Traffic Manual

March 2008

Oregon Department of Transportation
Highway Division—Technical Services
Traffic—Roadway Section
http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/

The material contained in this electronic document is for reference purposes only to aid new employees and those unfamiliar with ODOT traffic engineering practices in accessing applicable standards, statutes, rules and policies. The material contained in this electronic document is for information purposes only.

This is an electronic copy in Adobe Acrobat format of the Oregon Department of Transportation's Traffic Manual.

Its primary purpose is to provide our customers and new employees with information regarding practices, procedures, and organization. The manual will also clarify roles and responsibilities, as well as provide information that may be required when considering traffic control changes. This manual includes information on where to find policies, procedures, warrants, and design considerations for traffic related items. The manual should not be regarded as policy, rather it should be used for information and training.

Every effort was taken to carefully edit and assemble this manual; however omissions and errors can occur. If you have any questions or comments on the contents, format or wording of this document please submit them in writing to the State Traffic Engineer.

State Traffic Engineer
Oregon Department of Transportation
Traffic—Roadway Section
355 Capitol Street NE, 5th Floor
Salem, OR 97301-3871

Summary of Major Changes for March 2008 Edition of Traffic Manual

Chapter 1—Organization

- Minor editing of entire chapter to further distinguish the differences between roadway engineering publications such as the Highway Design Manual and traffic engineering publications such as the Traffic Manual both of which are produced by the Traffic—Roadway Section. Also recognize that the Traffic Standards and Asset Management Unit (TSAMU) now provides limited design support to the Regions upon request.

Chapter 3—Publications

- Removed some outdated publications from the list and updated latest publication dates to match Traffic—Roadway Section internet site

Chapter 5—Delegated Authorities

- Revised Section 5.2.2.2 Delegated Authority for Existing Traffic Signals based on discussion at December 6, 2007 TOLT meeting

Chapter 6—Traffic Engineering Practices

- Revised Section 6.6 Crosswalks and added text from Technical Bulletins TR06-02(B) Marked crosswalks at uncontrolled locations and TR06-04(B) Textured & Colored Crosswalks

- Revised Section 6.8 Freeway Median Crossovers by deleting standard drawing and simplified language referring people to OAR 734-020-0100 through 734-020-0115

- Added new Section 6.9 Highway Advisory Radio based on materials Jan Gipson brought to TOLT at previous meetings

- Added new Section 6.10 Highway Safety Engineering based on newly published Highway Safety Program Guide

- Revised Section 6.32 Speed Zones based on input and editing by Debby Corey, Jan Gipson, and Scott McCanna

- Removed Section 6.33 SPIS Investigation since the information is duplicated in new Section 6.10 Highway Safety Engineering

- Added new Section 6.37.4 Right-Turn Acceleration Lanes based on text from Technical Bulletin TR07-11(B)

Chapter 7—Appendices

- Removed Section 7.5.1 Highway Safety Improvement Program (HSIP) and incorporated updated information into new Section 6.10 also referring people to Highway Safety Program Guide

- Removed Section 7.5.2 Project Safety Management System and incorporated updated information into new Section 6.10 also referring people to Highway Safety Program Guide

- Moved Section 7.5.3 Safety Priority Index System (SPIS) to new Section 6.10 Highway Safety Engineering

- Removed Section 7.5.4 Safety Investment Program (SIP) as this information is covered in the Highway Safety Program Guide

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1 ORGANIZATION

1.1 Traffic—Roadway Section

1.1.1 Overview

The Traffic—Roadway Section is within Technical Services, which is part of the Highway Division. Technical Services consists of five sections: Bridge Engineering, Geo-Environmental, Construction, Right of Way, and Traffic—Roadway. In addition, there are two units which report directly to the Technical Services Manager: Branch Operations and Access Management. There are approximately 340 employees in Technical Services, with an operating budget of approximately $77 million per biennium. Technical Services maintains liaison with the Regions during the Four-Year Statewide Transportation Improvement Program (STIP) plan development and field location design; provides support to the Regions in delivering Oregon Transportation Investment Act (OTIA) projects; identifies and purchases needed right-of-way; develops standards and specifications for all transportation facilities; and provides related design, materials, operations, and construction support services.

The Traffic—Roadway Section has approximately 80 employees and was formed in September 2006 by merging the former Traffic Engineering and Operations Section with the Roadway Engineering Section. Traffic—Roadway Section traffic engineering programs affect all ODOT divisions, the State Police, the Public Utilities Commission, cities and counties, the Oregon Travel Information Council, motorist services providers, the Speed Zone Review Panel, the Oregon Transportation Safety Committee, and all road users on all public roads in Oregon. The traffic engineering programs at ODOT provide statewide policies and guidelines for all traffic control devices; develops and maintains standards for traffic signals, illumination, and signing; provides technical analysis for traffic operation improvements on all state highways; administers the federal Highway Safety Improvement Program (HSIP); manages programs; manages speed zoning for all public roads; monitors traffic speeds; and optimizes operation of statewide traffic signal systems.

1.1.2 Traffic Manual

The Traffic Manual focuses on ODOT traffic engineering policies and practices. The manual also clarifies roles and responsibilities, as well as providing information that may be required when considering traffic control changes.

1.1.3 Highway Design Manual

Highway design practices and policies are not found in the Traffic Manual. For issues related to geometric design and roadway engineering, users should consult the Highway Design Manual maintained by the Roadway Engineering Services Unit of the Traffic—Roadway Section.

1.1.4 Organizational Structure

The Traffic—Roadway Section includes five central units: Roadway Engineering Services Unit, Specifications and Pre-Letting Unit, Geometronics Unit, Traffic Standards and Asset Management Unit, and Traffic Engineering Services Unit. The latter two units which focus exclusively on traffic engineering issues are described in more detail below.

1.1.4.1 Traffic Standards and Asset Management Unit

The Traffic Standards and Asset Management Unit has expertise in a wide variety of installations related to roadway signing, striping, traffic structures, traffic control plans, and traffic signals. The unit's primary purpose is to develop and maintain standards for design and construction, review contract plans, provide training in design and construction inspection, and asset management of signs, signals, and traffic structures. The unit also provides standard drawings, special provisions, and specialized work as needed. This unit consists of four teams providing expertise in the following areas:

Signing and Striping

Provides engineering expertise and maintains standards for all highway signs and pavement markings (see Sign Policy and Guidelines for the State Highway System, and Striping Design Guidelines). The team also develops specifications, maintains standard drawings, reviews new products, and develops manuals to provide training for designers. The team may provide some designs for ODOT regions.

Traffic Signals

Provides engineering expertise for temporary traffic signals, permanent traffic signals, flashing beacons, ramp meters and some portions of weigh stations. The team also develops specifications, maintains standard drawings, and maintains qualified products lists. The team also reviews local agency and developer agreements and plans for traffic control devices, reviews new products, maintains asset management databases, and provides annual training and certification for inspectors of traffic signal construction. The team also produces some designs for Regions on an as requested basis.

Traffic Structures

Provides engineering expertise and designs for sign bridges, cantilever sign supports, traffic signal poles, illumination poles, VMS supports and other miscellaneous traffic structures.

Traffic Control Plans

Develops the standards for traffic control plans for construction projects. When construction projects suspend the normal function of the roadway, a traffic control plan is developed to assure the safety of all road users, and the protection of workers. At the same time, the traffic control plan provides for continuity of the movement of motor vehicles, bicycle and pedestrian traffic while allowing for the efficient completion of the construction project.

Illumination

Provide engineering expertise, designs and standards for roadway illumination.

1.1.4.2 Traffic Engineering Services Unit

The Traffic Engineering Services Unit consists of two work teams. The teams provide engineering services in the following areas:

Safety and Investigations

Provides highway safety analyses; maintain the Safety Priority Index System (SPIS); administers the Highway Safety Improvement Program (HSIP) and Project Safety Management System as well as safety tools used within ODOT; and provides coordination and liaison for safety efforts with other parts of ODOT and outside agencies, including the Highway Safety Engineering Committee and the Oregon Transportation Safety Committee.

The group also provides traffic engineering expertise for research studies, legislative issues, crash analyses, safety reviews, access management issues, review and approval of traffic engineering delegated authorities, speed monitoring, speed zoning, new products, highway litigation and tort liability as well as supporting the Speed Zone Review Panel.

The Safety and Investigations group provides expertise for the development and update of traffic engineering policies, procedures and ODOT manuals. The group also gathers and provides input and recommendations for any proposed changes to the Manual on Uniform Traffic Control Devices, maintains and updates the Oregon Supplement to the MUTCD and works with the Oregon Traffic Control Devices Committee (OTCDC) to establish statewide traffic control standards.

Signal Operations

The Signal Operations group prepares traffic signal and signal system timing, and provides engineering expertise in traffic signal operation, installation of traffic signals, traffic signal approvals, vehicle detection systems, traffic signal software and communication development, ramp meter system operations and railroad preemption systems. The Signal Operations team also provides engineering support for transportation operations research and analysis, HOV lane applications, and signal mounted preemption system design (for emergency and transit vehicles). The group also provides expertise for the development of traffic engineering policies, procedures and proposed legislation.

1.2 Region Traffic Unit

1.2.1 Overview

A Region Traffic Unit is located in each of the five ODOT Regions throughout the state. The Region Traffic Unit is part of each Region's Technical Center and reports directly to the Technical Center manager. (See ODOT Region Map)

Region Traffic Unit staff provide expertise to the region and district staff on current traffic policies and procedures. Staff are responsible for overseeing most traffic engineering design including most signal and sign design for Region projects. Staff actively participates as members of project development teams to help insure that traffic related issues are considered early in the process and to provide traffic information to the team. They also act as the traffic liaison to local agencies on behalf of ODOT.

Members of the unit conduct field investigations at the request of the public, local government, or ODOT personnel. When requested, they conduct engineering investigations, determine appropriate solutions, make written recommendations, and when necessary, request approval of the State Traffic Engineer for installation of traffic control devices or modifications to traffic control.

Engineering investigations for changes to traffic control devices often result from safety concerns and can include requests for signs, signals, striping, parking restrictions and speed reductions. They also conduct field safety investigations of the sites and make recommendations for corrective action. Staff also conduct speed zone investigations and/or oversee consultants performing the work and make recommendations for changes to the State Traffic Engineer based on the results.

1.2.2 Region Traffic Design and Operations

Region Traffic Unit staff oversee design for all Region projects containing traffic engineering elements including signing, striping, and signals. The units provide expertise in signal timing, operations, and vehicle detection systems. They may also provide expertise for the operation of ramp metering systems. Signal system coordination is done in Regions 1 and 2 by the Region Traffic Unit staff. Regions 3, 4, and 5 signal coordination is handled by Traffic—Roadway Section staff. Some units oversee signing, striping and electrical crews for their region.

1.2.3 Region Traffic Investigations

Staff reviews traffic studies for developments and land use actions for their impacts to the state highway system and make recommendations regarding access, traffic mitigation requirements, safety and operation of the State Highway system. They also review corridor plans and Transportation System Plans (TSPs) for traffic-related issues.

1.2.4 Region Transportation Safety Coordinator

Each Region Traffic Unit has a traffic safety advocate (Region Transportation Safety Coordinator) who is a technical resource for local safety education and law enforcement efforts, and provides access to safety grant funds, materials and training. They handle programs regarding education on child occupant protection, DUII, pedestrian, teen driving, bicycle, and work zone enforcement. They also work with local safety committees on traffic issues.

1.2.5 Region Intelligent Transportation System (ITS) Activities

Region Traffic Units often oversee Intelligent Transportation System (ITS) related activities in their areas. The Traffic Management and Operations Centers monitor and control traffic operations through the latest Intelligent Transportation Systems (ITS) technologies to provide real-time transportation system control, communications, monitoring and information.

The ITS unit is part of the Office of Maintenance and not part of Traffic-Roadway Section (see ITS unit below).

1.2.6 Region Access Management

Region Traffic Unit staff are often involved in the access management programs for each Region (some regions incorporate Access Management into Traffic other incorporate it into Planning). Each Region has a Region Access Management Engineer (RAME) who provides key technical support for access management practices in the region. The RAMEs also provide a valuable communication link between central staff and region staff and act as an ODOT advisory group on access management issues, policies and practices.

1.3 Other Traffic Related Units within ODOT

1.3.1 Intelligent Transportation Systems Unit

Within the Office of Maintenance and Operations, the Intelligent Transportation Systems Unit provides identification, planning, design, specification and deployment of ITS systems including incident management systems, some communication systems and travelers' information systems. Some of the device types include cameras, weather stations, variable message signs, highway advisory radio, automatic vehicle location, weather hazard monitoring and warning systems.

The unit also provides standardization for ITS devices, performs strategic planning for ITS deployment within the state, and helps the ODOT regions in the identification of local partnerships and the use of ITS technologies. Other activities include researching of emerging technology, promoting technology partnerships with other public and private sectors, and supporting ITS deployment by other modes.

1.3.2 Traffic Systems Services Unit

Also within the Office of Maintenance and Operations, the Traffic Systems Services Unit provides expertise in traffic signal testing, turn-on, inspection, and maintenance. The unit also supports the ODOT Intelligent Transportation Systems (ITS) program with expert technical support for Road Weather Information Systems (RWIS), Closed-Circuit Television (CCTV) surveillance systems, Fixed and Portable Variable Message Signs (VMS), and Fiber-optics data communication networks.

The Traffic Systems Services Unit operates the only approved materials testing laboratory for traffic control products in Oregon. The laboratory operates to ensure compliance with OAR 734-020-0005 which establishes the manual and specifications for traffic control devices within the state and Section 00990.70 of Oregon's Standard Specifications which describes the testing and turn-on procedures for all new traffic systems installations.

1.3.2.1 Field Applications

Employees of the unit have the responsibility for setting minimum maintenance standards for traffic signal equipment on the state highway system. Employees working with region/district electricians repair and modify all traffic signals maintained by the department. TSSU or Region 1 Signal Maintenance Crews are responsible for periodic inspection and maintenance of signal control equipment at signalized intersections while Region/District electricians are responsible for performing maintenance on other elements of the traffic signal system. Inspections will assist the project manager in assuring compliance with the project plans and specifications.

1.3.2.2 Shop Applications

Employees of the unit have the responsibility for maintaining the following records:

- Inventory of all traffic signal control devices;

- Records of inspections of existing traffic signal control devices;
- Maintenance records of all trouble calls;
- Environmental testing chamber and turn-on records of control equipment;
- Shop repair records of control equipment; and
- Documentation of systematic upgrading of equipment.

Shop applications also include environmental testing of all traffic signal equipment used within Oregon. TSSU also provides repair and testing of state maintained control equipment modules.

1.3.3 Crash Analysis and Reporting Unit

Within the Transportation Data Section of the Transportation Development Division, the Crash Analysis and Reporting Unit provides motor vehicle crash data through database creation, maintenance and quality assurance, information and reports, and limited database access. Ten years of crash data is maintained at all times. Fatality Analysis Reporting System is a comprehensive file on fatal crashes in Oregon. The motor carrier file contains detailed information on truck related crashes.

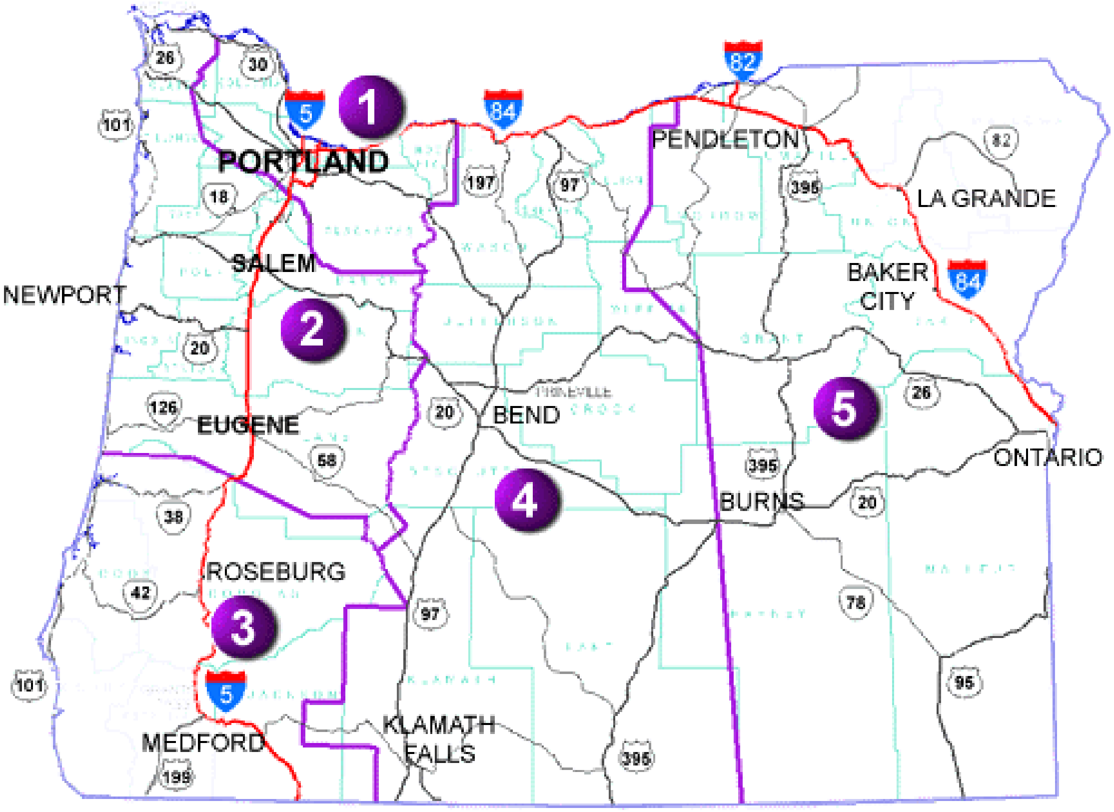
1.3.4 Transportation Systems Monitoring Unit

Also within the Transportation Data Section, the Transportation Systems Monitoring Unit is responsible for the Traffic Monitoring Program, which provides vehicle class, occupancy, and traffic volumes for federal, state, local and private decision makers; they support the Integrated Transportation Information System (ITIS) with traffic, speed limit, parking and terrain information.

