving federal financial assistance

Americans with Disabilities Act of 1990 (ADA) (28 CFR Part 36, Appendix A)

Civil Rights Restoration Act of 1987

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency

Revised Code of Washington (RCW) 47.50, Highway Access Management

RCW 47.52, Limited Access Facilities

Section 504 of the Rehabilitation Act of 1973, as amended

Title VI of the Civil Rights Act of 1964

(2) Design Guidance

Design Manual, Chapter 220, for environmental references, and Division 14 chapters for access control and right of way references

Environmental Procedures Manual, M 31-11
www.wsdot.wa.gov/Publications/Manuals/M31-11.htm

WSDOT Headquarters (HQ) Development Services & Access Manager, (360) 705-7251 – home page:
www.wsdot.wa.gov/Design/accessandhearings

(3) Supporting Information

Improving the Effectiveness of Public Meetings and Hearings, Federal Highway Administration (FHWA) Guidebook

Public Involvement Techniques for Transportation Decision-Making, FHWA September 1996; provides tools and techniques for effective public involvement:
www.fhwa.dot.gov/reports/pittd/cover.htm

Relocation brochures: www.wsdot.wa.gov/realestate

WSDOT *Communications Manual* for public involvement:
www.wsdot.wa.gov/Communications/

WSDOT Context Sensitive Solutions Internet site and national context sensitive site:
www.wsdot.wa.gov/biz/csd/ExecutiveOrder.htm
www.contextsensitivesolutions.org/

210.03 Definitions

affidavit of publication A notarized written declaration stating that a ***notice of hearing*** (or ***notice of opportunity for a hearing***) was published in the legally prescribed manner.

affidavit of service by mailing A notarized written declaration stating that the limited access hearing packet was mailed at least 15 days prior to the hearing and entered into the record at the hearing.

auxiliary aids and services (1) Qualified interpreters, notetakers, transcription services, written materials, telephone handset amplifiers, assistive listening devices, assistive listening systems, telephones compatible with hearing aids, open and closed captioning, telecommunications devices for deaf persons (TDDs), videotext displays, or other effective methods for making aurally delivered materials available to individuals with hearing limitations; (2) Qualified readers, taped texts, audio recordings, Brailled materials, large print materials, or other effective methods for making visually delivered materials available to individuals with visual impairments; (3) Acquisition or modification of equipment or devices; (4) Other similar services and actions; and (5) Providing and disseminating information, written materials, and notices in languages other than English, where appropriate.

context sensitive solutions (CSS) *A collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic, and environmental resources while maintaining safety and mobility. CSS is an approach that considers the total context within which a transportation improvement project will exist*.* (See 210.02 and 210.04(2) for more information.)

*From *"Understanding Flexibility in Transportation Design – Washington,"* WSDOT, April 2005

court reporter A person with a license to write and issue official accounts of judicial or legislative proceedings.

findings and order A document containing the findings and conclusions of a limited access hearing approved by the Assistant Secretary, Engineering & Regional Operations (see 210.09(12) and (13)).

hearing An assembly to which the public is invited and at which participation is encouraged. Types of hearings include:

- ***administrative appeal hearing*** A formal process whereby a property owner may appeal WSDOT's implementation of access management legislation. The appeal is heard by an administrative law judge (ALJ), who renders a decision. (See Chapter 540 for administrative appeal hearing procedures.)

- ***combined hearing*** A hearing held when there are public benefits to be gained by combining environmental, corridor, design, and/or limited access subjects.
- ***corridor hearing*** A formal or informal hearing that presents the corridor alternatives to the public for review and comment before a commitment is made to any one route or location. This type of hearing is beneficial for existing corridors with multiple Improvement projects programmed over a long duration.
- ***design hearing*** A formal or informal hearing that presents the design alternatives to the public for review and comment before the selection of a preferred alternative.
- ***environmental hearing*** A formal or informal hearing documenting that social, economic, and environmental impacts have been considered and that public opinion has been solicited.
- ***limited access hearing*** A formal hearing that gives local public officials, owners of abutting properties, and other interested persons an opportunity to be heard about the limitation of access to the highway system.
- ***formal hearing format*** A hearing conducted by a moderator using a formal agenda, overseen by a hearing examiner, and recorded by a court reporter, as required by law. Limited access hearings require the use of the formal hearing format (see 210.05(3)).
- ***informal hearing format*** A hearing where oral comments are recorded by a court reporter, as required by law. An informal hearing often uses the "open house" format (see 210.04(1)(a)). A formal agenda and participation by a hearing examiner are optional.

hearing agenda An outline of the actual public hearing elements, used with formal hearings. (See 210.05(9)(a) for contents.)

Hearing Coordinator The Development Services & Access Manager within the HQ Access and Hearings Section, (360) 705-7251.

hearing examiner An administrative law judge from the Office of Administrative Hearings, or a WSDOT designee, appointed to moderate a hearing.

hearing script A written document of text to be presented orally by department representatives at a hearing.

hearing summary Documentation prepared by the region and approved by Headquarters that summarizes environmental, corridor, and design hearings. (See 210.05(10) for content requirements.)

hearing transcript A document prepared by the court reporter that transcribes verbatim all oral statements made during the hearing, including public comments. This document becomes part of the official hearing record.

NEPA National Environmental Policy Act.

notice of appearance A form provided by WSDOT for anyone wanting to receive a copy of the findings and order and the adopted limited access plan (see 210.09(3) and (8)).

notice of hearing (or ***hearing notice***) A published advertisement that a public hearing will be held.

notice of opportunity for a hearing An advertised offer to hold a public hearing.

order of hearing The official establishment of a hearing date by the Director & State Design Engineer, Development Division.

prehearing packet A concise, organized collection of all necessary prehearing data, prepared by the region and approved by the HQ Development Services & Access Manager prior to the hearing (see 210.05(4) and Exhibit 210-3).

project management plan A formal, approved document that defines how the project is executed, monitored, and controlled. It may be in summary or detailed form and may be composed of one or more subsidiary management plans and other planning documents. For further information, see the *Project Management Online Guide*: www.wsdot.wa.gov/Projects/ProjectMgmt/Process.htm

public involvement plan A plan to collaboratively involve the public in decision making, tailored to the specific needs and conditions of a project and the people and communities it serves. It is often part of a broader communications plan.

relocation assistance program A program that establishes uniform procedures for relocation assistance that will ensure legal entitlements and provide fair, equitable, and consistent treatment to persons displaced by WSDOT-administered projects, as defined in the *Right of Way Manual*.

résumé An official notification of action taken by WSDOT following adoption of a findings and order (see 210.09(14)).

SEPA State Environmental Policy Act.

study plan A term associated with environmental procedures, this plan proposes an outline or "road map" of the environmental process to be followed during the development of a project that requires complex NEPA documentation. (See 210.06 and the *Environmental Procedures Manual*.)

210.04 Public Involvement

Developing and implementing an effective plan for collaboration with the public:

- Is critical to the success of WSDOT's project delivery effort.
- Provides an opportunity to understand and achieve diverse community and transportation goals.

Effective public involvement must begin with clearly defined, project-related goals that focus on specific issues, specific kinds of input needed, and specific people or groups that need to be involved. The more detailed a public involvement plan, the greater its chances of obtaining information WSDOT can use in decision making.

Transportation projects with high visibility or community issues or effects often attract the attention of a broad range of interested people. These types of projects will best benefit from early public involvement, which can influence the project's success and community acceptance.

Developing a profile (through demographic analysis) of the affected community is critical to achieving successful public involvement and should be the first order of business when developing a public involvement plan. The profile will enable the department to tailor its outreach efforts toward the abilities and needs of the community.

historically they have experienced barriers to participation in the public decision-making process and are therefore underrepresented. These barriers arise from both the historical nature of the public involvement process and from cultural, linguistic, and economic differences. For example, a community made up of largely senior citizens (with limited mobility/automobile usage) may mean:

- Meetings/open houses are planned in locations easily accessible to them, such as senior centers and neighborhood community centers.
- Meetings are scheduled in the mornings or midday to accommodate individuals who prefer not to leave home after dark.
- Meetings are scheduled in the evenings to accommodate persons who work during the day.

A project's affected area might consist of a population with limitations in speaking or understanding English. This may entail:

- Developing/disseminating materials in other languages, as appropriate.
- Having a certified translator on hand at the meetings.

Extra effort may be needed to elicit involvement from people unaccustomed to participating in the public involvement process. They often have different needs and perspectives than those who traditionally participate in transportation decision making, and they may have important, unspoken issues that should be heard. They not only may have greater difficulty getting to jobs, schools, recreation, and shopping than the population at large, but also they are often unaware of transportation proposals that could dramatically change their lives.

NEPA and SEPA environmental policies and procedures are intended to provide relevant environmental information to public officials, agencies, and citizens, and allow public input to be considered before decisions are made. There are also various other laws, regulations, and policies that emphasize public involvement, including 23 CFR, Title VI of the Civil Rights Act, the Americans with Disabilities Act, and Executive Orders 12898 and 13166.

WSDOT's collaborative process with the public should be open, honest, strategic, consistent, inclusive, and continual. Initiating a project in an atmosphere of collaboration and partnership can go a long way toward providing equal opportunities for all parties (local, state, tribal, private, nonprofit, or federal) to participate in a project vision. This collaboration requires an intensive communications effort that is initiated during project visioning and extends through construction and eventual operation of the facility.

Department specialists in public communications, environmental procedures, traffic engineering, real estate services, and limited access control are routinely involved with public outreach efforts and project hearings. Depending on the scale and complexity of a project, the region is encouraged to engage the participation of interdisciplinary experts when developing a public involvement plan and communicating project details.

- Specified comment period
- Hearing summary (see 210.05(10))

In addition to providing oral comments, people can write opinions on the comment forms available at or after the hearing and submit them before the announced deadline.

(b) **Informal Hearings**

An informal hearing is also known as an open format hearing. Individual oral comments are recorded by a court reporter. The presence of a hearing examiner and a formal agenda are optional.

These events are typically scheduled for substantial portions of an afternoon or evening so people can drop by at their convenience and fully participate. Activities usually include attending a presentation, viewing exhibits, talking to project staff, and submitting written or oral comments.

The following items are features of an open format (or informal) hearing:

- They can be scheduled to accommodate people's work schedules.
- Brief presentations about the project and hearing process are advertised at preset times in the hearing notice. Presentations can be live, videotaped, or computerized.
- Agency or technical staff is present to answer questions and provide details of the project.
- Information is presented buffet-style, allowing participants access to specific information.
- Graphics, maps, photos, models, videos, and related documents are frequently used.
- People have the opportunity to clarify their comments by reviewing materials and asking questions before commenting.
- People can comment formally before a court reporter, or they can write opinions on comment forms and submit them before the announced deadline.

(4) Hearing Preparation

When region staff have determined that a formal or informal public hearing will be held, they should contact the HQ Hearing Coordinator to discuss preliminary details. The HQ Hearing Coordinator specializes in assisting with preparations for the hearing and will usually attend. Other WSDOT groups involved with the project and tasked with developing and implementing the public involvement plan can assist with hearing preparations and provide assistance at the hearing.

The exhibits in this chapter can be used as checklists to identify important milestones and work products needed. Important elements include setting an initial target date for the hearing and agreeing on staff roles and responsibilities at the hearing.

(a) **Setting the Hearing Date and Other Arrangements**.

The Director & State Design Engineer, Development Division, sets the hearing date at the recommendation of the HQ Hearing Coordinator. This is known as the order of hearing. Final arrangements for the hearing date can be handled by telephone or brief check-in meetings between the HQ Hearing Coordinator and the region.

The region proposes a hearing date based on the following considerations:

- Convenient for community participation. Contact local community and government representatives to avoid possible conflict with local activities. Consider times and locations that are most appropriate for the community.
- For corridor and design hearings, at least 30 days after circulation of the draft environmental impact statement (DEIS) or the published notice of availability of any other environmental document.
- In most cases, more than 45 days after submittal of the prehearing packet.

The region makes other arrangements as follows:

- Reviews the location of the hearing hall to ensure it is easily accessed by public transportation (whenever possible), convenient for community participation, and ADA accessible.
- Arranges for a court reporter.
- Requests that the HQ Hearing Coordinator provide a hearing examiner for all limited access hearings and for other hearings, if desired.
- Develops a hearing agenda for all limited access hearings and for other types of hearings, if desired.
- If requested in response to the hearing notice, provides communication auxiliary aids and other reasonable accommodations required for persons with disabilities. Examples include interpreters for persons who are deaf; audio equipment for persons who are hard of hearing; language interpreters; and the use of guide animals and Braille or taped information for persons with visual impairments.
- All public hearings and meetings require the development of procedures for the collection of statistical data (race, color, sex, and national origin) on state highway program participants and beneficiaries such as relocatees, impacted citizens, and affected communities. Public Involvement Forms should be available for meeting attendees to complete. This form requests attendees to provide information on their race, ethnicity, national origin, and gender. It is available in English, Spanish, Korean, Russian, Vietnamese, Tagalog, and Traditional and Simplified Chinese at:
  www.wsdot.wa.gov/equalopportunity/PoliciesRegs/titlevi.htm
- If demographics indicate that 5% or 1000 persons or more in the affected project area speak a language other than English, vital documents, advertisements, notices, newspapers, mailing notices, and other written and verbal media and informational materials may need to be translated into other languages to ensure social impacts to communities and people are recognized and considered throughout the transportation planning and decision-making process. In addition, language interpreters may need to be present during the hearings or public meetings to ensure individuals and minority communities are included throughout the process.

(b) **Developing the Prehearing Packet**

The region prepares a prehearing packet, which contains an organized grouping of project information to be used at the hearing. The project team members and specialists enlisted to support the public involvement and hearing processes typically coordinate to produce the prehearing packet elements. Much of the information needed in the prehearing packet will come from the project's public involvement plan.

The following information is included in the prehearing packet:

1. **Project Background Information and Exhibits**

   A project vicinity map and pertinent plans and exhibits for the hearing. The prehearing packet also contains a brief written narrative of the project. Usually, this narrative is already prepared and available in Project File documents, public involvement plans, or on a project Internet page.

2. **Proposed Hearing Type, Format, and Logistics**

   The prehearing packet identifies the type of hearing required. A hearing support team provides various planning details and helps with arrangements (date, time, place, and announcements). A public open house is often scheduled on the same day, preceding a formal hearing, to provide opportunity for community involvement.

3. **News Release**

   The region Communications Office can assist in preparing announcements for the hearing and other public events.

4. **Legal Hearing Notice**

   Notices must contain certain legal statements provided by the HQ Access and Hearings Section. (See 210.05(5) and (6) for guidance on notices.)

5. **List of Newspapers and Other Media Sources**

   These are the media sources used to announce the hearing. The region Communications Office has developed relations with reporters and media outlets, including minority publications and media, and is accustomed to working these issues. Enlist the office's support for hearing preparations.

6. **List of Legislators and Government Agencies Involved**

   Special notice is sent to local officials and legislators announcing public hearings. At formal hearings, the moderator and agenda typically identify those officials so they can interact with the public. The HQ Government Relations Office can assist with identifying and notifying legislators and key legislative staff within the project area.

7. **The Hearing Agenda and Script**

   These are required for formal hearings and are prepared by the region. The HQ Access and Hearings Section can provide sample agendas and scripts to support the region in its hearing preparations.

Exhibit 210-3 provides a checklist of prehearing packet contents, including additional items needed for limited access hearings.

(c) **Preparing and Sending a Prehearing Packet**

You should prepare a prehearing packet at least 45 days in advance of the public hearing and send it to the HQ Access and Hearings Section. The HQ Hearing Coordinator reviews and concurs with the region's plans and recommends the Director & State Design Engineer, Development Division's approval of the hearing date. Headquarters concurrence with the prehearing packet typically requires two weeks after receipt of the information.

(5) Public Hearing Notices: Purpose and Content

There are two types of public notices for hearings: notice of hearing and notice of opportunity for a hearing. Consult the HQ Hearing Coordinator for specific project hearing requirements and implementation strategies.

(a) **Notice of Hearing**

A notice of hearing is prepared and published when a hearing is required by law and cannot be waived.

(b) **Notice of Opportunity for a Hearing**

In select cases, a notice of opportunity for a hearing is prepared and published in order to gauge the public's interest in having a particular hearing. This kind of notice is only used if the requirements for a hearing can be legally waived. In these cases, documentation is required as set forth in 210.05(7).

(c) **Content Requirements**

The HQ Access and Hearings Section provides sample notices to the region upon request. Public notices include statements that are required by state and federal statutes. Some important elements of a notice include the following:

- A map or graphic identifying project location and limits.
- For a notice of opportunity for a hearing, include the procedures for requesting a hearing and the deadline, and note the existence of the relocation assistance program for persons or businesses displaced by the project.
- For an environmental, corridor, design, or combined corridor-design hearing, or for a notice of opportunity for a hearing, announce the availability of the environmental document and accessible locations.
- Project impacts to wetlands; flood plains; prime and unique farmlands; Section 4(f), 6(f), or 106 properties; endangered species or related habitats; or affected communities.
- Information on any associated prehearing presentation(s).
- Americans with Disabilities Act and Title VI legislation statements.

(6) Publishing Hearing Notices: Procedure

To advertise a legal notice of hearing or a notice of opportunity for a hearing, use the following procedure for appropriate media coverage and timing requirements:

(a) **Headquarters Concurrence**

As part of the prehearing packet, the region transmits the proposed notice and a list of the newspapers in which the notice will appear to the HQ Hearing Coordinator for concurrence prior to advertisement.

(b) **Region Distribution of Hearing Notice**

Upon receiving Headquarters concurrence, the region distributes copies of the hearing notice and news release as follows:

- Send a copy of the hearing notice and a summary project description to appropriate legislators and local officials one week before the first publication of a hearing notice. Provide the HQ Government Relations Office with a copy of all materials that will be distributed to legislators, along with a list of legislative recipients.
- Advertise the hearing notice in the appropriate newspapers within one week following the mailing to legislators. The advertisement must be published in a newspaper with general circulation in the vicinity of the proposed project or with a substantial circulation in the area concerned, such as foreign language and local newspapers. If affected limited-English-proficient populations have been identified, other foreign language newspapers may be appropriate as well. The legal notices section may be used or, preferably, a paid display advertisement in a prominent section of the newspaper, such as the local news section. With either type of advertisement, request that the newspaper provide an affidavit of publication.
- Distribute the project news release to all appropriate news media about three days before the first publication of a hearing notice, using newspapers publishing the formal advertisement of the notice.
- Additional methods may also be used to better reach interested or affected groups or individuals, including notifications distributed via project e-mail lists, ads in local community news media, direct mail, fliers, posters, and telephone calls.
- For corridor and design hearings, the first notice publication must occur at least 30 days before the date of the hearing. The second publication must be 5 to 12 days before the date of the hearing (see Exhibit 210-4). The first notice for a corridor or design hearing shall not be advertised prior to public availability of the draft environmental document.
- For limited access and environmental hearings, the notice must be published at least 15 days prior to the hearing. The timing of additional publications is optional (see Exhibit 210-5).
- For a notice of opportunity for a hearing, the notice must be published once each week for two consecutive weeks. The deadline for requesting a hearing must be at least 21 days after the first date of publication and at least 14 days after the second date of publication.
- A copy of the published hearing notice is sent to the HQ Hearing Coordinator at the time of publication.

(c) **Headquarters Distribution of Hearing Notice**

The HQ Hearing Coordinator sends a copy of the notice of hearing to the Transportation Commission, Attorney General's Office, HQ Communications Office, and FHWA (if applicable).

For a summary of the procedure and timing requirements, see Exhibit 210-4 (for environmental, corridor, and design hearings) or Exhibit 210-5 (for limited access hearings).

(7) No Hearing Interest: Procedure and Documentation

As described in 210.05(5), in select cases the region can satisfy certain project hearing requirements by advertising a notice of opportunity for a hearing. This procedure can be beneficial, particularly with limited access hearings in cases where very few abutting property owners are affected. If no hearing requests are received after issuing the notice of opportunity, the following procedures and documentation are required to waive a hearing.

(a) Corridor or Design Hearing

If no requests are received for a corridor or design hearing, the region transmits a package, which includes the notice of opportunity for a hearing, the affidavit of publication of the notice, and a letter stating that there were no requests for a hearing, to the HQ Access and Hearings Section.

(b) Limited Access Hearing

When a notice of opportunity for a hearing is used to fulfill the requirements for a limited access hearing and there are no requests for a hearing, the following steps are taken:

- The region must secure signed hearing waivers from every abutting property owner whose access rights will be affected by the project, as well as the affected local agency. The HQ Access and Hearings Section can supply a sample waiver to the region.
- The Project Engineer must contact every affected property owner of record (not tenant) and the local agency to explain the proposed project. This explanation must include information on access features, right of way acquisition (if any), and the right to a hearing. Property owners must also be advised that signing the waiver will not affect their right to fair compensation for their property, nor will it affect their access rights or relocation benefits.
- The region transmits the original signed waivers to the HQ Access and Hearings Section, along with the affidavit of publication of the notice of opportunity for a limited access hearing and a recommendation for approval of the right of way plan. Once the completed package is received by the HQ Access and Hearings Section, it is submitted to the Director & State Design Engineer, Development Division, for review and approval.

(c) Environmental Hearing

Environmental hearings cannot use the process of waivers to satisfy project hearing requirements.

(8) Prehearing Briefs and Readiness

After publication of a hearing notice, the region should expect to receive public requests for information and project briefings, including requests for information in languages other than English.

(a) Presentation of Material for Inspection and Copying

The information outlined in the hearing notice and other engineering and environmental studies, as well as information intended to be presented at the hearing, must be made available for public review and copying throughout

(1) Environmental Hearing Summary

The environmental hearing summary includes the items outlined in 210.05(10).

(2) Adoption of Environmental Hearing

Chapter 220 and the *Environmental Procedures Manual* provide guidance on NEPA and SEPA procedures, documentation requirements, and approvals.

210.07 Corridor Hearing

A corridor hearing is a public hearing that:

- Is held before WSDOT is committed to a preferred alternative establishing the final route corridor.
- Is held to ensure opportunity is afforded for effective participation by interested persons in the process of determining the need for and location of a state highway.
- Provides the public an opportunity to present views on the social, economic, and environmental effects of the proposed alternative highway corridors.

A corridor hearing is required if any of the following project actions would occur:

- Proposed route on new location.
- Substantial social, economic, or environmental impacts.
- Significant change in layout or function of connecting roads or streets.

When a corridor hearing is held, the region must provide enough design detail on the proposed alignment(s) within the corridor(s) that an informed presentation can be made at the hearing. Justification to abandon an existing corridor must also be presented.

For general procedures and notification requirements, see 210.05 and Exhibit 210-4.

(1) Corridor Hearing Summary

After the hearing, the region:

- Reviews the hearing transcript.
- Responds to all questions or proposals submitted at or subsequent to the hearing.
- Compiles a corridor hearing summary.
- Transmits three copies (four copies for Interstate projects) to the HQ Access and Hearings Section.

When appropriate, the hearing summary may be included in the FEIS. If not included, submit the complete corridor hearing summary to the HQ Access and Hearings Section within approximately two months following the hearing.

The corridor hearing summary includes the items outlined in 210.05(10).

(2) Adoption of Corridor Hearing Summary

The HQ Access and Hearings Section prepares a package that contains the corridor hearing summary and a formal description of the project and forwards it to the Assistant Secretary, Engineering & Regional Operations, for adoption. The HQ Hearing Coordinator notifies the region when adoption has occurred and returns an approved copy to the region.

210.08 Design Hearing

A design hearing is a public hearing that:

- Is held after a route corridor is established and approved, but before final design of a highway is engineered.
- Is held to ensure an opportunity is afforded for the public to present its views on each proposed design alternative, including the social, economic, and environmental effects of those designs.

A design hearing is required if any of the following project actions will occur:

- Substantial social, economic, or environmental impacts.
- Significant change in layout or function of connecting roads or streets.
- Acquisition of a significant amount of right of way results in relocation of individuals, groups, or institutions.

For general procedures and notification requirements, see 210.05 and Exhibit 210-4.

(1) Design Hearing Summary

The design hearing summary includes the elements outlined in 210.05(10).

Submit the complete hearing summary to the HQ Access and Hearings Section within approximately two months following the hearing.

If new studies or additional data are required subsequent to the hearing, the region compiles the information in coordination with the HQ Design Office.

(2) Adoption of Design Hearing Summary

After the hearing, the region reviews the hearing transcript, responds to all questions or proposals submitted at or subsequent to the hearing, compiles a hearing summary, and transmits three copies (four copies for Interstate projects) to the HQ Access and Hearings Section. When appropriate, the design hearing summary may be included in the final environmental document. The HQ Access and Hearings Section prepares a formal document that identifies and describes the project and submits it to the Director & State Design Engineer, Development Division, for approval. One approved copy is returned to the region. The HQ Hearing Coordinator notifies the region that adoption has occurred.

On Interstate projects, the Director & State Design Engineer, Development Division, (or designee) submits the approved design hearing summary to the FHWA for federal approval. If possible, this submittal is timed to coincide with the submittal of the Design Decision Summary to the FHWA.

(3) Public Notification of Action Taken

The region prepares a formal response to individuals who had unresolved questions at the hearing. The region keeps the public advised regarding the result(s) of the hearing process, such as project adoption or revision to the plan. A project newsletter sent to those on the interest list is an effective method of notification. Project news items can be sent via e-mail or by more traditional methods.

210.09 Limited Access Hearing

Limited access hearings are required by law (per RCW 47.52) whenever limited access is established or revised on new or existing highways. Decisions concerning limited access hearings are made on a project-by-project basis by the Director & State Design Engineer, Development Division, based on information that includes the recommendations submitted by the region (see Chapters 510, 520, 530, and 540).

Limited access hearing procedures generally follow those identified in 210.05; however, several unique products and notifications are also prepared. These include limited access hearing plans and notifications sent to abutting property owners and local jurisdictions. (See 210.09(4) and Exhibit 210-3 for a listing of these products.) Exhibit 210-5 presents a summary of the limited access hearing procedures.

Prior to the limited access hearing (RCW 47.52.131), discussions with the local jurisdictions shall be held on the merits of the limited access report and the limited access hearing plan(s). These are required exhibits for the limited access hearing. (See Chapter 530 for guidance on limited access reports.)

The following information applies only to limited access hearings and procedures for approval of the findings and order.

(1) Hearing Examiner

The HQ Access and Hearings Section hires an administrative law judge from the Office of Administrative Hearings to conduct the limited access hearing.

(2) Order of Hearing

The order of hearing officially establishes the hearing date. The Director & State Design Engineer, Development Division, approves the order of hearing. The HQ Hearing Coordinator then notifies the region, the Attorney General's Office, and the hearing examiner of the official hearing date.

(3) Limited Access Hearing Plan

The region prepares a limited access hearing plan to be used as an exhibit at the formal hearing and forwards it to the HQ Plans Engineer for review and approval approximately 45 days before the hearing. This is a Phase 2 Plan (see Chapter 510). The HQ Plans Engineer schedules the approval of the limited access hearing plan on the Director & State Design Engineer, Development Division's calendar.

(4) Limited Access Hearing Information to Abutters

The region prepares an information packet that must be mailed to abutters, and other entities as specified below, at least 15 days prior to the hearing and concurrent with advertisement of the hearing notice. These items are elements of the prehearing packet as described in 210.05(4)(b) and in Exhibit 210-3. If some of the limited access hearing packets are returned as undeliverable, the region must make every effort to communicate with the property owners.

The limited access hearing packet for abutters contains the following:

- Limited access hearing plan
- Limited access hearing notice
- Notice of appearance

The region also sends the limited access hearing packet to:

- The county and/or city.
- The owners of property listed on the county tax rolls as abutting the section of highway, road, or street being considered at the hearing as a limited access facility.
- Local agencies and public officials who have requested a notice of hearing or who, by the nature of their functions, objectives, or responsibilities, are interested in or affected by the proposal.
- Every agency, organization, official, or individual on the interest list.

The limited access hearing packet is also sent, when applicable, to:

- State resource, recreation, and planning agencies.
- Tribal governments.
- Appropriate representatives of the Department of the Interior and the Department of Housing and Urban Development.
- Other federal agencies.
- Public advisory groups.

(5) Affidavit of Service by Mailing

The region prepares an affidavit of service by mailing. This affidavit states that the limited access hearing packet was mailed at least 15 days prior to the hearing and that it will be entered into the record at the hearing.

(6) Limited Access Hearing Plan Revisions

The limited access hearing plan cannot be revised after the Director & State Design Engineer, Development Division (or designee), approves the plan without rescheduling the hearing. If significant revisions to the plan become necessary during the period between the approval and the hearing, the revisions can be made and must be entered into the record as a revised (red and green) plan at the hearing.

(7) Limited Access Hearing Notice

The limited access hearing notice must be published at least 15 calendar days before the hearing. This is a legal requirement and the hearing must be rescheduled if the advertising deadline is not met. Publication and notice requirements are the same as those required in 210.05, except that the statutory abutter mailing must be mailed after notification to the appropriate legislators.

(8) Notice of Appearance

The HQ Hearing Coordinator transmits the notice of appearance form to the region. Anyone wanting to receive a copy of the findings and order and the adopted right of way and limited access plan must complete a notice of appearance form and return it to WSDOT either at the hearing or by mail.

(9) Reproduction of Plans

The HQ Hearing Coordinator submits the hearing plans for reproduction at least 24 days prior to the hearing. The reproduced plans are sent to the region at least 17 days before the hearing, for mailing to the abutters at least 15 days before the hearing.

(10) Limited Access Hearing Exhibits

The region retains the limited access hearing exhibits until preparation of the draft findings and order is complete. The region then submits all the original hearing exhibits and three copies to the HQ Access and Hearings Section as part of the findings and order package. Any exhibits submitted directly to Headquarters are sent to the region for inclusion with the region's submittal.

(11) Limited Access Hearing Transcript

The court reporter furnishes the original limited access hearing transcript to the region. The region forwards the transcript to the hearing examiner, or presiding authority, for signature certifying that the transcript is complete. The signed original and three copies are returned to the region for inclusion in the findings and order package.

(12) Findings and Order

The findings and order is a document containing the findings and conclusions of a limited access hearing, based entirely on the evidence in the hearing record. The region reviews a copy of the transcript from the court reporter and prepares a findings and order package. The package is sent to the HQ Access and Hearings Section.

The findings and order package contains:

- The draft findings and order.
- Draft responses to comments (reserved exhibits).
- A draft findings and order Plan as modified from the hearing plan.
- All limited access hearing exhibits: originals and three copies.
- The limited access hearing transcript: original and three copies.
- The notice of appearance forms.
- Estimate of the number of copies of the final findings and order plan and text the region will need for the mailing.

(13) Adoption of Findings and Order

The Assistant Secretary, Engineering & Regional Operations, adopts the findings and order based on the evidence introduced at the hearing and any supplemental exhibits.

Following adoption of the findings and order, the HQ Plans Section makes the necessary revisions to the limited access hearing plan, which then becomes the findings and order plan.

The HQ Access and Hearings Section arranges for reproduction of the findings and order plan and the findings and order text and transmits them to the region.

The region mails a copy of the findings and order plan and the findings and order text to all parties that filed a notice of appearance and to all local governmental agencies involved. Subsequent to this mailing, the region prepares an affidavit of service by mailing and transmits it to the HQ Access and Hearings Section.

At the time of mailing, but before publication of the résumé, the region notifies the appropriate legislators of WSDOT's action.

(14) Résumé

The résumé is an official notification of action taken by WSDOT following adoption of a findings and order. The HQ Access and Hearings Section provides the résumé to the region. The region must publish the résumé once each week for two consecutive weeks, not to begin until at least ten days after the mailing of the findings and order.

(15) Final Establishment of Access Control

When the findings and order is adopted, the findings and order plan becomes a Phase 4 Plan (see Chapter 510). The establishment of access control becomes final 30 days from the date the findings and order is mailed by the region, as documented by the affidavit of service by mailing.

(16) Appeal Process

An appeal from the county or city must be in the form of a written disapproval, submitted to the Secretary of Transportation, requesting a hearing before a board of review.

An appeal from abutting property owners must be filed in the Superior Court of the state of Washington, in the county where the limited access facility is to be located, and shall affect only those specific ownerships. The plan is final for all other ownerships.

210.10 Combined Hearings

A combined hearing often alleviates the need to schedule separate hearings to discuss similar information. A combined hearing is desirable when the timing for circulation of the draft environmental document is simultaneous with the timing for corridor and design hearings and when all alternative designs are available for each alternative corridor.

When deciding whether to combine hearings, consider:

- Whether there is controversy.
- Whether alternative corridors are proposed.
- The nature of the environmental concerns.
- The benefits to the public of a combined hearing.

210.11 Administrative Appeal Hearing

Administrative appeal hearings apply only to managed access highways, are conducted as formal hearings, and are initiated by a property owner seeking to appeal a decision made to restrict or remove an access connection. This is also known as an adjudicative proceeding, and the procedure is presented in Chapter 540.

Sequence for Corridor, Design, and Environmental Hearings	
Preparatory Work	
Consult with HQ Hearing Coordinator and environmental specialists to determine specific requirements for a hearing or a notice of opportunity for a hearing.	[see 210.05 & Exhibit 210-1]
Assemble support team; identify and schedule tasks and deliverables.	[see 210.05(4)]
Prepare prehearing packet (news releases, legal notices, exhibits).	[see 210.05(4)(b) & Exhibit 210-3]
♦ **Minimum 45 Days Prior to Hearing: Transmit Prehearing Packet to HQ** HQ Hearing Coordinator reviews and concurs; schedules hearing.	[see 210.05(4)(b)]
Public Notifications and News Releases	[see 210.05(5) & (6)]
♦ **35–40 Days Prior to Hearing** (1 week prior to first public ad) Send notice to legislators and local officials.	
♦ **33–35 Days Prior to Hearing** (about 3 days before advertisement) Send letter with news release to media.	
♦ **30 Days Prior to Hearing** Draft EIS becomes available and its open comment period begins.	
Corridor and Design Hearings ♦ **30 Days Prior to Hearing: Publish First Notice*** Advertise at least 30 days in advance of hearing, but not prior to public availability of draft environmental document. ♦ **5–12 Days Prior to Hearing: Publish Second Notice**	
Environmental Hearings ♦ **15 Days Prior to Hearing: Publish First Notice** Advertise at least 15 days in advance; timing of additional notices optional. (If done in combination with design or corridor hearing, use 30-day advance notice.)	
Prehearing Briefings	[see 210.05(8)]
♦ **5–12 Days Prior to Hearing** Region confers with local jurisdictions; conducts hearing briefings and presentations; and makes hearing materials and information available for public inspection and copying.	
Conduct the Hearing	[see 210.05(9)]
Conduct environmental, corridor, or design hearing.	
Posthearing Actions	
Court reporter provides hearing transcript to region (usually within 2 weeks).	
♦ **2 Months After Hearing: Prepare Hearing Summary and Send to HQ** Region addresses public comments from hearing and throughout comment period; prepares hearing summary and transmits to HQ Hearing Coordinator for processing.	[see 210.05(10)]
HQ Hearing Coordinator transmits hearing summary package to HQ approval authority for approval.	[see Exhibit 210-6]
HQ Hearing Coordinator notifies region of adoption and returns a copy of approved hearing summary to region.	

Notes:

Important timing requirements are marked ♦

* If the advertisement is a notice of opportunity for a hearing, requests must be received within 21 days after the first advertisement. If there are no requests, see 210.05(7).

Sequence for Corridor, Design, and Environmental Hearings
Exhibit 210-4

Sequence for Limited Access Hearing	
Preparatory Work	
Consult with HQ Access and Hearings Section. Determine requirements for a limited access hearing or a notice of opportunity for a hearing.	[see 210.05 & Exhibit 210-1]
Assemble support team; identify and schedule tasks and deliverables.	[see 210.05(4)]
Prepare limited access report and limited access hearing plan(s).	[see Chapters 510 & 530]
Prepare prehearing packet (legal notice, exhibits, information packets for abutting property owners).	[see 210.05(4)(b) & Exhibit 210-3]
♦ **Minimum 45 Days Prior to Hearing: Transmit Prehearing Packet to HQ – Transmit Limited Access Report and Hearing Plans for Approval** HQ Hearing Coordinator reviews and concurs; schedules hearing; transmits limited access report and limited access hearing plan.	[see 210.05(4)(b) & 210.09]
♦ **45 Days Prior to Hearing** HQ actions: Calendar order of hearing & limited access hearing plan approved	[see 210.09(2)&(3)]
♦ **24 Days Prior to Hearing: HQ Reproduction of Plans** HQ action: Approved limited access hearing plan(s) are reproduced in number sufficient for mailing to abutters and other handout needs; one set to be used as hearing exhibit.	[see 210.09(9)]
Notifications, News Releases, Confer With Local Agencies	
♦ **35–40 Days Prior to Hearing** Send notice to legislators and local officials (1 week prior to first public ad).	[see 210.05(6)]
♦ **33–35 Days Prior to Hearing** Send letter with news release to media (about 3 days before advertisement).	[see 210.05(6)]
♦ **15 Days Prior to Hearing: Publish First Notice*** Advertise at least 15 days in advance; timing of additional notices optional.	[see 210.05(6)]
♦ **15 Days Prior to Hearing: Send Hearing Packets to Abutters** (Hearing notice, limited access hearing plan, notice of appearance form).	[see 210.05(4)]
♦ **15 Days Prior to Hearing: Confer With Local Jurisdictions**	[see 210.05(8)]
Conduct the Hearing	[see 210.05(6)]
Using agenda and script, conduct formal limited access hearing.	
Posthearing Actions	
Court reporter provides limited access hearing transcript to region.	[see 210.09(11)]
Region prepares findings and order document and transmits to HQ Hearing Coordinator.	[see 210.09(12)]
Assistant Secretary, Engineering & Regional Operations, adopts findings and order.	[see 210.09(13)]
Limited access hearing plan becomes findings and order plan.	[see 210.09(15)]
Findings and order reproduced and mailed to abutters and local jurisdictions.	[see 210.09(13)]
HQ provides résumé to region and region publishes.	[see 210.09(14)]

Notes:
Important timing requirements are marked ♦

* If the advertisement is a notice of opportunity for a hearing, requests must be received within 21 days after the first advertisement. If there are no requests, see 210.05(7).

Sequence for Limited Access Hearing
Exhibit 210-5

Hearing Summary Document	WSDOT HQ Approval Authority
Limited access hearing findings and order	Assistant Secretary, Engineering & Regional Operations
Corridor hearing summary	Assistant Secretary, Engineering & Regional Operations
Environmental hearing summary	Director, Environmental Services
Design hearing summary	Director & State Design Engineer, Development Division

Hearing Summary Approvals
Exhibit 210-6

It is a prudent practice to start the compilation of design documentation early in a project and to acquire Project Development Approval before the completion of the project. At the start of a project, it is critical that WSDOT project administration staff recognize the importance of all required documentation and how it will be used in the design-build project delivery process.

300.09 Process Review

The process review is done to provide reasonable assurance that projects are prepared in compliance with established policies and procedures and that adequate records exist to show compliance with state and federal requirements. Process reviews are conducted by WSDOT, FHWA, or a combination of both.

The design and PS&E process review is performed in each region at least once each year by the HQ Design Office. The documents used in the review process are the Design Documentation Checklist, the PS&E Review Checklist, and the PS&E Review Summary. These are generic forms used for all project reviews. Copies of these working documents are available for reference when assembling project documentation. The HQ Design Office maintains current copies at: www.wsdot.wa.gov/design/projectdev

Each project selected for review is examined completely and systematically beginning with the scoping phase (including planning documents) and continuing through contract plans and, when available, construction records and change orders. Projects are normally selected after contract award. For projects having major traffic design elements, the HQ Traffic Operations Office is involved in the review. The WSDOT process reviews may be held in conjunction with FHWA process reviews.

The HQ Design Office schedules the process review and coordinates it with the region and FHWA.

(1) Process Review Agenda

A process review follows this general agenda:

1. Review team meets with region personnel to discuss the object of the review.
2. Review team reviews the design and PS&E documents, construction documents, and change orders (if available) using the checklists.
3. Review team meets with region personnel to ask questions and clarify issues of concern.
4. Review team meets with region personnel to discuss findings.
5. Review team submits a draft report to the region for comments and input.
6. If the review of a project shows a serious discrepancy, the region design authority is asked to report the steps that will be taken to correct the deficiency.
7. Process review summary forms are completed.
8. Summary forms and checklists are evaluated by the Director & State Design Engineer, Development Division.
9. Findings and recommendations of the Director & State Design Engineer, Development Division, are forwarded to the region design authority for action and/or information within 30 days of the review.

Project Design	FHWA Oversight Level	Deviation and Corridor/Project Approval[1][2]	EU Approval[2]	Design and Project Development Approvals
Interstate				
New/Reconstruction[3] Federal funds No federal funds	[4] [5]	FHWA	Region	FHWA[10]
Intelligent Transportation Systems (ITS) Improvement project over $1 million Preservation project	[6] [6]	HQ Design HQ Design	Region Region	HQ Design Region
All Other[7] Federal funds State funds Local agency funds	[6] [6] [5]	HQ Design	Region	Region
National Highway System (NHS)				
Managed access highway outside incorporated cities and towns or inside unincorporated cities and towns, or limited access highway	[6]	HQ Design	Region	Region
Managed access highway within incorporated cities and towns[8] Inside curb or EPS[9][13] Outside curb or EPS	[6] [6]	HQ Design HQ H&LP	Region N/A	Region City/Town
Non-National Highway System (Non-NHS)				
Improvement project on managed access highway outside incorporated cities and towns or within unincorporated cities and towns, or on limited access highway (Matrix lines 5-9 through 5-24)	N/A	HQ Design	Region	Region
Improvement project on managed access highway within incorporated cities and towns[8] Inside curb or EPS[9][13] Outside curb or EPS (Matrix lines 5-9 through 5-24)	N/A N/A	HQ Design HQ H&LP	Region N/A	Region City/Town
Preservation project on managed access highway outside incorporated cities and towns or within unincorporated cities and towns, or on limited access highway[11] (Matrix lines 5-2 through 5-8)	N/A	Region[12]	Region	Region
Preservation project on managed access highway within incorporated cities and towns[8][11] Inside curb or EPS[9][13] Outside curb or EPS (Matrix lines 5-2 through 5-8)	N/A N/A	Region HQ H&LP	Region N/A	Region City/Town

For table notes, see the following page.

Design Approval Level

Exhibit 300-2

Item	Approval Authority		
	Region	HQ	FHWA
Design (continued)			
Signal Permits	X[14]		
Geotechnical Report		X[13]	
Tied Bids	X[15]		X[9][15]
Bridge Design Plans (Bridge Layout)	X	X	
Hydraulic Report	X[16]	X[16]	
Preliminary Signalization Plans		X[6][20]	
Signalization Plans	X[22]		
Illumination Plans	X[22]		
Intelligent Transportation System (ITS) Plans	X[22]		
ITS Project Systems Engineering Review Form (Exhibit 1050-2)	X[22]		X[1]
Rest Area Plans		X	
Roadside Restoration Plans	X[18]	X[19]	
Structures Requiring TS&Ls		X	X
Planting Plans	X[18]	X[19]	
Grading Plans	X		
Continuous Illumination – Main Line		X[20]	
Tunnel Illumination		X[20]	
High Mast Illumination		X[20]	
Project Change Request Form	X[21]	X[21]	
Work Zone Transportation Management Plan/Traffic Control Plan	X[22]		
Public Art Plan – Interstate (see Chapter 950)	X[18][23]	X[19][23]	X[9][19][23]
Public Art Plan – Non-Interstate (see Chapter 950)	X[18][23]	X[19][23]	
ADA Maximum Extent Feasible Document (see Chapter 1510)	X	X	

X Normal procedure *If on the preapproved list

Notes:

[1] Federal-aid projects only.
[2] Approved by Assistant Secretary, Engineering & Regional Operations.
[3] Approved by Director & State Design Engineer, Development Division.
[4] Approved by Right of Way Plans Manager.
[5] Refer to Chapter 210 for approval requirements.
[6] Final review & concurrence required at the region level prior to submittal to approving authority.
[7] Final review & concurrence required at HQ prior to submittal to approving authority.
[9] Applies to new/reconstruction projects on Interstate routes.
[10] Approved by HQ Project Control & Reporting.
[11] Include channelization details.
[12] Certified by the responsible professional licensee.
[13] Submit to HQ Materials Laboratory for review and approval.
[14] Approved by Regional Administrator or designee.
[15] See 23 CFR 635.111.
[16] See the *Hydraulics Manual* for approvals levels.
[18] Applies only to regions with a Landscape Architect.
[19] Applies only to regions without a Landscape Architect.
[20] Approved by State Traffic Engineer.
[21] Consult HQ Project Control & Reporting for clarification on approval authority.
[22] Region Traffic Engineer or designee.
[23] The State Bridge and Structures Architect reviews and approves the public art plan (see Chapter 950 for further details on approvals).

Approvals

Exhibit 300-3 (continued)

Item	New/Reconstruction (Interstate only)	NHS and Non-NHS
DBE/training goals* **	(a)	(a)
Right of way certification for federal-aid projects	FHWA(b)	FHWA(b)
Right of way certification for state-funded projects	Region(b)	Region(b)
Railroad agreements	(c)	(c)
Work performed for public or private entities*	[1][2]	Region[1][2]
State force work*	FHWA[3][4](d)	Region[3](d)
Use of state-furnished stockpiled materials*	FHWA[4]	FHWA[4]
Stockpiling materials for future projects*	FHWA[4]	FHWA[4]
Work order authorization	[5](d)	[5](d)
Ultimate reclamation plan approval through DNR	Region	Region
Proprietary item use*	[6]	[6]
Mandatory material sources and/or waste sites*	FHWA[4]	Region[4]
Nonstandard bid item use*	Region	Region
Incentive provisions	FHWA	(e)
Nonstandard time for completion liquidated damages*	FHWA(e)	(e)
Interim liquidated damages*	(f)	(f)

Notes:

[1] This work requires a written agreement.
[2] Region approval subject to $250,000 limitation.
[3] Use of state forces is subject to $60,000 limitation and $100,000 in an emergency situation, as stipulated in RCWs 47.28.030 and 47.28.035.
[4] Applies only to federal-aid projects; however, document for all projects.
[5] Prior FHWA funding approval required for federal-aid projects.
[6] FHWA approves only for federal-aid projects and only when other equally suitable alternatives exist. In all other cases, the HQ Design Office is required to certify that the proprietary product is either: (a) necessary for synchronization with existing facilities; or (b) a unique product for which there is no equally suitable alternative.

Region or Headquarters Approval Authority:

(a) Office of Equal Opportunity
(b) HQ Real Estate Services Office
(c) HQ Design Office
(d) Project Control & Reporting Office
(e) HQ Construction Office
(f) Statewide Travel and Collision Data Office

References:

**Plans Preparation Manual*
***Advertisement and Award Manual*

PS&E Process Approvals

Exhibit 300-4

310.01 General

Value engineering (VE) analysis is a systematic process of reviewing and assessing a project by a multidisciplinary team not directly involved in the planning and development phases of a specific project. The VE process incorporates the values of design; construction; maintenance; contractor; state, local, and federal approval agencies; other stakeholders; and the public.

Value engineering analyses are conducted early in WSDOT project development to identify ideas that might reduce cost, refine scope definition, improve design functionality, improve constructability, improve coordination/schedule; and identify other value improvements, including reduced environmental impacts and congestion.

A VE analysis may be applied as a quick-response study to address a problem or as an integral part of an overall organizational effort to stimulate innovation and improve performance characteristics.

310.02 References

(1) Federal Laws and Codes

23 United States Code (USC) 106 (e, g, and h)

23 USC 112 (a and b)

23 USC 302

23 USC 315

49 Code of Federal Regulations (CFR) Part 18

23 CFR Part 627, Value Engineering

(2) Design Guidance

Order 1311.1A 5-25-2010, FHWA Value Engineering Policy

Value Engineering for Highways, Study Workbook, U.S. Department of Transportation, FHWA

Value Standard and Body of Knowledge, SAVE International, The Value Society:
🖰 www.value-eng.org/

WSDOT Value Engineering website:
🖰 www.wsdot.wa.gov/design/valueengineering/

310.03 Definitions

bridge project A bridge project shall include any project where the primary purpose is to construct, reconstruct, rehabilitate, resurface, or restore a bridge (23 CFR 636.103). Notes:

- A VE analysis must be conducted on all federally funded bridge projects with an estimated total cost of $20 million or more.
- WSDOT's policy is also to conduct a VE analysis for any bridge project with an estimated total cost of $20 million or more.

design-bid-build The project delivery method where design and construction are sequential steps in the project development process (23 CFR 636.103).

design-build contract An agreement that provides for design and construction of improvements by a consultant/contractor team. The term encompasses design-build-maintain, design-build-operate, design-build-finance, and other contracts that include services in addition to design and construction. Franchise and concession agreements are included in the term if they provide for the franchisee or concessionaire to develop the project that is the subject of the agreement (23 CFR 636.103).

final design Any design activities following preliminary design; expressly includes the preparation of final construction plans and detailed specifications for the performance of construction work (23 CFR 636.103). Final design is also defined by the fact that it occurs *after* NEPA/SEPA approval has been obtained.

project A portion of a highway that WSDOT or a public authority proposes to construct, reconstruct, or improve as described in the preliminary design report or applicable environmental document. A project is roadway/highway improvement within the logical termini identified in the environmental document and may consist of several contracts, or phases of a project or contract, that are implemented over several years.

Total Project Costs The costs of all phases of a project, including environmental, design, right of way, utilities, and construction.

value engineering (VE) analysis A systematic process of review and analysis of a project, during the concept and design phases, by a multidisciplinary team of impartial persons not involved with the project, that is conducted to provide recommendations for:

- Providing the needed functions safely, reliably, and at the lowest overall cost.
- Improving the value and quality of the project.
- Reducing the time to complete the project.

Value Engineering Change Proposal (VECP) A construction contract change proposal submitted by the construction contractor based on a VECP provision in the contract. The intent of these types of proposals is to (1) improve the project's performance, value, and/or quality, (2) lower construction costs, or (3) shorten the delivery time, while considering their impacts on the project's overall life-cycle cost and other applicable factors.

Value Engineering (VE) Job Plan A systematic and structured action plan (see Exhibit 300-1) for conducting and documenting the results of the VE analysis. While each VE analysis shall address each phase in the VE Job Plan, the level of analysis conducted and effort expended for each phase should be scaled to meet the needs of each individual project. The VE Job Plan includes and documents the following seven phases:

1. **Information Phase:** Gather project information, including project commitments and constraints.
2. **Function Analysis Phase:** Analyze the project to understand the required functions.
3. **Creative Phase:** Generate ideas on ways to accomplish the required functions, which improve the project's performance, enhance its quality, and lower project costs.
4. **Evaluation Phase:** Evaluate and select feasible ideas for development.
5. **Development Phase:** Develop the selected alternatives into fully supported recommendations.
6. **Presentation Phase:** Present the VE recommendation to the project stakeholders.
7. **Resolution Phase:** Evaluate, resolve, document, and implement all approved recommendations.

Post-analysis Job Plan activities include the implementation and evaluation of the outcomes of the approved recommendations. These post-analysis phases are conducted in accordance with the policies stated below and as described in paragraph 4f of FHWA Order 1311.1A, FHWA Value Engineering Policy.

310.04 Statewide VE Program

(1) Annual VE Plan

The State VE Manager coordinates annually with the Capital Program Development and Region VE Coordinators to prepare an annual VE Plan, with specific projects scheduled quarterly. The VE Plan is the basis for determining the projected VE program needs, including team members, team leaders, consultants, and training. The Statewide VE Plan is a working document, and close coordination is necessary between Headquarters (HQ) and the regions to keep it updated and projects on schedule.

(2) Selecting Projects for VE Analysis

(a) **Requirements**

WSDOT projects for VE studies may be selected from any of the categories identified in the Highway Construction Program, including Preservation and Improvement projects, depending on the size and/or complexity of the project. In addition to the cost, other issues adding to the complexity of the project design or construction are considered in the selection process. These include projects that have critical constraints, difficult technical issues, expensive solutions, external influences, and complicated functional requirements, regardless of the estimated project cost.

WSDOT may conduct VE analyses on any project the project manager determines will benefit from the exercise. In addition, WSDOT conducts VE analyses for all projects as required by the criteria set forth in Federal Highway Administration (FHWA) Value Engineering Policy Order 1311.1A, May 25, 2010:

1. A value engineering analysis is required for:
   - Any project with an estimated cost (which includes project development, design, right of way, and construction costs) of $25 million or more, regardless of funding;
   - Each bridge project located on or off of the federal-aid system with an estimated total cost of $20 million or more (WSDOT policy is to conduct a VE analysis regardless of funding source); and
   - Any other projects the Secretary or FHWA determines to be appropriate.
2. In addition to the projects described above, WSDOT strongly encourages VE analysis on other projects where there is a high potential for cost savings in comparison to the cost of the VE analysis, or the potential exists to improve the projects' performance or quality. Projects involving complex technical issues, challenging project constraints, unique requirements, and competing community and stakeholder objectives offer opportunities for improved value by conducting VE analyses.
3. Any use of Federal-Aid Highway Program (FAHP) funding on a Major Project[1] requires that a VE analysis be conducted. In some cases, regardless of the amount of FAHP funding, a project team may be required to perform more than one VE analysis for a Major Project.
4. After completing the required VE analysis, if the project is subsequently split into smaller projects in final design or is programmed to be completed by the advertisement of multiple construction contracts, an additional VE analysis is not required. However, splitting a project into smaller projects or multiple construction contracts is not an accepted method to avoid the requirements to conduct a VE analysis.
5. WSDOT may require a VE analysis to be conducted if a region or public authority encounters instances when the design of a project has been completed but the project does not immediately proceed to construction.
   a. If a project meeting the above criteria encounters a three-year or longer delay prior to advertisement for construction, and a substantial change to the project's scope or design is identified, WSDOT may require a new VE analysis or an update to the previous VE analysis; or
   b. If a project's estimated cost was below the criteria identified above but the project advances to construction advertisement, and a substantial change occurs to the project's scope or design, causing an increase in the project cost so that it meets the criteria identified above and results in a ***required re-evaluation of the environmental document***, WSDOT requires that a new VE analysis be conducted.

[1] Based on the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU),* signed into law on August 10, 2005, a Major Project is defined as "a project with a total estimated cost of $500 million or more that is receiving financial assistance." FHWA also has the discretion to designate a project with a total cost of less than $500 million as a Major Project. FHWA may choose to do so in situations where the projects require a substantial portion of the State Transportation Agency's (STA's) program resources; have a high level of public or congressional interest; are unusually complex; have extraordinary implications for the national transportation system; or are likely to exceed $500 million in total cost.

6. When the design of a project has been completed but the project does not immediately proceed to construction, the requirement to conduct a VE analysis is considered to be satisfied, or not necessary, if:

   a. A project met the criteria identified above and had a VE analysis conducted, and the project advances to advertisement for construction without any substantial changes in its scope or its design; or

   b. A project's estimated cost initially fell *below* the criteria identified above, but when advancing to advertisement for construction, falls *above* the criteria due to inflation, standard escalation of costs, or minor modifications to the project's design or contract.

   Other projects that should be considered for value engineering have a total estimated cost exceeding $5 million and include one or more of the following:

   - Alternative solutions that vary the scope and cost
   - New alignment or bypass sections
   - Capacity improvements that widen the existing highway
   - Major structures
   - Interchanges
   - Extensive or expensive environmental or geotechnical requirements
   - Materials that are difficult to acquire or that require special efforts
   - Inferior materials sources
   - New/Reconstruction projects
   - Major traffic control requirements or multiple construction stages

(3) VE Analysis Timing

(a) **When to Conduct the VE Analysis**

Timing is very important to the success of the VE analysis. A VE analysis should be conducted as early as practicable in the planning or development of a project, preferably before the completion of preliminary design. At a minimum, the VE analysis is to be conducted prior to completing the final design.

The VE analysis should be closely coordinated with other project development activities to minimize the impact approved recommendations might have on previous agency, community, or environmental commitments; the project's scope; and the use of innovative technologies, materials, methods, plans, or construction provisions. In addition, VE analyses should be coordinated with risk assessment workshops such as Cost Risk Assessment (CRA) or Cost Estimate Validation Process (CEVP) (see www.wsdot.wa.gov/design/saeo/).

Benefits can potentially be realized by performing a VE analysis at any time during project development; however, the WSDOT VE program identifies the following three windows of opportunity for performing a VE analysis.

1. **Scoping Phase**

   As soon as preliminary engineering information is available and the specific deficiencies or drivers are identified, the project scope and preliminary costs are under consideration. This is the best time to consider the various alternatives or design solutions with the highest potential for the VE team's recommendations to be implemented. At the conclusion of the VE study, the project scope, preliminary costs, and major design decisions can be based on the recommendations.

   When conducting a study during the scoping phase of a project, the VE analysis focuses on issues affecting project drivers. This stage often provides an opportunity for building consensus with stakeholders.

2. **Start of Design**

   At the start of design, the project scope and preliminary costs have already been established and the major design decisions have been made. Some Plans, Specifications, and Estimates (PS&E) activities may have begun, and coordination has been initiated with the various service units that will be involved with the design. At this stage, the established project scope, preliminary costs, and schedule will define the limits of the VE analysis and there is still opportunity for the study to focus on the technical issues of the specific design elements.

3. **Design Approval**

   After the project receives Design Approval, most of the important project decisions have been made and the opportunity to affect the project design is limited. Provided that the Design Approval is early enough to incorporate the adopted VE recommendations, the VE analysis should focus on constructability, construction sequencing, staging, traffic control, and any significant design issues identified during design development.

   An additional VE analysis may be beneficial late in the development stage when the estimated cost of the project exceeds the project budget. The value engineering process can be applied to the project to lower the cost while maintaining the value and quality of the design.

(b) **Design-Build Projects**

For design-build projects on which a VE analysis is required, the study must be performed prior to issuing the Request for Proposal (RFP); this allows the results to be a part of the RFP. It is not practicable to perform a VE analysis in the design-build contract phase.

(4) VE Program Roles and Responsibilities

(a) **Region VE Coordinator**

- Identifies region projects for VE analyses (from Project Summaries and available planning documents).
- Makes recommendations for timing of the VE analysis for each project.

- Presents a list of the identified projects to region management to prioritize into a regional annual VE Plan.
- Identifies potential team facilitators and members for participation statewide.

(c) **State VE Manager**

- Reviews regional VE Plans regarding content and schedule.

(d) **State VE Coordinator**

- Incorporates the regional annual VE Plans and the Headquarters Plan to create the Statewide VE Plan.
- Prepares annual VE Report.
- Maintains policy documents for the department.
- Coordinates studies.
- Arranges training for future VE team leaders and members.

(d) **VE Team Leader**

The quality of the VE analysis largely depends on the skills of the VE team leader. This individual guides the team's efforts and is responsible for its actions during the study. The VE team leader should be knowledgeable and proficient in transportation design and construction and in the VE analysis process for transportation projects.

The VE team leader's responsibilities include the following:

- Plans, leads, and facilitates the VE study.
- Ensures proper application of a value methodology.
- Follows the Job Plan.
- Guides the team through the activities needed to complete the pre-study, the VE study, and the post-study stages of a VE study.
- Schedules a pre-workshop meeting with the project team and prepares the agenda for the VE study.

Team leaders from within WSDOT are encouraged but not required to be certified by the Society of American Value Engineers (SAVE) as a Certified Value Specialist (CVS) or as a Value Methodology Practitioner (VMP). Team leadership can be supplied from within the region, from another region, or from Headquarters. A statewide pool of qualified team leaders is maintained by the State VE Coordinator, who works with the Region VE Coordinator to select the team leader.

When using consultant team leaders, SAVE certification is required.

(e) **VE Team Members**

The VE team is typically composed of five to ten people with diverse expertise relevant to the specific study. The team members may be selected from the regions; Headquarters; other local, state, or federal agencies; or the private sector.

Team members **are not** directly involved in the planning and development phases of the project and are selected based on the identified expertise needed to address the major functional areas and critical high-cost issues of the study. All team members must be committed to the time required for the study. It is desirable for team members to have attended Value Engineering Module 1 training before participating in a VE study.

310.05 VE Procedure

The VE analysis uses the Seven-Phase Job Plan shown in Exhibit 310-1. A detailed discussion of how each phase is supposed to be conducted can be found in the document, *Value Methodolgy Standard and Body of Knowledge*, developed by SAVE International, The Value Society. This document can be downloaded at the SAVE website:
www.value-eng.org/

(1) Pre-Study Preparation

To initiate a VE study, the project manager submits a Request for Value Engineering Study form to the Region VE Coordinator at least two months before the proposed study date. The form is located on the WSDOT value engineering website:
www.wsdot.wa.gov/design/valueengineering/tools/

The Region VE Coordinator then works with the State VE Coordinator to determine the team leader and team members for the VE study. Contacts are listed on the WSDOT value engineering website:
www.wsdot.wa.gov/design/valueengineering

The design team prepares a study package of project information for each of the team members. (A list of potential items is shown in Exhibit 310-2.) The VE team members should receive this information at least one week prior to the study so they have time to review the material.

The region provides a facility and the equipment for the study (see Exhibit 310-2).

(2) VE Analysis Requirements

The time required to conduct a VE analysis varies with the complexity and size of the project, but typically ranges from three to five days. The VE team leader working with the project manager will determine the best length for the study.

The VE analysis Final Report includes an executive summary; a narrative description of project information; the background, history, constraints, and controlling decisions; the VE team focus areas; a discussion of the team speculation and evaluation processes; and the team's final recommendations. All of the team's evaluation documentation, including sketches, calculations, analyses, and rationale for recommendations, is included in the Final Report. A copy of the Final Report is to be included in the Project File. The project manager will specify the number of copies to be provided to the project team. The State VE Manager also provides a copy of the report to the FHWA for projects on the National Highway System or federal-aid system.

Post-VE analysis activities include:

- Implementation and evaluation of the approved recommendations and their outcomes.
- Documentation of the reasons for not implementing approved recommendations.

Note: These post-analysis activities are conducted prior to the final design phase to ensure the recommendations are included in the final design or the reasons for not implementing the recommendations are included in the design documentation.

(3) Resolution Phase (Phase 7 of the VE Study)

As soon as possible, preferably no more than two weeks following the VE analysis, the project manager reviews and evaluates the VE team's recommendation(s). The project manager completes the VE Recommendation Approval form included in the Final Report and returns it to the Statewide VE Manager.

For each recommendation that is not approved or is modified by the project manager, the project manager provides justification in the form of a VE Decision Document. The VE Decision Document includes a specific response for each of the disapproved or modified recommendations. Responses include a summary statement containing the project manager's decision not to use the recommendations in the project.

The project manager sends the completed VE Recommendation Approval form and, if necessary, the VE Decision Document to the State VE Manager within three months following receipt of the Final Report or by September 1 of each year, whichever comes first, so the results can be included in WSDOT's annual VE Report to FHWA.

A VE Decision Document must be submitted and forwarded to the Director & State Design Engineer, Development Division, for review; the only time a VE Decision Document is not submitted is if all of the recommendations were adopted and implemented (in other words, no recommendations were rejected or modified).

310.06 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
🖰 www.wsdot.wa.gov/design/projectdev

As of the publication of this chapter of the *Design Manual,* the following value engineering documentation is required:

- **Project File –** Value Engineering Final Report
- **Design Documentation Package –** Value Engineering Recommendation Approval Form
- **Project File –** Value Engineering Decision Document

VE Study Phase	Job Plan
1. Information Phase	Gather project information, including project commitments and constraints. • *Investigate technical reports and field data* • *Develop team focus and objectives*
2. Function Analysis Phase	Analyze the project to understand the required functions. • *Define project functions using active verb/measurable noun context* • *Review and analyze these functions to determine which need improvement, elimination, or creation to meet project goals*
3. Creative Phase	Generate ideas on ways to accomplish the required functions that improve project performance, enhance quality, and lower project costs. • *Be creative* • *Brainstorm alternative proposals and solutions to lower project costs, improve project performance, and enhance quality*
4. Evaluation Phase	Evaluate and select feasible ideas for development. • *Analyze design alternatives, technical processes, and life-cycle costs*
5. Development Phase	Develop the selected alternatives into fully supported recommendations. • *Develop technical and economic supporting data to prove the benefits and feasibility of the desirable concepts* • *Develop team recommendations (long-term as well as interim solutions)*
6. Presentation Phase	Present the VE recommendation to the project stakeholders. • *Present the VE recommendation to the project team and region management in an oral presentation* • *Provide a written report*
7. Resolution Phase	Evaluate, resolve, and implement all approved recommendations and document in the VE Recommendation Approval form and VE Decision document.
Note: Phases 1–6 are performed during the study; see *Value Standard and Body of Knowledge* for procedures during these steps.	

Seven-Phase Job Plan for VE Studies

Exhibit 310-1

Project-Related Input* (Study Package)
Collision data
Aerial photos
Contour maps
Cross sections and profiles
Design file
Environmental documents
Estimates
Existing as-built plans
Geotechnical reports
Hydraulic Report
Land use maps
Large-scale aerial photographs
Plan sheets
Quadrant maps
Quantities
Right of way plans
Traffic data
Vicinity map

Study-Related Facilities and Equipment
AASHTO Green Book
Bridge list
Calculators
Computer / projector
Design Manual
Easel(s) and easel paper pads
Field tables
Marking pens
Masking and clear tape
Network computer access (if available)
Power strip(s) and extension cords
Room with a large table and adequate space for the team
Scales, straight edges, and curves
Standard Plans
Standard Specifications
State Highway Log
Telephone
Vehicle or vehicles with adequate seating to transport the VE team for a site visit**

* Not all information listed may be available to the team, depending on the project stage.
** If a site visit is not possible, provide video of the project.

VE Analysis Team Tools
Exhibit 310-2

directional design hour volume (DDHV) The traffic volume for the design hour in the peak direction of flow, in vehicles per hour. For example, if during the design hour, 60% of the vehicles traveled eastbound and 40% traveled westbound, then the DDHV for the eastbound direction would be the DHV x 0.60.

K-factor The proportion of AADT occurring in the analysis hour is referred to as the K-factor, expressed as a decimal fraction (commonly called "K," "K30," or "K100"). The K30 is the thirtieth (K100 is the one-hundredth) highest peak hour divided by the annual average daily traffic. Normally, the K30 or K100 will be in the range of 0.09 to 0.10 for urban and rural areas. Average design hour factors are available on the web in the Statewide Travel and Collision Data Office's Annual Peak Hour Report.

lead agency The public agency that has the principal responsibility for carrying out or approving a project.

level of service (LOS) A qualitative measure describing operational conditions within a traffic stream, based on service measures such as speed, travel time, freedom to maneuver, traffic interruptions, comfort, and convenience. Six levels of service are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each level of service represents a range of operating conditions and the driver's perception of those conditions. Safety is not included in the measures that establish service levels.

"pass-by" trips Pass-by trips are intermediate stops between an origin and a primary trip destination; for example, home to work, home to shopping.

peak hour The 60-minute interval that contains the largest volume of traffic during a given time period. If a traffic count covers consecutive days, the peak hour can be an average of the highest hour across all of the days. An a.m. peak is simply the highest hour from the a.m., and the p.m. peak is the highest from the p.m. The peak hour correlates to the DHV, but is not the same. However, it is close enough on items such as intersection plans for approval to be considered equivalent.

project Activities directly undertaken by government, financed by government, or requiring a permit or other approval from government.

"select zone" analysis A traffic model run, where the related project trips are distributed and assigned along a populated highway network. This analysis isolates the anticipated impact on the state highway network created by the project.

320.05 Travel Forecasting (Transportation Modeling)

While regional models are available in most urban areas, they may not be the best tool for reviewing developments. Most regional models are macroscopic in nature and do not do a good job of identifying intersection-level development impacts without further refinement of the model. The task of refining the model can be substantial and is not warranted in many instances. The region makes the determination whether a model or a trend line analysis can be used to take into account historical growth rates and background projects. This decision would be based on numerous factors, including the type, scale, and location of the development. The regional model is generally more appropriate for larger projects that generate a substantial number of new trips. The Traffic Impact Analysis (TIA) clearly describes the methodology and process used to develop the forecast that supports the analysis of a proposed project.

320.06 Traffic Analysis

The level of service (LOS) for operating state highway facilities is based upon measures of effectiveness (MOEs), in accordance with the latest version of the *Highway Capacity Manual*.

These MOEs (see Exhibit 320-1) describe the measures best suited for analyzing state highway facilities, such as freeway segments, signalized intersections, and on- or off-ramps. Depending on the facility, WSDOT LOS thresholds are LOS C and LOS D on state highway facilities. The LOS threshold for developer projects is set differently. Refer to Chapter 4 of the *Development Services Manual*.

(1) Trip Generation Thresholds

The following criteria are used as the starting point for determining when a TIA is needed:

- When a project changes local circulation networks that impact a state highway facility involving direct access to the state highway facility; includes a nonstandard highway geometric design feature, among others.
- When the potential for a traffic incident is significantly increased due to congestion-related collisions, nonstandard sight distance considerations, increases in traffic conflict points, and others.
- When a project affects state highway facilities experiencing significant delay: LOS “C” in rural areas or “D” in urban areas.

Note: A traffic analysis can be as simple as providing a traffic count or as complex as a microscopic simulation. The appropriate level of analysis is determined by the specifics of a project, the prevailing highway conditions, and the forecasted traffic. For developer projects, different thresholds may be used depending on local agency codes or interagency agreements (or both) between WSDOT and local agencies. For more information, refer to Chapter 4 of the *Development Services Manual*.

Type of Facility	Measure of Effectiveness (MOE)
Basic Freeway Segments	Density (pc/mi/ln)
Ramps	Density (pc/mi/ln)
Ramp Terminals	Delay (sec/veh)
Multilane Highways	Density (pc/mi/ln)
Two-Lane Highways	Percent-Time-Spent Following Average Travel Speed (mi/hr)
Signalized Intersections	Control Delay Per Vehicle (sec/veh)
Unsignalized Intersections	Average Control Delay Per Vehicle (sec/veh)
Urban Streets	Average Travel Speed (mi/hr)

Measures of Effectiveness by Facility Type
Exhibit 320-1

Chapter 510 Right of Way Considerations

510.01 General

Washington State Department of Transportation (WSDOT) Real Estate Services personnel participate in the project definition phase of a project to assist in minimizing right of way costs, defining route locations and acquisition areas, and determining potential problems and possible solutions.

Due to the variables in land acquisition, the categories of right of way costs considered in the project definition phase are:

- Purchase costs (acquisition compensation).
- Relocation assistance benefits payments.
- Other Real Estate Services staff expenses (acquisition services, relocation services, and interim property management services).

Right of way cost estimates are made by Real Estate Services specialists. When the parcels from which additional right of way will be acquired are known, title reports (including assessors' land areas) can be requested.

Real Estate Services personnel also make project field inspections at appropriate times throughout the development of a project to ensure adequate consideration is given to significant right of way elements involved (including possible social, economic, and environmental effects) in accordance with the *Right of Way Manual*.

During plan development:

- Title reports are examined for easements or other encumbrances that would reveal the existence and location of water lines, conduits, drainage or irrigation lines, and so on, that must be provided for in construction.
- Easements that indicate other affected ownerships are added to the right of way and limited access plan.
- Arrangements are made to obtain utility, railroad, haul road, detour routes, or other essential agreements, as instructed in the *Utilities Manual* and the *Agreements Manual*.
- Right of way acquisition, disposal, and maintenance are planned.
- Easements and permits are planned (to accommodate activities outside of the right of way).

For design right of way widths, see Chapter 1140. The widths may be modified based on Real Estate Services' input, but cannot be moved to coincide with property boundaries in anticipation of a total take. Jogs in the final widths of the right of way are held to a minimum. (See *Right of Way Manual* Chapter 6 for discussion of remainders.)

All acquisition documents are processed through Headquarters (HQ) Real Estate Services except temporary permits that are not shown on right of way plans and are not needed for the project (such as for driveway connections).

510.02 References

(1) Federal/State Laws and Codes

23 Code of Federal Regulations (CFR) Part 710

49 CFR Part 24, Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally Assisted Programs

Revised Code of Washington (RCW) 8.26, Relocation assistance – Real property acquisition policy

Washington Administrative Code (WAC) 468-100, Uniform relocation assistance and real property acquisition

(2) Design Guidance

Agreements Manual, M 22-99, WSDOT

Plans Preparation Manual, M 22-31, WSDOT

Right of Way Manual, M 26-01, WSDOT

Utilities Manual, M 22-87, WSDOT

510.03 Special Features

(1) Road Approaches

On managed access highways, the department will reconstruct legally existing road approaches that are removed or destroyed as part of the highway construction. New approaches required by new highway construction are negotiated by the region with the approval of the Regional Administrator. The negotiator coordinates with the region's design section to ensure new approaches conform to the requirements of Chapter 1340 for road approaches. All new approaches will be by permit through the appropriate region office.

On limited access highways, road approaches of any type must be approved by the Director & State Design Engineer, Development Division, before there is legal basis for negotiation by Real Estate Services. When approved, approaches will be specifically reserved in the right of way transaction and will contain the identical limitations set by the Director & State Design Engineer, Development Division, and as shown on the approved right of way and limited access plan.