1.3.5 Transportation Planning Analysis Unit

Within the Planning Section of the Transportation Development Division, the Transportation Planning Analysis Unit of ODOT is working to determine the present and future needs of the statewide transportation system, and evaluate alternative solutions to growing transportation demands. TPAU provides an essential link between long range planning and project development. TPAU also reviews system and corridor plans and provides traffic analysis of existing and future traffic demands for projects. TPAU participates in technical advisory committees, citizen advisory committees, and project development teams.

1.4 ODOT Region Map



2 GOALS AND OBJECTIVES

The goals and objectives of the policies and procedures contained in the ODOT Traffic Manual are to enhance the safety and efficiency of Oregon's transportation system by providing guidance for traffic operations, maintenance and project delivery.

3 PUBLICATIONS

The following table provides a listing of traffic related publications published by the Traffic—Roadway Section by subject category. Most publications are available on the internet at the Traffic—Roadway Section web site http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/. Some internal publications are only made available on the ODOT intranet site. The intranet site can only be accessed by ODOT employees at http://intranet.odot.state.or.us/tstrafmgt/.

For a listing of other publications utilized by the Traffic—Roadway Section, see the References section in Chapter 8.

Title	**Subject**	**Date Published**
2002 Policy Statement for Cooperative Traffic Control Projects	General	June 2002
A Guide to School Area Safety	General	August 2006
Descriptions of US and Oregon Routes	General	July 2007
Highway Safety Program Guide	General	September 2007
Guidelines for the Operation of Highway Advisory Radio and Traveler's Advisory Radio on State Highways	General	February 2007
Oregon Supplement to the MUTCD	General	July 2005
Traffic Manual	General	March 2008
Lighting Policy and Guidelines	Illumination	January 2003
Traffic Lighting Design Manual	Illumination	January 2003
Standards for Disabled Parking Spaces	Pavement Markings	January 2001
Traffic Line Manual	Pavement Markings	January 2007
Sign Policy and Guidelines for the State Highway System	Signs	September 2007
Traffic Sign Design Manual	Signs	September 2003
Speed Zone Manual	Speed Zones	August 2007

Title	**Subject**	**Date Published**
Railroad Preemption Design and Operation	Traffic Signals	October 2005
Red Light Running (RLR) Camera Guidelines	Traffic Signals	May 2004
Signal Design Manual	Traffic Signals	February 2007
Standard Specification for Microcomputer Signal Controller	Traffic Signals	September 2001
Chapter 12 (Supplemental): Specifications For Battery Backup System Equipment	Traffic Signals	February 2007
Traffic Signal Policy and Guidelines	Traffic Signals	September 2006
Guidelines for the Operation of Variable Message Signs on State Highways	Variable Message Signs	July 2006
Guidelines For The Use Of Portable Variable Message Signs On State Highway—Field Version	Variable Message Signs	June 2004
Oregon Temporary Traffic Control Handbook	Work Zones	May 2006

4 TRAFFIC ENGINEERING AND OPERATIONS TEAMS

The Traffic—Roadway Section provides expert staff and administrative support to several teams in specific traffic engineering disciplines on the local, regional, state, and national levels.

4.1 AASHTO Committees

Leader: AASHTO

Membership: varies

Focus: The Traffic—Roadway Section staff participates in two American Association of State Highway and Transportation Officials (AASHTO) committees.

4.1.1 Standing Highway Committee, Subcommittee on Traffic Engineering

Member: State Traffic Engineer

Schedule: varies

4.1.2 Subcommittee on System Operations and Management

Member: ITS Unit Manager

Schedule: varies

4.2 Forest Highway Tri-Agency Committee

Leader: Federal Highway Administration, Federal Lands Division

Membership: State Traffic Engineer representing ODOT and the Oregon Association of Counties; representatives from the US Forest Service and the Federal Lands Division of FHWA. Also attending the meetings are the Forest Highway (& Enhancement) Program Coordinator as well as representatives from AOC, and staff from FHWA and USFS.

Focus: This group is the authority that decides how the approximately $18 million in Federal Forest Highway money is spent in Oregon.

Schedule: Annual meetings plus supplemental meetings as needed.

4.3 Highway Safety Engineering Committee

Leader: State Traffic Engineer

Membership: Traffic—Roadway Section staff, Roadway Manager, Region Traffic Manager(s), FHWA, Safety Division staff

Focus: This group meets to discuss and establish policies and guidance for the safety programs in ODOT.

Schedule: every three months

4.4 IKS Software Users Group

Leader: varies

Membership: City, County and ODOT representatives

The IKS Software Users Group is a cooperative, interagency team including the City of Portland, City of Gresham, City of Vancouver, Clackamas County, Multnomah County, Washington County, Clark County, the Oregon Department of Transportation, the Washington State Department of Transportation and other users of the Wapiti Microsystems W4IKS software.

Schedule: Biannually

4.5 Oregon Historical Marker Committee

Leader: As voted by membership

Membership: TIC, ODOT, Tourism, Oregon Parks, OCTA, DOGAMI, others.

Focus: In July 1991, the Travel Information Council (TIC) adopted the Historical Marker Program from ODOT through an interagency agreement, along with other sign programs of a motorist service nature.

Schedule: Quarterly

4.6 Oregon Traffic Control Devices Committee (OTCDC)

Leader: Chair as voted in by membership

Membership: State Traffic Engineer, three city and three county representatives, ODOT Region Traffic Manager, Oregon ITE representative, OSP representative.

Focus: The Oregon Traffic Control Devices Committee is an advisory group to the state, cities, and counties in Oregon regarding traffic management issues. The committee meets to discuss programs, policy and procedures, and various transportation activities related as they affect local and state governments. The OTCDC meets every other month to exchange thoughts, ideas, and practices that will guide the direction for the future regarding transportation related activities as they affect the motoring public.

Schedule: every two months

4.7 Oregon Travel Information Council

Leader: TIC Manager and Council Chair selected by Council

Membership: Representatives of the restaurant, lodging, gasoline, outdoor advertising and citizens at large appointed by the Governor, State Traffic Engineer

Focus: The Oregon Travel Information Council (TIC) was founded by the Oregon State Legislature in 1972 to administer Oregon's Tourist Oriented Directional Signing (TODS) program, the Specific Motorist Services Signing (LOGO) Program, and the Off-interstate Historical and Cultural Sign Program.

Schedule: Quarterly meetings

4.8 Pavement Marking Committee

Leadership: District Manager

Membership: Maintenance Staff, Striping Crew Staff. Region Traffic Managers Staff, Traffic Devices Engineer

Focus: This workgroup meets to share best practices with the goal of developing and sharing new practices, materials and policies including maintenance and equipment practices for pavement markings. Group decisions impact ODOT's QPL for pavement marking materials and products, Standard Specifications and Traffic Line Manual.

Schedule: Monthly

4.9 Pavement Marking Design Working Group

Leader: Traffic Devices Engineer

Membership: Traffic—Roadway Section Staff, Region Traffic Staff, Region Roadway Designers

Focus: This workgroup meets to share best practices with the goal of sharing new practices, policies improving, design practices for striping and pavement markings. Group decisions impact ODOT's QPL for pavement markings, Standard Specifications and Standard drawings for Highway Construction and Striping Design Manual.

Schedule: Quarterly

4.10 Safety Investigations Group

Leader: Traffic Investigations Engineer

Membership: Traffic—Roadway Section staff, Region Traffic Investigators, Region Transportation Safety Coordinator from all regions

Focus: This is a working group of traffic investigators to advise staff on setting criteria and guidance for performing highway safety investigations statewide.

Schedule: Twice Yearly

4.11 Signal Timers Group

Leader: Senior Traffic Engineer

Membership: Traffic—Roadway Section staff, signal timing staff from all regions

Focus: This group meets to discuss traffic signal timing and operations.

Schedule: Quarterly

4.12 Speed Zone Review Panel

Leader: As voted in by panel members

Membership: County, City, ODOT, State Police, Safety representative and State Traffic Engineer as Secretary.

Focus: The Speed Zone Review Panel (SZRP) reviews contested speed zone cases. The panel receives testimony from the local road authority and makes the final recommendation. The panel is comprised of representatives from the Transportation Safety Committee, the Oregon State Police, the Association of Oregon Counties, the League of Oregon Cities, and the Department of Transportation.

Schedule: as needed

4.13 Statewide Grant Review Committee

Leader: State Traffic Engineer

Membership: State Traffic Engineer, District Manager or Permit Specialist, ROW representative, Access Management Engineer, Roadway Representative, Traffic Investigation Engineer, others as needed.

Focus: The Statewide Grant Review Committee (SGRC) reviews applications for grants of access to State Highways.

Schedule: as needed

4.14 Traffic Control Plans Discipline Group

Leader: TCP Engineer

Membership: TCP Designers in each of the five Tech Centers and the two TCP Engineers in Salem

Focus: The function of this Team would be to solidify the design practices being used by the TCP Designers in the Regions. The team would be able to focus on Design Standards, Specifications, Special Provisions, Standard Drawings, Cost Estimating details, Traffic Control Devices on the ODOT Qualified Products List (QPL) and other Temporary Traffic Control issues germane to the development of ODOT Traffic Control Plans.

Schedule: Quarterly

4.15 Traffic Control Plans Technology Committee

Leader: TCP Engineer

Membership: TCPU staff, one TCP Designer from each Region Tech Center, one representative for Oregon Bridge Delivery Partners, and one or two representatives from consulting industry.

Focus: Utilized primarily to share technical information across ODOT boundaries. The make-up of this group will provide valuable perspectives and insights regarding traffic control design, policy-making, safety and construction techniques, all for the purpose of helping strengthen our Statewide Traffic Control Plans standards and practices.

Schedule: Quarterly

4.16 Traffic Control Oversight Committee

Leader: TCP Engineer

Membership: Region Safety staff, Transportation Safety Division personnel, and others.

Focus: With a semi-authoritative position, this committee will focus its efforts on reviewing technologies and policies from other State agencies and businesses to draft, refine and implement policies, practices and design standards for the Temporary Traffic Control discipline within ODOT.

Schedule: Quarterly

4.17 Traffic –Roadway Section/Transportation Safety Division

Leadership: State Traffic Engineer and Transportation Safety Manager

Membership: Traffic—Roadway Section Safety & Investigations staff, TSD Roadway Safety Coordinator, and FHWA Safety Engineer.

Focus: Meet to coordinate safety programs and projects of mutual interest.

Schedule: Monthly

4.18 Traffic Operations Leadership Team (TOLT)

Leader: State Traffic Engineer

Membership: Region Traffic Managers and staff, Traffic—Roadway Section managers and staff

Focus: Region Traffic Managers/Engineers from each ODOT Region meet with Traffic—Roadway Section staff and the State Traffic Engineer to discuss traffic issues, concerns and operations.

Schedule: Bimonthly

4.19 Traffic Sign Design Working Group

Leader: Sign Engineer

Membership: Traffic—Roadway Section Staff, Region Traffic Sign Design Staff

Focus: This workgroup meets to share best practices with the goal of sharing new practices, policies improving, design practices for traffic signs. Group decisions impact ODOT's QPL for Sign Materials, Standard Specifications and Standard drawings for Highway Construction and Traffic Sign Design Manual.

Schedule: Quarterly

4.20 Traffic Signal Design Working Group

Leader: Traffic Signal Engineer

Membership: Traffic—Roadway Section Staff, Region Traffic Signals Design Staff, Region Traffic Signal Operations Staff (Optional)

Focus: This workgroup meets to share best practices with the goal of sharing new practices, policies improving, design practices for traffic signal systems. Group decisions impact ODOT's QPL for traffic signal equipment (also known as “Blue Sheets”), Standard Specifications and Standard Drawings for Highway Construction and Traffic Signal Design Manual.

Schedule: Quarterly

4.21 TransPort Committee

Leader: Region 1 Traffic Engineer

Membership: ODOT Region 1 staff, ODOT Traffic—Roadway Section Staff, WS DOT, Metro, Clackamas Co., Multnomah Co., Washington Co, City of Portland, City of Gresham, City of Beaverton, Port of Portland, City of Vancouver, Portland State University, TriMet, FHWA, Vancouver Area Regional Transportation Council.

Focus: Traffic—Roadway Section employees serve as members on the Region 1, TransPort Committee. This committee coordinates ITS deployment and operations activities across the agencies in the Portland metropolitan area.

Schedule: Monthly

4.22 Traffic Structures Design Working Group

Leader: Traffic Structures Engineer

Membership: Traffic—Roadway Section Staff, Region Traffic Staff, Region Bridge Designers

Focus: This workgroup meets to share best practices with the goal of sharing new practices, policies improving, design practices for Traffic Structures. Group decisions impact ODOT's Standard Specifications and Standard drawings for Highway Construction and Traffic Structures Design Manual.

Schedule: Quarterly

5 DELEGATED AUTHORITY

Traffic—Roadway Section staff review field investigations and make recommendations to the State Traffic Engineer concerning items of delegated authority. The Delegated Authorities of the State Traffic Engineer are derived from the Letter of Authority dated January 28, 1999 which authorizes the State Traffic Engineer to act on the behalf of the Technical Services Manager and OAR 734-020-0410 which delegates the authority to approve the installation of traffic control devices to the State Traffic Engineer.[1] These responsibilities may require consultation with various individuals or groups to provide expert or professional advice on the matter prior to a final decision by the State Traffic Engineer.

5.1 Letter of Authority

The Technical Services Manager authorizes the State Traffic Engineer to act on his/her behalf regarding the following responsibilities:

1. Establish speed zones on all highways pursuant to ORS 810.180 and in compliance with rules the Oregon Transportation Commission has adopted.
2. Approve procuring, installing, changing or removing traffic signals subject to the current warrant requirements and current funding the Oregon Transportation Commission has approved.[2]
3. Designate restricted parking or no-parking zones on any state highway under the provisions of ORS 810.160 and in accordance with rules the Oregon Transportation Commission has adopted.
4. In consultation with the Region Manager:
    a) Establish construction and temporary speed zones on any segment of the state highway system when unexpected or unusual conditions require a speed less than currently permitted.
    b) Determine and designate which highways will be designated as through highways at the intersection of two or more state highways under the provisions of ORS 810.110. Determine which intersections of any other highway, road or street with state highways require "STOP" or "YIELD" signs and approve installing or removing all "STOP" and "YIELD" signs and other traffic markers in accordance with standards adopted under the provisions of ORS 810.200.
    c) Approve installing or removing any sign prohibiting pedestrian traffic on any portion of the state highway system.
    d) Approve installing or removing any sign prohibiting non-motorized traffic on any portion of a state highway.
    e) Approve installing or removing any sign prohibiting non-transportation activities from any bridge on the state highway system.
    f) Approve installing or removing any sign allowing U-turns at signalized intersections on the state highway system according to rules the Oregon Transportation Commission has adopted.
    g) Designate intersections where turns are prohibited in any direction onto or from any state highway and exceptions for public transportation vehicles under the

provisions of ORS 810.130 and according to rules the Oregon Transportation Commission has adopted.

h) Designate intersections where dual left and right turns can be made onto or from state highways.

i) Designate pedestrian crossing and no-crossing sites at locations on the state highway system.

5. In consultation with the Region Manager and the Motor Carrier Services Manager:
   a) Designate highways, sections of highways, specific lanes or structures that allow one-way operation by class or type of vehicle.
   b) Under the provisions of ORS 810.030, approve installing or removing any sign prohibiting through truck traffic on any portion of a state highway.
6. In consultation with the Oregon Traffic Control Devices Committee, approve changes to traffic control device standards, manuals and guidelines for the state highway system and approve experimental projects related to traffic matters per ORS 810.200.[3]
7. In consultation with the Region Manager as necessary, approve the installation, modification or removal of traffic control devices, e.g. signs, striping, pavement markers, on the state highway system.
8. In consultation with the Oregon Disabilities Commission, approve changes to standards for disabled parking places under the provisions of ORS 447.233.
9. In consultation with the Region Manager, approve the installation, modification or removal of roundabouts on state highways.

5.2 Delegated Authorities of the State Traffic Engineer

The State Traffic Engineer has been delegated the authority to approve the installation of traffic control devices on state highways by the Oregon Transportation Commission.[4] This includes the installation of all new signals, selected modifications to existing signals, and installation of any other traffic control device on state highways.

The following subsections detail the specific Delegated Authorities of the State Traffic Engineer. Since traffic signals are a more complex type of traffic control device, they are dealt with in a separate subsection at the end of this chapter. The list of delegated authorities is regularly reviewed by Traffic—Roadway Section staff and the Traffic Operations Leadership Team for consistency with Oregon Revised Statutes (ORS), Oregon Administrative Rules (OAR), Letters of Authority, and Delegation Orders from the Oregon Transportation Commission. The list is revised and updated on an as-needed basis following consultation with the Traffic Operations Leadership Team.

5.2.1 Traffic Control Devices

All delegated authority requests for State Traffic Engineer approval should follow roughly the same process for approval:

1. Consultation with Region Traffic Unit; and

2. A request sent through the Region Traffic Manager/Engineer with supporting documentation.

5.2.1.1 State Traffic Engineer Authority

The following is a list of items that require approval by the State Traffic Engineer for use on state highways:

- Colored Pavements
- Crosswalk Closure[5]
- Dual Right or Left Turn Lanes[6]
- Freeway Median Crossovers[7]
- Highway Advisory Radio[8]
- Marked Crosswalks[9]
- Multiway Stop Applications[10]
- One-way Operation for Trucks and Buses[11]
- Parking Prohibitions or Restrictions[12]
- PREPARE TO STOP WHEN LIGHTS FLASH Sign Applications
- Right-Turn Permitted Without Stopping (RTPWS)
- Roundabouts
- Rumble Strips—Transverse, Centerline
- School Crossings[13]
- Speed Zones—Permanent, Emergency, Construction, Temporary, and School Areas on State Highways [14]
- STOP Sign Applications on State Highway[15]
- Through Highways at Intersections of the State Highway[16]
- Traffic Signals—Approval Process, Portable, Modifications (see 5.2.2.2 for a list of modifications that must be approved by the State Traffic Engineer), Temporary, or Removal[17]
- Truck Routes and Truck Prohibitions
- Turn Prohibitions[18]
- UNMUFFLED ENGINE BRAKING PROHIBITED signs on State Highways in concurrence with local jurisdiction[19]

- Variable Message Signs[20]
- YIELD Sign Applications on State Highway[21]

5.2.1.2 Region Traffic Manager/Engineer Authority

The Region Traffic Manager/Engineer may authorize standard applications of traffic control devices and some modifications to existing traffic control devices, provided the applications are in compliance with the principles outlined in the Manual on Uniform Traffic Control Devices and applicable ODOT policies and guidelines. The following is a list of items that may be authorized by the Region Traffic Manager/Engineer:

- Advance Stop Lines (at marked crosswalks)
- Bicycle Lanes
- Continental Style Crosswalks[22]
- Flashing Beacons as Supplements to a Warning or Regulatory Sign
- Flashing Beacons on School Speed Assemblies
- Highway Warning Signs & Systems (i.e., active bike/pedestrian warning, flood warning, debris warning, etc)
- Intersection Control Beacons[23]
- Left and Right Turn Lanes at unsignalized intersections
- Messages other than PSA's on VMS[24]
- No Passing Zones[25]
- Roadway Illumination[26]
- Rumble Strips—Shoulder
- Safe Speed on Curves
- Speed Displays in conjunction with Speed Limit or School Speed Limit signs
- STOP Sign Applications on cross streets that are not State Highways
- Traffic Signals—Modifications (see 5.2.2.2 for a select list of modifications to existing signals that may be approved by the Region Traffic Manager/Engineer)
- Wrong Way Treatments
- YIELD Sign Applications on cross streets that are not State Highways

5.2.2 Traffic Signals

Traffic signals including those in STIP and OTIA projects require State Traffic Engineer approval. Approval of new signal locations is not covered by the Oregon Transportation Commission's approval of the project.[27]

It is the position of the Traffic—Roadway Section that it is beneficial to ODOT to reaffirm a policy that all traffic signal requests and design plans must be reviewed by Traffic—Roadway Section staff and approved by the State Traffic Engineer. This provides statewide consistency and assures that the installation of the traffic signal will improve overall safety and operation of the intersection and the highway. It also ensures that everyone with a stake in the operation of traffic signal systems has had an opportunity for input into the project.

5.2.2.1 New Installations

On major projects, when a project team considers signalization, the Transportation Planning Analysis Unit is contacted to do a preliminary analysis of the projected warrants for a traffic signal. The Transportation Planning Analysis Unit should forward a copy of the warrants and any analysis to the Traffic—Roadway Section as well as the project team. This will provide notice to the Traffic—Roadway Section and provide an early opportunity to identify relevant issues. When the project team decides to recommend a signal on a project, a request should be sent through the Region Traffic Manager, requesting the approval of the State Traffic Engineer.

The request should contain the information on the projected warrants, a plan showing the location of proposed traffic signals, safety concerns, planning issues, etc. Any Region Traffic Manager's concerns should be resolved within the project team environment. Traffic signals approved by the State Traffic Engineer are subject to conditions noted on the approval. The Traffic—Roadway Section will maintain the Traffic Signal Approval List.

Applications for new traffic signal installations should follow the procedure outlined in the Oregon Administrative Rules[28].

5.2.2.2 Existing Traffic Signals

Modifications to existing traffic signals on state highways must be approved by either the State Traffic Engineer or the Region Traffic Manager/Engineer depending on the type of modification. A "modification" has been interpreted to mean a change in the operational function of a traffic signal and includes the addition or deletion of signal phases, modifications which provide or remove split phase operation, addition of equipment not normally a part of a traffic signal design, and the addition or removal of through vehicle lanes or pedestrian crossings at the intersection. Signal revisions and normal maintenance activities such as the replacement of detectors, poles, or controllers and timing adjustments that don't affect operation do not constitute a "modification."

The Traffic Operations Leadership Team maintains a list of items associated with traffic signals that may be approved by either the State Traffic Engineer or the Region

Traffic Manager/Engineer. The following items remain under the approval authority of the State Traffic Engineer:

- Emergency Service Providers authorized to use Preemption Systems
- New approaches to existing signalized intersections
- Phasing—Addition or removal of pedestrian phases, Concurrent to split phasing
- Preemption Systems—Addition or removal of transit priority[29]
- U-turns at Signalized Intersections[30]

Some items may be approved by the Region Traffic Engineer/Manager provided they are consistent with ODOT standards and practices set forth in the Traffic Signal Policy and Guidelines and the Manual on Uniform Traffic Control Devices. The following items may be approved by the Region Traffic Engineer/Manager provided the appropriate documentation is sent to the Traffic—Roadway Section justifying and explaining the type of modification that was made:

- Accessible Pedestrian Signals[31]
- Detection—Loop, Video, etc.
- Lane use signing at signalized intersections
- Left and right turn lanes at signalized intersections without phase changes
- Left turn phase modifications
    - Increased protection—Permissive to Protected-Permissive, Protected-Permissive to Protected, or Permissive to Protected
    - Less protection—Protected to Protected-Permissive, or Protected-Permissive to Permissive
- NO TURN ON RED signs[32]
- Pedestrian pedestals
- Pedestrian push buttons—Move or relocate
- Phasing—Addition or removal of overlap phasing
- Preemption Systems—Addition or removal of emergency preemption
- Ramp Meters[33]
- Signal heads—Change out protected left green arrow only to all arrow, Move or realign, Programmed, Supplemental

- Signal poles—Replacement
- Work zone modifications—Phasing, Signal head locations, etc.

File Code: COM 04

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[1] Refer to Section 7.6 in Traffic Manual

[2] Refer to OAR 734-020-0410

[3] FHWA approves alterations or deviations to the MUTCD, makes rulings on interpretations of the MUTCD, and approves experimental features requests

[4] Refer to OAR 734-020-0410

[5] Refer to Traffic Line Manual, Section B-15

[6] Refer to OAR 734-020-0135 through 0140

[7] Refer to OAR 734-020-0100 through 0115

[8] Refer to ODOT Guidelines for the Operation of Highway Advisory Radio

[9] Refer to Section 6.6.1 in Traffic Manual; Traffic Line Manual

[10] Refer to MUTCD, Section 2B.07

[11] Refer to OAR 734-020-0125 and 0130

[12] Refer to OAR 734-020-0020 and 0080 through 0090

[13] Refer to A Guide to School Area Safety

[14] Refer to Speed Zone Manual; OAR 734-020-0015; A Guide to School Area Safety

[15] Refer to MUTCD, Sections 2B.04 through 2B.07

[16] Refer to ORS 810.110

[17] Refer to ODOT Traffic Signal Policy and Guidelines; OAR 734-020-0400 through 0500

[18] Refer to OAR 734-020-0020

[19] Refer to ODOT Sign Policy and Guidelines

[20] Refer to ODOT Guidelines for the Operation of Variable Message Signs

[21] Refer to MUTCD, Sections 2B.08 through 2B.10

[22] Refer to Section 6.6.1 in Traffic Manual

[23] Refer to MUTCD, Section 4K.02

[24] Refer to ODOT Guidelines for the Operation of Variable Message Signs on State Highways

[25] Refer to MUTCD, Section 3B.02; Section 6.22.3 in Traffic Manual

[26] Refer to ODOT Lighting Policy and Guidelines

[27] Refer to OAR 734-020-400 through 734-020-500

[28] Refer to OAR 734-020-400 through 734-020-500

[29] Refer to ODOT Traffic Signal Policy and Guidelines

[30] Refer to OAR 734-020-0025

[31] Refer to ODOT Traffic Signal Policy and Guidelines; OAR 734-020-0400 through 0500

[32] Refer to ODOT Sign Policy & Guidelines

[33] Refer to Section 6.34.2.8 in Traffic Manual

6 TRAFFIC ENGINEERING PRACTICES

6.1 Access Management

6.1.1 Overview

Access Management is a comprehensive approach for improving safety and efficiency of traffic operations on transportation facilities, while providing statewide accessibility and mobility. Access management necessitates that a logical, functional hierarchy of all roads in the state be established; that hierarchy should then be reinforced by applying various levels of access control. The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 established strong national policy support for the consideration of access management in congestion management and corridor preservation. Standards are established for the different classes of roads in design characteristics such as:

- freeway/highway access control
- interchange spacing
- spacing and control of median openings
- signal spacing
- intersection spacing
- driveway spacing and consolidation
- provision of turn lanes, and acceleration and deceleration lanes

These standards usually reflect land-zoning regulations. Implementation of access management has the effect of separating and reducing conflicts, and thereby reducing the likelihood of traffic crashes. The provision of turn lanes removes decelerating vehicles from the traffic stream thus reducing rear-end crashes, and enabling the rest of the traffic stream to flow with less interruption. Consistent interchange spacing (together with full access control) helps ensure driver expectancy and reduces the turbulence caused by merging and diverging freeway traffic. Nationwide, access management has proven to:

- reduce crashes,
- reduce delays,
- reduce travel times and fuel consumption,

- help improve traffic signal progression by helping to maintain travel speeds,
- reduce congestion and environmental pollution, and help meet Congestion Management and Air Quality (CMAQ) goals,
- increase capacities of various types of facilities,
- improve local economies by improving accessibility to businesses and
- expanding their market areas, and
- reduce the urgency and pressure on local governments to build more roads to balance the effects of mismanagement of the existing facilities.

6.1.1.1 Criteria

Criteria for the Access Management policies and guidelines are covered in the Oregon Highway Plan and Chapter 734, Division 51 of the Oregon Administrative Rules.

Region Access Management Engineers (RAMEs) play a lead role in individual projects and the development review process. Providing key technical support for access management standards, the RAMEs provide a communication link between central staff and region staff.

They also act as an ODOT advisory group along with central staff on access management issues, reviewing standards, policies and practices and making recommendations.

The Traffic—Roadway Section plays a significant role in the determination of access management standards, with representation on various technical committees as well as oversight of the grants of access process. The Traffic—Roadway Section also ensures that access management standards are met by its involvement in the approval and design of traffic signals and other traffic control devices, lane configurations, U-turns, freeways, interchanges, etc. Review of traffic impact analyses provides the Traffic—Roadway Section an opportunity to determine the effects of new signals on traffic signal progression, check for adequate traffic storage and sight distances, and ensures designs that comply with the access management standards for the class of road facility. Such reviews also ensure the needs of transit, pedestrians, and bicyclists are included in the site and vicinity design.

6.1.2 Grants of Access

A Grant of Access is required to create a new approach where no right of access (access control) exists between the highway and a portion or all of a property abutting the highway.

The issues surrounding the applications for grants of access can be complex. The State Traffic Engineer chairs a centralized review committee, the Statewide Grant Review Committee (SGRC), with representatives from various disciplines within ODOT. The role of the committee is to provide consistent and fair decisions across the state, decisions that protect the Oregon's Highway system and are also in the best interests of the traveling public. A description of the process and criteria for determining if an approach can be granted are detailed in the *ODOT Access Management Manual* (under Grant of Access Procedure and Guidelines). (See also OAR 734-051-295)

When an application for an approach to a State Highway is received, ODOT must determine if an approach (either public or private) is legally permissible and if it meets established policies. If it is determined that the approach is in an area where an approach would not violate established policies but has no legal right of access to the highway, an application for a grant of access may be filed. To approve a grant of access ODOT must either determine that access control is no longer necessary or that the approach would benefit the State Highway System. For safety and operational reasons, breaking access control for grants of access is generally difficult to justify.

6.2 Active Bike and Pedestrian Warning Signs at Bridges

6.2.1 Background

The Oregon Department of Transportation (ODOT) has installed active warning signs at the entrance to tunnels on state highways that read "Bicycles in Tunnel When Lights Flash" The signs have flashing amber beacons that are activated when bicyclists push a button as they enter the tunnel. The device is timed for the average cyclist to travel the required distance before the flashers stop. The signs are popular with both drivers and bicyclists. There are only a few tunnels in Oregon, so their application has been fairly limited.

ODOT also receives requests for the use of these or other similar devices for application on narrow bridges, for both cyclists and pedestrians. There has been concern over the widespread application of these devices to bridges, since Oregon has many bridges and this could represent significant installation and maintenance costs (from $5,000 to more than $20,000 for each).

6.2.2 Criteria

The following criteria have been developed to help guide decision-makers when a request for application to a bridge must be considered. A flashing warning system for bicyclists and/or pedestrians on a bridge should be considered when an engineering study demonstrates their need and the location meets the following criteria:

1. There are inadequate shoulders or separation from traffic:

    a. For pedestrians: the shoulders are less than 3 feet wide and no sidewalk exists

    b. For Bicyclists: the shoulders less than 4 feet

c. Other situations where motor vehicles may encroach on pedestrian or bicycle space

2. There is demonstrated bicycle or pedestrian usage (at least 10 pedestrians and/or bicycles per hour for any four hours of the day is the minimum threshold suggested).

3. The public support has been demonstrated by a request from a local government body.

4. There is no other available/practical/safe route, or one cannot be provided at a reasonable cost.

5. Operational techniques (e.g. signing, restriping) cannot improve the situation, or construction measures are not practical or too expensive (e.g. removing fellow guard, adding sidewalks or providing a separate bridge).

6. A combination of the following criteria create traffic conditions unacceptable to pedestrians and/or cyclists on the bridge:

   a. Speed;

   b. ADT (include percentage of trucks, and peak hour, when pedestrians and/or bicyclists may be using the bridge);

   c. Sight distance; and

   d. Length of bridge.

7. Funding and maintenance have been agreed upon between the District and/or locals as to who will pay for maintenance and power.

6.2.3 Considerations

If all the above conditions are met, consider the following factors when providing a flashing warning system:

1. Historic character of bridge – many older narrow bridges are classified as historic, and the placement of a large warning sign may have a negative aesthetic impact; contact Environmental Section as needed.

2. Placement of sign – can it be placed in such a way that it is visible to motorists for them to adequately see, understand, react and adjust their speed?

3. Placement of push button – can they be placed in such a way that pedestrians and/or cyclists can access them easily and see that the warning lights have been activated?

4. For pedestrians – will they be crossing the bridge on either side, coming from both directions? If so, push buttons should be placed in all four quadrants at the bridge ends.

5. Beyond the bridge, do pedestrians and/or cyclists have safe and convenient access to the approach roads? This is especially applicable to freeway interchanges and bridges that terminate at intersections.

6. Local education of the pedestrian and/or bicyclists on the meaning and use of the devices may be needed.

6.2.4 Engineering Study

Region Traffic should conduct an investigation and analysis of the criteria and considerations as well as any other pertinent information. Written documentation of the investigation as well as a recommendation should be provided. A schematic plan detailing proposed locations and pictures of the area should be included. Support of Region Traffic and approval of the State Traffic Engineer is required before installation of the signs.

6.3 Bicycle Facilities

The Department of Transportation has adopted the AASHTO publication, *Guide for the Development of Bicycle Facilities*, to establish bikeway design and construction standards, to establish traffic control devices guidelines for bikeways, and recommend illumination standards. Bicycle facilities are covered by OAR 734-020-0055 and OAR 734-020-0060. (Refer also to Sign Policy and Guidelines for the State Highway System, Traffic Line Manual, Oregon Bicycle and Pedestrian Plan, and OAR 734 Division 56.)

File Code: LOC 03

6.3.1.1 <u>Shared (or combined) Bike and Right-Turn Lane</u>

See 6.37.5

6.4 Capacity Analysis

A capacity analysis is required to determine the existing or future quality of operations (level of service) on a part of a transportation system – freeways, rural highways, intersections, etc. It is recommended that the following steps be followed in carrying out a capacity analysis:

A. Study Area Inventory – Observe the road network, lane configurations, lane widths, lane continuity, availability of auxiliary lanes, roadway grades, general terrain, intersection and stopping sight distances, adjacent driveways and their spacing, vehicle platooning, traffic composition, intersection controls, pedestrian activity, bicycle facilities, transit and railroad facilities, vehicle queuing , etc.

B. Traffic volume count data – Identify morning and evening peak volumes and heavy midday volumes. If a new traffic generator is involved, determine anticipated traffic volumes and their distribution to and from the proposed site based on observations of similar generators within the study area or other appropriate methodology.

C. Analysis detail – Follow established Highway Capacity Manual procedures whether the calculation is manual or uses computer software. ODOT policy is to determine intersection operation based on volume-to–capacity ratio. (Note saturation levels, levels of service (LOS), queue lengths, etc.)

Capacity analysis results usually require a decision to be made involving access management issues, construction of a traffic signal, provision of extra lanes, etc. Some of these can only be approved by the State Traffic Engineer under a letter of authority from the Technical Services Manager or through Administrative Rule. Requests for approval should include all necessary documentation of a thorough investigation, and a recommendation from the investigator. Requests from the regions to the Traffic—Roadway Section to carry out a capacity analysis should also be addressed to the State Traffic Engineer, with all necessary information. Analysis results that influence decisions made at a local level will be returned to the requester. The Traffic—Roadway Section will support the regions on the analysis, but will normally not take the lead in public meetings that involve these investigations.

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File Code: TRA 03-00-01

6.5 Crash Analysis

6.5.1 Overview

Crash data is used by transportation engineers to identify and analyze high crash locations, evaluate engineering measures and identify trends in crash occurrences to develop solutions that improve safety. The data can be used to develop a better understanding of the performance of traffic control measures or to study specific sites where a safety problem may exist.

When locations are identified for crash analyses the first step is to gather all crash data relevant to the location. Several reports or tools exist to assist in this step (See Crash Analysis Data Sources). These reports allow data to be summarized by different characteristics, such as date and time, roadside culture, weather conditions, type of crash, types of vehicles, and other information. Preparing collision diagrams to identify patterns can assist the analyst in analyzing the situation. Collecting other data such as volumes and operating speeds can also be helpful.

Site visits and video logs can assist with familiarizing the analyst with physical features, roadway geometry and other site characteristics. Crash and fatality rates for the section should be compared to the statewide average for similar types of highways.

When the analyst has identified and completed analysis of the specific site, they can evaluate which corrective actions might be beneficial and cost effective. Several sources exist which are helpful including: *Synthesis of Safety Research Related to Traffic Control and Roadway Elements*, December 1982 and *Safety Effectiveness of Highway Design Features*, November 1992, both published by the Federal Highway Administration. The Traffic—Roadway Section routinely performs crash analysis for environmental documents and corridor studies and can help in the evaluation of specific sites or trends. Contact the Highway Safety Engineering Coordinator for assistance.