(2) Cattle Passes

The desirability of or need for a cattle pass will be considered during the appraisal or negotiation process. A cattle pass will be approved only after complete studies of location, utilization, cost, and safety elements have proved its necessity. Upon approval, such an improvement and appurtenant rights will be established. Future right of access for maintenance is negotiated during acquisition.

On limited access highways, approval by the Director & State Design Engineer, Development Division, and the addition of a traffic movement note on the right of way and limited access plan (see the *Plans Preparation Manual*) are required.

(3) Pit, Stockpile, and Waste Sites

These sites are investigated and planned as outlined in the *Plans Preparation Manual*. Detour and haul road agreements, approved by the Regional Administrator, are necessary when the state proposes to use city streets or county roads for the purpose of detouring traffic or hauling certain materials. (See the *Utilities Manual* for detour and haul road agreement guidelines.)

(4) International Boundaries

Construction proposed "within a 20-foot strip, 10 feet on each side of the international boundary," must be coordinated between the department and the British Columbia Ministry of Highways and Public Works.

Permission of the International Boundary Commission is required to work "within 10 feet of an international boundary." Their primary concern is monumentation of the boundary line and the line of sight between monuments. The Commission requires a written request stating what, when, and why construction will be done, sent to:

International Boundary Commission
2401 Pennsylvania Ave NW, Suite 475
Washington, DC 20037

510.04 Easements and Permits

(1) General

If others request rights within existing WSDOT ownership, they are to contact the region Real Estate Services Office.

Easements and permits to accommodate WSDOT activities outside the right of way usually fall into one of the categories defined below.

Easements and permits are processed in accordance with the requirements of the *Right of Way Manual*. The region Real Estate Services Office drafts the legal descriptions for all easements and permits for acquisition of property and property rights. HQ Real Estate Services drafts the legal description for all easements and permits for disposition of property or property rights. The region Real Estate Services Office either obtains or assists in obtaining easements and permits. The region is responsible for compliance with and appropriate retention of the final documents. Records of permanent property rights acquired are maintained by HQ Real Estate Services. Easements and permits are to be shown on the contract plans in accordance with the *Plans Preparation Manual*.

(2) Perpetual Easements

Perpetual easements are shown on the right of way plans in accordance with the *Plans Preparation Manual*.

(a) **State Maintenance Easement**

Used when the state is to construct a facility and provide all maintenance. Examples are slope and drainage easements.

(b) **Dual Maintenance Easement**

Used when the state is to construct and maintain a facility and the owner is to maintain the remainder. Examples include the surface area above a tunnel and the area behind a retaining wall or noise wall.

(c) **Transfer Easement**

On occasion an easement must be acquired for transfer to another party. In these cases, contact the region Real Estate Services Office for early involvement. The right of way and limited access plan is modified to identify the party to whom the easement will be transferred. The department cannot obtain easements for transfer across lands under the jurisdiction of the Department of Natural Resources (DNR), and WSDOT cannot condemn for a transfer easement.

(3) Temporary Easements

Temporary easements are used when the state requires a temporary property right that involves either more than minor work or construction activities on privately owned property. In the cases where the rights required or the work to be performed is not beneficial to the property owner, just compensation must be paid.

When WSDOT is paying for the rights or when the encroachment is significant, temporary easements are shown on the right of way plans, in accordance with the *Plans Preparation Manual*. Consult the region Plans and Real Estate Services personnel for exceptions. If the easement is not mapped, mark and submit plans according to the following information.

(a) The region provides a right of way plan with the required temporary easement(s) delineated in red to the region Real Estate Services Office. These plan sheets provide:

- Ownership boundaries. Confirmation of ownership and parcel boundaries may be completed by a search of county records and mapping; a formal title report is required for temporary easements.
- Parcel number assigned to each ownership.
- Sufficient engineering detail to write legal descriptions.
- Statement of the intended use of each temporary easement area.

(b) In limited access areas, contact the HQ Access and Hearings Office.

(4) Construction Permits

Construction permits are used for temporary rights during construction. They are not used when WSDOT needs a perpetual right. A construction permit is only valid with the current owner and must be renegotiated if property ownership changes before construction begins. For private ownerships, a temporary construction easement is recommended. A construction permit is recommended for rights of entry to publicly owned property. Local agencies might require the use of specific forms when applying for these rights of entry. Regardless of the form or its name, the region is responsible for appropriate central storage of the original document.

<table>
<tr><th>Plan Approval</th><th>Plan Approval</th><th>Programming of Funds for Appraisal and Acquisition</th></tr>
<tr><td colspan="3">Limited Access Highways</td></tr>
<tr><td>PHASE 1
Access
Report Plan</td><td>Director & State Design Engineer, Development Division,* approves access report plan for prehearing discussion with county and city officials.
The access report plan may be used for preparation of federal-aid program data for appraisals if federal funds are to be used for right of way acquisition. It may be used for requesting advance appraisal funds through the Planning and Capital Program Management for all projects with either state or federal funds.</td><td>Program appraisals of total takes. (No acquisition.)</td></tr>
<tr><td>PHASE 2
Access
Hearing Plan</td><td>Director & State Design Engineer, Development Division,* approves access hearing plan for use at a public access hearing. R/W information is complete.
The access hearing plan may be used for the preparation of federal-aid program data for negotiations on federally funded projects and for the preparation of true cost estimates and fund requests.</td><td>Program all appraisals and acquisitions.
Note: Do not appraise or purchase partial takes in areas subject to controversy. Appraise or purchase total takes only if federal design hearing requirements are met.</td></tr>
<tr><td>PHASE 3
Findings and
Order Plan</td><td>No signature required.
Results of findings and order access hearing are marked in red and green on access hearing plan and sent to HQ R/W Plans Section.</td><td>Program appraisals of partial takes where data is available to appraisers.
Acquisition of total takes.</td></tr>
<tr><td>PHASE 4
Final R/W
and L/A Plan</td><td>Director & State Design Engineer, Development Division,* approves final R/W and L/A plans or approves revisions to established R/W and L/A plans.</td><td>Program all remaining appraisals and all remaining acquisitions.
Note: If appeal period is not complete, delay action in areas subject to controversy and possible appeal.</td></tr>
<tr><td colspan="3">Managed Access Highways</td></tr>
<tr><td rowspan="2">PHASE 5
Final R/W Plan</td><td>R/W plan submitted to HQ R/W Plans Section for approval.</td><td>Program appraisals.</td></tr>
<tr><td>Director & State Design Engineer, Development Division,* approves new R/W plans or approves revisions to established R/W plans.</td><td>Program all appraisals and acquisitions.</td></tr>
</table>

*Or a designee.

Appraisal and Acquisition
Exhibit 510-1

520.03 Definitions

access A means of entering or leaving a public road, street, or highway with respect to abutting property or another public road, street, or highway.

access control The limiting and regulating of public and private access to Washington State's highways, as required by state law.

Access Control Tracking System Limited Access and Managed Access Master Plan A database list, related to highway route numbers and mileposts, that identifies either the level of limited access or the class of managed access:
www.wsdot.wa.gov/design/accessandhearings

access connection See ***approach and access connection***.

access connection permit A written authorization issued by the permitting authority for a specifically designed access connection to a managed access highway at a specific location; for a specific type and intensity of property use; and for a specific volume of traffic for the access connection based on the final stage of the development of the applicant's property. The actual form used for this authorization is determined by the permitting authority.

access deviation A deviation (see Chapter 300) that authorizes deferring or staging acquisition of limited access control, falling short of a 300-foot requirement, or allowing an existing access point to stay within 130 feet of an intersection on a limited access highway. Approval by the Director & State Design Engineer, Development Division, is required (see Chapter 530).

access hearing plan A limited access plan prepared for presentation at an access hearing.

access point Any point that allows private or public entrance to or exit from the traveled way of a state highway, including "locked gate" access and maintenance access points.

access point spacing On a managed access highway, the distance between two adjacent access points on one side of the highway, measured along the edge of the traveled way from one access point to the next (see also ***corner clearance***).

access report plan A limited access plan prepared for presentation to local governmental officials at preliminary meetings before preparation of the access hearing plan.

access rights Property rights that allow an abutting property owner to enter and leave the public roadway system.

allowed Authorized.

application for an access connection An application provided by the permitting authority to be completed by the applicant for access to a managed access highway.

approach and access connection These terms are listed under the specific access section to which they apply. The first section below is for limited access highways and uses the term *approach*. The second section below is for managed access highways and uses the term *access connection*.

Approaches and access connections include any ability to leave or enter a highway right of way other than at an intersection with another road or street.

(a) ***limited access highways: approach*** An access point, other than a public road/street, that allows access to or from a limited access highway on the state highway system. There are five types of approaches to limited access highways that are allowed:

- ***Type A*** An off and on approach in a legal manner, not to exceed 30 feet in width, for the sole purpose of serving a single-family residence. It may be reserved by the abutting owner for specified use at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways.
- ***Type B*** An off and on approach in a legal manner, not to exceed 50 feet in width, for use necessary to the normal operation of a farm, but not for retail marketing. It may be reserved by the abutting owner for specified use at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways. This approach type may be used for wind farms when use of the approach is limited to those vehicles necessary to construct and maintain the farm for use in harvesting wind energy.
- ***Type C*** An off and on approach in a legal manner, for a special purpose and width to be agreed upon. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed on partial and modified control limited access highways and on full control limited access highways where no other reasonable means of access exists, as solely determined by the department.
- ***Type D*** An off and on approach in a legal manner, not to exceed 50 feet in width, for use necessary to the normal operation of a commercial establishment. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed only on modified control limited access highways.
- ***Type E*** This type is no longer allowed to be constructed because of the requirements that there be only one access point per parcel on a limited access state highway.
- ***Type F*** An off and on approach in a legal manner, not to exceed 30 feet in width, for the sole purpose of serving a wireless communication site. It may be specified at a point satisfactory to the state at or between designated highway stations. This approach type is allowed only on partial control limited access highways. (See WAC 468-58-080(vi) for further restrictions.)

(b) ***managed access highways: access connection*** An access point, other than a public road/street, that permits access to or from a managed access highway on the state highway system. There are five types of access connection permits:

- ***conforming access connection*** A connection to a managed access highway that meets current WAC and WSDOT location, spacing, and design criteria.
- ***grandfathered access connection*** Any connection to the state highway system that was in existence and in active use on July 1, 1990, and has not had a significant change in use.
- ***joint-use access connection*** A single connection to a managed access highway that serves two or more properties.

- ***nonconforming access connection*** A connection to a managed access highway that does not meet current WSDOT location, spacing, or design criteria, pending availability of a future conforming access connection.
- ***variance access connection*** A connection to a managed access highway at a location not normally allowed by current WSDOT criteria.

(c) ***managed access connection category*** There are four access connection permit categories for managed access connections to state highways: Category I, Category II, Category III, and Category IV (see Chapter 540).

annual daily traffic (ADT) The volume of traffic passing a point or segment of a highway, in both directions, during a period of time, divided by the number of days in the period, and factored to represent an estimate of traffic volume for an average day of the year.

average annual daily traffic (AADT) The average volume of traffic passing a point or segment of a highway, in both directions, during a year.

average weekday vehicle trip ends (AWDVTE) The estimated total of all trips entering plus all trips leaving the applicant's site based on the final stage of proposed development.

connection See ***approach and access connection***.

contiguous parcels Two or more pieces of real property, under the same ownership, with one or more boundaries that touch and have similarity of use.

corner clearance On a managed access highway, the distance from an intersection of a public road or street to the nearest access connection along the same side of the highway. The minimum corner clearance distance (see Chapter 540, Exhibit 540-1) is measured from the closest edge of the intersecting road or street to the closest edge of the traveled way of the access connection, measured along one side of the traveled way (through lanes) (see also ***access point spacing***).

DHV Design hourly volume.

E&EP WSDOT's Environmental and Engineering Programs Division.

easement A documented right, as a right of way, to use the property of another for designated purposes.

findings and order (F&O) A legal package containing information based on the hearing record from a limited access hearing (see Chapters 210 and 530).

findings and order (F&O) plan A limited access plan, prepared after a limited access hearing, which is based on the hearing record.

HQ WSDOT's Headquarters in Olympia.

intersection An at-grade access point connecting a state highway with a road or street duly established as a public road or public street by the local governmental entity.

limited access Full, partial, or modified access control is planned and established for each corridor and then acquired as the right to limit access to each individual parcel.

- ***planned limited access control*** Limited access control is planned for sometime in the future; however, no access hearing has been held.
- ***established limited access control*** An access hearing has been held and the Assistant Secretary, Engineering & Regional Operations, has adopted the findings and order, which *establishes* the limits and level of control.
- ***acquired limited access control*** Access rights have been purchased.

limited access highway All highways listed as "Established L/A" on the Limited Access and Managed Access Master Plan (see below) and where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

- ***full access control*** This most restrictive level of limited access provides access, using interchanges, for selected public roads/streets only, and prohibits highway intersections at grade.
- ***partial access control*** The second most restrictive level of limited access. At-grade intersections with selected public roads are allowed, and there may be some crossings and some driveway approaches at grade. Direct commercial access is not allowed.
- ***modified access control*** The least restrictive level of limited access. Characteristics are the same as for partial access control except that direct commercial access is allowed.

managed access highway Any highway not listed as "Established L/A" on the Limited Access and Managed Access Master Plan and any highway or portion of a highway designated on the plan as "Established L/A" until such time as the limited access rights are acquired. Under managed access legislation, the property owner's access rights are regulated through an access connection permitting process.

Limited Access and Managed Access Master Plan A map of Washington State that shows established and planned limited access highways:
www.wsdot.wa.gov/design/accessandhearings

median The portion of a divided highway separating vehicular traffic traveling in opposite directions.

median opening An opening in a continuous median for the specific purpose of allowing vehicle movement.

MOU Memorandum of Understanding. There is one MOU (*Highways Over National Forest Lands)* between the United States Forest Service (USFS) and WSDOT that requires the USFS to obtain a road approach permit for new access to a state highway that is crossing Forest Service land.

permit holder The abutting property owner or other legally authorized person to whom an access connection permit is issued by the permitting authority.

permitted access connection A connection for which an access connection permit has been issued by a permitting authority.

Chapter 530 Limited Access Control

530.01 General

Limited access control is established to preserve the safety and efficiency of specific highways and to preserve the public investment. Limited access control is achieved by acquiring access rights from abutting property owners and by selectively limiting approaches to a highway. (For an overview of access control and the references list and definitions of terminology for this chapter, see Chapter 520, Access Control.)

Requirements for the establishment of limited access highways are set forth in Revised Code of Washington (RCW) 47.52. The level of limited access control is determined during the early stages of design in conformance with this chapter.

Highways controlled by acquiring abutting property owners' access rights are termed limited access highways and are further distinguished as having *full*, *partial*, *or modified* control. The number of access points per mile, the spacing of interchanges or intersections, and the location of frontage roads or local road/street approaches are determined by the:

- Functional classification and importance of the highway.
- Character of the traffic.
- Current and future land use.
- Environment and aesthetics.
- Highway design and operation.
- Economic considerations involved.

The Federal Highway Administration (FHWA) has jurisdiction on the Interstate System. The Washington State Department of Transportation (WSDOT) has full jurisdiction on all other limited access highways, whether they are inside or outside incorporated city limits.

WSDOT maintains a record of the status of limited access control, by state route number and milepost, in the Access Control Tracking System Limited Access and Managed Access Master Plan database. The database is available at:
www.wsdot.wa.gov/design/accessandhearings

Nothing in this chapter is to be construed in any way that would prevent acquisition of short sections of full, partial, or modified control of access.

530.02 Achieving Limited Access

(1) Project Scoping Evaluation

The acquisition of full, partial, or modified control is to be evaluated during project scoping if the route is shown in the Access Control Tracking System Limited Access and Managed Access Master Plan database as either "established" or "planned" for limited access. The matrices in Chapter 1100 list several project types for which acquisition is indicated as a Design Element.

The cost of acquiring limited access must be evaluated during project scoping to determine whether those costs will be included in the project. The evaluation includes the societal costs of collisions, current and future land use development, and the improved level of service of limited access highways. This cost will be evaluated against the cost to realign the highway in the future if limited access is not acquired at current prices.

(2) Process

All Washington State highways are managed access highways (see Chapter 540), except where limited access rights have been acquired. The right of way and limited access plans for routes show the acquired limited access boundaries. This is further represented in the Access Control Tracking System, a database that identifies the status and type of access control for all state highways. The database lists the specific types of limited access control (full, partial, or modified) and identifies whether the control is planned, established, or acquired for a specific route segment. If limited access has not been acquired, the database reports the type of managed access classification that currently applies. For help determining the status of limited access control for any state highway, consult the Headquarters (HQ) Access and Hearings Section.

(a) **Procedure for Limited Access Control**

Use the following procedure to achieve limited access control:

1. The Secretary of Transportation (or a designee) first identifies a highway as "Planned for Limited Access."
2. To establish or revise limited access on a new or existing highway, a limited access hearing is held. (See Chapter 210, Public Involvement and Hearings, regarding hearings, and Chapter 510, Right of Way, for the phases of appraisal and acquisition.)

   a. **Phase 1**

   The region develops a limited access report and a limited access report plan for department approval and presentation to local officials. The plan notes the level of limited access proposed to be established.

   b. **Phase 2**

   The region develops a limited access hearing plan for Director & State Design Engineer, Development Division (or designee), approval and for presentation at the hearing.

c. **Phase 3**

After the hearing, the region develops the findings and order and revises the limited access hearing plan to become the findings and order plan (see Chapter 210). The findings and order is processed and sent to the Headquarters (HQ) Access and Hearings Section for review and approval.

3. The Assistant Secretary, Engineering & Regional Operations, adopts the findings and order and thus establishes the limits and level of limited access control to be acquired.
4. The findings and order plan is now revised by the HQ Right of Way Plans Section for approval by the Director & State Design Engineer, Development Division (or designee), as a Phase 4 final right of way and limited access plan.
5. Real Estate Services acquires limited access rights from individual property owners based on final design decisions and updates the right of way and limited access plans and the property deed.
6. These highways or portions thereof are now limited access highways and no longer fall under the managed access program.

(3) Access Report

The Access Report is developed by the region to inform local governmental officials of the proposed limited access highway and the principal access features involved, and to secure their approval. This report is not furnished to abutting property owners. Three copies of the report are submitted to the HQ Access and Hearings Section for review and approval prior to submission to local authorities.

(a) **Access Report Content**

The Access Report consists of the following:

1. A description of the existing and proposed highways, including data on the history of the existing highway, which may include references to collisions and locations identified in WSDOT’s Priority Array.
2. Traffic analyses pertaining to the proposed highway, including available information about current and potential future traffic volumes on county roads and city streets crossing or severed by the proposed highway and reference sources such as origin-destination surveys.

   Traffic data developed for the Design Decision Summary, together with counts of existing traffic available from state or local records, is normally adequate. Special counts of existing traffic are obtained only if circumstances indicate that the available data is inadequate or outdated.
3. A discussion of factors affecting the design of the subject highway, including:
   - Design level.
   - Level of limited access, with definition.
   - Roadway section.
   - Interchange, grade separation, and intersection spacing.

- Pedestrian and bicycle trails or paths.
- Operational controls with emphasis on proposed fencing, the general concept of illumination, signing, and other traffic control devices.
- Location of utilities and how they are affected.
- Proposed plan for landscaping and beautification, including an artist's graphic rendition or design visualization.

4. Governmental responsibility, and comprehensive planning, land use, and community service relative to the new highway.
5. The disposition of frontage roads, city street and county road intersections, and excess right of way.
6. An appendix containing:
   - A glossary of engineering terms.
   - A traffic volume diagram(s).
   - Pages showing diagrammatically or graphically the roadway section(s), operational controls, and rest areas (if rest areas are included in the project covered by the report).
   - A vicinity map.
   - An access report plan and profiles for the project.

   The limited access report plan shows the effects of the proposed highway on the street and road system by delineating the points of public access. (See the *Plans Preparation Manual* for a list of the minimum details to be shown on the plan and for a sample plan.)
7. Notifications and Reviews. Upon receipt of the Phase 1 approval (see Exhibit 510-1) from the Director & State Design Engineer, Development Division, the region publishes the necessary copies, submits the limited access report to the county or city officials for review and approval, and meets with all involved local governmental agencies to discuss the report. Providing a form letter with a signature block for the local agency to use to indicate their approval of the limited access report can help expedite the review and approval process.

   Including local agencies as stakeholders from the onset of the project helps establish project expectations and positive working relationships, making reviews and approvals run as smoothly as possible. The region reviews any requests for modification and submits recommendations, with copies of any correspondence or related minutes, to the HQ Access and Hearings Section.

(4) Limited Access Hearing Plan

The region prepares a limited access hearing plan to be used as an exhibit at the public hearing (see Chapter 210 for hearings) and forwards it to the HQ Right of Way Plans Section for review. (See the *Plans Preparation Manual* for a list of data to be shown on the access hearing plan in addition to the access report plan data.)

When the plan review is completed by Headquarters, the access hearing plan is placed before the Director & State Design Engineer, Development Division, for approval of Phase 2 authority (see Exhibit 510-1).

(5) Documentation

Documentation for the establishment of limited access control is in Chapter 210.

(4) Location of Utilities, Bus Stops, and Mailboxes

(a) **Utilities**

Connecting utility lines are allowed along the outer right of way line between intermittent frontage roads. (See the *Utilities Accommodation Policy* regarding the location of and access to utilities.)

(b) **Bus Stops**

Common carrier or school bus stops are not allowed, except at:

- Railroad crossings (see Chapter 1350).
- Locations provided by the state on the interchanges (such as flyer stops).
- In exceptional cases, along the main roadway where pedestrian separation is available.

(c) **Mailboxes**

Mailboxes are not allowed on full control limited access highways. Mail delivery will be from frontage roads or other adjacent local roads.

(5) Pedestrian and Bicycle Crossings and Paths

All nonmotorized traffic is limited as follows:

- At-grade pedestrian crossings are allowed only at the at-grade intersections of ramp terminals.
- Pedestrian separations or other facilities provided specifically for pedestrian use.
- Bicyclists using facilities provided specifically for bicycle use (separated paths).
- Shared-use paths for bicyclists, pedestrians, and other forms of nonmotorized transportation.
- Bicyclists using the right-hand shoulders, except where such use has been specifically prohibited. Information pertaining to such prohibition is available from the Traffic Office of the HQ Maintenance and Operations Division.

Pedestrians and bicycles are allowed, consistent with “Rules of the Road” (RCW 46.61), within the limits of full control limited access highways. Where paths are allowed they must be documented on the right of way and limited access plan. The plan shows the location of the path and where the path crosses limited access and provides movement notes (see 530.10(1)).

530.04 Partial Control

(1) Introduction

Partial control may be established, when justified, on any highway except Interstate. Partial control provides a considerable level of protection from traffic interference and protects the highway from future strip-type development.

Upon acquisition of partial control limited access rights, the number, type, and use of access approaches of abutting property are frozen. The abutting property access rights and type of use are recorded on the property deed. The rights and use may not be altered by the abutting property owner, the local jurisdiction, or the region. This authority resides with the Director & State Design Engineer, Development Division (see 530.10).

(2) Application

Partial control will not normally be used in urban areas or inside corporate limits on existing principal arterial highways where traffic volumes are less than 700 design hourly volume (DHV).

Terminate limited access sections at apparent logical points of design change.

(a) **Principal Arterial**

Partial control is required when the estimated traffic volumes exceed 3000 average daily traffic (ADT) within a 20-year design period on principal arterial highways requiring two through traffic lanes. For multilane principal arterial highways, see 530.03(2)(b).

(b) **Minor Arterial**

The minimum route length is: urban, 2 miles; rural, 5 miles; and combination urban and rural, 3 miles.

Partial control is required on:

- Rural minor arterial highways at both new and existing locations.
- Urban minor arterial highways at new locations requiring four or more through traffic lanes within a 20-year design period or requiring only two through traffic lanes where the estimated traffic volumes exceed 3000 ADT within a 20-year design period.

Other rural minor arterial highways with only two lanes may be considered for partial control if any of the following conditions applies:

- The partial control can be acquired at a reasonable cost.
- The route connects two highways of a higher functional classification.
- The potential land development can result in numerous individual approaches, such as encountered in recreational or rapidly developing areas.
- The highway traverses publicly owned lands where partial control is desirable.

(c) **Collector: New Alignment**

Partial control is required on collector highways in new locations requiring four or more through traffic lanes in a 20-year design period.

(d) **Collector: Existing**

Existing collector highways will normally be considered for partial control limited access only when all of the following conditions apply:

- The highway serves an area that is not directly served by a higher functional classification of highway.
- Existing or planned development will result in traffic volumes significantly higher than what is required for partial control on minor arterials.
- Partial control can be established without a major impact on development of abutting properties within the constraints of established zoning at the time the partial control is proposed.

(3) Interchanges and Intersections

(a) **Interchanges**

Where an interchange occurs on a partial control limited access highway, full control applies at the interchange and interchange ramps. Refer to 530.03(3) and see Exhibits 530-1a, 1b, and 1c for required minimum lengths of access control along the crossroad. (See Chapter 1360 for guidance on interchange spacing.)

(b) **Intersections**

At an at-grade intersection on a partial control limited access highway, control will be established and acquired along the crossroad for a minimum distance of 300 feet from the centerline of the highway (see Exhibit 530-2a).

If another frontage or local road is located at or within 350 feet of the at-grade intersection, limited access will be established and then acquired along the crossroad, between the intersections, and:

- For an additional minimum distance of 130 feet in all directions from the centerline of the intersection of the frontage or local road (see Exhibit 530-2a).
- In the case of a roundabout, for an additional minimum distance of 300 feet along the crossroad, measured from the center of the roundabout (as shown in Exhibit 530-2b).

On multilane highways, measurements will be made from the centerline of the nearest directional roadway.

An approved access deviation is required if the limited access control falls short of 300 feet or for any access that has been allowed to remain within the first 130 feet.

At-grade intersections with public roads are limited to the number allowed for the functional classification of highway involved, as follows:

1. **Principal Arterial**

   If the ADT of the crossroad is less than 2000, 1-mile spacing (minimum), centerline to centerline. If over 2000 ADT within 20 years, plan for grade separation.

2. **Minor Arterial**

   If the ADT of the crossroad is less than 2000, ½-mile spacing (minimum), centerline to centerline. If over 2000 ADT within 20 years, plan for grade separation.

3. **Collector**

   Road (or street) plus property approaches, not more than six per side per mile.

With approval from the Director & State Design Engineer, Development Division, shorter intervals may be used where topography or other conditions restrict the design. Where intersecting roads are spaced farther apart than one per mile, median crossings may be considered for U-turns, in accordance with Chapter 1310. Keep U-turns to a minimum, consistent with requirements for operation and maintenance of the highway.

To discourage movement in the wrong direction on multilane highways, locate private approaches 300 feet or more from an at-grade intersection. At a tee intersection, a private approach may be located directly opposite the intersection or a minimum of 300 feet away from the intersection. Ensure a private approach directly opposite a tee intersection cannot be mistaken for a continuation or part of the public traveled way.

(4) Access Approach

Partial control is exercised to the level that, in addition to intersections with selected public roads, some crossings and private driveways may be allowed.

(a) **Approach Types**

Partial control limited access highways allow at-grade intersections with selected public roads and private approaches using Type A, B, C, and F approaches. (See Chapter 520 for the definitions of approach types.)

Type D, commercial approaches, are not allowed direct access to partial control limited access highways. Commercial access is allowed only by way of public roads.

The type of approach provided for each parcel is based on current and potential land use and on an evaluation. (See 530.05(4) for a list of evaluation criteria.)

(b) **Design Considerations**

The following considerations are used to determine the number and location of access approaches on partial control limited access highways.

1. Access approaches must be held to a minimum. The number is limited as follows:
   - Principal arterial: two per side per mile
   - Minor arterial: four per side per mile
   - Collector: six per side per mile, including at-grade intersections
2. Approaches in excess of the number listed above may be allowed as stage construction if approved by the Director & State Design Engineer, Development Division.
3. Approaches are not allowed for parcels that have reasonable access to other public roads unless a parcel has extensive highway frontage.
4. Relocate or close approaches in areas where sight limitations create undue hazards.
5. Allow only one approach for each parcel, except for very large ownerships, or where terrain features do not allow the property to be served by a single approach. This includes contiguous parcels under a single ownership.
6. Where possible, locate a single approach to serve two or more parcels.
7. The approved design is to provide for future development of frontage roads that will eliminate an excessive number of approaches.

(5) Location of Utilities, Bus Stops, and Mailboxes

(a) **Utilities**

Connecting utility lines are allowed along the outer right of way line between intermittent frontage roads. (See the *Utilities Accommodation Policy* regarding the location of and access to utilities.)

(b) **Bus Stops**

Bus stops for both common carriers and school buses are not allowed on either two-lane or four-lane highways except:

- At railroad crossings (see Chapter 1350).
- At locations of intersections with necessary pullouts to be constructed by the state.
- Where shoulder widening has been provided for mail delivery service.
- For a designated school bus loading zone on or adjacent to the traveled lane, that has been approved by WSDOT.

Buses are not allowed to stop in the traveled lanes blocking at-grade intersections or private approaches to load or unload passengers.

School bus loading zones on partial control limited access highways must be posted with school bus loading zone signs, in accordance with the latest edition of the *Manual on Uniform Traffic Control Devices* (MUTCD).

(c) **Mailboxes**

Locate mailboxes on frontage roads or at intersections, with the following exceptions for properties that are served by Type A or B approaches:

- Locate mailboxes on a four-lane highway only on the side of the highway on which the deeded approach is provided.
- Locate mailboxes on a two-lane highway on the side of the highway that is on the right in the direction of the mail delivery.

Wherever mailboxes are allowed on a partial control limited access highway, provide mailbox turnouts to allow mail delivery vehicles to stop clear of the through traffic lanes. (See Chapter 1600 for additional information concerning mailbox locations and turnouts.)

(6) Pedestrian and Bicycle Crossings and Paths

Pedestrian crossings are allowed when they are grade-separated.

At-grade pedestrian crossings are allowed:

- Only at intersections where an at-grade crossing is provided in accordance with Chapter 1510.
- On two-lane highways at mailbox locations.
- On two-lane highways not less than 100 feet from a school bus loading zone (pullout) adjacent to the traveled lane, if school district and WSDOT personnel determine that stopping in the traveled lane is hazardous.
- On two-lane highways where the school bus is stopped on the traveled lane to load or unload passengers and the required sign and signal lights are displayed.

On partial control limited access highways, pedestrian and bicycle traffic is allowed, consistent with "Rules of the Road" (RCW 46.61), except where unusual safety conditions support prohibition. Information pertaining to such prohibitions is available from the Traffic Office of the HQ Maintenance and Operations Division.

Where paths are allowed, they must be documented on the right of way and limited access plan. The plan shows the location of the path and where the path crosses limited access, and it provides movement notes (see 530.10(1)).

530.05 Modified Control (Least Restrictive)

(1) Introduction

Modified control is intended to prevent further deterioration in the safety and operational characteristics of existing highways by limiting the number and location of access points.

Upon acquisition of modified control limited access, the number, type, and use of access approaches of abutting property are frozen. The abutting property access rights and type of use are recorded on the property deed. The rights and use may not be altered by the abutting property owner, the local jurisdiction, or the region. This authority resides with the Director & State Design Engineer, Development Division (see 530.10).

(2) Application

In general, modified control is applied where some level of control is desired, but existing and potential commercial development precludes the implementation of full or partial control.

(a) **Existing Highways**

Modified control may be established and acquired on existing highways other than Interstate. Priority is given to highway segments where one or both of the following conditions applies:

- Commercial development potential is high, but most of the adjoining property remains undeveloped.
- There is a reasonable expectation that the adjoining property will be redeveloped to a more intensive land use, resulting in greater traffic congestion.

(b) **Design Analysis**

Selection of highways on which modified control may be applied is based on a design analysis that includes the following factors:

- Traffic volumes
- Level of service
- Safety
- Design class
- Route continuity
- Population density

- Except where the railroad is located in the median area, the approach is to be accomplished in a legal manner by right turns only, to and from the roadway nearest the railroad. Median crossing is not allowed.
- The approach is secured by a locked gate under arrangements satisfactory to the department. (See the Definitions section in Chapter 520 for Approach Type C, and Chapter 550.)
- The parking of any vehicles or railroad equipment is prohibited within limited access highway right of way.
- A special emergency maintenance permit must be obtained for periods of intensive railroad maintenance.
- The approach must be closed if the railroad operation ceases.
- Approaches are limited to use by the railroad company unless specific provisions for other use are shown on the right of way and limited access plan and included in the right of way negotiations.

(3) Restrictions

Direct access from the highway is considered unnecessary and is not allowed where:

- There are local roads adjacent to or crossing the railroad.
- A trail-type road can be provided by the railroad between crossroads.
- The limited access highway is paralleled by a frontage road adjacent to the railroad.
- No highway previously existed adjacent to the railroad.

530.10 Modifications to Limited Access Highways

(1) General

Modifications to limited access highways can only be made by the application of current design requirements and with the approval of the Assistant Secretary, Engineering & Regional Operations (or designee), and FHWA (when appropriate).

Any change is a modification to limited access; for example, constructing new fence openings, closing existing fence openings, adding trails that cross into and out of the right of way, and widening existing approaches. The right of way and limited access plan must be revised and, if private approaches are involved, deeds must be redone.

Any changes proposed on Interstate limited access facilities must include environmental documentation in the request. Contact the HQ Access and Hearings Section for assistance.

Consider the following factors when evaluating a request for modification of a limited access highway:

- Existing level of control on the highway
- Functional classification and importance of the highway
- Percentage of truck traffic
- Highway operations
- Present or future land use
- Environment or aesthetics
- Economic considerations
- Safety considerations

Evaluate all revisions to limited access highways to determine if access hearings are required.

For requirements to be met for selected modifications to full control limited access highways such as the Interstate System and multilane state highways, see Chapter 550, Interchange Justification Report.

(2) Modifications for Private Access Approaches

(a) **Requirements**

Examples of access modifications requested by abutting property owners include additional road approaches, changes in the allowed use, or additional users of existing road approaches.

Plan revisions that provide for additional access to abutting properties after WSDOT has purchased the access rights are discouraged. However, these revisions may be considered if all of the following can be established:

- There are no other reasonable alternatives.
- The efficiency and safety of the highway will not be adversely impacted.
- The existing situation causes extreme hardship on the owner(s).
- The revision is consistent with the limited access highway requirements.

(b) **Procedures**

The region initiates a preliminary engineering review of the requested modification to or break in limited access. This preliminary review will be conducted with the HQ Access and Hearings Section to determine whether conceptual approval can be granted for the request. If conceptual approval can be granted, then:

- The region initiates an engineering review of the requested modification.
- The region prepares and submits to the HQ Right of Way Plans Section a preliminary right of way and limited access plan revision, together with a recommendation for Headquarters approval. When federal-aid funds are involved in any phase of the project, the proposed modification will be sent to FHWA for its review and approval.
- The recommendation will include an item-by-item analysis of the factors listed in 530.10(1) and 530.10(2)(a).

(c) **Valuation Determination**

Upon preliminary approval, region Real Estate Services prepares an appraisal for the value of the access change using a before and after appraisal.

- The appraisal follows the requirements set forth in the *Right of Way Manual*.
- The appraisal is reviewed by HQ Real Estate Services. If the appraisal data does not support a value of $1,500 or more, a minimum value of $1,500 is used.
- The appraisal package is sent to HQ Real Estate Services for review and approval.
- If federal-aid funds were involved in purchasing access control, HQ Real Estate Services will send a copy of the appraisal package to FHWA for its review and approval.

(d) **Final Processing**

- Region Real Estate Services informs the requester of the approved appraised value for the change.
- If the requester is still interested, the region prepares a "Surplus Disposal Package" for HQ Real Estate Services' review and approval.
- At the same time, the preliminary right of way and limited access plan revision previously transmitted is processed for approval.
- After the department collects the payment from the requester, the region issues a permit for the construction, if required.
- If an existing approach is being surrendered, region Real Estate Services obtains a conveyance from the property owner.
- HQ Real Estate Services prepares and processes a deed granting the change to the access rights.

(3) Modifications for Public At-Grade Intersections

(a) **Requirements**

- Public at-grade intersections on partial control limited access highways serve local arterials that form part of the local transportation network.
- Requests for new intersections on limited access highways must be made by or through the local governmental agency to WSDOT. The region will forward this request, including the data referenced in 530.10(1) and 530.10(2)(a) to the HQ Access and Hearings Section.
- New intersections require full application of current limited access acquisition and conveyance to WSDOT. The access acquisition and conveyance must be completed prior to beginning construction of the new intersection. The new intersection is to meet WSDOT design and spacing requirements.

(b) **Procedures**

- The region evaluates the request for modification and contacts the HQ Access and Hearings Section for conceptual approval.
- The region submits an intersection plan for approval (see Chapter 1310) and a right of way and limited access plan revision request (see the *Plans Preparation Manual*). This plan includes the limited access design requirements along the proposed public at-grade intersection.
- The Director & State Design Engineer, Development Division, approves the intersection plan.
- The Assistant Secretary, Engineering & Regional Operations (or designee), approves the access revision.
- The region submits the construction agreement to the Director & State Design Engineer, Development Division (see the *Agreements Manual*).
- The Assistant Secretary, Engineering & Regional Operations (or designee), approves the construction agreement.

(c) **Valuation Determination**

- When a requested public at-grade intersection will serve a local arterial that immediately connects to the local transportation network, compensation will not be required.
- When a requested public at-grade intersection will serve only a limited area, does not immediately connect to the local transportation network, or is primarily for the benefit of a limited number of developers, compensation for the access change will be addressed in the plan revision request. In these situations, compensation is appropriate and a value will be determined as outlined in 530.10(2)(c).

530.11 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

550.04 Procedures

Gaining concurrence and approval for an access point revision is a multistep process. It begins with assembling a support team to conduct a feasibility or planning-level study. The purpose of this study is to determine whether there are improvements that can be made to the local roadway network to meet the purpose and need of the proposed access modification. If the study shows that the purpose and need of the proposal cannot be achieved with the local infrastructure only, the next step would normally be to prepare an IJR (see the Interstate IJR Process Flow Chart, Exhibit 550-3).

Steps in the IJR process include:

- Assemble the support team to engage subject experts and decision makers.
- Determine whether a feasibility study needs to be conducted or already exists.
- Prepare Methods and Assumptions Document to lay the groundwork for the IJR—this is required.
- Support team endorses Methods and Assumptions Document to prepare the IJR.
- Prepare IJR.
- IJR Review and Approval.

Exhibits 550-1 and 550-2 list the project types most likely to affect freeway safety and operations, requiring the submission of an IJR. Consult the HQ Access and Hearings Section early for specific direction.

Guidance and examples on assumptions documents are provided here:
www.wsdot.wa.gov/design/accessandhearings

(1) Organize Support Team and Conduct Study

(a) **Support Team**

Establish a support team before beginning the feasibility study. This same support team would also be involved with the IJR process if the study shows that either a revision or a new access point is needed to meet the proposal purpose and need.

The support team normally consists of the following:

A support team comprised of subject experts and approval authorities will ensure your IJR the highest possible level of success.

- FHWA Area Engineer and Mobility and ITS Engineer (for Interstate projects)
- Region Planning, Design, or Project Development Engineer (or designee)
- HQ Assistant State Design Engineer
- HQ Development Services & Access Manager
- HQ Traffic Office Representative
- Representative from local agencies (city, county, port, or tribal government)
- Recorder
- IJR writer

The support team enlists specialists, including:

- Metropolitan Planning Organization (MPO)
- Regional Transportation Planning Organization (RTPO)

- WSDOT region (planning, design, environmental, maintenance, and traffic)
- WSDOT Headquarters (design, bridge, traffic, and geotechnical)
- Project proponent specialists (region, local agency, developer)
- Transit agencies

The support team works together, from the corridor study through preparation of the assumptions document and completion of the IJR.

The support team's role is to:

- Review regional and state transportation plans to see if the request is consistent with the needs and solutions shown in those plans.
- Develop a charter that includes the processes for reaching agreement, resolving disputes, and assigning responsibility for final decisions.
- Develop purpose, need, and vision statements for the study. They should be consistent with the project environmental document.
- Expedite the study steps (and, if needed, the IJR development and review process) through early communication and agreement.
- Establish the agreed-upon study area (including baseline transportation improvements) and future travel demand forecasts for each of the alternatives being considered.
- Develop and endorse the Methods and Assumptions Document.
- Provide guidance and support.
- Evaluate data and identify possible alternatives for the proposal during the study and, if needed, for an IJR.
- Contribute material for the report that documents the discussions and decisions.
- Review results and determine whether an IJR is warranted.
- Ensure the compatibility of data used in various studies.
- Ensure integration of the Project Definition process, value engineering studies, public involvement efforts, environmental analyses, operational analyses, safety analyses, other analyses for the study (and, if needed, to prepare an IJR). This encourages the use of consistent data.
- Address design elements. Status of known deviations must be noted in Policy Point 4. Deviations are discouraged on new accesses.

(b) **Feasibility Study**

Study the transportation network in the area. This study will identify the segments of both the local and regional network that are currently experiencing congestion or safety deficiencies, or where planned land use changes will prompt the need to evaluate the demands on and the capacity of the transportation system. The study area includes the affected existing and proposed interchanges/intersections upstream and downstream from the proposed access point revision. Extend the study far enough that the proposal creates no significant impacts to the adjacent interchanges/intersections, then analyze only through the area of influence. When the area of influence extends beyond the one interchange/intersection upstream and downstream, extend the analysis far enough to include the extent of the traffic impacts.

- Any local roadway network conditions that will affect traffic entering or exiting the freeway. If entering traffic is to be metered, explain the effect on the connecting local system (for example, vehicle storage).
- When the existing local and freeway network does not meet agreed-upon level of service standards, show how the proposal will improve the level of service or keep it from becoming worse than the no-build condition in the year of opening and the design year. Level of service should not be the only performance measure evaluated. There are other measures of effectiveness that can be used to illustrate a broader traffic operation perspective.

(b) **Collision Analysis**

This analysis identifies areas where there may be a safety concern. The study limits are the same as for operational analyses.

Identify and document all safety program (I2) locations. Identify and document collision histories, rates, and types for the freeway section and the adjacent affected local surface system. Project the rates that will result from traffic flow and geometric conditions imposed by the proposed access point revision. Document the basis for all assumptions.

Demonstrate that (1) the proposal does not have a significant adverse impact on the safety of the freeway or the adjacent affected local surface system, or (2) the impacts will be mitigated. The safety analysis for both existing and proposed conditions should include the following:

1. **Type of Collisions**
   - What types of collisions are occurring (overturns, rear-ends, enter-at-angle, hitting fixed object)?
   - What types of collision s are most prevalent?
   - Are there any patterns of collision type or cause?
2. **Severity of Collisions**
   - Fatalities, serious injuries, evident injuries, property damage
3. **Collision Rates and Numbers**
   - Document the number and rate of collisions within the study limits for existing and proposed conditions.
   - What are the existing and anticipated crash/serious injury/fatality rates and numbers by proximity to the interchange exit and entrance ramps?
   - How do these rates compare to similar corridors or interchanges?
   - How do these rates compare to the future rates and numbers?
   - What are the existing and anticipated crash/serious injury/fatality rates and numbers for the impacted adjacent and parallel road system (with and without the access revision)?
4. **Contributing Factors and Conclusions**
   - Document contributing causes of collisions and conclusions. What are the most prevalent causes?

- Evaluate and document the existing and proposed roadway conditions for geometric design standards, stopping sight distance, and other possible contributing factors. Would the proposal reduce the frequency and severity of collisions?

(4) Policy Point 4: Access Connections and Design

Will the proposal provide fully directional interchanges connected to public streets or roads, spaced appropriately, and designed to full design level geometric control criteria?

Provide for all directions of traffic movement on Interstate system-to-system type interchanges, unless justified. The intent is to provide full movement at all interchanges, whenever feasible. Partial interchanges are discouraged. Less than fully directional interchanges for special-purpose access for transit vehicles, for HOVs, or to or from park & ride lots will be considered on a case-by-case basis.

A proposed new or revised interchange access must connect to a public freeway, road, or street and be endorsed by the local governmental agency or tribal government having jurisdiction over said public freeway, road, or street.

Explain how the proposed access point relates to present and future proposed interchange configurations and the *Design Manual* spacing criteria. Note that urban and rural interchange spacing for crossroads also includes additional spacing requirements between adjacent ramps, as noted in Chapter 1360.

Develop the proposal in sufficient detail to conduct a design and operational analysis. Include the number of lanes, horizontal and vertical curvature, lateral clearance, lane width, shoulder width, weaving distance, ramp taper, interchange spacing, and all traffic movements. This information is presented as a sketch or a more complex layout, depending on the complexity of the proposal.

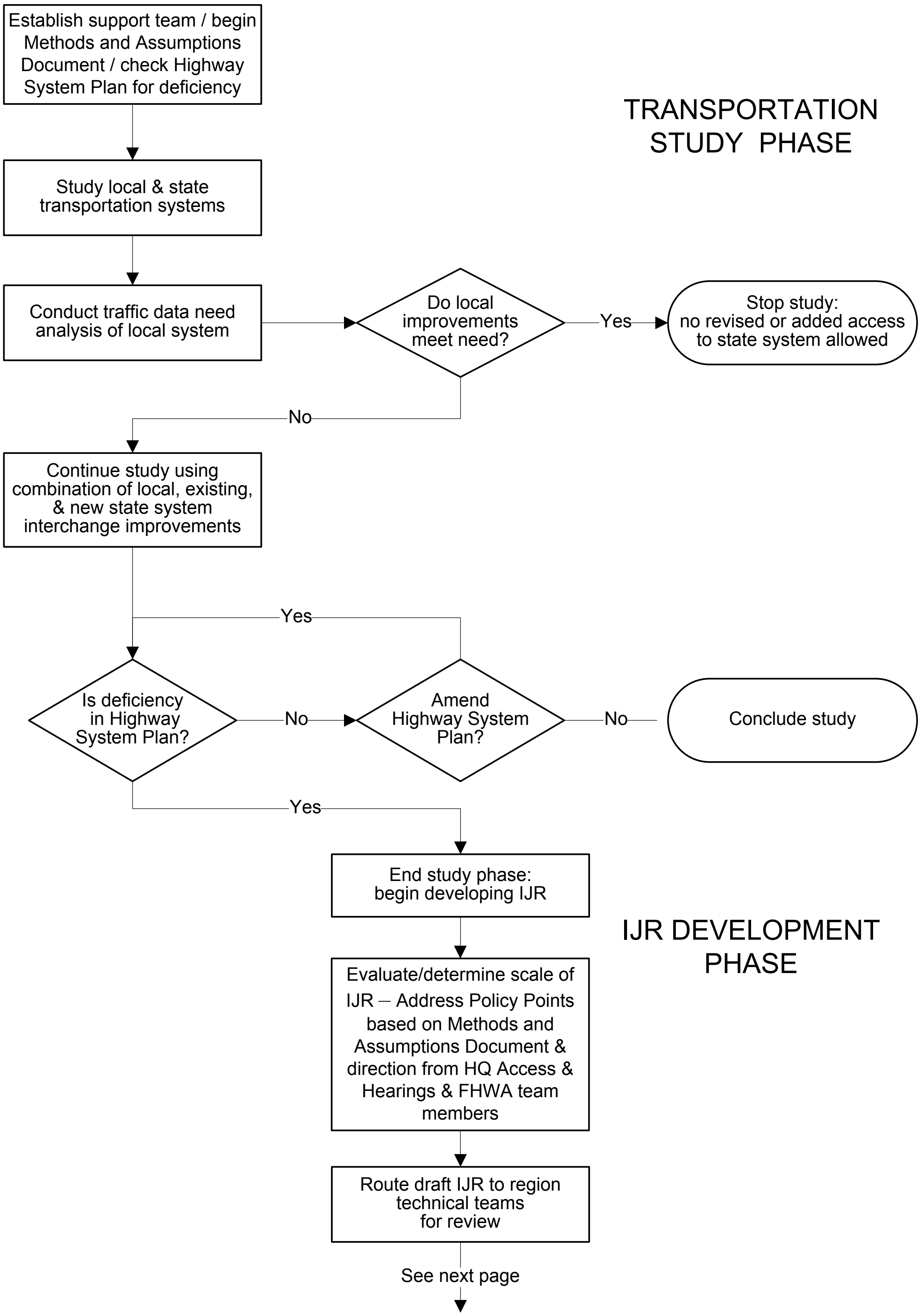
The status of all known or anticipated project deviations must be noted in this policy point, as described in Chapter 300.

(5) Policy Point 5: Land Use and Transportation Plans

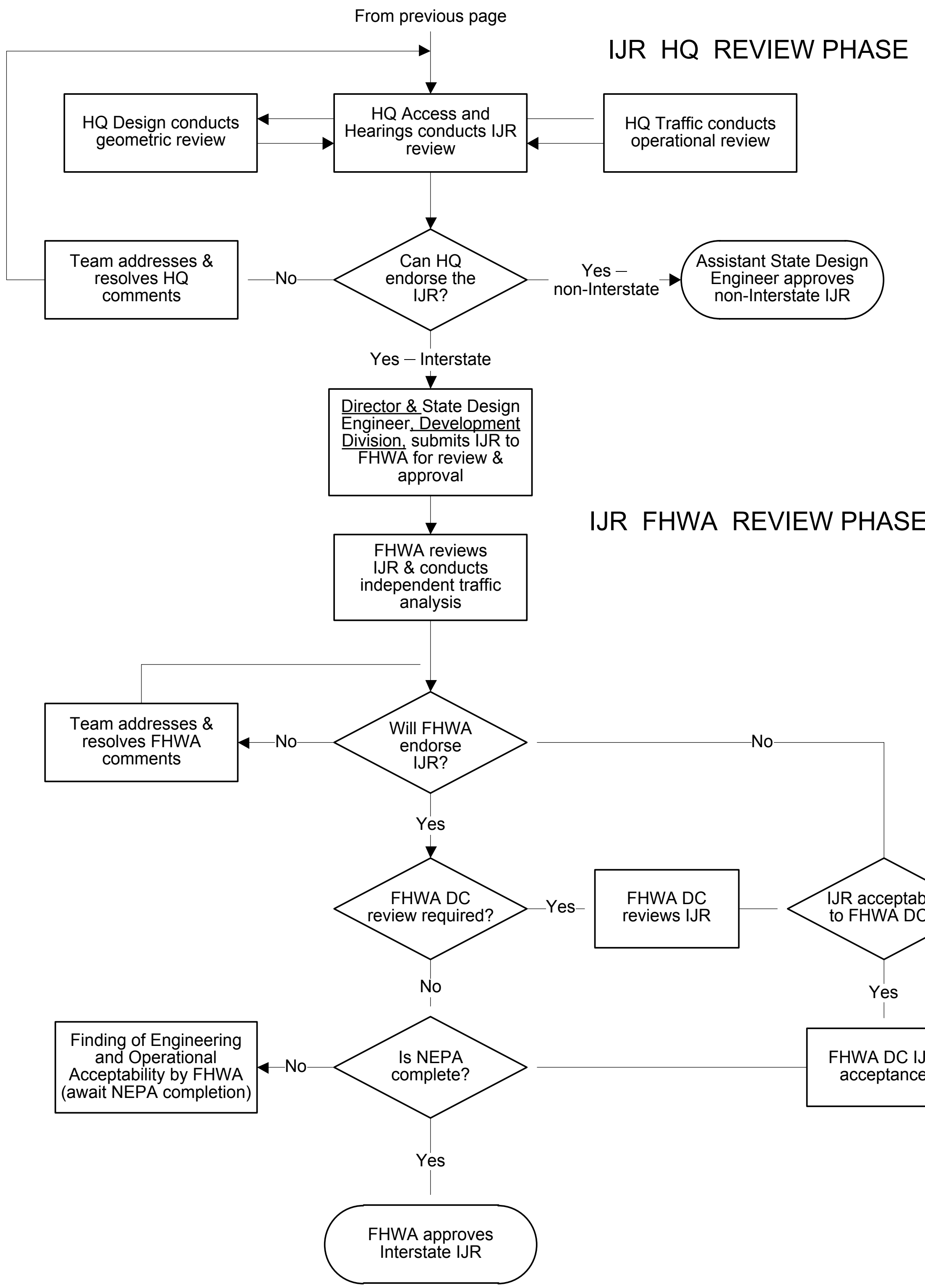
Is the proposed access point revision compatible with all land use and transportation plans for the area?

Show that the proposal is consistent with local and regional land use and transportation plans. Before final approval, all requests for access point revisions must be consistent with the regional or statewide transportation plan, as appropriate (see Chapter 120). The proposed access point revision may affect adjacent land use and, conversely, land use may affect the travel demand generated. Therefore, reference and show compatibility with the land use plans, zoning controls, and transportation ordinances in the affected area.

Explain the consistency of the proposed access point revision with the plans and studies, the applicable provisions of 23 CFR Part 450, the applicable transportation conformity requirements of 40 CFR Parts 51 and 93, and Chapter 36.70A RCW.



<u>Interstate </u>IJR: Process Flow Chart
Exhibit 550-3



Interstate IJR: Process Flow chart

Exhibit 550-3 (continued)

Chapter 560 Fencing

560.01 General

Fencing is provided primarily to discourage encroachment onto Washington State Department of Transportation (WSDOT) highway right of way from adjacent property, to delineate the right of way, and to replace fencing that has been disrupted by construction.

Encroachment onto the right of way is discouraged to limit the presence of people and animals that might disrupt the efficient flow of traffic on the facility. Although not the primary intent, fencing does provide some separation between people, animals, traffic flow, and other features.

560.02 References

(1) Design Guidance

Plans Preparation Manual, M 22-31, WSDOT

Roadside Manual, M 25-30, WSDOT

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), M 41-10, WSDOT

560.03 Design Criteria

(1) General

Fencing on a continuous alignment usually has a pleasing appearance and is the most economical to construct and maintain. The recommended practice is to locate fencing on or, depending on the terrain, 12 inches inside the right of way line.

Where the anticipated or existing right of way line has abrupt irregularities over short distances, coordinate with Maintenance and Real Estate Services personnel to dispose of the irregularities as excess property (where possible) and fence the final property line in a manner acceptable to Maintenance.

Whenever possible, preserve the natural assets of the surrounding area and minimize the number of fence types on any particular project.

(2) Limited Access Highways

On highways with full and partial limited access control, fencing is mandatory unless it has been established that such fencing may be deferred. Fencing is not required for modified limited access control areas, but may be installed where appropriate. Fencing is required between frontage roads and adjacent parking or pedestrian areas (such as rest areas and flyer stops) and highway lanes or ramps unless other barriers are used to discourage access violations.

On new alignment, fencing is not provided between the frontage road and abutting property unless the abutting property was enclosed prior to highway construction. Such fencing is normally part of the right of way negotiation.

Unless there is a possibility of access control violation, fencing installation may be deferred until needed at the following locations:

- In areas where rough topography or dense vegetation provides a natural barrier.
- Along rivers or other natural bodies of water.
- In sagebrush country that is sparsely settled.
- In areas with high snowfall levels and sparse population.
- On long sections of undeveloped public or private lands not previously fenced.

When in doubt about fencing installation, consult the Headquarters (HQ) Development Services & Access Manager.

(3) Managed Access Highways

Fencing is not required for managed access highways. When highway construction will destroy the fence of an abutting property owner (which was originally constructed on private property), the cost of replacement fencing may be included in the right of way payment. When the fences of several property owners will be impacted, it may be cost-effective to replace the fences as part of the project.

If fencing is essential to the safe operation of the highway, it will be constructed and maintained by the state. An example is the separation of traveled highway lanes from adjacent facilities with parking or pedestrian areas (such as rest areas and flyer stops).

(4) Special Sites

Fencing may be needed at special sites such as pit sites, stockpiles, borrow areas, and stormwater detention facilities.

Fencing is not normally installed around stormwater detention ponds. Evaluate the need to provide fencing around stormwater detention facilities when pedestrians or bicyclists are frequently present. Document your decision in the Design Documentation Package.

The following conditions suggest a need to evaluate fencing:

- Children or persons with mobility impairments are frequently present in significant numbers in locations adjacent to the facility, such as routes identified in school walk route plans or nearby residential areas or parks.
- Water depth reaches or exceeds 12 inches for several days.
- Sideslopes into the facility are steeper than 3H:1V.

Fencing proposed at sites that will be outside WSDOT right of way requires that local ordinances be followed if they are more stringent than WSDOT's.

Chapter 720 Bridges

720.01 General

The National Bridge Inspection Standards (NBIS), published in the Code of Federal Regulations (23 CFR 650, Subpart C), defines a bridge as:

> *A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.*

Bridge design is the responsibility of the Washington State Department of Transportation (WSDOT) Headquarters (HQ) Bridge and Structures Office, which develops a preliminary bridge plan for a new or modified structure in collaboration with the region. This chapter provides basic design considerations for the development of this plan. Unique staging requirements, constructability issues, and other considerations are addressed during plan development. Contact the HQ Bridge and Structures Office early in the planning stage regarding issues that might affect the planned project (see Chapter 700). A Project File (PF) is required for all bridge construction projects.

720.02 References

(1) Federal/State Laws and Codes

23 CFR Part 650, Subpart C – National Bridge Inspection Standards

Washington Administrative Code (WAC) 480-60, Railroad companies – Clearances

(2) Design Guidance

Bridge Design Manual, M 23-50, WSDOT

Geotechnical Design Manual, M 46-03, WSDOT

Local Agency Guidelines (LAG), M 36-63, WSDOT

LRFD Bridge Design Specifications, 4th Edition, Washington DC, AASHTO, 2007

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

Standard Plans for Road, Bridge, and Municipal Construction (*Standard Plans*), M 21-10, WSDOT

Standard Specifications for Road, Bridge, and Municipal Construction (*Standard Specifications*), M 41-10, WSDOT

Traffic Manual, M 51-02, WSDOT

(3) Supporting Information

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO, 2004

Manual for Railway Engineering, American Railway Engineering and Maintenance-of-Way Association (AREMA), 2006

720.03 Bridge Locations

Bridge locations are chosen to conform to the alignment of the highway. Conditions that can simplify design efforts, minimize construction activities, and reduce structure costs are:

- A perpendicular crossing.
- The minimum required horizontal and vertical clearances.
- A constant bridge width (without tapered sections).
- A tangential approach alignment of sufficient length not to require superelevation on the bridge.
- A crest vertical curve profile that will facilitate drainage.
- An adequate construction staging area.

720.04 Bridge Site Design Elements

(1) Structural Capacity

The structural capacity of a bridge is a measure of the structure's ability to carry vehicle loads. For new bridges, the bridge designer chooses the design load that determines the structural capacity. For existing bridges, the structural capacity is calculated to determine the "load rating" of the bridge. The load rating is used to determine whether or not a bridge is "posted" for legal weight vehicles or "restricted" for overweight permit vehicles.

(a) New Structures

All new structures that carry vehicular loads are designed to HL-93 notional live load in accordance with AASHTO's LRFD Bridge Design Specifications.

(b) Existing Structures

When the Structural Capacity column of a design matrix applies to the project, request a Structural Capacity Report from the Risk Reduction Engineer in the HQ Bridge and Structures Office. The report will state:

- The structural capacity status of the structures within the project limits.
- What action, if any, is appropriate.
- Whether a deficient bridge is included in the 6-year or 20-year plans for replacement or rehabilitation under the P2 program and, if so, in which biennium the P2 project is likely to be funded.

Include the Structural Capacity Report in the Design Documentation Package (DDP).

The considerations used to evaluate the structural capacity of a bridge are as follows:

1. On National Highway System (NHS) routes (including Interstate routes):
   - The operating load rating is at least 36 tons (which is equal to HS-20).
   - The bridge is not permanently posted for legal weight vehicles.
   - The bridge is not permanently restricted for vehicles requiring overweight permits.
2. On non-NHS routes:
   - The bridge is not permanently posted for legal weight vehicles.
   - The bridge is not permanently restricted for vehicles requiring overweight permits.

(2) Bridge Widths for Structures

(a) New Structures

Full design level widths are provided on all new structures (see Chapter 1140). All structures on city or county routes crossing over a state highway must conform to the *Local Agency Guidelines*. Use local city or county adopted and applied criteria when their minimum width exceeds state criteria.

(b) Existing Structures

For guidance on existing structures, see the design matrices in Chapter 1100.

(3) Horizontal Clearance

Horizontal clearance for structures is the distance from the edge of the traveled way to bridge piers and abutments, traffic barrier ends, or bridge end embankment slopes. Minimum distances for this clearance vary depending on the type of structure. (See Chapters 1600 and 1610 and the *Bridge Design Manual* for guidance on horizontal clearance.)

For structures involving railroads, contact the HQ Design Office Railroad Liaison.

(4) Bridge Medians

Designs for bridges on divided multilane highways often include the decision to join parallel bridges as one or build them as independent structures. There are several factors in this decision, such as in new corridor construction, phased construction of corridors over time, and the general median width of the divided highway. This section covers some common design considerations related to bridge medians.

For divided multilane highways, the minimum median widths for new bridges are as shown in Chapters 1130 and 1140. Chapter 1230 provides minimum design criteria for medians. Chapter 1230 indicates that independent horizontal and vertical alignments are desirable on divided highways, particularly in rural settings.

Past *Design Manual* guidance on bridge medians stated a preference for joining two parallel structures as one, based on the distance between the structures. This guidance originated from a concern that errant vehicles may travel into the open space between two separate, parallel structures. Joining the two roadways on a single bridge and separating traffic with median barrier addressed this concern. Errant motorists occur on highways, and reducing the crash severity of these types of collision remains a priority for WSDOT. Advances in crash barriers and their applications have resulted in an expanded set of choices for bridge medians on divided highways.

Changed barrier designs and applications have allowed for longer runs of traffic barrier, different barrier types, and bullnose guardrail designs for shielding the gap between parallel structures. These tools have reduced collisions with abrupt bridge ends as well as shielded the opening between bridges.

WSDOT designers today encounter varying constraints, tradeoffs and existing contexts, along with limited project scopes and budgets. With fewer new corridors being constructed, many WSDOT projects are devoted to preservation of the mature highway system, leading to additional project considerations and tradeoffs.

Some highway corridors are initially planned as multilane divided highways but may be developed in logical, affordable phases and individual projects. This could result in an initial phase where a corridor may open as a two-lane rural highway used by both travel directions. A later phase could convert the facility to a divided highway, bringing with it the need for median separation. Consider the long-range plans when determining median widths for bridges. The photos in Exhibit 720-4 show a completed multilane highway where two separate bridges were ultimately constructed years apart and a new corridor underway where one bridge is now built.

Joining two structures may not be the most cost-effective or sustainable solution for all projects. Coordinate with the Bridge and Structures Office and the local Maintenance Office when discussing options and concerns. For bridges on parallel horizontal and vertical alignments, practical considerations for joining two structures as one include, but are not limited to:

- Phased development where one structure exists and another is planned.
- Old and new structure types and compatibility (with phased corridor construction).
- Median width.
- Median barrier treatment options.
- Environmental contexts and regulations.
- Seismic conditions and load ratings.
- Bridge maintenance and inspection techniques: accessibility options and equipment for terrain in specific contexts. An open area between structures may be needed for bridge inspection.
- Economics.
- Historical/aesthetic value of existing bridges to remain in place.

Document this evaluation in the Design Documentation Package.

(5) Vertical Clearance

Vertical clearance is the critical height under a structure that will accommodate vehicular and rail traffic based on its design characteristics. This height is the least height available from the lower roadway surface (including usable shoulders) or the plane of the top of the rails to the bottom of the bridge. Usable shoulders are the design shoulders for the roadway and do not include paved widened areas that may exist under the structure.

In addition to the following vertical clearance guidance, consider whether the corridor experiences overheight loads. Consider a vertical clearance such that it will not create a new "low point" in the corridor.

(a) Vertical Falsework Clearance for Bridges Over Highways

Construction of new bridges and the reconstruction or widening of existing structures often requires the erection of falsework across the traveled way of a highway. The erection of this falsework can reduce the vertical clearance for vehicles to pass under the work area. The potential for collisions to occur by hitting this lower construction stage falsework is increased.

1. On all routes that require a 16-foot-6-inch vertical clearance, maintain the 16-foot-6-inch clearance for falsework vertical clearance.
   - On structures that currently have less than a 16-foot-6-inch vertical clearance for the falsework envelope, maintain existing clearance.
   - On new structures, maintain the falsework vertical clearance at least to those of the minimum vertical clearances referenced below.
2. Any variance from the above must be approved by the Regional Administrator or designee in writing and made a part of the Project File.

(b) Minimum Clearance for New Structures

For new structures, the minimum vertical clearances are as follows:

1. **Bridge Over a Roadway**

   The minimum vertical clearance for a bridge over a roadway is 16.5 feet.

2. **Bridge Over a Railroad Track**

   The minimum vertical clearance for a bridge over a railroad track is 23.5 feet (see Exhibit 720-2). A lesser clearance may be negotiated with the railroad company based on certain operational characteristics of the rail line; however, any clearance less than 22.5 feet requires the approval of the Washington State Utilities and Transportation Commission (WUTC) per WAC 480-60. Vertical clearance is provided for the width of the railroad clearance envelope. Coordinate railroad clearance issues with the HQ Design Office Railroad Liaison.

3. **Pedestrian Bridge Over a Roadway**

   The minimum vertical clearance for a pedestrian bridge over a roadway is 17.5 feet.

Project Type	Vertical Clearance[8]	Documentation Requirement (see notes)
Interstate and Other Freeways[1]		
New Bridge	> 16.5 ft	[2]
Widening Over or Under Existing Bridge	> 16 ft	[2]
	< 16 ft	[4]
Resurfacing Under Existing Bridge	> 16 ft	[2]
	< 16 ft	[4]
Other With No Change to Vertical Clearance	> 14.5 ft	[3]
	< 14.5 ft	[4]
Nonfreeway Routes		
New Bridge	> 16.5 ft	[2]
Widening Over or Under Existing Bridge	> 15.5 ft	[2]
	< 15.5 ft	[4]
Resurfacing Under Existing Bridge	> 15.5 ft	[2]
	< 15.5 ft	[4]
Other With No Change to Vertical Clearance	> 14.5 ft	[3]
	< 14.5 ft	[4]
Bridge Over Railroad Tracks[7]		
New Bridge	> 23.5 ft < 23.5 ft	[2] [4][5]
Existing Bridge	> 22.5 ft < 22.5 ft	[2] [4][5]
Pedestrian Bridge Over Roadway		
New Bridge	> 17.5 ft	[2]
Existing Bridge	17.5 ft	[6]

Notes:

[1] Applies to all bridge vertical clearances over highways and under highways at interchanges.
[2] No documentation required.
[3] Document to Design Documentation Package.
[4] Approved deviation required.
[5] Requires written agreement between railroad company and WSDOT and approval via petition from the WUTC.
[6] Maintain 17.5-ft clearance.
[7] Coordinate railroad clearance with the HQ Design Office Railroad Liaison.
[8] See 720.04(5).

Bridge Vertical Clearances

Exhibit 720-1

(c) Minimum Clearance for Existing Structures

The criteria used to evaluate the vertical clearance for existing structures depend on the work being done on or under that structure. When evaluating an existing structure on the Interstate System, see 720.04(5)(e), Coordination. This guidance applies to bridge clearances over state highways and under state highways at interchanges. For state highways over local roads and streets, city or county vertical clearance requirements may be used as minimum design criteria. (See Exhibit 720-1 for bridge vertical clearances.)

1. **Bridge Over a Roadway**

For a project that will widen an existing structure over a highway or where the highway will be widened under an existing structure, the vertical clearance can be as little as 16.0 feet on the Interstate System or other freeways or 15.5 feet on nonfreeway routes. An approved deviation is required for clearance less than 16.0 feet on Interstate routes or other freeways and 15.5 feet on nonfreeway routes.

For a planned resurfacing of the highway under an existing bridge, if the clearance will be less than 16.0 feet on the Interstate System or other freeways and 15.5 feet on nonfreeway routes, evaluate the following options and include in a deviation request:

- Pavement removal and replacement.
- Roadway excavation and reconstruction to lower the roadway profile.
- Providing a new bridge with the required vertical clearance.

Reducing roadway paving and surfacing thickness under the bridge to achieve the minimum vertical clearance can cause accelerated deterioration of the highway and is not recommended. Elimination of the planned resurfacing in the immediate area of the bridge might be a short-term solution if recommended by the Region Materials Engineer (RME). Solutions that include milling the existing surface followed by overlay or inlay must be approved by the RME to ensure adequate pavement structure is provided.

For other projects that include an existing bridge where no widening is proposed on or under the bridge, and the project does not affect vertical clearance, the clearance can be as little as 14.5 feet. For these projects, document the clearance in the Design Documentation Package. For an existing bridge with less than a 14.5-foot vertical clearance, an approved deviation request is required.

2. **Bridge Over a Railroad Track**

For an existing structure over a railroad track, the vertical clearance can be as little as 22.5 feet. A lesser clearance can be used with the agreement of the railroad company and the approval of the Washington State Utilities and Transportation Commission. Coordinate railroad clearance issues with the HQ Design Office Railroad Liaison.

(d) Signing

Low-clearance warning signs are necessary when the vertical clearance of an existing bridge is less than 15 feet 3 inches. Refer to the *Manual on Uniform Traffic Control Devices* and the *Traffic Manual* for other requirements for low-clearance signing.

(e) Coordination

The Interstate System is used by the Department of Defense (DOD) for the conveyance of military traffic. The Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) represents the DOD in public highway matters. The MTMCTEA has an inventory of vertical clearance deficiencies over the Interstate System in Washington State. Contact the MTMCTEA, through the Federal Highway Administration (FHWA), if either of the following changes is proposed to these bridges:

- A project would create a new deficiency of less than a 16.0-foot vertical clearance over an Interstate highway.
- The vertical clearance over the Interstate is already deficient (less than 16.0 feet) and a change (increase or decrease) to vertical clearance is proposed.

Coordination with MTMCTEA is required for these changes on all rural Interstate highways and for one Interstate route through each urban area.

(6) Liquefaction Impact Considerations

To determine the amount of settlement and the potential for the soil to flow laterally during the design level earthquake due to liquefaction, an analysis performed by the HQ Geotechnical Services Division is needed for each bridge project site location. The information collected is used by bridge engineers to determine the bridge's capability to withstand the movement and loading in a seismic event and to explore other foundation mitigation options not necessitating total bridge replacement.

The HQ Bridge and Structures Office, in collaboration with the HQ Geotechnical Services Division, evaluates bridge-widening projects involving liquefiable soils and recommends appropriate liquefaction mitigation. The following guidance is intended to assist designers in making project decisions that balance project risks with project and program budget realities.

(a) Design Decision Considerations

The following design decision guidance is generally in order of the complexity of project decision making, starting with the most straightforward through the most complex.

1. New bridges will be designed to current seismic and liquefaction standards.
2. Bridge widening that does not require new substructure (a new column) does not require consideration of liquefaction mitigation.
3. Widening that involves any new substructure will require a settlement and lateral loading analysis by the HQ Bridge and Structures Office in collaboration with the HQ Geotechnical Services Division. Each analysis will be unique to the conditions at that particular bridge site.

a. If a bridge has less than 15 years of its service life remaining, no liquefaction mitigation is necessary according to FHWA guidelines.

b. If the HQ Geotechnical Services Division analysis demonstrates that the differential settlement induced by liquefaction between the existing bridge and the widened portion will not create forces great enough to cause collapse of the existing bridge, and if lateral loading and movement caused by the liquefaction is minimal, liquefaction mitigation may not be necessary. The decision must be endorsed by the State Geotechnical Engineer, the State Bridge Engineer and the Regional Administrator. The decision and rationale are to be included in the Design Documentation Package.

c. If the HQ Geotechnical Services Division analysis demonstrates that the differential settlement induced by liquefaction or the lateral loading and movement will be substantial and these movements will result in the collapse of the existing and widened portion of the bridge, additional analysis and documentation are necessary for the project to proceed. A preliminary design and estimate of the mitigation necessary to prevent collapse needs to be performed. Consider alternative designs that eliminate or reduce the need for the widening.

(b) Deferring Liquefaction Mitigation

1. **Consideration of Deferment**

   If an alternative design concept is not feasible given the constraints of the project or program, consideration may be given to defer the liquefaction mitigation. Project-related structural retrofits that are deferred because of scope-related issues are to be considered for implementation through the WSDOT seismic retrofit program. The operating characteristics of the roadway and overall estimated cost of the liquefaction mitigation is typically considered in making that decision.

2. **Deferment Requires Approval**

   A decision to defer the mitigation to the seismic retrofit program is made by the WSDOT Chief Engineer after reviewing and considering the alternatives. The decision is to be included in the Design Documentation Package (DDP). A memo from the Chief Engineer will be provided to the structural designer of record documenting the agency’s decision to defer the mitigation work to the WSDOT seismic retrofit program. A copy of the memo is to be included in the DDP and the contract general notes.