6.5.2 Crash Analysis Data Sources

The following discussion identifies data sources for crash analysis. The statistical treatment of the data and other reference material is contained in Section 7.4. Crash Analysis is an important traffic engineering tool used to answer questions about road design, maintenance, and operations. Crash analysis can also be used to learn what questions to ask. The choice and arrangement of the data depend heavily upon the nature of the question, availability of pertinent data, and time available.

Crash data sources readily available to ODOT employees include:

6.5.2.1 <u>Oregon Motor Vehicle Traffic Crash Database</u>

This is the main database compiled and maintained by the Crash Analysis and Reporting Unit. It covers all state, county, and city roadways. All crashes reported to DMV and forwarded to the Crash Analysis and Reporting Unit are entered into the database if there is property damage exceeding a minimum dollar amount, or if there are any injuries. This data can be queried directly by the Crash Analysis and Reporting Unit to provide lists that meet very selective criteria.

The most recent ten years of crash data can be accessed on the ODOT Intranet as part of the Oregon Transportation Management System (OTMS).

6.5.2.2 <u>Oregon Traffic Crash Summary</u>

This extract from the main database listed above, has been published annually by the Crash Analysis and Reporting Unit of the Transportation Data Section since 1994. Previously, these reports were published by Driver and Motor Vehicle Services Division. These tables provide selected crash tallies for statewide, countywide, and, in some cases, citywide coverage. Subsets for truck, pedestrian, bicycle, and motorcycle crashes were published until 1987. From 1987 to 1996, the subsets were not published, but printouts were provided directly to the Traffic—Roadway Section. Beginning in 1989, additional subsets were generated for crashes on state highways and for fatal crashes only. The Oregon Traffic Crash Summary book has included all the subsets since 1996. A separate publication of crash rates on state highways is also available.

6.5.2.3 <u>Accident Summary Database</u>

This has been produced annually since 1990. This is a database/software combination for use on a desktop computer to generate reports at the request of the user. The summaries generated by this program are frequently helpful because the answers are often sufficient, or time may be too short to permit more detailed analysis. Each set contains three years of simplified crash data for the entire state highway system, plus estimates of traffic volume for each mainline crash site, plus information on SPIS sites. The crash data are extracted from the main database listed above. Traffic volume estimates come from the mileage control tape for the middle year of the three years covered. SPIS numbers are imported and assigned to each rated milepost.

These three-year databases are coupled with a summary program to produce a summary tally that includes an estimate of the crash rate and traffic volume for the selected section. Each summary must be for one continuous portion of one highway for all three years. The estimate of traffic volume is a simple average of all the volume estimates for each crash site. When a short part of the section specified has high volumes and many crashes but the remainder has low volumes and few crashes, the estimated crash rate will be too low. When appropriate, the crash rate should be corrected manually on the face of the printout using a better estimate of overall volume. Alternatively, separate summaries could be generated for each dissimilar segment.

6.5.2.4 TransGIS Mapping Tool

The TransGIS mapping tool was developed in order to provide a graphical method to display Category 1-5 segment information, SPIS locations, crash data, street and road information, and Average Daily Traffic (ADT) information. TransGIS displays this information on a state map. The user can choose the information that is displayed and can zoom into the map to increase detail, as well as display city and county maps behind this data.

6.5.2.5 Crash Graphing Tool

The Crash Graph Tool was created to automatically create graphs and summary tables of ODOT crash data in Microsoft Excel directly from the "Direction (Vehicle)" report from the State Highway Crash Reports on the ODOT Intranet. The tool is a Microsoft Excel Add-in and can be downloaded from the ODOT Intranet. External customers interested in obtaining the Crash Graph Tool should contact the Traffic—Roadway Section Highway Safety Engineering Coordinator for additional information.

6.5.2.6 Hardcopies

These have been generated by the Crash Analysis and Reporting Unit over the years for the State Highway System. These books are extracts of data from the main database listed above. Working libraries of these reports are maintained by the Traffic—Roadway Section and other offices. These books contain lists of crash data for one or five years, and lists of various crash rates for one or five years. These books are the normal source of data for those years no longer available directly from the mainframe computer.

6.5.2.7 Crash Rate Tables

These have been published annually by the Crash Analysis and Reporting Unit since at least 1948. Tables in the front of the book list statewide crash rates for several categories of the State Highway System. More tables list the crash rates for selected sections of each state highway, as well as a rural/urban break out. Additional tables list intersection crash data and fatal crash data.

6.5.2.8 Traffic Volume Tables

These have been published annually by the Transportation Data Section since at least 1939. There are no crash data in this book. It contains volume estimates for the entire state highway system. These volumes can be used for calculating crash rates. Information provided for automatic traffic recorders can be used in some instances to learn about seasonal or about weekend vs. weekday crash rates.

File Code: TRA 03-00-01

6.6 Crosswalks

6.6.1 Marked Crosswalks at Uncontrolled Locations on State Highways

6.6.1.1 Policy overview

The Traffic—Roadway Section issued a technical bulletin in April 2006 to provide direction to project delivery teams and District Managers relating to the establishment of marked crosswalks at uncontrolled locations on state highways as part of Statewide Transportation Improvement Program (STIP) and Oregon Transportation Investment Act (OTIA) projects and each District's pavement marking maintenance program.

6.6.1.2 Definitions of key terms

Uncontrolled location on state highway: A location on the state highway which lacks a STOP sign, YIELD sign, or Traffic Signal for controlling and stopping traffic on the state highway.

6.6.1.3 Background

The Oregon Transportation Commission, through ODOT's Chief Engineer has delegated the State Traffic Engineer with the authority to designate pedestrian crossings on state highways. The Traffic Operations Leadership Team (TOLT) has become concerned that many local agencies have chosen to mark crosswalks across state highways at uncontrolled locations without a proper engineering investigation or review by the Region Traffic Engineer and State Traffic Engineer.

Additionally, the increased use of consultants to provide roadway and traffic engineering services has resulted in varying levels of quality in striping plans. Some consultants have produced striping plans placing marked crosswalks across the state highway at all intersections within the project limits regardless of whether an engineering investigation has been conducted or not. Such over-use of crosswalks is a violation of our standard practice, creates a potential liability exposure to the department and creates a definite increase in maintenance costs. The ODOT Traffic Manual provides clear guidance for the conditions in which marked crosswalks at uncontrolled locations should be considered. Locations that do not meet the criteria listed in the manual should be recommended for removal.

6.6.1.4 Responsibilities of Parties Involved

Highway Division personnel such as Project Leaders and Consultant Project Managers, whose duties include project delivery, are expected to coordinate engineering investigations of marked crosswalks at uncontrolled locations with the Region Traffic Engineer to insure timely delivery of project designs. District Managers are expected to verify that the marked crosswalks at uncontrolled locations being maintained by the Region striping crew in their particular District have received proper approval by the State Traffic Engineer.

6.6.1.5 Action Required

Project delivery teams shall identify all marked crosswalks at uncontrolled locations during the preliminary scoping process for projects. The project delivery team shall coordinate an engineering investigation with the Region Traffic Engineer. The investigation shall document which marked crosswalks were previously approved by the State Traffic Engineer and which new or previously unapproved crosswalks are consistent with the guidelines set forth in the ODOT Traffic Manual. Any previously unapproved marked crosswalks to be included in the project shall be submitted by the Region Traffic Engineer to the State Traffic Engineer for consideration of approval.

District Managers or Striping Supervisors should whenever possible identify existing crosswalks in advance of re-striping activities and coordinate with either the Region Traffic Office or the Traffic—Roadway Section to assess whether the crosswalks have been approved and who has the responsibility for maintenance. This will become easier as we continue to build our database of pavement marking information.

6.6.1.6 Implementation

The implementation of this policy will be closely monitored by Traffic—Roadway Section staff and the Traffic Operations Leadership Team comprised of the State Traffic Engineer and the Region Traffic Managers from all 5 ODOT Region Technical Centers. Any revisions will be based on feedback from the Region Technical Centers, the Maintenance Leadership Team, and the Traffic Operations Leadership Team.

6.6.2 Criteria for Establishing Marked Crosswalks on State Highways

6.6.2.1 Overview

Crosswalks should be marked at urban roundabouts and across all signalized approaches at intersections, unless the crossing is closed by official action. Marked crosswalks may be established at rural roundabouts, across stop controlled approaches at intersections, or across channelized right turn lanes. Crosswalks shall be marked at established school crossings.

In an effort to ensure that marked crosswalks are placed where they are needed, specific engineering studies must be conducted. An engineering study and State Traffic

Engineer approval is required before establishing marked crosswalks at locations other than signalized approaches at intersections, stop signs, roundabouts, or channelized right turn lanes. The following criteria and considerations are guidelines for assisting in the determination of when a pedestrian crossing should be marked with a crosswalk.

6.6.2.2 Criteria for Marking Crosswalks at Uncontrolled Approaches of Intersections

Generally marked crosswalks are discouraged at uncontrolled approaches due to a concern that they may not improve safety and may, if inappropriate, put a pedestrian more at risk. The criteria are primarily restrictions on marking crosswalks in locations that would be potentially hazardous. In situations where the pedestrian volumes justify marking crosswalks (well above minimum threshold levels) additional safety measures (i.e., pedestrian refuges) should be considered above and beyond marking. Installation of a marked crosswalk will not, in and of itself, increase the level of safety for pedestrians. Marked crosswalks should only be considered at uncontrolled approaches when an engineering study demonstrates their need and the location meets the following criteria:

Required

- There is good visibility of the crosswalk from all directions, or it can be obtained. Stopping sight distance is a minimum.
- There is no reasonable alternative crossing location.
- There is established pedestrian usage. Considerations include: volume of pedestrians, opportunity for safe crossing (i.e., sufficient gaps in traffic), percentage of elderly or young children, and the nature of the attraction (See ITE suggested pedestrian volume thresholds in Section 6.6.2.11). Lower pedestrian volumes would be acceptable for areas where there is greater proportion of less experienced and less agile pedestrians (e.g., near schools and/or elderly housing areas)
- Posted speeds should be 35 mph or less.
- Traffic Volumes should be less than 10,000 ADT or if above 10,000 ADT raised median islands should be included.
- On multi-lane highways, pedestrian crossing enhancements (curb extensions and/or pedestrian refuges) should be considered.

6.6.2.3 Criteria for Marking Crosswalks at Mid-Block Locations

Installations of mid-block crosswalks are discouraged for the same reasons uncontrolled approaches are discouraged.

Mid-block crosswalks often do not get good compliance from motorists. Only consider mid block crosswalks when an engineering study demonstrates their need and the location meets the following criteria:

Required

- There is good visibility of the crosswalk from all directions or it can be obtained. Stopping sight distance is a minimum.

- Posted vehicular speeds should be 35 mph or less.

- There is not a reasonable alternative at a stop-controlled intersection.

- There is established pedestrian usage. Considerations include: volume of pedestrians, opportunity for safe crossing (i.e., sufficient gaps in traffic), percentage of elderly or young children, and the nature of the attraction (see ITE suggested pedestrian volume thresholds in Section 6.6.2.11). Lower pedestrian volumes would be acceptable for areas where there is greater proportion of less experienced and less agile pedestrians (e.g. near schools and/or elderly housing areas).

- Locations should be more than 300 feet to nearest crossing or marked crosswalk.

- Traffic Volumes should be less than 10,000 ADT or if above 10,000 ADT raised median islands should be included.

- Pedestrian crossing enhancements (curb extensions and/or pedestrian refuges) should be considered.

Optional

- Where a marked crosswalk can concentrate or channelize multiple pedestrian crossings to a single location.

- Free turning movements or other operational considerations inhibit pedestrian crossing opportunities at the nearest intersection.

- Established bus stops where riders need access to the opposite side of road from the bus stop where the stop can't be relocated.

6.6.2.4 <u>Criteria for Marking School Crossings at Uncontrolled Locations</u>

When establishing marked school crossings across uncontrolled locations the applicable criteria for marking crosswalks should be followed. Generally school crossings are established based on School Route Plans and are sited to take advantage of existing traffic controls such as traffic signals. Where existing traffic controls are not available and it is not feasible to require children to walk out of direction a marked crosswalk may be established. The number and age of the students using the crossing should be taken into consideration. Adult crossing guards should be considered for established school crossings at uncontrolled locations where gaps are not sufficient to permit a reasonably safe crossing.

6.6.2.5 Criteria for Marking Continental Crosswalk Markings (Longitudinal Marking)

Continental crosswalk markings provide special emphasis markings, so their use should be limited to preserve their effectiveness to call attention to special areas. Continental markings are the standard crosswalk marking for roundabouts and may be used at any uncontrolled approach or unsignalized approaches of channelized right turn lanes. At other locations continental crosswalk markings should only be considered when an engineering study demonstrates their need and the location meets the following criteria:

Required

- Areas where special emphasis is required, i.e., school crossings and mid-block crossings

- Areas where higher visibility is needed

Optional

- Their use should be limited to unsignalized locations

- Posted vehicular speed of greater than 35 mph

- Substantial public comments (see local support for marked crosswalk)

- High pedestrian crash rate with existing transverse markings

- Consistency with other crosswalk markings in city

6.6.2.6 Criteria for In-Street Pedestrian Crossing Signs

Guidance on the use of In-Street Pedestrian Crossing signs is given in Sections 2B.12 and 7B.09 of the Manual on Uniform Traffic Control Devices. The Oregon Supplement to the MUTCD allows only the "STOP FOR" legend to be used in Oregon.

Agencies wishing to install In-Street Pedestrian Crossing signs on state highways are required to submit a request to ODOT. Region traffic managers/engineers may approve these signs for installation (with concurrence from ODOT District Maintenance). Ordinarily the agency agrees to assume responsibility for the costs associated with installing and maintaining the sign. The agency may enter into an intergovernmental agreement with ODOT or obtain a special permit to install and maintain the sign.

Before installing signs, each location should be reviewed separately in terms of site conditions and pedestrian safety. Observe traffic flow to determine the most strategic location for each sign. Signs should be installed on the centerline and as close as practical to the marked crossing without placing it in the crosswalk, typically with one to five feet in advance of the crosswalk.

Suitable locations for deployment of in-street pedestrian crossing signs

- At a mid-block marked crossing.

- At a marked school crossing.
- On a pedestrian refuge island.
- Where the posted roadway speed limit is equal to or less than 35 MPH.
- Where the roadway configuration is 2 travel lanes, one in each direction.
- The crossing experiences regular pedestrian traffic.

Sites to be avoided

- At stop or signal controlled intersections.
- Where there is a two-way left turn lane or left turn refuge.

Considerations

- Where there is a left turn lane an on-site investigation may consider placing the signs in the median if there is sufficient width to provide shy distance of 1 to 2 feet.
- Where there is a high volume of turning movements, on-site traffic observations should be made before placing signs near driveways and turn lanes. A sign will not be successful and will become a maintenance problem if it is an obstacle to drivers.
- If large vehicles frequent the area, it is desirable to conduct on-site observations of traffic flow before placing an in-street sign. Vehicles like delivery trucks, buses, and construction trucks with larger turning radii will likely have difficulty maneuvering around the in-street sign.
- Placing signs outside the fog lines may be considered but consideration should be given to placing the appropriate pedestrian signing (W11-2) with downward arrows instead, these signs are much larger and can be legible for a greater distance.
- Narrow streets or streets with parking may pose a problem. There is a certain amount of "shy distance" needed for signs placed in the street.
- Placing the signs in the crosswalk shall be avoided, it may pose a problem for pedestrians and a potential hazard for the vision impaired.
- Permanent in-pavement anchors should be considered for easy maintenance and replacement and to reduce theft of the signs.
- Sign supports shall be as required by the Manual on Uniform Traffic Control Devices.

- Signs in school area may be placed and removed daily as an indication to motorists to expect children arriving or departing school. Used in conjunction with traffic patrols these signs can be very effective.

- If the roadway is 4 travel lanes (two in each direction) there should be adequate space in the median to place the sign. A better option for 4 lane plus roadways is to place advance stop bars and use "STOP HERE FOR Ped" sign at the advance location.

6.6.2.7 Criteria for In-Roadway Warning Lights at Crosswalks

See Section 6.6.7

6.6.2.8 Criteria for Textured/Colored Crosswalks

See Section 6.6.8

6.6.2.9 Criteria for Marking Crosswalks across Channelized Right Turn Lanes

An island separates channelized right turn lanes from other intersection approach lanes. They are often found at signalized intersections and are typically curbed but may be paint. The turn lane may be controlled by a traffic signal, stop sign, yield sign or may be uncontrolled (i.e., "slip lane").

Crosswalks on unsignalized approaches should be located one car length back (approx. 25 feet) from Yield line, Stop line or gore point of island. Staggered continental crosswalks may be used across unsignalized turn lanes.

Crosswalks should be marked at turn lanes controlled by a traffic signal or stop sign where there are crosswalks marked across the other controlled approaches. At other locations where the turn lane is controlled by a yield sign or uncontrolled, marking of pedestrian crosswalks may be considered if the location meets all the following criteria:

Required

- There is good visibility of the crosswalk, or it can be obtained. Safe Stopping distance is required.

- Provides consistent walking path of pedestrians (i.e., marked crosswalks across the controlled approach(es)).

- Properly designed island (usually curbed) encourages lower speed turns, provides good sight angles for vehicles and properly orients visually impaired pedestrians.

- The approach allows for the marked crosswalk to be placed 25 to 40 feet from the yield line, stop bar, or island gore point at non-signal controlled channelized right turn lanes to allow for one car length of storage.

- The curbed island has pedestrian curb cuts, or ramps if the island is wide enough, for the disabled.

Marking of pedestrian crosswalks on uncontrolled or yield controlled turn lanes are discouraged when the following is true:

- Operating speeds at the crosswalk are greater than 35 MPH.

- Poor geometrics of the intersection or island encourage higher speed turning or may require drivers to look over their shoulders, turning their attention away from pedestrians crossing their path.