(7) Pedestrian and Bicycle Facilities

When pedestrians or bicyclists are anticipated on bridges, provide facilities consistent with guidance in Chapters 1510, 1515, and 1520. For instances where pedestrian users are not anticipated, evaluate the potential for stranded motorists to become pedestrians, where they may have exited their vehicle after a breakdown or other emergency. The infrequent and random nature of these occurrences makes it difficult to identify locations with even a moderate probability of pedestrian exposure.

Evolving programs and technologies such as incident response, personal cell phones, and ITS cameras have further reduced the probability of motorists becoming pedestrians. Investigate other methods of treatment such as pedestrian scale signing or other low-cost safety improvement measures. Document decisions in the DDP.

(8) Bridge Approach Slab

Bridge approach slabs are reinforced concrete pavement installed across the full width of the bridge ends. They provide a stable transition from normal roadway cross section to the bridge ends, and they compensate for differential expansion and contraction of the bridge and the roadway.

Bridge approach slabs are provided on all new bridges. If an existing bridge is being widened and it has an approach slab, slabs are required on the widenings. The region, with the concurrence of the State Geotechnical Engineer and the State Bridge Engineer, may decide to omit bridge approach slabs.

(9) Traffic Barrier End Treatment

Plans for new bridge construction and bridge traffic barrier modifications include provisions for the connection of bridge traffic barriers to the longitudinal barrier approaching and departing the bridge. Indicate the preferred longitudinal barrier type and connection during the review of the bridge preliminary plan.

(10) Bridge End Embankments

The design of embankment slopes at bridge ends depends on several factors. The width of the embankment is determined not only by the width of the roadway, but also by the presence of traffic barriers, curbs, and sidewalks, all of which create the need for additional widening. Examples of the additional widening required for these conditions are shown in the *Standard Plans*.

The end slope is determined by combining the recommendations of several technical experts within WSDOT. Exhibit 720-3 illustrates the factors taken into consideration and the experts involved in the process.

(11) Bridge Slope Protection

Slope protection provides a protective and aesthetic surface for exposed slopes under bridges. Slope protection is normally provided under:

- Structures over state highways.
- Structures within an interchange.
- Structures over other public roads unless requested otherwise by the public agency.
- Railroad overcrossings if requested by the railroad.

Slope protection is usually not provided under pedestrian structures.

The type of slope protection is selected at the bridge preliminary plan stage. Typical slope protection types are concrete slope protection, semi-open concrete masonry, and rubble stone.

(12) Slope Protection at Water Crossings

The HQ Hydraulics Section determines the slope protection requirements for structures that cross waterways. The type, limits, and quantity of slope protection are shown on the bridge preliminary plan.

(13) Screening for Highway Structures

The Washington State Patrol (WSP) classifies the throwing of an object from a highway structure as an assault, not an accident. Therefore, records of these assaults are not contained in WSDOT's collision databases. Contact the Region Traffic Engineer, RME's office and the WSP for the history of reported incidents.

Screening might reduce the number of incidents, but will not stop a determined individual at that location, or deter them from moving to other locations in the area. Enforcement provides the most effective deterrent and is typically the first approach used.

Installation of screening is analyzed on a case-by-case basis at the following locations:

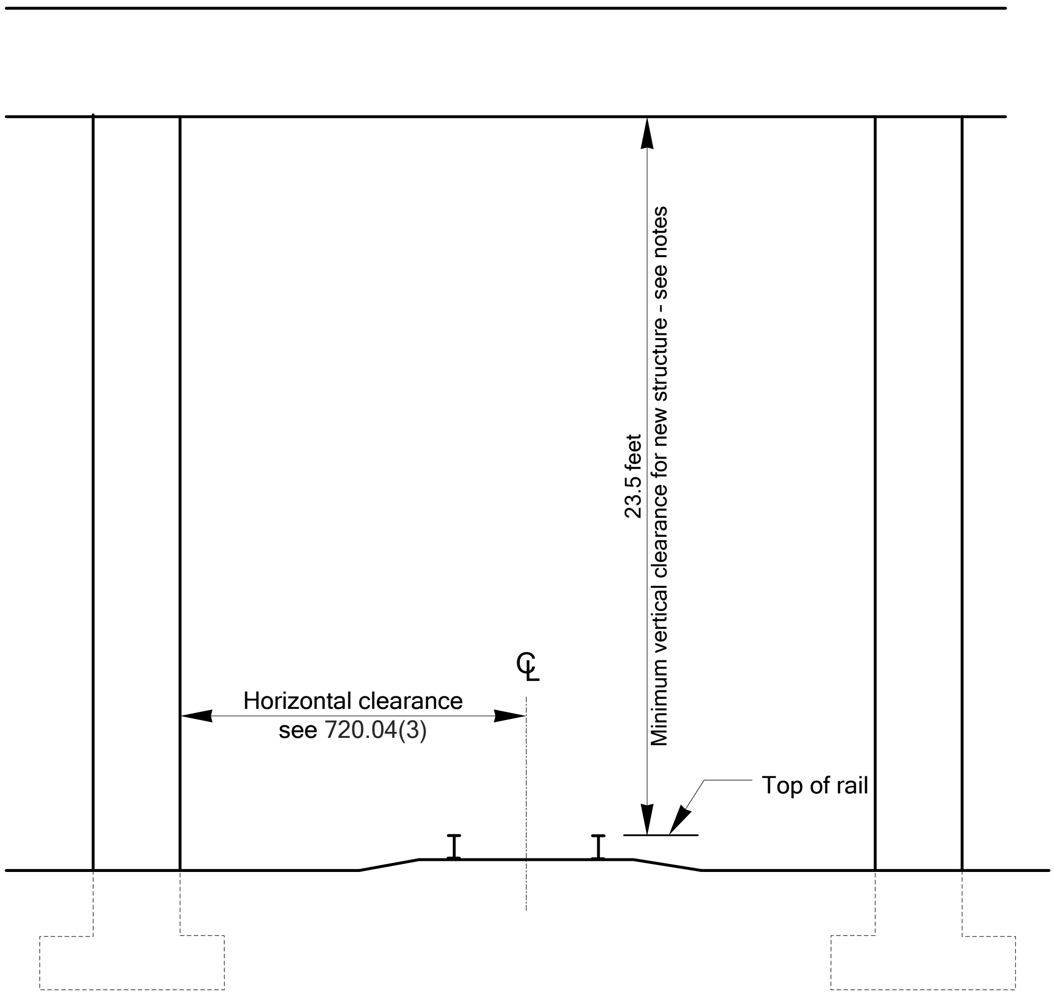
- On existing structures where there is a history of multiple incidents of objects being dropped or thrown and where enforcement has not changed the situation.
- On new structures near schools, playgrounds, or areas frequently used by children not accompanied by adults.
- In urban areas on new structures used by pedestrians where surveillance by local law enforcement personnel is not likely.
- On new structures with walkways where experience on similar structures within a 1-mile radius indicates a need.
- On private property structures, such as buildings or power stations, that are subject to damage.

In most cases, the installation of a screen on a new structure can be postponed until there are indications of need.

Submit all proposals to install screening on structures to the Director & State Design Engineer, Development Division, for approval. Contact the HQ Bridge and Structures Office for approval to attach screening to structures and for specific design and mounting details.

720.05 Documentation

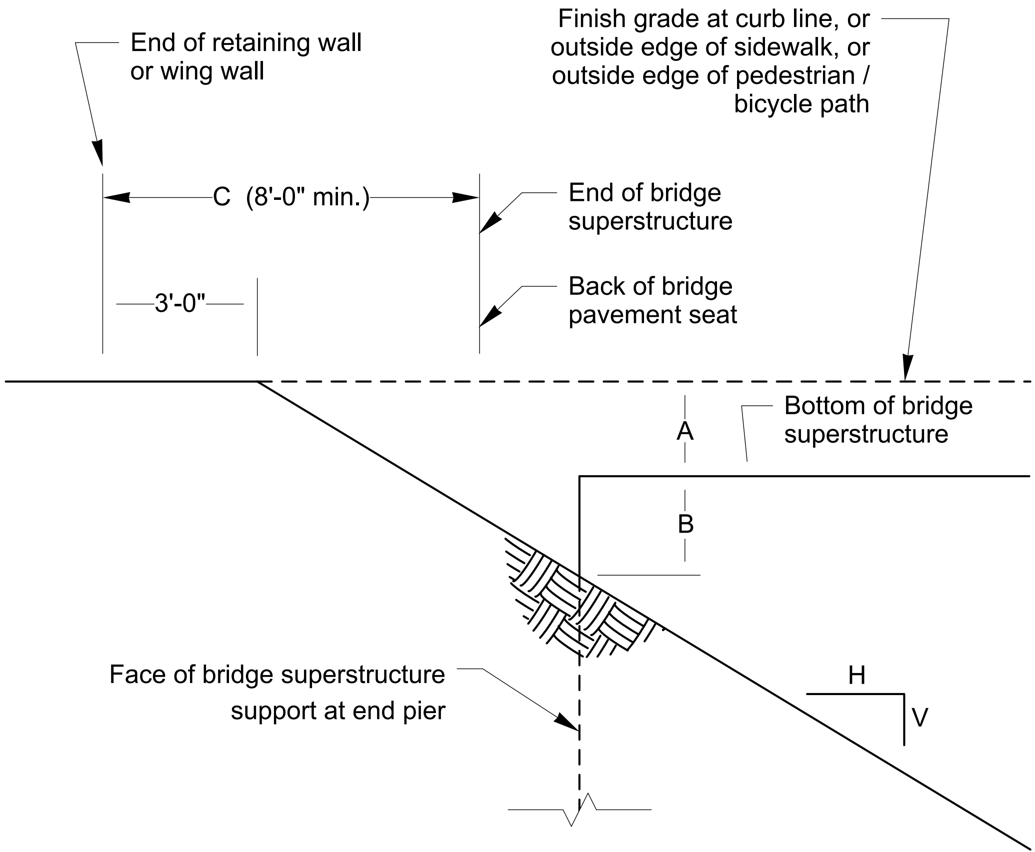
For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



Notes:

- Use 22.5-foot vertical clearance for existing structures.
- Lesser vertical clearance may be negotiated (see 720.04(5)).
- Increase horizontal clearance when the track is curved.
- Coordinate railroad clearance issues with the HQ Design Office Railroad Liaison.

Highway Structure Over Railroad
Exhibit 720-2



Bridge End Elevation

Applies to retaining wall or wing wall (or combination) extending beyond bridge superstructure (barrier omitted for clarity)

Legend

A = Superstructure depth: recommended by HQ Bridge and Structures Office

B = Vertical clearance from bottom of superstructure to embankment: recommended by Bridge Preservation Engineer

C = Distance from end of retaining wall or wing wall to back of pavement seat: recommended by HQ Bridge and Structures Office

H & V = Embankment slope: recommended by Geotechnical Engineer

Embankment Slope at Bridge Ends
Exhibit 720-3

Phased Development of Multilane Divided Highways
Exhibit 720-4

for use is classified as experimental, a work plan is to be prepared by WSDOT and approved by the FHWA.

An approved public interest finding, signed by the Director & State Design Engineer, Development Division, is required for the use of a sole source proprietary wall.

(c) **Gabion Walls**

Gabion walls are nonstandard walls that are to be designed for overturning, sliding, overall slope stability, settlement, and bearing capacity. A full design for gabion walls is not provided in the *Standard Plans*. Gabion baskets are typically 3 feet high by 3 feet wide, and it is typically safe to build gabions two baskets high (6 feet) but only one basket deep. This results in a wall base width of 50% of the wall height, provided soil conditions are reasonably good (medium-dense to dense granular soils are present below and behind the wall).

(2) Responsibility and Process for Design

A flow chart illustrating the process and responsibility for retaining wall/reinforced slope design is provided in Exhibit 730-13a. As shown in the exhibit, the region initiates the process except for walls developed as part of a preliminary bridge plan. These are initiated by the HQ Bridge and Structures Office. In general, it is the responsibility of the design office initiating the design process to coordinate with other groups in the department to identify all wall/slope systems that are appropriate for the project in question. Coordinate with the region and the HQ Bridge and Structures Office, Geotechnical Services Division, and State Bridge and Structures Architect as early in the process as feasible.

Headquarters or region consultants, if used, are considered an extension of the Headquarters staff and must follow the process summarized in Exhibit 730-13a. All consultant designs, from development of the scope of work to the final product, are to be reviewed and approved by the appropriate Headquarters offices.

(a) **Standard Walls**

The regions are responsible for detailing retaining walls for which standard designs are available.

For standard walls greater than 10 feet in height, and for all standard walls where soft or unstable soil is present beneath or behind the wall, a geotechnical investigation will be conducted, or reviewed and approved, by the Geotechnical Services Division. Through this investigation, provide the foundation design, including bearing capacity requirements and settlement determination, overall stability, and the selection of the wall types most feasible for the site.

For standard walls 10 feet in height or less where soft or unstable soils are not present, it is the responsibility of the region Materials Laboratory to perform the geotechnical investigation. If it has been verified that soil conditions are adequate for the proposed standard wall that is less than or equal to 10 feet in height, the region establishes the wall footing location based on the embedment criteria in the *Bridge Design Manual*, or places the bottom of the wall footing below any surficial loose soils. During this process, the region also evaluates other wall types that may be feasible for the site in question.

The *Standard Plans* provides design charts and details for standard reinforced concrete cantilever walls. The *Standard Plans* are used to size the walls and determine the factored bearing pressure to compare with the factored bearing resistance determined from the geotechnical investigation. The charts provide maximum soil pressure for the LRFD service, strength, and extreme event limit states. Factored bearing resistance for the LRFD service, strength, and extreme event limit states can be obtained from the Geotechnical Services Division for standard walls over 10 feet in height and from the region Materials Laboratory for standard walls less than or equal to 10 feet in height. The *Standard Plans* can be used for the wall design if the factored bearing resistance exceeds the maximum soil pressure shown in the *Standard Plans* for the respective LRFD limit states.

Contact the HQ Bridge and Structures Office if the factored bearing resistance provided by the geotechnical investigation does not exceed the maximum soil pressure shown in the *Standard Plans* for one or all of the LRFD limit states. The wall is considered a nonstandard wall design and the *Standard Plans* cannot be used.

If the standard wall must support surcharge loads from bridge or building foundations, other retaining walls, noise walls, or other types of surcharge loads, a special wall design is required. The wall is considered to be supporting the surcharge load and is treated as a nonstandard wall if the surcharge load is located within a 1H:1V slope projected up from the bottom of the back of the wall. Contact the HQ Bridge and Structures Office for assistance

The *Standard Plans* provides eight types of reinforced concrete cantilever walls (which represent eight loading cases). Reinforced concrete retaining walls Types 5 through 8 are not designed to withstand western Washington earthquake forces and are not to be used in western Washington (west of the Cascade crest).

Once the geotechnical and architectural assessments have been completed, the region completes the PS&E for the standard wall option(s) selected, including a generalized wall profile and plan, a typical cross section as appropriate, and details for desired wall appurtenances, drainage details, and other details as needed.

Metal bin walls, Types 1 and 2, have been deleted from the *Standard Plans* and are therefore no longer standard walls. Metal bin walls are seldom used due to cost and undesirable aesthetics. If this type of wall is proposed, contact the HQ Bridge and Structures Office for plan details and toe bearing pressures. The applied toe bearing pressure will then have to be evaluated by the Geotechnical Services Division to determine whether the site soil conditions are appropriate for the applied load and anticipated settlement.

(b) **Preapproved Proprietary Walls**

Final approval of preapproved proprietary wall design, with the exception of geosynthetic walls, is the responsibility of the HQ Bridge and Structures Office. Final approval of the design of preapproved proprietary geosynthetic walls is the responsibility of the Geotechnical Services Division. It is the region's responsibility to coordinate the design effort for all preapproved wall systems.

740.04 Procedures

The noise unit notifies the Project Engineer's Office when a noise barrier is recommended in the noise report.

The Project Engineer's Office is responsible for interdisciplinary teams, consultation, and coordination with the public, noise specialists, maintenance, construction, region Landscape Architecture Office (or the HQ Roadside and Site Development Section), right of way personnel, Materials Laboratory, State Bridge and Structures Architect, HQ Bridge and Structures Office, CAE Support Team, HQ Development Services & Access Manager, consultants, and many others.

If a noise wall is contemplated, the region evaluates the soils (see Chapters 610 and 710) and obtains a list of acceptable wall design options. The list is obtained by sending information pertaining to soils and drainage conditions, alignment, and height of the proposed wall to the State Bridge and Structures Architect.

If a vegetated earth berm is considered, see the *Roadside Manual* for procedures.

The State Bridge and Structures Architect coordinates with the HQ Bridge and Structures Office, HQ Hydraulics Section, HQ Geotechnical Services Division, and the region to provide a list of acceptable standard, draft-standard, and preapproved proprietary noise wall designs, materials, and finishes that are compatible with existing visual elements of the corridor. Only wall designs from this list may be considered as alternatives. Limit design visualizations of the highway side of proposed walls (available from the CAE Support Team in Olympia) to options from this list. The visual elements of the private property side of a wall are the responsibility of the region unless addressed in the environmental documents.

After the noise report is completed, any changes to the dimensions or location of a noise barrier must be reviewed by the appropriate noise unit to determine the impacts of the changes on noise abatement.

On limited access highways, coordinate any opening in a wall or fence (for pedestrians or vehicles) with the HQ Development Services & Access Manager and obtain approval from the Director & State Design Engineer, Development Division.

On nonlimited access highways, an access connection permit is required for any opening (approach) in a wall or fence.

The HQ Bridge and Structures Office provides special substructure designs to the regions upon request; reviews contract design data related to standard, draft-standard, and preapproved designs; and reviews plans and calculations that have been prepared by others (see Chapter 710).

Approval by the State Bridge and Structures Architect is required for any attachment or modification to a noise wall and for the design, appearance, and finish of door and gate-type openings.

Approval by the State Bridge and Structures Architect is also required for the final selection of noise wall appearance, finish, materials, and configuration.

740.05 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

Chapter 1010 Work Zone Safety and Mobility

1010.01 General

Addressing work zone impacts is an important component in the design of a project and needs to be given adequate consideration early in the design process. Most work zones create some level of traffic impacts and require additional safety features; therefore, all work areas and operations needed for construction must be identified and addressed during the project design. It is not acceptable to allow a project to move forward to advertisement without appropriately addressing work zone impacts, as the costs can account for up to 30% of the project cost. Planners, designers, construction engineers, maintenance personnel, and others all play a role in developing a comprehensive work zone design.

This chapter provides the designer with guidance to develop comprehensive work zone strategies and plans to address a project's safety, mobility, and constructibility issues. A systematic process for addressing work zone impacts is required by federal regulations and state policy.

1010.02 References

(1) Federal/State Laws and Codes

23 CFR 630 Subpart J – Work Zone Safety and Mobility

Americans with Disabilities Act of 1990 (ADA) (28 Code of Federal Regulations [CFR] Part 36, Appendix A, as revised July 1, 1994)

"Final Rule on Work Zone Safety and Mobility," Federal Highway Administration (FHWA), Effective Date October 12, 2007
www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

(2) Design Guidance

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO

Accessible Rights-of-Way: A Design Guide, U.S. Access Board, Washington DC
www.access-board.gov/prowac/alterations/guide.htm

Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines (ADAAG), July 23, 2004, U.S. Access Board
www.wbdg.org/ccb/astand/ada_aba.pdf

Executive Order E 1001, Work Zone Safety and Mobility
http://wwwi.wsdot.wa.gov/docs/operatingrulesprocedures/1001.pdf

Executive Order E 1033, WSDOT Employee Safety
http://wwwi.wsdot.wa.gov/docs/operatingrulesprocedures/1033.pdf

Plans Preparation Manual, M 22-31, WSDOT

Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), M 41-10, WSDOT

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-10, WSDOT

Traffic Manual, M 51-02, WSDOT

Work Zone Traffic Control Guidelines, M 54-44, WSDOT

(3) Supporting Information

Construction Manual, M 41-01, WSDOT

"Crashworthy Work Zone Traffic Control Devices," Report 553, NCHRP, 2006

Environmental Procedures Manual, M 31-11, WSDOT

Highway Capacity Manual, 2000, TRB

ITE Temporary Traffic Control Device Handbook, 2001

ITS in Work Zones
www.ops.fhwa.dot.gov/wz/its/

"Recommended Procedures for the Safety Evaluation of Highway Features," Report 350, NCHRP, 1993

Roadside Design Guide, AASHTO, 2006

Work Zone & Traffic Analysis, FHWA
www.ops.fhwa.dot.gov/wz/traffic_analysis.htm

Work Zone Operations Best Practices Guidebook, FHWA, 2000
www.ops.fhwa.dot.gov/wz/practices/practices.htm

Work Zone Safety and Mobility, FHWA
www.ops.fhwa.dot.gov/wz/index.asp

Work Zone Safety Web Page, WSDOT
www.wsdot.wa.gov/safety/workzones/

1010.03 Definitions

transportation management plan (TMP) A set of traffic control plans, transportation operations plans, and public information strategies for managing the work zone impacts of a project. A TMP is required for all projects to address work zone safety and mobility impacts.

traveling public Motorists, motorcyclists, bicyclists, pedestrians, and pedestrians with disabilities.

work zone An area of a highway with construction, maintenance, or utility work activities. A work zone is identified by the placement of temporary traffic control devices that may include signs, channelizing devices, barriers, pavement markings, and/or work vehicles with warning lights. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device (MUTCD).

work zone impact Highway construction, maintenance, or utility work operations in the traveled way, adjacent to the traveled way, or within the highway's right of way that creates safety and mobility concerns for workers or the traveling public.

work zone traffic control The planning, design, and preparation of contract documents for the modification of traffic patterns due to work zone impacts.

1010.04 Work Zone Safety and Mobility

In September 2004, the Federal Highway Administration (FHWA) published updates to the work zone regulations in 23 CFR 630 Subpart J, Work Zone Safety and Mobility. The updated regulation is referred to as "the Final Rule" on work zone safety and mobility and applies to all state and local governments that receive federal-aid highway funding. At the heart of the Rule is a requirement for agencies to develop an agency-level work zone safety and mobility policy. The policy is intended to support systematic consideration and management of work zone impacts across all stages of project development. Also required by the Rule is the development of processes and procedures to sustain the policy and transportation management plans (TMPs) for project-level procedures to manage work zone impacts.

WSDOT policy and the guidance to carry out the policy are outlined in Executive Order E 1001, Work Zone Safety and Mobility. The policy states:

> *All WSDOT employees are directed to make the safety of workers and the traveling public our highest priority during roadway design, construction, maintenance, and related activities.*

Designers need to be familiar with this document. The policy defines how WSDOT programs address work zone safety and mobility issues during project planning, design, and construction, and during highway maintenance.

1010.05 Transportation Management Plans and Significant Projects

(1) Transportation Management Plan (TMP)

A transportation management plan is a set of strategies for managing the corridor-wide work zone impacts of a project. A TMP is required for all projects and is a key element in addressing all work zone safety and mobility impacts. The TMP development begins in the scoping phase of a project by gathering project information, traffic data, impacts assessments, strategies, and mitigation and design solutions.

The three major components of a TMP are described below.

(a) **Temporary Traffic Control (TTC)**

- Control Strategies: Could include staged construction, full road closures, lane shifts or closures, night work, or one-lane two-way operations (flagging and or pilot car).
- Traffic Control Devices: Temporary signing, channelizing devices (cones, drums), changeable message signs, arrow panels, temporary signals, and temporary pavement markings.
- Project Coordination, Contracting Strategies, and Innovative Construction Strategies: A+B bidding, incentives/disincentives, and precast members or rapid cure materials.

These strategies are to be included in the Plans, Specifications, and Estimates (PS&E) as traffic control plans (TCPs) and contract provisions.

(b) **Transportation Operations (TO)**

- Demand Management Strategies: Transit service improvements, transit incentives, and park & ride promotion.
- Corridor/Network Management (traffic operations) Strategies: Signal timing/coordination improvements, temporary signals, bus pullouts, reversible lanes, and truck/heavy-vehicle restrictions.
- Work Zone Safety Management Strategies: Speed limit reductions, barrier and attenuators, and automated flagger assistance devices.
- Traffic/Incident Management and Enforcement Strategies: Work Zone Intelligent Transportation Systems (ITS), Washington State Patrol, tow service, WSDOT Incident Management vehicle(s), and traffic screens.

Some of these strategies may be included in the PS&E, but could also be WSDOT-managed elements outside the contract.

(c) **Public Information (PI)**

- Public Awareness Strategies: Brochures or mailers, press releases, paid advertisements, and project website (consider providing information in other languages if appropriate).
- Motorist Information Strategies: Highway advisory radio (HAR), changeable message signs, and transportation management center (TMC).

Public awareness strategies may be developed and implemented by WSDOT through the region or Headquarters (HQ) Communications offices and implemented before and during construction. Motorist information strategies may be WSDOT-managed elements with state equipment outside the contract or identified on plans in the PS&E.

Refer to the *Rule on Work Zone Safety and Mobility* at:
http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/trans_mgmt_plans.pdf

(2) Significant Projects

The FHWA definition of a "significant project" is as follows:

> *A significant project is one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on state policy and/or engineering judgment.*
>
> *All Interstate system projects within the boundaries of a designated Transportation Management Area (TMA) that occupy a location for more than three days with either intermittent or continuous lane closures shall be considered as significant projects.*

It is possible to request an exception from FHWA for Interstate projects if sufficient justification is present to demonstrate that a project will not have sustained work zone impacts.

Note: Significant projects require a TMP document addressing safety and mobility impacts.

Required TMP components are:

- **Traffic Control Plans** (TCPs): Required (includes appropriate contract specifications) for all projects.
- **Transportation Operations Plans** (TOPs): Required for significant projects.
- **Public Information Plans** (PIPs): Required for significant projects.

(a) Addressing Impacts Within a Project Not Defined as Significant

Within a given project, significant work zone safety and mobility impacts can exist for a specific element of work. Those individual work zone-related impacts must be addressed and mitigated to an acceptable level. An acceptable level will be defined by the region based on an impact assessment and the adverse effects on safety and mobility. Some examples of these impacts are:

- Traffic delay beyond a local accepted level—possibly in the range of 15 to 20 minutes, but could vary based on local expectations.
- Traffic impacts that extend beyond the project limits and impact other roads.
- Safety or access impacts to emergency services or to a school, hospital, or community that exceed local expectations based on public input.
- Economic impacts due to traffic delays or restricted access beyond normal local expectations.
- Seasonal impacts that affect recreation or business due to work zone impacts.

If these examples or other impacts exist, the TMP should reflect a mitigating solution that is incorporated into the project. A formal TMP document would not be required. If the impacts cannot be mitigated to an acceptable level, elements of a PIP or TOP may be appropriate for inclusion in the TMP. This does not change the designation of the project as significant.

(b) **Significant Project Definition and Evaluation**

The Final Project Definition document must include a Work Zone Strategy Statement and indicate whether the project is significant in regard to work zone impacts.

Significant projects often require a Value Engineering (VE) study (see Chapter 310) and a Cost Risk Assessment (CRA) or Cost Estimate Validation Process (CEVP) that could help define strategies or identify risks:
www.wsdot.wa.gov/projects/projectmgmt/riskassessment/

(3) TMP Process

It is very important to continue the development of the TMP throughout the project development process. Not all work zone impacts will be addressed within the specific work zone elements of the contract plans. This is why it is critical to consider work zone impacts during the ongoing design of the actual project features, materials selection, working day considerations, overbuilding, temporary widening, phasing, structures, and so on. Many work zone impacts will need to be addressed by design solutions that resolve the impacts within staging plans, structure plans, and various construction plans and details. Some work zone impacts, especially those that are related to time duration may be resolved through innovative bidding and contract administration. Ongoing communication with the designer(s) of project features that will have work zone impacts is critical to ensure design solutions and mitigation measures are included within the project and TMP.

Use the TMP Checklist in Exhibit 1010-3 to help identify issues and strategies for the above-three TMP components. Include the completed checklist in the Project File. For significant projects, develop this checklist and the supporting plans, data, impacts assessments, strategies, and endorsements into a formal TMP document to be included in the Project File. For TMP examples, see:
http://www.ops.fhwa.dot.gov/wz/resources/final_rule/tmp_examples/sample_tmps.htm

1010.06 Work Zone TMP Strategy Development

(1) Work Zone Key Considerations

The following list provides a quick review of the elements contained within or related to this chapter. These elements are part of WSDOT's work zone policy and are required or are key to the successful development of work zone design decisions. Federal and state regulations set the level of compliance for work zones. This list is intended to alert the designer that these items are not optional and must be addressed. The elements summarized below have more detailed information within this chapter or are contained within related manuals and documents such as the MUTCD, Revised Codes of Washington, and Washington Administrative Codes.

- Minimize, mitigate, and manage work zone impacts.
- Integrate work zone impacts strategies early, during planning, programming, and design.
- Develop an accurate scoping estimate based on the work zone strategies.
- Utilize the Work Zone TMP Checklist/TMP document required for significant projects.
- Hold a Work Zone Design Strategy Conference early in the design process.

- Emphasize flagger safety.
- Address work zone mobility through a capacity analysis.
- Determine work zone impacts through an impact assessment process.
- Integrate project constructibility into the work zone design strategy.
- Attend required work zone training.
- Address state of Washington traffic and safety regulations as provided for by state law.
- Use the legally adopted *Manual on Uniform Traffic Control Devices* (MUTCD), with Washington State modifications as the minimum standard.
- Provide an appropriate level of traffic control plans (TCPs).
- Consider work zone ITS elements.
- Use established design criteria in work zone roadway and roadside design.
- Accommodate pedestrian (including ADA requirements) and bicycle traffic.
- Consider maintenance of existing transit stops.
- Consider school zone impacts.
- Consider risk management and tort liability exposure.
- Consider work efficiency and cost containment.
- Approach the work zone design from the road user's perspective.
- Incorporate worker and other roadway user needs in your work zone designs.
- Account for all needed work areas and operations.
- Address work vehicle ingress and egress to each work area.

(2) Impacts Assessment

One of the most important tasks in developing TMP strategies is assessing all project impacts to mobility and safety. Impacts that are not identified and addressed in the TMP during design will undoubtedly become issues during the construction phase of the project. Addressing these impacts later during construction can significantly affect a project's costs and schedule, as well as increase traffic delays and safety concerns. The construction project may be well underway by the time these unidentified impacts are discovered, and the options to address them may be limited. A complete impacts assessment allows the project designer to develop more effective TMPs that should only need minor modifications to address construction issues.

An impacts assessment allows you to:

- Manage identified impacts within the structure of the TMP, even though the project may not be identified as significant.
- Develop TTC, TO, and PI strategies to address identified impacts as needed to effectively manage the project.
- Resolve potential work zone impacts within the project design features as design decisions are made. Informed decisions that consider work zone impacts during bridge type selection, materials selection, advertisement dates, and more have the potential to resolve work zone impacts before they happen.
- Engage construction PEs at the design level for input and decisions on the management of impact issues. The TMP needs to reflect those decisions.

- Consider innovative mitigation strategies such as staged closures or ITS solutions to solve an otherwise difficult impact that would be hard to manage during construction.

Impacts assessment starts in the scoping phase of a project and is an ongoing process through construction completion. During the design process, design details can produce a need for traffic control strategy revisions. Changes in design, such as types of materials (HMA vs. PCCP) or bridge footings types (shafts vs. spread) can have a big effect on the traffic control strategy. A designer needs to possess a clear understanding of all the features and how they will be constructed to determine the impact. Work closely with the roadway and bridge designers and construction personnel when assessing the impacts.

Once the designer knows what will be constructed and how, including the required work methods, equipment, materials, and duration to complete the work, an accurate assessment can be made. With this information, work areas can be determined. The work area and the duration of time it will be needed define the impact. If the work area requires a lane closure during actual work operations only on a low-volume highway, the impacts are minor. The strategy may be a typical single-lane closure during nonpeak traffic hours to perform the work. If the work area requires a lane closure until the work is completed over several weeks on a high-volume highway, the impact can be significant. The strategy may be to reduce the lane widths to maintain the same number of lanes and provide barrier to protect the work area. If traffic will be shifted onto the shoulder, the pavement depth on the shoulder needs to be determined. This strategy is much more complex and requires project-specific traffic control plans with temporary channelization and possible pavement reconstruction. If a project has many work areas, consider combining the work areas, if possible, or constructing the project in stages.

Not all impacts need to be addressed with traffic restrictions, closures, or other traffic control methods. Design changes, materials selection, construction methods, or construction sequence may reduce or eliminate some impacts. This is why the traffic control designer needs to understand design and construction issues and work closely with project designers and the Construction Office to develop the best overall traffic control strategy.

Some impacts may be difficult to completely solve and may ultimately need a management decision to determine the level of mitigation or impact to accept. These types of impacts need to be clearly addressed in the TMP with documentation supporting and explaining the decision.

(a) Impacts to Manage During Design

The following impacts should be managed during the design of a project:

1. Bridge construction sequence or falsework openings need to match the TCP staging or temporary channelization plans. The bridge falsework opening detail shown in the plans must be consistent with how the traffic will be maintained through the opening. Coordination with the HQ Bridge and Structures Office is essential. Maintain the legal height of 16 feet 6 inches as the minimum falsework opening whenever possible; anything less than this must consider overheight vehicle impacts and possible additional signing needs. Refer to Chapter 720 for additional requirements. Coordination with the Permits Office may be needed.

2. Can the existing signals and lighting be maintained during the construction phases or do temporary connections need to be considered or temporary systems installed? Existing lighting at the exit and entrance ramps must be maintained at all times during construction and are often one of the first items of work that the contractor disables.
3. Temporary traffic loops and signal detection: Consider the detection needs in relation to the work operation and duration (such as temporary loops, video, radar, and timed system).
4. Permanent traffic loop installation (such as advance loops, turn pockets, and stop bars): Consider access to these locations and what types of traffic control will be needed.
5. Temporary pavement marking needs: What type of marking is most appropriate for the work operation and the pavement surface? When removed, how are existing markings going to impact the roadway surface? Consider how to best minimize for "ghost stripe" potential.
6. Pavement marking installations (crosswalks, arrows, and so on).
7. Utility relocation needs: How will existing utilities conflict with temporary needs?
8. Temporary impact attenuator installation needs: Determine the appropriate type for the location proposed and the specific needs or materials for the installation pad.
9. Lane shifts onto existing shoulders:
   - Is the depth of the existing shoulder adequate to carry the extra traffic?
   - Are there any existing catch basins or junction boxes located in the shoulder that cannot accept traffic loads over them? Are there existing shoulder rumble strips to be addressed?
   - What is the existing sideslope rate? If steeper than 4H:1V, does it need mitigation? Are there existing roadside objects that, when the roadway is shifted, are now within the clear zone limits?
   - Shifting of more than one lane in a direction is only allowed with temporary pavement markings. Shifting lanes by using channelizing devices is not allowed due to the high probability that devices used to separate the traffic will be displaced.
   - Existing drainage features: Will they be adversely impacted by temporary lane shifts or by anticipated work operations?
   - Signal head alignment: When the lane is shifted approaching the intersection, is the signal head alignment within appropriate limits?
10. Roundabout construction at an existing intersection requires site-specific staging plans. Roundabouts create many unique construction challenges and each roundabout usually has very specific design features. There are no established national standards or guidelines for the construction of roundabouts under traffic. Each roundabout must be approached individually for the location and the traffic operational movements that exist.

(3) Work Duration

The duration of work is a major factor in determining a strategy and the amount and types of devices to use in traffic control work zones. A project may have work operations with durations that meet several or all of the following conditions. Refer to the MUTCD for additional information regarding work duration.

(a) **Long-Term Stationary Work Zone**

This is work that occupies a location continuously for more than three days. There is ample time to install and realize benefits from the full range of traffic control procedures and devices. Construction signs should be post-mounted and larger; more stable channelizing devices should be used for increased visibility. Temporary barriers, pavement markings, illumination, and other considerations may be required for long-term stationary work. Staged construction or temporary alignment/ channelization plans are required with this type of work.

(b) **Intermediate-Term Stationary Work Zone**

This is work that occupies a location for up to three days. Signs may still be post-mounted if in place continuously. Temporary pavement markings, in addition to channelization devices, may be required for lane shifts. Barrier and temporary illumination would normally not be used in this work zone duration.

(c) **Short-Term Stationary Work Zone**

This is work that occupies a location for more than one hour within a single day. At these locations, all devices are placed and removed during the single period.

(d) **Short-Duration Work Zone**

This is work that occupies a location for up to one hour. Because the work time is short, the impact to motorists is usually not significant. Simplified traffic control set-ups are allowed, to reduce worker exposure to traffic. The time it may take to set up a full complement of signs and devices could approach or exceed the amount of time required to perform the work. Short-duration work zones usually apply to maintenance work and are not used on construction projects. (See *Work Zone Traffic Control Guidelines* for more information.)

(e) **Mobile Work Zone**

This is work that moves intermittently or continuously. These operations often involve frequent stops for activities such as sweeping, paint striping, litter cleanup, pothole patching, or utility operations, and they are similar to short-duration work zones. Truck-mounted attenuators, warning signs, flashing vehicle lights, flags, and channelizing devices are used, and they move along with the work. When the operation moves along the road at low speeds without stopping, the advance warning devices are often attached to mobile units and move with the operation.

Pavement milling and paving activities are similar to mobile operations in that they can progress along a roadway several miles in a day. These operations, however, are not considered mobile work zones, and work zone traffic control consistent with construction operations is required.

(4) TMP Strategies

When the list of project impacts is complete, the designer can begin to develop strategies for addressing them. There are often several strategies that can be employed to manage traffic through a work zone. The designer will need to analyze the traffic capacity, consider the cost/benefit of the strategy, and consider constructibility issues. Constructibility is a key element in a successful work zone strategy. Safety and mobility are the main concerns, but if the proposed strategy has constructibility issues, the construction costs can escalate, and safety and mobility impacts may not be addressed. Selecting a strategy is often a compromise and involves many engineering and nonengineering factors. Continue to work closely with roadway and bridge designers and construction and maintenance personnel when selecting strategies. The selected strategies are developed into the traffic control PS&E or included in the TMP document to be performed outside the contract.

Do not assume that strategies chosen for past projects will adequately address the impacts for similar projects in the future. There may be similarities with the type of work, but each project is unique and is to be approached in that manner. Always look for other options or innovative approaches; many projects have unique features that can be turned to an advantage if carefully considered. Even a basic paving project on a rural two-lane highway may have opportunities for detours, shifting traffic, or other strategies.

For a list of work zone analysis tools, see:
http://ops.fhwa.dot.gov/wz/traffic_analysis/index.htm#tools

(5) Temporary Traffic Control (TTC) Strategies

(a) Lane Closure

One or more of the traffic lanes are closed in this work zone type. A capacity analysis is necessary to determine the extent of congestion that might result. This may require night work or peak hour restriction. Consider traffic safety drums and truck-mounted attenuators for freeway or expressway lane closures.

(b) Shoulder Closure

A shoulder closure is used for work areas at the edge of the paved shoulder or off the pavement edge. On high-volume freeways or expressways, they should not be in place during peak traffic hours.

(c) Alternating One-Lane Two-Way Traffic

This strategy involves using one lane for both directions of traffic. Flaggers are normally used to alternate the traffic movements. Do not include alternating traffic with flaggers as a traffic control strategy until all other reasonable means of traffic control have been considered. Options to remove flaggers during alternating traffic operations are temporary portable traffic signals or automated flagging assistance devices (AFAD).

If flaggers are used at an intersection, a flagger is required for each leg of the intersection. Only law enforcement personnel are allowed to flag from the center of an intersection. When multiple lanes are present at an intersection, close the lanes so only one lane of traffic approaches the flagger location. When an existing signal is present at the intersection, the signal is to either be turned off or set to flash mode when flagging.

Flagger safety is a high emphasis area. Flagging stations need to be illuminated at night. Flaggers need escape routes in case of errant vehicles. Provide a method of alerting them to vehicles approaching from behind. Two-way radios or cellular phones are required to allow flaggers to communicate with one another. The flagger's location, escape route, protection, signing, and any other safety-related issues all need to be incorporated into the traffic control plan for the flagging operation. Flaggers are not to be used on freeways or expressways. The WSDOT publication, *Work Zone Traffic Control Guidelines*, and the *Standard Specifications* have more information on flaggers, including the Washington State Department of Labor and Industries safety regulations for flaggers.

Using flaggers solely to instruct motorists to proceed slowly is ineffective and is an unacceptable practice. A spotter (not to be confused with a flagger) is used solely to alert workers of an errant vehicle. A spotter does not use a flagging paddle, but instead uses a warning device like an air horn. Intended spotter locations are to be shown on traffic control plans. Additional information on the use of spotters is available in the *Standard Specifications*.

Law enforcement personnel may be considered for some flagging operations and can be very effective where additional driver compliance is desired. The *Traffic Manual* contains information on the use of law enforcement personnel at work zones.

(d) **Rolling Slowdown**

Rolling slowdowns are commonly practiced by the Washington State Patrol (WSP) for emergency closures. They are a legitimate form of traffic control for contractors or utility and highway maintenance crews for *very specific* short-duration closures (to move large equipment across the highway, to pull power lines across the roadway, to switch traffic onto a new alignment, and so on). They are not to be used for routine work that can be addressed by lane closures or other formal traffic control strategies. Traffic control vehicles, during off-peak hours, form a moving blockade, which reduces traffic speeds and creates a large gap (or clear area) in traffic, allowing very short-term work to be accomplished without completely stopping the traffic.

Consider other forms of traffic control as the primary choice before the rolling slowdown. A project-specific traffic control plan (TCP) must be developed for this operation. The TCP or contact provisions should list the work operations in which a rolling slowdown is allowed. The gap required for the work and the location where the rolling slowdown begins needs to be addressed on the TCP. Use of the WSP is encouraged whenever possible. Refer to the *Standard Specifications* and *Work Zone Traffic Control Guidelines* for additional information on rolling slowdown operations.

(e) **Intermittent Closure**

This work zone type involves stopping all traffic in both directions for a relatively short time to allow the work to proceed. After a certain amount of time, based on traffic volume, the roadway is reopened. An example of this type of closure would be a girder-setting operation for a bridge project: typically, the closure would be limited to a ten-minute maximum and would occur in early morning hours when traffic volumes are at a minimum. A traffic control plan is required for this operation detailing the method that will be used to stop traffic. Typically, this will be done by closing the lanes of a multilane roadway to a single lane and using either a flagger or law enforcement at the point of closure. These closure points must be shown on a plan.

(f) **Temporary Bypass**

This strategy involves total closure of one or both directions of travel on the roadway. Traffic is routed to a temporary bypass usually constructed within the highway right of way. An example of this is the replacement of an existing bridge by building an adjacent temporary structure and shifting traffic onto the temporary structure. A temporary channelization plan is required to show pavement markings, barrier and attenuators, and sign and device placement.

(g) **Median Crossover**

This strategy involves placing all multilane highway traffic on one side of the median. Lanes are usually reduced in both directions and one direction is routed across the median. Median paving may be required to create crossover locations. For long-duration crossovers, temporary channelization plans are required, with barrier to separate the two directions of traffic and temporary illumination required at the crossover locations (see Exhibit 1040-24).

(h) **Lane Shift/Reduced Lane Width**

Traffic lanes may be shifted and/or width-reduced in order to accommodate a long-duration work area when it is not practicable, for capacity reasons, to reduce the number of available lanes. Shifting more than one lane of traffic requires the removal of conflicting pavement markings and the installation of temporary markings; the use of channelization devices to separate multiple lanes of traffic is not allowed. Use advanced warning signs to show the changed alignment when the lateral shifting distance is greater than one-half of a lane width, and consider the use of solid lane lines through the shift areas.

Utilizing the existing shoulder may be necessary to accommodate the shifting movement. First, analyze the structural capacity of the shoulder to determine its ability to carry the proposed traffic. Remove and inlay existing shoulder rumble strips prior to routing any traffic onto the shoulder.

(i) **Total Closures**

Total closures may be for the project duration or for a critical work operation that has major constructibility or safety issues. The main requirement for total closures is the availability of a detour route and whether or not the route can accommodate the increased traffic volumes. For the traveling public, closing the road for a short time might be less of an inconvenience than driving through a work zone for an extended period of time (see the *Traffic Manual* and RCW 47.48). Advance notification of the closure is required, and a signed detour route may be required.

Consider the following road closure issues:

- Communication with all stakeholders, including road users, local businesses, local agencies, transit agencies, emergency services, schools, and others, is required when considering a total closure strategy. This helps determine the level of support for a closure and development of an acceptable closure duration.

- Analyze a closure strategy and compare it to other strategies, such as staged work zones, to determine which is overall more beneficial. This information helps stakeholders understand the impacts if a closure is not selected.
- A closure decision (other than short-term, minor-impact closures) will require stakeholder acceptance and management approval once impacts and benefits have been analyzed.
- Closures that reopen to a new, completed roadway or other noticeable improvements are generally more accepted by the public.
- Route-to-route connections and other strategic access points may have to be maintained or a reasonable alternative provided.
- Material selection, production rates, and work operation efficiencies have a direct tie to the feasibility of the closure strategy. A strong emphasis has been placed on this area and several successful strategies have been implemented, such as weekend-long closures or extended-duration single-shift closures. These strategies use specific materials such as quick-curing concrete, accelerated work schedules, prefabricated structure components, on-site mix plants, and so on, and are based on actual production rates. The WSDOT Materials Laboratory and the HQ Construction Office are good resources for more information on constructibility as a component of an effective work zone strategy.
- Short-duration closures of ramps or intersecting streets during off-peak hours do not require extensive approval if advance notice is provided and reasonable alternate routes are available.
- Detailed, project-specific traffic control plans, traffic operation plans, and public information plans are required.
- Document road closure decisions and agreements in the Project File.

(j) **Staged Construction**

Staged construction entails combining multiple work areas into a logical order to provide large protected work areas for long durations, which maximizes work operations and minimizes daily impacts to traffic. Temporary alignment and channelization plans must be designed to place traffic in these semipermanent locations. Minimum geometric design criteria are to be used when developing these plans. Design strategies such as overbuilding for future stages or the use of temporary structures are often part of staged construction on significant impact projects or mega projects. Develop detailed capacity analysis and traffic modeling for each stage.

Implementation of the staged temporary alignment and channelization or transitioning from one stage to the next can be a safety and mobility impact. Production rates for removing and replacing pavement markings, temporary barrier, or pavement work at the tie-in locations can create lane and duration impacts that need to be considered. Strategies and plans to implement or change stages must be considered.

(k) **Traffic Split or Island Work Zone**

This strategy separates lanes of traffic traveling in one direction around a work area. On higher-speed roadways, temporary barriers are provided to prevent errant vehicles from entering the work area. Some drivers have difficulty understanding "lane split" configurations, which sometimes results in poor driving decisions such as unnecessary or late lane changes. Braking and erratic lane changes decrease the traffic capacity through the work zone, which results in an unstable traffic flow approaching the lane split. Evaluate other strategies, such as overbuilding, to keep traffic on one side of the work area to avoid a traffic split if possible.

Consider the following guidance for traffic split operations:

- Define the work operation and develop the traffic control strategy around the specific operation.
- Limit the duration the traffic split can be in place. Consider incentives and disincentives to encourage the contractor to be as efficient as possible. A higher level of traffic impacts may be acceptable if offset with fewer impacted days.
- Advance warning signs advising drivers of the approaching roadway condition are required. Consider the use of Portable Changeable Message Signs (PCMS signs), portable Highway Advisory Radio (HAR), and other dynamic devices.
- Consider how the operation will impact truck traffic. If the truck volumes are high, additional consideration may be prudent to control in which lane the trucks drive. If the trucks are controlled, it eliminates much of the potential for truck/car conflicts and sorts out undesirable truck lane changes through the work zone. For questions concerning truck operations, contact the HQ Freight Systems Division.
- To discourage lane changing, consider the use of solid lane line markings to delineate traffic approaching the split or island. Refer to the MUTCD for additional details.
- Consider the use of STAY IN LANE (black on white) signs, or set up a "no pass" zone approaching the lane split and coordinate with the Washington State Patrol (WSP).
- Supplement the existing roadway lighting with additional temporary lighting to improve the visibility of the island work area (see Exhibit 1040-23).
- Coordinate with the region Traffic Office for signing and pavement marking details when designing island work zones.

(l) **A+B Bidding**

Use A+B bidding to reduce the contract time by requiring bidders to determine the working days as part of their bid. For more information, see:
www.wsdot.wa.gov/projects/delivery/alternative/abbidding

(m) **Incentive/Disincentive Clauses**

These are contract provisions that place financial consequences, good or bad, to ensure high-impact work or projects are finished as soon as possible. These provisions could also include accelerated work schedules for high-impact work operations.

(n) **Innovative Design/Construction Methods**

- Overbuild beyond normal project needs to maintain additional traffic or facilitate staged construction.
- Replace bridges using new alignments so they can be built with minimal impacts.
- Design bridges using super girders, falsework restrictions, or temporary structures.
- Bring adjacent lifts of hot mix asphalt (HMA) to match the latest lifts (lag up), to minimize abrupt lane edges to improve motorist safety.
- Require a tapered wedge joint on HMA lifts to eliminate an abrupt drop-off.

(6) Transportation Operations (TO) Strategies

(a) **Demand Management**

- Provide transit service improvements and possible incentives to help reduce demand.
- For long-term freeway projects, consider ramp metering.
- Provide a shuttle service for pedestrians and bicyclists.
- Provide local road improvements (signals modifications, widening, and so on) to improve capacity for use as alternate routes.
- Provide traffic screens to reduce driver distraction.

(b) **Corridor/Network Management**

- Provide a temporary express lane with no access through the project.
- Consider signal timing or coordination modifications.
- Provide emergency pullouts for disabled vehicles on projects with narrow shoulders.
- Use heavy-vehicle restrictions and provide alternate routes or lane use restrictions.

(c) **Work Zone Safety Management**

- Provide temporary access road approaches for work zone access.
- Use positive protective devices (barrier) for long-term work zones to improve the environment for workers and motorists.
- Install intrusion alarms or vehicle arresting devices.
- Use speed limit reductions when temporary conditions create a need for motorist slow-downs.

(d) **Traffic/Incident Management and Enforcement**

- Provide law enforcement patrols to reduce speeding and aggressive drivers.
- Provide incident response patrols during construction to reduce delays due to collisions in the work zone.
- Include work zone ITS elements in the project or coordinate with TMC to use existing equipment.
- Provide a dedicated tow service to clear incidents.

(7) Public Information (PI) Strategies

(a) **Public Awareness**

One PI strategy is a public awareness campaign using the media, project websites, public meetings, e-mail updates, and mailed brochures. This gives regular road users advance notice of impacts they can expect and time to plan for alternate routes or other options to avoid project impacts. Involve the region or HQ Communications Office in developing and implementing these strategies.

(b) **Driver Information**

In addition to work zone signs, provide driver information using highway advisory radio (HAR) and changeable message signs (existing or portable). Provide additional work zone ITS features that could include traffic cameras or queue detection along with changeable message signs to provide drivers with real time information on delays and traffic incidents. Involve the region TMC in the development and implementation of these strategies. Coordinate freight travel information and restrictions through the Freight Systems Office. Additional information on work zone ITS can be found on the Work Zone Safety web page:
www.wsdot.wa.gov/safety/workzones/

Work zone strategy development is a fluid process and may be ongoing as project information and design features are developed during the design process. There may be many factors involved with strategy development, and it is necessary to be well organized to make sure all the relative factors are identified and evaluated.

(c) **Pedestrian and Bicycle Information**

Include pedestrian and bicycle access information and alternate routes in the public awareness plans. Pedestrian and bicyclist information signing, including alternate route maps specifically for these road users, could be considered.

1010.07 Capacity Analysis

Work zone congestion and delay is a significant issue for many highway projects. High-volume locations with existing capacity problems will certainly be candidates for further capacity problems when a work zone is in place. Work zones can create many types of roadway restrictions, such as lane closures, shoulder closures, narrowed lanes, closures and detours, and diversions, which all reduce capacity. Even when the construction work does not affect adjacent traffic lanes, slowdowns in the traffic flow are common because these activities can distract a motorist.

All work zone restrictions need to be analyzed to determine the level of impacts. Short-term impacts may only require work hour restrictions; long-term impacts require a detailed capacity analysis of the proposed mitigation strategies to select the best method of maintaining mobility. Include the *Work Zone & Traffic Analysis* in the Project File.

Work zone mobility impacts can have the following effects:

- **Crashes:** Most work zone crashes are congestion-related, usually in the form of rear-end collisions due to traffic queues. Traffic queues beyond the advance warning signs increase the risk of crashes.

- **Driver Frustration:** Drivers expect to travel to their destinations in a timely manner. If delays occur, driver frustration can lead to aggressive or inappropriate driving actions.
- **Constructibility:** Constructing a project efficiently relies on the ability to pursue work operations while maintaining traffic flow. Delays in material delivery, work hour restrictions, and constant installation and removal of traffic control devices all detract from constructibility.
- **Local Road Impacts:** Projects with capacity deficiencies can sometimes cause traffic to divert to local roadways, which may impact the surrounding local roadway system and community. Local roads may have lower geometric criteria than state facilities. Placing additional and new types of traffic on a local road may create new safety concerns, especially when drivers are accustomed to the geometrics associated with state highways. Pavement integrity and rehabilitation may need to be addressed when traffic is detoured to local roadways.
- **Public Credibility:** Work zone congestion and delay can create poor credibility for WSDOT with drivers and the surrounding community in general.
- **Restricted Access:** Severe congestion can effectively gridlock a road system, preventing access to important route connections, businesses, schools, hospitals, and so on.
- **User Cost Impacts:** Congestion and delay, as well as associated collisions and other impacts, can create significant economic impacts to road users and the surrounding community. Calculate user costs as part of a work zone capacity analysis; the costs may be used to determine liquidated damages.

WSDOT has a responsibility to maintain traffic mobility through and around its projects. The goal is to keep a project's work zone traffic capacity compatible with existing traffic demands. Maintaining the optimum carrying capacity of an existing facility during construction may not be possible, but an effort must be made to maintain existing traffic mobility through and/or around the work zone.

Maintaining mobility does not rule out innovative strategies such as roadway closures. Planned closures can accelerate work operations, reducing the duration of impacts to road users. These types of traffic control strategies must include a plan to notify road users and mitigate and manage the congestion as much as possible. Traffic capacity mitigation measures are important since many projects cannot effectively design out all the work zone impacts.

A capacity analysis helps determine whether a work zone strategy is feasible. Mitigation measures that provide the right combination of good public information, advance signing and notification, alternate routes, detours, and work hour restrictions, as well as innovations such as strategic closures, accelerated construction schedules, or parallel roadway system capacity improvements, can be very effective in reducing mobility impacts.

Some of the impact issues and mitigating measures commonly addressed by traffic analyses include:

- Work hour time restrictions
- Hourly liquidated damage assessment
- Use of staged construction

- Working day assessment
- Public information campaign
- User cost assessment
- Local roadway impacts
- Special event and holiday time restrictions
- Closure and detour options
- Mitigation cost justification
- Level of service
- Queue lengths
- Delay time
- Running speed
- Coordination with adjoining projects (internal and local agency)

Many projects will have several potential work zone strategies, while other projects may only have one obvious work zone strategy. It is possible that a significant mobility impact strategy may be the only option. TMP strategies still need to be considered. An analysis will help show the results of these mitigating measures.

There is no absolute answer for how much congestion and delay are acceptable on a project; it may ultimately become a management decision.

Reductions in traffic capacity are to be mitigated and managed as part of the TMP. The traffic analysis process helps shape the TMP as the work zone strategies are evaluated and refined into traffic control plans and specifications. Maintain analysis documents in the Project File.

(1) Collecting Traffic Volume Data

Current volume data in the project vicinity is required for accurate traffic analysis results. Seasonal adjustment factors may be needed depending on when the data was collected and when the proposed traffic restrictions may be in place. Assess existing data as early as possible to determine whether additional data collection may be required. The region Traffic Office and the HQ Statewide Travel & Collision Data Office can assist with collecting traffic volume data. Coordination with local agencies may be needed to obtain data on affected local roads.

(2) Short-Term Lane Closure Work Zone Capacity

For short-term lane closures on multilane highways or alternating one-way traffic on two-lane highways, see Exhibit 1010-1, General Lane Closure Work Zone Capacity. It provides information for a quick analysis when compared to current hourly volumes on the highway. The basic traffic analysis programs QUEWZ 98 and QuickZone, along with hourly volume input, the number of lanes to be closed, the hours of closure, and other default information, will output queue length, delay time, user costs, and running speed.

Roadway Type	Work Zone Capacity
Multilane Freeways/Highways	1300 VPHPL*
Multilane Urban/Suburban	600 VPHPL*
Two-Lane Rural Highway	400 VPHPL/ 800 VPH total*
*These are average capacity values. The actual values would be dependent on several factors, which include the existing number of lanes, number of lanes closed, traffic speed, truck percentage, interchanges/intersections, type of work, type of traffic control, and seasonal factors (among others). For further information, consult the *Highway Capacity Manual*.	

General Lane Closure Work Zone Capacity
Exhibit 1010-1

(3) Long-Term Work Zone Capacity

For complex strategies that change traffic patterns, a more detailed analysis is required using advanced traffic modeling software. These strategies could include reducing lane and shoulder widths for extended lengths, reducing the number of lanes for extended durations, moving all lanes of traffic onto a temporary alignment, changing access locations to and from the highway, or closures with detours (including public information and traffic operation plans with anticipated reduction in demand). Work with the region Traffic Office for assistance with this level of analysis.

The following resources are also available to assist with the actual analysis and mitigation strategy development upon request:

- HQ Statewide Travel & Collision Data Office
- HQ Traffic Offices
- Region Work Zone Specialist
- Region Public Information Office

Training is also available to obtain further knowledge and expertise in traffic analysis (see 1010.12).

1010.08 Work Zone Design Standards

Part 6 of the MUTCD mostly addresses short-duration temporary traffic control standards. Some long-duration work zones may require temporary alignments and channelization, including barrier and attenuator use, temporary illumination and signals, and temporary pedestrian and bicycle routes. Refer to the *Design Manual's* chapters on permanent features for design guidance.

(1) Lane Widths

Maintain existing lane widths during work zone operations whenever possible. For projects that require lane shifts or narrowed lanes due to work area limits and staging, consider the following before determining the final lane width to be implemented:

- Overall roadway width available
- Posted speed limit

- Traffic volumes through the project limits
- Number of lanes
- Existing lane and shoulder widths
- Length of project
- Duration of lane width reduction (if in place)
- Roadway geometry (cross slope, vertical and horizontal curves)
- Truck percentage

Work zone geometric transitions should be minimized or avoided if possible. When necessary, such transitions should be made as smoothly as the space available allows. Maintain approach lane width, if possible, throughout the connection. Design lane width reductions prior to any lane shifts within the transition area. Do not reduce curve radii and lane widths simultaneously.

The minimum allowable striped lane width is 11 feet to a maximum allowable lane width of 14 feet when the radius is greater than 500 feet. Follow existing lane widths when delineating temporary lanes with channelizing devices. For low-speed low-volume roadways, 10-foot lanes are allowed with approval from the region Traffic Engineer.

When determining lane widths, the objective is to use lane geometrics that will be clear to the driver and keep the vehicle in the intended lane. Lane lines and construction joints are treated to provide a smooth flow through the transition area. In order to maintain the minimum lane widths and shy distances, temporary widening may need to be considered.

(2) Buffer Space and Shy Distance

Buffer spaces separate road user flow from the work space or other areas off-limits to motorists, and they might provide some recovery space for errant vehicles.

- A lateral buffer provides space between the vehicles and adjacent work space, traffic control device, or a condition such as an abrupt lane edge or drop-off. At a minimum, a 2-foot lateral buffer space is recommended.
- A longitudinal buffer is used after traffic lanes or shoulders are closed or shifted. This space provides a recovery area for errant vehicles before the work space.
- Shy distance is the distance from the edge of the traveled way beyond which a roadside object will not be perceived as an immediate concern by the typical driver to the extent that the driver will change the vehicle's placement or speed. A 2-foot shy distance to barriers is required.

Devices used to separate the driver from the work space should not encroach into adjacent lanes. If encroachment is necessary, it is recommended to close the adjacent lane to maintain the lateral buffer space.

In order to achieve the minimum lateral clearances, there may be instances where temporary pavement widening or a revision to a stage may be necessary. In the case of short-term lane closure operations, the adjacent lane may need to be closed or traffic may need to be temporarily shifted onto a shoulder to maintain a lateral buffer space. During the design of the traffic control plan, the lateral clearance needs to be identified on the plan to ensure additional width is available; use temporary roadway cross sections to show the space in relation to the traffic and work area.

(3) Work Zone Clear Zone

The contractor's operations present opportunities for errant vehicles to impact the clear area adjacent to the traveled way. A work zone clear zone (WZCZ) is established for each project to ensure the contractor's operations provide an appropriate clear area. The WZCZ addresses items such as storage of the contractor's equipment and employee's private vehicles and storage or stockpiling of project materials. The WZCZ applies during working and nonworking hours and applies only to roadside objects introduced by the contractor's operations. It is not intended to resolve preexisting deficiencies in the Design Clear Zone or clear zone values established at the completion of the project. Those work operations or objects that are actively in progress and delineated by approved traffic control measures are not subject to the WZCZ requirements.

Minimum WZCZ values are presented in Exhibit 1010-2. WZCZ values may be less than Design Clear Zone values due to the temporary nature of the construction and limitations on horizontal clearance. To establish an appropriate project-specific WZCZ, it may be necessary to exceed the minimum values. The following conditions warrant closer scrutiny of the WZCZ values, with consideration of a wider clear zone:

- Outside of horizontal curves or other locations where the alignment presents an increased potential for vehicles to leave the traveled way.
- The lower portion of long downgrades or other locations where gradient presents an increased potential for vehicles to exceed the posted speed.
- Steep fill slopes and high traffic volumes. (Although it is not presented as absolute guidance, the Design Clear Zone exhibit in Chapter 1600 may be used as a tool to assess increases in WZCZ values.)

Posted Speed	Distance From Traveled Way (ft)
35 mph or less	10
40 mph	15
45 to 55 mph	20
60 mph or greater	30

Minimum Work Zone Clear Zone Distance
Exhibit 1010-2

(4) Abrupt Lane Edges and Drop-offs

Minimize, mitigate, or eliminate abrupt lane edges adjacent to the traveled lane whenever possible. There are work operations where drop-offs are unavoidable in order to perform the work, but in these instances, the drop-off can generally be anticipated and addressed in the work zone traffic control plan design. Contract provisions should be included limiting the duration of edges from planing and paving operations and requiring a step wedge on new pavement edges or a lag up requirement to minimize the instances of abrupt lane edges. Use the following guidance examples for drop-off protection measures. Note: These are general guidance examples only. For a complete discussion of abrupt lanes edges and drop-offs, see Standard Specification 1-07.23(1):
www.wsdot.wa.gov/Publications/Manuals/M41-10.htm

- Drop-offs up to 0.20 foot may remain exposed with appropriate warning signs alerting motorists of the condition.
- Drop-offs more than 0.20 foot are not allowed in the traveled way or auxiliary lane unless protected with appropriate warning signs, channelization devices, or barrier.
- Drop-offs more than 0.20 foot, but no more than 0.50 foot, that will not be within the traveled way shall be protected with appropriate warning signs, a wedge of compacted stable material at a slope of 4:1 or flatter, channelization devices, or barrier.
- Drop-offs more than 0.50 foot, but less than 2 feet, not within the traveled way or auxiliary lane shall be protected with appropriate warning signs, wedge of compacted stable material at a slope of 4:1 or flatter, channelization devices, or barrier. This drop-off is allowed only if it is less than 1 mile in length, does not remain for more than three working days, and is only on one side of the roadway.
- Drop-offs more than 0.50 foot that will not be within the traveled way or auxiliary lane and are not otherwise covered by the above shall be protected with appropriate warning signs and wedge of compacted stable material at a slope of 4:1 or flatter or barrier. (See Chapter 1610 for information on deflection if using barrier.)
- Open trenches within the traveled way or auxiliary lane shall have a steel-plate cover placed and anchored over them. A wedge of suitable material, if required, shall be placed for a smooth transition between the pavement and the steel plate. Warning signs shall be used to alert motorists of the presence of the steel plates.

Abrupt lane edges and drop-offs require additional warning and considerations for motorcyclists, bicyclists, and pedestrians, including pedestrians with disabilities. Adequate signing to warn the motorcycle rider of these conditions is required. (See RCW 47.36.200 and WAC 468-95-305 for signing details.)

(5) Vertical Clearance

In accordance with Chapter 720, the minimum vertical clearance over new highways is 16.5 feet. Anything less than the minimum must follow the reduced clearance criteria discussed in Chapter 720 and be included in the temporary traffic control plans. Maintain legal height on temporary falsework for bridge construction projects. Anything less than this must consider overheight vehicle impacts and possible additional signing needs and coordination with permit offices. Widening of existing structures can prove challenging when the existing height is at or less than legal height, so extra care is required in the consideration of overheight vehicles when temporary falsework is necessary. Coordination with the HQ Bridge and Structures Office is essential to ensure traffic needs have been accommodated. Vertical clearance requirements associated with local road networks may be different than what is shown in Chapter 720. Coordinate with the local agency.

(6) Temporary Median Crossover Requirements

When two-way traffic is placed on one side of a multilane divided highway, consider the following guidelines when designing the crossover:

- Separate opposing traffic with either temporary traffic barriers (on high-speed roadways) or with channelizing devices throughout the length of the two-way operation. Temporary pavement markings, removal of conflicting existing markings, and construction signs are also required.

- The crossover locations are to be paved, and temporary pavement markings are required. Temporary illumination is required to improve the visibility of the crossover location. Temporary drainage may be necessary under the median fill when applicable.
- Geometrics design for temporary crossovers needs to follow the same guidance as permanent construction and have horizontal curves calculated to fit the location.
- Design crossovers for operating speeds not less than 10 mph below the posted speed limit unless unusual site conditions require a lower design speed.
- Straight line crossover tapers work best for highways with narrow paved medians.
- Provide a buffer space between the lane closures and crossover locations.
- Design crossovers to accommodate all roadway traffic, including trucks, buses, motor homes, motorcycles, and bicycles.
- A good array of channelizing devices and properly placed pavement markings is essential in providing clear, positive guidance to drivers.
- Provide a clear roadside recovery area adjacent to the crossover. Consider how the roadway safety hardware (guardrail, crash cushions, and so on) may be impacted by the traffic using the crossover if the traffic is going against the normal traffic flow direction. Avoid or mitigate possible snagging potential. Avoid placing crossover detours near structures.
- A site-specific traffic control plan is required.

(7) Temporary Alignment and Channelization

Temporary alignment and channelization plans may be necessary for some long-term work zones.

The following are guiding principles for the design of temporary alignment and channelization plans:

- Use site-specific base data.
- Use permanent geometric design criteria.
- Provide beginning and ending station ties and curve data.
- Include lane and shoulder widths.
- Provide temporary roadway sections.
- To avoid confusion, do not show existing conflicting or unnecessary details on the plan.
- Do not use straight line tapers through curves; use circular alignment.
- Be aware of existing crown points, lane/shoulder cross slope breaks, and superelevation transitions that may affect a driver’s ability to maintain control of a vehicle through a work zone.
- If the project has multiple stages, from one stage to the next, show newly constructed features as existing elements. For example, if an edge line is removed in one stage, the following stage would show the change by indicating where the new edge line is located.
- Consider the time constraints for the removal of existing markings and the time required to install new markings, especially if the work is for multilane staged construction. In urban areas where work hour restrictions for lane closures are

limited, special consideration may be necessary to allow for time to address pavement markings, or interim stages may be necessary. Reopened temporary traffic lanes are to be marked and in compliance with criteria established in this chapter.

- Use shoulder closure signing and channelizing devices to close a shoulder prior to a temporary impact attenuator and run of temporary concrete barrier.
- Existing signing may need to be covered or revised, and additional construction warning signs may be needed for the new alignment.
- For better guidance through shifting or taper areas, consider solid lane lines. Return to broken lane lines between shift areas.

(8) Reduced Speeds in Work Zones

As part of the design process for construction projects, speed reductions are an option requiring thorough traffic analysis prior to adopting this option. Traffic control design assumes that drivers will reduce their speed only if they clearly perceive a need to do so. Reduced speed limits are used only where roadway and roadside conditions or restrictive features are present, such as narrow, barrier-protected work areas with major shifts in roadway alignment and where a reduced speed is truly needed to address the altered geometry of the roadway. Speed reductions are not applied as a means for selecting lower work zone design criteria (tapers, temporary alignment, device spacing, and so on). Avoid frequent changes in the speed limit.

Speed limit reductions are categorized as follows:

- Continuous Regulatory Speed Limit Reduction: A speed reduction in place 24 hours a day during the number of days that construction is present.
- Variable Regulatory Speed Limit Reduction: A speed reduction in place, usually during an active work shift.
- Advisory Speed Reduction: A specific signed warning message with an advised safe speed for that given work zone condition.

Proposed speed limit reductions of more than 10 mph on any route or less than 60 mph on freeways require HQ Traffic Office approval. The Regional Administrator is authorized to approve regulatory speed limit reductions in work zones as provided for in RCW 47.48. The region Traffic Engineer is responsible for recommending or denying a speed limit reduction request to the Regional Administrator. (See the *Traffic Manual* for additional guidance on speed limit reductions.) Include speed limit reduction approvals in the Project File.

Do not use the advisory speed plaque alone or in conjunction with any sign other than a warning sign. In combination with a warning sign, an advisory speed plaque may be used to indicate a recommended safe speed through a work zone. Refer to the MUTCD for additional guidance.

(9) Accommodation for Pedestrians and Bicyclists

Many public highways and streets accommodate pedestrians and bicyclists, predominately in urban areas. During construction, access must be maintained through or around the work zones. When existing pedestrian routes that are accessible to pedestrians with disabilities are closed, the alternate routes must be designed and constructed to the same level of accessibility. Temporary pedestrian facilities within the work zone must meet accessibility criteria to the maximum extent feasible. (See 1510.06 and 1510.07 for pedestrian circulation path and pedestrian access route accessibility criteria.) Covered walkways are to be provided where there is a potential for falling objects. In work areas where the speeds are low (25 mph), or the ADT is 2,000 or less, bicyclists can use the same route as motorized vehicles. For work zones on higher-speed facilities, bicyclists will need a minimum 4-foot shoulder or detour route to provide passage through or around a work zone. Bicyclists may be required to dismount and walk their bikes through a work zone on the route provided for pedestrians (see Exhibit 1520-1).

It may be possible to make other provisions to transport pedestrians and bicyclists through a work zone or with a walking escort around the active work area. Roadway surfaces are an important consideration for pedestrian and bicycle use. Loose gravel, uneven surfaces, milled pavement, and asphalt tack coats endanger the bicyclist and restrict access to pedestrians with disabilities.

Information can be gathered on bike issues by contacting local bike clubs. Coordination with local bike clubs goes a long way to ensuring their members are notified of work zone impacts, and it helps maintain good public relations. (See Chapter 1520 for more bicycle design requirements and Chapter 1510 and MUTCD Chapter 6D for pedestrian work zone design requirements.)

(10) Motorcycles

The same road surfaces that are a concern for bicyclists are also a concern for motorcyclists. Stability at high speed is a far greater concern for motorcycles than cars on grooved pavement, milled asphalt, and transitions from existing pavement to milled surfaces. Contractors must provide adequate warning signs for these conditions to alert the motorcycle rider. The WSDOT publication, *Work Zone Traffic Control Guidelines*, has more information on regulations for providing warnings to motorcyclists (RCW 47.26.200).

(11) Oversized Vehicles

The region Maintenance offices and the HQ Commercial Vehicle Services Office issue permits to allow vehicles that exceed the legal width, height, or weight limits to use certain routes. If a proposed work zone will reduce roadway width or vertical clearance, or have weight restrictions, adequate warning signs and notification to the HQ Commercial Vehicle Services Office and the appropriate region Maintenance Office is required as a minimum. Document communication with these offices and any other stakeholders in the Project File.

In the permit notification, identify the type of restriction (height, weight, or width) and specify the maximum size that can be accommodated. On some projects, it may be necessary to designate a detour route for oversized vehicles. An important safety issue associated with oversized loads is that they can sometimes be unexpected in work zones, even though warning and restriction or prohibition signs may be in place. Some oversized loads can overhang the temporary barrier or channelization devices and endanger workers. Consider the potential risk to those within the work zone. Routes with high volumes of oversized loads or routes that are already strategic oversized load routes may not be able to rely only on warning or prohibition signs. Protective features or active early warning devices may be needed. If the risk is so great that one oversized load could potentially cause significant damage or injury to workers, failsafe protection measures may be needed to protect structures and workers. The structure design, staging, and falsework openings may need to be reconsidered to safely accommodate oversized loads.

1010.09 Temporary Traffic Control Devices

FHWA regulations require that all roadside appurtenances such as portable sign stands, barricades, traffic barriers, barrier terminals, crash cushions, and work zone hardware be compliant with the National Cooperative Highway Research Program (NCHRP) 350 crash test requirements. For additional information on the NCHRP 350 requirements and for additional descriptions of devices, refer to the MUTCD. For additional information and use guidelines for the following work zone devices, refer to *Work Zone Traffic Control Guidelines*.

(1) Channelizing Devices

Channelizing devices are used to alert and guide road users through the work zone. They are a supplement to signing, pavement markings, and other work zone devices. Typical channelizing devices include the following:

(a) **Cones**

Traffic safety cones are the most commonly used devices for traffic control and are very effective in providing delineation to the work zone. Cones are orange in color and are constructed of a material that will not cause injury to the occupants of a vehicle when impacted. For daytime operations on lower-speed (40 mph or lower) roadways, 18-inch-high cones can be used. For nighttime operations and high-speed roadways, reflectorized 28-inch-high cones are necessary. Traffic cones are used to channelize traffic, divide opposing traffic lanes, and delineate short-duration work zones.

(b) **Traffic Safety Drums**

Drums are fluorescent orange in color, constructed of lightweight, flexible materials, and are a minimum of 3 feet in height and 18 inches in diameter. They are highly visible and appear to be formidable obstacles. They are also less likely to be displaced by the wind generated by moving traffic. For these reasons, drums are preferred on high-speed roadways. Type-C steady-burn warning lights may be installed atop drums to improve visibility.

(c) **Tall Channelizing Devices**

Tall channelizing devices are 42 inches tall, fluorescent orange in color, and are constructed of lightweight, flexible material that may be less likely to cause injury in an impact. Tall channelizing devices are used to channelize traffic, divide opposing traffic lanes, and delineate short-duration work zones. These devices provide a larger target value in terms of retroreflectivity than cones, but less than that of drums. They do have a smaller footprint than drums, so they are a good alternative in narrow shoulder conditions.

(d) **Tubular Markers**

Tubular markers are not a recommended device unless they are being used to separate traffic on low-volume low-speed roadways.

(e) **Barricades**

The barricades used in work zone applications are portable devices. They are used to control traffic by closing, restricting, or delineating all or a portion of the roadway. There are four barricade types:

1. **Type 1 Barricade:** Used on lower-speed roads and streets to mark a specific object.
2. **Type 2 Barricade:** Used on higher-speed roadways; it has more reflective area for nighttime use to mark a specific object.
3. **Type 3 Barricade:** Used for lane and road closures.
4. **Directional Indicator Barricade:** A special-use device not commonly used. The device is used to define the route of travel on low-speed streets or in urban areas where tight turns are required. In lane reductions, the directional arrow on this barrier can be used in the transition taper to indicate the direction of the merge.

(f) **Longitudinal Channelizing Devices**

Longitudinal channelizing devices such as lightweight water-filled barriers are an improvement over the traffic cones and drums used to channelize traffic through a work zone. These types of barriers are **not intended** as a replacement for concrete barrier.

(g) **Barrier Drums**

Barrier drums are low-density polyethylene fabricated devices placed on and along temporary concrete barriers. They are fluorescent orange with retro-reflective bands and are designed to straddle a concrete barrier. They can be used in place of barrier reflectors for barrier delineation.

(2) Portable and Temporary Signing

Portable and temporary signs (Class B Construction Signs) are generally used in short-term work zones. They are set up and removed daily or frequently repositioned as the work moves along the highway. These signs are mounted on crashworthy, collapsible sign supports. They need to be placed such that they do not obstruct pedestrian facilities. Warning signs in place longer than three days at one location must be post-mounted.

(3) Fixed Signing

Fixed signing (Class A Construction Signs) are the signs mounted on conventional sign supports along or over the roadway. This signing is used for long-term stationary work zones. Ground-mounted sign supports are usually timber; details for their design are in Chapter 1020 and the *Standard Plans*. Sign messages, color, configuration, and usage are shown in the MUTCD and the *Sign Fabrication Manual*. Existing signs may need to be covered, removed, or modified during construction.

(4) Warning Lights

Warning lights are either flashing or steady burn (Types A, B, or C) and are mounted on channelizing devices, barriers, and signs. Secure warning lights to the channelizing device or sign so they will not come loose and become a flying object if impacted by a vehicle. (See the MUTCD for additional information.)

- **Type A:** Low-intensity flashing warning light used to warn road users during nighttime hours that they are approaching a work zone.
- **Type B:** High-intensity flashing warning light used to warn road users during both daytime and nighttime hours.
- **Type C and Type D 360 degree:** Steady-burn warning lights designed to operate 24 hours a day to delineate the edge of the roadway.

(5) Arrow Panel

The arrow panel (Sequential Arrow Sign) displays either an arrow or a chevron pointing in the direction of the intended route of travel. Arrow panel displays are required for lane closures on multilane roadways. When closing more than one lane, use an arrow panel display for each lane reduction. Place the arrow panel at the beginning of the transition taper and out of the traveled way. The caution display (four corner lights) is only used for shoulder work. Arrow panels are not used on two-lane two-way roadways. (See the MUTCD for additional information.)

(6) Portable Changeable Message Signs (PCMS)

PCMS displays have electronic displays that can be modified and programmed with specific messages, and they are supplemental to other warning signs. These signs are usually mounted on trailers and use solar power and batteries to energize the electronic displays. The maximum number of message panels is two per location. If additional information is necessary, consider using a second sign. Place the PCMS far enough in advance of the roadway condition to allow the approaching driver adequate time to read the sign's message twice. PCMS systems are typically used where:

- Traffic speed is expected to drop substantially.
- Significant queuing and delays are expected.
- There are extreme changes in alignment or surface conditions.
- Advance notice of ramp, lane, or roadway closures is necessary.
- Incident management teams are used.

(7) Transportable Attenuators

A transportable attenuator is a portable impact attenuator attached to the rear of a large truck. Ballast is added to the truck to minimize the roll-ahead distance when impacted by a vehicle. Transportable attenuators are used as a shield to prevent errant vehicles from entering the work zone. They should be used on all high-speed roadways. If a transportable attenuator is not available, the use of a protective or shadow vehicle is still highly recommended.

(8) Portable Temporary Traffic Control Signals

Portable temporary traffic signals are trailer-mounted and used in work zones to control traffic. These versatile portable units allow for alternative power sources such as solar power, generators, and deep-cycle marine batteries, in addition to AC power. (See the MUTCD for additional information). Portable traffic signals are typically used on two-lane two-way highways where one lane is closed for an extended duration and alternating traffic movements need to be maintained. Contact the region Traffic Office and Signal Superintendent for specific guidance and advice on the use of these systems; a traffic control plan is required.

(9) Portable Highway Advisory Radio (HAR)

A HAR is a roadside radio system that provides traffic and travel-related information (typically affecting the roadway being traveled) via AM radio. The system may be a permanently located transmitter or a portable trailer-mounted system that can be moved from location to location as necessary. Contact the region Traffic Office for specific guidance and advice on the use of these systems.

(10) Automated Flagger Assistance Device (AFAD)

The AFAD is an automated flagging machine that is operated remotely by a flagger located off the roadway and away from traffic. The device is a safety enhancement for projects that use alternating traffic control by physically placing the human flagger off the roadway while maintaining control of the traffic movements approaching the work zone. Contact the region Traffic Office for specific guidance and advice on the use of these systems. A traffic control plan is required for use of the AFAD.

1010.10 Other Traffic Control Devices or Features

(1) Barriers (Positive Protection)

Barriers are used in work zones to separate traffic moving in opposing directions and to separate road users from the work area. Temporary concrete barrier is the most common type of positive protection. (See Chapter 1610 for guidance on barriers.)

Providing positive barrier protection may become the key component of the work zone strategy. Barrier use usually requires long-term stationary work zones and pavement marking revisions, and it can increase the traffic control costs. The safety benefit versus the cost of using barrier requires careful consideration, and cost should not be the only or primary factor determining the use of barrier.

Traditional lane closures using channelizing devices may not provide adequate worker and road user protection for some types of construction. Use barriers for the following conditions:

- To separate opposing high-speed traffic normally separated by a median or existing median barrier.
- Where existing traffic barriers or bridge railings are to be removed.
- For drop-off protection during widening or excavations. (See Standard Specification 1-07.23(1).)
- When temporary slopes change clear zone requirements.
- For bridge falsework protection.
- When equipment or materials must remain in the work zone clear zone.
- When newly constructed features in the clear zone will not have permanent protection until later in the project.
- Where temporary signs or light standards are not crashworthy.
- Where drums, cones, or barricades do not provide adequate protection for the motorist or worker.

(a) **Temporary Concrete Barriers**

These are the safety-shape barriers shown in the *Standard Plans*. Lateral displacement from impacts is usually in the range of 2 to 4 feet. (See chapter 1610 for detailed information on deflection.) When any barrier displacement is unacceptable, these barriers are anchored to the roadway or bridge deck. Anchoring systems are also shown in the *Standard Plans*.

(b) **Movable Barriers**

Movable barriers are specially designed segmental barriers that can be moved laterally one lane width or more as a unit with specialized equipment. This allows strategies with frequent or daily relocation of a barrier. The ends of the barrier must be located out of the clear zone or fitted with an impact attenuator. Storage sites at both ends of the barrier will be needed for the barrier-moving machine.

(c) **Portable Steel Barriers**

Portable steel barriers have a lightweight stackable design. They have options for gate-type openings and relocation without heavy equipment. Lateral displacement from impacts is in the range of 6 to 8 feet. Steel barriers can be anchored according to the manufacturer's specifications. Some deflection with anchored systems is still expected.

(2) Impact Attenuators

Within the Design Clear Zone, the approach ends of temporary concrete barriers are fitted with impact attenuators to reduce the potential for occupant injury during a vehicle collision with the barrier. Impact attenuators are addressed in Chapter 1620.

The selection and location of impact attenuators in work zones can present situations that do not exist on a fully operational highway. Consider all work zone and traffic protection needs. The information in Chapter 1620 provides all the needed impact attenuator performance information, but the actual work zone location may require careful consideration by the designer to ensure the correct application is used. Consider the dynamic nature of work operations where work zone ingress and egress, work area protection, worker protection, and traffic protection all factor into the final selection as well as the placement surface available. Redirective and nonredirective devices can both be used as long as the aforementioned issues are resolved and the devices also meet the Chapter 1620 criteria when applied to a given work zone location. Also, impact attenuators used in work zones are much more likely to be impacted, which again requires careful consideration of those devices that are durable and easy to repair. Some common impact attenuator work zone issues are:

- Nonredirective device is improperly located. This is usually associated with an inadequate length of need calculation (see Chapter 1610) or protection issues not fully considered.
- Narrow temporary medians, narrow work zones, narrow or no shoulders, temporary median openings, and inadequate installation area (width, cross and approach slope, or base material).
- Temporary or short-term protection issues associated with the removal or relocation of existing or temporary barriers and impact attenuators.

Designers need to ensure the approved list of temporary impact attenuators is appropriate for the individual work zone plan locations. The designer may remove from the list those devices that are not appropriate for a given location.

(3) Delineation

Pavement markings provide motorists with clear guidance through the work zone and are necessary in all long-term work zones. Temporary pavement markings can be made using paint, tape, or raised pavement markers. Lateral clearance markers are used at the angle points of barriers where they encroach on or otherwise restrict the adjacent shoulder. Barrier delineation is necessary where the barrier is less than 4 feet from the edge of traveled way. For concrete barrier, delineation can either be barrier reflectors attached to the face of the barrier or barrier drum delineators that sit on the barrier.

Existing contradictory pavement markings must be removed. Other delineation devices are guideposts, concrete barrier delineators, and lateral clearance markers. Show these features on the traffic control plans. These devices have retroreflective properties and are used as a supplement in delineating the traveled way during the nighttime. (See Chapter 1030 for delineation requirements.)

Removal of existing or temporary pavement markings can leave a scar, creating a "ghost stripe" effect on the pavement. Under certain conditions, this scar can appear as a valid marking, which could cause driver confusion. Destructive removal such as intensive grinding can actually leave a groove in the pavement that can hold rainwater and leave the appearance of a stripe, especially at night when headlight reflections intensify the effect.

Consider the types of removal for markings and their potential for ghost stripes and other distracting or conflicting leftover markings. Less destructive types of removal, such as hydroblasting and the use of removable temporary markings, can significantly improve pavement marking performance through the work zone. Continuous positive guidance through high-quality temporary pavement markings, alone or in combination with existing markings, is a substantial benefit to drivers in work zones. Contact the region or HQ Traffic Office for further information on this subject.

Due to the above-referenced ghosting, marking conflicts, and associated degradation of the pavement integrity, an overlay of the roadway may be considered.

(4) Screening

Screening is used to block the motorist's view of construction activities adjacent to the roadway. Construction activities can be a distraction, and motorist reactions might cause unsafe vehicle operation and undesirable speed reductions. Consider screening the work area when the traffic volume approaches the roadway's capacity. Screening can either be vertically supported plywood/plastic panels or chain link fencing with vertical slats. These types of screening are positioned behind traffic barriers to prevent impacts by errant vehicles. The screening is anchored or braced to resist overturning when buffeted by wind. Commercially available screening or contractor-built screening can be used, provided the device meets crashworthy criteria and is approved by the Engineer prior to installation.

Glare screening is another type of screening used on concrete barriers separating two-way traffic to reduce headlight glare from oncoming traffic. Woven wire and vertical blade-type screens are commonly used in this installation. This screening also reduces the potential for motorist confusion at nighttime by shielding construction equipment and the headlights of other vehicles on adjacent roadways. Make sure that motorists' sight distance is not impaired by these glare screens. Contact the HQ Design Office and refer to AASHTO's *Roadside Design Guide* for additional information on screening.

(5) Illumination

Illumination might be justified if construction activities take place on the roadway at night for an extended period of time. Illumination might also be justified for long-term construction projects at the following locations:

- Road closures with detours or diversions.
- Median crossovers on freeways.
- Complex or temporary alignment or channelization.
- Haul road crossings (if operational at night).
- Temporary traffic signals.
- Temporary ramp connections.
- Projects with lane shifts and restricted geometrics.
- Projects with existing illumination that needs to be removed as part of the construction process.

Illumination is required when:

- Traffic flow is split around or near an obstruction.

Flaggers are necessary for nighttime construction activities (supplemental lighting of the flagger stations by use of portable light plants or other approved methods). (See Standard Specification 1-10.3(1)A.) For information on light levels and other electrical design requirements, see Chapter 1040.

(6) Signals

A permanent signal system can be modified for a temporary configuration such as temporary pole locations during intersection construction, span wire systems, and adjustment of signal heads and alternative detection systems to accommodate a construction stage (see Chapter 1330).

(7) Work Zone Intelligent Transportation Systems (ITS)

Intelligent Transportation Systems apply advanced technologies to optimize the safety and efficiency of the existing transportation network. Many permanent systems already exist throughout Washington State and provide the opportunity to greatly enhance construction projects that fall within the limits of the ITS network. ITS applications in work zones can be used to provide traffic monitoring and management, data collection, and traveler information.

ITS can provide real-time work zone information and associated traffic conditions such as slowed or stopped traffic ahead, or they can advise of alternate routes. This gives motorists more information as they make decisions about travel plans.

Work zone ITS technology is an emerging area that can provide the means to better monitor and manage traffic flow through and around work zones. Equipment used in work zones, such as portable camera systems, highway advisory radios, variable speed limits, ramp metering systems, and queue detection sensors, helps ensure a more efficient traffic flow with a positive impact on safety, mobility, access, and productivity.

Identify work zone ITS elements early in the strategy development process and include them in the preliminary estimate so they can be designed along with the other traffic control elements. For large mobility projects that have existing freeway cameras already in place, temporary ITS features (such as temporary poles and portable systems) may be necessary to ensure the network can be maintained during construction, especially if existing camera locations are in conflict with construction activities. In locations that do not have existing camera locations, but have significant construction projects planned, work zone ITS may be a good opportunity to bring ITS technology to the route.

Refer to Chapter 1050 and the work zone safety web page for additional ITS information and guidance.

1010.11 Traffic Control Plan Development and PS&E

WSDOT is obligated to provide a proposal in the PS&E for controlling traffic that is consistent with the project construction requirements. Even though there may be more than one workable solution, a thorough analysis of all the variables will help produce a TMP that addresses all impacts and establishes the appropriate levels of safety, mobility, and constructibility.

The preparation of traffic control plans (TCPs) requires the designer to not only have a thorough knowledge of highway construction activities, but also traffic engineering knowledge and an understanding of the unique traffic flow patterns within the specific project. Road users have little or no understanding of the construction occurring in the work zone and require far greater guidance than the contractor or agency personnel who are familiar with the project.

Traffic control plans can generally be broken down into three specific categories: typical, project-specific, and site-specific. The work zone location, ramps, intersections, access, and other site information will determine the level of detail necessary. Consider these categories for each work zone when developing TCPs.

TCPs are designed from the perspective of drivers, pedestrians, and bicyclists to provide the necessary information to assist them in navigating a work zone. Unexpected roadway conditions, changes in alignment, and temporary roadside obstacles relating to the work activity should be defined adequately to eliminate users' uncertainty. Keep in mind the construction workers' exposure to traffic as the traffic control plans are being developed.

It is recommended that multiple work operations be combined under a single traffic control plan to minimize the impacts to traffic and encourage the efficiency of the contractor. The intention is not to direct the contractor in how to pursue or perform the work, but to provide the most efficient approach to protect the work area and to establish the level of safety and traffic control while maintaining traffic mobility. A constructible and biddable set of traffic control plans is the goal. The contractor has the option of adopting the contract plans or proposing an alternative method.

(1) Traffic Control Plan Types

"Typical" traffic control plans are generic in nature and are not intended to satisfy all conditions for all work zones. They are adaptable to many roadway conditions and work operations. Use this type of plan if it can be applied with little or no field modification. Typical plans may be included in every project. The majority of the time, they will be used to supplement project- or site-specific plans, especially for a complex project. For projects with routine day-to-day operations, such as paving projects on a two-lane roadway, typical plans work well. Even "routine" projects may have some unique work that needs more specific plan development. As a starting point, use the typical plans located at: http://www.wsdot.wa.gov/design/standards/plansheet/tc.htm

A "project-specific" traffic control plan can be a typical plan that has been modified to include project-specific details such as side roads, business approaches, horizontal curves, and so on. A project-specific plan may also be drawn using existing base data, but may not necessarily be a scaled drawing. Project-specific plans are a good compromise between a typical plan with no specific detail and a scaled base data-developed plan, especially when base data may not be available.

"Site-specific" traffic control plans are drawn using scaled base data with scaled traffic control device placements to provide the highest level of accuracy. They ensure that the proposed work operation will actually fit the location and that a workable method to maintain traffic flow can be achieved. If properly designed, site-specific plans need very little field modification. The use of site-specific plans is the best approach to satisfy the intent of a TMP by addressing impacts clearly and completely with detailed plans. For complex work zones, draw the traffic control plans with site-specific base data.

Do not place typical plan-type details on scaled site-specific plans. An example of this would be to use a scaled site-specific base plan and draw typical plan generic "L" distance to represent the lane closure taper distance, with the distance to come from a data box based on the highway speed. Another example is construction signs at specific locations on the scaled plan with a typical "X" distance dimension representing sign spacing. These examples misrepresent where the tapers begin or end and the actual locations where signs will be placed in the field. Inspectors or contractors then have to make field decisions and revisions to the plans that should have been addressed during the design.

The following are types of TCPs and details to consider in addressing TMP strategies in the PS&E.

(a) **Temporary Channelization Plans**

Temporary channelization plans are site-specific TCPs for long-term work zones or staged traffic control. They show the station limits for the beginning and ending locations of the temporary markings and taper rates when applicable. These plans also show the type of markings (such as lane line or edge line) on the plan with enough detail to assist the field inspector with field layout. When applicable, these plans also include temporary concrete barrier locations, flare rates, beginning and ending stations, and attenuator information (among others).

(b) **Temporary Median Crossovers**

These are another type of temporary channelization plan. Geometrics for the crossovers need to follow the same guidance as permanent alignments, and they have horizontal curves calculated to fit the location. Paved roadway surfaces and temporary pavement markings are required. Consider temporary illumination to improve the visibility of the operation. Temporary drainage may be necessary under the median fill, when applicable.

(c) **Temporary Roadway Cross Sections**

These plan details can be invaluable in providing additional details not easily visible when looking at the plan view of a TCP, especially when the roadway is in a temporary shift or configuration. This is also an excellent way to identify roadway drop-off conditions and vertical clearance issues.

(d) **Temporary Pavement Marking Details**

Detail sheets can be helpful in providing the specific details necessary to explain marking installation needs to supplement temporary pavement marking special provisions.

(e) **Temporary Portable Signal Plan**

For projects that include temporary portable signal systems, a traffic control plan is required. Example projects would be alternating one-lane traffic operations on a two-way facility (such as two-lane bridge widening), replacement projects, or emergency slide repair. The plan must include the entire advance signing for the system, temporary markings, location in relation to work operation, temporary lighting at stop bars, and so on. Use a portable signal unit only for projects where the length between signal heads is 1,500 feet maximum and no other accesses lie in between the temporary signals. There are specific temporary signal requirements that go into a project; therefore, for assistance, contact the region Traffic Office.

(f) **Detour and Alternate Route Plan**

For projects that anticipate the need for a detour or alternate route, ensure that sign placement will fit the locations shown along the route and that the signs will not conflict with existing signs, driveways, or pedestrian movements. Additionally, placement of construction signing should not obstruct approach or intersection sight distance. Depending on the duration, the detour that will be in place, and the anticipated amount of traffic that will use the route, consider upgrades to the route (such as signal timing, intersection turning radius for large vehicle, structural pavement enhancements, or shoulder widening). Note: A signed detour agreement with the appropriate local agency is required for detour routes using local roadways and must be completed prior to project advertisement.

(g) **Pedestrian and Bike Detour Route**

When existing pedestrian and signed bike routes are disrupted due to construction activities, address detour routes with a traffic control plan. The plan must show enough detail and be specific enough to address the conflicts and ensure the temporary route is reasonably safe and adequate to meet the needs of the user. Also, consider the impacts to the transit stops for pedestrians: Will the bus stops be able to remain in use during construction or will adjustments be necessary? (See Chapter 1510 for pedestrian work zone design requirements.)

(h) **Advance Warning Sign Plan**

May be combined with the vicinity map or shown on a separate plan. Show Class A Construction Signs that will remain in place for the duration of the project. Locate the signs by either station or milepost. Verify the locations to avoid conflicts with existing signing or other roadway features. These locations may still be subject to movement in the field to fit specific conditions.

(i) **Construction Sign Specification Sheet**

Provide a Class A Construction Sign Specifications sheet on complex or staged projects. Include location, post information, and notes for *Standard Plans* or other specific sign information and sign details.

(j) **Quantity Tabulation Sheets**

Quantity Tabulation sheets are a good idea for barrier and attenuator items and temporary pavement markings on projects with large quantities of these items or for staged construction projects.

(k) **Traffic Control Plan Index**

An Index sheet is a useful tool for projects that contain a large quantity of traffic control plans and multiple work operations at various locations throughout the project. The Index sheet provides the contractor a quick referencing tool indicating the applicable traffic control plan for the specific work operation.

(2) Plans to Address TMP Strategies

The following are plans that often must be considered when addressing TMP strategies in the PS&E.

(a) **Construction Sequence Plans**

These plans are placed early in the plan set and are intended to show the proposed construction stages and the work required for each stage. They should refer to the corresponding TCPs for the traffic control details of each stage.

(b) **Temporary Signal Plan**

The temporary signal plan will follow conventions used to develop permanent signals (as described in Chapter 1330), but will be designed to accommodate temporary needs and work operations to ensure there will be no conflicts with construction operations. Ensure opposing left-turn clearances are maintained as described in Chapter 1310 if channelization has been temporarily revised, or adjust signal timing to accommodate. Some existing systems can be maintained using temporary span wires for signal heads and video, microwave actuation, or timed control.

(c) **Temporary Illumination Plan**

Full lighting is normally provided through traffic control areas where power is available. The temporary illumination plan will follow conventions used to develop permanent illumination (as described in Chapter 1040), but will be designed to accommodate temporary needs and work operations to ensure there will be no conflicts with construction operations.

(3) Contract Specifications

Work hour restrictions for lane closure operations are to be specifically identified for each project where traffic impacts are expected and liquidated damages need to be applied to the contract. Refer to the *Plans Preparation Manual* for additional information on writing traffic control specifications.

(4) Cost Estimating

Temporary traffic control devices and traffic control labor can be difficult to estimate. There is no way of knowing how many operations a contractor may implement at the same time. The best method is to follow the working day estimate schedule and the TCPs that will be used for each operation. Temporary signs and devices will be used on many plans, but the estimated quantity reflects the most used at any one time. To use the lump sum item to pay for all temporary traffic control, be certain how the contractor's work operations will progress and that the traffic control plans fully define the work zone expectations.

1010.12 Training and Resources

Work zone-related training is an important component in an effective work zone safety and mobility program. Federal regulations require that those involved with work zone design and implementation be trained at a level consistent with their responsibilities. It is valuable to know what training classes are available and how those classes relate to the project design and construction programs.

(1) Training Courses

There are many work zone-related courses available, and the HQ Staff Development Office and HQ Traffic Office's Traffic Training Program Manager can assist with the availability and scheduling of classes. Consider the following training courses to develop an overall proficiency in work zone safety and mobility design:

- **Work Zone Traffic Control Design Course:** This course, taught by the HQ Traffic Office, focuses on work zone safety and mobility through transportation management plan development and WZTC PS&E.
- **QuickZone Course:** This course, taught by McTrans, explores the QuickZone work zone traffic capacity analysis program. QuickZone is a useful tool for determining capacity needs, and it allows comparison of alternative strategies.
- **MUTCD Course:** This course, taught by Transpeed, focuses on the content and use of the MUTCD, including Part 6, Temporary Traffic Control.
- **Traffic Control Supervisor (TCS) Course:** This course, taught by the Evergreen Safety Council, NW Laborers Union, and ATSSA, is primarily for those students who intend to become a TCS or those who have TCS-related responsibilities. TCS training offers value to designers regarding how implementation issues interact with design issues. Designer attendance may be restricted to "space available" status.
- **Certified Flagger Training Course:** This course is directed at students who will become certified flaggers in Washington State and is not intended for designers. Designers may want to use the *Flagger Handbook* as a resource to learn about flagger-controlled traffic control and flagging techniques and issues. This class may be valuable for increasing the safety of designers anticipating extensive field surveying and data gathering work during the project development phase.

Other courses on work zone safety, mobility, and related subjects may be available on a limited basis. Some of these courses would fall into the categories of traffic analysis and traffic engineering and may be appropriate, depending on individual designer needs and responsibilities.

(2) Resources

The responsibility of the designer to fully address all work zone traffic control impacts is very important because the level of traffic safety and mobility will be directly affected by the effectiveness of the transportation management plan (TMP). The following resources are available to assist the designer with various aspects of the work zone design effort.

(a) Region Work Zone Resources

Each region has individuals and offices with various resources that provide work zone guidance and direction beyond what may be available at the project Design Office level. They include:

- Region Traffic Office
- Region Work Zone Specialist
- Region Construction and Design Offices

(b) Headquarters (HQ) Work Zone Resources

The HQ Traffic Office has a work zone team available to answer questions, provide information, or otherwise assist. The HQ Design and Construction offices may also be able to assist with some work zone issues. They include:

- State Work Zone Safety & Mobility Manager
- State Work Zone Engineer
- State Work Zone Training Specialist
- WSDOT Work Zone Web Page

(c) FHWA Work Zone Resources

The FHWA Washington Division Office and Headquarters (HQ) Office may be able to provide some additional information through the WSDOT HQ Traffic Office. The FHWA also has a work zone web page: www.ops.fhwa.dot.gov/wz/

1010.13 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

Use the following checklist to develop a formal TMP document on significant projects.

TMP Component	
1. Introductory Material	
Cover page	
Licensed Engineer stamp page (if necessary)	
Table of contents	
List of figures	
List of tables	
List of abbreviations and symbols	
Terminology	
2. Executive Summary	
3. TMP Roles and Responsibilities	
TMP manager	
Stakeholders/review committee	
Approval contact(s)	
TMP implementation task leaders (public information liaison, incident management coordinator)	
TMP monitors	
Emergency contacts	
4. Project Description	
Project background	
Project type	
Project area/corridor	
Project goals and constraints	
Proposed construction phasing/staging	
General schedule and timeline	
Adjacent projects	
5. Existing and Future Conditions	
Data collection and modeling approach	
Existing roadway characteristics (history, roadway classification, number of lanes, geometrics, urban/suburban/rural)	
Existing and historical traffic data (volumes, speed, capacity, volume-to-capacity ratio, percent trucks, queue length, peak traffic hours)	
Existing traffic operations (signal timing, traffic controls)	
Incident and crash data	
Local community and business concerns/issues	
Traffic growth rates (for future construction dates)	
Traffic predictions during construction (volume, delay, queue)	
6. Work Zone Impacts Assessment Report	
Qualitative summary of anticipated work zone impacts	
Impacts assessment of alternative project design and management strategies (in conjunction with each other)	
• Construction approach/phasing/staging strategies	
• Work zone impacts management strategies	

Transportation Management Plan Components Checklist
Exhibit 1010-3

Traffic analysis results (if applicable)	
• Traffic analysis strategies	
• Measures of effectiveness	
• Analysis tool selection methodology and justification	
• Analysis results	
Traffic (volume, capacity, delay, queue, noise)	
Safety	
Adequacy of detour routes	
Business/community impact	
Seasonal impacts	
Cost-effectiveness/evaluation of alternatives	
Selected alternative	
• Construction approach/phasing/staging strategy	
• Work zone impacts management strategies	
7. Selected Work Zone Impacts Management Strategies	
Temporary Traffic Control (TTC) strategies	
• Control strategies	
• Traffic control devices	
• Project coordination, contracting, and innovative construction strategies	
Public Information (PI)	
• Public awareness strategies	
• Motorist information strategies	
Transportation Operations (TO)	
• Demand management strategies	
• Corridor/network management strategies	
• Work zone safety management strategies	
• Traffic/incident management and enforcement strategies	
8. TMP Monitoring	
Monitoring requirements	
Evaluation report of successes and failures of TMP	
9. Contingency Plans	
Trigger points	
Decision tree	
Contractor's contingency plan	
Standby equipment or personnel	
10. TMP Implementation Costs	
Itemized costs	
Cost responsibilities/sharing opportunities	
Funding source(s)	
11. Special Considerations (as needed)	
12. Attachments (as needed)	

Transportation Management Plan Components Checklist
Exhibit 1010-3 (continued)

The HQ Bridge and Structures Office designs structure-mounted sign mountings, monotube sign bridges, and monotube cantilever sign supports. For overhead sign installation designs, provide sign dimensions, horizontal location in relation to the roadway, and location of the lighting fixtures to facilitate design of the mounting components by the HQ Bridge and Structures Office.

(1) Illumination

The retroreflectivity of currently approved sign sheeting removes the need to provide illumination for most sign installations. Ground-mounted signing, regardless of sign type or message content, does not require sign lighting for nighttime legibility. Only overhead-mounted signs with "EXIT ONLY" panels in noncontinuous illumination areas or overhead-mounted guide signs for left side exits in all areas are illuminated.

The sign lights for existing illuminated overhead and ground-mounted signs can only be de-energized and removed if the retroreflective sheeting is adequate for nighttime legibility. A nighttime assessment of all nonilluminated overhead signs within the project limits is required. Replace all signs that have inadequate retroreflectivity (contact the region Traffic Office). In situations where a nonhighway light source interferes with a sign's legibility, consider relocating the sign or providing sign lights.

Flashing beacon signs are used to alert motorists of unusual or unexpected driving conditions ahead. Sign lights are unnecessary on flashing beacon signs when appropriate sign sheeting, full circle or tunnel signal head visors, and automatic dimmer devices are used.

Overhead Sign Type	Continuous or Noncontinuous Illumination	Sign Lighting Required	Sheeting Type (Background)	Sheeting Type (Legend & Border)
EXIT ONLY guide sign	Continuous	No	IV*	VIII or IX
EXIT ONLY guide sign	Noncontinuous	Yes	II	III or IV
Guide signs for left side exits	Both	Yes	II	III or IV
Other guide signs	Both	No	III or IV	VIII or IX
Regulatory signs	Both	No	IV	n/a
Warning signs	Both	No	VIII or IX	n/a

*For Yellow Background Sheeting, use Type VIII or IX Fluorescent Sheeting.

Note:
Continuous (Full) Illumination is when light standards (luminaires) exist between interchanges.

Reflective Sheeting Requirements for Overhead Signs
Exhibit 1020-1

All other overhead signs are illuminated only when one of the following conditions is present:

- Sign visibility is less than 800 feet due to intervening sight obstructions such as highway structures or roadside features.
- Signs directly adjacent to other overhead signs have sign lights.

(2) Vertical Clearance

The minimum vertical clearance from the roadway surface to the lowest point of an overhead sign assembly is 17 feet 6 inches. The minimum vertical clearance from the roadway surface to the lowest point of an overhead sign assembly without sign light(s) is 19 feet 6 inches. The maximum clearance is 21 feet. Contact the HQ Traffic Office regarding signs under bridges and in tunnels.

(3) Horizontal Placement

Consider roadway geometrics and anticipated traffic characteristics when locating signs above the lane(s) to which they apply. Install advance guide signs and exit direction signs that require an EXIT ONLY and "down arrow" panel directly above the drop lanes. To reduce driver confusion about which lane is being dropped, avoid locating a sign with an EXIT ONLY panel on a horizontal curve.

(4) Service Walkways

Walkways are provided on structure-mounted signs, truss-type sign bridges, and truss-type cantilever sign supports where roadway and traffic conditions prohibit normal sign maintenance activities. Monotube sign bridges and cantilever sign supports normally do not have service walkways.

Vandalism of signs, particularly in the form of graffiti, can be a major problem in some areas. Vandals sometimes use the service walkways and vandalize the signs. Maintenance costs for cleaning or replacing the vandalized signs at these locations can exceed the benefit of providing the service walkway.

1020.05 State Highway Route Numbers

For state routes, RCW 47.36.095 authorizes WSDOT to sign state highways using a system of state route numbers assigned to eliminate duplication of numbers. This numbering system follows the system employed by the federal government in the assignment of Interstate and U.S. routes: odd numbers indicate general north-south routes and even numbers indicate general east-west routes.

1020.06 Mileposts

Milepost markers are a part of a statewide system for all state highways and are installed in accordance with Directive E 1064, "State Route Mileposts," and Chapter 2 of the *Traffic Manual*.

(18) Safety Rest Areas

Provide illumination within rest areas at the roadway diverge and merge sections, the walkways between parking areas and rest room buildings, and the parking areas the same as for a major parking lot (see Exhibit 1040-19).

(19) Chain-Up/Chain-Off Parking Areas

Provide the necessary number of luminaires to illuminate the design area of the chain-up/chain-off parking area (see Exhibit 1040-20).

(20) Tunnels

Long tunnels have a portal-to-portal length greater than the stopping sight distance. Provide both nighttime and daytime illumination for long tunnels. Consider illumination for short tunnels if the horizontal-to-vertical ratio is ≥ 10:1 (see Chapter 1260 and Exhibit 1040-21). Provide daytime security lighting in pedestrian tunnels.

(21) Bridge Inspection Lighting

Provide the necessary number of light fixtures <u>and electrical outlets</u> to illuminate the interior inspection areas of floating bridges, steel box girder bridges <u>and concrete box girder bridges where access is provided</u> (see Exhibit 1040-22). Coordinate bridge illumination requirements with the HQ Bridge and Structures Office.

(22) Same Direction Traffic Split Around an Obstruction

Provide the necessary number of light standards to illuminate the design area where traffic is split around an obstruction. This requirement applies to permanent and temporary same-direction split channelization. For temporary work zones, illuminate the obstruction for the duration of the traffic split (see Exhibit 1040-23).

(23) Overhead Sign Illumination

Provide sign lighting on overhead signs as discussed in Chapter 1020. Sign illumination is provided with sign lighting fixtures mounted directly below the sign. The light source of the fixture is an 85 watt induction lamp. Provide one <u>fixture per</u> sign with a width of 16 feet or less. For wider signs, provide two or more sign lights with a spacing not exceeding 16 feet. If two or more closely spaced signs are in the same vertical plane on the structure, consider the signs as one unit and use a uniform light fixture spacing for the entire width. Voltage drops can be significant when the electrical service is not nearby. In areas where an electrical power source is more than ½ mile away, utility company installation costs can be prohibitive. With justification, overhead sign illumination is not required where the power source is more than ½ mile away.

1040.06 Additional Illumination

At certain locations, additional illumination is desirable to provide better definition of nighttime driving conditions or to provide consistency with local agency goals and enhancement projects. For Improvement projects on state highways, additional illumination is considered under certain circumstances, which are listed in this section. Justify the additional illumination in the Design Documentation Package (DDP).

(1) Conditions for Additional Illumination

Following are some conditions used in making the decision to provide additional illumination:

(a) **Diminished Level of Service**

Diminished level of service is a mobility condition where the nighttime peak hour level of service is D or lower. To determine the level of service, use traffic volume counts taken during the evening peak hour. Peaking characteristics in urban areas are related to the time of day. Traffic counts taken in the summer between 4:30 p.m. and 7:30 a.m. may be used as nighttime volumes if adjustment factors for differences in seasonal traffic volumes are applied for November, December, and January.

(b) **Nighttime Collision Frequency**

This is when the number of nighttime collisions equals or exceeds the number of daytime collisions. An engineering study indicating that illumination will result in a reduction in nighttime collisions is required as justification. Consider the seasonal variations in lighting conditions when reviewing reported collisions. Collision reporting forms, using a specific time period to distinguish between "day" and "night," might not indicate the actual lighting conditions at the time of a collision. Consider the time of year when determining whether a collision occurred at nighttime. A collision occurring at 5:00 p.m. in July would be a daytime collision, but a collision occurring at the same time in December would be during the hours of darkness.

(c) **Nighttime Pedestrian Accident Locations (PALs)**

The mitigation of nighttime PALs requires different lighting strategies than vehicular collision locations. Provide light levels to emphasize crosswalks and adjacent sidewalks. Multilane highways with two-way left-turn lanes, in areas transitioning from rural land use to urban land use, or areas experiencing commercial growth or commercial redevelopment, are typically high-speed facilities with numerous road approaches and driveways. These approaches allow numerous vehicle entry and exit points and provide few crossing opportunities for pedestrians; consider additional illumination.

(2) Highways

Proposals to provide full (continuous) illumination require the approval of the State Traffic Engineer. Regions may choose to develop (regional or corridor-specific) system plans for providing full (continuous) illumination. The State Traffic Engineer's approval of a system plan will eliminate the need for a project-specific approval from the State Traffic Engineer.

The decision whether to provide full (continuous) illumination is to be made during the scoping stage and communicated to the designers as soon as possible.

(a) On the main line of full limited access highways, consider full (continuous) illumination if a diminished level of service exists and any two of the following conditions are satisfied:

5. **Intersections Channelized With Pavement Markings**

   The design area has two components: the intersection area and the approach areas. The intersection area is the area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks. The approach areas are the areas on the main roadway between the stopping point and where the left-turn lane is full width.

6. **Intersections With Raised Channelization**

   The design area has two components: the intersection area and the approach areas. The intersection area is the area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks. The approach areas are the areas on the main roadway between the stopping point and where the left-turn taper begins.

7. **Unchannelized Intersection**

   The area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks.

8. **Railroad Crossing**

   The roadway width from a point 50 feet on either side of the track (the approach side only for one-way roadways).

9. **Transit Loading Area**

   The lane width and length designated for loading.

10. **Major Parking Lot**

    The entire area designated for parking, including internal access lanes.

11. **Scale Platform at Weigh Site**

    The approach width from the beginning of the scale platform to the end of the platform.

12 **Inspection Area at Weigh Site**

    The area dedicated to inspection as agreed upon with the Washington State Patrol.

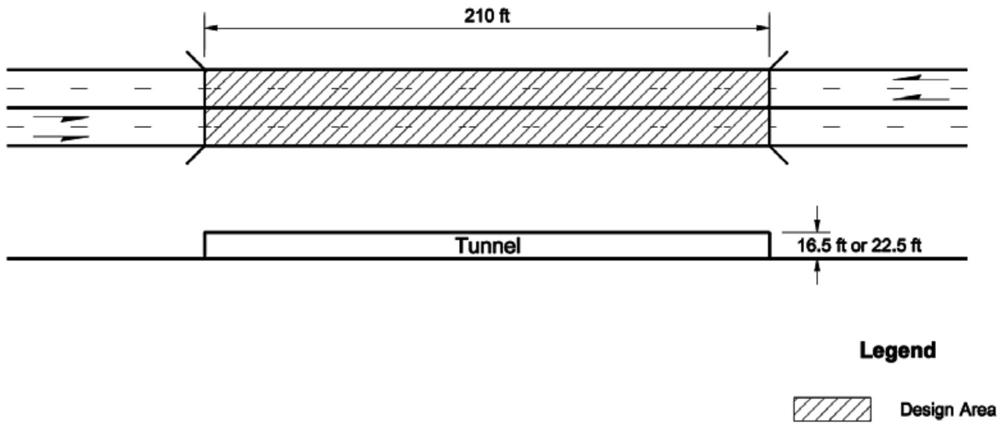
13. **Bridge Inspection Lighting System**

    Fixtures are to be ceiling mounted. <u>For steel box girder bridges, the spacing shall not be greater than the smaller of 4 times the web depth or 25 ft. For concrete box girder bridges, the spacing shall not be greater than the smaller of 8 times the web depth or 50 ft.</u> Illumination is to consists of a 100 watt incandescent (or fluorescent equivalent) fixture. Each fixture is to be designed with a 20 amp rated ground fault circuit interrupt (GFCI) receptacle. A light switch is needed at each entrance to any common inspection area. For inspection areas with two or more entrances, three-way or four-way switches are required.

(3) Daytime Light Levels for Tunnels and Underpasses

It is important to provide sufficient illumination inside a tunnel. When driving into and through a tunnel during the day, a driver's eyes have to adjust from a high light level (daylight) to a lower lighting level inside the tunnel. Motorists require sufficient time for their eyes to adapt to the lower light level of the tunnel itself. When sufficient lighting is not provided in the threshold, transition, or interior zones of a tunnel, a motorist's eyes may not have enough time to adapt and may experience a "black hole" or "blackout" effect. This "black hole" effect may cause a motorist to slow down, reducing the efficiency of the roadway. When leaving the tunnel, the driver's eyes have to adjust from a low lighting level back to daytime conditions. The full design considerations for tunnel lighting are covered in 1040.02 in the Supporting Information section. All designs for illuminating tunnels are to be reviewed and approved by the State Traffic Engineer.

- Long tunnels are divided into zones for the determination of daytime light levels. Each zone is equal in length to the pavement stopping sight distance. The entrance zone beginning point is a point outside the portal where the motorist's view is confined to the predominance of the darkened tunnel structure.
- The daytime entrance zone light level is dependent upon the brightness of the features within the motorists' view on the portal approach. The brightness level is defined as the average brightness measured over a 20° cone at a point 500 feet in advance of the portal. The entrance zone light level produced within the tunnel must be sufficient to provide a brightness level of approximately 5% of the measured portal brightness, after adjustment for the reflectivity of the roadway, walls, and ceiling. Design successive zones for a daytime light level of 5% of the previous zone light level to a minimum value of five footcandles. Requirements for nighttime light levels for long tunnels on continuously illuminated roadways are the same as the light level required on a roadway outside the tunnel. Provide illumination of fire protection equipment, alarm pull boxes, phones, and emergency exits in long tunnels. (See NFPA 502 for additional information.)
- A short tunnel or underpass has a length-to-vertical clearance ratio of 10:1 or less. Short tunnels and underpasses in rural areas or with low pedestrian usage normally do not have daytime illumination. Short tunnels and underpasses in urban areas with high pedestrian usage may require daytime and nighttime illumination. Consultation with the affected local agency is recommended. Short tunnels and underpasses with length-to-vertical clearance ratios greater than 10:1 are treated the same as an entrance zone on a long tunnel to establish daytime light levels. Short tunnels and underpasses where the exit portal is not visible from the entrance portal due to curvature of the roadway are to be considered long tunnels. Nighttime light level requirements for short tunnels on continuously illuminated roadways are the same as the light level required on the roadway outside the tunnel.



If tunnel length exceeds stopping sight distance, then it is classified as a long tunnel.

Example #1

- The stopping sight distance for a 30 mph roadway is 196.7’
- The tunnel length is 210’

196.7’ < 210’ – This would be a long tunnel.

Example #2

- The stopping sight distance for a 40 mph roadway is 300.6’
- The tunnel length is 210’

300.6’ > 210’ – This would be a short tunnel.

Determining whether a short tunnel needs illumination.

Example #1

- Vertical clearance is 16.5’
- Tunnel length is 210’

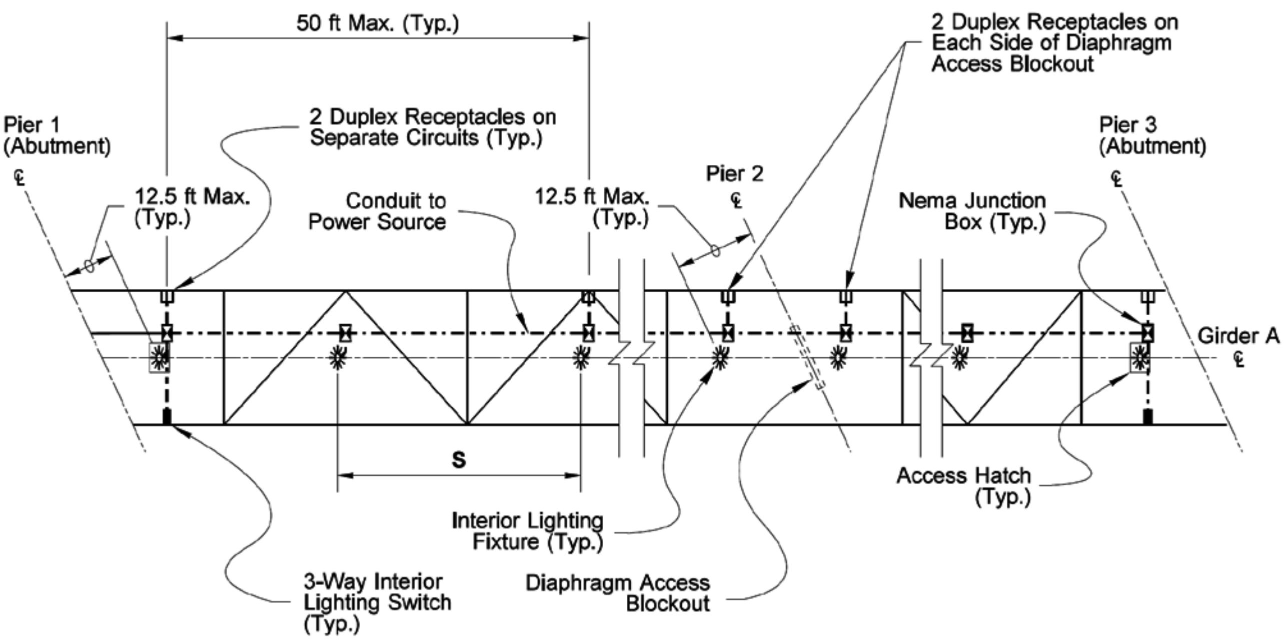
If horizontal-to-vertical ratio is 10:1 or greater, then illuminate.
210’ divided by 16.5’ = 12.7:1 ratio – This ratio exceeds the short tunnel horizontal-to-vertical ratio of 10:1, so this tunnel would need illumination—OR—How long can the tunnel be at a given height before it needs to be illuminated?
Tunnel height x maximum ratio factor of short tunnel (10:1 or less).
16.5’ x 10 = 165’
165’ < 210’ – This tunnel would need illumination.

Example #2

- Vertical clearance is 22.5’
- Tunnel length is 210’

If horizontal-to-vertical ratio is 10:1 or greater, then illuminate.
210’ divided by 22.5’ = 9.3:1 ratio – This ratio is less than the short tunnel horizontal-to-vertical ratio of 10:1, so this tunnel would not need illumination—OR—How long can the tunnel be at a given height before it needs to be illuminated?
Tunnel height x maximum ratio factor of short tunnel (10:1 or less).
22.5’ x 10 = 225’
225’ > 210’ – This tunnel would not need illumination.

Tunnel
Exhibit 1040-21



Note:
Maximum Lighting Fixture Spacing (S):

Steel Box Girder Bridge S = 4 x (WEBDEPTH) ≤ 25 FT
Concrete Box Girder Bridge S = 8 x (WEBDEPTH) ≤ 50 FT

Bridge Inspection Lighting System
Exhibit 1040-22

Washington State
Department of Transportation

Design Manual

Volume 2 – Design Criteria

M 22-01.09

July 2012

Division 11 – Project Design Criteria
Division 12 – Geometrics
Division 13 – Intersections and Interchanges
Division 14 – HOV and Transit
Division 15 – Pedestrian and Bicycle Facilities
Division 16 – Roadside Safety Elements
Division 17 – Roadside Facilities

Engineering and Regional Operations

Development Division, Design Office

Americans with Disabilities Act (ADA) Information

This material can be made available in an alternate format by e-mailing the Washington State Department of Transportation (WSDOT) Diversity/ADA Compliance Team at wsdotada@wsdot.wa.gov or by calling toll free, 855-362-4ADA (4232). Persons who are deaf or hard of hearing may make a request by calling the Washington State Relay at 711.

Title VI Notice to Public

It is WSDOT's policy to ensure no person shall, on the grounds of race, color, national origin, or sex, as provided by Title VI of the Civil Rights Act of 1964, be excluded from participation in, be denied the benefits of, or be otherwise discriminated against under any of its federally funded programs and activities. Any person who believes his/her Title VI protection has been violated may file a complaint with WSDOT's Office of Equal Opportunity (OEO). For Title VI complaint forms and advice, please contact OEO's Title VI Coordinator at 360-705-7082 or 509-324-6018.

To get the latest information on individual WSDOT publications, sign up for e-mail updates at:
www.wsdot.wa.gov/publications/manuals

Division 11 – Project Design Criteria

Division 13 – Intersections and Interchanges

Division 14 – HOV and Transit

Division 15 – Pedestrian and Bicycle Facilities

Division 17 – Roadside Facilities

1100.01 General

The *Design Manual* provides guidance for three levels of design for highway projects: basic, modified, and full design levels. The design matrices in this chapter are used to identify the design level(s) for a project and the associated processes for allowing design variances. The matrices address the majority of Preservation and Improvement projects and focus on those design elements that are of greatest concern in project development.

The design matrices are five tables that are identified by route type. Two of the matrices apply to Interstate highways; the other three apply to non-Interstate highways and address Preservation and Improvement projects.

A design matrix is used to determine the design level for the design elements of a project. Apply the appropriate design levels and document the design decisions as required by this chapter and Chapter 300.

1100.02 Selecting a Design Matrix

Selection of a design matrix (see Exhibit 1100-1) is based on highway system (Interstate, NHS excluding Interstate, and non-NHS) and location (main line and interchange).

Highway System	Location	
	Main Line	Interchange Area
Interstate	Matrix 1	Matrix 2
NHS*	Matrix 3	Matrix 4
Non-NHS	Matrix 5	Matrix 4

* Except Interstate.

Design Matrix Selection Guide
Exhibit 1100-1

(1) Interstate System

The Interstate System (Matrices 1 and 2) is a network of routes selected by the state and the FHWA under terms of the federal-aid acts. These routes are the principal arterials that are the most important to the economic welfare and defense of the United States. They connect, as directly as practicable, the following:

- Principal metropolitan areas and cities
- Industrial centers
- International border crossings

The Interstate System includes important routes into, through, and around urban areas; serves the national defense; and (where possible) connects with routes of continental importance. It also serves international and interstate travel and military movements.

The Interstate System is represented on the list of NHS highways (see http://wsdot.wa.gov/mapsdata/grdo_home.htm) with the letter "I" before the route number.

(2) National Highway System (NHS)

The National Highway System (Matrices 3 and 4) is an interconnected system of principal arterial routes and highways, including toll facilities, that serves the following:

- Major population centers
- International border crossings
- Industrial centers
- Ports
- Airports
- Public transportation facilities
- Other intermodal transportation facilities
- Other major travel destinations

The NHS includes the Interstate System and the Strategic Highway Corridor Network (STRAHNET) and its highway connectors to major military installations (Interstate and non-Interstate).

The NHS meets national defense requirements and serves international, interstate, and interregional travel (see http://wsdot.wa.gov/mapsdata/grdo_home.htm).

(3) Non-NHS Highways

The non-NHS highways (Matrices 4 and 5) are state routes that form a highway network that supplements the NHS system by providing for freight mobility and regional and interregional travel. Highways not included on the list of NHS routes are non-NHS highways.

1100.03 Using a Design Matrix

The design matrices and associated notes are shown in Exhibits 1100-2 through 1100-7. Follow *Design Manual* guidance for all projects except as noted in the design matrices (and elsewhere as applicable). The definitions presented in this chapter are meant to provide clarification of terminology used in the *Design Manual*. There is no assurance that these terms are used consistently in references outside the *Design Manual*.

(1) Project Type

For project types (such as unstable slopes) not listed in the design matrices, see *Design Manual* section 300.04 and consult the Headquarters (HQ) Design Office for guidance.

In the design matrices, row selection is based on Project Type. The Project Summary (see Chapter 300) defines the purpose and needs for the project and describes the project. For NHS and non-NHS routes (Matrices 3, 4, and 5), the project's program/subprogram might provide sufficient information to identify the Project Type. (See the *Programming Manual* for details about budget programs and subprograms.)

The various sources of funds for these subprograms carry eligibility requirements that the designers and project developers must identify and monitor throughout project development. This is especially important to ensure accuracy when writing agreements and to avoid delaying advertisement for bids if the Project Type changes.

Some projects involve work from several subprograms. In such cases, identify the various limits of the project that apply to each subprogram. Where the project limits overlap, apply the higher design level to the overlapping portion.

Project Types (in alphabetical order) are:

At Grade: Safety Improvement projects on NHS and non-NHS highways (45 mph or higher) to build grade-separation facilities that replace the existing intersections.

Bike Routes (Shldrs): Main line economic development Improvement projects to provide a statewide network of rural bicycle touring routes with shoulders a minimum of 4 feet wide.

Bike/Ped. Connectivity: Improvement projects to provide bicycle/pedestrian connections, along or across state highways within urban growth areas, to complete local networks.

Bridge Deck Rehab: Structures Preservation projects that repair delaminated bridge decks and add protective overlays to provide a sound, smooth surface, prevent further corrosion of the reinforcing steel, and preserve operational and structural integrity.

Bridge Rail Upgrades: Safety Improvement projects to update older bridge rails to improve strength and redirectional capabilities.

Bridge Repl. (Multilane): Non-NHS main line structures Preservation projects that replace bridges on multilane highways to improve operational and structural capacity.

Bridge Replacement: NHS and two-lane non-NHS (main line and interchange) structures Preservation projects that replace bridges to improve operational and structural capacity.

Bridge Restrictions: Main line economic development Improvement projects that remove vertical or load capacity restrictions to benefit the movement of commerce.

BST: Roadway Preservation projects that resurface highways at regular intervals.

Collision Analysis Locations (CALs), Collision Analysis Corridors (CACs), Intersection Analysis Locations (IALs): Sites identified through a system-wide analysis that have a high-severity collision history. These sites are created with the intent to modify, where appropriate, specific highway elements that are focused on addressing the contributing factors of the identified high-severity collisions. See WSDOT's Safety Management website for additional information:
http://wwwi.wsdot.wa.gov/planning/cpdmo/highwaysafetymanagement.htm

Corridor: Main line Improvement projects to reduce and prevent vehicular, nonmotorized, and pedestrian collisions (within available resources).

Diamond Grinding: Grinding a concrete pavement, using gang-mounted diamond saw blades, to remove surface wear or joint faulting.

Dowel Bar Retrofit: Reestablishing the load transfer efficiencies of the existing concrete joints and transverse cracks by cutting slots, placing epoxy-coated dowel bars, and placing high-early strength nonshrink concrete.

Four-Lane Trunk System: NHS economic development Improvement projects to complete contiguous four-lane limited access facilities on a trunk system consisting of all Freight and Goods Transportation Routes (FGTS) with a classification of 10,000,000 tons/year.

Freight & Goods (Frost Free): Main line economic development Improvement projects to reduce delay from weather-related closures on high-priority freight and goods highways.

Guardrail Upgrades: Safety Improvement projects limited to the specified roadside design elements. These projects focus on W-beam with 12-foot-6-inch spacing and on guardrail systems with concrete posts. The length of need is examined and minor adjustments are made. Removal is an option if guardrail is no longer needed.. For non-Interstate routes, additional length of more than 5% of the existing length is beyond the intent of this program. In these instances, consider funding in accordance with priority programming instructions and, if the length of need is not met, document to the Design Documentation Package (DDP) that the length of need is not addressed because it is beyond the intent of this program.

HMA Overlays: An HMA pavement overlay that is placed to minimize the aging effects and minor surface irregularities of the existing HMA pavement structure and to protect the public investment.

HOV: Main line mobility Improvement projects completing the freeway Core HOV lane system in the Puget Sound region and providing level of service C on HOV lanes (including business access transit lanes) within congested highway corridors. For Interstate see New/Reconstruction.

HOV Bypass: NHS and non-NHS ramp mobility Improvement projects to improve mobility within congested highway corridors by providing HOV bypass lanes on freeway ramps. Congested highway corridors have high congestion index values as described in the Highway System Plan (footnote in text for Improvement/Mobility). For Interstate see New/Reconstruction.

Intersection: Within available resources, Safety Improvement projects to reduce and prevent collisions, increase the safety of highways, and improve pedestrian safety.

Median Barrier: Limited safety Improvement projects: mainly new median barrier, with a focus on cable barrier, to reduce median crossover collisions.

Milling with HMA Inlays: Removing a specified thickness of the existing HMA pavement, typically from the traveled lanes, and then overlaying with HMA at the same specified thickness.

New/Reconstruction projects include the following types of work:

- Capacity changes: add a through lane, convert a general-purpose (GP) lane to a special-purpose lane (such as an HOV lane), or convert a high-occupancy vehicle (HOV) lane to GP.
- Other lane changes: add or eliminate a collector-distributor or auxiliary lane (a rural truck-climbing lane that, for its entire length, meets the warrants in Chapter 1270 is not considered new/reconstruction).
- New interchange.
- Changes in interchange type such as diamond to directional or adding a ramp.
- New or replacement bridge (on or over, main line or interchange ramp).
- New Safety Rest Areas Interstate.

Non-Interstate Freeway (mobility): On non-NHS and NHS interchanges and on NHS main line, these are mobility Improvement projects on multilane divided highways with limited access control within congested highway corridors.

Non-Interstate Freeway (safety): NHS and non-NHS (main line and interchanges) safety Improvement projects on multilane divided highways with limited access control to increase the safety within available resources.

PCCP Single Lane Rehab: Rehabilitation projects that removes a contiguous single lane of PCCP and replaces with PCCP in excess of ½ mile. Short sections of PCCP rehab should be considered preventative maintenance.

Preventive Maintenance: Includes roadway work such as pavement patching, crack sealing, restoration of drainage system, panel replacement, and joint and shoulder repair, and bridge work such as crack sealing, joint repair, slope stabilization, seismic retrofit, scour countermeasures, and painting. Preventive maintenance projects must not degrade any existing safety or geometric aspects of the facility. Any elements that will be reconstructed as part of a preventive maintenance project are to be addressed in accordance with full design level for NHS Routes and modified design level for non-NHS Routes.

Replace HMA w/PCCP at I/S (intersections): NHS and non-NHS main line roadway Preservation projects that restore existing safety features and replace existing HMA intersection pavement that has reached the point of lowest life cycle cost (11–15 years old) with PCCP that has about a 40-year life cycle.

Rest Areas (New): NHS and non-NHS main line economic development and safety Improvement projects to provide rest areas every 60 miles and some RV dump stations. For Interstate see New/Reconstruction.

Rural: Mobility Improvement projects providing uncongested level of service on rural highways within congested highway corridors. Congested highway corridors have high congestion index values as described in the Highway System Plan.

Urban: NHS and two-lane non-NHS (main line and interchange) mobility Improvement projects within congested urban highway corridors. Congested highway corridors have high congestion index values as described in the Highway System Plan.
Urban (multilane): Non-NHS mobility Improvement projects within congested urban multilane highway corridors. Congested highway corridors have high congestion index values as described in the Highway System Plan.

(2) Design Elements

The column headings on a design matrix are **Design Elements**. Not all potential design elements have been included in the matrices.

The design elements that are included are based on the following thirteen Federal Highway Administration (FHWA) controlling design criteria: design speed, lane width, shoulder width, bridge width, structural capacity, horizontal alignment, vertical alignment, grade, stopping sight distance, cross slope, superelevation, vertical clearance, and horizontal clearance. For the column headings, some of these controlling criteria have been combined (for example, design speed is part of horizontal and vertical alignment).

If addressing a design element that is not on the assigned matrix, use full design level as found elsewhere in this manual. With justification, on non-NHS routes, modified design level may be used.

If including a design element that is not covered in this manual, use an approved manual or guidance on the subject and document the decision and the basis for the decision.

The following elements are shown on the design matrices with references to chapters on those topics.

Horizontal Alignment: The horizontal attributes of the roadway, including horizontal curvature, superelevation, and stopping sight distance: all based on design speed. (See Chapter 1210 for horizontal alignment, Chapter 1250 for superelevation, Chapter 1260 for stopping sight distance, and Chapters 1140 or 1360 for design speed.)

Vertical Alignment: The vertical attributes of the roadway, including vertical curvature, profile grades, and stopping sight distance: all based on design speed. (See Chapter 1220 for vertical alignment, Chapters 1130, 1140, 1220, and 1360 for grades, Chapters 1130 and 1260 for stopping sight distance, and Chapters 1130, 1140, or 1360 for design speed.) **Lane Width:** Defined in Chapter 1140 (also see Chapters 1130, 1230, 1240, and 1360).

Shoulder Width: Defined in Chapter 1140 (also see Chapters 1130, 1230, and 1360). For shy distance requirements when barrier is present, see Chapter 1610.

Lane Transitions (pavement transitions): The rate and length of transition of changes in width of lanes (see Chapter 1210).

On/Off Connection: The widened portion of pavement at the end of a ramp connecting to a main lane of a freeway (see Chapter 1360).

Median Width: The distance between inside edge lines (see Chapters 1140 and 1230).

Cross Slope: Lane: The rate of elevation change across a lane. This element includes the algebraic difference in cross slope between adjacent lanes (see Chapters 1130 and 1230).

Cross Slope: Shoulder: The rate of elevation change across a shoulder (see Chapters 1130 and 1230).

Fill/Ditch Slopes: The downward slope from edge of shoulder to bottom of ditch or catch (see Chapters 1130 and 1230).

Access: The means of entering or leaving a public road, street, or highway with respect to abutting private property or another public road, street, or highway (see Chapters 520 and 1340).

Clear Zone: The total roadside border area, starting at the edge of the traveled way, available for use by errant vehicles. This area may consist of a shoulder, a recoverable slope, a nonrecoverable slope, and/or a clear run-out area. The median is part of a clear zone (see Chapter 1600).

Signing, Delineation, Illumination, ITS: Signs, guideposts, pavement markings, lighting, and intelligent transportation systems equipment. (See Chapters 720 for bridge signs and 1020 for signing, Chapter 1030 for delineation, Chapter 1040 for illumination, and Chapter 1050 for ITS.)

Vertical Clearance: Defined in Chapter 720.

Bicycle and Pedestrian: Defined in Chapter 1510, Pedestrian Design Considerations, Chapter 1515, Shared-Use Paths, and Chapter 1520, Roadway Bicycle Facilities.

Bridges: Lane Width: The width of a lane on a structure (see Chapters 720, 1130, 1140, 1230, 1240, and 1360).

Bridges: Shoulder Width: The distance between the edge of traveled way and the face of curb or barrier, whichever is less (see Chapters 720, 1130, 1140, 1230, and 1360; also see Chapter 1610 for shy distance requirements).

Bridges/Roadway: Vertical Clearance: The minimum height between the roadway, including shoulder, and an overhead obstruction (see Chapter 720).

Bridges: Structural Capacity: The load-bearing ability of a structure (see Chapter 720).

Intersections/Ramp Terminals: Turn Radii: Defined in Chapter 1310.

Intersections/Ramp Terminals: Angle: Defined in Chapters 1130 and 1310.

Intersections/Ramp Terminals: Intersection Sight Distance: Defined in Chapter 1310, Intersections at Grade, and Chapter 1360, Interchanges.

Barriers: Terminals and Transition Sections:

- Terminals: Crashworthy end treatments for longitudinal barriers that are designed to reduce the potential for spearing, vaulting, rolling, or excessive deceleration of impacting vehicles from either direction of travel. Impact attenuators are considered terminals. Beam guardrail terminals include anchorage.
- Transition Sections: Sections of barriers used to produce a gradual stiffening of a flexible or semirigid barrier as it connects to a more rigid barrier or fixed object (see Chapters 1600, 1610, and 1620).

Barriers: Standard Run: Guardrail and other barriers as shown in the *Standard Plans for Road, Bridge, and Municipal Construction*, excluding terminals, transitions, attenuators, and bridge rails (see Chapter 1610).

Barriers: Bridge Rail: Barrier on a bridge, excluding transitions (see Chapter 1610).

(3) Design Level

The design levels of basic, modified, and full (B, M, and F) were used to develop the design matrices. Each design level is based on the investment intended for the highway system and Project Type. (For example, the investment is greater for an Interstate overlay than for an overlay on a non-NHS route.)

(a) Blank Cell

A blank cell in a design matrix row signifies that the design element will not be addressed because it is beyond the scope of the typical project. In rare instances, a design element with a blank cell may be included if that element is linked to the original need that generated the project and is identified in the Project Summary or a Project Change Request Form.

(b) Basic Design Level (B)

Basic design level preserves pavement structures, extends pavement service life, and maintains safe highway operations. (See Chapter 1120 for design guidance.)

(c) **Modified Design Level (M)**

Modified design level preserves and improves existing roadway geometrics, safety, and operational elements. (See Chapter 1130 for design guidance.) Use full design level for design elements or portions of design elements that are not covered in Chapter 1130.

(d) **Full Design Level (F)**

Full design level improves roadway geometrics, safety, and operational elements. (See Chapter 1140 and other applicable *Design Manual* chapters for design guidance.)

(4) Safety Improvement Projects

In an effort to provide the greatest safety benefit with limited funding, it is WSDOT policy to focus highway safety project modifications on improvements that have the greatest potential to reduce severe or fatal injuries. The intent of this policy is to:

- Address the elements that are associated with severe-injury collision.
- Consider a range of solutions that include minor operational modifications, lower-cost improvements such as channelization, and higher-cost improvements such as, roundabouts, signalization, and widening.
- Recognize the substantial tradeoffs that must be made with the numerous competing needs and costs a highway designer faces in project development.

Because these projects are developed on a "substantive safety" basis, a matrix approach is not the most efficient method of scoping them. Conduct a collision data analysis to determine the contributing factors associated with the collisions. Once the contributing factors are identified, countermeasures should be identified that range from low cost to high cost. A benefit cost analysis should be completed to determine what countermeasure will be selected. Based on the selected countermeasure, determine and document those design elements and levels to be included in the project. See Safety Project Scoping process flowchart. The following documentation should be completed:

- Include an analysis of the collision history to identify contributing factors.
- Identify which of the 4 E's (Engineering, Enforcement, Education and Emergency Services) will best address the contributing factors, if Engineering solutions are selected to address the contributing factors, then consider countermeasures that include operational, low-cost, and high-cost solutions.
- Select the recommended countermeasure based on a benefit/cost analysis. Tools that are available for use in selecting recommended countermeasures include, HSM, Safety Analyst, Road Safety Assessments (RSA's), Interactive Highway Safety Design Model (IHSDM), and the Crash Modification Clearinghouse. New and other tools will be assessed for use as they become available.

Safety improvements may be implemented as a project focused on safety, as a minor part of a preservation project, or as a minor operational improvement.

- For I2-funded projects, see the Design Matrices.
- For spot improvements in P1, see Chapter 1120.
- For Q projects, see Chapter 1110.

(5) Design Variances

Types of design variances are design exceptions, evaluate upgrades, and deviations. (See Chapter 300 regarding the Design Variance Inventory System (DVIS).)

(a) **Design Exception (DE)**

A design exception in a matrix cell indicates that WSDOT has determined the design element is usually outside the scope of the Project Type. Therefore, an existing condition that does not meet or exceed the design level specified in the matrix may remain in place unless a need has been identified in the Highway System Plan and prioritized in accordance with the programming process. (See Chapter 300 regarding documentation.)

(b) **Evaluate Upgrade (EU)**

An evaluate upgrade in a matrix cell indicates that WSDOT has determined the design element is an item of work that is to be considered for inclusion in the project. For an existing element that does not meet or exceed the specified design level, an analysis is required to determine the impacts and cost-effectiveness of including the element in the project. The EU analysis must support the decision regarding whether or not to upgrade that element. (See Chapter 300 regarding documentation.)

(c) **Deviation**

A deviation is required when an existing or proposed design element differs from the specified design level for the project and neither DE nor EU processing is indicated. (See Chapter 300 regarding documentation.)

(d) **DE or EU with /F or /M**

DE or EU with /F or /M in a cell means that the design element is to be analyzed with respect to the specified design level. For instance, a DE/F is analyzed with respect to full design level and might be recorded as having an existing design element that does not meet or exceed current full design level. An EU/M is analyzed to decide whether or not to upgrade any existing design element that does not meet or exceed the current modified design level.

(6) Terminology in Notes

The **Access Control Tracking System** mentioned in note [3] in Design Matrices 3, 4, and 5 is a database list related to highway route numbers and mileposts. The database is available at: www.wsdot.wa.gov/design/accessandhearings. (See Chapter 520 for access control basics and Chapters 530 and 540 for limited and managed access, respectively.)

The **corridor or project analysis** mentioned in notes [2] and [4] in Design Matrices 3, 4, and 5 is the documentation needed to support a change in design level from the indicated design level and to support decisions to include, exclude, or modify design elements. The first step is to check for recommendations for future improvements in an approved route development plan or other approved study. If no approved plans or studies are available, an analysis can be based on route continuity and other existing features. (See Chapter 300 regarding documentation.) A project analysis is also used for multiple related design variances. Check with the HQ Design Office before using this approach. A corridor analysis is also used to establish design speed, as discussed in Chapters 1130 and 1140.