- Lack of pedestrian facilities (i.e., sidewalks or shoulders) makes it hazardous or unlikely for pedestrians to use.

Note: Channelized left turn lanes from one-way streets may be handled in the same manner as above.

6.6.2.10 Considerations for Marking Crosswalks

Engineering Study

The following considerations should be addressed in an Engineering Study:

1. Marked crosswalks at other than signalized intersections or stop-controlled approaches should be used selectively. Allowing a proliferation of marked crosswalks may reduce the overall effectiveness of marking crosswalks.

2. Consideration must be given to concerned citizens, civic groups, and neighborhood organizations; balancing engineering judgment with perceived public need.

3. The roadway design features that influence the pedestrians' ability to cross the street, e.g., street width, presence of a median, one-way versus two-way operation, and geometrics of the highway or intersection being crossed, all need to be included in the planning of the crosswalk. Other pedestrian design improvements such as curb extensions and pedestrian refuges should be encouraged to increase the safety of the crossing.

4. A three to five-year pedestrian crash history should be obtained.

5. The walking path of the pedestrian. Will marking crosswalks encourage pedestrians to use a single point of crossing rather than choosing random crossing points?

6. There should be opportunities for crossing (sufficient gaps in traffic)

7. Uncontrolled marked crosswalks may be continental crosswalk marking and should be accompanied by other enhancements such as pedestrian refuge islands, bulb-outs, pedestrian signs etc.

8. There should be adequate sight distance for the motorist and the pedestrian, or it can be obtained. This includes examination of on-street parking, street furniture (e.g., mailboxes, utility poles, newspaper stands), and landscaping. Corrective measures should be taken wherever possible.

9. All crosswalk locations should be investigated for adequate illumination where there is prevalent nighttime pedestrian activity.

10. Mid-block and school crossings must be supplemented with crosswalk signs

11. Mid-block crosswalks should not be located immediately down-stream from bus stops.

12. For mid-block crosswalks: are there more reasonable locations pedestrians could cross, i.e., no more than a block (300 feet) from a location being considered?

Local Jurisdictions

1. Local Jurisdiction Installs - When a local jurisdiction installs marked crosswalks on State Highways they should be in substantial compliance with these guidelines and obtain prior approval of ODOT. Ordinarily a local jurisdiction may install marked crosswalks if the local jurisdiction agrees to enter into an Inter-Governmental Agreement with ODOT and assumes responsibility for all costs associated with the marked crosswalks including maintenance.

2. ODOT Installs - When a local jurisdiction requests ODOT to install marked crosswalks on State Highways other than at signals and school crossings, they shall be in substantial compliance with these guidelines and must be approved by ODOT. Ordinarily ODOT will agree to install the crosswalk if the local jurisdiction agrees to enter into an Inter-Governmental Agreement with ODOT and assumes responsibility for all costs associated with the crosswalks including installation and maintenance.

3. Continental Crosswalks - Ordinarily ODOT installs standard transverse crosswalk markings. A local jurisdiction may request to ODOT to install continental crosswalk markings if the jurisdiction has standardized on the marking for all other crossings in the community. Ordinarily ODOT will agree to install the staggered continental style crosswalk if the local jurisdiction agrees to enter into an Inter-Governmental Agreement with ODOT and assumes responsibility for all costs associated with the crosswalk including installation and maintenance.

4. Textured/Colored Crosswalks - Ordinarily ODOT does not install textured or colored crosswalks. A local jurisdiction may request to install textured or colored crosswalks on State Highways. ODOT may agree to the installation of a textured or colored crosswalk if the local jurisdiction agrees to enter into an Inter-Governmental Agreement with ODOT and assumes responsibility for all costs associated with the crosswalk including installation and maintenance.

5. ODOT Maintains - ODOT may choose to install and maintain crosswalks within a local jurisdiction at selected locations other than signalized intersections and school crossings. Generally this will be at locations that meet all criteria and there has been a demonstrated problem at the location, such as a crash history.

6. Intergovernmental Agreement (IGA) – When an IGA specifies that the crosswalk is the responsibility of the jurisdiction to maintain it will describe how this is done either by local jurisdiction resources or by reimbursement of ODOT striping crews. The IGA will require the local jurisdiction to properly maintain the crosswalk to an acceptable standard. If the agency fails to maintain the marked crosswalk or the crosswalk becomes a safety problem, ODOT may remove it or bring the crosswalk up to standard at the expense of the local jurisdiction.

7. ODOT Responsibility - When ODOT has signed an agreement with a local jurisdiction, and an ODOT construction project or maintenance activity obliterates previously approved crosswalk markings, ODOT will replace them at no cost to the local jurisdiction.

Definitions

Continental (or Longitudinal) crosswalk marking is a series of uniform parallel solid white longitudinal lines that mark the pedestrian's path (without transverse lines).

Engineering study is a careful examination or analysis of an event, condition, development or question with documented results.

Ladder Crosswalk markings combine both the continental and standard crosswalk into one path with the continental lines providing the rungs of the ladder (typically not used by ODOT).

Slip Lane is an uncontrolled channelized turn lane separated by an island (no signal or stop sign).

Staggered Continental crosswalk is a continental crosswalk marking designed so that the lines do not fall in the vehicles wheel path. (See ODOT Standard Drawing TM 535).

Standard crosswalk marking is a set of parallel solid white transverse lines that mark both edges of the pedestrian crosswalk. (See ODOT Standard Drawing TM 535).

Stop Controlled Approach is an approach at an intersection that is controlled either by a stop sign or a traffic signal.

Uncontrolled Approach is an approach at an intersection that is not controlled by a traffic control device (such as a traffic signal, stop sign or yield sign).

6.6.2.11 Figures and Illustrations

Various types of crosswalks

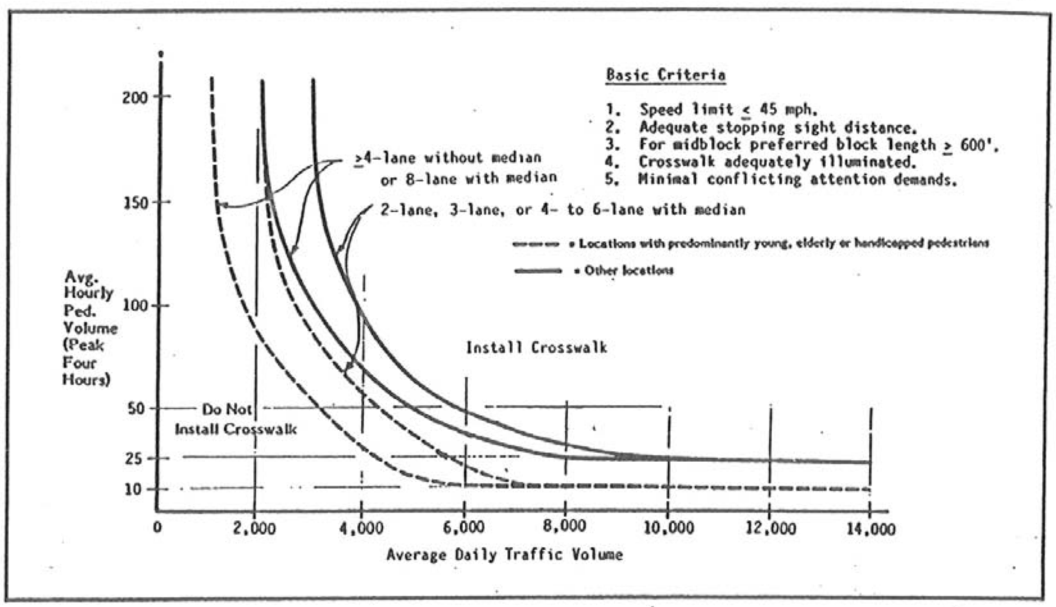
Examples of typical crosswalk markings can be found in Figure 3B-16 of the Manual on Uniform Traffic Control Devices (2003 Edition). Standards and guidance for how crosswalk markings are to be used are found in Section 3B.17 of the Manual on Uniform Traffic Control Devices (2003 Edition). The ODOT Traffic Line Manual should be consulted for all types of crosswalk markings applied to state highways.

ITE Guidelines for Crosswalk Installation

ITE (Institute of Transportation Engineers) Journal

August 1989

BY FRED RANCK



6.6.3 Crosswalk Approval

Crosswalks shall be marked across all signalized approaches at intersections unless the crossing is closed by official action. Marked crosswalks may be established across stop controlled approaches at intersections (at stop signs) or across channelized right turn lanes. Crosswalks shall be marked at established school crossings. Crosswalks should be marked at all urban roundabouts. In rural locations where pedestrian activity is minimal, marked crosswalks at roundabouts are optional and their use may be based on engineering judgment.

An engineering study and State Traffic Engineer approval are required before establishing marked crosswalks at locations other than signalized approaches at intersections, stop signs, channelized right turn lanes or at roundabouts. Marked crosswalks should only be considered at uncontrolled approaches (other than channelized right turn lanes) when an engineering study demonstrates their need (See Criteria for Establishing Marked Crosswalks on State Highways). These include criteria and considerations for the determination of when a pedestrian crossing should be marked with a crosswalk and when it is appropriate to consider using continental style crosswalks.

Agencies wishing to mark and maintain crosswalks on state highways within their jurisdiction are required to submit engineering study justifying the marking of each crosswalk to the Region Traffic Manager.

6.6.4 Crosswalks at Signalized Intersections

Marked crosswalks are required at all signalized approaches of an intersection, unless a traffic engineering investigation shows that a crosswalk should not be allowed. Pedestrian signals heads shall be installed unless the crosswalk is closed by official action. Barrier and signs shall be posted for all officially closed crosswalks. All crosswalk closures at signalized intersections on state highways require the approval of the State Traffic Engineer based on a traffic engineering investigation. The primary reason for closing a crosswalk is safety, however geometric and operational factors may also be considered.

Installation or removal of any sign prohibiting pedestrian traffic or closing a crosswalk requires the approval of the State Traffic Engineer. (See Traffic Signal Policy and Guidelines for pedestrian crossings at signalized intersections) Pedestrian push buttons shall be accessible, preferably from an all-weather level landing. Crosswalks should be marked at channelized turn lanes controlled by a traffic signal or stop sign where there are crosswalks marked across the other controlled approaches. If the turn lane is controlled by a yield sign or uncontrolled, marking of pedestrian crosswalks may still be considered (See Criteria for Establishing Marked Crosswalks on State Highways).

When used, a crosswalk across a non-signal controlled channelized right turn lane should be located one car length back (approx. 25 feet) from Yield line, Stop line or gore point of island. This will allow the driver to deal with one conflict at a time. Staggered continental crosswalks may be used across unsignalized turn lanes.

Stop lines should not be used with crosswalks at signalized approaches unless it is desirable to stop vehicles in advance of the crosswalk. The crosswalk marking, either standard transverse lines or longitudinal lines (continental style) serve as the indication of where vehicles are required to stop.

6.6.5 Crosswalk Safety

There is conflicting evidence as to the effectiveness of marked crosswalks on motorist behavior and pedestrian safety. ODOT has followed a practice of reluctance to mark crosswalks at locations other than controlled locations (i.e., signals and stop signs) and school crossings. Numerous studies (San Diego, 1972, Long Beach, 1986, Brigham Young, 1996, Santa Anna, 1999) have shown that marking crosswalks at uncontrolled locations can increase crash risk for pedestrians. In contrast some studies show higher rates of motor vehicle yielding to pedestrians at marked crosswalks.

Recent studies (Zegeer, 2000) suggest that wider (multi-lane) or higher volumes (above 10,000 ADT) contribute to higher crash risk for marked crosswalk vs. unmarked crosswalks. The study also found that the presence of a raised median was associated with a lower crash risk. Another study (Knoblauch, 1999) documented that pedestrians and motorists did not exhibit observable unsafe behaviors in marked crosswalks, in fact observable pedestrian behavior actually improved. The previous study commented that one possible explanation to higher crash rates in marked crosswalks is that a marked crosswalk may attract a higher percentage at-risk pedestrians, children and older adults (Zegeer, 2000).

From the pedestrian's point of view, a crosswalk is large and clearly marked. Crosswalks are far less visible to the drivers than to the pedestrians. At speeds greater than 45 mph, crosswalks are indiscernible at the distance a driver needs to begin braking to safely stop for pedestrians. It is important to ensure that the crosswalk markings and pedestrians are highly visible to motorists.

Marked crosswalks are routinely requested to increase the safety of crossing the highway. The function of the marked crosswalk is to provide guidance to the proper crossing location and to serve to alert motorists of a pedestrian crossing point. But unjustified or poorly located crosswalks may not increase safety. Marking crosswalks unnecessarily or in locations where there are few pedestrians may lead motorists to disrespect the marking.

A driver who passes over crosswalks marked at every intersection or a location that rarely has pedestrians may be conditioned to not expect pedestrians and thus loses respect for crosswalk marking. These crosswalks may increase the crash risk to pedestrians and motorists alike.

Most experts agree that on a busy highway, marking a crosswalk alone is rarely an effective safety measure and in some cases may actually increase the pedestrian's crash risk. Other measures such as median refuge islands, curb extensions and illumination should be considered before a crosswalk is marked. Other improvements include improving sight distance, better access management to reduce conflicts with driveways, pedestrian signs, etc. Consideration should also be given to the overall environment in which the pedestrian crossing occurs, beyond the immediate vicinity of the proposed crosswalk, i.e. sign clutter and visual distractions. (See also Crossing Strategies)

File Code: TRA 07-11

6.6.6 Crossing Strategies

The need for convenient, practical and safe pedestrian crossings of highways is a high priority for virtually all cities. Dispersed land use and long distances between intersections make it impractical in most cases to provide grade separation (over/underpasses) or positive traffic controls (signals). Another common request is for marked crosswalks.

There are many reasons pedestrians have difficulty crossing a highway:

- High traffic volumes

- Lack of adequate gaps
- High traffic speeds
- Long crossing distances
- Multiple travel lanes
- Poor visibility

The first two obstacles (high traffic volumes and lack of adequate gaps) are difficult to resolve with a simple crossing strategy, but there are several ways to mitigate the other factors. The following measures should be instituted before a crosswalk is marked at a location other than a traffic signal:

6.6.6.1 Traffic Speeds

Most conventional "traffic-calming" methods are not appropriate on state highways, but there are measures a jurisdiction can undertake to alert drivers they are entering an area with expected pedestrian activity. These include, but are not limited to, sidewalks, street trees, median islands, bike lanes, visually narrowing the cross-section with better lane definition, bringing buildings closer to the back of sidewalks, maintaining on-street parking, etc.

6.6.6.2 Long Crossing Distances

Using good design practices, the roadway cross-section can be reduced by selectively narrowing or even eliminating unnecessary roadway elements (i.e. travel lanes, turning lanes, bike lanes or parking). Where on-street parking is present, curb extensions should be considered.

6.6.6.3 Multiple Travel Lanes

Assessing a safe and adequate gap in traffic becomes more difficult as the number of travel lanes increases. Islands can break up the crossing into discrete steps, so the pedestrian has to deal with fewer conflicts at a time. If the crossing point is at an intersection with a right-turn lane, an island between the right-turn lane and the through lanes enables the pedestrian to cross just the turning lane first. This breaks the crossing into more manageable parts.

The most important island to provide is in the median. This enables a pedestrian to cross traffic in one direction only, in two easy steps. It can be up to 5-7 times easier to cross a 4-lane road in two steps than all at once.

6.6.6.4 Poor Visibility

Pedestrians rarely knowingly step in front of moving traffic, and drivers don't purposely hit a pedestrian they could see and react to in time. Measures to address visibility include removal or relocation of obstructions (signs, signal boxes, etc), curb extensions (where on-street parking is present) and illumination. Curb extensions allow pedestrians to better see on-coming traffic, and drivers to better see pedestrians about to cross. Approximately 60% of pedestrian crashes occur at night, which is out of proportion to exposure. Illumination should be provided at all designated crossing points.

Note: providing visibility should not be carried to extremes; for example, removing all on-street parking, trees and other vertical elements may have the negative effect of increasing travel speeds, which is potentially a greater hazard to safe crossing.

6.6.6.5 Total Crossing Strategy

Before a crosswalk is considered at a location other than a controlled location (i.e., signalized intersection), all the following issues should be addressed:

- Speed- ODOT and the local jurisdiction should work at slowing traffic speeds in a realistic manner;

- Crossing distance - Review roadway width and reduce cross-section where possible;

- Multiple travel lanes - Provide median and/or channelization islands

- Visibility - Remove sight obstruction, provide curb extensions (where possible) and provide illumination if warranted. Pedestrian crossing signs, or improved signs - larger size and/or better reflectivity – should be considered

Only after all of the above issues have been adequately addressed should a marked crosswalk be considered on a busy, multi-lane highway.

Other issues that might deserve special attention include:

- Reducing conflicts by use of appropriate access management techniques;

- Considering the special needs of vulnerable or at-risk pedestrians; and

- Proper signing of pedestrian crossings.

In slower-speed, two-lane environments, it may be more acceptable to mark crosswalks without all of these elements in place, though visibility is always important. The needs of the aging pedestrian should be addressed as well including the increased time needed to cross similar roadway widths.

A recent research report jointly sponsored by TCRP and NCHRP (TCRP 112 and NCHRP 562 – Improving Pedestrian Safety at Unsignalized Crossings) summarizes engineering treatments to improve safety for pedestrian crossings at unsignalized intersections, in particular high speed high volume roadways served by public transportation. The research developed recommended guidelines for selecting pedestrian crossing treatments, summaries of pedestrian treatments (including many noted within this manual), and possible revisions to the MUTCD for pedestrian warrants.

6.6.7 In-Roadway Warning Lights at Crosswalks

6.6.7.1 Background

In-roadway or in-pavement flashing lights for crosswalks are being touted as a method to alert drivers to the presence of pedestrians entering or within the crosswalk. The flashing lights can be activated by pushbutton or with passive detection. Once activated the lights flash at various rates or remain lit depending on the product characteristics. Most manufacturers offer various colors of flashing lights. Several cities in Washington and California, as well as some in Oregon, have installed the devices at marked crosswalks.

The Manual on Uniform Traffic Control Devices has a section dedicated to In-Roadway Lights, Chapter 4L. The Manual on Uniform Traffic Control Devices specifies flashing rates, color of the warning lights and placement criteria.