See the following pages for Design Matrices 1–5

⇩ Project Type	Main Line																Bridges			Barriers		
Design Elements ⇨	**Horizontal Alignment**	**Vertical Alignment**	**Lane Width**	**Shoulder Width [13]**	**On / Off Connection**	**Median Width**	**Cross Slope Lane**	**Cross Slope Shoulder**	**Fill / Ditch Slopes**	**Clear Zone**	**Signing [10]**	**Delineation [9]**	**Illumination & ITS**	**Basic Safety**	**Vertical Clear. [11]**	**Bike and Pedestrian**	**Lane Width**	**Shoulder Width**	**Structural Capacity**	**Term. & Trans. Section [12]**	**Standard Run**	**Bridge Rail [14] [19]**
(1-1) Preventative Maintenance																						
	Pavement Restoration																					
(1-2) Diamond Grinding/Dowel Bar Retrofit									[28]	[28]	[28]	[28]	[28]	B						F	[28]	F
(1-3) BST							[28]		[28]	[28]	[28]	[28]	[28]	B						F	[28]	F
(1-4) Milling with HMA Inlays							[28]		[28]	[28]	[28]	[28]	[28]	B						F	[28]	F
(1-5) HMA Overlays							[28]	[28]	[29]	[28]	[28]	[28]	[28]	B	F					F	F	F
(1-6) PCCP Single Lane Rehab							[28]	[28]	[29]	[28]	[28]	[28]	[28]	B	EU/F					F	F	F
	Bridge Rehabilitation																					
(1-7) Bridge Deck Rehabilitation												F			F				[11]	F[6]	F[22]	F
	Safety																					
(1-8) Median Barrier																				F[20]	F[20]	
(1-9) Bridge Rail Upgrades																				F	F[22]	F
(1-10) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures[27]																					
	Reconstruction [16]																					
(1-11) New / Reconstruction	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F

Design Matrix 1: Interstate Routes (Main Line)
Exhibit 1100-2

⇩ Project Type	Ramps and Collector Distributors															Ramp Terminals			Barriers			Crossroad								Barriers		
Design Elements ⇨	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width	Lane Transition	On / Off Connection	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Limited Access	Clear Zone	Sign., Delin., Illum., & ITS [9] [10]	Basic Safety	Vertical Clear. [11]	Bike and Pedestrian	Turn Radii	Angle	I/S Sight Distance	Term. & Trans. Section [12]	Standard Run	Bridge Rail [14] [19]	Lane Width	Shoulder Width	Fill / Ditch Slopes	Limited Access	Clear Zone	Sign., Delin., Illum. & ITS [10]	Vertical Clear. [11]	Bike and Pedestrian	Term. & Trans. Section [12]	Standard Run	Bridge Rail [14] [19]
(2-1) Preventative Maintenance																																
	Pavement Restoration																															
(2-2) Diamond Grinding/Dowel Bar Retrofit									[28]		[28]	[28]	B						F	[28]	F			[28]		[28]	[28]			F	[28]	F
(2-3) BST							[28]		[28]		[28]	[28]	B						F	[28]	F			[28]		[28]	[28]			F	[28]	F
(2-4) Milling With HMA Inlays							[28]		[28]		[28]	[28]	B		M				F	[28]	F			[28]		[28]	[28]		M	F	[28]	F
(2-5) HMA Overlays							[28]	[28]	[29]		[28]	[28]	B	F	M				F	F	F			[29]		[28]	[28]	EU/F	M	F	F	F
	Bridge Rehabilitation																															
(2-6) Bridge Deck Rehabilitation													B	F	M				F[6]	F[22]	F							F	M	F[6]	F[22]	F
	Safety																															
(2-7) Intersection			F	F	F				F	F	F	F			M	F	F	F	F	F	F	F	F	F	F	F	F	F	M	F	F	F
(2-8) Guardrail Upgrades											F								F	F[23]										F	F[23]	
(2-9) Bridge Rail Upgrades																			F	F[22]	F									F	F[22]	F
(2-10) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures[27]																															
	Reconstruction[16]																															
(2-11) New / Reconstruction	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F

Design Matrix 2: Interstate Interchange Areas
Exhibit 1100-3

⇩ Project Type	Main Line															Bridges[11]				Intersections			Barriers		
Design Elements ⇨	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width	Lane Transition	On / Off Connection	Median Width	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Access [3]	Clear Zone [18]	Sign., Del., Illum., & ITS	Basic Safety	Bike & Ped.	Lane Width	Shoulder Width	Vertical Clearance	Structural Capacity	Turn Radii	Angle	I/S Sight Distance	Term. & Trans. Section [12]	Standard Run	Bridge Rail [14] [19]
(3-1) Preventative Maintenance																									
Preservation																									
Roadway																									
(3-2) BST								[28]		[28]		[28]	[28]	B								[28]	F	[28]	F
(3-3) Milling With HMA Inlays								[28]		[28]		[28]	[28]	B	M							[28]	F	[28]	F
(3-4) HMA Overlays								[28]		[28]		[28]	[28]	B	M			EU/F				[28]	F	[28]	F
(3-5) Replace HMA w/PCCP at I/S			EU/M	EU/M	EU/F			EU/M	EU/M	[28]		[28]	[28]	B	M			F		EU/F	EU/F	[28]	F	[28]	F
Structures																									
(3-6) Bridge Replacement	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F[2]		F	F		F	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(3-7) Bridge Deck Rehab.												[28]	[28]	B	M			F	[11]			[28]	F[6]	F[22]	F
Improvements[16]																									
Mobility																									
(3-8) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F
(3-9) Urban	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(3-10) Rural	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(3-11) HOV	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(3-12) Bike/Ped. Connectivity [5]			F[2]	F[2]											F	F[2]	F[2]								
Safety																									
(3-13) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F
(3-14) Intersection[1]			F[2]	F[2]	F					F[2]	F	F	F		M					F	F	F	F	F	F
(3-15) Corridor[1][24]	M[4]	M[4]	M[4]	M[4]	F	F[17]	M[4]	M[4]	M[4]	M[4]	F	F	F		F	M[4]	M[4]	F		M[4]	M[4]	F	F	F	F
(3-16) Median Barrier				DE/F																			F[20]	F[20]	
(3-17) Guardrail Upgrades				DE/F																			F	F[23]	
(3-18) Bridge Rail Upgrades																							F	F[22]	F
(3-19) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures[27]																								
Economic Development																									
(3-20) Freight & Goods (Frost Free)[8]	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F[2]	EU/F	F	F		EU/F[26]	DE/F	DE/F	F	F	EU/F	EU/F	EU/F	F	F	F
(3-21) Four-Lane Trunk System	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F
(3-22) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F		F	F	F	F	F	F
(3-23) Bridge Restrictions	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F[2]		F	F		EU/F[26]	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(3-24) Bike Routes (Shldrs)			EU/M	[7]	EU/F				EU/M	EU/M		[28]	[28]	B	F	EU/M	EU/M	F				[28]	F	[28]	EU/F

Design Matrix 3: Main Line NHS Routes (Except Interstate)
Exhibit 1100-4

⇩ Project Type	Ramps and Collector-Distributors																			Crossroad											
														Ramp Terminals			Barriers												Barriers		
Design Elements ⇨	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width	Lane Transition	On / Off Connection	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Access [3]	Clear Zone	Sign., Del., Illum., & ITS	Basic Safety	Bike & Ped	Turn Radii	Angle	I/S Sight Distance	Term. & Trans. Section [12]	Standard Run	Bridge Rail [14] [19]	Lane Width	Shoulder Width	Fill / Ditch Slopes	Access [3]	Clear Zone	Sign., Del., Illum., & ITS	Basic Safety	Vertical Clearance [11]	Ped. & Bike	Term. & Trans. Section [12]	Standard Run	Bridge Rail [14] [19]
(4-1) Preventative Maintenance																															
Preservation																															
Roadway																															
(4-2) BST							[28]		[28]		[28]	[28]	B				[28]	F	[28]	F					[28]	[28]	B			F	[28]	F
(4-3) Milling with HMA Inlays							[28]		[28]		[28]	[28]	B	M			[28]	F	[28]	F					[28]	[28]	B		M	F	[28]	F
(4-4) HMA Overlays							[28]		[28]		[28]	[28]	B	M			[28]	F	[28]	F					[28]	[28]	B	EU	M	F	[28]	F
Structures																															
(4-5) Bridge Replacement	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F	F	F	F	F	F	F[2]	F[2]	F[2]	F	F	F		F	F	F	F	F
(4-6) Bridge Deck Rehab.											[28]	[28]	B	M			[28]	F[6]	F[22]	F					[28]	[28]	B	F	M	F[6]	F[22]	F
Improvements[16]																															
Mobility																															
(4-7) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F	F	F
(4-8) Urban	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F	F	F[2]	F[2]	F[2]	F	F	F		F	F	F	F	F
(4-9) Rural	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F	F	F[2]	F[2]	F[2]	F	F	F		F	F	F	F	F
(4-10) HOV Bypass	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F	F	F[2]	F[2]	F[2]	F	F	F		F	F	F	F	F
(4-11) Bike/Ped. Connectivity [5]			F[2]	F[2]										F							F[2]	F[2]							F			
Safety																															
(4-12) Non-Interstate Freeway	F	F	F	F	F	F	F	F	F	F	F	F		M	F	F	F	F	F	F	F	F	F	F	F	F		F	M	F	F	F
(4-13) At Grade[1][25]	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	F	F	F[2]	F[2]	F[2]	F	F	F		F	F	F	F	F
(4-14) Intersection[1]			F[2]	F[2]	F				F[2]	F	F	F		M	F	F	F	F	F	F			F[2]	F	F	F		F	M	F	F	F
(4-15) Guardrail Upgrades				DE/F														F	F[23]											F	F[23]	
(4-16) Bridge Rail Upgrades																														F	F[22]	F
(4-17) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures[27]																														
Economic Development																															
(4-18) Four-Lane Trunk System	F	F	F	F	F	F	F	F	F	F	F	F			F		F	F	F	F	F	F	F	F	F	F		F		F	F	F

Design Matrix 4: Interchange Areas, NHS (Except Interstate), and Non-NHS
Exhibit 1100-5

⇩ Project Type	Main Line														Bridges[11]				Intersections			Barriers		
Design Elements ⇨	Horizontal Alignment	Vertical Alignment	Lane Width	Shoulder Width	Lane Transition	Median Width	Cross Slope Lane	Cross Slope Shoulder	Fill / Ditch Slopes	Access [3]	Clear Zone [18]	Sign., Del., Illum., & ITS	Basic Safety	Bike & Ped.	Lane Width	Shoulder Width	Vertical Clearance	Structural Capacity	Turn Radii	Angle	I/S Sight Distance	Term. & Trans. Section [12]	Standard Run	Bridge Rail [19]
(5-1) Preventative Maintenance																								
Preservation																								
Roadway																								
(5-2) BST							[28]		[28]		[28]	[28]	B								[28]	F	[28]	F
(5-3) Milling with HMA Inlays							[28]		[28]		[28]	[28]	B	M							[28]	F	[28]	F
(5-4) HMA Overlays							[28]		[28]		[28]	[28]	B	M			EU/F				[28]	F	[28]	F
(5-5) Replace HMA w/PCCP at I/S			EU/M	EU/M	EU/F		EU/M	EU/M	[28]		F	[28]	B	M			F		EU/F	EU/F	[28]	F	F	F
Structures																								
(5-6) Bridge Replacement	M	F	M	M	F		M	M	M		F	F		F	F[2]	F[2]	F	F	M	M	F	F	F	F
(5-7) Bridge Repl. (Multilane)	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]		F	F		F	F[2]	F[2]	F	F	F[2]	F[2]	F	F	F	F
(5-8) Bridge Deck Rehab.												[28]	B	M				[11]			[28]	F[6]	F[22]	F
Improvements[16]																								
Mobility																								
(5-9) Urban (Multilane)	F[2]	F[2]	F[2]	F[2]	F	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F	F	EU/F	EU/F	F	F	F	F
(5-10) Urban	M	M	M	M	F		M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-11) Rural	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-12) HOV	M	M	M	M	F	M	M	M	M	F	F	F		F	M	M	F	F	EU/M	EU/M	F	F	F	F
(5-13) Bike/Ped. Connectivity [5]			F[2]	F[2]										F	F[2]	F[2]								
Safety																								
(5-14) Non-Interstate Freeway	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F[2]	F	F	F		F	F[2]	F[2]	F		F[2]	F[2]	F	F	F	F
(5-15) Intersection[1]			M[4]	M[4]	F				M[4]	F	F	F		M					M[4]	M[4]	F	F	F	F
(5-16) Corridor[1][24]	M[4]	M[4]	M[4]	M[4]	F	M[4]	M[4]	M[4]	M[4]	F	F	F		M	M[4]	M[4]	F		M[4]	M[4]	F	F	F	F
(5-17) Median Barrier				DE/F																		F[20]	F[20]	
(5-18) Guardrail Upgrades				DE/F																		F	F[23]	
(5-19) Bridge Rail Upgrades																						F	F[22]	F
(5-20) CAL/CAC/IAL	Design Elements determined based on identified Counter Measures[27]																							
Economic Development																								
(5-21) Freight & Goods (Frost Free)[8]	EU/M	EU/M	EU/M	EU/M	EU/M	EU/M	M	M	EU/M		F	[28]	B	EU/F[26]	DE/M	DE/M	F		EU/M	EU/M	EU/F	F	[28]	F
(5-22) Rest Areas (New)	F	F	F	F	F	F	F	F	F	F	F	F		F	F	F			F	F	F	F	F	F
(5-23) Bridge Restrictions	M	F	M	M	F	M	M	M	M		F	F		EU/F[26]	M	M	F	F	M	M	F	F	F	F
(5-24) Bike Routes (Shldrs)			EU/M	[7]	EU/F			EU/M	EU/M		[28]	[28]	B	F	EU/M	EU/M					[28]	F	[28]	EU/F

Design Matrix 5: Main Line Non-NHS Routes

Exhibit 1100-6

Design Matrix Notes:

☐ A blank cell indicates that the element is not applicable.
B Basic Design Level (see Chapter 1120).
F Full design level (see Chapter 1140).
M Modified design level (see Chapter 1130).
DE Design Exception to design level indicated.
EU Evaluate Upgrade to design level indicated.

[1] Collision Reduction or Collision Prevention (At-Grade Removal, Signalization & Channelization). Specific deficiencies that created the project must be upgraded to design level as stated in the matrix.
[2] Modified design level may apply based on a corridor or project analysis (see 1100.03(6)).
[3] If designated as L/A acquired in the Access Control Tracking System, limited access requirements apply. If not, managed access applies (see 1100.03(6)).
[4] Full design level may apply based on a corridor or project analysis (see 1100.03(6)).
[5] For bike/pedestrian design, see Chapters 1510, 1515, and 1520.
[6] Applies only to bridge end terminals and transition sections.
[7] 4-ft minimum shoulders.
[8] If all-weather structure can be achieved with spot digouts and overlay, modified design level applies to NHS highways and basic design level applies to non-NHS highways.
[9] Continuous shoulder rumble strips required in rural areas (see Chapter 1600).
[10] See Chapter 1020.
[11] See Chapter 720.
[12] Impact attenuators are considered as terminals.
[13] See Chapters 1140 and 1230.
[14] Includes crossroad bridge rail (see Chapter 1610).
[16] For design elements not in the matrix headings, apply full design level as found in the applicable chapters and see 1100.03(2). Document with an evaluate upgrade.
[17] DE for existing acceleration/deceleration lanes when length meets posted freeway speed and no significant crash history (see Chapter 1360).
[18] On managed access highways within the limits of incorporated cities and towns, city and county design standards apply to areas outside the curb or outside the paved shoulder where no curb exists.
[19] The funding sources for bridge rail are a function of the length of the bridge. Consult programming personnel.
[20] Applies to median elements only.
[22] Upgrade barrier, if necessary, within 200 ft of the end of the bridge.
[23] See description of Guardrail Upgrades Project Type, 1100.03(1), regarding length of need.
[24] Apply full design level to projects that realign or reconstruct significant portions of the alignment.
[25] For impacts to the main line, use the Project Type row for Safety, Non-Interstate Freeway on Matrix 3 for NHS and on Matrix 5 for non-NHS.
[26] Sidewalk ramps must be addressed for ADA compliance (see Chapter 1510).
[27] Collision Analysis Locations (CALs), Collision Analysis Corridors (CACs), and Intersection Analysis Locations (IALs) require a collision data analysis to identify the contributing factors to the crashes from which counter measures will be identified to reduce the frequency and severity of the collisions. See Safety Project Scoping process flowchart.
[28] See 1120 Basic Design Level, for further information.
[29] EU for Fill and Ditch foreslopes steeper than 4:1. Addressing of the back slope or slopes protected by barrier is not required.

Design Matrix Notes
Exhibit 1100-7

Chapter 1110 Minor Operational Enhancement Projects

1110.01 General

This chapter complements Chapter 1100 by providing guidance for development of minor operational enhancement projects. Do not use this chapter to develop Preservation or Improvement projects. Refer to Chapter 1100 for guidance in development of Preservation and Improvement projects and also for projects initiated by local agencies or developers. The minor operational enhancement matrices contained in this chapter identify the design level(s) for a project, the associated approval level, and the documentation requirements for the most common minor operational enhancement projects. The matrices focus on the various elements of greatest concern during project development.

Minor enhancement projects are categorized as low-cost enhancements to improve the operational safety and efficiency of the highway system. These enhancements are most often installed by state forces through work orders, but may be accomplished through a stand-alone state contract funded entirely through the Q Program; a Q Program-funded bid item within a larger Improvement project; a change order to an existing state contract; or agreements with local agencies. An important characteristic of these projects is the ability to quickly develop and implement them without a cumbersome approval process. Balanced with this is a need to apply consistency in design policies and guidelines in the development and approval processes. Therefore, the intent of this chapter is to clarify the design guidelines and documentation requirements for minor operational enhancement projects without unduly impeding the process.

The objective of the Q Program is to maximize highway transportation system safety and efficiency through a statewide program focused on the WSDOT business function for "Traffic Operations." It is the smallest of the four major highway programs that comprise the Highway System Plan (Improvement, Maintenance, Preservation, and Traffic Operations). Elements within the Q Program include:

- Q1 – Traffic Operations Program Management
- Q2 – Traffic Operations Program Operations
- Q3 – Special Advanced Technology Projects

This chapter is intended to guide the development of projects in the Low-Cost Enhancements subcategory within the Q2 program. Large capital Improvement projects developed for the Q3 subprogram are beyond the scope and intent of this chapter. Normally, these projects are developed using *Design Manual* guidelines for Preservation and Improvement projects. Consult the Headquarters (HQ) Traffic Operations Office for guidance when designing Q3 subprogram projects.

The minor operational enhancement matrices consist of three tables and are identified by route type. One of the matrices applies to Interstate and NHS freeways, one applies to NHS nonfreeway routes, and the third matrix applies to non-NHS routes.

1110.02 References

(1) Federal/State Laws and Codes

Revised Code of Washington (RCW) 47.28.030, Contracts – State forces – Monetary limits – Small businesses, minority, and women contractors – Rules

(2) Supporting Information

Chart of Accounts, M 13-02, WSDOT

1110.03 Definitions

National Highway System (NHS) For the definition and a list of specific routes on the NHS, see: http://wsdot.wa.gov/mapsdata/grdo_home.htm

freeway Applies to multilane divided highways with full access control.

minor operational enhancement projects These projects usually originate from the Q2 component of the Q Program and are quick responses to implement low-cost improvements. They are typically narrow in scope and focus on improvements to traffic operations and modifications to traffic control devices. Guidance on the type of work included in the Q subprograms is in the *Chart of Accounts*.

(1) Project Types

Minor operational and enhancement project types include the following:

(a) **Regulatory Projects**

Regulatory projects include actions undertaken to manage or regulate traffic conflict, movement, and use of the roadway. Potential projects in this category include revisions to speed limits, parking restrictions, turn restrictions, truck restrictions, signal operations, unsignalized intersection control, intersection lane-use control, ramp meters, no-passing zones, crosswalks, special traffic control schemes, and lane use restrictions.

(b) **Driver Guidance Projects**

Driver guidance projects are actions to improve driver guidance, clarify options, or reduce hazards in the roadway setting. Potential projects include informational signs, warning signs, lighting and supplemental illumination, supplemental delineation, glare screen, signals, roadside guidance, and Intelligent Transportation Systems (ITS)

(b) **Ramps**

Sight Distance: Any combination of horizontal and vertical stopping sight distance, decision sight distance, and intersection sight distance. (See Chapters 1260 and 1310 for definitions and guidance.)

Lane Width: The lane width for ramp alignments. (See Lane Width definition in Chapter 1100.)

Lane Transition: The lane transition applied to a ramp alignment. (See definition for Lane Transitions in Chapter 1100; also see Chapter 1360.)

Shoulder Width: The shoulder width for a ramp alignment. (See Shoulder Width definition in Chapter 1100.)

Fill/Ditch Slopes: The fill/ditch slope along a ramp alignment. (See Fill/Ditch Slope definition in Chapter 1100.)

Clear Zone: The clear zone along a ramp alignment. (See Clear Zone definition in Chapter 1100.)

(c) **Ramp Terminals or Intersections**

Turn Radii: Definition is in Chapter 1310.

Angle: Definition is in Chapter 1310.

Sight Distance: Definition is in Chapter 1310.

(d) **Crossroads at Ramps**

Lane Width: The lane width on a crossing alignment intersected by a ramp. (See Lane Width definition in Chapter 1100.)

Shoulder Width: The shoulder width on a crossing alignment intersected by a ramp. (See Shoulder Width definition in Chapters 1100 and 1140.)

Pedestrian and Bike: The facilities on a crossing alignment intersected by a ramp for accommodation of pedestrians and/or bicycles. (See Chapter 1510 for pedestrian design and Chapter 1520 for bicycles.)

Fill/Ditch Slopes: The fill/ditch slope along a crossroad intersected by a ramp. (See Fill/Ditch Slope definition in Chapter 1100.)

Clear Zone: The clear zone along a crossroad intersected by a ramp. (See Clear Zone definition in Chapter 1100.)

(e) **Barriers All**

Terminals and Transition Sections: Definition is in Chapter 1100.

Standard Run: Definition is in Chapter 1100.

(f) **Ped & Bike**

Pedestrian and Bike: The facilities along a route for accommodation of pedestrians and bicycles. (See Chapter 1510 for pedestrian design and Chapter 1520 for bicycles.)

1110.04 Minor Operational Enhancement Matrix Procedures

During Project Definition and design, the following steps are used to select and apply the appropriate *minor operational enhancement matrix*. Each step is further explained in this chapter.

- Select a *minor operational enhancement matrix* by identifying the route: Interstate/NHS Freeway, NHS Nonfreeway, or Non-NHS.
- Within the minor operational enhancement matrix, select the *row* by the type of work.
- Use the minor operational enhancement matrix to determine the *documentation and approval levels* for the various design elements in the project. Apply the appropriate design levels, and document the design decisions as required by this chapter and Chapter 300.

1110.05 Selecting a Minor Operational Enhancement Matrix

Selection of a minor operational enhancement matrix is based on the highway system: Interstate/NHS Freeway, NHS Nonfreeway, Non-NHS (see Exhibit 1110-1). For a list of the NHS and Interstate routes in Washington, see: http://wsdot.wa.gov/mapsdata/grdo_home.htm. The minor operational enhancement matrices are shown in Exhibits 1110-2 through 1110-4. Follow *Design Manual* guidance for all projects except as noted in the minor operational enhancement matrices.

Route	Project	
	Freeway	Nonfreeway
Interstate	Matrix 1	
NHS	Matrix 1	Matrix 2
Non-NHS	Matrix 1	Matrix 3

Minor Operational Enhancement Matrix Selection Guide
Exhibit 1110-1

1110.06 Project Type

Row selection in the design matrices is based on project type or type of work (see 1110.03(1)). For projects not listed in the matrices, consult the HQ Traffic Office and the HQ Design Office.

Some projects might include work from several project types. In such cases, identify the design and approval level for each project element. In all cases, select the higher design level and approval level where overlaps are found.

1110.07 Using a Minor Operational Enhancement Matrix

The column headings on a minor operational enhancement matrix are design elements. They are based on the following 13 Federal Highway Administration (FHWA) controlling design criteria: design speed, lane width, shoulder width, bridge width, structural capacity, horizontal alignment, vertical alignment, grade, stopping sight distance, cross slope, superelevation, vertical clearance, and horizontal clearance. For the column headings, some of the controlling criteria are combined (for example, design speed is part of horizontal and vertical alignment).

Chapter 1120 Basic Design Level

1120.01 General

Basic design level (B) preserves pavement structures, extends pavement service life, and restores the roadway for reasonably safe operations, which may include safety enhancements. Flexibility is provided so that other enhancements may be made while remaining within the scope of pavement preservation work.

The basic safety items of work listed in this chapter may be programmed under a separate project from the paving project as long as:

- There is some benefit to the delay.
- The safety features remain functional.
- The safety work planning is coordinated with the Capital Program Development and Management Office, in accordance with programming instructions and region strategies
- A separate project file is maintained that addresses the separation of work and the planned delivery of the future project. Specify the project delivery plans for the basic safety project in the Design Documentation Package.

The basic safety work can be accomplished separately using a corridor-by-corridor approach. If a standalone basic safety project is developed it shall include the design elements in the original matrix from which this work was deferred.

Each project should complete a GIS map with Roadside Features Inventory (RFIP) data and collisions plotted on it to assist with the identification of the following basic safety work.

1120.02 Basic Safety

For basic design level, include the following items of work:

- Install and replace delineation in accordance with Chapter 1030.
- Install and replace rumble strips in accordance with the design matrices (see Chapters 1100 and 1600).
- Adjust existing features (such as monuments, catch basins, and access covers) that are affected by resurfacing.
- Adjust existing standard run of barriers, including guardrail height, in accordance with Chapter 1610.
- Replace signing as needed; this does not include replacement of sign bridges or cantilever supports. Refer to Chapter 1020 for design guidance.

- Relocate, protect, or provide breakaway features for sign supports, luminaires, WSDOT electrical service poles, and other intelligent transportation systems (ITS) equipment inside the Design Clear Zone. Consult with the region Traffic Engineer and review the WSDOT ITS plan to determine the specific ITS devices within the project limits and the requirements for each project (see Chapters 1020, 1040, 1050, and 1330).
- Restore sight distance at public road intersections and the inside of curves through low-cost measures (when available) such as removal or relocation of signs and other obstructions or cutting of vegetative matter (see Chapter 1310).
- Upgrade bridge rail in accordance with the matrices and Chapter 1610.
- Upgrade barrier terminals and bridge end protection, including transitions, in accordance with Chapter 1610.
- Restore the cross slope to 1.5% when the existing cross slope is flatter than 1.5% and the steeper slope is needed to provide adequate highway runoff in areas of intense rainfall (see Chapter 1230).
- Remove the rigid top rail and brace rails from Type 1 and Type 6 chain link fence and retrofit with a tension wire design (see Chapter 560).

1120.03 Minor Safety and Minor Preservation Work

Consider the following items, where appropriate, within the limits of a pavement Preservation project:

- Spot safety enhancements, which are modifications to isolated roadway or roadside features that, in the engineer's judgment, reduce potential collision frequency and/or severity. Use the Roadside Features Inventory Program (RFIP) data, GIS mapping with collisions plotted on them, and SafetyAnalyst AASHTOWare to assist with the identification of spot safety locations for consideration.
- When recommended by the region Traffic Engineer, additional or improved channelization to address intersection-related safety concerns, where sufficient pavement width and structural adequacy exist or can be obtained. With justification, which addressees the impacts to all roadway users, channelization improvements may be implemented, with lane and shoulder widths no less than the design criteria specified in the "Rechannelize Existing Pavement projects" section in Chapter 1110. Consider illumination of these improvements. Document decisions when full illumination is not provided, including an analysis of the frequency and severity of nighttime collisions.
- Roadside safety hardware (such as guardrail, signposts, and impact attenuators).
- Addressing Location 1 Utility Objects in accordance with the *Utilities Accommodation Policy*.
- Consider the addition of traffic signal control, illumination, and intelligent transportation systems (ITS) equipment. Consult with the region Traffic Engineer and review the WSDOT ITS plan to determine the specific requirements for each project (see Chapters 1040, 1050, and 1330).

To maintain the intended function of existing systems, consider the following:

- Right of way fencing (see Chapter 560)
- Drainage (see Chapter 800)
- Illumination (see Chapter 1040)
- Intelligent transportation systems (ITS) (see Chapter 1050)
- Traffic control signals (see Chapter 1330)
- Pedestrian use (see Chapters 1510 and 1515)
- Bicycle use (see Chapters 1515 and 1520)

Examples of the above include, but are not limited to:

- Installing short sections of fence needed to control access.
- Replacing grates that are not bicycle-safe (see Chapter 1520).
- Upgrading electrical system components that require excessive maintenance.
- Replacing or upgrading a traffic signal controller.
- Installing conduit and junction boxes for future traffic signal control, illumination, or ITS projects.
- Replacing or upgrading nonstructural traffic control signals, illumination, and ITS equipment that is near or beyond the life expectancy.
- Beveling culverts.

1120.04 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

	Multilane Divided				Multilane Undivided			
	Trucks Under 10%		Trucks 10% and Over		Trucks Under 10%		Trucks 10% and Over	
Design Class	**MDL-1**	**MDL-2**	**MDL-3**	**MDL-4**	**MDL-5**	**MDL-6**	**MDL-7**	**MDL-8**
Current ADT[1]	Under 4000	Over 4000	Under 4000	Over 4,000	Under 4000	Over 4000	Under 4000	Over 4000
Design Speed	See Exhibit 1130-1							
Traffic Lanes Number Width	 4 or more 11 ft	 4 or more 11 ft	 4 or more 11 ft	 4 or more 12 ft	 4 or more 11 ft	 4 or more 11 ft	 4 or more 11 ft	 4 or more 12 ft
Shoulder Width Right[3] Left[4]	 4 ft 2 ft	 6 ft 2 ft	 4 ft 2 ft	 6 ft 2 ft	4 ft	6 ft[5]	4 ft	6 ft[5]
Parking Lanes Urban	None	None	None	None	8 ft	8 ft[2]	8 ft	8 ft[2]
Median Width[15] Rural Urban	 Existing Existing	 Existing Existing	 Existing Existing	 Existing Existing	 2 ft 2 ft	 4 ft 2 ft	 4 ft 2 ft	 4 ft 2 ft
Minimum Width for Bridges to Remain in Place[6][7][8]	24 ft[9]	26 ft[9]	24 ft[9]	26 ft[10]	48 ft[9]	50 ft[9][11]	50 ft[9][11]	54 ft[10][11]
Minimum Width for Rehabilitation of Bridges to Remain in Place[6][8][12]	28 ft[9]	30 ft[9]	28 ft[9]	32 ft[10]	54 ft[9]	60 ft[9][11][13]	56 ft[9][11]	64 ft[10][11][13]
Minimum Width for Replacement Bridges	Full Design Level Applies[14]							
Access Control	For limited access highways, see Chapters 530 and 540 and the Limited Access and Managed Access Master Plan, or WAC 468-52 and the region's Highway Management Classification Report.							

Notes:

[1] If current ADT is approaching a borderline condition, consider designing for the higher classification.

[2] Parking restricted when ADT is over 15,000.

[3] When a curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft. In urban areas, see Chapter 1140. On a route identified as a local, state, or regional significant bicycle route, the minimum shoulder width is 4 ft (see Chapter 1520).

[4] When a curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 1 ft on the left.

[5] May be reduced by 2 ft under urban conditions.

[6] Width is the clear distance between curbs or rails, whichever is less.

[7] Use these widths for bridge deck treatment or thrie beam retrofit only.

[8] For bridge median guidance, see Chapter 720.

[9] Add 11 ft for each additional lane.

[10] Add 12 ft for each additional lane.

[11] Includes a 4-ft median, which may be reduced by 2 ft under urban conditions.

[12] Use these widths for any bridge work beyond the treatment of the deck, such as bridge rail replacement, deck replacement, or widening.

[13] Includes 6-ft shoulders; may be reduced by 2 ft on each side under urban conditions.

[14] Modified design level lane and shoulder widths may be used, when justified, with a corridor or project analysis.

[15] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by up to 4 inches.

Multilane Highways and Bridges: Modified Design Level

Exhibit 1130-10

	Two-Lane Highways					
	Trucks Under 10%			Trucks 10% and Over		
Design Class	**MDL-9**	**MDL-10**	**MDL-11**	**MDL-12**	**MDL-13**	**MDL-14**
Current ADT[1]	Under 1000	1000-4000	Over 4000	Under 1000	1000-4000	Over 4000
Design Speed	See Exhibit 1130-1					
Traffic Lane Width[2]	11 ft	11 ft	11 ft	11 ft	11 ft	12 ft
Shoulder Width[4]	2 ft	3 ft[5]	4 ft	2 ft	3 ft[5]	4 ft
Parking Lanes Urban	8 ft	8 ft	8 ft[3]	8 ft	8 ft	8 ft[3]
Minimum Width for Bridges to Remain in Place[6][7]	22 ft[8]	24 ft	28 ft	22 ft[8]	24 ft	28 ft
Minimum Width for Rehabilitation of Bridges to Remain in Place[7][9]	28 ft[10]	32 ft	32 ft	28 ft[10]	32 ft	32 ft
Minimum Width for Replacement Bridges	Full Design Level Applies[11]					
Access Control	For limited access highways, see Chapters 530 and 540 and the Limited Access and Managed Access Master Plan, or WAC 468-52 and the region's Highway Management Classification Report.					

Notes:

[1] If current ADT is approaching a borderline condition, consider designing for the higher classification.

[2] For turning roadways, see Exhibits 1130-12a and 1130-12b.

[3] Parking restrictions are desirable when ADT exceeds 7500.

[4] When a curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft. In urban areas, see Chapter 1140. On a route identified as a local, state, or regional significant bicycle route, the minimum shoulder width is 4 ft (see Chapter 1520).

[5] For design speeds of 50 mph or less on roads of 2000 ADT or less, width may be reduced by 1 ft, with justification.

[6] Use these widths for bridge deck treatment or thrie beam retrofit only.

[7] Width is the clear distance between curbs or rails, whichever is less.

[8] 20 ft when ADT is 250 or less.

[9] Use these widths when a for any bridge work beyond the treatment of the deck, such as bridge rail replacement, deck replacement, or widening.

[10] 26 ft when ADT is 250 or less.

[11] Modified design level lane and shoulder widths may be used, when justified, with a corridor or project analysis.

Two-Lane Highways and Bridges: Modified Design Level
Exhibit 1130-11

Chapter 1140 Full Design Level

1140.01 General

Full design level is the highest level of design and is used on new and reconstructed highways. These projects are designed to provide optimum mobility, safety, and efficiency of traffic movement. The overall objective is to move the greatest number of vehicles, at the highest allowable speed, and at optimum safety. Major design controls are: functional classification; terrain classification; urban or rural surroundings; traffic volume; traffic character and composition; design speed; and access control.

1140.02 References

(1) Federal/State Laws and Codes

Revised Code of Washington (RCW) 46.61.575, Additional parking regulations

RCW 47.05.021, Functional classification of highways

RCW 47.24, City streets as part of state highways

Washington Administrative Code (WAC) 468-18-040, Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings

(2) Design Guidance

Local Agency Guidelines (LAG), M 36-63, WSDOT

Plans Preparation Manual, M 22-31, WSDOT

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications), M 41-10, WSDOT

(3) Supporting Information

A Policy on Design Standards: Interstate System, AASHTO, 2005

A Policy on Geometric Design of Highways and Streets (Green Book), AASHTO, 2004

1140.03 Definitions

auxiliary lane The portion of the roadway adjoining the traveled way for parking, speed change, turning, storage for turning, weaving, truck climbing, passing, and other purposes supplementary to through-traffic movement.

collector system Routes that primarily serve the more important intercounty, intracounty, and intraurban travel corridors; collect traffic from the system of local access roads and convey it to the arterial system; and on which, regardless of traffic volume, the predominant travel distances are shorter than on arterial routes (RCW 47.05.021).

design speed The speed used to determine the various geometric design features of the roadway.

divided multilane A roadway with two or more through lanes in each direction and a median that physically or legally prohibits left turns, except at designated locations.

expressway A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and that may or may not have grade separations at intersections.

freeway A divided highway that has a minimum of two lanes in each direction for the exclusive use of traffic and with full control of access.

frontage road A road that is a local road or street located parallel to a highway for service to abutting property and adjacent areas and for control of access.

functional classification The grouping of streets and highways according to the character of the service they are intended to provide.

high pavement type Portland cement concrete pavement or hot mix asphalt (HMA) pavement on a treated base.

highway A general term denoting a street, road, or public way for the purpose of vehicular travel, including the entire area within the right of way.

incorporated city or town A city or town operating under RCW 35 or 35A.

intermediate pavement type Hot mix asphalt pavement on an untreated base.

Interstate System A network of routes designated by the state and the Federal Highway Administration (FHWA) under terms of the federal-aid acts as being the most important to the development of a national system. The Interstate System is part of the principal arterial system.

lane A strip of roadway used for a single line of vehicles.

lane width The lateral design width for a single lane, striped as shown in the *Standard Plans* and the *Standard Specifications*. The width of an existing lane is measured from the edge of traveled way to the center of the lane line or between the centers of adjacent lane lines.

limited access highway Highways where the rights of direct access to or from abutting lands have been acquired from the abutting landowners.

low pavement type Bituminous surface treatment (BST).

managed access highway Highways where the rights of direct access to or from abutting lands have not been acquired from the abutting landowners.

median The portion of a highway separating the traveled ways for traffic in opposite directions.

minor arterial system A rural network of arterial routes linking cities and other activity centers that generate long distance travel and, with appropriate extensions into and through urban areas, form an integrated network providing interstate and interregional service (RCW 47.05.021).

National Highway System (NHS) An interconnected system of principal arterial routes that serves interstate and interregional travel; meets national defense requirements; and serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities, and other major travel destinations. The Interstate System is a part of the NHS.

operating speed The speed at which drivers are observed operating their vehicles during free-flow conditions. The 85^{th} percentile of the distribution of observed speeds is most frequently used.

outer separation The area between the outside edge of traveled way for through traffic and the nearest edge of traveled way of a frontage road or collector-distributor (C-D) road.

posted speed The maximum legal speed as posted on a section of highway using regulatory signs.

principal arterial system A connected network of rural arterial routes with appropriate extensions into and through urban areas, including routes designated as part of the Interstate System, that serves corridor movements with travel characteristics indicative of substantial statewide and interstate travel (RCW 47.05.021).

roadway The portion of a highway, including shoulders, for vehicular use.

rural design area An area that meets none of the conditions to be an urban design area.

shoulder The portion of the roadway contiguous with the traveled way, primarily for accommodation of stopped vehicles, emergency use, lateral support of the traveled way, and use by pedestrians and bicycles.

shoulder width The lateral width of the shoulder, measured from the edge of traveled way to the edge of roadway or the face of curb.

suburban area A term for the area at the boundary of an urban design area. Suburban settings may combine higher speeds common in rural design areas with activities that are more common to urban settings.

traveled way The portion of the roadway intended for the movement of vehicles, exclusive of shoulders and lanes for parking, turning, and storage for turning.

two-way left-turn lane (TWLTL) A lane, located between opposing lanes of traffic, to be used by vehicles making left turns from either direction, from or onto the roadway.

undivided multilane A roadway with two or more through lanes in each direction on which left turns are not controlled.

urban area An area designated by the Washington State Department of Transportation (WSDOT) in cooperation with the Transportation Improvement Board and Regional Transportation Planning Organizations, subject to the approval of the FHWA.

urban design area An area where urban design criteria are appropriate, that is defined by one or more of the following:

- An urban area.
- An area within the limits of an incorporated city or town.
- An area characterized by intensive use of the land for the location of structures, that receives urban services such as sewer, water, and other public utilities, as well as services normally associated with an incorporated city or town. This may include an urban growth area defined under the Growth Management Act (see RCW 36.70A, Growth management – Planning by selected counties and cities), but outside the city limits.
- An area with not more than 25% undeveloped land.

urbanized area An urban area with a population of 50,000 or more.

usable shoulder The width of the shoulder that can be used by a vehicle for stopping.

1140.04 Functional Classification

The state highway system is divided and classified according to the character and volume of traffic carried by the routes and distinguished by specific geometric design criteria (RCW 47.05.021). The functional classifications (from highest to lowest) used on highways are: Interstate, principal arterial, minor arterial, and collector. The higher functional classes give more priority to through traffic and less to local access. NHS routes are usually designed to a higher level of design than non-NHS routes.

For functional classification maps and criteria, see:
http://www.wsdot.wa.gov/mapsdata/travel/hpms/functionalclass.htm

1140.05 Terrain Classification

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

- **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.
- **Rolling:** Hills and foothills, with slopes that rise and fall gently; however, occasional steep slopes might offer some restriction to horizontal and vertical alignment.
- **Mountainous:** Rugged foothills; high, steep drainage divides; and mountain ranges.

Terrain classification pertains to the general character of the specific route corridor. Roads in valleys or passes of mountainous areas might have the characteristics of roads traversing level or rolling terrain and are usually classified as level or rolling, rather than mountainous.

Divided Multilane		
Design Class	I-1	
Design Year	[1]	
Access Control[2]	Full	
Separate Cross Traffic Highways Railroads	 All All	
Design Speed (mph)[3] Rural Urbanized	 80[4] 70[5]	
Traffic Lanes Number Width (ft)	 4 or more divided 12	
Median Width (ft)[6]	Minimum width is as required for shoulders and barrier (including shy distance) or ditch (see 1140.10).	
Shoulder Width (ft)[7] Right of Traffic Left of Traffic	4 through lanes 10[8] 4	6 or more through lanes 10[8] 10[8][9]
Pavement Type[10]	High	
Right of Way Width (ft)[11] Rural Urban	 63 from edge of traveled way As required[12]	
Structures Width (ft)[13]	Full roadway width each direction[14]	

Type of Terrain	Design Speed (mph)						
	50	55	60	65	70	75	80
Level	4	4	3	3	3	3	3
Rolling	5	5	4	4	4	4	4
Mountainous	6	6	6	6	5	5	5

Grades (%)[15]

Interstate Notes:

[1] The design year is 20 years after the year the construction is scheduled to begin.
[2] For access control, see Chapter 530.
[3] For existing roadways, see 1140.07.
[4] 80 mph is the desirable design speed; with a corridor analysis, the design speed may be reduced to 60 mph in mountainous terrain and 70 mph in rolling terrain. Do not select a design speed that is less than the posted speed.
[5] 70 mph is the desirable design speed; with a corridor analysis, the design speed may be reduced to 50 mph. Do not select a design speed that is less than the posted speed.
[6] Independent alignment and grade are desirable in rural areas and where terrain and development permit in urban areas.
[7] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by up to 4 inches.
[8] 12-ft shoulders are desirable when the truck DDHV is 250 or greater.
[9] For existing 6-lane roadways, an existing 6-ft left shoulder is a design exception when the shoulder is not being reconstructed and no other widening will be provided.
[10] For pavement type determination, see Chapter 620.
[11] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 1140.15).
[12] In urban areas, make right of way widths not less than those for cross section elements.
[13] For minimum vertical clearance, see Chapter 720.
[14] For bridge median guidance, see Chapter 720.
[15] Grades 1% steeper may be provided in urban areas and mountainous terrain with critical right of way controls.

Geometric Design Data: Interstate

Exhibit 1140-5

Design Class	Divided Multilane				Two-Lane						Undivided Multilane	
	P-1		P-2		P-3		P-4		P-5		P-6[1]	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year[2] NHS Non-NHS	Over 1,500		Over 700[3]		Over 201[4] Over 301		61–200 101–300		60 and Under 100 and Under		Over 700[3]	
Access Control[5]	Full		Partial[6]									
Separate Cross Traffic Highways Railroads[7]	All All		Where Justified All		Where Justified All[8]		Where Justified Where Justified[9]		Where Justified Where Justified[9]		Where Justified Where Justified[9]	
Design Speed (mph)[10] Desirable[11] Minimum[12]	80 60[13]		70 50[14]		70 50	60 40[14]	70 50	60 40[14]	60 40	60 30[14]	70 40	60 30[14]
Traffic Lanes Number Width (ft)	4 or more divided 12		4 or 6 divided 12		2 12		2 12		2 12		4 12	4 or 6 11[15]
Shoulder Width (ft)[16] Right of Traffic Left of Traffic	10[17] Variable[19][20]		10 Variable[19][20]		8[31]		6		4		8[32]	8[18]
Median Width (ft)	Minimum width is as required for shoulders and barrier (including shy distance) or ditch (see 1140.10)										(See 1140.10)	
Parking Lanes Width (ft) – Minimum	None		None		None		None	10	None	10	None	10[21]
Pavement Type[22]	High				High or Intermediate							
Right of Way Width (ft)[23]	[24]	[25]	[24]	[25]	120	80	120	80	100	80	150	80
Structures Width (ft)[26]	Full Roadway Width[27]				40		36[33]		32		Full Rdwy Width	
Other Design Considerations–Urban					[28]		[28]		[28]		[28]	

Type of Terrain	Rural Design Speed (mph)									Urban Design Speed (mph)						
	40	45	50	55	60	65	70	75	80	30	35	40	45	50	55	60[29]
Level	5	5	4	4	3	3	3	3	3	8	7	7	6	6	5	5
Rolling	6	6	5	5	4	4	4	4	4	9	8	8	7	7	6	6
Mountainous	8	7	7	6	6	5	5	5	5	11	10	10	9	9	8	8

Grades (%)[30]

Geometric Design Data: Principal Arterial

Exhibit 1140-6

Principal Arterial Notes:

[1] Justify the selection of a P-6 design class on limited access highways.

[2] The design year is 20 years after the year the construction is scheduled to begin.

[3] When considering a multilane highway, perform an investigation to determine whether a truck-climbing lane or passing lane will satisfy the need (see Chapter 1270).

[4] Where DHV exceeds 700, consider 4 lanes. When the volume/capacity ratio is equal to or exceeds 0.75, consider the needs for a future 4-lane facility. When considering truck-climbing lanes on a P-3 design class highway, perform an investigation to determine whether a P-2 design class highway is justified.

[5] For access control, see Chapters 530 and 540 and the Limited Access and Managed Access Master Plan. Contact the HQ Design Office Access & Hearings Unit for additional information.

[6] Full or modified access control may also be used.

[7] Contact the Rail Office of the Public Transportation and Rail Division for input on railroad needs.

[8] Separate main line and major spur railroad tracks. Consider allowing at-grade crossings at minor spur railroad tracks.

[9] Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the risk. Provide justification for railroad grade separations.

[10] For existing roadways, see 1140.07.

[11] These are the design speeds for level and rolling terrain in rural design areas. They are the desirable design speeds for mountainous terrain and urban design areas. Higher design speeds may be selected, with justification.

[12] These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

[13] In urbanized areas, with a corridor analysis, 50 mph may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[14] In urban design areas, with a corridor analysis, these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[15] Provide 12-ft lanes when the truck DDHV is 150 or greater.

[16] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[17] 12-ft shoulders are desirable when the truck DDHV is 250 or greater.

[18] When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

[19] Minimum left shoulder width is to be as follows: 4 through lanes – 4 ft; 6 or more through lanes – 10 ft. Consider 12-ft shoulders on facilities with 6 or more lanes and a truck DDHV of 250 or greater.

[20] For existing 6-lane roadways, an existing 6-ft left shoulder is a design exception when the shoulder is not being reconstructed and no other widening will be provided.

[21] Restrict parking when DHV is over 1500.

[22] For pavement type determination, see Chapter 620.

[23] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 1140.15).

[24] 63 ft from edge of traveled way.

[25] Make right of way widths not less than those for cross section elements.

[26] For the minimum vertical clearance, see Chapter 720.

[27] For bridge median guidance see Chapter 720.

[28] For bicycle guidelines, see Chapter 1520. For pedestrian and sidewalk guidelines, see Chapter 1510. For shared-use path design, see Chapter 1515. Curb guidelines are in 1140.11. Lateral clearances from the face of curb to obstruction are in Chapter 1600.

[29] For grades at design speeds greater than 60 mph in urban design areas, use rural criteria.

[30] Grades 1% steeper may be used in urban design areas and mountainous terrain with critical right of way controls.

[31] Consider 10-ft shoulders when truck DHV is 250 or greater.

[32] Consider 10-ft shoulders when truck DDHV is 250 or greater.

[33] Consider 40 ft for shorter structures.

Geometric Design Data: Principal Arterial
Exhibit 1140-6 (continued)

Design Class		Divided Multilane		Two-Lane						Undivided Multilane	
		M-1		M-2		M-3		M-4		M-5[1]	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year[2]	NHS	Over 700[3]		Over 201[4]		61–200		60 and Under		Over 700[3]	
	Non-NHS			Over 401		201–400		200 and Under			
Access Control[5]		Partial[6]									
Separate Cross Traffic											
Highways		Where Justified		Where Justified		Where Justified		Where Justified		Where Justified	
Railroads[7]		All		All[8]		Where Justified[9]		Where Justified[9]		Where Justified[9]	
Design Speed (mph)[10]											
Desirable[11]		70		70	60	70	60	60	60	70	60
Minimum[12][13]		50		50	40	50	40	40	30	40	30
Traffic Lanes											
Number		4 or 6 divided		2		2		2		4	4 or 6
Width (ft)		12		12		12		12		12	11[14]
Shoulder Width (ft)[15]											
Right of Traffic		10		8[30]		6		4		8[31]	8[16]
Left of Traffic		Variable[17][18]									
Median Width (ft)		[19]								[19]	
Parking Lanes Width (ft) – Minimum		None		None		None	10	None	10	None	10[20]
Pavement Type[21]		High								High or Intermediate	
Right of Way Width (ft)[22]		[23]	[24]	120	80	120	80	100	80	150	80
Structures Width (ft)[25]		Full Rdwy Width[26]		40		36[32]		32		Full Rdwy Width	
Other Design Considerations–Urban				[27]		[27]		[27]		[27]	

Type of Terrain	Rural Design Speed (mph)									Urban Design Speed (mph)					
	40	45	50	55	60	65	70	75	80	30	35	40	45	50	55	60[28]
Level	5	5	4	4	3	3	3	3	3	8	7	7	6	6	5	5
Rolling	6	6	5	5	4	4	4	4	4	9	8	8	7	7	6	6
Mountainous	8	7	7	6	6	5	5	5	5	11	10	10	9	9	8	8

Grades (%)[29]

Geometric Design Data: Minor Arterial
Exhibit 1140-7

Minor Arterial Notes:

[1] Justify the selection of an M-5 design class on limited access highways.

[2] The design year is 20 years after the year the construction is scheduled to begin.

[3] When considering a multilane highway, perform an investigation to determine whether a truck-climbing lane or passing lane will satisfy the need (see Chapter 1270).

[4] Where DHV exceeds 700, consider 4 lanes. When the volume/capacity ratio is equal to or exceeds 0.75, consider the needs for a future 4-lane facility. When considering truck-climbing lanes on an M-2 design class highway, perform an investigation to determine whether an M-1 design class highway is justified.

[5] For access control, see Chapters 530 and 540 and the Limited Access and Managed Access Master Plan. Contact the Access & Hearings Section of the HQ Design Office for additional information.

[6] Full or modified access control may also be used.

[7] Contact the Rail Office of the Public Transportation and Rail Division for input on railroad needs.

[8] Separate main line and major spur railroad tracks. Consider allowing at-grade crossings at minor spur railroad tracks.

[9] Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the risk. Provide justification for railroad grade separations.

[10] For existing roadways, see 1140.07.

[11] These are the design speeds for level and rolling terrain in rural design areas. They are the desirable design speeds for mountainous terrain and urban design areas. Higher design speeds may be selected, with justification.

[12] In urban design areas, with a corridor analysis, these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[13] These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

[14] When the truck DDHV is 150 or greater, consider 12-ft lanes.

[15] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[16] When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

[17] The minimum left shoulder width is 4 ft for 4 through lanes and 10 ft for 6 or more through lanes.

[18] For existing 6-lane roadways, an existing 6-ft left shoulder is a design exception when the shoulder is not being reconstructed and no other widening will be provided.

[19] Minimum median width is as required for shoulders and barrier (including shy distance) or ditch (see 1140.10).

[20] Restrict parking when DHV is over 1500.

[21] For pavement type determination, see Chapter 620.

[22] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 1140.15).

[23] 63 ft from edge of traveled way.

[24] Make right of way widths not less than those for cross section elements.

[25] For the minimum vertical clearance, see Chapter 720.

[26] For bridge median guidance see Chapter 720.

[27] For bicycle guidelines, see Chapter 1520. For pedestrian and sidewalk guidelines, see Chapter 1510. For shared-use path guidelines, see Chapter 1515. Curb guidelines are in 1140.11. Lateral clearances from the face of curb to obstruction are in Chapter 1600.

[28] For grades at design speeds greater than 60 mph in urban design areas, use rural criteria.

[29] Grades 1% steeper may be used in urban design areas and mountainous terrain with critical right of way controls.

[30] Consider 10-ft shoulders when truck DHV is 250 or greater.

[31] Consider 10-ft shoulders when truck DDHV is 250 or greater.

[32] Consider 40 ft for shorter structures.

Geometric Design Data: Minor Arterial

Exhibit 1140-7 (continued)

Design Class	Undivided Multilane		Two-Lane					
	C-1		C-2		C-3		C-4	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
DHV in Design Year[1] NHS Non-NHS	Over 900[2]		Over 301[3] Over 501		201–300 301–500		200 and Under 300 and Under	
Access Control	[4]		[4]		[4]		[4]	
Separate Cross Traffic Highways Railroads[5]	Where Justified Where Justified[6]		Where Justified All[6]		Where Justified Where Justified[6]		Where Justified Where Justified[6]	
Design Speed (mph)[7] Desirable[8] Minimum[9][10]	70 40	60 30	70 50	60 40	70 50	60 40	60 40	60 30
Traffic Lanes Number Width (ft)	4 12	4 or 6 11[11]	2 12		2 12		2 12	
Shoulder Width (ft)[12]	8[21]	8[13]	8[22]		6		4	
Median Width (ft)	[14]							
Parking Lane Width (ft) – Minimum	None	10	None		None	10	None	10
Pavement Type[15]	High or Intermediate							
Right of Way (ft)[16]	150	80	120	80	120	80	100	80
Structures Width (ft)[17]	Full Roadway Width		40		36[23]		32	
Other Design Considerations – Urban	[18]		[18]		[18]		[18]	

Type of Terrain	Rural Design Speed (mph)										Urban Design Speed (mph)								
	25	30	35	40	45	50	55	60	65	70	20	25	30	35	40	45	50	55	60[19]
Level	7	7	7	7	7	6	6	5	5	4	9	9	9	9	9	8	7	7	6
Rolling	10	9	9	8	8	7	7	6	6	5	12	12	11	10	10	9	8	8	7
Mountainous	11	10	10	10	10	9	9	8	8	6	14	13	12	12	12	11	10	10	9

Grades (%)[20]

Geometric Design Data: Collector

Exhibit 1140-8

Collector Notes:

[1] The design year is 20 years after the year the construction is scheduled to begin.

[2] When considering a multilane highway, perform an investigation to determine whether a truck-climbing lane or passing lane will satisfy the need (see Chapter 1270).

[3] Where DHV exceeds 900, consider 4 lanes. When the volume/capacity ratio is equal to or exceeds 0.85, consider the needs for a future 4-lane facility. When considering truck-climbing lanes on a C-2 design class highway, perform an investigation to determine whether a C-1 design class highway is justified.

[4] For access control, see Chapters 530 and 540 and the Limited Access and Managed Access Master Plan. Contact the Access & Hearings Section in the HQ Design Office for additional information.

[5] Contact the Rail Office of the Public Transportation and Rail Division for input on railroad needs.

[6] Criteria for railroad grade separations are not clearly definable. Evaluate each site regarding the risk. Provide justification for railroad grade separations.

[7] For existing roadways, see 1140.07.

[8] These are the design speeds for level and rolling terrain in rural design areas. They are the desirable design speeds for mountainous terrain and urban design areas. Higher design speeds may be selected, with justification. Do not select a design speed that is less than the posted speed.

[9] In urban design areas, with a corridor analysis, these values may be used as the minimum design speed. Do not select a design speed that is less than the posted speed.

[10] These design speeds may be selected in mountainous terrain, with a corridor analysis. Do not select a design speed that is less than the posted speed.

[11] Consider 12-ft lanes when the truck DDHV is 200 or greater.

[12] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[13] When curb section is used, the minimum shoulder width from the edge of traveled way to the face of curb is 4 ft.

[14] Minimum median width is as required for shoulders and barrier (including shy distance) or ditch (see 1140.10).

[15] For pavement type determination, see Chapter 620.

[16] Desirable width. Provide right of way width 10 ft desirable, 5 ft minimum, wider than the slope stake for fill and slope treatment for cut (see 1140.15).

[17] For the minimum vertical clearance, see Chapter 720.

[18] For bicycle guidelines, see Chapter 1520. For pedestrian and sidewalk guidelines, see Chapter 1510. For shared-use path guidelines, see Chapter 1515. Curb guidelines are in 1140.11. Lateral clearances from the face of curb to obstruction are in Chapter 1600.

[19] For grades at design speeds greater than 60 mph in urban design areas, use rural criteria.

[20] Grades 1% steeper may be used in urban design areas and mountainous terrain with critical right of way controls.

[21] Consider 10-ft shoulders when truck DDHV is 250 or greater.

[22] Consider 10-ft shoulders when truck DHV is 250 or greater.

[23] Consider 40 ft for shorter structures.

Geometric Design Data: Collector

Exhibit 1140-8 (continued)

Design Class	Divided Multilane		Undivided Multilane		Two-Lane	
	$U_{M/A}$-1	$U_{M/A}$-2	$U_{M/A}$-3	$U_{M/A}$-4	$U_{M/A}$-5	$U_{M/A}$-6
DHV in Design Year[1]	Over 700	Over 700	700–2,500	Over 700	All	All
Design Speed (mph)	Greater than 45	45 or less	35 to 45	30 or less	Greater than 45	45 or less
Access	[2]	[2]	[2]	[2]	[2]	[2]
Traffic Lanes						
Number	4 or more	4 or more	4 or more	4 or more	2	2
Width (ft) NHS	12[4]	12[3]	12[3]	12[3]	12[6]	12[3]
Width (ft) Non-NHS	12[4]	11[5]	11[5]	11[5]	12[6]	11[7]
Shoulder Width (ft)[8]						
Right of Traffic[9]	10	10	8	8	8[10]	4
Left of Traffic	4	4				
Median Width (ft)[11]			[12]	[12]		
Parking Lane Width (ft)	None	10[13]	10[13]	8[14]	10[15]	8[14]
Structures Width (ft)[16]	Full Roadway Width[17]		Full Roadway Width		32	30
Other Design Considerations	[18]	[18]	[18]	[18]	[18]	[18]

Urban Managed Access Highways Notes:

[1] The design year is 20 years after the year the construction is scheduled to begin.

[2] The urban managed access highway design is used on managed access highways (see Chapter 540).

[3] May be reduced to 11 ft, with justification.

[4] May be reduced to 11 ft, with justification, when truck DDHV is less than 200.

[5] Consider 12-ft lanes when truck DDHV is 200 or greater.

[6] May be reduced to 11 ft, with justification, when truck DHV is less than 100.

[7] Consider 12-ft lanes when truck DHV is 100 or greater.

[8] When curb section is used, see Exhibit 1140-3.

[9] When guardrail is installed along existing shoulders with a width greater than 4 ft, the shoulder width may be reduced by 4 inches.

[10] When DHV is 200 or less, may be reduced to 4 ft.

[11] Minimum width is as required for shoulders and barrier or ditch (see 1140.10).

[12] 2 ft desirable. When a TWLTL is present, 13 ft is desirable, 11 ft is minimum.

[13] Prohibit parking when DHV is over 1500.

[14] 10 ft is desirable.

[15] Prohibit parking when DHV is over 500.

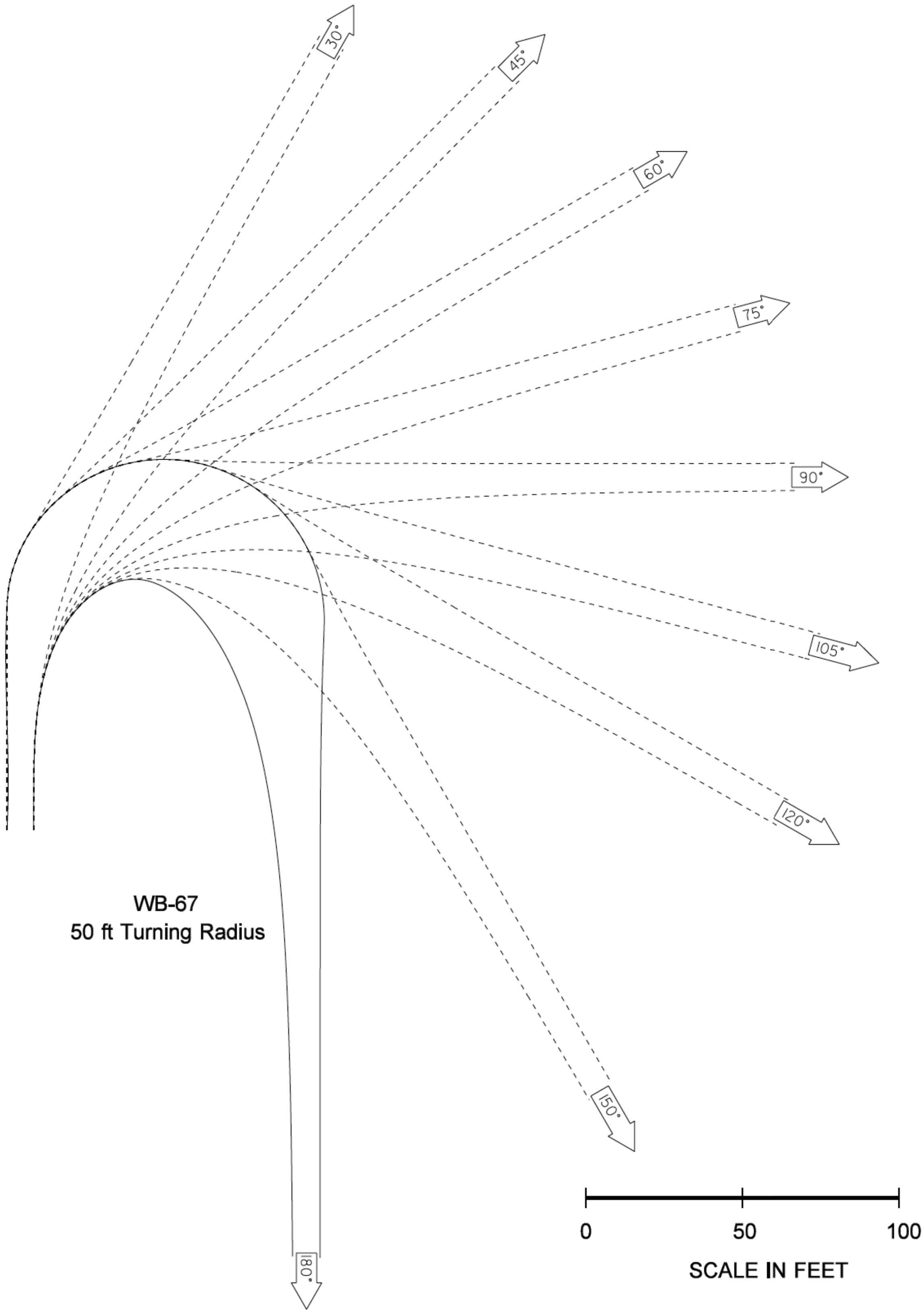
[16] For minimum vertical clearance, see Chapter 720.

[17] For bridge median guidance, see Chapter 720.

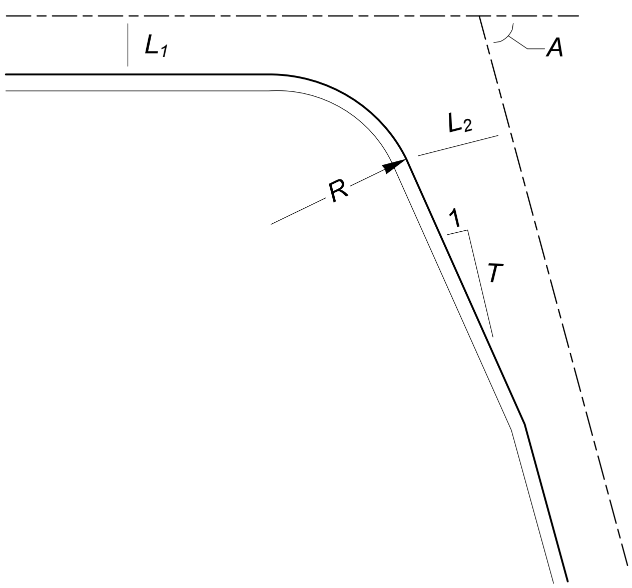
[18] For bicycle guidelines, see Chapter 1520. For pedestrian and sidewalk guidelines, see Chapter 1510. For shared-use path guidelines, see Chapter 1515. Lateral clearances from face of curb to obstruction are in Chapter 1600. For railroad and other roadway grade separation, maximum grade, and pavement type for the functional class, see Exhibits 1140-6 through 1140-8. Make right of way widths not less than for cross section elements.

Geometric Design Data: Urban Managed Access Highways

Exhibit 1140-9



Turning Path Template
Exhibit 1310-13c



L_1 = Minimum available roadway width[2] that the vehicle is turning from

L_2 = Available roadway width[2] for the vehicle leaving the intersection

R = Radius to the edge of traveled way

T = Taper rate (length per unit of width of widening)

A = Delta angle of the turning vehicle

Vehicle	*A*	*R*	L_1[1]	L_2[2]	*T*	Vehicle	*A*	*R*	L_1[1]	L_2[2]	*T*
WB-67	60	85	11	22	7	WB-40	60	55	11	15	7.5
	75	75	11	21	8		75	55	11	15	7.5
	90	70	11	21	8		90	55	11	14	7.5
	105	55	11	24	7		105	45	11	16	7.5
	120	50	11	24	7		120	45	11	15	7.5
WB-50	60	55	11	19	6	SU & BUS	All	50	11	11	25
	75	55	11	18	6	P	All	35	11	11	25
	90	55	11	17	6						
	105	50	11	17	6						
	120	45	11	18	6						

Notes:

[1] When available roadway width is less than 11 ft, widen at 25:1.

[2] Available roadway width includes the shoulder, less a 2-ft clearance to a curb, and all the same-direction lanes of the exit leg at signalized intersections.

General:

All distances given in feet and angles in degrees.

Right-Turn Corner

Exhibit 1310-14

additional lanes are provided at a roundabout exit. Instead of two dense platoons needing distance to spread out and merge downstream of a signal, vehicles exiting a roundabout are usually more evenly spaced, making merging easier and requiring less distance before beginning the taper (see Exhibit 1320-27). A practical way to end or drop the lane as it transitions from two exit lanes to one exit lane is to taper each lane symmetrically in order to indicate to drivers that the left exit lane is not prioritized over the other (right) exit lane. This type of lane strategy improves lane utilization for multilane roundabouts in both the entry and exit areas and the circulating roadway.

(k) **Railroad Crossings**

Although it is undesirable to locate any intersection near an at-grade railroad crossing, a crossing is acceptable near a roundabout as long as the roundabout does not force vehicles to stop on the tracks. The distance between the yield point and the tracks is sized to at least accommodate the design vehicle length, unless there is a gate on the circulating roadway that allows the roundabout entry to clear prior to the train's arrival (see Exhibit 1320-28).

The intersection analyses and site-specific conditions help determine the need for, and optimum placement of, a gate on the circulating roadway. Exhibit 1320-28 shows two example locations for railroad gates on the circulating roadway, however only one would be used. While a roundabout has a tendency to lock up as soon as the gates come down on the circulating roadway, the affected leg is very efficient at returning to normal operation.

1320.07 Pedestrians

Pedestrian crossings at roundabouts are unique in that the pedestrian crosses at a point behind the first vehicle waiting at the yield point. When pedestrian activity is anticipated, include a pedestrian refuge in the splitter island and mark all pedestrian crosswalks. Position the crosswalk one car length (approximately 20 feet) from the yield point and perpendicular to the entry and exit roadways (see Exhibit 1320-21). Consider landscaping strips to discourage pedestrians crossing at undesirable locations. Where possible, provide a buffer between the traveled way and sidewalk.

Provide a barrier-free passageway at least 10 feet wide (desirable) through all islands and buffers. Whenever a raised splitter island is provided, provide a 6-foot island width for pedestrian refuge. This facilitates pedestrians crossing in two separate movements.

Give special attention to assisting visually impaired pedestrians through design elements, such as providing truncated domes for tactile cues at curb ramps and splitter islands. Provide appropriate informational cues to pedestrians regarding the location of the sidewalk and the crosswalk.

For additional information on sidewalk ramps and pedestrian needs, see Chapter 1510.

1320.08 Bicycles

In most cases, the operating speed of vehicles within roundabouts is similar to the speed of bicyclists, and both can use the same roadway without conflict or special treatment. Less experienced cyclists may not feel comfortable riding with traffic and may want to use a sidewalk instead. End marked bicycle lanes or shoulders before they enter a roundabout in order to direct bicycles to either enter traffic and use the circulating roadway or leave the roadway onto a separate shared-use path or shared-use sidewalk. When using a shared-use sidewalk, the width is the same as a separate shared-use path. (See Exhibit 1320-29 for the recommended design for ending a bicycle lane with a shared-use sidewalk at a roundabout and Chapter 1515 for shared-use path widths.)

1320.09 Signing and Pavement Marking

A typical roundabout sign layout is shown in Exhibit 1320-30. A diagrammatic guide sign, as shown in the exhibit, can be used to provide the driver with destination information. Provide a route confirmation sign on state routes shortly after exiting the roundabout, but after the pedestrian crossing (if there is one) so that the sign will not distract drivers from watching for pedestrians. For multilane roundabouts, provide a lane use sign after the directional sign, but far enough before the crosswalk that changing lanes will not distract drivers from watching for pedestrians. If there is an add lane and it is short enough, it is desirable to place the lane use sign prior to the add lane to cut the number of lane changes.

Provide pavement markings to reinforce appropriate lane use adjacent to the lane use sign if there are two lanes at that point; otherwise, at the point at which there are two lanes and in the circulating roadway where appropriate. If lane use markings are used in the circulating roadway, make them visible to vehicles from the yield point. Contact the region or HQ Traffic Office for additional information when completing the channelization plan for a roundabout. Examples of pavement marking layouts for single and multilane roundabouts are shown in Exhibit 1320-31. For additional details on signing and pavement marking, see the MUTCD.

1320.10 Illumination

Provide illumination for each of the conflict points between circulating and entering traffic in the roundabout and at the beginning of the raised splitter islands. Illuminate raised channelization or curbing. Position the luminaires on the downstream side of each crosswalk to improve the visibility of pedestrians. Light the roundabout from the outside in toward the center. This improves the visibility of the central island and circulating vehicles to motorists approaching the roundabout. Ground-level lighting within the central island that shines upward toward objects in the central island can also improve their visibility. Exhibit 1320-32 depicts the light standard placement for a four-leg roundabout. (For additional information on illumination, see Chapter 1040.)

1420.07 Traffic Design Elements

Traffic design elements are critical to the safe and efficient use of HOV direct access facilities. The following discusses the elements of traffic design that might be different for HOV direct access facilities.

(1) Traffic Barriers

Separate the main line from the HOV direct access facilities with a traffic barrier. Whenever possible, separate opposing traffic lanes in the facility by using traffic barrier (see Chapter 1610). This is especially important in areas where opposing traffic is changing speeds to or from main line speeds. Concrete barrier is generally desirable on these facilities due to lower maintenance requirements.

Provide crashworthy end treatments to the approach ends of traffic barriers. In areas where the operating speed is greater than 35 mph, provide an impact attenuator (see Chapter 1620). Consider concrete barrier and low-maintenance impact attenuators, such as the REACT 350 or QuadGuard Elite, where there is a potential for frequent impacts (such as in gore areas).

When the operating speed is 25 mph or lower, and where an at-grade pedestrian crossing transit stop has an opening in a concrete barrier, a sloped-down end as shown in the *Standard Plans* is acceptable.

When providing a break in the barrier for turning maneuvers, consider sight distance when determining the location for stopping the barrier (see Chapter 1260).

In areas where headlight glare is a concern, consider glare screens such as taller concrete barrier. Other glare screen options that mount on the top of a barrier tend to be high-maintenance items and are discouraged.

Taller barrier might also be desirable in areas where pedestrian access is discouraged, such as between opposing flyer stops or between a flyer stop and the main line.

(2) Signing

Design and place HOV signing to clearly indicate whether the signs are intended for motorists in the HOV lane or the general-purpose lanes. The purposes of the signs are to:

- Enhance safety.
- Convey the message that HOV lanes are restricted to HOVs.
- Provide clear directions for entrances and exits.
- Define vehicle occupancy requirements or other restrictions.

Because HOV facilities are not found in many regions, the signing not only considers the commuter but also the occasional user of the facility who might be unfamiliar with the HOV facility and its operation.

(a) **Safety**

Much of HOV signing relates to enhancing safety for motorists. Not only are geometrics often minimized due to the lack of right of way, but there are unusual operational characteristics such as the differential speed between the HOV vehicle and the adjacent general-purpose traffic. To allow for the lack of passing opportunities in the HOV lane and the necessity for frequent merging and weaving actions, use messages that are clear and concise, and use symbols wherever possible.

Because left-side off connections are unusual, advance warning signing alerting the motorist that an exit is on the left becomes more important.

For T ramps, provide traffic control at the T to assign priority to one of the conflicting left turn movements and to avert wrong-way movements.

(b) **Diamond Symbols**

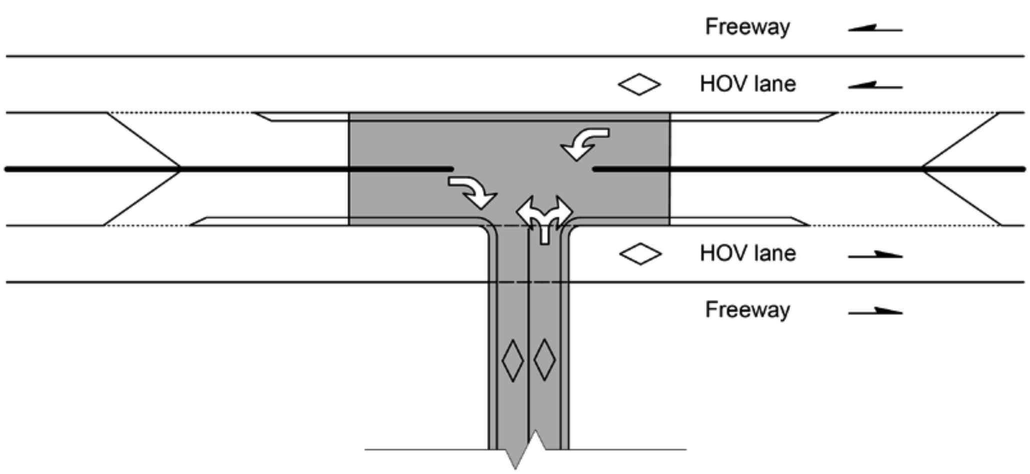
The diamond symbol is used to designate HOV facilities where carpools are allowed. For all signs, whether regulatory, guide, or warning, the symbol is white on a black background to convey the restrictive nature of the HOV lane and to make the signs more uniformly recognizable. The use of the symbol with all HOV signs also informs drivers that the message is intended for HOVs. The diamond symbol is only for HOV lanes where carpools are allowed; it is not used for bus, taxi, or bicycle preferential lanes.

(c) **Selection and Location**

The signing details given in Exhibits 1420-16 through 21 provide for the HOV geometric configurations used within the right of way. Signing for other types of HOV facilities (such as those used for reversible-flow and for HOV direct access between freeways and temporary HOV lanes used during construction) is designed on a case-by-case basis and requires consultation with the appropriate Headquarters and region traffic personnel. In addition to the normal regulatory signs, include HOV guide signs, both advance and action, in the design of signing for HOV direct access between freeways.

(d) **Regulatory Signs**

Regulatory signs for HOV facilities follow the normal regulatory signing principles: black legend with a white reflective background on a rectangular panel. Keep in mind that messages conveyed by the HOV signs (such as signs concerning violations and those indicating the beginning of an HOV lane downstream) are not necessarily intended only for the HOV vehicle. Therefore, it might be prudent to place additional signs on the right side of the freeway where this conforms to sound engineering practice.



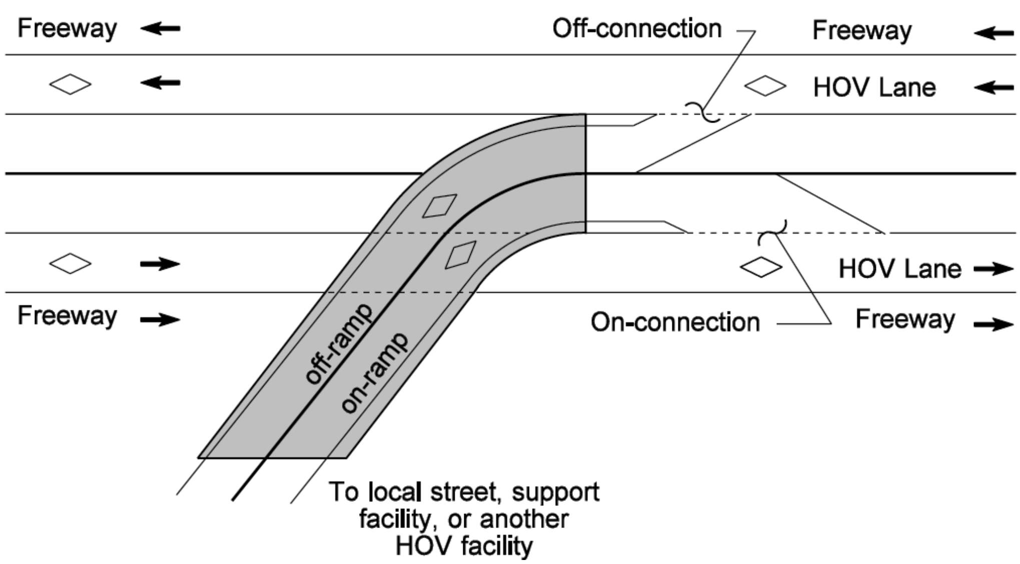
Note:

Refer to Exhibit 1420-15 for additional design information.

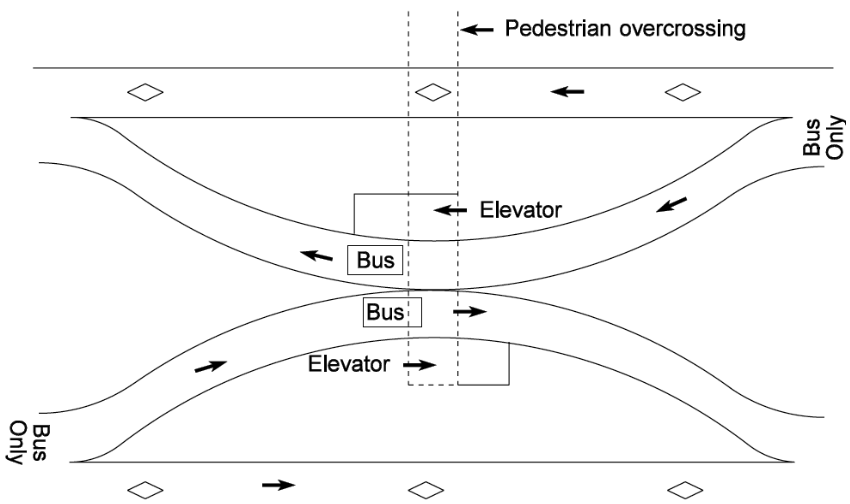
T Ramp

Exhibit 1420-4

Photograph from FHWA/PB *HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe*



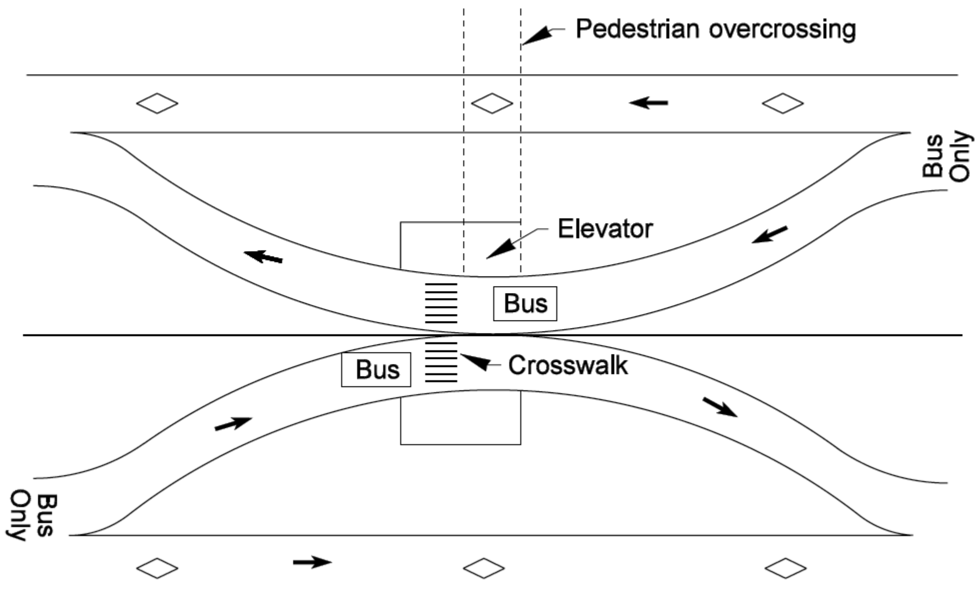
Flyover Ramp
Exhibit 1420-5



Note:
The side platform flyer stop with grade-separated access to each platform is the preferred design.

Side Platform Flyer Stop

Exhibit 1420-6



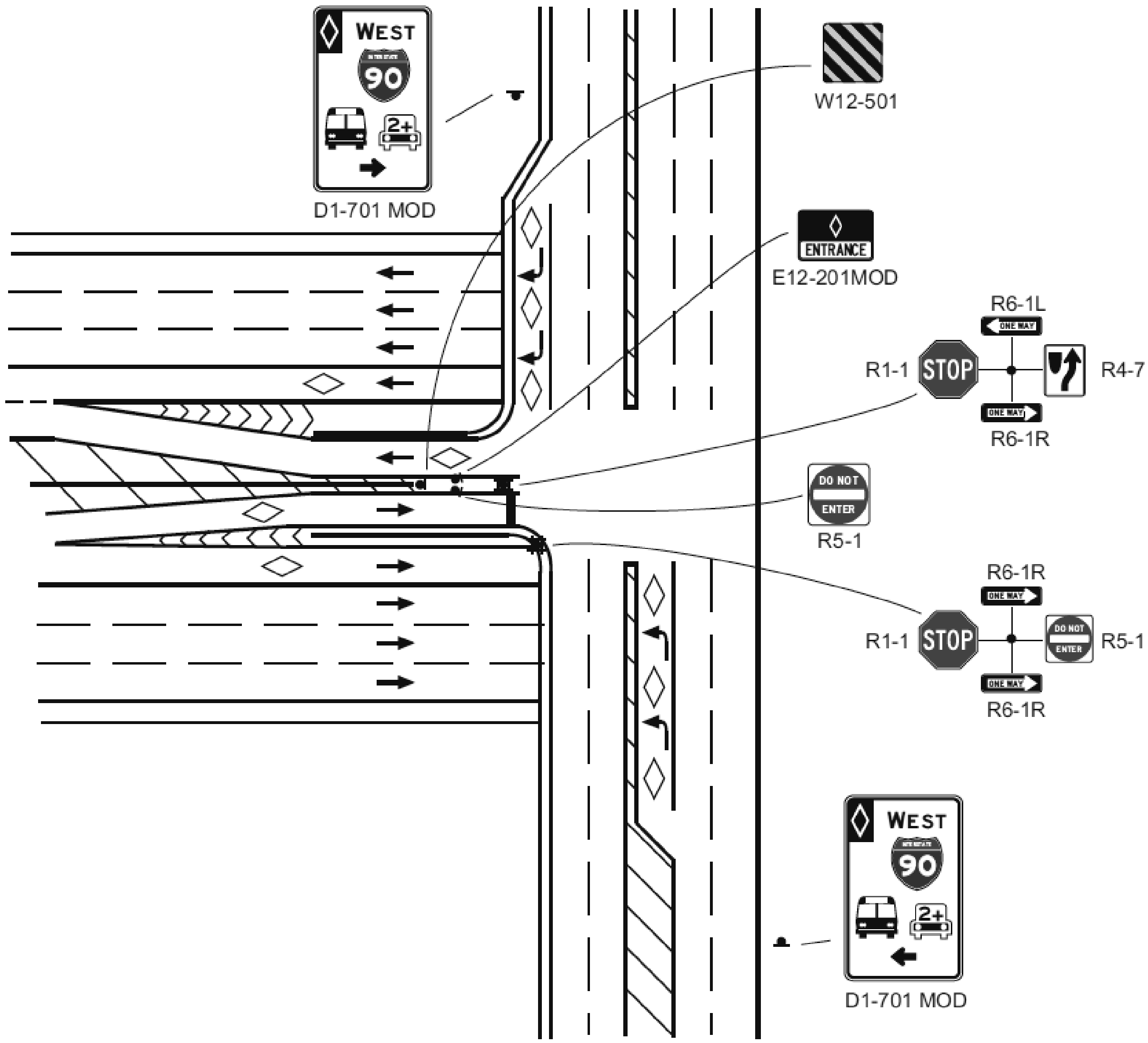
Note:

Consider flyer stops with at-grade pedestrian crossing only when anticipated volumes are low. Design to allow for the future addition of grade-separated access to both platforms. (See side platform flyer stop design, Exhibit 1420-6.)

Photograph from FHWA/PB *HOV Interactive 1.0 High Occupancy Vehicle Data Base from the U.S., Canada and Europe*

At-Grade Crossing Flyer Stop

Exhibit 1420-7

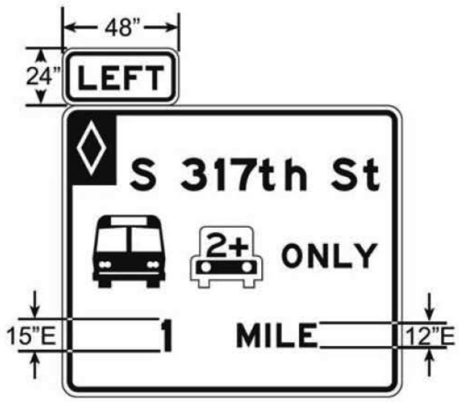


Notes:

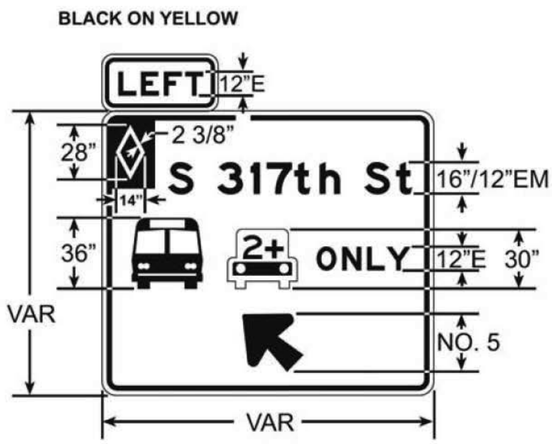
- Sign placement shall be in accordance with the MUTCD.
- For non-HOV sign details, see the *Sign Fabrication Manual*.
- For modified sign details, see Exhibits 1420-19 and 1420-20.

HOV Direct Access Signing: Local Street and Ramp Terminal

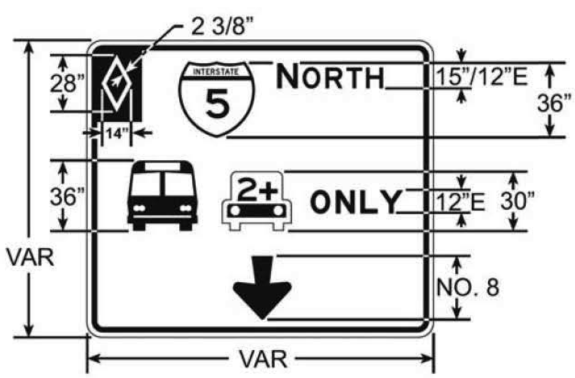
Exhibit 1420-18



E1-1 MOD.
BLACK ON WHITE

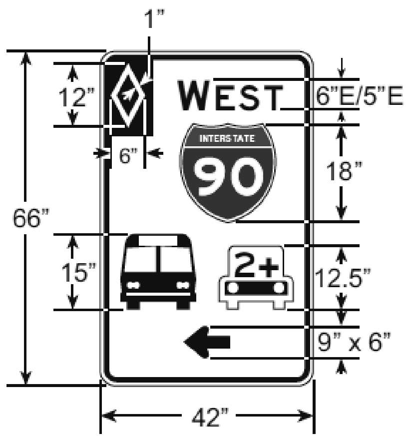


E6-101 MOD.
BLACK ON WHITE

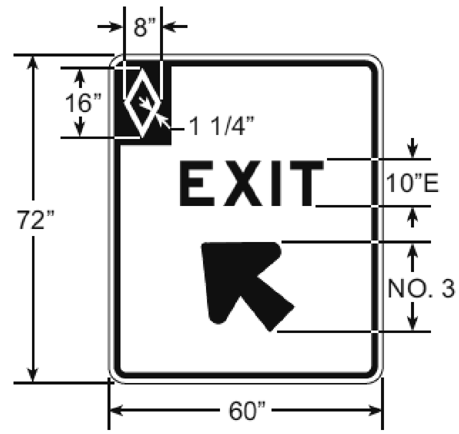


E6-2 MOD.
BLACK ON WHITE

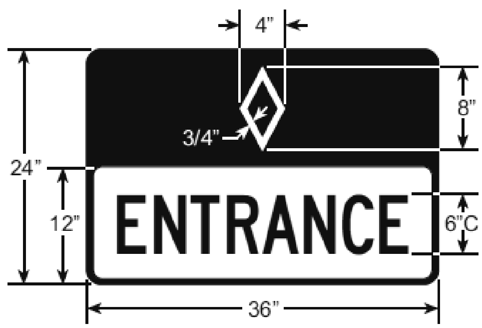
HOV Direct Access Overhead Signs
Exhibit 1420-19



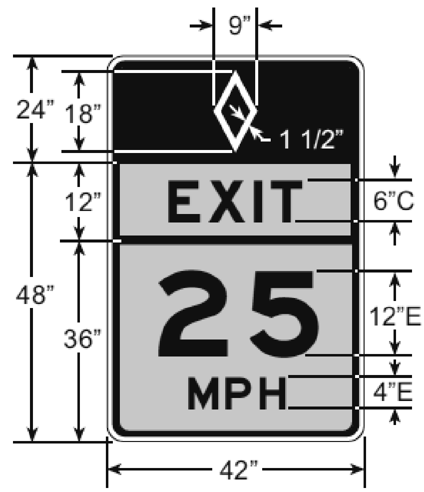
D1-701 MOD.
BLACK ON WHITE
SHIELD
LEGEND - WHITE (REFL)
TOP - RED (REFL)
BOTTOM - BLUE (REFL)



E5-1 MOD.
BLACK ON WHITE



E12-201 MOD.
BLACK ON WHITE



W13-2 MOD.
WHITE ON BLACK &
BLACK ON YELLOW

HOV Direct Access Shoulder-Mounted Signs

Exhibit 1420-20

Guide striping provided for left-hand turns.

Do Not Enter sign located on the left side at the top of each off-ramp.

Keep Right sign located at the top of the median barrier separating on- and off-ramps.

HOV Entrance sign located on the right side at the beginning of each on-ramp.

Wrong Way signs (30° rotation at potential wrong-way entrance point).

Diamonds and Turn Only pavement markings on off-ramps.

HOV Direct Access Signing and Pavement Markings
Exhibit 1420-21

Chapter 1515 Shared-Use Paths

1515.01 General

Shared-use paths are designed for both transportation and recreation purposes and are used by pedestrians, bicyclists, skaters, equestrians, and other users. Some common locations for shared-use paths are along rivers, streams, ocean beachfronts, canals, utility rights of way, and abandoned railroad rights of way; within college campuses; and within and between parks as well as within existing roadway corridors. A common application is to use shared-use paths to close gaps in bicycle networks. There might also be situations where such facilities can be provided as part of planned developments. Where a shared-use path is designed to parallel a roadway, provide a separation between the path and the vehicular traveled way in accordance with this chapter.

As with any roadway project, shared-use path projects need to fit into the context of a multimodal community. Exhibits are provided throughout this chapter to illustrate possible design solutions, which should be treated with appropriate flexibility as long as doing so complies with corresponding laws, regulations, standards, and guidance. Engage various discipline experts, including landscape architects, soil and pavement engineers, maintenance staff, traffic control experts, ADA and bicycle coordinators, and others. Additionally, when designing such facilities, consider way-finding.

This chapter includes technical provisions for making shared-use paths accessible to persons with disabilities. Design shared-use paths and roadway crossings in consultation with your region's ADA Coordinator, Bicycle Coordinator, and State Bicycle and Pedestrian Coordinator. For additional information on pedestrian and bicycle facilities, see Chapters 1510 and 1520, respectively.

1515.02 References

(1) Federal/State Laws and Codes

Americans with Disabilities Act of 1990 (ADA)

ADA (28 CFR Part 35, as revised September 15, 2010)

23 CFR Part 652, Pedestrian and Bicycle Accommodations and Projects

49 CFR Part 27, Nondiscrimination on the Basis of Disability in Programs or Activities Receiving Federal Financial Assistance (Section 504 of the Rehabilitation Act of 1973 implementing regulations)

(2) Design Guidance

Guide for the Development of Bicycle Facilities, 4th Edition, AASHTO, 2012

Revised Draft Guidelines for Accessible Public Rights-of-Way (PROWAG), November 23, 2005, U.S. Access Board. The current best practices for evaluation and design of pedestrian facilities in the public right of way per the following FHWA Memoranda:
http://www.fhwa.dot.gov/environment/bikeped/prwaa.htm
http://www.fhwa.dot.gov/civilrights/memos/ada_memo_clarificationa.htm
www.access-board.gov/prowac/draft.htm

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA, as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

ADA Standards for Accessible Design, USDOJ, 2010; consists of 28 CFR parts 35 & 36 and the *ADA and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities* (ADA-ABAAG; also referred to as the 2004 ADAAG), July 23, 2004, U.S. Access Board
http://www.access-board.gov/ada/

(3) Supporting Information

Equestrian Design Guidebook for Trails, Trailheads and Campgrounds, Chapter 3, provides guidance on shared-use paths for equestrian users, FHWA

Pedestrian Bicycle Information Center
http://www.bicyclinginfo.org/engineering/paths-principles.cfm

1515.03 Definitions

rest area An area to the side of a path.

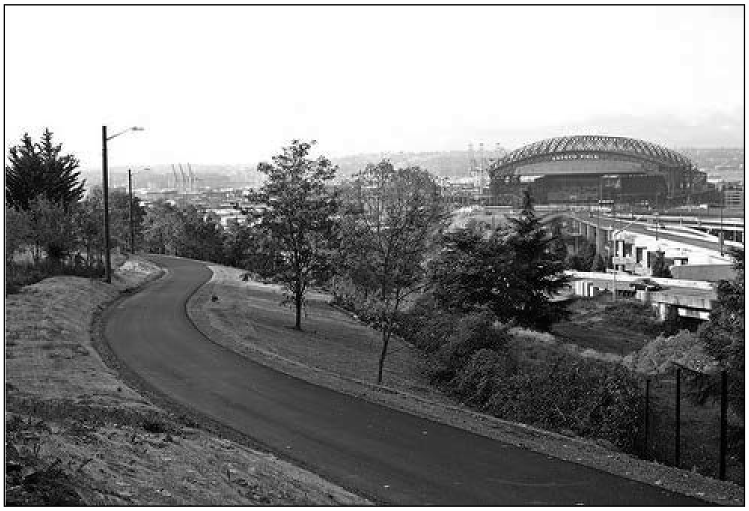
running slope A slope measured in the direction of travel, normally expressed as a percent.

shared-use landing A level (0 to 2% grade cross slope and running slope) paved area within the shared-use path, designed to provide turning and maneuvering space for wheelchair users and as a resting place for pedestrians.

shared-use path A facility physically separated from motorized vehicular traffic within the highway right of way or on an exclusive right of way with minimal crossflow by motor vehicles. Shared-use paths are primarily used by bicyclists and pedestrians, including joggers, skaters, and pedestrians with disabilities, including those who use nonmotorized or motorized wheeled mobility devices. With appropriate design considerations, equestrians may also be accommodated by a shared-use path facility.

1515.04 Shared-Use Path Design – The Basics

When designing shared-use paths, the bicyclist may not be the critical design user for every element of design. For example, the crossing speeds of most intersections between roads and pathways should be designed for pedestrians, as they are the slowest users. Accommodate all intended users, and minimize conflicts. When designing to serve equestrians, it is desirable to provide a separate bridle trail along the shared-use path to minimize conflicts with horses.



Shared-Use Path
Exhibit 1515-1

(1) Design Speed

The design speed for a shared-use path is based on the bicycle user and is dependent on the terrain and the expected conditions of use. Design the shared-use path to encourage bicyclists to operate at speeds compatible with other users. Higher speeds are discouraged in a mixed-use setting. Design shared-use paths to maintain speeds at or below the speeds shown in Exhibit 1515-2 by designing to the horizontal curve radii shown.

Conditions	Design Speed (mph)	Curve Radius (ft)
Long downgrades (steeper than 4% and longer than 500 ft)	30	166
Open country (level or rolling); shared-use paths in urban areas	20	74
Approaching intersections	12	27

Bicycle Design Speeds
Exhibit 1515-2

When minimum radius curves cannot be obtained because of right of way, topographical, or other constraints, consider installing the following mitigation measures for traffic calming to slow bicyclists when approaching curves:

- Intermittent curves to slow or maintain desired speeds.
- Standard curve warning signs and supplemental pavement markings in accordance with the MUTCD.
- Perpendicular stripes painted on the pathway in decreasing intervals to provide the perception of increased speed. This has been shown to slow drivers when applied to roadways.
- Changes in pavement texture to encourage reductions in speed at tight curve approaches.

The negative effects of tight radius curves can also be partially offset by widening the pavement through the curves. Steeper vertical grades affect the running speed of bicycles. A shared-use path should be designed not to exceed 5%. Refer to 1515.04(3) for further guidance.

(2) Widths, Cross Slopes, Side Slopes, and Clearances

(a) Shared-Use Path Widths

The appropriate paved width for a shared-use path is dependent on the context, volume, and mix of users. The desirable paved width of a shared-use path, excluding the shoulders on either side, is 12 feet. The minimum paved width, excluding the shoulders on either side, is 10 feet.

A paved width of more than 12 feet, excluding the shoulders on either side, may be appropriate when substantial use by both pedestrians and bicyclists is expected or maintenance vehicles are anticipated.

Shared-use path shoulders are typically unpaved and 2 feet wide on either side. Exhibits 1515-3 through 1515-5 provide additional information and cross-sectional elements.

On bridges or tunnels, it is common to pave the entire shared-use path, including shoulders. This usable width can be advantageous for emergency, patrol, and maintenance vehicles and allows for maneuvering around pedestrians and bicyclists who may have stopped. It also keeps the structure uncluttered of any loose gravel shoulder material.

1. **Exceptions to Minimum Path Widths**

A reduced path width of 8 feet may be designed at spot locations that present a physical constraint such as an environmental feature or other obstacle. Refer to the MUTCD for signing and pavement markings for such conditions.

In very rare circumstances, a reduced width of 8 feet may be used where the following conditions prevail:

- Bicycle traffic is expected to be low, even on peak days or during peak hours.
- Pedestrian use of the facility is not expected to be more than occasional.
- Horizontal and vertical alignments provide frequent, well-designed passing and resting opportunities.
- The shared-use path will not be regularly subjected to maintenance vehicle loading conditions that would cause pavement edge damage.
- The share-use path is for a short distance such as a spur connection to a neighborhood.

(b) Existing Shared-Use Paths – Considerations

Some existing shared-use paths were constructed to narrower dimensions, generally providing 8 feet of pavement. Evaluate existing older paths for current needs. Consider widening an existing shared-use path to meet current geometric standards.

(c) **Cross Slope**

The maximum cross slope on a paved shared-use path is to be 2%. The cross slope of the shoulders can be no steeper than 6H:1V. To accommodate drainage, the entire section, including shoulders, should transition through curves. It is desirable to design the pivot point on the outside edge of one side of the shoulder or the other to avoid a pavement crown (see Exhibits 1515-3 through 1515-5).

It is recommended that cross slopes be designed to be less than the allowed maximum to account for some tolerance in construction. For example, design for a 1.5% cross slope (rather than the 2% maximum).

Sloping the pavement surface to one side is desirable and usually simplifies drainage design and surface construction. Generally, surface drainage from the path is dissipated as it flows down the side slope.

(d) **Side Slopes and Pedestrian Rail**

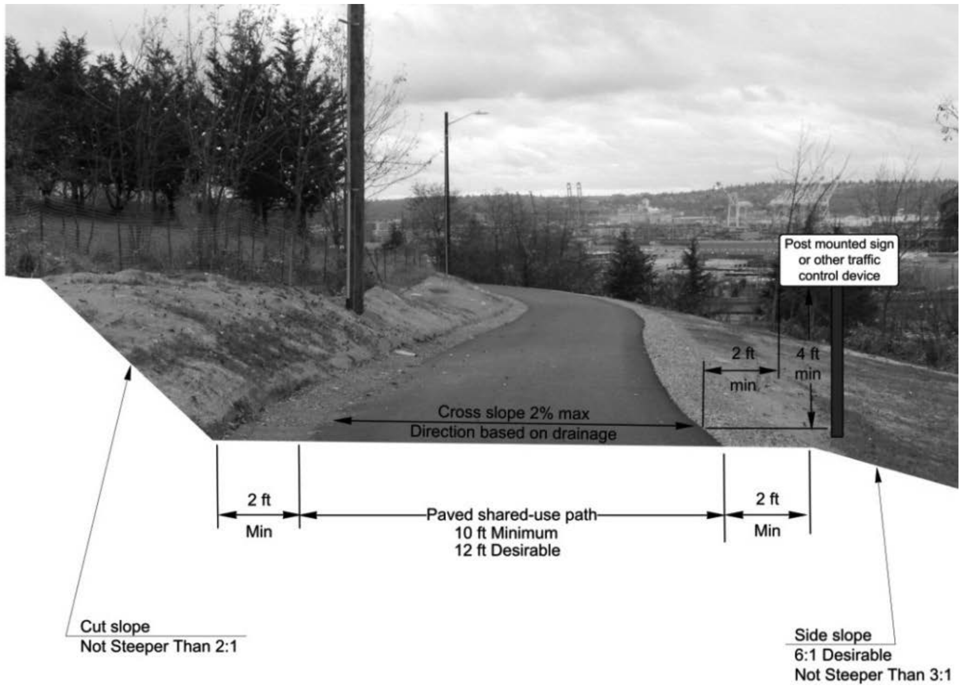
Side slopes along shared-use paths are an important design feature. Embankment side slopes of 6H:1V or flatter provide a gently sloping path border.

For shared-use paths with side slopes steeper than 3H:1V, or where obstacles or waterways may exist, evaluate the potential risk and provide mitigation such as:

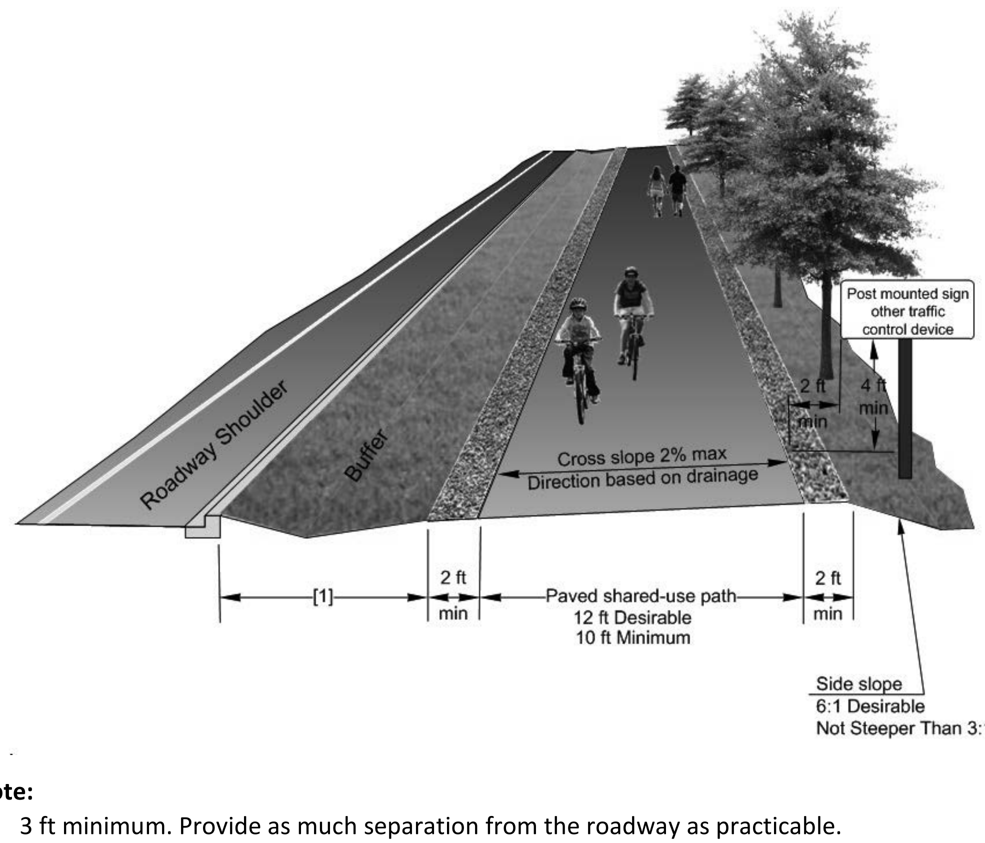
- A minimum 5-foot separation from the edge of the pavement to the embankment edge. This can be accomplished by providing a 5-foot shoulder as shown in Exhibit 1515-5, Example 2.
- A natural barrier such as dense shrubbery on the side slopes.
- A physical barrier, such as railing or chain link fencing, may be beneficial at the top of a high embankment.
- Where a shared-use path is adjacent to a vertical drop of 2 feet 6 inches or more, a pedestrian rail or chain link fencing is needed (see Exhibit 1515-5, Example 4).
- If the vertical drop is less than 2 feet 6 inches, then a 4-inch curb at the edge of the shared-use path is recommended in place of pedestrian railing or fencing.
- Where a shared-use path is constructed on the side of a hill, drainage facilities may need to be considered.

(e) **Clearances**

The minimum horizontal clearance from the edge of pavement to an obstruction (such as bridge piers or guardrail) is 2 feet. Provide a minimum vertical clearance of 10 feet from the pavement surface to overhead obstructions to accommodate maintenance vehicles, bicyclists, and equestrians.

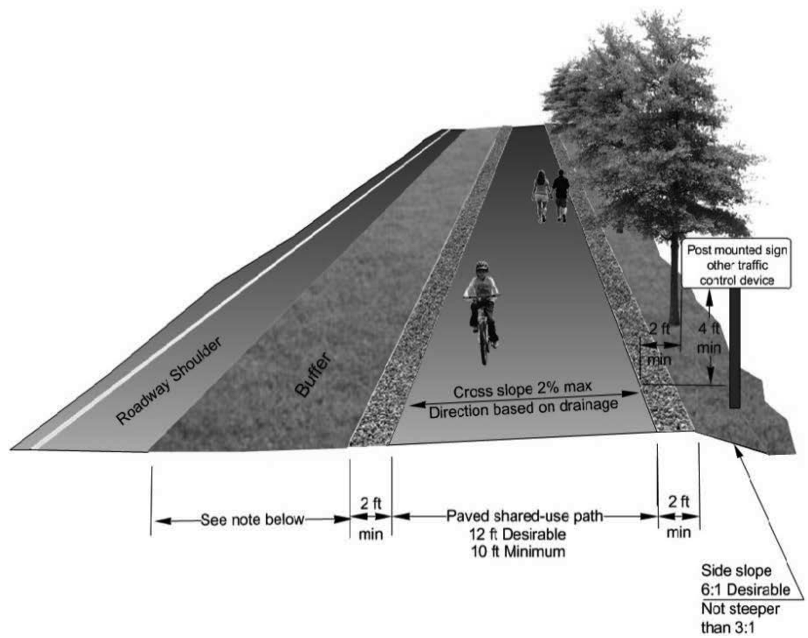


Two-Way Shared-Use Path: Independent Alignment
Exhibit 1515-3



Note:
[1] 3 ft minimum. Provide as much separation from the roadway as practicable.

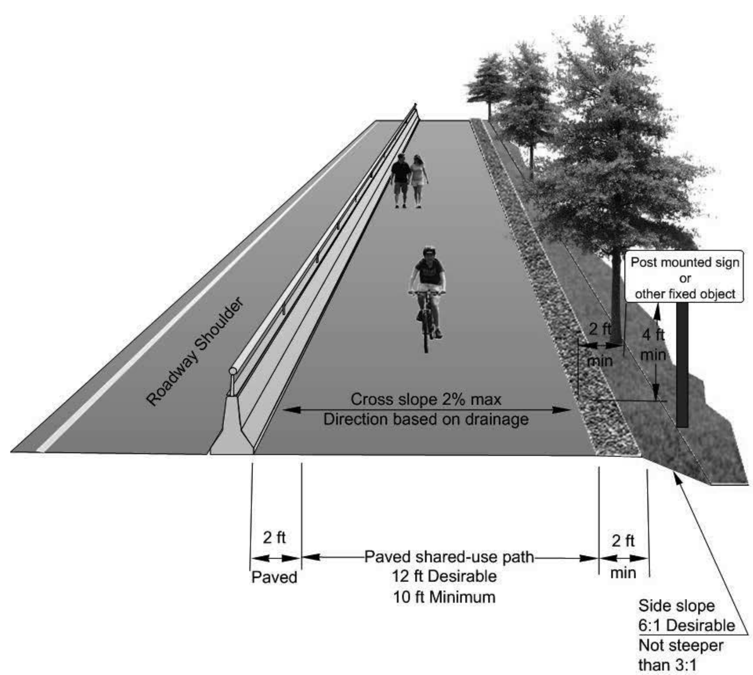
Two-Way Shared-Use Path: Adjacent to Roadway (≤ 35 mph)
Exhibit 1515-4a



Notes:
- A separation greater than 5 feet is required for path user comfort. If separation greater than 5 feet cannot be obtained, provide barrier separation in accordance with Exhibit 1515-4c.
- See Chapter 1600 for roadway clear zone design guidance for fixed objects.

Two-Way Shared-Use Path: Adjacent to Roadway (> 35mph)

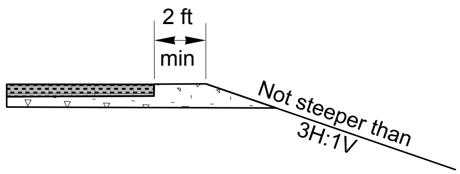
Exhibit 1515-4b



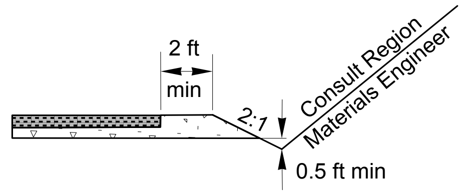
Notes:
- It is desirable for the cross slope to slope toward grass areas for drainage.
- See Chapter 1610 for barrier design. Pedestrian rail height minimum is 42 inches.

Two-Way Shared-Use Path: Attached to Roadway (>35mph)

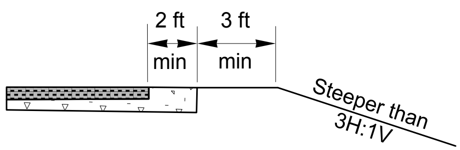
Exhibit 1515-4c



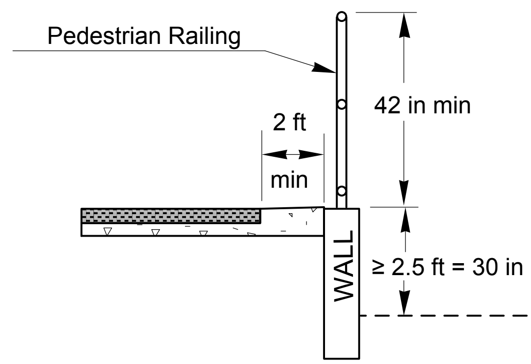
Example 1: Embankment
Based on context, flatter slopes are desirable.



Example 3: Cut section with ditch
Consult with the Region Materials Engineer to determine for appropriate cut slopes.



Example 2: Shoulder widening to 5 feet or more
Used with steeper fill slopes to provide clear space between the hinge point and path. Vegetation can also be used as a buffer on slopes. In lieu of 3 ft additional widening, consider a natural or physical barrier.



Example 4: Railing used at drop off
Apply railing or fencing a minimum of 42 inches high when a drop off is present, such as along a retaining wall. Consult with the Region Materials Engineer to determine if shoulder along wall should be paved.

Note: These drawings depict some common applications for various slope alternatives.

Shared-Use Path Side Slopes and Railing

Exhibit 1515-5

(3) Running Slopes, Landings, and Rest Areas

(a) **Running Slopes**

Design running slopes (grades) on shared-use paths less than or equal to 5% to accommodate all user types, including pedestrians with disabilities.

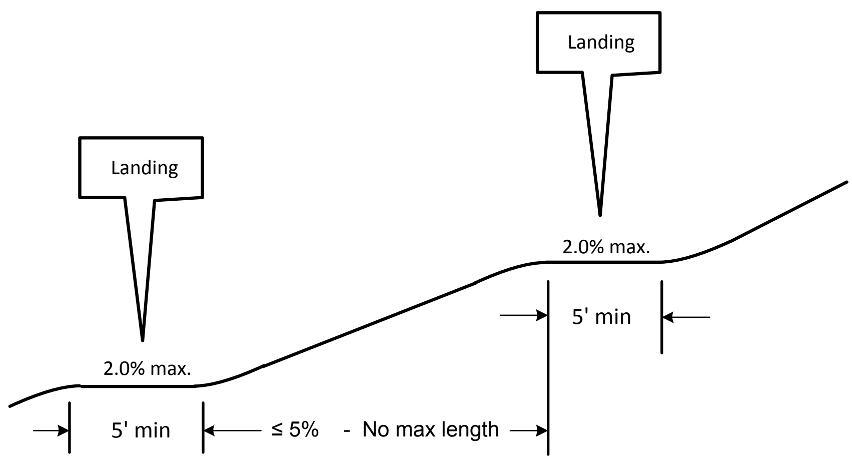
When the path is within the highway right of way, its running slope can match the general grade established for the adjacent roadway.

(b) **Landings**

Shared-use path landings provide users a level place to rest on extended grades. Exhibits 1515-6 and 1515-7 show these features.

Design landings to:

- Permit users to stop periodically and rest.
- Not exceed maximum running slopes and cross slopes of 2%.
- Be in line and as wide as the shared-use path. Landings are to be at least 5 feet long.
- Avoid abrupt grade changes or angle points. Design transitions to landings using vertical curves.



Notes:

- Landings are desirable on extended grades.
- Design vertical curves to transition from the grade to the landing.
- Exhibit 1515-7 illustrates a landing and a rest area.

Shared-Use Path Landing Profile

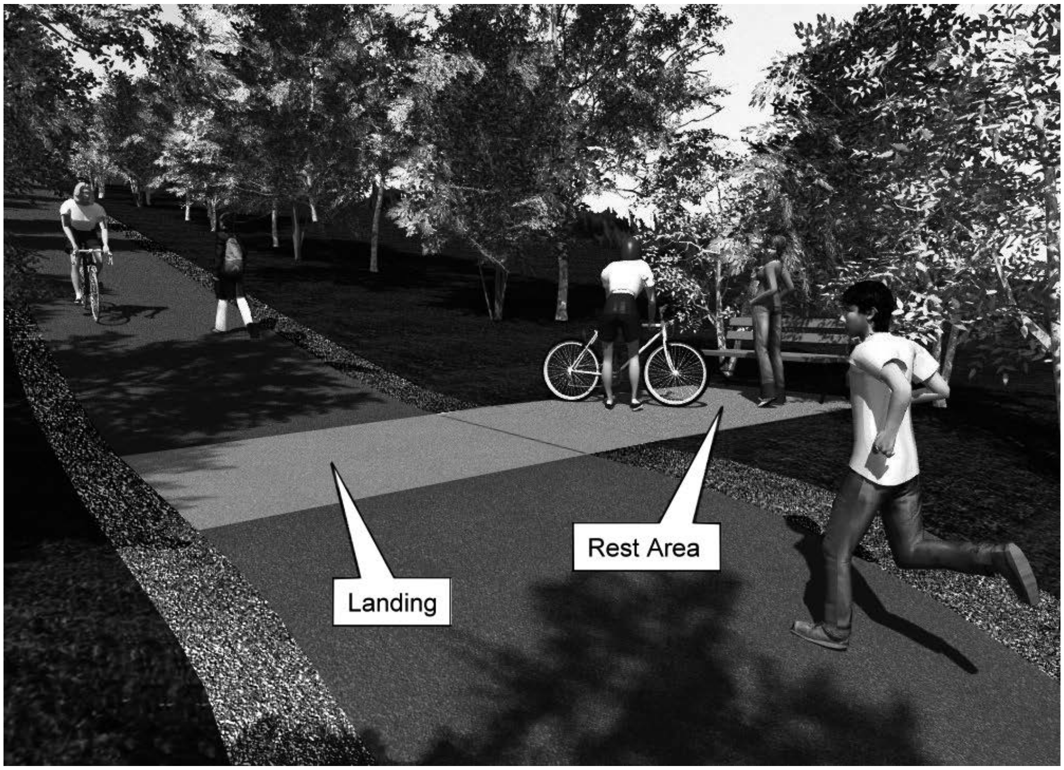
Exhibit 1515-6

(c) **Rest Areas**

Although not required, rest areas may be provided adjacent to the shared-use path outside of the path travelled way as shown in Exhibit 1515-7.

Requirements for rest areas include:

- The maximum running slope and cross slopes are 2%.
- The minimum size is to be 5 feet by 5 feet.
- If features such as benches are provided, they must meet ADA requirements; consult with the region ADA Coordinator for guidance.



Notes:
- Design inline landings at least 5 feet long and as wide as the shared-use path.
- Design inline landings with a maximum cross slope and running slope of 2%.

Shared-Use Path Landing and Rest Area
Exhibit 1515-7

(4) Pavement Structural Section

Design the pavement structural section of a shared-use path in the same manner as a highway, considering the quality of the subgrade and the anticipated loads on the path. (Design loads are normally maintenance and emergency vehicles.) Provide a firm, stable, slip-resistant pavement surface.

Design the pavement structural section as recommended by the Region Materials Engineer.

Use crushed rock or other suitable material for shoulder graded areas. Consult with the Region Materials Engineer. On bridges or tunnels, it is common to pave the entire shared-use path, including shoulders across the structure.

(5) Stopping Sight Distance

The distance needed to bring a shared-use path user to a complete stop is a function of the user's perception and braking reaction times, the initial speed, the coefficient of friction between the wheels and the pavement, the braking ability of the user's equipment, and the grade. Exhibits 1515-14a and 14b provide a graph and an equation to obtain minimum stopping sight distances for various design speeds and grades.

(a) **Stopping Sight Distance on Crest Vertical Curves**

Exhibit 1515-15 provides a chart or equations to obtain the minimum lengths of crest vertical curves for varying stopping sight distances and algebraic differences in grade. The values are based on a 4.5-foot eye height for the bicyclist and a 0-foot height for the object (path surface).

(b) **Stopping Sight Distance on Horizontal Curves**

Exhibit 1515-16 gives the minimum clearances to line-of-sight obstructions for sight distance on horizontal curves. Provide lateral clearance based on the sum of stopping sight distances from Exhibits 1515-14a and 14b for bicyclists traveling in both directions and the proposed horizontal curve radius. Where this minimum clearance cannot be obtained, provide curve warning signs and use centerline pavement markings in accordance with the MUTCD.

Exhibits 1515-14a, 14b, 15, and 16 are presented at the end of the chapter.

1515.05 Intersections and Crossings Design

This section covers path/roadway intersections and grade-separated crossings. Detectable warning surfaces are required where shared-use paths connect to the roadway.

(1) Intersections With Roadways

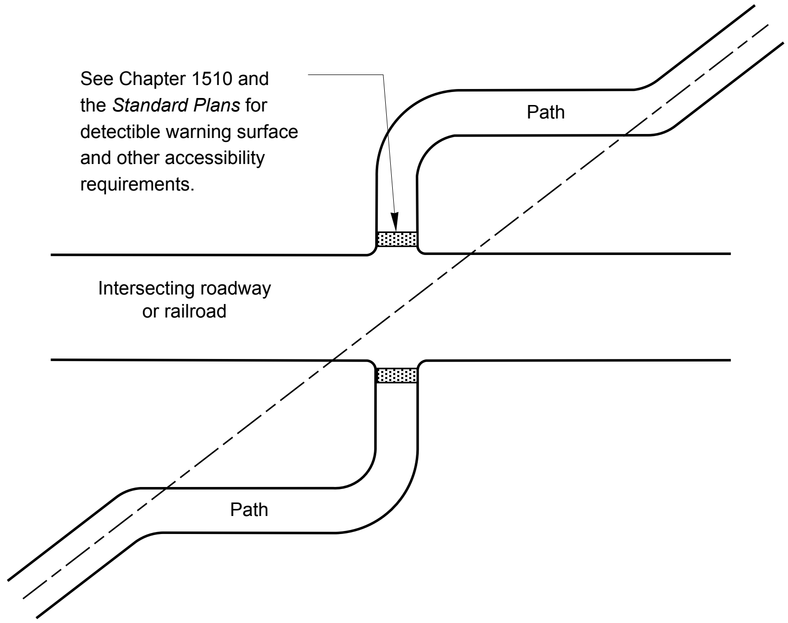
Clearly define who has the right of way and provide sight distance for all users at shared-use path and roadway intersections.

The common types of shared-use path/roadway at-grade intersection crossings are midblock and adjacent.

For roadway intersections with roundabouts, see Chapter 1320.

Midblock crossings are located between roadway intersections. Installation of a midblock crossing on a state highway is a design deviation that requires ASDE approval and documentation. When possible, locate the path crossings far enough away from intersections to minimize conflicts between the path users and motor vehicle traffic. It is preferable for midblock path crossings to intersect the roadway at an angle as close to perpendicular as practicable. A minimum 60-degree crossing angle is acceptable to minimize right of way needs. A diagonal midblock crossing can be altered as shown in Exhibit 1515-8.

There are other considerations when designing midblock crossings. They include traffic right of way assignments; traffic control devices; sight distances for both bicyclists and motor vehicle operators; refuge island use; access control; and pavement markings.



Notes:

- For path and highway signing and markings, see the MUTCD and the *Standard Plans*.
  http://www.wsdot.wa.gov/publications/fulltext/Standards/english/PDF/m09.60-00_e.pdf
- For radii approaching roadway intersections, see Exhibit 1515-2.

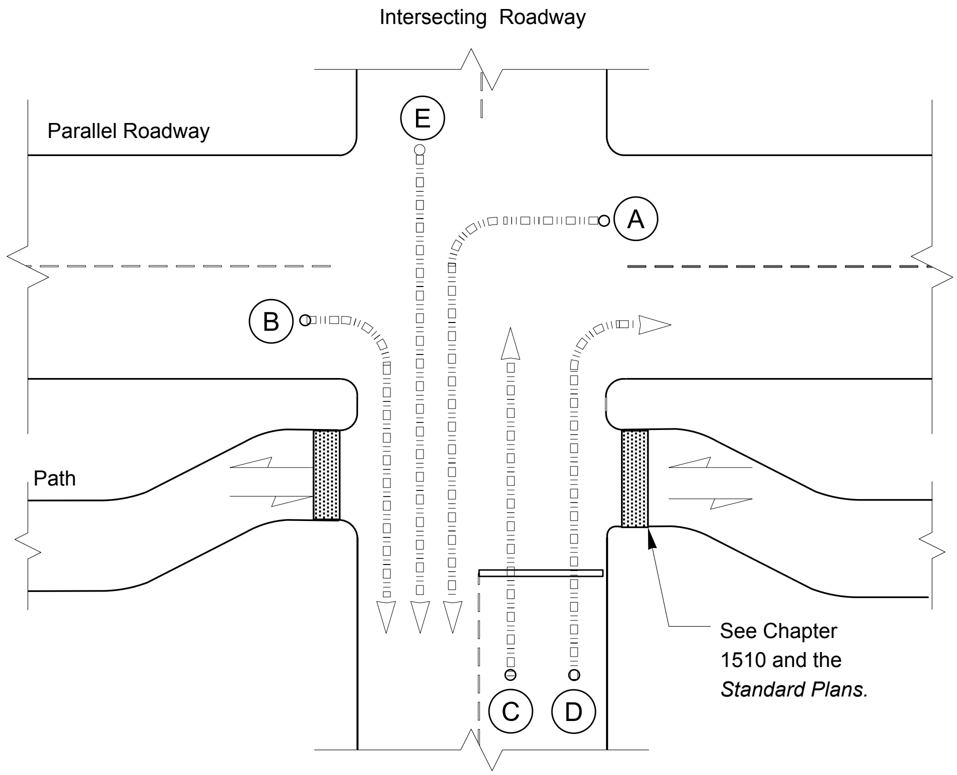
Typical Redesign of a Diagonal Midblock Crossing
Exhibit 1515-8

Adjacent path crossings are located at or near public intersection crosswalks and are normally placed with them. These crossings are usually placed with pedestrian crossings, where motorists can be expected to stop. If alternate intersection locations for a shared-use path are available, select the one with the greatest sight distance.

Adjacent path crossings occur where a path crosses an existing intersection of two roadways, a T intersection (including driveways), or a four-way intersection, as shown in Exhibit 1515-9. It is desirable to integrate this type of crossing close to an intersection so that motorists and path users recognize one another as intersecting traffic. The path user faces potential conflicts with motor vehicles turning left (A) and right (B) from the parallel roadway and on the crossed roadway (C, D, and E).

Consider crossing improvements on a case-by-case basis. Suggested improvements include: move the crossing; evaluate existing or proposed intersection control type; change signalization timing; or provide a refuge island and make a two-step crossing for path users.

Important elements that greatly affect the design of these crossings are traffic right of way assignments, traffic control devices, and the separation distance between path and roadway.



Note:
For signing and pavement markings, see the MUTCD and the *Standard Plans*.

Adjacent Shared-Use Path Intersection
Exhibit 1515-9

(a) Additional Roadway/Path Intersection Design Considerations

Additional roadway/path intersection design considerations include the following:

1. **Evaluate Intersection Control**

   Determine the need for traffic control devices at path/roadway intersections by using MUTCD warrants and engineering judgment. Bicycles are considered vehicles in Washington State, and bicycle path traffic can be classified as vehicular traffic for MUTCD warrants. Provide traffic signal timing set for pedestrians.

2. **Signal Actuation Mechanisms**

   Place the manually operated accessible pedestrian pushbutton in a location that complies with ADA requirements. For additional information, see Chapters 1330 and 1510. A detector loop in the path pavement may be provided in addition to the manually operated accessible pedestrian push button.

3. **Signing**

   Provide sign type, size, and location in accordance with the MUTCD. Place path STOP signs as close to the intended stopping point as feasible. Do not place the shared-use path signs where they may confuse motorists or place roadway signs where they may confuse shared-use path users. For additional information on signing, see the MUTCD and Chapter 1020.

4. **Approach Treatments**

   Design shared-use path and roadway intersections with level grades, and provide sight distances. Provide advance warning signs and pavement markings that alert and direct path users that there is a crossing (see the MUTCD). Do not use speed bumps or other similar surface obstructions intended to cause bicyclists to slow down. Consider some slowing features such as horizontal curves (see Exhibits 1515-2 and 1515-8). Avoid locating a crossing where there is a steep downgrade where bike speeds could be high.

5. **Sight Distance**

   Sight distance is a principal element of roadway and path intersection design. At a minimum, provide stopping sight distance for both the roadway and the path at the crossing. Decision sight distance is desirable for the roadway traffic. Refer to Chapter 1260 for stopping sight distance for the roadway and 1515.04(5) for shared-use path stopping sight distance.

6. **Curb Ramp Widths**

   Design curb ramps with a width equal to the shared-use path. Curb ramps and barrier-free passageways are to provide a smooth transition between the shared-use path and the roadway or sidewalk (for pedestrians). Curb ramps at path/roadway intersections must meet the requirements for curb ramps at a crosswalk. For design requirements, see Chapter 1510, and for curb ramp treatments at roundabouts, see Chapter 1320.

7. **Refuge Islands**

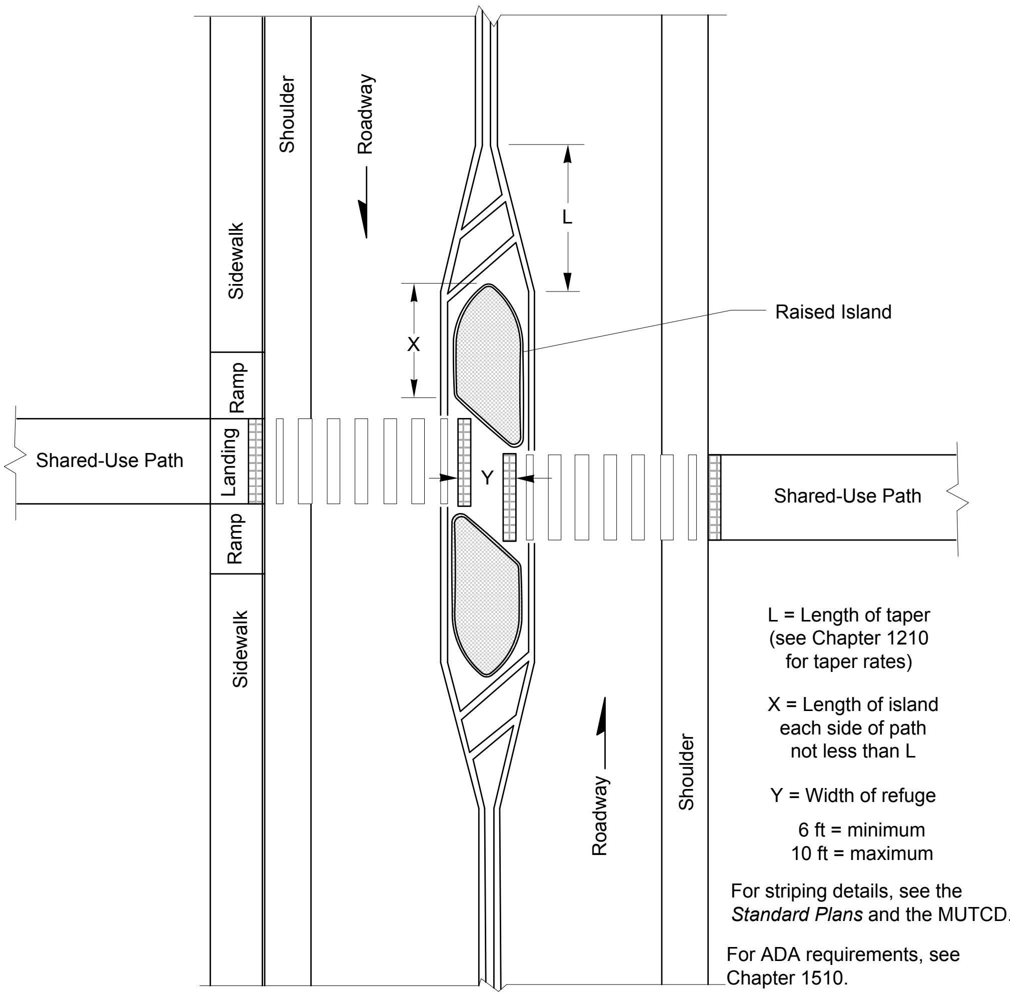
   Consider refuge islands where a shared-use path crosses a roadway when one or more of the following applies:

   - High motor vehicle traffic volumes and speeds
   - Wide roadways
   - Use by the elderly, children, the disabled, or other slow-moving users

   The refuge area may either be designed with the storage aligned perpendicularly across the island or be aligned diagonal (as shown in Exhibit 1515-10). The diagonal storage area has the added benefit of directing attention toward oncoming traffic since it is angled toward the direction from which traffic is approaching.

(2) At-Grade Railroad Crossings

Wherever possible, design the crossing at right angles to the rails. For signing and pavement marking for a shared-use path crossing a railroad track, see the MUTCD and the *Standard Plans*. Also, see Chapter 1510 for design of at-grade pedestrian railroad crossings.



Note:
This exhibit shows a case where a path intersects a roadway framed with both a sidewalk and a paved shoulder, for the purpose of showing detectible warning surface placements.

Roadway Crossing Refuge Area
Exhibit 1515-10

1515.06 Grade Separation Structures

Provide the same minimum clear width as the approach paved shared-use path plus the graded clear areas.

Carrying full widths across structures has two advantages:

- The clear width provides a minimum horizontal shy distance from the railing or barrier.
- It provides needed maneuvering room to avoid pedestrians and other bicyclists.

For undercrossings and tunnels, provide a minimum vertical clearance of 10 feet for path users from the path pavement to the structure above. This allows access by emergency, patrol, and maintenance vehicles on the shared-use path.

Consult the region Maintenance Office and the HQ Bridge Preservation Office to verify that the planned path width meets their needs. If not, widen to their specifications.

Use expansion joints that accommodate shared-use path users. Expansion joints should be perpendicular to the path and have a maximum gap of ½ inch or be covered with a slip-resistant plate.

Vertical clearance is the critical height under a structure that will accommodate vehicular and rail traffic based on its design characteristics. (See Chapter 720 for minimum vertical clearance guidance.)

The installation of protective screening is analyzed on a case-by-case basis. Refer to Chapter 720 for guidance.

Note:
On structures, the bridge railing type and height are part of the structure design. Contact the HQ Bridge and Structures Office for additional information.

Shared-Use Path Bridge and Approach Walls
Exhibit 1515-11

Notes:

- The photo above shows a bridge with a shared-use path separating the users from the roadway. Pedestrian rail is used on the outside edge.
- On structures, the bridge railing type and height are part of the structure design. Contact the HQ Bridge and Structures Office for additional information.

Bridge and Pedestrian Rail
Exhibit 1515-12

1515.07 Signing, Pavement Markings, and Illumination

Generally, WSDOT does not provide continuous centerline striping or channelization for user modes on shared-use paths. However, signing and pavement markings can be beneficial to warn shared-use path users of curves, grades, obstructions, and intersections.

Refer to the MUTCD for guidance and directions regarding signing (regulatory, warning, and way finding) and pavement markings.

The *Standard Plans* shows shared-use path pavement markings at obstructions in accordance with the MUTCD and also shows placement of detectible warning surfaces.

For pavement marking around bollards and other obstructions, see Standard Plan M-9.60:
http://www.wsdot.wa.gov/publications/fulltext/standards/english/pdf/m09.60-00_e.pdf

The level of illumination on a shared-use path is dependent on the amount of nighttime use expected and the nature of the area surrounding the facility. If illumination is used, provide illumination in accordance with Chapter 1040.

1515.08 Restricted Use Controls

This section presents considerations on use of fencing and other treatments to restrict roadway and path users to their domains.

(1) Fencing

Limited access highways often require fencing or other forms of controlling access. Shared-use paths constructed within these corridors, such as shown in Exhibit 1515-13, likely require fencing. For guidance on fencing, limited access controls, and right of way, refer to Division 5 of the *Design Manual*. Evaluate the impacts of fencing on sight distances.

Shared-Use Path in Limited Access Corridor
Exhibit 1515-13

(2) Restriction of Motor Vehicle Traffic

Shared-use paths often need some form of physical barrier at roadway intersections to prevent unauthorized motor vehicles from entering.

Bollards have been used by many path owners to prevent unauthorized vehicle access. However, bollards should not be applied indiscriminately, and there are other considerations to bollard installation.

(a) Landscaped Islands

A preferred method of restricting entry of motor vehicles is to split the entry way into two sections separated by low landscaping, thereby splitting a path into two channels at roadway intersections. This method essentially creates an island in the middle of the path rather than installing a bollard. Such an island could be planted with low-growing, hardy vegetation capable of withstanding the occasional authorized vehicle traveling over it. When splitting a path, employ MUTCD pavement markings and signing, such as is used for bollards and obstructions.

(b) Bollard Considerations

Typically, one bollard located in the center of the path is sufficient to control motor vehicle access to the path. If more than one bollard is needed, the additional bollards should be placed at the edge of the shared-use path.

Install bollards at entrances to shared-use paths to discourage motor vehicles from entering. Do not use bollards to divert or slow path traffic. When locating such installations, stripe an envelope around the bollards and paint and reflectorize them to be visible to path users both day and night. Bollards located on or adjacent to shared-use paths represent an object that needs to be avoided by bicyclists and pedestrians. To increase the potential for appropriate maneuvering to occur, provide designs where the post is clearly visible and recognizable.

When designing bollards, the following apply:

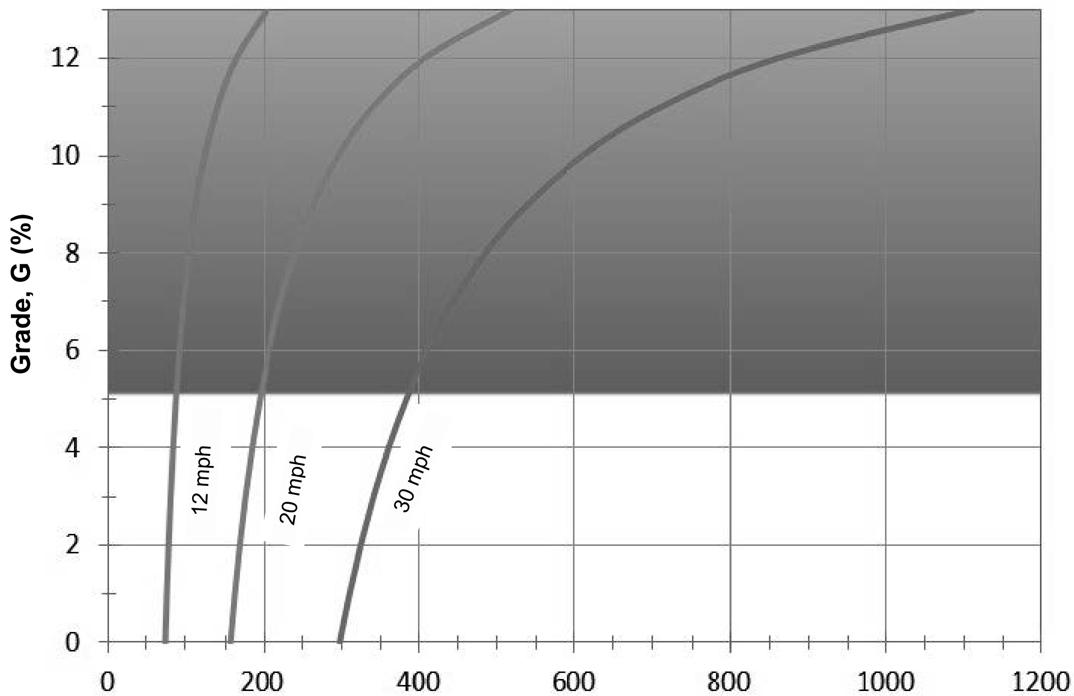
- The desirable design is to provide a single bollard, installed in the middle of the path to reduce confusion.
- When multiple bollard posts are used in wide path sections, use a minimum 5-foot spacing between the edge of concrete footings to permit passage of bicycle-towed trailers, wheelchairs, and adult tricycles, with room for bicycle passage without dismounting.
- Provide 4 feet minimum (5 feet desirable) clear width between the edge of concrete footing and edge of path.
- At a minimum, provide stopping sight distance to bollards. An ideal location for bollard placement is in a relatively straight area of the path where the post placement has the stopping sight distance given in Exhibit 1515-14a and 14b. Do not place bollards in difficult-to-see locations (for example, immediately upon entering a tunnel).
- For cases where multiple posts are used longitudinally along the path, locate them at least 20 feet apart, with the first post in line from each direction having stopping sight distance.
- Use a contrasting striping pattern on the post.
- Use reflective materials on the post, such as a band at the top and at the base.
- Design all bollards along a corridor to be uniform in appearance. Frequent cyclists can become familiar with the posts and recognize them easily.
- Provide pavement markings in accordance with the *Standard Plans* and MUTCD at all bollards on paved paths.
- Use removable bollards (Bollard Type 1) to permit access by emergency and service vehicles.
- Nonremovable bollards (Bollard Type 2) may be used where access is not needed.

Refer to the *Standard Plans* for bollard designs and the *Standard Plans* and MUTCD for pavement markings at bollards.

When bollards need to be placed near the roadway, see Chapter 1600 for clear zone requirements.

1515.09 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



Stopping Sight Distance, *S* (ft)
(Based on 2.5 second reaction time)

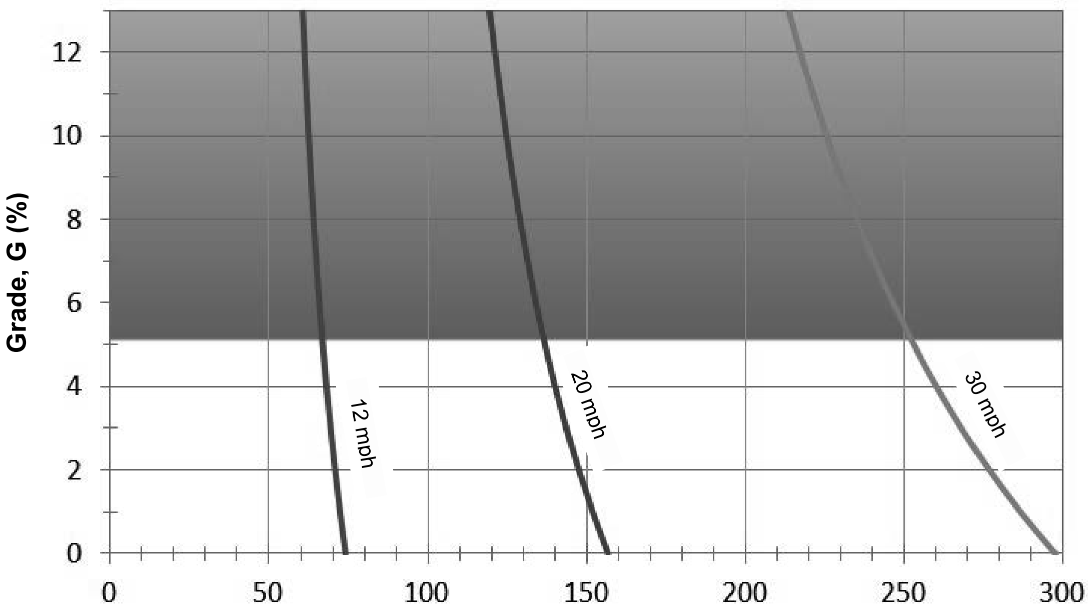
Note:
Shaded area represents grades greater than 5%.

$$S = \frac{V^2}{0.30(f - G)} + 3.67V$$

Where:

S = Stopping sight distance (ft)
V = Speed (mph)
f = Coefficient of friction (use 16)
G = Grade (%)

Stopping Sight Distance for Downgrades
Exhibit 1515-14a



Stopping Sight Distance, *S* (ft)
(Based on 2.5 second reaction time)

Note:
Shaded area represents grades greater than 5%.

$$S = \frac{V^2}{0.30(f + G)} + 3.67V$$

Where:

S = Stopping sight distance (ft)
V = Speed (mph)
f = Coefficient of friction (use 16)
G = Grade (%)

Stopping Sight Distance for Upgrades
Exhibit 1515-14b

A (%)	Stopping Sight Distance, S (ft)												
	40	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	
2	3	3	3	3	3	3	3	3	3	3	30	70	110	150
3	3	3	3	3	3	3	20	60	100	140	180	220	260	300
4	3	3	3	3	15	55	95	135	175	215	256	300	348	400
5	3	3	3	20	60	100	140	180	222	269	320	376	436	500
6	3	3	10	50	90	130	171	216	267	323	384	451	523	600
7	3	3	31	71	111	152	199	252	311	376	448	526	610	700
8	3	8	48	88	128	174	228	288	356	430	512	601	697	800
9	3	20	60	100	144	196	256	324	400	484	576	676	784	900
10	3	30	70	111	160	218	284	360	444	538	640	751	871	1,000
11	3	38	78	122	176	240	313	396	489	592	704	826	958	1,100
12	5	45	85	133	192	261	341	432	533	645	768	901	1,045	1,200
13	11	51	92	144	208	283	370	468	578	699	832	976	1,132	1,300
14	16	56	100	156	224	305	398	504	622	753	896	1,052	1,220	1,400
15	20	60	107	167	240	327	427	540	667	807	960	1,127	1,307	1,500
16	24	64	114	178	256	348	455	576	711	860	1,024	1,202	1,394	1,600
17	27	68	121	189	272	370	484	612	756	914	1,088	1,277	1,481	1,700
18	30	72	128	200	288	392	512	648	800	968	1,152	1,352	1,568	1,800
19	33	76	135	211	304	414	540	684	844	1,022	1,216	1,427	1,655	1,900
20	35	80	142	222	320	436	569	720	889	1,076	1,280	1,502	1,742	2,000
21	37	84	149	233	336	457	597	756	933	1,129	1,344	1,577	1,829	2,100
22	39	88	156	244	352	479	626	792	978	1,183	1,408	1,652	1,916	2,200
23	41	92	164	256	368	501	654	828	1,022	1,237	1,472	1,728	2,004	2,300
24	43	96	171	267	384	523	683	864	1,067	1,291	1,536	1,803	2,091	2,400
25	44	100	178	278	400	544	711	900	1,111	1,344	1,600	1,878	2,178	2,500

Minimum Length of Vertical Curve, L (ft)

$$L = \frac{AS^2}{900} \quad \text{when } S < L$$

$$L = 2S - \frac{900}{A} \quad \text{when } S > L$$

Where:
S = Stopping sight distance (ft)
A = Algebraic difference in grade (%)
L = Minimum vertical curve length (ft)
Based on an eye height of 4.5 ft and an object height of 0 ft.

Note:
Below ▬▬ represents $S \le L$.
Shaded area represents A>10%.

Minimum Lengths for Crest Vertical Curves
Exhibit 1515-15

Height of eye: 4.50 ft

Height of object: 0.0 ft

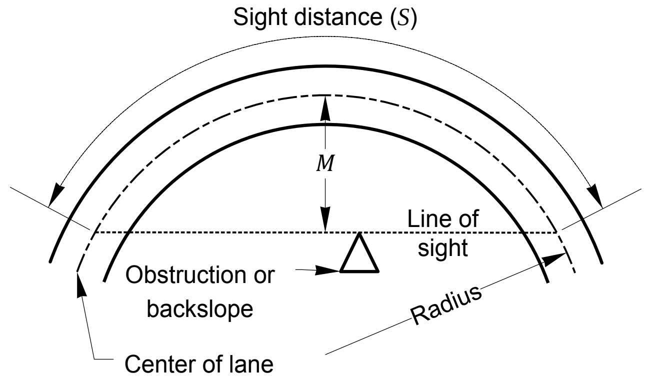
Line of sight at the M distance is normally 2.3 ft above centerline of inside lane at point of obstruction, provided no vertical curve is present in horizontal curve.

$$M = R\left(1 - \text{COS}\frac{S\,28.65}{R}\right)$$

$$S = \frac{R}{28.65}\left[\text{COS}^{-1}\left(\frac{R-M}{R}\right)\right]$$

$S \leq$ Length of curve

Angle is expressed in degrees.