There is some evidence (Whitlock & Weinberger Transportation, Inc., *An Evaluation of a Crosswalk Warning System utilizing in-pavement Flashing Lights*, April, 1998) that the in-roadway lights increase the percentage of drivers yielding to pedestrians; at least on a short term basis. However, research clearly documenting the safety benefits (i.e., percent reduction of pedestrian crashes) of in-roadway flashing lights, particularly on a long-term basis, is not available. ITE has prepared an informational report that contains information and data on the in-roadway flashing light systems. The report gives a history of the system and a description of lighting devices and installation, as well as activation methods.

6.6.7.2 Investigation

Of particular interest is the effectiveness of the devices as safety improvements. There is a concern that the crossings, particularly where the pedestrian activates the warning lights by push button, could increase pedestrian assertiveness and potentially be dangerous. Also of concern are the potential maintenance costs (some systems have had reports of poor reliability and problems with the equipment), potential liability, effectiveness of driver compliance, and their effectiveness over longer periods of time.

Observations of these devices by ODOT employees indicate that the devices tend to be hard to see during the daytime. The low angle and bright conditions tend to wash out the visibility of the in-roadway lights. The flashing lights did not appear to reduce the likelihood of a multiple threat crash as some motorists failed to see the lights in daytime conditions. Pedestrians do not appear to use the devices as an excuse to practice unsafe behavior, (i.e., walking in front of on-coming vehicles). Nor did the pedestrian push button activation appear to influence the pedestrian aggressiveness. ODOT would like to see further research into the safety of these devices (i.e., estimated crash reduction) as well as suggested guidelines and criteria for their use and their direct comparison to pedestrian actuated flashing lights mounted above the roadway.

Some jurisdictions, struggling with where to initially install these devices, have proposed that locations with little or no safety improvements receive the in-roadway lights first. This assumes that the in-roadway lights provide a safety benefit comparable to other treatments. This is not supported at this time. It must be emphasized that in-roadway lights are not a substitute for proven pedestrian safety measures such as pedestrian refuge islands or curb bulb-outs.

While these devices appear to improve pedestrian mobility, they do come at a cost. Estimates vary depending on the width of the roadway, from $18,000 to more than $30,000 per crosswalk. Passive detection systems cost even more. Logically their use should be limited given their initial cost and unknown safety and maintenance record. CalTrans has adopted a policy that a city may install these devices on state highways if they agree to assume all costs associated with their installation and operation. CalTrans is preparing guidelines for the installation of these devices.

6.6.7.3 Guidelines for Approval

ODOT has received several requests to install these devices on State Highways. Until such time as more experience is developed with these devices and because of limited funding ODOT should continue to support the installation of proven techniques for pedestrian safety prior to the installation of these devices. The use of these devices should be limited to areas where proven pedestrian safety measures have been installed and additional pedestrian warning is desired. Below are proposed criteria for installation of these devices on State Highways.

6.6.7.4 Introduction to Criteria

In-roadway warning lights at crosswalks provide additional warning to motorists of their approach to a marked crosswalk. Chapter 4L of the Manual on Uniform Traffic Control Devices describes the purpose, operation and use of In-Roadway Warning Lights at Crosswalks.

The usefulness of these lights is limited during daylight hours; they are difficult to see under normal daylight conditions. These devices tend to have a more significant effect during hours of darkness, rain or fog. Currently there is no confirmation that these devices reduce crash risk to pedestrians, but there is some supporting evidence that they increase driver's awareness of pedestrians. Because of their relatively high installation costs, potentially high maintenance costs and their unproven safety record during key periods of pedestrian use, their installation should be limited to locations where they are justified.

Other proven pedestrian safety measures (i.e., overhead illumination or median pedestrian refuges) should be employed and monitored for effectiveness before in-roadway lights are considered. Although these other methods can be as much or more expensive than the in-roadway lights their benefits are proven any time of the day, they require little or no maintenance and they have benefits to the motor vehicles as well as pedestrians.

6.6.7.5 Criteria

The in-roadway lights should only be considered when a crosswalk location meets the following criteria. Limiting the in-roadway lights to the locations listed in the criteria will direct them to areas where they will be most beneficial and maintain their effectiveness by limiting their use.

Engineering Criteria

- A location where special emphasis is required such as mid-block crossings, crossings with a high percentage of vulnerable pedestrians (predominately young, elderly or disabled), or a history of pedestrian crashes.

- Proven pedestrian safety measures such as median refuge islands and/or curb bulb-outs are (or will be) in place.

- In-roadway lights might be most appropriate in locations where there is nighttime pedestrian activity or a nighttime crash history.

- The crosswalk crosses a multi-lane roadway (more than one lane in each direction) with more than 8,000 Average Daily Traffic (ADT) volume, 6,000 ADT if high percentage of vulnerable pedestrians.

- The crosswalk is not controlled by traffic signal, stop sign or yield sign. There should be no other crosswalks, traffic signals or stop signs within 250 feet of the crosswalk.

- Posted speeds should be 35 mph or less, but may not exceed 45 mph.

- The in-roadway lights will meet all standards outlined in Chapter 4L of the Manual on Uniform Traffic Control Devices.

- The crosswalk has an average of 25 pedestrians per hour (10 pedestrians per hour with high percentages of vulnerable pedestrians) for any four hours of the day. The crosswalk has nighttime pedestrian activity (at least half the volumes above for any two hours during the nighttime).

Local Support

- The installation of in-roadway lights has public support.

- Local jurisdictions agree to pay for installation, power and maintenance.

- There is local commitment to education of the driver and pedestrian on the meaning and use of the devices.

Considerations

- Consideration should be given to installing a pedestrian traffic signal if the location meets an applicable traffic signal warrant.

- Overhead illumination for pedestrians is a proven safety measure for nighttime pedestrian activity. Good overhead lighting will allow the pedestrian to be more visible and may help wash out the glow of the in-roadway lights so they do not distract the pedestrian.

- Applicable crossing signs need to be installed adjacent to the crossing location and will be supplemented with flashing beacons that are activated along with the in-roadway lights. Advance crossing signs may be used and may be supplemented with flashing beacons particularly when sight distance to the crosswalk is limited.

- School crossings may not be the best location for in-roadway lights. Most activity in school crossings should be during daylight hours. Overhead illumination and/or crossing guards may be better options.

- Downtown areas may not be the best location for in-roadway lights. The addition of flashing lights in an already cluttered and distracting environment may do little to enhance pedestrian safety.

- It is recommended that drivers have sufficient decision sight distance to the in-roadway lights to be able to respond and stop for pedestrians if required.

- On roadways with bike lanes the outer lights should be placed to avoid the path of bicyclists.

- Either automatic (passive detection) or push-button activation is allowed. If push-button activated the proper signing should be attached next to the push-button, such as "PUSH BUTTON FOR CROSSWALK WARNING LIGHTS / WATCH FOR TRAFFIC".

6.6.8 Textured/Colored Crosswalks

6.6.8.1 Overview

The Traffic—Roadway Section issued a technical bulletin in December 2006 to provide direction to project delivery teams and District Managers relating to textured and colored crosswalks on state highways as part of Statewide Transportation Improvement Program (STIP) and Oregon Transportation Investment Act (OTIA) projects and each District's pavement marking maintenance program.

6.6.8.2 Definitions of key terms

Textured Crosswalk: A surface material at a crosswalk such as brick, concrete pavers, or stamped asphalt, which is installed to produce small, constant changes in vertical alignment and to aesthetically enhance the crosswalk.

Colored Crosswalk: A pavement marking or proprietary product at a crosswalk, which is installed to contrast with adjoining paved areas and to aesthetically enhance the crosswalk.

6.6.8.3 Policy

ODOT practice is to not install textured or colored crosswalks. It is sometimes, however, a wish of a local road authority to install them. The perception is often times that the textured or colored crosswalk alone will be more visible than standard crosswalk marking. But often times that is not the case, textured or colored crosswalks can actually be LESS visible than conventional marked crosswalks (red brick tends to fade to black, especially at times of low visibility).

Textured crosswalks can be rough, impeding the movement of pedestrians with wheelchairs and walkers. They can become uneven, presenting a tripping hazard to pedestrians, especially the sight impaired. Textured or colored crosswalks are typically higher maintenance and some materials can become slick creating a slipping hazard. Installation costs are also high in comparison to conventional marked crosswalks.

6.6.8.4 Background

The Oregon Transportation Commission, through ODOT's Chief Engineer has delegated the State Traffic Engineer with the authority to designate pedestrian crossings on state highways. The Traffic Operations Leadership Team (TOLT) has become concerned that project teams have been specifying textured and colored crosswalks in STIP and OTIA projects without a proper engineering review by the Region Traffic Engineer and approval from the State Traffic Engineer. Additionally, some project teams have used safety funds to pay for these aesthetic enhancements. Textured or colored crosswalk enhancements have not been documented to improve safety at crossings. Such use of safety funds to pay for textured and colored crosswalks is inappropriate and reduces the availability of these funds to pay for other proven pedestrian safety countermeasures such as curb extensions, raised median islands, illumination, and proper signing. The ODOT Traffic Manual provides clear guidance on textured and colored crosswalks on state highways. An Intergovernmental Agreement (IGA) with the local jurisdiction is necessary to ensure these enhancements are installed and maintained correctly. The IGA should be established with the local jurisdiction prior to letting any contracts for work involving the installation or maintenance of textured/colored crosswalks. Where textured/colored crosswalks have been installed without such an IGA, ODOT should negotiate either (1) entering into an IGA with the local jurisdiction to cover ongoing maintenance and replacement costs OR (2) removal.

6.6.8.5 Action Required

Project delivery teams shall coordinate an engineering review with the Region Traffic Engineer for all proposed textured and colored crosswalks. The review shall document the proposed coloring, materials, pattern, funding source, installation, and maintenance requirements including consistency with the guidelines set forth in the ODOT Traffic Manual. Safety funds should not be used for coloring or pavement texturing of crosswalks. Any previously unapproved textured or colored crosswalks to be included in the project shall be submitted by the Region Traffic Engineer to the State Traffic Engineer for consideration of approval.

District Managers or Striping Supervisors should, whenever possible, identify existing textured and colored crosswalks in advance of re-striping activities and coordinate with either the Region Traffic Office or the Traffic-Roadway Section to assess whether the crosswalks have been approved and who has the responsibility for maintenance. This will become easier as we continue to build our database of pavement marking information.

6.6.8.6 Implementation

The implementation of this policy will be monitored by Traffic-Roadway staff, the TOLT, and the Maintenance Leadership Team (MLT). Any revisions will be based on feedback from the Region Technical Centers, the TOLT, the MLT, and District Managers.

6.6.8.7 Procedure

Agencies wishing to textured/color crosswalks on state highways within their jurisdiction are required to submit justification for crosswalk texturing or coloring to the Region Traffic Manager/Engineer for review. On the state highway system, approval of the State Traffic Engineer is required. Ordinarily, a local jurisdiction agrees to enter into an Inter-Governmental Agreement with ODOT to assume responsibility for all costs associated with the crosswalks including maintenance. If textured or colored crosswalks are used, they should be made of durable materials, such as stamped concrete, with minimal beveling. The textured surface should be built to adequate strength, with a good base resulting in low maintenance.

Colored crosswalks should consist of white or gray coloring. Alternate colors such as blue, red (brick), or green may be used provided the coloring is muted. Yellow or fluorescent yellow green coloring shall not be used since these colors are reserved for transverse lines separating traffic.

All textured or colored crosswalks shall be supplemented with lateral white lines to increase their visibility to motorists. Texturing or coloring should not be used at locations where crossings are not established because they might indicate a crossing to pedestrians (i.e., mid-block between alleys).

Textured or colored crosswalk designs shall conform to the following:

- Made of durable materials
- Adequate strength with good base
- Non-slip surface (even after wear)
- Minimal beveling

6.7 Flashing Beacons

Flashing beacons are described in Chapter 4K of the Manual on Uniform Traffic Control Devices. These standards should be consulted by anyone considering a request or need for a flashing beacon. Note that flashing beacons, which include pedestrian crossing beacons, must be supplemental to the appropriate warning or regulatory signing.

6.7.1 Intersection Control Beacons

ODOT has historically taken a conservative approach to installing flashing beacons at intersections, especially for intersection control.

This follows the Manual on Uniform Traffic Control Devices guidelines to limit use so as to maintain whatever effectiveness these devices may have. Intersection control beacons are generally installed where there has been a history of crashes, particularly crashes involving disregard for the existing stop and/or yield signs. A flasher supplemental to an intersection ahead sign may do more to warn traffic of an upcoming intersection than an intersection beacon. Several studies have been made to try to establish the effective uses for intersection beacons. All such studies have been inconclusive. It does not appear the installation of an intersection beacon alone is an effective safety measure.

It has been established for ODOT that the most successful intersection beacon installations have been a part of several steps taken to improve that particular intersection. It is recommended, therefore, that installation of intersection control beacons generally be considered only when other improvements can be made. These improvements should include any of the following that may be relevant:

- Installation of left or right turn lanes
- Sight distance improvements
- Improved advance warning signing such as additional signs, the use of larger signs and/or more-reflective sheeting

Although each of these improvements can be considered to reduce crashes alone, where there is a high rate of crashes, combining improvements appears to do more than any single improvement. The intersection beacon installation should be considered only if these improvements still leave some doubt as to the visibility of the intersection or intersection control.

The installation of Intersection Control Beacons requires the approval of the Region Traffic Manager/Engineer.

6.7.2 Flashing Beacons as Supplements to a Warning or Regulatory Sign

The installation or removal of Flashing Beacons as supplements to existing warning signs (except for the Emergency Signal signs) does not require the approval of the State Traffic Engineer. The installation or removal of Flashing Beacons as supplements to the Emergency Signal signs does require the approval of the State Traffic Engineer.

6.7.2.1 School Speed Limit Sign Beacons

Section 7B.11 of the Manual on Uniform Traffic Control Devices discusses School Speed Limit sign beacons. Further guidance on the use of these beacons is contained in the ODOT publication A Guide to School Area Safety. Flashing beacons to indicate children arriving at or leaving school do not require the approval of the State Traffic Engineer.

The use of flashing beacons may be required as a condition of the school speed zone by the State Traffic Engineer.

File Code: TRA 16-6-42

6.8 Freeway Median Crossovers

Criteria for approval of freeway median crossovers, conditions under which crossovers may be utilized, and persons authorized to use crossovers are covered in OAR 734-020-0100 through 734-020-0115. The State Traffic Engineer can approve freeway crossovers if the location meets **all** criteria and conditions listed in OAR 734-020-0105. All requests meeting the criteria should be forwarded to State Traffic Engineer for review. However, if one or more of those criteria are not met, the ODOT Chief Engineer (also called the Technical Services Manager) with FHWA consultation, considering need and safety, may approve and order the construction and installation of a freeway median crossover following and based upon an engineering investigation. The Traffic—Roadway Section must review the Region's recommendation and submit them to the Chief Engineer (Technical Services Manager) with FHWA consultation for approval. Sign Number OR-22-13, "Authorized and Emergency Vehicles Only" should be used at median crossovers to direct motorists not to use the crossovers.

File Code: TRA 16-08-05

6.9 Highway Advisory Radio

The Federal Communications Commission (FCC) licenses state and local agencies and government-affiliated agencies, such as airport authorities, to use low-power roadside transmitters to provide motorists with up-to-the-minute travel information via their AM/FM radios. These systems, which the FCC calls Travelers Information Stations (TIS), can provide warnings, advisories, directions, or other non-commercial material of importance to motorists. These licenses are issued under and must be operated in compliance with federal rule 47 CFR Chapter I, Part 90.242.

TIS operated by ODOT are known as Highway Advisory Radio (HAR). ODOT utilizes HAR to supplement messages provided on standard highway signs or variable message signs. HAR are permanently installed at locations where communication with travelers may be critical and may be temporarily installed in some work zones to provide travelers with timely information about a construction or maintenance project. Advance signs are posted to inform motorists about the availability of a HAR.

Messages, which are usually less than a minute in length, are recorded for continuous repetition. The message length is adjusted to permit the driver to receive the message at least twice while passing through the station's coverage zone.

For ODOT HAR, the ISB Wireless Group is responsible for obtaining and maintaining the FCC licenses. A license is specific to a transmitter location and broadcast area for permanent HAR installations. For temporary HAR, an area license which allows use on any state highway or for a specific corridor is required. ODOT does not maintain any license for temporary HAR and any temporary installations must be planned well enough in advance to obtain the required FCC license.

For TIS operated by other state agencies and local agencies with an established FCC license, advance signs may be posted on a state highway with State Traffic Engineer approval. Examples of TIS uses other than for state highway information include severe weather alerts, Port traffic instructions, event management and local road construction or other detours. These signs must be installed in accordance with the guidelines given in ODOT's Sign Policy and Guidelines for the State Highway System for the State Highway System (Chapter 5-12).

6.9.1 Guidelines for the Operation of Highway Advisory Radio and Traveler's Advisory Radio on State Highways

The Guidelines for the Operation of Highway Advisory Radio and Traveler's Advisory Radio on State Highways provides all of the guidelines and requirements for installing and operating HAR stations on state highways. The latest version is available for download from the ODOT Traffic—Roadway Section internet site under the Publications link.

6.10 Highway Safety Engineering

6.10.1 Highway Safety Program Guide

The mission of the Highway Safety Program at the Oregon Department of Transportation (ODOT) is to carry out highway safety improvement projects to achieve a significant reduction in traffic fatalities and serious injuries. The Highway Safety Program Guide documents program philosophy and the application process for all Highway Safety funding. For purposes of programming Highway Safety funds in the Statewide Transportation Improvement Program (STIP), all highway safety infrastructure improvement projects shall follow the Highway Safety Program Guide regardless of funding type (federal or state). This document is available online from the Traffic—Roadway Section Publications web page.

6.10.2 Highway Safety Improvement Program (HSIP)

The federal Highway Safety Improvement Program (HSIP) funds that comprise a majority of the funding for the ODOT Highway Safety Program come from the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) signed into law on August 10, 2005. HSIP funds are primarily intended for infrastructure safety improvements on the state highway system while High Risk Rural Roads (HR3) funds are primarily intended for infrastructure improvements on rural county roads. Non-infrastructure highway safety improvements such as education and enforcement programs are administered by the ODOT Transportation Safety Division and are typically funded with separate funding from the National Highway Traffic Safety Administration (NHTSA), the Federal Highway Administration (FHWA), or state funds.