Where:

S = Sight distance (ft)

R = Centerline radius of inside lane (ft)

M = Distance from inside lane centerline (ft)

R (ft)	**Stopping Sight Distance, S (ft)[1]**													
	40	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**240**	**260**	**280**	**300**
25	7.6	15.9												
50	3.9	8.7	15.2	23.0	31.9	41.5								
75	2.7	5.9	10.4	16.1	22.7	30.4	38.8	47.8	57.4	67.2				
95	2.1	4.7	8.3	12.9	18.3	24.6	31.7	39.5	47.9	56.9	66.2	75.9	85.8	
125	1.6	3.6	6.3	9.9	14.1	19.1	24.7	31.0	37.9	45.4	53.3	61.7	70.5	79.7
150	1.3	3.0	5.3	8.3	11.8	16.0	20.8	26.2	32.1	38.6	45.5	52.9	60.7	69.0
175	1.1	2.6	4.6	7.1	10.2	13.8	18.0	22.6	27.8	33.4	39.6	46.1	53.1	60.4
200	1.0	2.2	4.0	6.2	8.9	12.1	15.8	19.9	24.5	29.5	34.9	40.8	47.0	53.7
225	0.9	2.0	3.5	5.5	8.0	10.8	14.1	17.8	21.9	26.4	31.2	36.5	42.2	48.2
250	0.8	1.8	3.2	5.0	7.2	9.7	12.7	16.0	19.7	23.8	28.3	33.0	38.2	43.7
275	0.7	1.6	2.9	4.5	6.5	8.9	11.6	14.6	18.0	21.7	25.8	30.2	34.9	39.9
300	0.7	1.5	2.7	4.2	6.0	8.1	10.6	13.4	16.5	19.9	23.7	27.7	32.1	36.7
350	0.6	1.3	2.3	3.6	5.1	7.0	9.1	11.5	14.2	17.1	20.4	23.9	27.6	31.7
400	0.5	1.1	2.0	3.1	4.5	6.1	8.0	10.1	12.4	15.0	17.9	20.9	24.3	27.8
500	0.4	0.9	1.6	2.5	3.6	4.9	6.4	8.1	10.0	12.1	14.3	16.8	19.5	22.3
600	0.3	0.7	1.3	2.1	3.0	4.1	5.3	6.7	8.3	10.1	12.0	14.0	16.3	18.7
700	0.3	0.6	1.1	1.8	2.6	3.5	4.6	5.8	7.1	8.6	10.3	12.0	14.0	16.0
800	0.2	0.6	1.0	1.6	2.2	3.1	4.0	5.1	6.2	7.6	9.0	10.5	12.2	14.0
900	0.2	0.5	0.9	1.4	2.0	2.7	3.6	4.5	5.5	6.7	8.0	9.4	10.9	12.5
1,000	0.2	0.4	0.8	1.2	1.8	2.4	3.2	4.0	5.0	6.0	7.2	8.4	9.8	11.2

Minimum Lateral Clearance, M (ft)

Note:

[1] S is the sum of the distances (from Exhibits 1515-14a and 14b) for bicyclists traveling in both directions.

Lateral Clearance for Horizontal Curves

Exhibit 1515-16

- When removing and resetting guardrail runs, consider using steel posts and reusing or replacing other components and hardware depending on condition.

(4) Additional Guidance

- Weak post W-beam guardrail (Type 20) and thrie beam guardrail (Type 21) are flexible barrier systems that can be used where there is adequate deflection distance. These systems use weak steel posts. The primary purpose of these posts is to position the guardrail vertically, and they are designed to bend over when struck. These more flexible systems will likely result in less damage to the impacting vehicle. Since the weak posts will not result in snagging, blockouts are not necessary.
- Keep the slope of the area between the edge of the shoulder and the face of the guardrail 10H:1V or flatter. On fill slopes between 6H:1V and 10H:1V, avoid placing within 12 feet of the break point. Do not place beam guardrail on a fill slope steeper than 6H:1V. (See Exhibit 1610-4 for additional guidance on beam guardrail slope placement.)
- On the high side of superelevated sections, place beam guardrail at the edge of shoulder prior to the slope break.
- For W-beam guardrail installed at or near the shoulder, 2 feet of shoulder widening behind the barrier is generally provided from the back of the post to the beginning of a fill slope (see Exhibit 1610-11, Case 2). If the slope is 2H:1V or flatter, this distance can be measured from the face of the guardrail rather than the back of the post (see Exhibit 1610-11, Case 1).
- On projects where no roadway widening is proposed and the minimum 2-foot shoulder widening behind the barrier is not practicable, long post installations are available as shown in Exhibit 1610-11, Cases 3, 4, 5, and 6. When guardrail is to be installed in areas where the roadway is to be widened or along new alignments, the use of Cases 4, 5, and 6 requires a design deviation.
- Rail washers on beam guardrail are not normally used. If rail washers are present, removal is not necessary except for posts 2 through 8 of an existing BCT installation. However, if the rail element is removed for any reason, do not reinstall rail washers. In areas where heavy snow accumulations are expected to cause the bolts to pull out, specify snowload post washers and rail washers in the contract documents. (Snowload post washers are used to help prevent the bolts from pulling through the posts, and snowload rail washers are used to help prevent the bolt head from pulling through the rail.) In other installations, it is normal to have the rail pull loose from the bolt head when impacted. Do not use rail washers within the limits of a guardrail terminal except at the end post where they are needed for anchorage of the rail.
- The use of curb in conjunction with beam guardrail is discouraged. If a curb is needed, the 3-inch-high curb is preferred. If necessary, the 4-inch-high extruded curb can be used behind the face of rail at any posted speed. The 6-inch-high extruded curb can be used at locations where the posted speed is 50 mph or below. When replacing extruded curb at locations where the posted speed is above 50 mph, use 3-inch-high or 4-inch-high curb. (See the *Standard Plans* for extruded curb designs.)

Note: When used in conjunction with the 31-inch-high Type 31 W-beam guardrail, an acceptable option is to place up to a 6-inch-high extruded curb at a maximum 6-inch offset outside the face of the rail at any posted speed. Contact the WSDOT Design Office for more information.

- Beam guardrail is usually galvanized and has a silver color. It can also be provided in weathering steel that has a brown or rust color. Along Scenic Byways, Heritage Tour Routes, state highways through national forests, or other designated areas, consider using weathering steel guardrail, colored terminals (powder-coated galvanized steel), and colored steel posts (galvanized weathering steel or powder-coated galvanized steel) to minimize the barrier's visual impact (see 1610.05).
- In areas where weathering steel will be used and the steel post options cannot be used because of stakeholder constraints, the wood post option may be used with justification (Design Decision Memo).
- There are new methods under development that may change the options for providing colored guardrail to meet the aesthetic criteria for Scenic Byway locations. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

(5) Terminals and Anchors

A guardrail anchor is needed at the end of a run of guardrail to develop tensile strength throughout its length. In addition, when the end of the guardrail is subject to head-on impacts, a crash-tested guardrail terminal is needed (see the *Standard Plans*).

(a) Buried Terminal (BT)

A buried terminal is designed to terminate the guardrail by burying the end in a backslope. The BT is the preferred terminal because it eliminates the exposed end of the guardrail.

The BT uses a Type 2 anchor to develop the tensile strength in the guardrail. The backslope needed to install a BT is to be 3H:1V or steeper and at least 4 feet in height above the roadway. The entire BT can be used within the length of need for backslopes of 1H:1V or steeper if the barrier remains at full height in relation to the roadway shoulder to the point where the barrier enters the backslope. For backslopes between 1H:1V and 3H:1V, design the length of need beginning at the point where the W-beam remains at full height in relation to the roadway shoulder—usually beginning at the point where the barrier crosses the ditch line. If the backslope is flatter than 1H:1V, provide a minimum 20-foot-wide by 75-foot-long distance behind the barrier and between the beginning length of need point at the terminal end to the mitigated object to be protected.

For new BT installations, use the Buried Terminal Type 2. Note: Previously, another BT option (the Buried Terminal Type 1) was an available choice. For existing situations, it is acceptable to leave this option in service as long as height requirements and other previous design criteria can still be met.

- **Cases 12 and 13** are called "Weak Post Intersection Designs." They are used where an intersection design needs a gap in the guardrail or there is not adequate space for a bridge approach installation that includes a transition, a terminal, or both. These placements are designed to collapse when hit at the nose, and the ribbon strength of the rail brings the vehicle to a stop. A Type 7 anchor is used to develop the ribbon strength. These designs include a Type 5 transition for connection with bridge rail and a Type 5 anchor at the other end of the rail. The Type 5 anchor is not a breakaway anchor and therefore can typically be used only in situations where a crash-tested terminal is not needed; for example, where slow-moving vehicles are anticipated, such as some side roads and driveways.

  Since an impacting vehicle might penetrate into the system, it is critical that no fixed feature be located within the clear area shown in the Standard Plans. The 25 feet of barrier length beyond the PC along the side road are critical for the operation of this system.

  These designs were developed for intersections that are approximately perpendicular. Evaluate installation on skewed intersections on a case-by-case basis. Use the Case 22 placement if it is not feasible to install this design according to the *Standard Plans*.

- **Case 14** shows the approach rail layout for a Service Level 1 bridge rail system. Type 20 guardrail is used on the approach and no transition is needed between the Type 20 guardrail and the Service Level 1 bridge rail since they are both weak post systems. A Type 6 transition is used when connecting the Type 20 to a strong post guardrail or a terminal.
- **Case 15** is used to carry guardrail across a box culvert where there is insufficient depth to install standard posts for more than 17 feet 8 inches. This design uses steel posts anchored to the box culvert to support the rail. Newer designs—Cases 19, 20, and 21—have replaced this design for shorter spans.
- **Cases 16 and 17** are similar to Cases 1 and 2, except that they flare the rail and terminal as far from the road as possible and reduce the length of need.
- **Case 18** is used on the trailing end of bridge rail on a one-way roadway. No transition is needed.
- **Case 19 (A and B)** is used where it is not possible to install a post at the 6-foot-3-inch spacing. This design omits one post (resulting in a span of 11 feet 6 inches, which is consistent with a post spacing of 12 feet 6 inches) and uses nested W-beam to stiffen the rail. The cases differ by the location of the splice. No cutting of the rail or offsetting of the splices is needed or desirable.
- **Case 20** is similar to Cases 19A and 19B, except that it allows for two posts to be omitted, which results in a span consistent with post spacing of 18 feet 9 inches.
- **Case 21** has a similar intent as Cases 19A, 19B, and 20 in that it allows for the omission of posts to span an obstruction. This design uses CRT posts with additional post blocks for three posts before and after the omitted posts. The design allows for three posts to be omitted, which results in a span consistent with a post spacing of 25 feet.
- **Case 22** is the "Strong Post Intersection Design" that provides a stiff barrier. This design is to be used as a last resort at crossroads or road approaches where a barrier is needed and there isn't a clear area behind the nose or minimum distances for a "Weak Post Intersection Design" (see Cases 12 and 13).

Note: Some placement cases for use with Beam Guardrail Type 31 are currently under development. As plans become available, they will be housed in the HQ Design Standards (Plan Sheet Library) until they become Standard Plans (www.wsdot.wa.gov/design/standards/plansheet).

1610.07 Cable Barrier

Cable barrier is a flexible barrier system that can be used on a roadside or as a median barrier. It is used primarily in medians and is preferred for many installations due in part to its high benefit-to-cost ratio. Some of the advantages of cable barrier are:

- It provides effective vehicle containment and redirection while imposing the lowest deceleration forces on the vehicle's occupant(s).
- It may reduce the severity of collisions, which is of significant importance on high-speed facilities.
- After it is struck, it has a tendency not to redirect vehicles back into traffic, which can help reduce the frequency of secondary collisions.
- It can often be placed on existing facilities without the delay of extended environmental permitting and the expense of complex highway reconstruction that might be needed for other barrier system choices.
- It has advantages in heavy snowfall areas because it has minimal potential to create snowdrifts.
- In crucial wildlife habitats, it can aid in some types of animal movements.
- It does not present a visual barrier, which may make it desirable on Scenic Byways (see 1610.05).
- The effort (time and materials) needed to maintain and repair cable barrier systems is much less than the effort needed for a W-beam system.

Deflection is a consideration in narrower median areas and in many urban and other limited-width situations. Use of cable barrier in these situations may not be possible or may require special designs.

For new installations, use four-cable high-tension cable barrier systems, which are available from several manufacturers.

(1) High-Tension Cable Barrier Placement

For typical median applications with slopes between 10H:1V and 6H:1V, the following apply when using single runs of cable barrier (see Exhibit 1610-13a):

- Cable barrier may be installed in the centerline of the ditch.
- Cable barrier can be offset from the ditch centerline no more than 1 foot (left or right).
- Avoid installing cable barrier within a 1-foot to 8-foot offset from the ditch centerline.
- When locating cable barrier between an 8-foot offset from the ditch centerline and the slope breakpoint, place the cable barrier as far from the edge of traveled way as practicable. Provide a minimum placement distance of 8 feet to the edge of traveled way to allow vehicles to use this area for refuge (see Exhibit 1610-13a).

- For median shoulder applications, place the cable barrier as far from the edge of traveled way as practicable. Maintain a minimum of 8 feet of usable shoulder width between the edge of traveled way and the face of the cable barrier system (see Exhibit 1610-13a).

  Note: Exhibit 1610-13a shows typical median placement criteria for single runs of cable barrier. Additional placement cases are shown in the WSDOT *Standard Plans*. For non-typical installations, such as double runs of cable barrier or median ditch cross sections that differ significantly from those shown, contact the HQ Design Office for guidance.
- In some situations with cable barrier installations in medians, it is advantageous to terminate a run on one side of the median and begin an adjacent run on the opposite side. In this type of application, it is important to provide adequate cable barrier overlap distance between the two runs. For placement guidance, see Exhibit 1610-13c.

Narrow medians provide little space for maintenance crews to repair or reposition the barrier. Wherever site conditions permit, provide at least 14 feet of clearance from the adjacent lane edge to the cable barrier.

For typical non-median shoulder applications (see Exhibit 1610-13b), the following apply:

- Place the cable barrier as far from the edge of traveled way as practicable.
- For shoulder widths less than 8 feet, see 1610.05(2) for further guidance.
- Install cable between slope breakpoints as shown in Exhibit 1610-13b.
- Install cable barrier on slopes that are 6H:1V or flatter.
- Cable barrier can be installed up to 1 foot in front of slope breakpoints as steep as 2H:1V.

Note: There are approved high-tension cable barrier systems that can be placed on slopes as steep as 4H:1V. The use of these systems requires special placement considerations. Contact the HQ Design Office for guidance when selecting these systems.

(2) High-Tension Cable Barrier Deflection Distances

Depending on the system and post spacing, deflection distances for high-tension barrier systems may range from approximately 6 to 12 feet. Specify the maximum allowable deflection distance in the contract documents. (See Exhibits 1610-13a and 13b for placement details.)

Note: There are new high-tension cable barrier systems under development that may change selection and placement criteria. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

(3) High-Tension Cable Barrier Termination

- It is possible to terminate high-tension cable barrier systems by connecting directly to beam guardrail runs that are rigidly anchored (such as transitions to bridge rails) and also to a separate anchorage system. Designers should review field conditions, check local maintenance personnel needs, and then specify the required connection option in the contract documents. If a separate anchorage system is used, refer to Exhibit 1610-13c for placement guidance.

- When cable barrier is to be connected to a more rigid barrier, a transition section is typically needed. Contact the HQ Design Office for further details.

(4) High-Tension Cable Barrier Height Criteria

Select a high-tension four-cable barrier system with a height to the center of the top cable of not less than 35 inches and a height to the center of the bottom cable not greater than 19 inches.

(5) High-Tension Cable Barrier Curb Placement

Avoid the placement of curb in conjunction with high-tension cable barrier systems. Currently, there are no known acceptable cable barrier systems that have been successfully crash tested with this feature present.

Note: There are high-tension cable barrier systems under development that may change selection and placement criteria. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.

1610.08 Concrete Barrier

General Considerations:

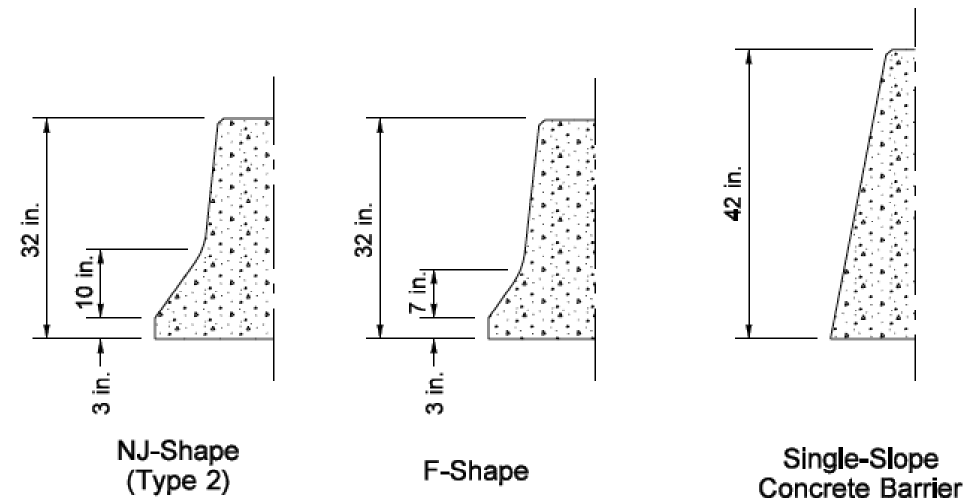
- Concrete barriers are rigid, rigid anchored, or unrestrained rigid systems. Commonly used in medians, they are also used as shoulder barriers. These systems are stiffer than beam guardrail or cable barrier, and impacts with these barriers tend to be more severe.
- Light standards mounted on top of concrete median barrier must not have breakaway features. (See the concrete barrier light standard section in the *Standard Plans*.)
- When concrete barrier is considered for use in areas where drainage and environmental issues (such as stormwater, wildlife, or endangered species) might be adversely impacted, contact the HQ Hydraulics Office and the appropriate environmental offices for guidance.

(1) Concrete Barrier Shapes

Concrete barriers use a single-slope or safety shape (New Jersey or F-Shape) to redirect vehicles while minimizing vehicle vaulting, rolling, and snagging. A comparison of these barrier shapes is shown in Exhibit 1610-7.

The single-slope barrier face is the recommended option for embedded rigid concrete barrier applications.

Note: There are new precast concrete barrier systems under development that may change future selection and placement criteria. The HQ Design Office will circulate guidance on these new developments as they are adopted as WSDOT policy.



Concrete Barrier Shapes
Exhibit 1610-7

When the single-slope or F-Shape face is used on structures, and precast barrier is selected for use on the approaches, a cast-in-place transition section is needed so that no vertical edges of the barrier are exposed to oncoming traffic. For details on bridge rail designs, see the *Bridge Design Manual*.

For aesthetic reasons, avoid changes in the shape of the barrier face within a project or corridor.

The New Jersey shape and F-shape barriers are commonly referred to as "safety shapes." The New Jersey shape and F-shape have an initial overall height of 32 inches. This height includes provision for up to a 3-inch future pavement overlay that can reduce the barrier height to 29 inches minimum.

(a) New Jersey Shape Barrier

The New Jersey shape face is primarily used on precast concrete barrier.

Concrete barrier Type 2 (see the *Standard Plans*) is a precast barrier that has the New Jersey shape on two sides and can be used for both median and shoulder installations.

The cost of precast Type 2 barrier is significantly less than the cost of the cast-in-place barriers. Therefore, consider the length of the barrier run and the deflection needs to determine whether transitioning to precast Type 2 barrier is desirable. If precast Type 2 barrier is used for the majority of a project, use the New Jersey face for small sections that need cast-in-place barrier, such as for a light standard section.

Concrete barrier Type 4 is also a precast, single-faced New Jersey shape barrier. These units are not freestanding and are to be placed against a rigid structure or anchored to the pavement. If Type 4 barriers are used back to back, consider filling any gap between them to prevent tipping.

Concrete barrier Type 5 is a precast barrier that has a single New Jersey face and is intended for use at bridge ends where the flat side is highly visible. Both Type 2 and Type 5 designs are freestanding, unanchored units connected with steel pins through wire rope loops. For permanent installation, this barrier is placed on a paved surface and a 2-foot-wide paved surface is provided beyond the barrier for its displacement during impact (see Chapter 1230).

Precast barrier can be anchored where a more rigid barrier is needed. (Anchoring methods are shown in the *Standard Plans*.) The Type 1 and Type 2 anchors are for temporary installations on a rigid pavement. Type 3 anchors can be used in temporary or permanent installations on an asphalt pavement. Consult the HQ Bridge and Structures Office for details when anchoring permanent precast concrete barrier to a rigid pavement.

Precast barrier used on the approach to bridge rail is to be connected to the bridge rail by installing wire rope loops embedded 1 foot 3 inches into the bridge rail with epoxy resin.

Place unrestrained (unanchored) precast concrete barrier on foundation slopes of 5% or flatter. In difficult situations, a maximum slope of 8% may be used. Keep the slope of the area between the edge of the shoulder and the face of the traffic barrier as flat as possible. The maximum slope is 10H:1V (10%).

(b) Single-Slope Barrier

The single-slope concrete barrier can be cast in place, slipformed, or precast. The most common construction technique for this barrier has been slipforming, but some precast single-slope barrier has been installed. The primary benefit of using precast single-slope barrier is that it can be used as temporary barrier during construction and then reset into a permanent location. In temporary applications, the single-slope barrier may also offer the added benefits of reducing headlight glare and providing reduced deflection characteristics over some other barrier types.

Single-slope barrier is considered a rigid system regardless of the construction method used. For new installations, the minimum height of the barrier above the roadway is 2 feet 10 inches, which allows a 2-inch tolerance for future overlays. The minimum total height of the barrier section is 3 feet 6 inches, with a minimum of 3 inches embedded in the roadway wearing surface. This allows for use of the 3 foot-6-inch barrier between roadways with grade separations of up to 5 inches. A grade separation of up to 10 inches is allowed when using a 4-foot-6-inch barrier section, as shown in the *Standard Plans*. The barrier is to have a depth of embedment equal to or greater than the grade separation. Contact the HQ Bridge and Structures Office for grade separations greater than 10 inches.

(c) Low-Profile Barrier

Low-profile barrier designs are available for median applications where the posted speed is 45 mph or below. These barriers are normally used in urban areas. They are typically 18 to 20 inches high and offer sight distance benefits. For barrier designs, terminals, and further details, contact the HQ Design Office.

(2) High-Performance Concrete Barrier

High-Performance Concrete Barrier (HP Barrier) is a rigid barrier with a minimum height of 42 inches above the roadway surface. This barrier is designed to function more effectively during heavy-vehicle collisions. This taller barrier may also offer the added benefits of reducing headlight glare and reducing noise in surrounding environments. HP

Barrier is generally considered single-slope barrier. (See the *Standard Plans* for barrier details.) For additional available shapes, contact the HQ Design Office.

For new/reconstruction, use HP Barrier in freeway medians of 22 feet or less. Also, use HP Barrier on Interstate or freeway routes where accident history suggests a need or where roadway geometrics increase the possibility of larger trucks hitting the barrier at a high angle (for example, on-ramps for freeway-to-freeway connections with sharp curvature in the alignment).

Consider the use of HP Barrier at other locations such as nonfreeway narrow medians, near highly sensitive environmental areas, near densely populated areas, over or near mass transit facilities, or on vertically divided highways.

(3) Concrete Barrier Terminals

Whenever possible, bury the end of the concrete barrier in the backslope. The backslope needed to bury the end is to be 3H:1V or steeper and at least 4 feet in height above the roadway. Flare the concrete barrier into the backslope using a flare rate that meets the criteria in 1610.05(4). Provide a 10H:1V or flatter foreslope into the face of the barrier and maintain the full barrier height to the foreslope/backslope intersection. This might create the need to fill ditches and install culverts in front of the barrier face.

The 7-foot-long precast concrete terminal end section for concrete barrier Type 2 and the 10- to 12-foot single-slope barrier terminal may be used:

- Outside the Design Clear Zone.
- On the trailing end of the barrier when it is outside the Design Clear Zone for opposing traffic.
- On the trailing end of one-way traffic.
- Where the posted speed is 25 mph or below.

Another available end treatment for Type 2 barriers is a precast or cast-in-place tapered terminal section with a minimum length of 48 feet and a maximum length of 80 feet. It is used infrequently for special applications and is designed to be used for posted speeds of 35 mph or below. For details, contact the HQ Design Office or refer to the Plan Sheet Library: www.wsdot.wa.gov/design/standards/plansheet/

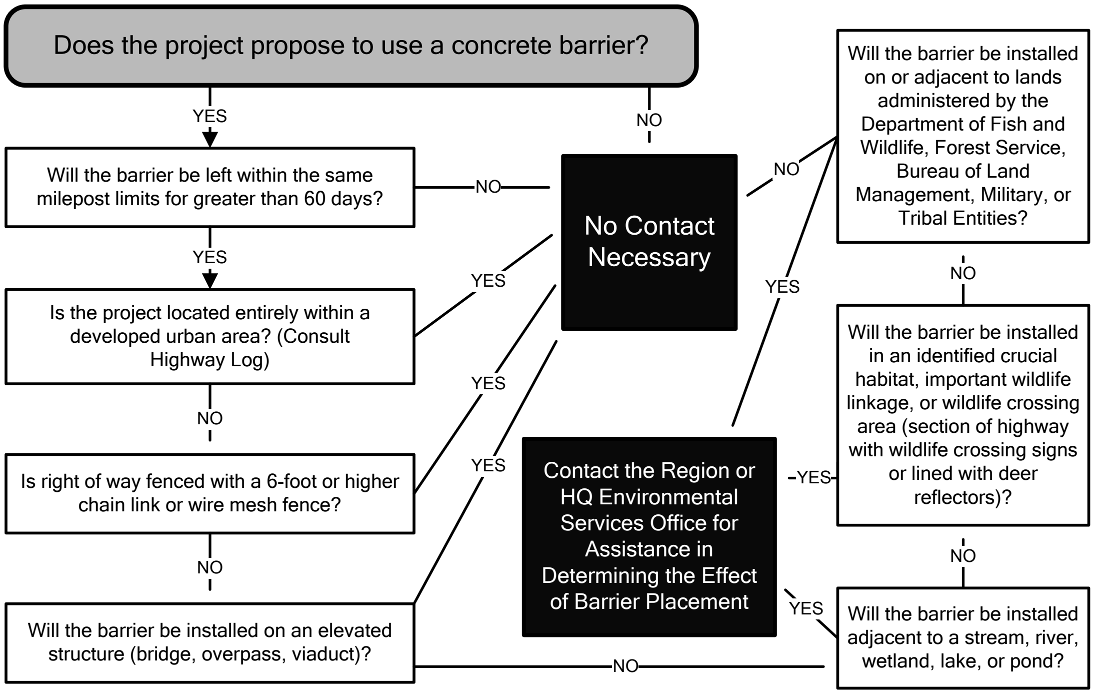
When the “Barrier Terminals and Transitions” column of a Design Matrix applies to a project, existing sloped-down concrete terminals that are within the Design Clear Zone are to be replaced when they do not meet the above criteria.

When the end of a concrete barrier cannot be buried in a backslope or terminated as described above, terminate the barrier using a guardrail terminal and transition or an impact attenuator (see Chapter 1620).

(4) Assessing Impacts to Wildlife

The placement of concrete barriers in locations where wildlife frequently cross the highway can influence traffic safety and wildlife mortality. When wildlife encounter physical barriers that are difficult to cross, they often travel parallel to those barriers. With traffic barriers, this means that they often remain on the highway for a longer period, increasing the risk of wildlife/vehicle collisions or vehicle/vehicle collisions as motorists attempt avoidance.

Traffic-related wildlife mortality may play a role in the decline of some species listed under the Endangered Species Act. To address public safety and wildlife concerns, see Exhibit 1610-8 to assess whether concrete barrier placement needs to have an evaluation by the HQ Environmental Services Office to determine its effect on wildlife. Conduct this evaluation early in the project development process to allow adequate time for discussion of options.



Concrete Barrier Placement Guidance: Assessing Impacts to Wildlife
Exhibit 1610-8

(5) Assessing Impacts to Stormwater and Wetlands

In locations where medians or roadsides are used for drainage, the retention of stormwater or the existence of wetlands can influence the choice and use of barrier systems. For example, the placement of concrete barrier and beam guardrail in many of these cases may create the need for additional impervious material, which can result in complete retrofit and reconstruction of the existing systems. When water is drained, stored, or treated, and where wetlands exist, the ability to provide alternative facilities that replace the functions of the existing ones may be nonexistent or prohibitively expensive to provide elsewhere.

To address public safety, stormwater, and wetland concerns, assess whether concrete barrier or beam guardrail placement will cause the need for an evaluation by the HQ Environmental Services Office. Conduct this evaluation early in the project development process to allow adequate time for discussion of options.

1610.09 Special-Use Barriers

The following barriers may be used on designated Scenic Byway and Heritage Tour routes if funding can be arranged (see 1610.05 and Chapter 120).

(1) Steel-Backed Timber Guardrail

Steel-backed timber guardrails consist of a timber rail with a steel plate attached to the back to increase its tensile strength. There are several variations of this system that have passed crash tests. The nonproprietary systems use a beam with a rectangular cross section that is supported by either wood or steel posts. A proprietary (patented) system called the Ironwood Guardrail is also available. This system uses a beam with a round cross section and is supported by steel posts with a wood covering to give the appearance of an all-wood system from the roadway. The Ironwood Guardrail can be allowed as an alternative to the nonproprietary system. However, specifying this system exclusively needs approval by an Assistant State Design Engineer of a public interest finding for the use of a sole source proprietary item.

The most desirable method of terminating the steel-backed timber guardrail is to bury the end in a backslope, as described in 1610.06(5). When this type of terminal is not possible, use of the barrier is limited to highways with a posted speed of 45 mph or below. On these lower-speed highways, the barriers can be flared away from the traveled way and terminated in a berm outside the Design Clear Zone.

For details on these systems, contact the HQ Design Office.

(2) Stone Guardwalls

Stone guardwalls function like rigid concrete barriers but have the appearance of natural stone. These walls can be constructed of stone masonry over a reinforced concrete core wall or of simulated stone concrete. These types of barriers are designed to have a limited projection of the stones to help aid in the redirectional characteristics of the barrier. The most desirable method of terminating this barrier is to bury the end in a backslope, as described in 1610.08(3). When this type of terminal is not possible, use of the barrier is limited to highways with a posted speed of 45 mph or below. On these lower-speed highways, the barrier can be flared away from the traveled way and terminated in a berm outside the Design Clear Zone.

For details on these systems, contact the HQ Design Office.

1610.10 Bridge Traffic Barriers

Bridge traffic barriers redirect errant vehicles and help to keep them from going over the side of the structure. (See the *Bridge Design Manual* for information regarding bridge barrier on new bridges and replacement bridge barrier on existing bridges.)

For new bridge rail installations, use a 2-foot-10-inch-high single-slope or a 2-foot-8-inch-high safety shape (F-Shape) bridge barrier. A transition is available to connect the New Jersey shape (Type 2 concrete barrier) and the F-Shape bridge barrier. (See the *Standard Plans* for further details.)

Use taller 3-foot-6-inch single-slope or safety shape bridge barriers on Interstate or freeway routes where accident history suggests a need or where taller barrier is required on approaching roadways with narrow medians, as defined in 1610.08(2). Also, consider taller 3-foot-6-inch barrier when geometrics increase the possibility of larger trucks hitting the barrier at a high angle (such as on-ramps for freeway-to-freeway connections with sharp curvature in the alignment).

For further guidance on bridges where high volumes of pedestrian traffic are anticipated, see Chapters 720, 1510, 1515, and 1520.

Approach barriers, transitions, and connections are usually needed on all four corners of bridges carrying two-way traffic and on both corners of the approach end for one-way traffic. (See 1610.06(6) for guidance on transitions.)

If the bridge barrier system does not meet the criteria for strength and geometrics, modifications to improve its redirectional characteristics and its strength may be needed. The modifications can be made using one of the retrofit methods described below.

(1) Concrete Safety Shape

Retrofitting with a new concrete bridge barrier is costly and needs to have justification when no widening is proposed. Consult the HQ Bridge and Structures Office for design details and to determine whether the existing bridge deck and other superstructure elements are of sufficient strength to accommodate this bridge barrier system.

(2) Thrie Beam Retrofit

Retrofitting with thrie beam is an economical way to improve the strength and redirectional performance of bridge barriers. The thrie beam can be mounted to steel posts or the existing bridge barrier, depending on the structural adequacy of the bridge deck, the existing bridge barrier type, the width of curb (if any), and the curb-to-curb roadway width carried across the structure.

The HQ Bridge and Structures Office is responsible for the design of thrie beam bridge barrier. Exhibit 1610-14 shows typical retrofit criteria. Contact the HQ Bridge and Structures Office for assistance with thrie beam retrofit design.

Consider the Service Level 1 (SL-1) system on bridges with wooden decks and for bridges with concrete decks that do not have the needed strength to accommodate the thrie beam system. Contact the HQ Bridge and Structures Office for information needed for the design of the SL-1 system.

A sidewalk reduction of up to 6 inches as a result of a thrie beam retrofit can be documented as a design exception.

The funding source for retrofit of existing bridge rail is dependent on the length of the structure. Bridge rail retrofit, for bridges less than 250 feet in length, or a total bridge rail length of 500 feet, is funded by the project (Preservation or Improvement). For longer bridges, the retrofit can be funded by the I-2 subprogram. Contact the HQ Program Development Office to determine whether funding is available.

1610.11 Other Barriers

(1) Dragnet

The Dragnet Vehicle Arresting Barrier consists of chain link or fiber net that is attached to energy absorbing units. When a vehicle hits the system, the Dragnet brings the vehicle to a controlled stop with limited damage. Possible uses for this device include the following:

- Reversible lane entrances and exits
- Railroad crossings

- Truck escape ramps (instead of arrester beds—see Chapter 1270)
- T-intersections
- Work zones
- Swing span bridges

For permanent installations, this system can be installed between towers that lower the unit into position when needed and lift it out of the way when it is no longer needed. For work zone applications, it is critical to provide deflection space for stopping the vehicle between the system and the work zone. For additional information on the Dragnet, contact the HQ Design Office.

1610.12 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/

Connecting W-Beam Guardrail to: Transitions and Connections			Transition Type*	Connection
Bridge Rail	New Installation		20, 21	D
	Existing Concrete	Concrete Parapet > 20 inches	20, 21, 4[4]	Exhibit 1610-6
		Concrete Parapet < 20 inches	2, 4[4]	Exhibit 1610-6
		Existing W-Beam Transition	2[1][5], 4[4]	[1]
	Thrie Beam at Face of Curb[3]	Approach End	23	n/a
		Trailing End (two-way traffic only)	23	n/a
	Thrie Beam at Bridge Rail (curb exposed)[3]	Approach End	22	n/a
		Trailing End (two-way traffic only)	22	n/a
	Weak Post Intersection Design (see 1610.06(7)(b), Cases 12 & 13)		5	Exhibit 1610-6
Concrete Barrier	Rigid & Rigid Anchored		21	Exhibit 1610-6
	Unrestrained		2, 4[4]	A
Weak Post Barrier Systems (Type 20 and 21)			6	n/a
Rigid Structures such as Bridge Piers	New Installation (see Cases 11–31)		21	n/a
	Existing W-Beam Transition		[2]	n/a
Connecting Thrie Beam Guardrail to:			**Transition Type***	**Connection**
Bridge Rail or Concrete Barrier	New Installation (example: used with thrie beam bull nose)		1B	Exhibit 1610-6

*Consult Section C of the *Standard Plans* for details on transition types.

Notes:

[1] If work creates the need for reconstruction or resetting of the transition, upgrade as shown above. Raising the guardrail is not considered reconstruction. If the transition is not being reconstructed, the existing connection may remain in place. When Type 3 anchors are encountered, see 1610.06(5)(e) for guidance.

[2] For new/reconstruction, use Case 11 (thrie beam). For existing Case 11 with W-beam, add a second W-beam rail element.

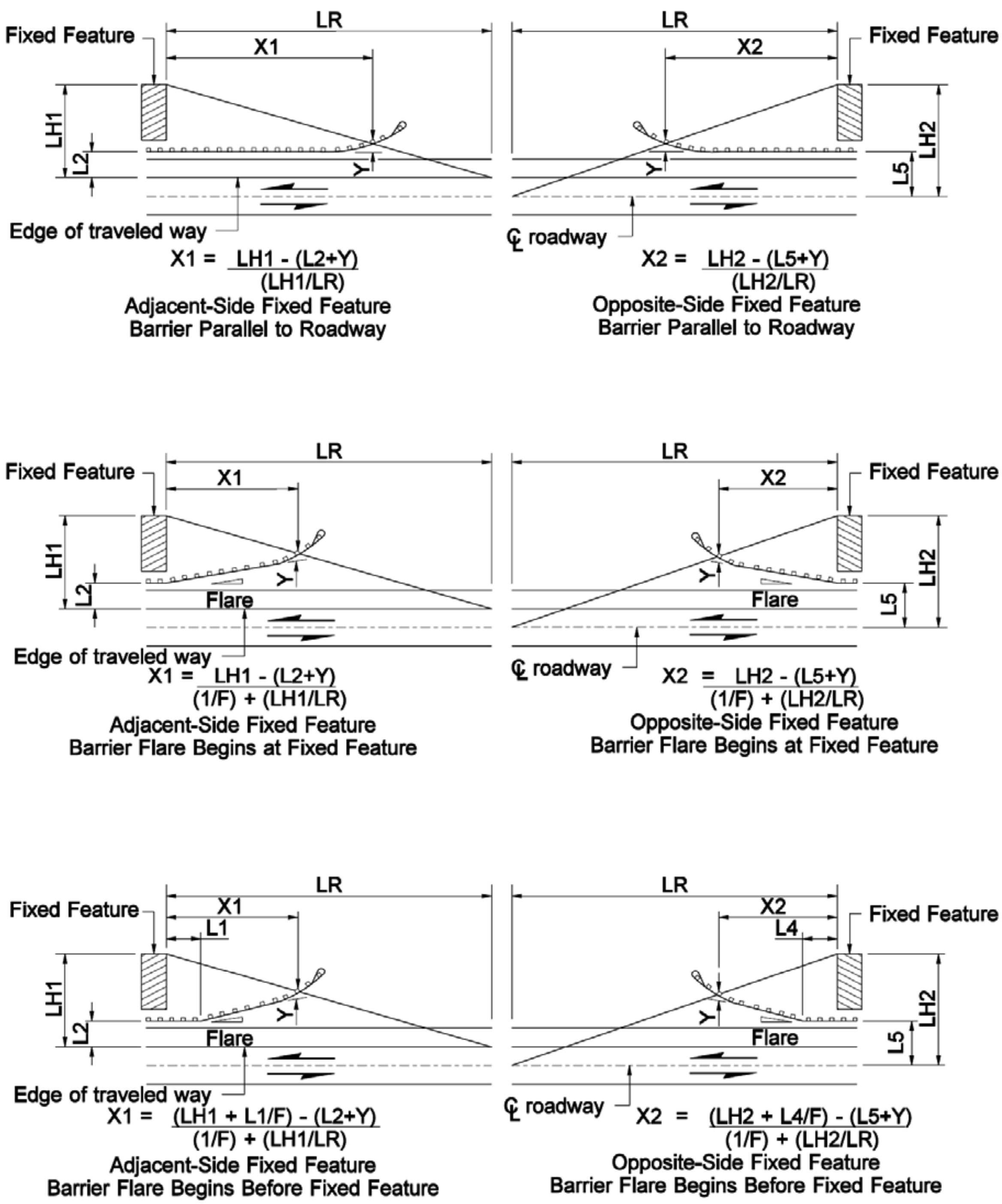
[3] For Service Level 1 bridge rail, see 1610.06(7)(b), Case 14.

[4] Use on highways with speeds 45 mph or below.

[5] If existing transition has the needed guardrail height—three 10″ x 10″ (nominal) posts and three 6″ x 8″ (nominal) posts spaced 3′-1.5″ apart—it is acceptable to nest existing single W-beam element transitions.

Transitions and Connections

Exhibit 1610-9



Note:

For supporting length of need equation factors, see Exhibit 1610-10b.

Barrier Length of Need on Tangent Sections

Exhibit 1610-10a

Posted Speed (mph)	Design Parameters						
	ADT				Barrier Type		
	Over 10,000	5,000 to 10,000	1,000 to 4,999	Under 1,000	Rigid & Rigid Anchored Barrier	Rigid Unrestrained Barrier	Semirigid Barrier
	LR (ft)	LR (ft)	LR (ft)	LR (ft)	F	F	F
65 & 70	460	395	345	295	20	18	15
60	360	295	260	230	18	16	14
55	310	260	230	195	16	14	12
50	260	215	180	165	14	12	11
45	245	195	165	150	12	11	10
40	215	180	150	130	11	10	9
35	185	155	130	115	11	10	9
30	165	135	115	105	11	10	9
25	150	125	105	95	11	10	9

L1 = Length of barrier parallel to roadway from adjacent-side fixed feature to beginning of barrier flare. This is used if a portion of the barrier cannot be flared (such as a bridge rail and the transition).

L2 = Distance from adjacent edge of traveled way to portion of barrier parallel to roadway.

L4 = Length of barrier parallel to roadway from opposite-side fixed feature to beginning of barrier flare.

L5 = Distance from centerline of roadway to portion of barrier parallel to roadway. Note: If the fixed feature is outside the Design Clear Zone when measured from the centerline, it may only be necessary to provide a crash-tested end treatment for the barrier.

LH1 = Distance from outside edge of traveled way to back side of adjacent-side fixed feature. Note: If a fixed feature extends past the Design Clear Zone, the Design Clear Zone can be used as LH1.

LH2 = Distance from centerline of roadway to back side of opposite-side fixed feature. Note: If a fixed feature extends past the Design Clear Zone, the Design Clear Zone can be used as LH2.

LR = Runout length, measured parallel to roadway.

X1 = Length of need for barrier to shield an adjacent-side fixed feature.

X2 = Length of need for barrier to shield an opposite-side fixed feature.

F = Flare rate value.

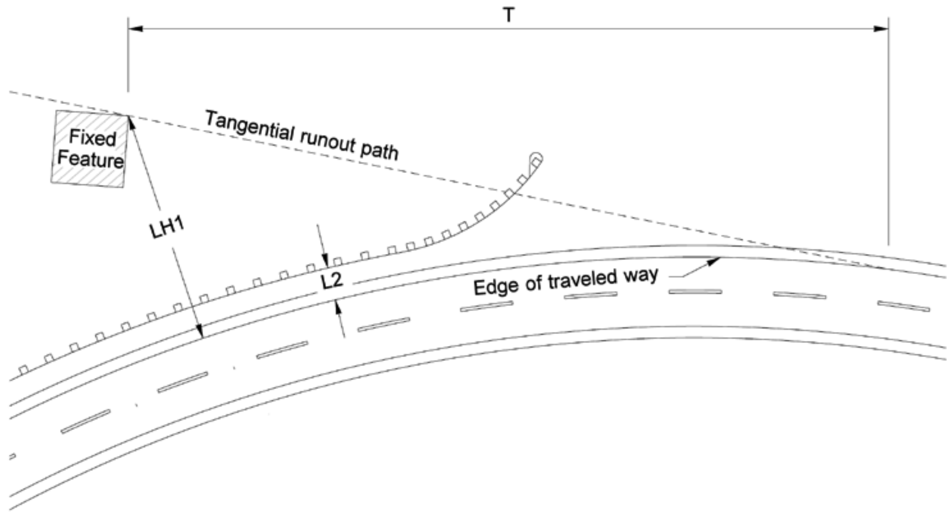
Y = Offset distance needed at the beginning of the length of need.

Different end treatments need different offsets:

- For the SRT 350 and FLEAT 350, use Y = 1.8 feet.
- For evaluating existing BCTs, use Y = 1.8 feet.
- For the FLEAT TL-2, use Y = 0.8 feet.
- No offset is needed for the nonflared terminals or impact attenuator systems. Use Y = 0.
- Buried terminal end treatments are used with barrier flares and have no offset. Use Y = 0.

Barrier Length of Need

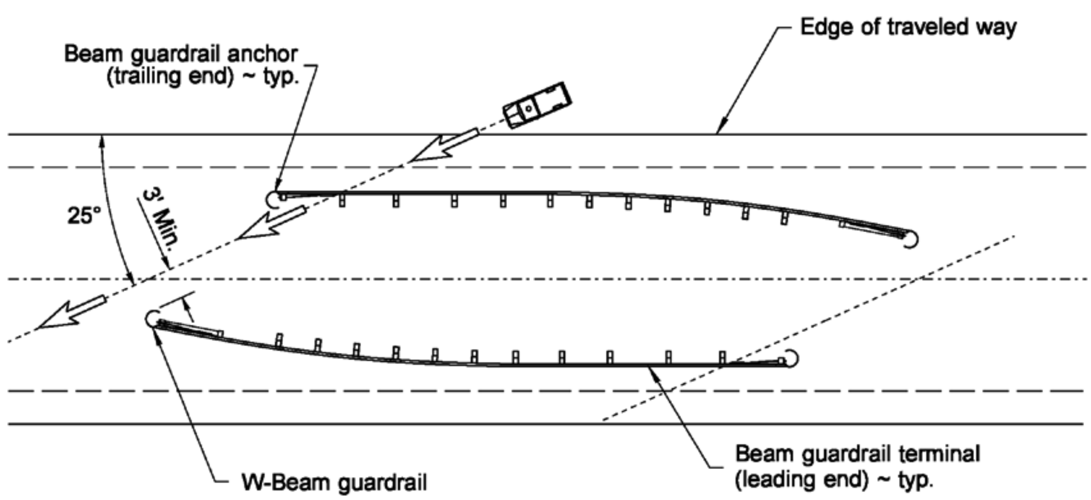
Exhibit 1610-10b



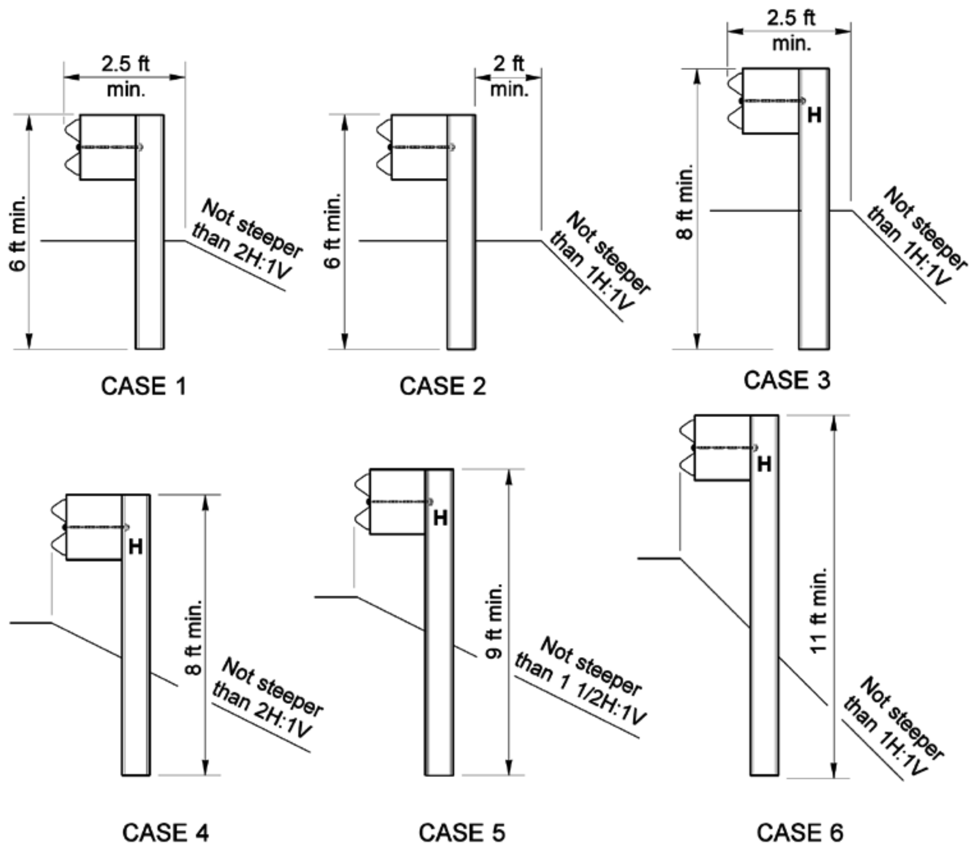
Notes:

- This is a graphical method for determining the length of need for barrier on the outside of a curve.
- On a scale drawing, draw a tangent from the curve to the back of the fixed feature. Compare T to LR from Exhibit 1610-10b and use the shorter value.
- If using LR, follow Exhibits 1610-10a and 10b.
- If using T, draw the intersecting barrier run to scale and measure the length of need.

Barrier Length of Need on Curves
Exhibit 1610-10c



W-Beam Guardrail Trailing End Placement for Divided Highways
Exhibit 1610-10d



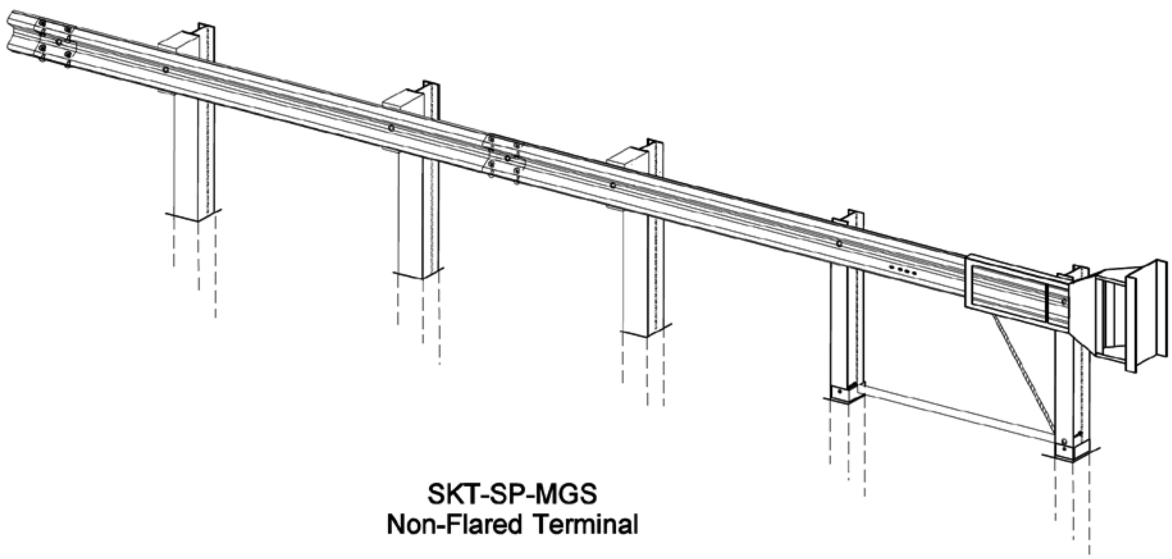
Type 31 Shown

Notes:

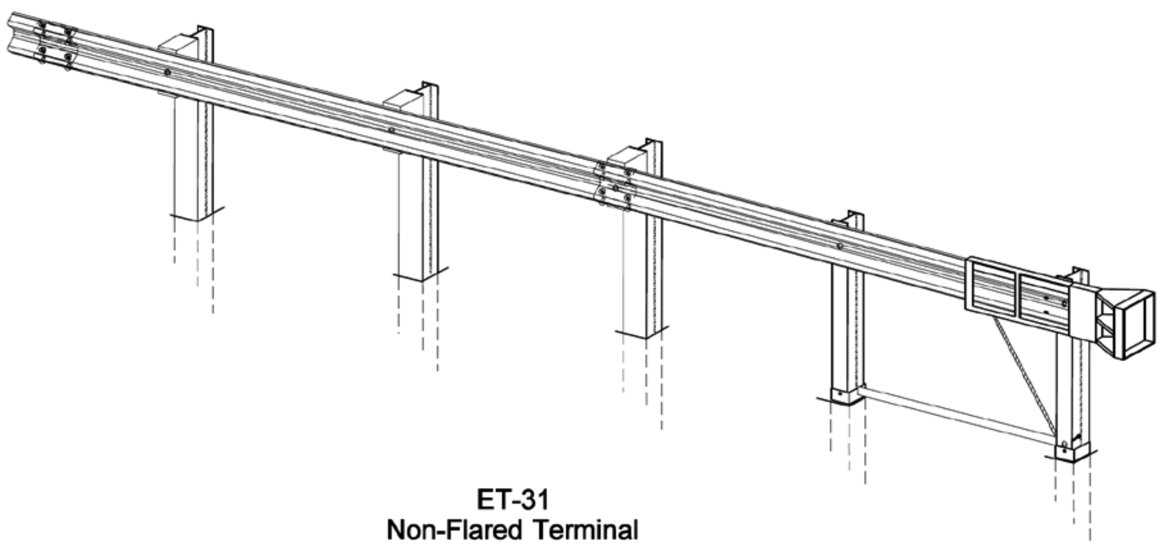
- Use Cases 1 and 3 when there is a 2.5-foot or greater shoulder widening from face of guardrail to the breakpoint.
- Use Case 2 when there is a 4.0-foot or greater shoulder widening from the face of the guardrail to the breakpoint.
- Use Cases 4, 5, and 6 when there is less than a 2.5-foot shoulder widening from face of guardrail to the breakpoint.

Beam Guardrail Post Installation

Exhibit 1610-11



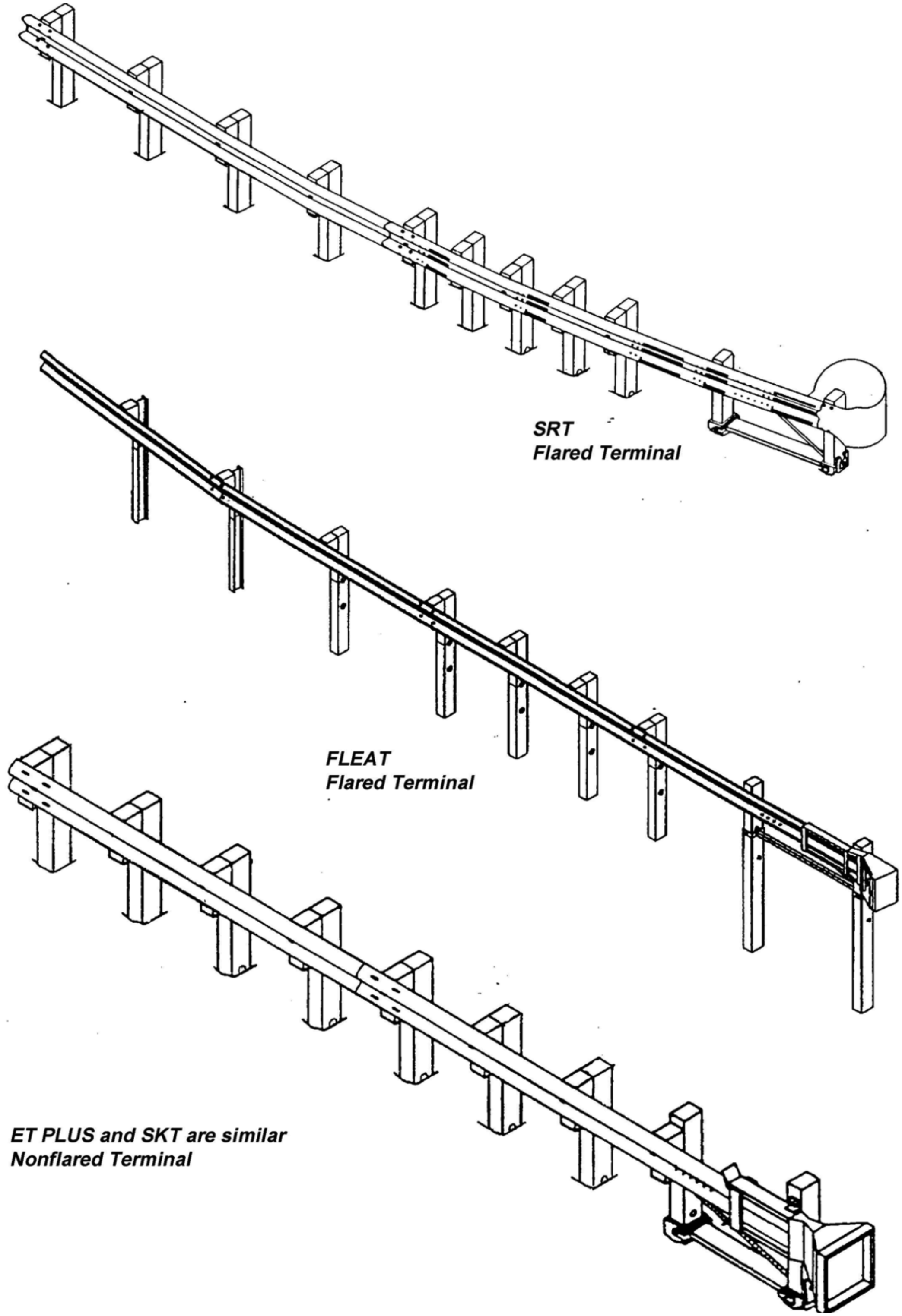
SKT-SP-MGS
Non-Flared Terminal



ET-31
Non-Flared Terminal

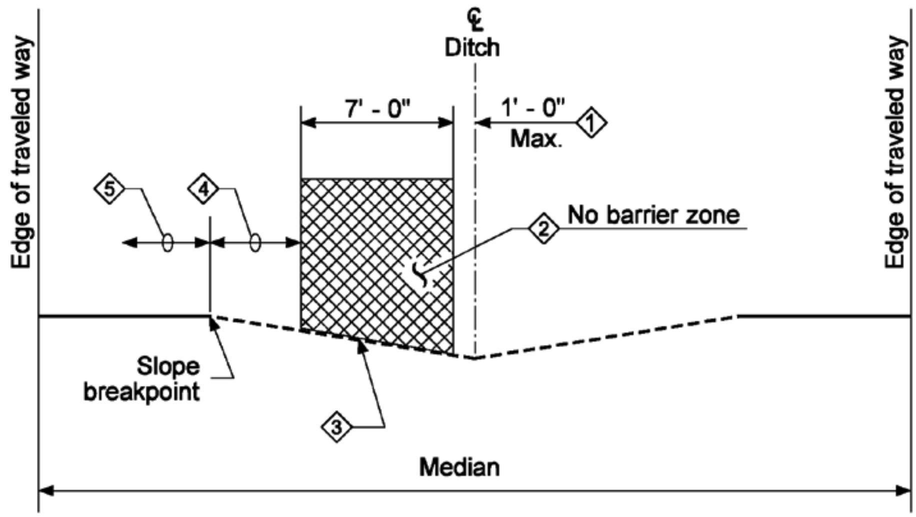
Beam Guardrail Terminals

Exhibit 1610-12a

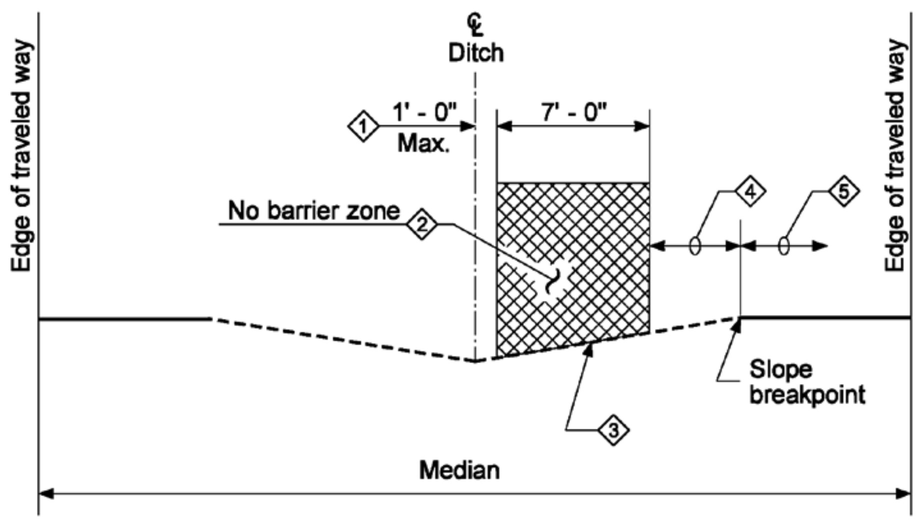


Beam Guardrail Terminals

Exhibit 1610-12b



Median Placement - Left



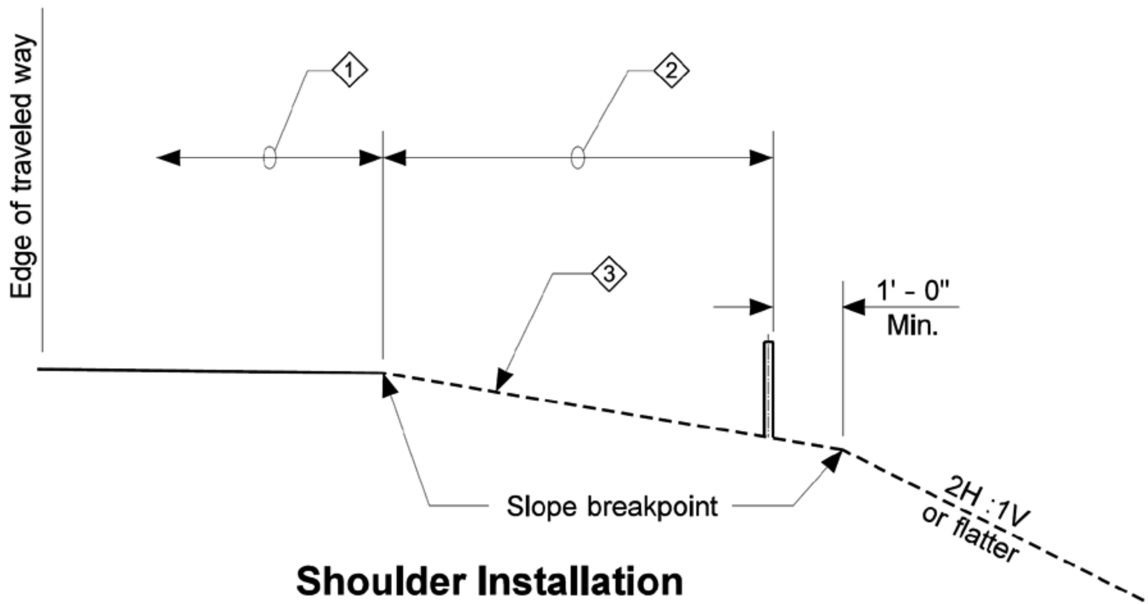
Median Placement - Right

Notes:

1. Cable barrier may be installed in the center of the ditch and from the ditch centerline a maximum of 1 foot (left or right).
2. Avoid installing cable barrier within a 1-foot to 8-foot offset from the ditch centerline.
3. Applies to slopes between 10H:1V and 6H:1V.
4. Slope Installation: Install cable barrier between an 8-foot offset from the ditch centerline and the slope breakpoint. Provide a maximum deflection distance of 8 feet to the edge of traveled way.
5. Shoulder Installation: For median shoulder applications, maintain a minimum of 8 feet of usable shoulder width between the edge of traveled way and the face of the cable barrier system.

Single Cable Barrier Placement Locations on Median Slopes

Exhibit 1610-13a

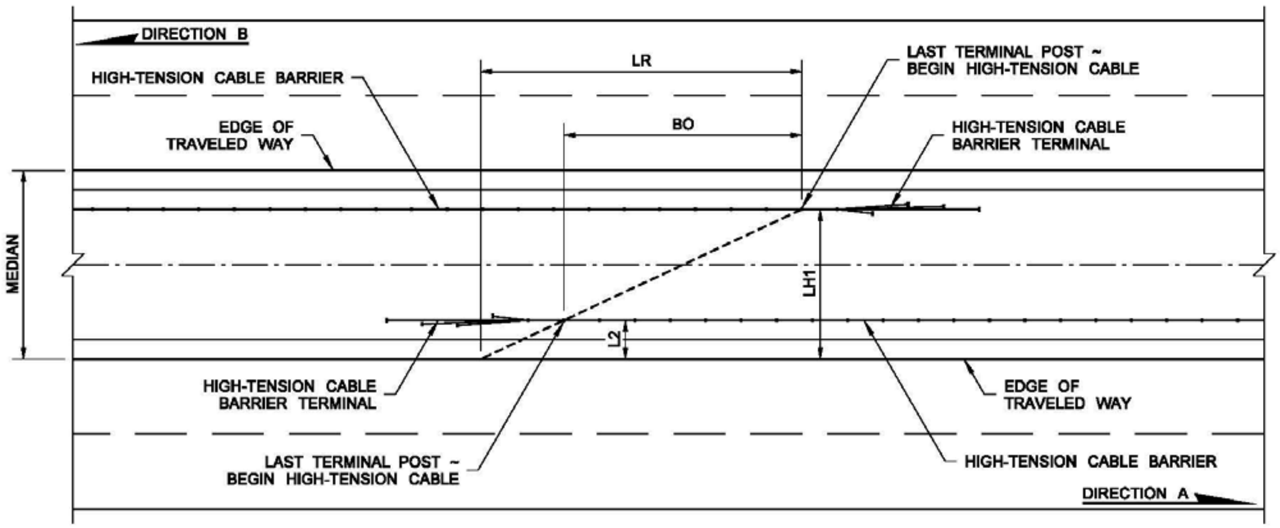


Notes:

1. For shoulder widths less than 8 feet, see 1610.05(2) for further guidance.
2. Slope Installation: Install cable barrier relative to the slope breakpoints within the limits shown.
3. Applies to slopes that are 6H:1V or flatter.

Cable Barrier Locations on Shoulder Slopes

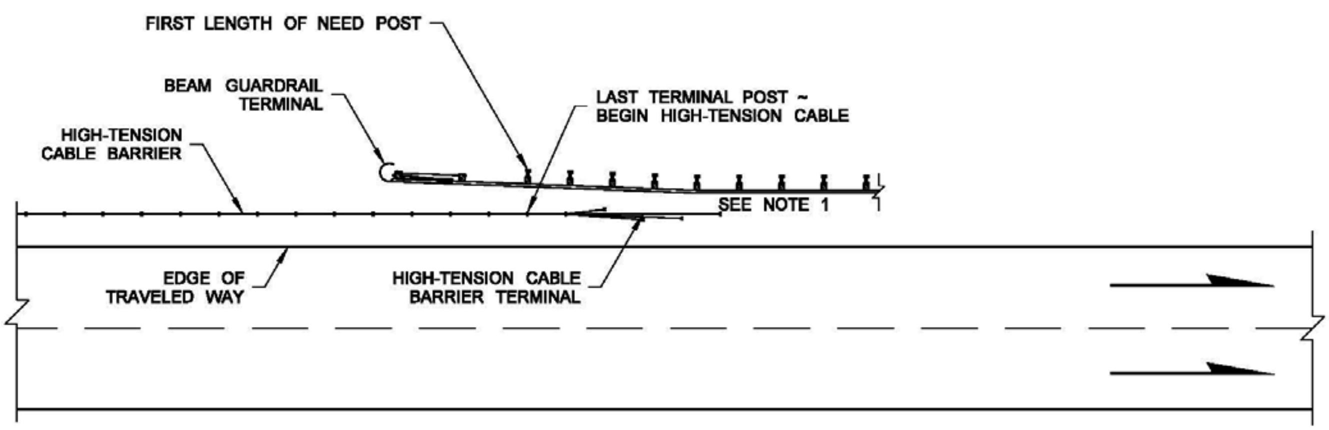
Exhibit 1610-13b



Cable Barrier Median Overlap

$$BO = \frac{LH1 - L2}{(LH1/LR)} \quad \text{(Direction A shown)}$$

Note:
Calculate barrier overlap (BO) from both directions of travel. Use the greatest value of BO obtained.



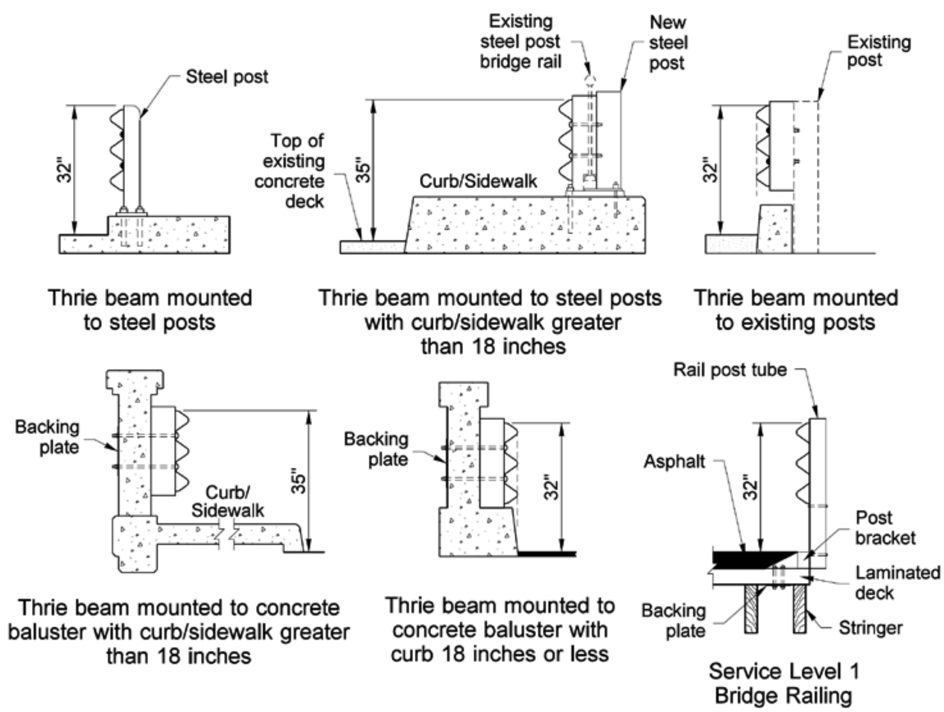
Cable Barrier Overlap With Beam Guardrails

Notes:
[1] The beam guardrail may need to be extended and flared to maintain adequate barrier overlap and shoulder width.
[2] Typical applications may be at bridge transitions or where high-tension cable and beam guardrail systems end or begin.
[3] For supporting length of need equation factors, see Exhibit 1610-10b.

Cable Barrier Placement for Divided Highways

Exhibit 1610-13c

Curb Width	Bridge Width	Concrete Bridge Deck		Wood Bridge Deck or Low-Strength Concrete Deck
		Concrete Bridge Rail (existing)	Steel or Wood Post Bridge Rail (existing)	
<18 inches		Thrie beam mounted to existing bridge rail[2] and blocked out to the face of curb. Height = 32 inches	Thrie beam mounted to steel posts[2] at the face of curb. Height = 32 inches	• Service Level 1 Bridge Rail[2] • Height = 32 inches • Curb or wheel guard needs to be removed
>18 inches	**> 28 ft (curb to curb)**	Thrie beam mounted to steel posts[2] at the face of curb.[1] Height = 32 inches		
>18 inches	**< 28 ft (curb to curb)**	Thrie beam mounted to existing bridge rail.[2] Height = 35 inches	Thrie beam mounted to steel posts[2] in line with existing rail. Height = 35 inches	



Thrie beam mounted to steel posts

Thrie beam mounted to steel posts with curb/sidewalk greater than 18 inches

Thrie beam mounted to existing posts

Thrie beam mounted to concrete baluster with curb/sidewalk greater than 18 inches

Thrie beam mounted to concrete baluster with curb 18 inches or less

Service Level 1 Bridge Railing

Notes:

[1] To maximize available curb/sidewalk width for pedestrian use, thrie beam may be mounted to the bridge rail at a height of 35 inches.

[2] Contact the HQ Bridge and Structures Office for design details on bridge rail retrofit projects.

Thrie Beam Rail Retrofit Criteria

Exhibit 1610-14

Chapter 1620 Impact Attenuator Systems

1620.01 General

Impact attenuator systems are protective systems that help aid an errant vehicle from impacting an object by either gradually decelerating the vehicle to a stop when hit head-on or by redirecting it away from the feature when struck on the side. These barriers are used for rigid objects or other features that cannot be removed, relocated, or made breakaway.

Approved systems are shown in Exhibits 1620-2a through 1620-4b and on the Washington State Department of Transportation (WSDOT) Headquarters (HQ) Design Office web page: www.wsdot.wa.gov/design/policy/roadsidesafety.htm

Approved systems shall meet standardized testing defined in NCHRP Report 350 or the Manual for Assessing Safety Hardware (MASH). In addition, these devices shall have an acceptance letter from FHWA that documents that the device meets the appropriate crash test criteria and can be used on the National Highway System (NHS).

(1) Permanent Installations

For systems used in permanent installations, a description of the system's purpose, parts, and function, as well as transition needs, foundation, and slope, are provided as follows and in Exhibit 1620-5.

(a) **Crash Cushion Attenuating Terminal (CAT-350)**

1. **Purpose:** The CAT-350 is an end treatment for W-beam guardrail. It can also be used for concrete barrier if a transition is provided.
2. **Description:** The system consists of slotted W-beam guardrail mounted on both sides of breakaway timber posts. Steel sleeves with soil plates hold the timber posts in place (see Exhibit 1620-2a).
3. **Function:** When hit head-on, the slotted guardrail is forced over a pin that shears the steel between the slots. This shearing dissipates the energy of the impact.
4. **Foundation:** Concrete footings or foundations are not needed.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Trinity Industries, Inc.

(b) **Brakemaster 350**

1. **Purpose:** The Brakemaster 350 system is an end treatment for W-beam guardrail. It can also be used for concrete barrier if a transition is provided.
2. **Description:** The system contains an embedded anchor assembly, W-beam fender panels, transition strap, and diaphragm (see Exhibit 1620-2a).

3. **Function:** The system uses a brake and cable device for head-on impacts and for redirection. The cable is embedded in a concrete anchor at the end of the system.
4. **Foundation:** A concrete foundation is not needed for this system, but a paved surface is recommended.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(c) **QuadTrend 350**

1. **Purpose:** The QuadTrend 350 is an end treatment for 2-foot-8-inch-high concrete barriers. The system's short length allows it to be used at the ends of bridges where the installation of a beam guardrail transition and terminal is not feasible.
2. **Description:** This system consists of telescoping quadruple corrugated fender panels mounted on steel breakaway posts (see Exhibit 1620-2a).
3. **Function:** Sand-filled boxes attached to the posts dissipate a portion of the energy of an impact. An anchored cable installed behind the fender panels directs the vehicle away from the barrier end.
4. **Foundation:** The system is installed on a concrete foundation to support the steel posts.
5. **Slope:** A 6H:1V or flatter slope is needed behind the barrier to allow for vehicle recovery.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(d) **Universal TAU-II**

1. **Purpose:** The Universal TAU-II crash cushion system is an end treatment for concrete barrier, beam guardrail, and fixed objects up to 8 feet wide.
2. **Description:** The system is made up of independent collapsible bays containing energy-absorbing cartridges that are guided and supported during a head-on hit by high-strength galvanized steel cables and thrie beam rail panels. Each bay is composed of overlapping thrie beam panels on the sides and structural support diaphragms on the ends. Structural support diaphragms are attached to two cables running longitudinally through the system and attached to foundations at each end of the system (see Exhibit 1620-2c).
3. **Function:** Overlapping panels, structural support diaphragms, cable supports, cables, and foundation anchors allow the system to resist angled impacts and mitigate head-on impacts.
4. **Foundation:** The system is installed on a concrete foundation or asphaltic concrete foundations conforming to the manufacturer's recommendations.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Barrier Systems, Inc.

(e) **QuadGuard**

1. **Purpose:** The QuadGuard is an end treatment for concrete barrier and beam guardrail and is also used to mitigate fixed objects up to 10 feet wide.
2. **Description:** The system consists of a series of Hex-Foam cartridges surrounded by a framework of steel diaphragms and quadruple corrugated fender panels (see Exhibit 1620-2b).
3. **Function:** The internal shearing of the cartridges and the crushing of the energy absorption material absorb impact energy from end-on hits. The fender panels redirect vehicles impacting the attenuator on the side.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the QuadGuard.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(f) **QuadGuard Elite**

1. **Purpose:** The QuadGuard Elite is an end treatment for concrete barrier and beam guardrail and is also used for fixed objects up to 7 feet 6 inches wide.
2. **Description:** The system consists of telescoping quadruple corrugated fender panels mounted on both sides of a series of polyethylene cylinders (see Exhibit 1620-2b).
3. **Function:** The cylinders are compressed during a head-on impact and return to their original shape when the system is reset. It is anticipated that this system will need very few replacement parts or extensive repair.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the QuadGuard Elite.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(g) **Reusable Energy Absorbing Crash Terminal (REACT 350)**

1. **Purpose:** The REACT 350 is an end treatment for concrete barriers and is also used for fixed objects up to 3 feet wide.
2. **Description:** The system consists of polyethylene cylinders with varying wall thickness, redirecting cables, a steel frame base, and a backup structure (see Exhibit 1620-2d).
3. **Function:** The redirecting cables are anchored in the concrete foundation at the front of the system and in the backup structure at the rear of the system. When hit head-on, the cylinders compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. For side impacts, the cables restrain the system enough to help prevent penetration and redirect the vehicle. It is anticipated that this system will need very few replacement parts or extensive repair.

4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the REACT 350.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(h) **REACT 350 Wide**

1. **Purpose:** The REACT 350 Wide is a device that can be used to shield objects with widths up to 10 feet wide.
2. **Description:** The system consists of polyethylene cylinders with varying wall thickness, internal struts, space frame diaphragms, and a monorail (see Exhibit 1620-2d).
3. **Function:** When hit head-on, the cylinders compress, absorb the impact energy, and immediately return to much of their original shape, position, and capabilities. For side impacts, the system is designed to restrain and redirect the vehicle. It is anticipated that this system will need very few replacement parts or extensive repairs.
4. **Foundation:** The system is installed on a concrete foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 8% for the REACT 350 Wide.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(i) **Inertial Barrier**

Inertial barrier configurations are shown in the *Standard Plans*. If a situation is encountered where the configurations in the *Standard Plans* are not appropriate, contact the HQ Design Office for further information.

1. **Purpose:** Inertial barrier is an end treatment for concrete barrier and is used to mitigate fixed objects. This system does not provide redirection from a side impact.
2. **Description:** This system consists of an array of plastic containers filled with varying weights of sand (see Exhibit 1620-2d).
3. **Function:** The inertial barriers slow an impacting vehicle by the transfer of the momentum of the vehicle to the mass of the barrier. This system is not suitable where space is limited to less than the widths shown in the *Standard Plans*. Whenever possible, align inertial barriers so that an errant vehicle deviating from the roadway by 10° would be on a parallel path with the attenuator alignment (see the *Standard Plans*). In addition, inertial barriers do not provide any redirection and are not appropriate where high-angle impacts are likely.
4. **Foundation:** A concrete or paved surface is recommended.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed. "Excessive" is defined as steeper than 5% for inertial barriers.

6. **Manufacturer/Supplier:** Approved Inertial Barrier systems (sand barrel arrays) are listed in the Qualified Products List.

(j) **SCI100GM / SCI70GM**

1. **Purpose:** The SCI100GM / SCI70GM are end treatments that can be used for concrete barrier and beam guardrail with widths up to 2 feet.
2. **Description:** The system for both models consists of telescoping quadruple corrugated fender panels mounted on both sides of a series of tubular steel support frames (see Exhibit 1620-2e).
3. **Function:** A hydraulic cylinder is compressed during a head-on impact. It is anticipated that this system will need very few replacement parts or extensive repairs.
4. **Foundation:** The system is installed on a concrete or asphalt foundation. (See manufacturer's installation information for details.)
5. **Slope:** 12H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Work Area Protection Corp.

(2) Work Zone (Temporary) Installation

Several of the impact attenuators previously listed under the heading “Permanent Installations” are also appropriate for use in work zones or other temporary locations. The following is a list of these devices:

- QuadGuard
- QuadGuard Elite
- REACT 350
- REACT 350 Wide
- Inertial Barriers
- SCI100GM
- SCI70GM

The following systems are appropriate only in work zones or other temporary installations. However, the TRACC impact attenuator may be considered for permanent use, with the concurrence of WSDOT Maintenance personnel.

Descriptions of each work zone (or other temporary) system’s purpose, parts, and functionality, as well as guidance for transition, foundation, and slope, are provided as follows and in Exhibit 1620-5:

(a) **ABSORB 350**

1. **Purpose:** The ABSORB 350 is an end treatment limited to temporary installations for both concrete barrier and the Quickchange Moveable Barrier (QMB).
2. **Description:** The system contains water-filled Energy Absorbing Elements. Each element is 2 feet wide, 2 feet 8 inches high, and 3 feet 3½ inches long (see Exhibits 1620-3a and 3b).

3. **Function:** The low-speed (below 45 mph) system uses five Energy Absorbing Elements, and the high-speed (45 mph and above) system uses eight. The energy of an impact is dissipated as the elements are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Barrier Systems, Inc.

(b) **Advanced Dynamic Impact Extension Module 350 (ADIEM 350)**

1. **Purpose:** The ADIEM 350 is limited to temporary installations where vehicle speeds are 45 mph or lower. It is generally used as an end treatment for concrete barrier. Currently, there are a few existing permanent units in service. It is permissible to reset these existing devices. However, some of these units may exhibit significant deterioration, and replacement may be the appropriate option.
2. **Description:** The system is 30 feet long and consists of ten lightweight concrete modules on an inclined base (see Exhibit 1620-3a).
3. **Function:** An inclined base provides a track for placement of the modules and provides redirection for side impacts for roughly half the length. The energy of an impact is dissipated as the concrete modules are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** If the site has excessive grade or cross slope, additional site preparation or modification to the units in accordance with the manufacturer’s literature is needed. Excessive is defined as steeper than 8% for the ADIEM 350.
6. **Manufacturer/Supplier:** Trinity Industries, Inc.

(c) **QuadGuard CZ**

This system is like the permanent QuadGuard listed for permanent systems above, except that it can be installed on a 6-inch-minimum-depth asphalt concrete surface that has a 6-inch-minimum-depth compacted base (see Exhibit 1620-3a).

(d) **Reusable Energy Absorbing Crash Terminal (REACT 350)**

This is the same system listed for permanent systems above except that it can be installed on a 6-inch-minimum-depth asphalt concrete surface that has a 6-inch-minimum-depth compacted base (see Exhibit 1620-2d).

(e) **Non-Redirecting Energy Absorbing Terminal (N-E-A-T)**

1. **Purpose:** The N-E-A-T system is an end treatment for temporary concrete barrier where vehicle speeds are 45 mph or lower.
2. **Description:** The N-E-A-T system’s cartridge weighs about 300 pounds and is 9 feet 8 inches long. The system consists of aluminum cells encased in an aluminum shell with steel backup, attachment hardware, and transition panels. It can be attached to the ends of New Jersey shaped portable concrete barrier and the Quickchange Moveable Barrier (see Exhibit 1620-3b).
3. **Function:** The energy of an impact is dissipated as the aluminum cells are crushed.

4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Energy Absorption Systems

(f) **Trinity Attenuating Crash Cushion (TRACC)**

1. **Purpose:** The TRACC is an end treatment for concrete barriers. It is limited to use in construction or other work zones on a temporary basis.
2. **Description:** The 21-foot-long TRACC includes four major components: a pair of guidance tracks, an impact sled, intermediate steel frames, and 10 gauge W-beam fender panels (see Exhibit 1620-3b).
3. **Function:** The sled (impact face) is positioned over the upstream end of the guidance tracks and contains a hardened steel blade that cuts the metal plates on the sides of the guidance tracks as it is forced backward when hit head-on.
4. **Foundation:** The system needs a concrete foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Trinity Industries, Inc.

(g) **Inertial Barrier**

This is the same system listed for permanent systems above. It is not suitable where space is limited to less than the widths shown in the *Standard Plans* (see Exhibit 1620-2d).

(h) **Truck-Mounted Attenuator (TMA)**

TMAs are portable systems mounted on trucks. They are intended for use in work zones and for temporary applications.

(i) **Triton CET**

1. **Purpose:** The Triton CET is an end treatment limited to temporary concrete barrier installations.
2. **Description:** The system contains water-filled Energy Absorbing Elements (see Exhibit 1620-3b).
3. **Function:** The system uses six Energy Absorbing Elements. The energy of an impact is dissipated as the elements are crushed.
4. **Foundation:** The system does not need a paved foundation.
5. **Slope:** 10H:1V or flatter slope between the edge of the traveled way and the near face of the unit.
6. **Manufacturer/Supplier:** Energy Absorption, Inc.

(j) **QUEST**

1. **Purpose:** The QUEST is an end treatment limited to temporary applications. This system is designed to shield features 2 feet or less in width.

2. **Description:** The system consists of two front anchor assemblies; a nose assembly containing an integrated trigger assembly; two shaper rail assemblies; a support rail assembly with two energy-absorbing tube shapers; a diaphragm assembly; a bridge assembly; two rear rails; a freestanding backup assembly; and W-beam fender panels (see Exhibit 1620-3b). Transition panels are needed when traffic approaches from the rear of the unit.
3. **Function:** During head-on impacts, the Quest system telescopes rearward and energy is absorbed through momentum transfer, friction, and deformation. When impacted from the side, the QUEST system restrains lateral movement by dynamic tension developed between the end restraints.
4. **Foundation:** The system is installed on a concrete or asphalt foundation. (See manufacturer's installation information for details.) The unit is attached to the road surface with 30 to 34 anchors.
5. **Slope:** 12H:1V (8%) or flatter slope between the edge of the traveled way and the near face of the unit is needed. In addition, if the slope varies (twists) more than 2% over the length of the system, a concrete leveling pad may be needed.
6. **Manufacturer/Supplier:** Energy Absorption Systems, Inc.

(3) Older Systems

The following systems are in use on Washington State highways and may be left in place or reset. New installations of these systems need approval from the HQ Design Office.

(a) **Sentre**

The Sentre is a guardrail end treatment. Its overall length of 17 feet allowed it to be used where space was not available for a guardrail transition and terminal. The system is very similar to the QuadTrend 350 in both appearance and function except that it uses thrie beam fender panels instead of the quadruple corrugated panels. This system needs a transition when used to terminate rigid barriers (see Exhibit 1620-4a).

(b) **TREND**

The TREND is an end treatment with a built-in transition and was used at the end of rigid barriers including bridge rails. The system is similar to the QuadTrend 350 except that it uses thrie beam fender panels (see Exhibit 1620-4a).

(c) **Guard Rail Energy Absorption Terminal (G-R-E-A-T)**

This system was primarily used as an end treatment for concrete barrier.

It is similar to the QuadGuard except that it uses thrie beam fender panels (see Exhibit 1620-4a).

(d) **Low-Maintenance Attenuator System (LMA)**

The LMA is an end treatment for concrete barrier and beam guardrail and was used for fixed objects up to 3 feet wide. The system is similar to the QuadGuard Elite except that it uses thrie beam fender panels and rubber cylinders (see Exhibit 1620-4b).

(e) **Hex-Foam Sandwich**

The Hex-Foam Sandwich system (see Exhibit 1620-4b) is an end treatment for beam guardrail and concrete barrier and was also used for fixed objects 3 feet or more in width. This system consists of a number of Hex-Foam cartridges containing an energy absorption material separated by a series of diaphragms and restrained by anchor cables. It is installed on a concrete slab. Impact energy is absorbed by the internal shearing of the cartridges and crushing of the energy absorption material. The lapped panels on the perimeter serve to redirect vehicles for side impacts. If the site has grade or cross slope in excess of 5%, additional site preparation or modification to the units in accordance with the manufacturer's literature is needed.

1620.02 Design Criteria

The following design criteria apply to new or reset permanent and temporary impact attenuators. The design criteria also apply to existing systems to be left in place when the Barrier Terminals and Transition Sections columns on a design matrix apply to the project (see Chapter 1100).

Impact attenuators are placed so that they do not present a feature that needs mitigating in relation to opposing traffic. For median and reversible lane locations, the backup structure or attenuator-to-object connection is designed to help in aiding opposing traffic from being snagged. It is desirable that existing curbing be removed and the surface smoothed with asphalt or cement concrete pavement before an impact attenuator is installed. However, curbs 4 inches or less in height may be retained depending on the feasibility of their removal.

In general, attenuators are aligned parallel to the roadway except the inertial barriers.

1620.03 Selection

When selecting an impact attenuator system, consider the:

- Posted speed.
- Average Daily Traffic (ADT).
- Repair crew exposure.
- Proximity to the roadway.
- Anticipated number of yearly impacts.
- Available space (length and width).
- Maintenance costs.
- Initial cost.
- Duration (permanent or temporary use).
- Portion of the impact attenuator that is redirective/nonredirective (see Exhibits 1620-5 and 1620-6).

It is very important for designers to consider the portion of an impact attenuator that is designed to redirect vehicles during a side impact of the unit. It is crucial to consider that fixed objects, either permanent or temporary (such as construction equipment), not be located behind the nonredirective portion of these devices.

The posted speed is a consideration in the selection of the QuadGuard, REACT 350, Universal TAU-II, and Inertial Barrier systems. Use Exhibit 1620-1 to select the permanent system sizes needed for the various posted speeds.

Posted Speed (mph)	Quad Guard (Bays)	Universal TAU-II* (Bays)	REACT 350 (Cylinders)	Inertial Barrier (Type)
40 or less	3	2–3	4	1
45	4	3–4	6	2
50	5	4–5	6	3
55	6	5–7	6	4
60	6	7–8	9	5
65	8	7–8	9	6
70	9	7–8	9	6
*Dependent on the width of the system.				

Impact Attenuator Sizes
Exhibit 1620-1

If it is anticipated that a large volume of traffic will be traveling at speeds higher than the posted speed limit, then the next larger unit may be specified.

For a comparison summary of space and initial cost information related to the impact attenuator systems, see Exhibit 1620-5.

When maintenance costs are considered, anticipate the average annual impact rate. If few impacts are anticipated, lower-cost devices such as inertial barriers might meet the need. Inertial barriers have the lowest initial cost and initial site preparation. However, maintenance will be costly and necessary after each impact. Labor and equipment are needed to clean up the debris and install new containers (barrels). Also, inertial barriers are not be used where flying debris might be a danger to pedestrians.

In selecting a system, one consideration is the anticipated exposure to traffic that the workers making the repairs may encounter. In areas with high traffic exposure, a low-maintenance system that can be repaired quickly is most desirable. Some systems need nearly total replacement or replacement of critical components (such as cartridges or braking mechanisms) after a head-on impact, while others simply need resetting. Consult with the Area Maintenance Superintendent who will be maintaining the systems.

(1) Low-Maintenance Category

The REACT 350, SCI100GM / SCI70GM, and the QuadGuard Elite have a higher initial cost, requiring substantial site preparation, including a backup or anchor wall in some cases and cable anchorage at the front of the installation. However, repair costs are comparatively low, with labor being the main expense. Maintenance might not be needed after minor side impacts with these systems.

Limit the selection of impact attenuators to low-maintenance devices for:

- Locations with an average daily traffic (ADT) of 25,000 or more or a history/anticipation of multiple impacts each year.
- Sites with limitations on repair time or locations within 10 feet of the traveled way.
- Sites requiring night repairs or gore locations.

The QuadGuard Elite, SCI100GM, and REACT 350 are considered low-maintenance devices. Consider upgrading existing ADIEM, G-R-E-A-T, and Hex-Foam impact attenuators to these low-maintenance devices when the repair history shows one or more impacts per year over a three- to five-year period.

To be included in the low-maintenance category, a threshold on repair parts for each impact will be $500 or less per impact. A threshold on repair time considering a four-person crew will be one hour or less.

Approved attenuator systems that have little or no performance history in Washington State may be considered low-maintenance devices with concurrence from the HQ Design Office and the Area Maintenance Superintendent (or designee) responsible for maintaining the device. Product vendors or distributors are responsible for obtaining the concurrence from HQ Design Office representatives.

To be included in the low-maintenance category, a threshold on repair parts for each impact will be $500 or less per impact. A threshold on repair time considering a four-person crew will be one hour or less. Attenuators selected as low-maintenance devices will:

- Be approved for use in Washington State (see 1620.01).
- Have been in use for a minimum of two years.
- Include a two-year "In-Service Evaluation Report" based on the usage in Washington and/or other states that represents at least 25 impacts as a basis for the repair history. The impacts provided will include both side and leading end impacts. The minimum information in the "In-Service Evaluation Report" will include:
  - Number of impacts and type (such as side or front).
  - Impacting vehicle type with a description of collision (such as speeds or impact angle).
  - Specific location of impacts.
  - Repair dates.
  - Parts needed for repair (itemized list).
  - Cost of parts.
  - Repair time (total hours).
  - Repair personnel contact information.

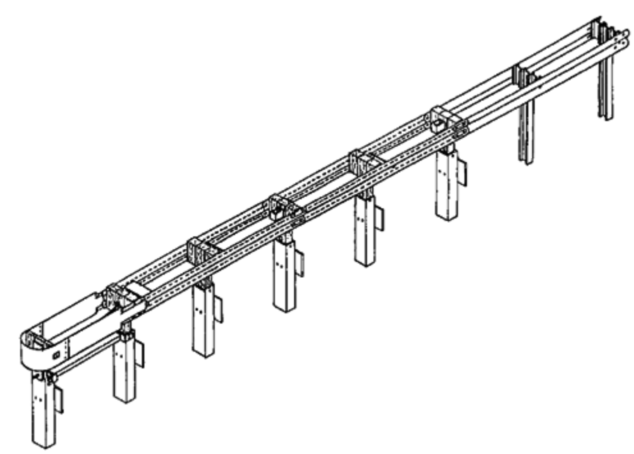
It is very important to consider that each application is unique when selecting impact attenuators for use in particular applications. This applies to both permanent and temporary installations. When specifying the system or systems that can be used at a specific location, the list shown in Exhibit 1620-5 is to be used as a starting point. As the considerations discussed previously are analyzed, inappropriate systems may be identified and eliminated from further consideration. Systems that are not eliminated may be appropriate for the project. When the site conditions vary, it might be necessary to have more than one list of acceptable systems within a contract. Systems are not to be eliminated without documented reasons. Also, wording such as "or equivalent" is not to be used when specifying these systems. If only one system is found to be appropriate, then approval from the Assistant State Design Engineer of a public interest finding for the use of a sole source proprietary item is needed.

When a transition to connect with a concrete barrier (see Exhibit 1620-5) is needed, the transition type and connection are to be specified and are included in the cost of the impact attenuator. (See Chapter 1610 for information on the transitions and connections to use.)

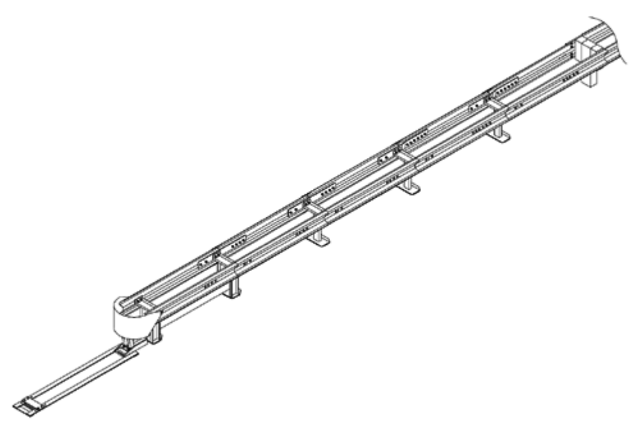
Contractors can be given more flexibility in the selection of work zone (temporary) systems, since long-term maintenance and repair are not a consideration.

1620.04 Documentation

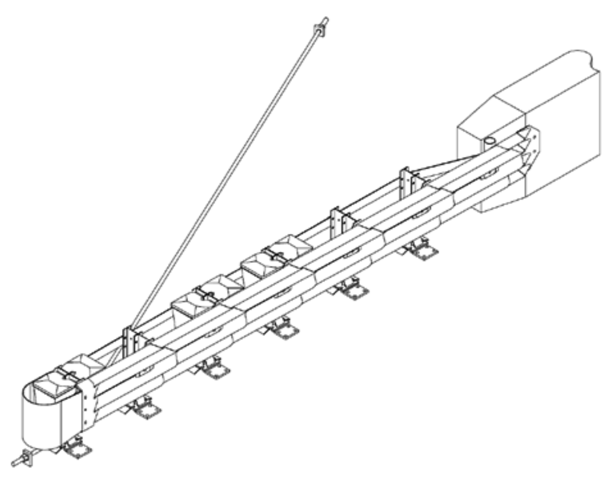
For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
www.wsdot.wa.gov/design/projectdev/



CAT - 350



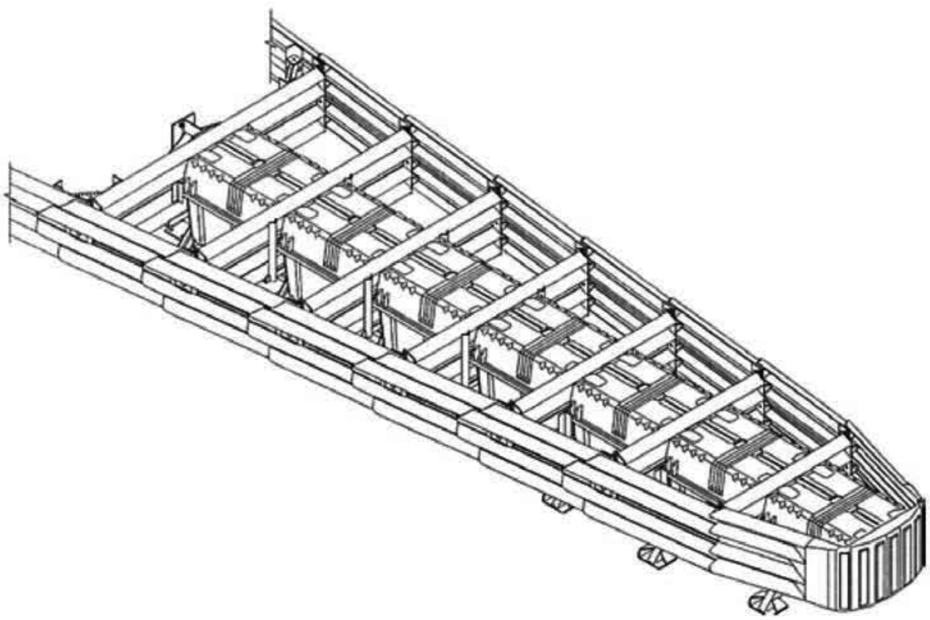
Brakemaster



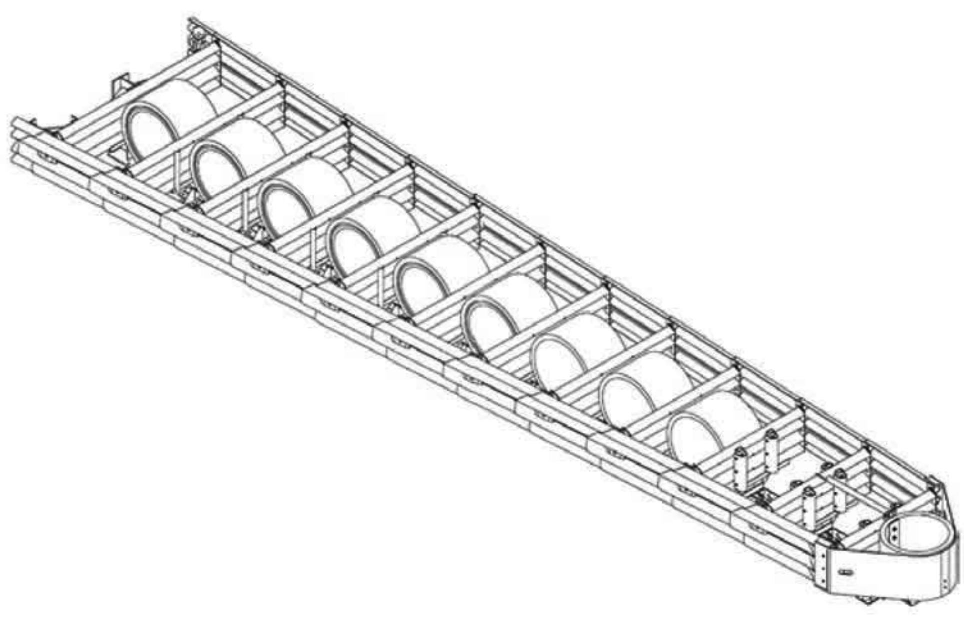
QuadTrend 350

Impact Attenuator Systems: Permanent Installations

Exhibit 1620-2a



QuadGuard



QuadGuard Elite

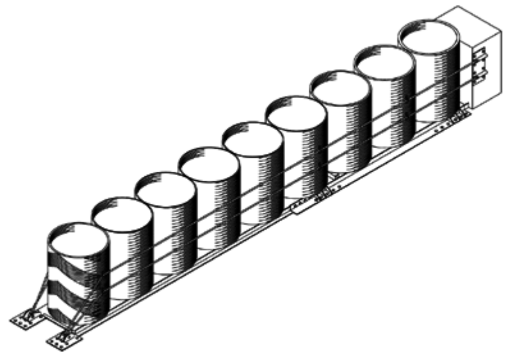
Impact Attenuator Systems: Permanent Installations

Exhibit 1620-2b

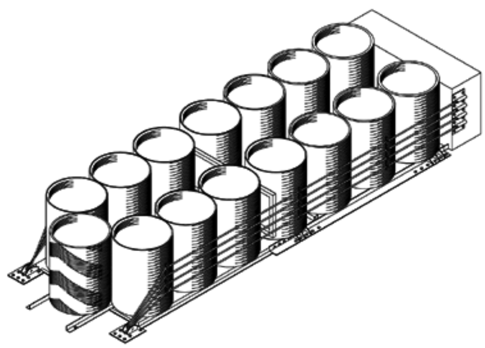
Universal TAU - II

Impact Attenuator Systems: Permanent Installations

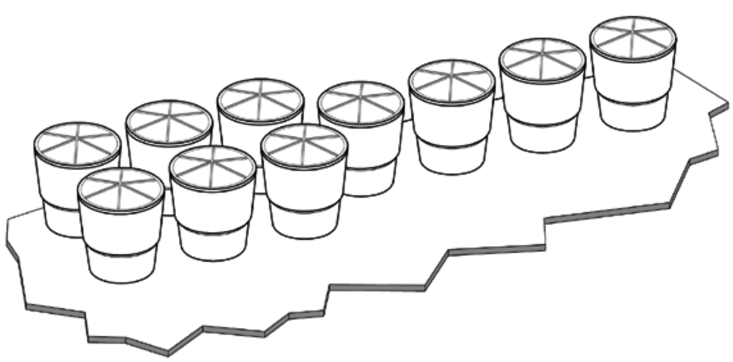
Exhibit 1620-2c



REACT 350



REACT 350 WIDE



INERTIAL BARRIER

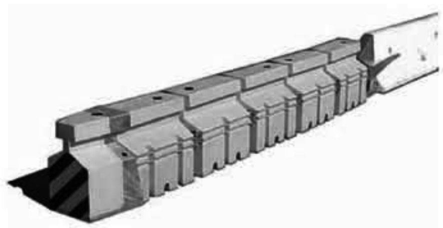
Impact Attenuator Systems: Permanent Installations

Exhibit 1620-2d

SCI100GM / SCI70GM

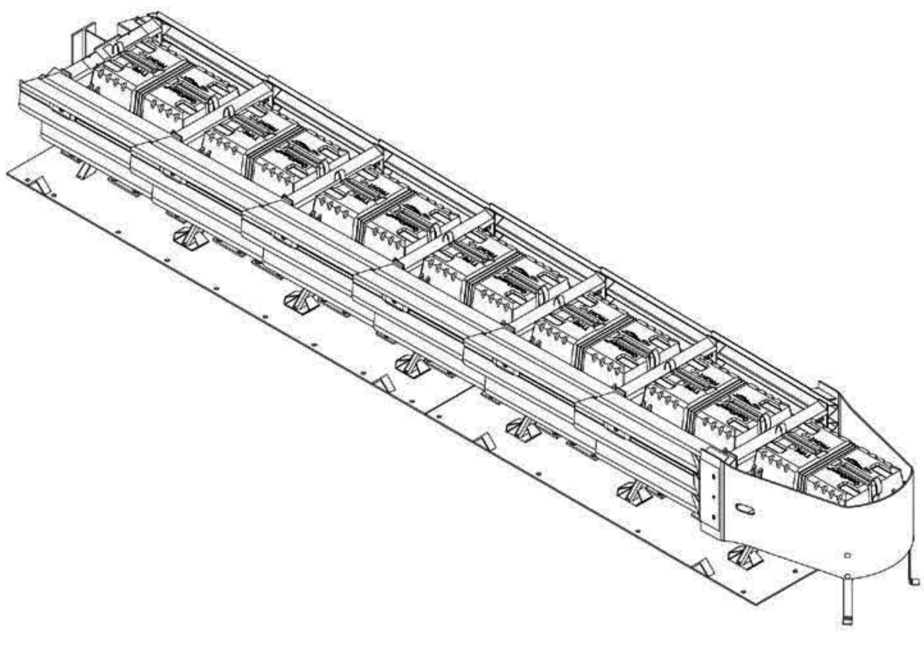
Impact Attenuator Systems: Permanent Installations

Exhibit 1620-2e



ABSORB 350

ADIEM 350



QuadGuard CZ

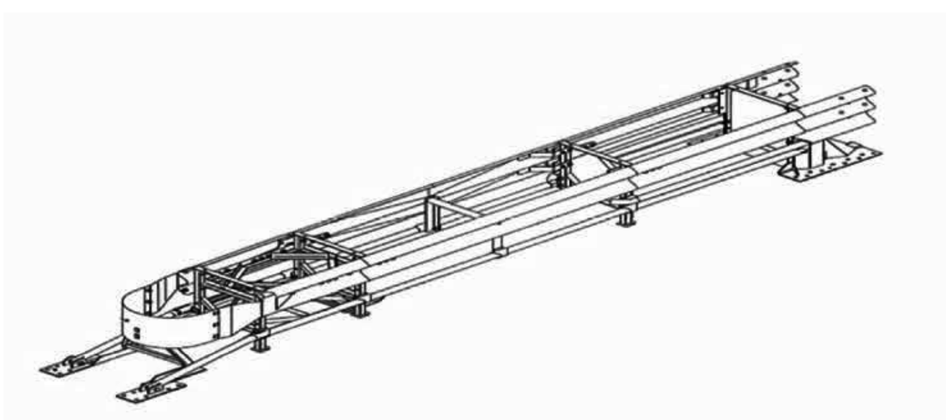
Impact Attenuator Systems: Work Zone Installations

Exhibit 1620-3a

N-E-A-T

TRACC

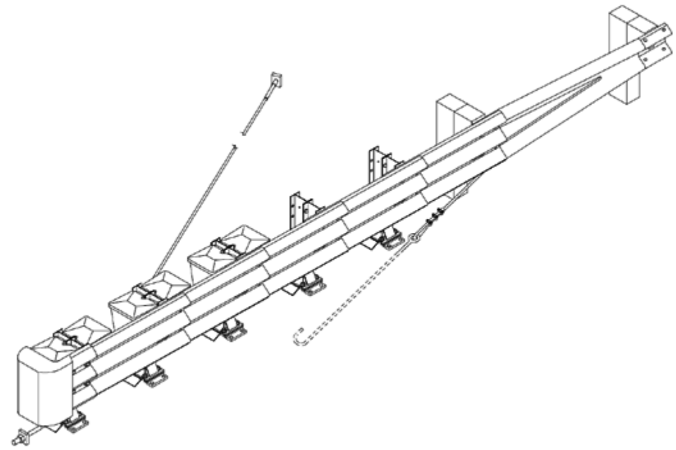
Triton CET



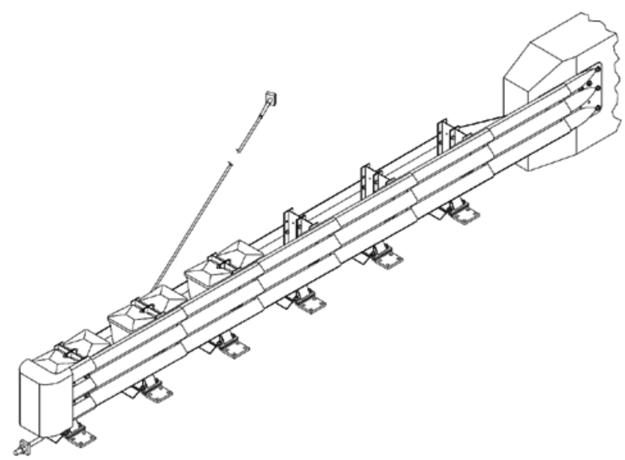
QUEST

Impact Attenuator Systems: Work Zone Installations

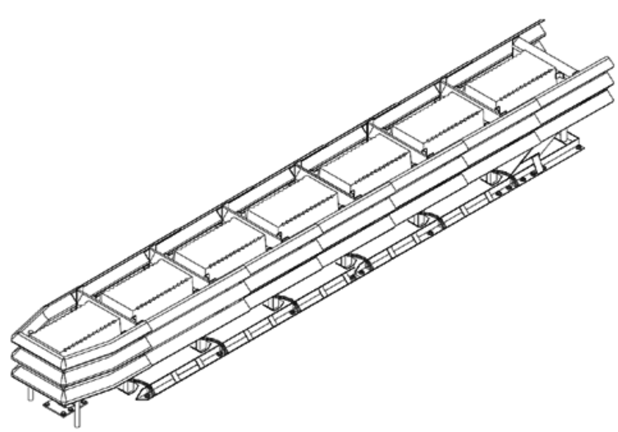
Exhibit 1620-3b



Sentre



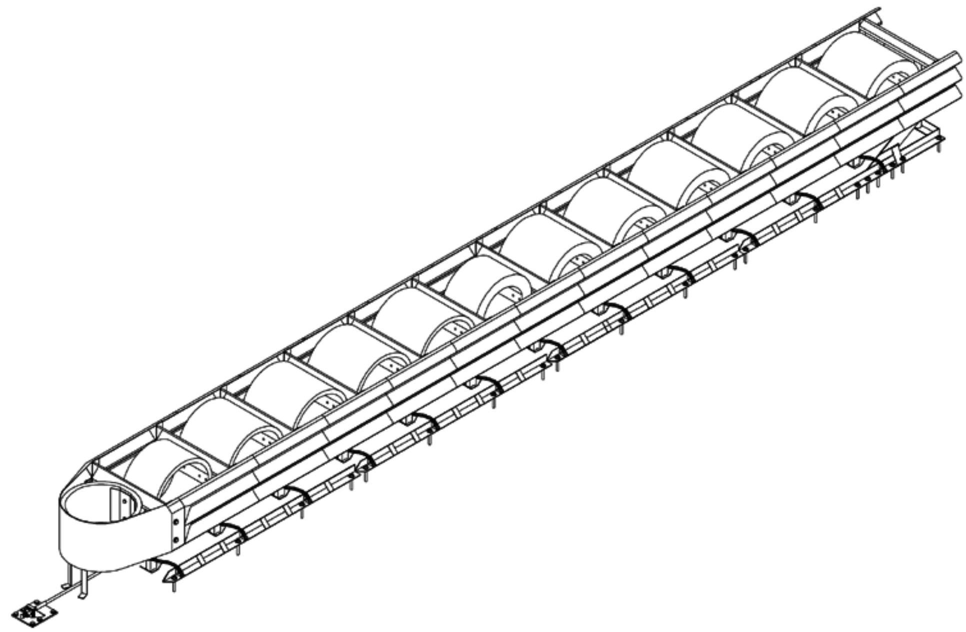
TREND



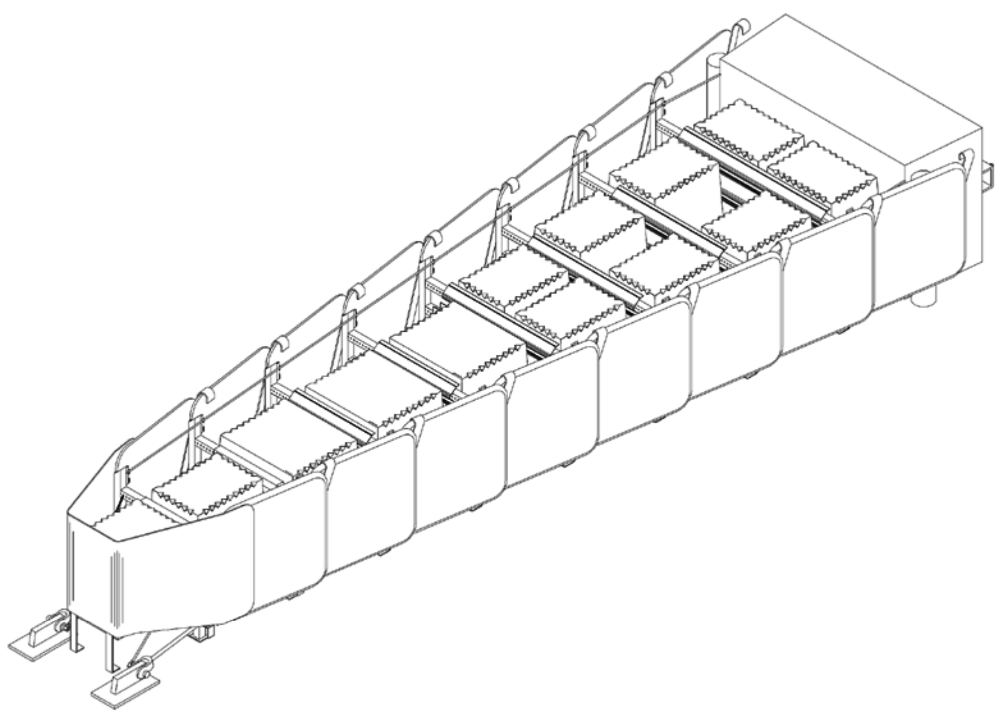
G-R-E-A-T

Impact Attenuator Systems: Older Systems

Exhibit 1620-4a



LMA



Hex-Foam Sandwich

Impact Attenuator Systems: Older Systems

Exhibit 1620-4b

Impact Attenuator Systems (All dimensions in feet)

System	(P) Permanent (T) Temporary (B) Both	Approximate Outside Width[10]	Approximate System Length[11]	Transition to Rigid System Needed?	Distance Beyond Length of Need (See Exhibit 1620-6)	Initial Cost Category[1]
CAT 350[2]	P	2.5	31.3	Y	18.8	A
Brakemaster 350[2]	P	2.1	31.5	Y	15.8	A
QuadTrend – 350[6]	P	1.3	20.0	N	10.5	A
Universal TAU-II	P	2.9–8.7	12.0–26.0[4]	N	3.0	B[5]
QuadGuard	B	2.8–10.8	13.1–32.5[4]	N	3.3	B[5]
QuadGuard Elite	B	2.8–8.3	23.8–35.5	N	3.3	D
REACT 350	B	4	13.8–30.2[4]	N	4.3	C[5]
REACT 350 Wide	B	5.7–10.7	30.8–34.8	Y	4.3	D[5]
Inertial Barriers	B	7	17.0–34.5[4]	N	[3]	A[5]
SCI100GM	B	3.1	21.5	Y	3	C
SCI70GM[8]	B	2.8	13.5	Y	3	B
ABSORB 350[9]	T	2	19.0–32.0	Y	[3]	A[5]
ADIEM 350[7][8]	T	2.7	30	N	14.1	B
QuadGuard CZ	T	2.75–3.25	13.1–22.1	N	3.3	C[5]
N-E-A-T[8]	T	1.9	9.7	N	[3]	A[5]
TRACC[12]	T	2.6	21.3	N	8	B
Triton CET[9]	T	1.8	40	N	[3]	A
QUEST	T	2.8	22.2	Y	3.5	B

For table notes, see the following page.

Impact Attenuator System Comparison

Exhibit 1620-5

Notes:

[1] A ($5,000 to $10,000); B ($10,000 to $15,000); C ($15,000 to $25,000); D ($25,000 to $50,000). These are rough initial cost estimates; verify actual costs through manufacturers/suppliers. Some products are priced very close to the margin between cost categories.

[2] Generally for use with double-sided beam guardrail. Usage as an end treatment for concrete barrier needs a transition.

[3] The N-E-A-T, Inertial Barriers, Triton CET, and ABSORB 350 may only be used beyond the length of need.

[4] For sizes or configuration type, see Exhibit 1620-1.

[5] The lengths of the Universal TAU-II, QuadGuard, QuadGuard Elite, REACT 350, REACT 350 Wide, ABSORB 350, QuadGuard CZ, and Inertial Barriers vary because their designs are dependent upon speed. Costs indicated are for a typical 60 mph design. In addition to length, several of the systems also vary in width. For estimating purposes, the following model widths were considered.

- Universal TAU II – 24”
- QuadGuard – 24”
- QuadGuard Elite – 24”
- REACT 350 Wide – 60”
- QuadGuard CZ – 24”

[6] Generally for use at the ends of bridges where installation of a beam guardrail transition and terminal is not feasible.

[7] Generally for use with concrete barrier. Other uses may need a special transition design.

[8] Use limited to highways with posted speeds of 45 mph or lower.

[9] Test Level 3 version on high-speed facilities should be limited to locations where the likelihood of being hit is low.

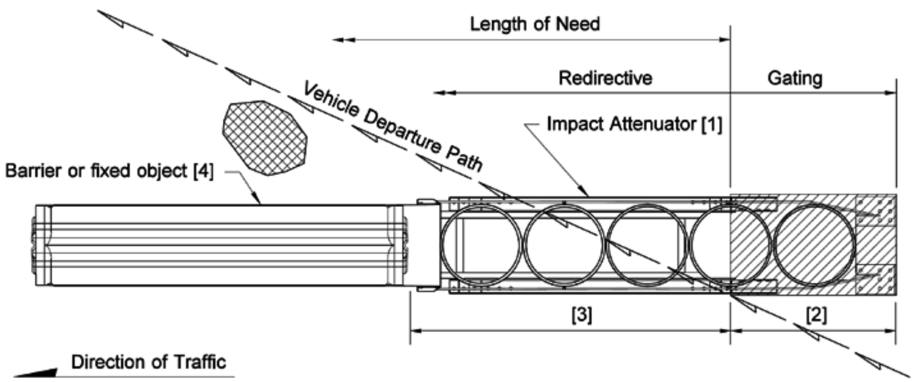
[10] The given dimension is the approximate outside width of each system. In most cases, this width is slightly wider than the effective width. To determine the width of an object that may be shielded, refer to the manufacturer’s specifications. (See the WSDOT Design Policy, Standards, & Safety Research Unit’s website for links to this information.)

[11] The given dimension is the approximate system length. The effective length may vary depending on such factors as the physical design and type of anchorage used. To determine the total length needed, refer to the manufacturer’s specifications. (See the WSDOT Design Policy, Standards, & Safety Research Unit’s website for links to this information.)

[12] May be considered for permanent installations with concurrence of Maintenance personnel.

Impact Attenuator System Comparison

Exhibit 1620-5 (continued)



Notes:

[1] Impact attenuator type and manufacturer varies with application (see Exhibit 1620-5).

[2] Distance beyond the length of need (see Exhibit 1620-5). This portion is nonredirective (gating).

[3] This portion is redirective and can be included as part of the barrier needed to satisfy length of need.

[4] Concrete barrier shown for illustration purposes only. Type of object varies.

Impact Attenuator Distance Beyond Length of Need

Exhibit 1620-6

Chapter 1710 Safety Rest Areas

1710.01 General

The Washington State Department of Transportation (WSDOT) has developed a statewide system of traveler stopping opportunities along Interstate highways and state routes. This system includes safety rest areas (see Exhibit 1710-1), roadside parks, and viewpoints. These services provide universal access for rest, traveler information, and restroom facilities. Benefits include improved safety by reducing driver fatigue and the number of vehicles parked on the shoulders of state routes, refuge from adverse driving conditions, and increased tourism promotion.

Safety rest areas (SRAs) are spaced approximately every 60 miles on the National Highway System and on Scenic and Recreational Highways. Use the Safety Rest Area Program Strategic Plan as a guide when selecting a site location. The link to the SRA Strategic Plan can be found in the SRA Section of the Capital Facilities Office internal web page at: 🖰 http://wwwi.wsdot.wa.gov/operations/facilities/

Safety rest areas are planned and designed by a multidisciplinary team lead through the Facilities Administrator in the Capital Facilities Office, a branch of Maintenance Operations. (See 1710.04 for an expanded discussion on team roles and membership.)

Photo: Keith Anderson, VERG

WSDOT Safety Rest Area

Exhibit 1710-1

1710.02 References

(1) Federal/State Laws and Codes

23 Code of Federal Regulations (CFR) 1.23, Rights-of-way

23 CFR 635, Construction and Maintenance

23 CFR 752, Landscape and roadside development

23 CFR 771, Environmental impact and related procedures

42 United States Code (USC) Chapter 126, Section 12101 et seq., Americans with Disabilities Act of 1990

20 USC Chapter 6A, Section 107, The Randolph-Sheppard Act

Revised Code of Washington (RCW) 46.17.375, Recreational vehicle sanitary disposal fee

RCW 46.68.170, RV account – Use for sanitary disposal systems

RCW 47.01.460, Adjustments to recreational vehicle fees

RCW 47.06.040, Statewide multimodal transportation plan

RCW 47.28.030, Contracts – State forces

RCW 47.38, Roadside areas – Safety rest areas

RCW 47.39, Scenic and Recreational Highway Act of 1967

RCW 47.42, Scenic Vistas Act

Washington Administrative Code (WAC) 246-290, Group A public water supplies

WAC 468-66, Highway Advertising Control Act

(2) Design Guidance

As the lead WSDOT organization for SRA project teams, the Capital Facilities Office coordinates design details and standards for SRA-related items.

ADA Accessibility Guidelines for Buildings and Facilities (ADAAG)
www.access-board.gov/adaag/html/adaag.htm

Manual on Uniform Traffic Control Devices for Streets and Highways, USDOT, FHWA; as adopted and modified by Chapter 468-95 WAC "Manual on uniform traffic control devices for streets and highways" (MUTCD)
www.wsdot.wa.gov/publications/manuals/mutcd.htm

Highway Runoff Manual, M 31-16, WSDOT

Hydraulics Manual, M 23-03, WSDOT

Plans Preparation Manual, M 22-31, WSDOT

Maintenance Manual, M 51-01, WSDOT

Right of Way Manual, M 26-01, WSDOT

Roadside Classification Plan, M 25-31, WSDOT

Standard Plans for Road, Bridge, and Municipal Construction (*Standard Plans*), M 22-01, WSDOT

Traffic Manual, M 51-02, WSDOT

(3) Supporting Information

Safety Rest Area Strategic Plan, WSDOT Capital Facilities Office
http://wwwi.wsdot.wa.gov/operations/facilities/

Guide for Development of Rest Areas on Major Arterials and Freeways, AASHTO Task Force on Geometric Design

Project Management Online Guide, WSDOT

(4) Agreements

Interpretive Signs and Markers Agreement – Washington State Parks Commission

- (GM 869) 1989 Highways and Local Programs Division

Traveler and Commercial Information Services – Private Vendor (StoreyCo, Inc.)

- (AA-1-12097) 2007 Capital Facilities Office

Vending Machines – Department of Services for the Blind (DSB)

- (GCA 10377) Capital Facilities Office

1710.03 Definitions

ancillary services Those secondary services, also considered amenities, provided at safety rest areas that include, but are not limited to, vending machines, picnic areas, interpretive signing, telephones, recreational vehicle (RV) sanitary disposal facilities, trails, scenic viewpoints, commercial and public information displays, and visitor information centers.

Recreational Vehicle Account In 1980 the RV account was established for use by the department of transportation for the construction, maintenance, and operation of recreational vehicle sanitary disposal systems at safety rest areas (RCW 46.68.170). A recreational vehicle sanitary disposal fee is required for registration of a recreational vehicle (RCW 46.17.375). Adjustments to the recreational vehicle fee by the department of transportation may be implemented after consultation with the citizens' representatives of the recreational vehicle user community (RCW 47.01.460).

roadside park A roadside user facility for safe vehicular parking off the traveled way and separated from the highway by some form of buffer. These sites might be equipped with features or elements such as points of interest, picnic tables, and/or vault toilet buildings. Unlike a safety rest area, a roadside park does not always provide a permanent restroom building.

safety rest area (SRA) A roadside facility equipped with permanent restroom building(s), a parking area, picnic tables, refuse receptacles, illumination, and other ancillary services. SRAs typically include potable water and might include traveler information and telephones.

Safety Rest Area Strategic Plan Developed in 2008 under a stakeholder-coordinated effort of executive and advisory team members, this plan provides guidance for current and future management of the SRA program.

traveler information Commercial and noncommercial information that informs and orients the traveling public. This includes access information for food, gas, lodging, local attractions, regional tourist attractions, roadway conditions, and construction schedules.

universal access Access for all persons regardless of ability or stature.

viewpoint A roadside stopping opportunity with a view of some point of interest or area scenery. This area is not typically separated from the traveled way by some form of highway buffer.

Visitor Information Center (VIC) A staffed or nonstaffed booth or separate building that displays and dispenses free tourist travel maps and brochures. These are typically located at border-entry SRAs to provide travel information to highway users as they enter the state.

1710.04 Safety Rest Area Project Team

The Capital Facilities Office has primary responsibility for program oversight and communication and is the primary point of contact for questions concerning SRAs. Duties include planning and programming for capital Preservation and Improvement projects, maintenance operations oversight and policy development, and project delivery.

Exhibits 1710-2 and 1710-3 outline the many disciplines involved with SRA planning, design, construction, and maintenance. The exhibits outline roles during the different phases of SRA management. Services are provided by internal WSDOT staff, other government agencies, and private consultants.

1710.05 Location, Access, and Site Design

(1) Conformance With the Safety Rest Area Strategic Plan

Regional planners, in coordination with the Capital Facilities Office, will use the Safety Rest Area Strategic Plan as a guide to determine which areas in the state are potential areas of need for a new facility. Verify current locations of SRAs, roadside parks, viewpoints, and undeveloped SRA properties that could be utilized for development of a new SRA. Coordinate all SRA planning and design efforts with the SRA Program located in the Capital Facilities Office.

(2) Highway Spacing Guidelines

It is preferred to space SRAs and roadside parks approximately every 60 miles on the National Highway System and Scenic Byways. Consider the location of other available public facilities when deciding where to locate an SRA. Other public or private facilities may offer stopping opportunities that could mitigate the need for construction of a new SRA. Reference the SRA Strategic Plan for potential areas of need for new stopping opportunities.

WSDOT Office	Planning	Programming & Budget	Design	Construction	Operations & Maintenance[1]	Agreements & Partnerships
Capital Facilities	Lead	Lead	Lead	Lead	Oversight	Lead
Maintenance Operations	Support	N/A	Support	Support	Lead	Lead/Support
Capital Program Development	Approver	Approver	Approver	Approver	N/A	N/A
Budget and Financial Analysis	N/A	Approver	N/A	N/A	N/A	N/A
Highways and Local Programs	Support	N/A	Support	N/A	N/A	Support
Design	Support	N/A	Support	Support	N/A	N/A
Construction	NA	N/A	Support	Support	N/A	N/A
Landscape Architect	Support	N/A	Support	Support	Support	N/A
Utilities	NA	N/A	Support	Support	Support	Support
Environmental	Support	N/A	Support	Support	Support	N/A
Hydraulics	Support	N/A	Support	Support	N/A	N/A
Traffic	Support	N/A	Support	Support	Support	N/A
Public-Private Partnerships	Support	N/A	Support	N/A	N/A	Lead/Support
Freight Systems Division	Support	N/A	Support	N/A	N/A	Support
Statewide Travel and Collision Data	Support	N/A	Support	N/A	N/A	N/A
Real Estate Services	Support	N/A	Support	N/A	Support	Support
Emergency Management	Support	N/A	Support	N/A	Support	N/A

Note:

[1] The SRA section in the WSDOT *Maintenance Manual* provides additional information pertaining to daily operations at the rest areas. Operations policy is outlined for all the ancillary services provided at each rest area site, such as the free coffee program, vending machines, literature distribution and posting, site security, seasonal or temporary closures, and other site activities.

WSDOT's SRA Project and Programming Roles

Exhibit 1710-2

Organization	Planning	Programming & Budget	Design	Construction	Operations & Maintenance	Agreements & Partnerships
Federal Highways Administration	Approver	N/A	Approver	Approver	Support	Approver
Attorney General	N/A	N/A	N/A	N/A	N/A	Support
Washington State Patrol	Support	N/A	Support	Support	Support	Support
Department of Commerce	Support	N/A	N/A	N/A	N/A	Support
Washington State Historical Society	Support	N/A	Support	N/A	N/A	Support
RV Citizens Advisory Committee[1]	Support	Support	Support	N/A	Support	Support
Association of Visitor Information Centers of WA	Support	N/A	N/A	N/A	N/A	Support
Washington State Hotel and Lodging Association	Support	N/A	N/A	N/A	N/A	Support

Note:

[1] **Recreational Vehicle Citizens Advisory Committee:** The department utilizes a volunteer citizen-based group of recreational vehicle users to help define the RV needs at SRAs. This group provides guidance on the expenditure of funds from the RV account and fee adjustments. The fee adjustments must be preceded by an evaluation per RCW 47.01.460.

Additional Safety Rest Area Resources
Exhibit 1710-3

(3) Adjacent Land Use

Consult local planning offices for information about zoning and expected development in the area of a proposed site to ensure compatibility with a new safety rest area or roadside park. Acquire a buffer area or scenic easement on adjacent lands, if possible, to protect scenic views and existing vegetation. Incorporate any cultural, historical, or scenic points of interest into the site design to enhance visitor experience and area education. For Interstate safety rest areas, vehicular ingress and egress will be from the main line only.

(4) Availability of Utilities

Determine the proximity and availability of water, power, and sewer systems prior to site acquisition. Prepare required legal documents such as well agreements, easements, water rights, and acquisition documents. The Capital Facilities Office uses annual traffic data in the area to estimate the number of rest area users and determine the adequacy of potable water supply, power capacity, parking space needs, and sewage disposal system options. New construction should meet the 20-year projected growth rate based on potential traffic increases.

(5) Level of Development

Roadside facilities have different levels of development and require varying site size and amenity levels. Exhibit 1710-4 shows recommended site sizing and amenities for SRAs, roadside parks, and viewpoints.

(6) Site Conditions

SRAs need large parcels of land to provide adequate space for parking passenger vehicles and trucks, on-site sewage treatment, and on-site water systems if provided. Any selected site should consider the terrain to allow for safe ingress and egress from the highway. Other considerations are:

- Grades and slopes to accommodate parking, sewage treatment, and the building site.
- High water level, particularly if the site is in a floodplain.
- Soil conditions and soil type for structural designs and the on-site sewage treatment system.
- Vegetation and natural features to understand potential mitigation costs from impacts to existing wetlands or stormwater drainage, etc.
- Prevailing wind direction and typical wind velocities that can affect building siting/design and visitor experience.

(7) Site Security

Design the facility to maximize line of sight for rest area users. Design vegetation for visibility to avoid hiding places on-site. If electrical power is available on-site, provide lighting around all parking areas, buildings, and other site amenities that are made available to the public.

(8) Site Sustainability

During site development, adhere to the U.S. Green Building Council's Leadership in Energy and Environmental Design standards where practicable. Strive for energy efficiency, water conservation, and low operational costs in building designs. Ensure landscaping features will be durable and easy to maintain. Contact the Capital Facilities Office for minimum requirements and standard details.

(9) Stormwater Management

For stormwater management, particularly in areas covered by the National Pollutant Discharge Elimination System (NPDES) permit, make an effort to minimize the use of storm drainage devices such as catch basins, oil-water separators, and retention vaults. Design the site to accommodate sheet flow off paved surfaces to vegetative areas for on-site infiltration and management of stormwater where practicable. (See the *Highway Runoff Manual* for stormwater design information.)

(10) Traffic Ingress and Egress

Design connections to the main line highway in accordance with *Design Manual* chapters in Division 13. Consult with the HQ Access and Hearings Section for establishing new or modifying existing highway access points.

Site Development	Safety Rest Area	Roadside Park	Viewpoint
Site			
Minimum site size – Professional judgment should be used based on site-specific requirements	Up to 30 acres	Up to 3 acres	Up to 1 acre
ADAAG code compliance	Required	Required	Required
Utilities			
Potable water	Optional	Optional	No
Off-site sewage disposal	Optional	Optional	No
On-site sewage disposal	Optional	Optional	No
RV sanitary disposal systems	Optional	No	No
Electrical power	Optional	Optional	Optional
Electric vehicle charging stations*	Optional	No	No
Restroom Buildings			
Permanent building	Required	Optional	No
Toilets and hand cleaning	Required	Optional	No
Portable toilets: vault, chemical, or composting	Optional	Optional	Optional
ADAAG code compliance	Required	Required	Required
Parking and Pavement			
Impervious	Required	Optional	Optional
Truck parking	Optional	Optional	No
RV parking	Optional	Optional	Optional
Site Amenities			
Pedestrian plaza	Optional	Optional	No
Sidewalks	Optional	Optional	Optional
Picnic tables	Optional	Optional	Optional
Recreation trails	Optional	Optional	Optional
Pet walking area	Optional	Optional	No
Bicycle access and/or racks	Optional	Optional	Optional
Historical or area information display	Required	Optional	Optional
Ancillary Services			
Telephone service	Optional	Optional	No
Refuse receptacles	Required	Optional	Optional
Vending machines*	Optional	No	No
Volunteer refreshment area*	Optional	No	No
Visitor information booth*	Optional	No	No
Travel information kiosk*	Optional	Optional	No
Interpretive displays, markers, or memorial signs	Optional	Optional	Optional
Safety and Security			
Fencing	Optional	Optional	Optional
Site illumination*	Optional	Optional	No
Surveillance cameras*	Optional	No	No

*If provided, electrical power is required.

Roadside Facilities Level of Development
Exhibit 1710-4

(11) ADAAG Compliance

You must comply with the *Americans with Disabilities Act Accessibility Guidelines* (ADAAG) for all site components that are made available to the public. Provide at least one accessible route of travel, defined in ADAAG, from the parking area to each on-site amenity or ancillary service.

(12) Parking Area Design

Consider the parking area layout when generating a site master plan. Include stages of construction if applicable. Provide separate parking areas for trucks/RVs/buses and passenger cars. For new designs, locate large-vehicle parking on the far side of the site away from the highway for improved highway visibility and site security purposes. Provide shade for vehicles where practicable. Exhibit 1710-5 shows an example of a truck parking area layout. AASHTO's *Guide for Development of Rest Areas on Major Arterials and Freeways* provides parking area design considerations. Consider areas for snow storage needs. Refer to the *Hydraulics Manual* for drainage design. Preserve existing landscape features to the greatest extent possible. Design vehicular and pedestrian routes to be safe, simple, direct, and obvious. Meet local building codes and ADAAG requirements for public parking.

(13) Recreational Vehicle (RV) Sanitary Disposal Facilities

Construct RV sanitary disposal facilities (dump stations) only at sites served by municipal sewage disposal systems, or at sites served by sewage lagoons with adequate capacity. On-site septic systems with drainfields are not an option for RV dump stations because of sewage volume, technical/maintenance requirements, and costs. Contact the Capital Facilities Office for details on RV dump station design and operation.

(14) Walkways

Design walkways for direct pedestrian movement to all facilities and comply with ADAAG requirements. Provide sidewalk width a minimum of 48 inches, which exceeds ADAAG requirements.

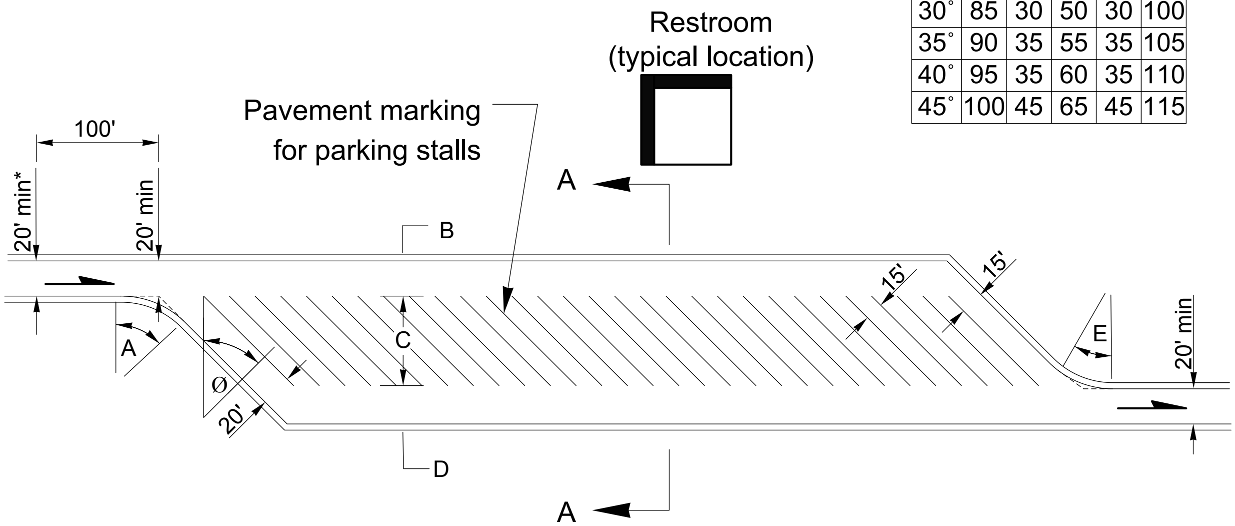
(15) Vegetation

Vegetation enhances the physical environment by providing shade, shelter from wind, visual screening, wildlife habitat, and other benefits. Landscape Architects engaged in the project employ designs that emphasize low-maintenance practices and obstacle-free lawns, and minimize water usage for irrigation and impacts to existing native vegetation where practicable.

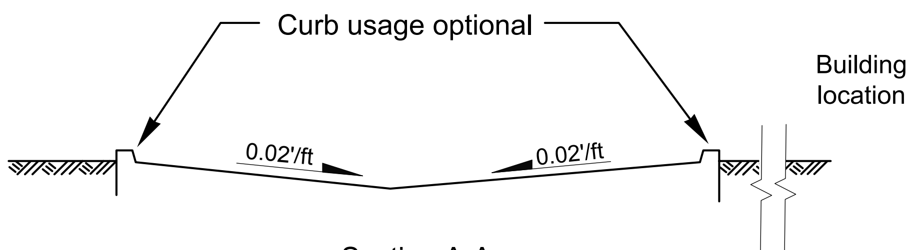
(16) Picnic Tables

Provide one picnic table for every ten passenger car parking stalls, with a minimum of four tables per SRA where practicable. Provide shelters for 50% of the picnic tables on-site. Provide windscreens for picnic tables exposed to frequent high winds. Each SRA is required to provide a minimum of one picnic table that complies with ADAAG requirements. Place picnic tables near walkways but also provide privacy from restroom users.

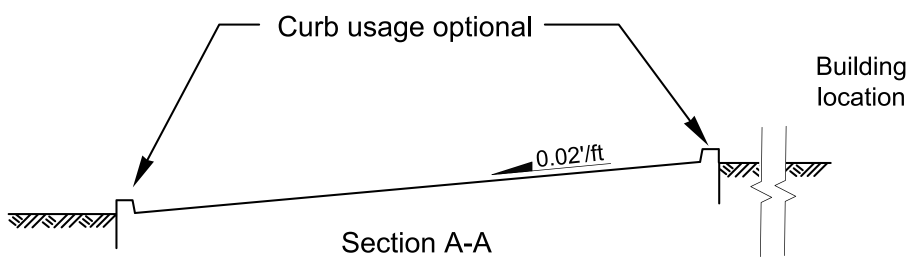
	Variables (ft)				
Ø	A	B	C	D	E
30˚	85	30	50	30	100
35˚	90	35	55	35	105
40˚	95	35	60	35	110
45˚	100	45	65	45	115



* If exit ramp is tangent or has curve radii greater than 1,000', this width may be reduced to 14'.



Section A-A



Section A-A
Alternate

Typical Truck Storage

Exhibit 1710-5

(17) Recreation Trails

Provide trails or nature walks where practicable. (See Chapter 1515 for more information about shared-use paths.)

(18) Pet Areas

Provide ADAAG-compliant, well-lit areas for visitors to walk their pets away from kiosks, plaza areas, and moving vehicles. Provide trash receptacles and pet waste bags near pet areas.

(19) Electric Vehicle Charging Stations

Electric vehicle (EV) charging stations are provided at select sites. One ADAAG-compliant parking stall with an accessible route is required when EV charging stations are installed. Because EV charging is not the primary purpose of SRAs, locate the EV parking stalls at the ends of the passenger vehicle parking area.

(20) Bicycle Facilities

Provide bicycle racks where this type of active transportation mode is accessible to an SRA. (See Chapter 1520 for more information about roadway bicycle facilities.)

1710.06 Buildings

(1) Codes

Comply with current versions of the International Building Code, International Plumbing Code, National Electric Code, *Americans with Disabilities Act Accessibility Guidelines*, and all applicable state and local code requirements.

(2) Americans with Disabilities Act Accessibility Guidelines (ADAAG)

You must comply with accessibility guidelines specified in ADAAG for all building components that are available to the public. Design restrooms, ancillary service buildings, picnic benches, and information kiosks to ADAAG standards.

(3) Restroom Capacity

Provide a male/female restroom stall ratio of 40:60, and one unisex restroom that can be opened to allow for daily cleaning operations where practicable. If the unisex restroom is the only ADAAG-compliant toilet stall on-site, it must remain open at all times. Contact the Capital Facilities Office for restroom standards and to verify the number of stalls that should be provided at each site.

(4) Building Security

Design rest area buildings to provide a safe, comfortable experience for the traveling public. Avoid building designs with potential hiding places, and ensure adequate building lighting is provided around the perimeter.

(5) Building Sustainability

Buildings and systems are to adhere to the U.S. Green Building Council's Leadership in Energy and Environmental Design standards where practicable. Design facilities for energy efficiency, water conservation, and low operational costs. Ensure materials are durable and easy to maintain. Contact the Capital Facilities Office for minimum requirements and standard details.

(6) Vandalism Mitigation

Consider vandal-resistant materials as a preferred option for building components such as fixtures, fasteners, and surface coatings.

WSDOT Safety Rest Area Building – Adaptive Reuse Historic Preservation
Exhibit 1710-6

(7) Plaza Areas

Provide paved/concrete plaza areas at all new SRAs, where practicable, to enhance safety, reduce wear and maintenance on heavy-travel areas, and provide unobstructed pedestrian movement. Consider pedestrian movement when designing exterior fixtures such as benches, kiosks, telephones, and vending machines in plaza areas. Avoid creating potential hiding places and ensure appropriate lines of sight for safety.

(8) Building Signage

Ensure building signage meets current standards for rest area signage. Contact the Capital Facilities Office for details.

(9) Kiosks

Install travel information kiosks at all Interstate rest areas and at non-Interstate rest areas as needed. A kiosk is usually equipped with backlit information displays.

(10) Volunteer Refreshment and Coffee Services

Construct volunteer services buildings at all Interstate rest areas and at non-Interstate rest areas as needed. They can usually be incorporated with the travel information kiosks. Wire, plumb, and heat these buildings to meet building codes as an occupied space. Locate these buildings to give volunteers an unobstructed view of restroom entrances and parking areas if feasible.

(11) Rehabilitation and Expansion

Minor renovation projects to address specific building and system deficiencies such as roofs, interior fixtures and partitions, wall and floor surfaces, HVAC, electrical, water, and sewer will extend the usefulness of the building and minimize maintenance and operations costs. When major renovations are needed, consider restroom capacity increases to meet current standards based on expected user volumes.

Other facility components that will eventually need rehabilitation are kiosks, irrigation systems, sidewalks, picnic tables, parking areas, and RV dump stations. All projects must meet current ADAAG building and site requirements. Consider efficiency improvements that can be made to reduce operational costs. Coordinate with the Capital Facilities Office for all renovation or expansion projects.

1710.07 Utilities

Contact the region Utilities Office for acquisition of Utility Service Agreements for any utility needs. Coordinate with the Capital Facilities Office for long-term planning considerations. Telephones are provided at most SRAs and must meet ADAAG requirements. Because of the availability of cellular phones, and due to vandalism and other reasons, public telephone service may be cancelled after coordination between the Capital Facilities Office and region Maintenance.

(1) Power Capacity

A new or upgraded electrical service provided on-site will meet the projected needs of the facility over the next 20 years where practicable. Provide three-phase service where available. Consider building capacity increases, site lighting improvements, electric vehicle charging stations, truck parking electrification, and other potential needs. Contact the Capital Facilities Office for site-specific details or master plans.

(2) Water & Sewer Systems

Refer to the *Hydraulics Manual* for information on water and sewage disposal systems, including reservoirs, long-distance pressure sewers, septic tanks, drainfields, and sewage lagoons. Install separate water meters to quantify irrigation, building, RV dump stations, and source water where practicable. Consider maintenance needs for water and sewer system designs. Coordinate with the Capital Facilities Office for all issues related to water and sewer systems at SRAs.

(3) Stormwater Systems

Stormwater management and treatment systems are to meet the guidelines and requirements of the National Pollutant Discharge Elimination System (NPDES). Ensure runoff from impervious surfaces at SRAs is managed on-site using typical best management practices. Contact the Hydraulics Office for specific design recommendations, and the Maintenance Operations Office for specific site requirements noted in the statewide NPDES permit.

(4) Future Utilities

Provide sleeves and conduits for future utilities in accordance with the site master plan for water, sewer, power, and telephone. Address site-specific agreements by coordinating with region Maintenance, utility companies, the Capital Facilities Office, and others during site design.

1710.08 Documentation

(1) Design Documentation Checklist

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist:
🖰 www.wsdot.wa.gov/design/projectdev/

Also, coordinate design documentation with the Capital Facilities Office for any SRA design projects.

(2) Environmental Documentation and Permitting

Coordinate with the appropriate environmental support personnel or region Environmental Office during the planning and design stages of the project to determine what environmental, cultural, or historical documentation will be required. Environmental staff will determine applicable exemptions and required environmental permits for project delivery.

(3) Permanent Safety Rest Area Closures

Safety rest areas may be closed permanently or relocated. Federal Highways Administration approval is required for any closure or transfer of such facilities to other federal, state, or local agencies. Detailed closure procedures are stated in 23 CFR 752. Coordinate with the Capital Facilities Office for proposal to close any WSDOT SRA.