The Oregon Transportation Commission (OTC) has allocated approximately $28 to 29 million dollars a year to the ODOT Highway Safety Program for 2006 through 2009 for infrastructure improvements. Of the total amount, approximately $14 million per year is from the federal HSIP. Another $1.1 million (approximately) is set aside for the federal HR3 program administered by the ODOT Local Government Section in cooperation with the Association of Oregon Counties (AOC). The remaining funds in the Highway Safety Program are made up of eligible federal or state funds.

This Highway Safety Program Guide replaces the former Hazard Elimination Program (HEP) manual published in October 2002. Federal legislation (SAFETEA-LU) signed into law on August 10, 2005 established a new Highway Safety Improvement Program (HSIP, under 23USC148) eliminating the former HSIP (23USC152) which included the Hazard Elimination Program. Projects eligible for funding include the familiar hazard elimination type projects plus SAFETEA-LU expanded the eligibility to more types of infrastructure improvements. Projects Eligible for HSIP Funding

6.10.3 State Strategic Highway Safety Plan

The State Strategic Highway Safety Plan (SSHSP) is a SAFETEA-LU requirement and was developed by ODOT to address engineering, management, operation, education, enforcement and emergency services elements of highway safety. The SSHSP identifies highway safety improvement opportunities by addressing engineering, management, operations, education, enforcement and emergency management in order to focus resources on areas of greatest need and coordinate with other highway safety programs. The SSHSP may identify programs of projects, strategies or other key factors to reduce or eliminate safety hazards. The priorities identified in the SSHSP should be used to address all Safety and HSIP projects.

In response to the SSHSP requirement, Oregon has adopted the Oregon Transportation Safety Action Plan (TSAP). The TSAP in conjunction with the safety projects included in the Statewide Transportation Improvement Program (STIP) comprise Oregon's SSHSP. Because ODOT has officially adopted the TSAP, SAFETEA-LU allows ODOT some flexibility to use up to 10% of HSIP funds for other highway safety projects typically administered under Section 402 when all infrastructure safety needs, including those for highway-rail grade crossings, have been met for a particular year.

6.10.4 Program Management

ODOT has placed the responsibilities of Highway Safety Program management with the Traffic-Roadway Section (TRS). ODOT Regions are responsible for fund management within their own Regions and gathering information in support of the annual reporting process required by SAFETEA-LU.

6.10.5 Highway Safety Engineering Committee

The Highway Safety Engineering Committee (HSEC) is set up by the Highway Division of ODOT to guide and give direction for highway safety engineering needs within the Department. The HSEC is responsible for reviewing and making recommendations for strategies and/or projects to be included in the State Strategic Highway Safety Plan and the ODOT Highway Safety Program. The committee also makes recommendations on emphasis areas to fund, approves regional safety funding allocation strategies, provides oversight on discretionary highway safety funding, and approves enhancements to Safety Management System (SMS) tools such as SPIS, SIP, CRF, and B/C analysis tools.

6.10.6 Safety Priority Index System (SPIS)

6.10.6.1 Overview

The Safety Priority Index System (SPIS) is a method developed in 1986 by the Oregon Department of Transportation (ODOT) for identifying potential safety problems on state highways. The development of SPIS complied with the federal Highway Safety Improvement Program (HSIP) and the Federal Highway Administration (FHWA) accepted SPIS as fulfilling the requirements of the HSIP. When Oregon began developing its Safety Management System in response to the 1991 ISTEA, it identified SPIS as one of several essential building blocks. SPIS has been recognized as an effective problem identification tool for evaluating state highways for segments with higher crash histories.

Several modifications to SPIS were implemented following the study, "An Evaluation of the Safety Priority Index System (SPIS)," completed by Dr. Robert Layton of the Transportation Research Institute at Oregon State University. These modifications were implemented in the 1998 SPIS reports, and were "fine-tuned" in the 1999 SPIS reports. These adjustments to the calculations created a large difference in the number of sites located in 1998 in comparison to years past, making it *appear* that more sites exist. However, the new calculations and listings are more applicable to both urban and rural sites, and should allow a better understanding of the reported values. The Traffic—Roadway Section is planning to implement several further enhancements to SPIS, including the following:

- An additional analysis tool for assigning a safety rating to road segments of variable length greater than 0.10 mile.
- Additional analysis tools to identify intersections that should be evaluated.
- Additional information on circumstances contributing to crashes that are statistically significant for the site, segment, or intersection.
- Improved access to information on alternative solutions to help users evaluate options and select alternatives.
- A computerized SPIS Feedback System.

6.10.6.2 SPIS Method

The SPIS is a method of identifying locations where safety money may be spent to the highest benefit. The SPIS score is based on three years of crash data and considers crash frequency, crash rate, and crash severity. A roadway segment becomes a SPIS site if a location has three or more crashes <u>or</u> one or more fatal crashes over the three-year period. The priority index has three parameters and associated Indicator Values (IV):

crash frequency indicator value (IVFreq)	*25% of SPIS score*
crash rate indicator value (IVRate)	*25% of SPIS score*
crash severity indicator value (IVSeverity)	*50% of SPIS score*

Crash frequency indicator value (IVFreq)

The *crash frequency indicator value,* IV*Freq*, is a value between 0 and 25 determined using a logarithmic distribution based on total crashes in a three-year period.

IV*Freq* = (LOG(Total Crashes+1)/LOG(150+1))*25

The <u>maximum</u> indicator value of 25% is attained when the total number of crashes reaches 150 crashes on the same 0.10-mile segment over a 3-year period.

Crash rate indicator value (IVRate)

The *crash rate indicator*, IV*Rate*, is a value between 0 and 25, also determined by using a logarithmic distribution based on the following crash rate calculations:

Crash Rate = (Total Crashes * 1,000,000)/(3 years * 365 * ADT)

IV*Rate* = (LOG(Crash Rate+1)/LOG(7+1))*25

Again, the <u>maximum</u> indicator value of 25% is attained when the crash rate reaches seven crashes per million entering vehicles.

Crash severity indicator value (IVSeverity)

The *crash severity indicator*, IV*Severity*, is a value between 0 and 50, which is determined by using a linear distribution from the calculation below:

IV*Severity* = $[((100 * (FATAL+INJ_A)) + (10 * (INJ_B + INJ_C)) + (1 * PDO)) * 50]/300$

Where:

FATAL = the number of fatalities,

INJ_A = the number of severe injuries (Class A),

INJ_B = the number of moderate injuries (Class B),

INJ_C = the number of minor injuries (Class C),

PDO = the number of “property damage only” crashes.

The formula considers severity values between 0 and 300 only; therefore severity products above 300 are assigned the maximum value, to match the maximum indicator value of 50%.

The SPIS value is the sum of the above indicator values (IV*Freq*+IV*Rate*+IV*Severity*) for 0.10 mile (0.16 km) sections of urban and rural roads, shifted by 0.01 mile for each new section.

6.10.6.3 Reports

Each year, the Traffic—Roadway Section generates regional reports of the top 5% ranked SPIS sites for review by the five Region Traffic Units. The Region staff evaluates the sites on this "Top 5%" list and considers the safety problems that may be contributing to the crash history at these locations. If a correctable problem is identified, benefit/cost analysis is performed on viable options and appropriate projects are initiated. Regions report the results of these site evaluations, including potential causes, possible corrections, and estimated costs to the State Traffic Engineer. While the SPIS reports are computer-generated by the Traffic—Roadway Section, the rest of the process is manual and is primarily performed by Regional personnel.

Traffic-Roadway Section produces two reports for FHWA each year. The first is a summary of the Top 5% list and potential remedies to the locations, estimated costs and impediments to implementation. A second report is produced evaluating the highway safety engineering program and the effectiveness of Safety Projects at reducing fatalities and injuries.

An Crash Summary Database is also created annually by the SPIS process for use by staff in evaluating sections of highway. The interface allows the user to enter a section of state highway, from milepost 'x' to milepost 'y'. The database then yields information for that section of highway regarding number and type of crashes, highest and lowest SPIS values, and traffic volume information. Contact the Highway Safety Engineering Coordinator for further information.

File Code: TRA 10-22-01

6.11 Historical Markers

The Historical Marker Program has been transferred to the Travel Information Council through an interagency agreement, along with other sign programs of motorist service nature. The Oregon Historical Marker Committee oversees the program and meets on a quarterly basis. A staff member of the Traffic—Roadway Section serves on the committee.

File Code: PAR 07-03

6.12 Illumination

6.12.1 Overview

All illumination on State Highways (both temporary and permanent) shall follow policy set forth in the ODOT Lighting Policy and Guidelines. Additional guidance on illumination design is provided in the ODOT Traffic Lighting Design Manual. Both publications are available electronically from the ODOT Traffic—Roadway Section web site.

6.12.2 Temporary Illumination

Determining the need for temporary illumination on construction projects is part of the illumination design process. The engineer-of-record submits requests to the Region Traffic Manager/Engineer on highway construction projects where illumination for temporary protection and direction of traffic is recommended. Staff from the Region Traffic Unit investigate and approve the amount of illumination needed based on ODOT Lighting Policy and Guidelines. Any deviation from statewide policies or standards must be reviewed by the Traffic—Roadway Section and submitted to the State Traffic Engineer for approval.

A consistent and systematic approach is used which considers, at a minimum, the cost, safety (traffic, pedestrian and construction worker), traffic volume and speed, geometric conditions, crash history, weather, length of contract, and the amount and complexity of stage construction. Attention is given to installing proposed permanent lighting as soon in the construction project as practical so as to serve for temporary protection and direction of traffic purposes.

6.12.3 Permanent Illumination

Roadway lighting warrants are covered in the ODOT Lighting Policy and Guidelines. ODOT does not use specific illumination warrants to determine whether lighting is to be provided on a project.

An investigation is conducted and the agency utilizes engineering judgment of local conditions, considering such factors as availability of funds, traffic and crash data, roadway characteristics, etc., in determining when and where lighting is to be provided.

Lighting maintenance, energy and construction costs are evaluated when recommending illumination. Policy for illumination cost sharing with cities and counties on state highways is published in the 2002 Policy Statement for Cooperative Traffic Control Projects. Region Traffic Unit staff identify locations for illumination in the project development process for incorporation into the State Transportation Improvement Program (STIP).

The Safety Priority Index System (SPIS) and the crash database are used as tools to identify potential locations. The percentage of nighttime crashes and total crash history is considered in the benefits of installing illumination. Sometimes, improvements in traffic control devices, and/or geometric designs, will also serve to cut down on nighttime crashes and lighting may not be needed.

Illumination is reviewed by the Region Traffic Unit for policy agreement and statewide consistency before going to the engineer-of-record for incorporation into project plans. Any deviation from statewide policies or standards must be reviewed by the Traffic—Roadway Section and submitted to the State Traffic Engineer for approval.

File Code: TRA 16-01

6.13 Land Use and Transportation

The Oregon Highway Plan encourages compact development in urban areas while supporting mobility on designated highways segments. Expressway classification supports mobility on designated highways and highway segments by providing for high speed and high volume traffic with minimal interruption. Special Transportation Areas (STA's) promote community vitality and livability in downtown areas by encouraging compact development and reducing local trips on the state highway and encouraging more opportunity for walking, bicycling or transit use. Urban Business Areas (UBA's) and Commercial Centers improve the connection between the use of the highway and commercial activity and are used in conjunction with STA's and expressways to balance mobility and livability.

See the Oregon Highway Plan (OHP) on the ODOT Planning Section web site for copies of the OHP and the Implementation Handbook.

6.14 Lanes

6.14.1 Climbing and Passing Lanes

Passing lanes are distinguished from climbing lanes. Climbing lanes are generally used where grades cause unreasonable reductions in operating speeds of some vehicles. Passing lanes are typically used where there may be inadequate passing opportunities either because of sight distance limitation or as traffic volumes begin to approach capacity.

Passing lanes tend to reduce unsafe passing maneuvers and may aid in reduction of head-on and sideswipe crashes. The addition of a climbing or passing lane can break up the formation of queues for a limited distance. Typically, queues begin to re-form downstream from a climbing/passing lane within a distance of ½ to 1 mile (800 to 1600m). Note that passing and climbing lanes do not actually add capacity to a facility.

Slow vehicle turnouts are not considered adequate opportunities for passing, since they are ineffective without the cooperation of slower vehicles and are generally too short to completely break up an established queue. *Current ODOT policy does not allow construction of new slow vehicle turnouts unless allowed by a Roadway Design*

Exception. These should only be considered when a passing lane is not feasible and not as an alternative to a passing lane.

The need for a passing or climbing lane may be identified at the District or Region level. Transportation Planning Analysis Unit should be contacted to help analyze when and where climbing or passing lanes may be needed. Region Traffic can assist by requesting or conducting spot speed checks, requesting crash data summaries, and documenting on-site observations.

See the *ODOT Highway Design Manual* for more information on climbing or passing lanes. Climbing and passing lanes are not a delegated authority of the State Traffic Engineer and do not require the State Traffic Engineer's approval.

6.14.2 Lane Drops

When reducing the number of lanes of traffic, the right lane is normally dropped. This practice should be followed whenever possible. Uniform signing and striping reduces driver confusion. In situations where terrain, roadway geometry, or other factors suggest otherwise, the left lane may be dropped. All lane drops should be signed, following guidance provided in the Sign Policy and Guidelines for the State Highway System and Section 2C.33 of the Manual on Uniform Traffic Control Devices.

Supplemental pavement markings, "lane reduction arrows" (see standard drawing no. TM556), may be used to warn drivers to merge left or right. In cases where there is a demonstrated problem or there is some confusion over which lane ends, lane reduction arrows should be used to reinforce the warning to drivers that it is necessary to merge.

6.14.3 Right-Turn Acceleration Lanes

See 6.37.4

6.14.4 Turn Lanes

See 6.37

6.15 Legislative Concepts

The Traffic—Roadway Section serves as advisor on legislative bills relating to traffic issues and participates in setting the direction and completing the analysis of such bills. This includes reviewing and tracking traffic engineering related bills, identifying potential ODOT impact, preparing for the hearings and providing the fiscal impact and written testimony for each bill and/or amendments. Testimony at the hearing is sometimes provided. Participants work through the Highway Division Coordinators and the ODOT Legislative Coordinators in presenting the agency's position on numerous bills. For more information on the ODOT Legislative Process and Exceptions refer to the *ODOT - DMV Bill Analysis Handbook*.

The Traffic—Roadway Section sometimes initiates legislation through ODOT to help introduce or clarify traffic issues covered in the Oregon Revised Statues.

File Code: LEG 05

6.16 Litigation

The State of Oregon is self-insured through the Risk Management Division of the Department of Administrative Services. If a claim for damages involving ODOT is filed against the State, Risk Management conducts an investigation to determine whether the claim should be approved or denied. In some instances, the Risk Management Specialist in charge of processing the claim will contact one of the Traffic—Roadway Section's investigators to request a recommendation and/or documentation, or to clarify a policy. If documentation is required, the Risk Management Specialist coordinates with ODOT sections or other public agencies to produce copies of the necessary documents.

Similarly, the Traffic—Roadway Section sometimes acts as a liaison for the Oregon Department of Justice when a request is made for information and documents by an Assistant Attorney General who is defending ODOT in a lawsuit. In addition to collecting documents and other evidence, the Traffic—Roadway Section may coordinate the acquisition of expert witnesses for testimony at trial. On occasion, a Traffic—Roadway Section employee may be required to testify, if he or she possesses specialized knowledge in a relevant area. At the request of the Department of Justice attorney, the Traffic—Roadway Section may also produce courtroom displays using mounted photo enlargements, graphics or video presentations.

Claims and lawsuits may result from a crash or construction and maintenance activities. When there is damage to ODOT facilities, such as a bridge damaged in a crash, ODOT may pursue damages from the party determined to be at fault.

The Traffic—Roadway Section also assists in gathering the information to support ODOT in these claims. The most effective way to reduce ODOT liability in litigation is to conform as closely as possible to standards, policies, and good engineering in the course of design, construction, inspection and maintenance, and then to thoroughly document such conformance.

File Code: LEG 04

6.17 Manual on Uniform Traffic Control Devices

6.17.1 Overview

Traffic control devices installed on highways within the State of Oregon are required to conform to the Manual on Uniform Traffic Control Devices (MUTCD), published by the Federal Highway Administration (FHWA). The list of highways that are required to conform to the MUTCD includes all state highways and public roadways under the jurisdiction of cities and counties within the State of Oregon. This requirement is established by Oregon Revised Statute (ORS) (see ORS 810.200) and Oregon Administrative Rule (OAR) (see OAR 734-020-0005). To promote uniformity and understandability of traffic control devices, private property owners are also encouraged to conform to the MUTCD when installing devices on private property.

Devices installed or replaced after the publication date of this document shall conform to the MUTCD upon installation. Unless noted otherwise, existing devices that do not conform to the current MUTCD shall be replaced at the end of their useful life.

The intent of the MUTCD is to enhance road safety and operation by requiring uniform, understandable, and effective traffic control devices on Oregon highways.

6.17.2 Oregon Supplement to the MUTCD

Deviations to the MUTCD are published in the Oregon Supplement to the MUTCD and made for justifiable reasons such as instances where Oregon law deviates from the MUTCD. These deviations are adopted through the OAR process and by permission of the FHWA.

The document supplements the 2003 Edition of the MUTCD with Revision No. 1 Incorporated, dated November 2004. Both the Oregon Supplement and the MUTCD need to be consulted when researching traffic control issues.

The Oregon Supplement conforms to the organization and section numbering of the MUTCD. The two documents interact as follows:

- Unless otherwise noted, language in the Oregon Supplement is added to the end of the referenced MUTCD section.
- In other cases, the MUTCD language is deleted and/or the Oregon Supplement language inserted as directed by the instructions in italics.

The MUTCD is available on the internet in electronic format. Printed copies of the MUTCD 2003 Edition and cost information are available from the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the American Traffic Safety Services Association (ATSSA).

Design details for signs and traffic signals are not included in the MUTCD. They are in the Sign Policy and Guidelines for the State Highway System, the Traffic Signal Policy and Guidelines, and the FHWA Standard Highway Signs manual.

6.17.3 Exceptions to the MUTCD

There are no exceptions to the MUTCD. A change may be requested and requires a request for a change (See 6.17.6).

6.17.4 Deviations to the MUTCD

See Oregon Supplement to the MUTCD

6.17.5 Requests to Experiment

Requests to experiment include consideration of testing or evaluating new traffic control devices (See Section 1A.10 in the MUTCD).

6.17.6 Revisions to the MUTCD (Changes)

Changes to the MUTCD are adopted as part of the national standard and are published by FHWA (See Section 1A.10 in the MUTCD for the process to request a change).

File Code: TRA 16-09-02 Supplements / TRA 16-09-05 MUTCD Revisions

6.18 Naming Highway Facilities

The following guidelines are taken directly from *Transportation Commission – 05* policy for naming highway facilities and are to be case-by-case basis (adopted October 15, 1991 by the Oregon Transportation Commission):

1. The Oregon Transportation Commission generally will not name highway facilities after individuals.
2. The Oregon Transportation Commission may elect to suspend guideline 1 if a requester can show compliance with the following criteria:
    a. Demonstrated statewide support for naming a facility.
    b. The honored individual shall have made a lasting contribution, with a significant and historic impact on Oregon.
    c. The honored individual shall have been deceased for at least one year.
    d. The facility is long enough to merit a title, such as a bridge or tunnel more than one-half mile long, or a highway section with defined end-points which was completed as a whole.
3. The comments of the Oregon Geographic Names Board will be solicited prior to naming any highway facility. (Any federal recognition will be contingent upon their approval.)

File Code: PUB 17-01

6.19 New Products

Testing of many new products is performed in conjunction with the ODOT Construction Section, Federal Highway Administration, and/or manufacturers. Product testing and evaluation of traffic control devices and equipment is conducted by the Traffic Systems Services Unit, Traffic Standards and Asset Management Unit, and the Traffic Engineering Services Unit. Manufacturers and suppliers can contact the Traffic—Roadway Section for information related to the proper process to obtain product approvals.

All products which are approved for traffic signal construction are contained in the "Blue" and "Green" sheets. The "Blue" sheets contain field-qualified equipment and materials while the "Green" sheets list conditional qualified controller equipment.

New products are reviewed by the Traffic Standards and Asset Management Unit in cooperation with other units, added to the "Blue" or "Green" sheets with related special provisions are amended as necessary. The "Blue" and "Green" sheets for signal equipment are available from the Traffic Signal Engineer of the Traffic Standards and Asset Management Unit.

File Code: MAT 00-02 (Blue & Green Sheet Files) – Traffic Standards and Asset Management Unit

6.20 One-way Operation for Trucks and Buses

The State Traffic Engineer, in consultation with the Region Manager and Motor Carrier Services Manager, has been delegated the authority to designate sections of highways that allow one-way operation by class or type of vehicle. A field investigation shall be made and a written report prepared for each section of highway on which one-way truck and/or bus operation may be required. See OAR 734-020-0125 and 734-020-0130 for further information and the required field data for the report.

6.21 Parking

6.21.1 On-Street Parking

See the ODOT Highway Design Manual (HDM) for information regarding the appropriateness of on-street parking. Diagonal parking may be allowed in designated Special Transportation Areas (STA's) when jointly approved by the Roadway Engineering Manager and the State Traffic Engineer, see HDM for further criteria.

File Code: TRA 07-01 and TRA 07-01-05

6.21.2 Prohibitions and Restrictions

Parking control on highways is covered in ORS 810.160, ORS 810.200, OAR 734-020-0020, OAR 734-020-0080, OAR 734-020-0085, OAR 734-020-0090, and the Letter of Authority to the State Traffic Engineer. The Traffic—Roadway Section maintains a database of Parking Prohibitions and Restrictions that have been ordered by the State Traffic Engineer. The Traffic Engineering Services Unit provides a form for summarizing engineering investigation data. (See Parking Prohibition Request Form)

A request for a parking prohibition or restriction on a section of state highway may be made by a city or county through which the highway runs. That jurisdiction should request the appropriate ODOT Region office to conduct an investigation. As a minimum, the investigation should involve the following:

- On-site observation of safety and traffic flow conditions, preferably at a time of day when vehicles are parked in the proposed prohibition or restriction zone.

- Photographs of the area from different approaches to show conditions at the site, preferably at a time of day when vehicles are parked in the proposed prohibition or restriction zone.

- Contact, when appropriate, with affected businesses, citizens, police agencies, and local government jurisdictions, to explain the proposed parking prohibition or restriction, and to solicit their input. This can usually be accomplished by a person-to-person conversation, but in some instances may require attending a meeting of the local government authorities or a public hearing.

Once the investigation is completed, it is forwarded to the Traffic—Roadway Section for review and approval by the State Traffic Engineer. In order for a proper review to take place, the following three items need to be included:

- Completed Parking Prohibition Request Form

- Map or Sketch of the vicinity with the proposed locations clearly marked

- Photographs taken for the investigation

Normally, any one, or a combination of the following four justifications, is necessary for the State Traffic Engineer to consider approving a request to eliminate parking:

- Safety — this usually, but not always, has to do with sight distance for vehicles entering from a side street or driveway.

- Congestion — Vehicles parked in the area impede the flow of traffic.

- Damage to the facility — an example might be if parked vehicles are causing the shoulder to slough off.

- Frequent use of the facility for a purpose not intended — this could be any number of things (unauthorized vending, dumping of trash or sewage, etc.).

In addition to these four justifications, limited parking restrictions are sometimes granted as a courtesy to municipalities who request them (time limit, height restriction not related to sight distance, loading zone, etc.). These requests are evaluated on a case-by-case basis, and with the understanding that the city will be responsible for installation and maintenance of the signs, and for enforcing the restriction.

When a Parking Prohibition or Restriction has been approved, the Region Manager will receive a memo with instructions to have the appropriate signs installed, and to notify the State Traffic Engineer of the installation date. The State Traffic Engineer will also send a letter to the Oregon State Police, notifying them of the prohibition or restriction.

See the ODOT Highway Design manual (HDM) for information regarding the appropriateness of on-street parking. Diagonal Parking may be allowed in designated

STA's when jointly approved by the Roadway Engineering Manager and the State Traffic Engineer, see HDM for further criteria.

File Code: TRA 16 Procedures (Hwy. No. & Milepoint Letters of Approval)

6.22 Pavement Markings

6.22.1 Overview

The State Traffic Engineer has the responsibility to establish a uniform system of pavement markings. The State Traffic Engineer approves the installation, modification, and removal of traffic control devices including striping, other markings and pavement markers on the state highway system.

The traveling public relies heavily on pavement markings for guidance, positioning and information. Uniform pavement markings make a safer road system. Road users can respond appropriately and quickly when what they see has a standard, known meaning. Good application and maintenance of pavement markings is therefore an essential component of safe and efficient highways.

6.22.1.1 Pavement Markings Standard Drawings

The standard layouts for striping and marking of new construction or overlay sections are contained in the ODOT Oregon Standard Drawings, Traffic Section. These drawings should be consulted for striping and marking of new pavement when striping plans are not available. The standard drawings are also the basis for the design of striping plans on construction projects. See the Striping Design Guidelines_available from the Traffic Standards and Asset Management Unit for assistance in developing striping plans.

6.22.1.2 Traffic Line Manual

The Traffic Line Manual contains the ODOT policy and guidelines for installation of pavement markings. If markings not conforming to this manual are necessary, they should be reviewed and approved by the Region Traffic Manager/Engineer or, when required, by the State Traffic Engineer. It is intended to be used by maintenance crews and striping contractors to assist them in their daily work. The manual contains typical drawings based on the standard drawings to assist in the maintenance of pavement lines, markings and markers.

6.22.1.3 Striping Design Guidelines

These guidelines contain the Traffic Line Manual and the Standard Drawings as well as typical sections and examples to assist designers in the preparation of striping plans. The guidelines are based on the principles outlined in the Manual on Uniform Traffic Control Devices and the Oregon Supplement to the MUTCD.

6.22.1.4 Standards for Disabled Parking Spaces

In accordance with ORS 447.233, the Oregon Transportation Commission adopted standards for disabled person parking places, which took effect on January 22, 1992.

All new construction is required to meet new minimum standards. The standards are in compliance with 28 CFR Part 36 published by the Department of Justice in the Federal Register.

Different standards for signing and pavement markings have been adopted for public/private facilities and the state highway system. These standards are available on the internet at the Traffic—Roadway Section web site.

File Code: TRA 16-02

6.22.2 Advance Stop Bars

6.22.2.1 Background

"Multiple threat" crashes are a leading cause of pedestrian fatalities. A multiple threat crash occurs on multi-lane roads when one driver stops to let a pedestrian cross, but so close to the crosswalk as to obscure visibility in the adjacent lane. The pedestrian starts to cross, unaware that traffic behind the stopped vehicle or in the adjacent lane may not see him or her. Drivers behind the stopped vehicle or in the adjacent lane may not see the pedestrian and can't understand why the first vehicle stopped. If they change lanes or continue traveling in the adjacent lane at a high rate of speed, and the pedestrian doesn't see the car, the result is often a fatal or severe injury crash.

Recent research indicates a dramatic drop in multiple threat crashes when drivers are asked to stop approximately 30 feet back from the crosswalk. At higher distances (40 and 50 feet) stopping compliance rates begin to drop off. At shorter distances (20 feet) compliance marginally improves, but 20 feet does not provide as much visibility as 30 feet. Vehicles traveling at a high rate of speed may not be able to stop in time, but 30 feet frees up the sight distance triangle enough so the crossing pedestrian can see if a vehicle is proceeding towards him or her without stopping or slowing down, giving the pedestrian time to take evasive action.

6.22.2.2 Guidance

Advance stop bars, combined with the STOP HERE FOR PEDS sign (OR 22-25), should be installed at marked crosswalks at uncontrolled locations on multi-lane highway locations, unless unique circumstances prevent their installation.

Advance stop bars, (24-inch width), should be placed approximately 30 feet in advance of the marked crosswalk. They may be placed between 20 to 50 feet in advance if unique circumstances dictate a different location.

6.22.3 No Passing Zones

No-passing zones are established at vertical and horizontal curves and at other locations where passing is prohibited because of inadequate passing sight distance. No pass striping is warranted where the sight distance is less than the minimum necessary for safe passing at the 85 percentile speed or posted speed, whichever is higher.

The authority to establish no passing zones on Oregon highways is provided in Oregon law (ORS 810.120). Section 3B.02 of the Manual on Uniform Traffic Control Devices describes the criteria for determining the passing sight distance and application of no-pass zones.

Often a request is made to extend no-pass striping to include intersections near the end of no-pass zones or to provide no-pass striping at intersections. Generally these requests are denied because existing evidence tends to point to the fact that no-pass zones at intersections do not increase safety. Also Oregon law (ORS 811.305) states that it is unlawful to pass at any intersection. As statutory no-pass zones, these highway segments do not require no-pass markings.

Other options for addressing passing at intersections should be explored first. Intersection signing, both an Intersection Ahead warning sign and a road name sign, should be clearly posted. Other actions include making the intersection more visible from the highway by trimming back shrubbery or trees, making sure stop bars are clearly marked and placed so that vehicles can be seen before entering the highway, and making sure parking is not interfering with visibility of traffic or the cross-street. Considerations should include amounts of pedestrians in the vicinity, business activity or residences nearby. An important indicator is the crash history of the area. Consideration should also be given to the availability of passing opportunities near the area.

Rural intersections on the other hand typically have sufficient sight distance and the no-pass zones are ineffective at changing driver behavior. The installation of no-pass in these areas may contribute to unrealistic expectations on the part of motorists entering the highway or turning from the highway. If, after all other options have been exhausted, the intersection continues to have crash experience, a no-pass zone may be considered.

See the *ODOT Traffic Line Manual* for details and layout of no pass zones.

6.22.4 Two-Way Left Turn Lane

A two-way left turn lane shall be marked by a single direction, no passing marking on each edge of the lane. Pavement markings may be used. (Refer to the Manual on Uniform Traffic Control Devices and Traffic Line Manual)

6.22.5 Yield Control Markings

Pavement markings for yield control can be used to distinguish the point in which vehicles are required to yield at or behind. These markings should be placed in accordance with the Manual on Uniform Traffic Control Devices. In accordance with the Oregon Vehicle Code, yield control markings shall not be used in advance of a marked pedestrian crosswalk.

6.22.5.1 Sign Guidelines

See YIELD Sign Applications

6.22.6 Colored Pavements

The Manual on Uniform Traffic Control Devices provides standards for the use of colored pavements in Chapter 3E. All proposed colored pavement applications shall be reviewed by the Region Traffic Engineer/Manager and State Traffic Engineer for consistency with the Manual on Uniform Traffic Control Devices.

6.22.6.1 Textured/Colored Crosswalks

See 6.6.8

6.23 Railroad Crossings

6.23.1 Overview

Railroad crossings and traffic control devices used within the crossing area are under the jurisdiction of the ODOT Rail Division. A Railroad Crossing Order for each public road grade crossing, summarizes the obligations, including, but not necessarily limited to, design, cost, maintenance, signals, signs, and operational requirements for all involved parties. Additional information can be found in the Approval Process and Preemption sections of this manual. Design and operation details are also found in the following publications:

- Traffic Signal Design Manual
- Traffic Signal Policy and Guidelines

6.23.2 Added Stop Lanes

The following is the procedure for the investigation of added stop lanes for at grade railroad crossings. The purpose is to determine the need for additional stopping lanes at railroad at-grade crossings of a state highway when such crossings become involved in a major reconstruction project.

An additional lane constitutes an alteration (OAR Ch.741) to the grade crossing, which requires ODOT Rail Division approval as included in a Crossing Order.

Step 1- The Project Leader determines that an at-grade railroad crossing will exist within the project limits and requests an investigation from Region Traffic Engineer.

Step 2 - The Region Traffic Engineer determines the need for adding stopping lanes or justifying the omission of such lanes from the location project. If the existing facility has paved shoulders of adequate width to accommodate vehicles that must come to a stop at a rail crossing, added stopping lanes may not be needed. The Region Traffic Manager may perform a traffic engineering study considering at a minimum the following data: average daily traffic volumes, number of train movements, an estimate of the number of vehicles required to stop, a gap study, posted speed or 85 percent speed, physical characteristics, alignment, terrain, and sight distance. Prepares report and makes recommendation to Rail Division Manager for inclusion in Crossing Order if a stopping lane is required. If not required, all parties should be so informed.

Step 3 - The Rail Division Manager considers information submitted by the Region Traffic Engineer for the required crossing order. Rail Division must have ample opportunity to provide input and assure proper coordination with the affected railroad company, and forward copies of Crossing Order to all interested parties.

Step 4 - The Project Leader complies with the terms of the Crossing Order, contacts Region Traffic Engineer (if any questions arise), and proceeds to develop appropriate plans.

6.24 Road Closures

The temporary or conditional closure of highways is covered by OAR 734-020-0150. The Traffic—Roadway Section does not initiate closures, but may offer technical assistance. Highlights of the Administrative Rule include:

1. When weather conditions or road conditions constitute a danger of highway damage or a danger to the safety of the driving public, the Chief Engineer (Technical Services Manager), Region Manager, District Manager, or Assistant District Manager may prohibit the operation upon such highway or section of a highway of any or all vehicles, or any class or kind of vehicles.
2. The prohibition of vehicles may result in total closure or conditional closure of highways or highway sections. Conditional closures may, at the discretion of the Chief Engineer (Technical Services Manager), Region Manager, or District Manager, or Assistant District Manager, include but not be limited to prohibition of several identified classes or kinds of vehicles.
3. Closures or conditional closures should be accomplished by physically barricading or blocking the highway, with placement of appropriate warning signs or devices, and, where possible, signing indicating conditional closure with types of vehicles allowed or prohibited.
4. Road closures and conditional closures are to exist only on a temporary basis and should be removed as soon as road conditions or weather conditions permit, the hazard has been removed, and the danger to the highway or driving public no longer exists.

6.25 Roundabouts

6.25.1 Overview

Roundabouts are beginning to be recognized as an alternative form of intersection control in the United States. Generally, roundabouts are designed around a central island that prevents vehicles from passing through on a linear path. It is important to point out the distinction between the more general term "traffic circles" and a subset of traffic circles called "roundabouts" or sometimes "modern roundabouts." There are important characteristics distinguishing roundabouts from traffic circles. Probably the most important is vehicles entering a roundabout are required to yield to vehicles within the circulating roadway. Another important characteristic is the deflection of the vehicle path from a straight path and usually the approaches have raised splitter islands that aid in deflection.

Roundabouts show promise of reducing crashes and delay. They can be particularly efficient where traffic volumes are roughly equal on all approaches. But they also have limitations:

- Higher capacities can be achieved with traffic signals;
- More expensive than stop control at low volume locations;
- Determining which driver has the right-of-way is not as clear as a traffic signal; and
- Cannot provide a smooth progression for arterial flows.

Since this form of intersection control is still new to the United States, care must be taken in the placement and use of roundabouts. ODOT has prepared a report "*Modern Roundabouts for Oregon,*" Oregon Research Report No. OR-RD-98-17. It includes documentation of current research and practice on modern roundabouts, comparisons of advantages and disadvantages, summaries of safety implications, and discussions of pedestrian and bicycle considerations. Guidelines from other states, software analysis tools, and recommendations for Oregon are discussed. An additional source of information is an FHWA publication entitled *Roundabouts*: *An Informational Guide*. See Roundabout Selection Criteria and Approval Process for more details about using roundabouts in Oregon.

File Code: TRA 16-10 (Highway No. and Milepoint)

6.25.2 Roundabout Selection Criteria and Approval Process

The State Traffic Engineer has been delegated the authority to approve the installation of roundabouts on State Highways. Formal requests for evaluation of proposed roundabouts shall be sent to the State Traffic Engineer. Planning level evaluation requests including TSP and Comprehensive plan proposals shall be sent to the State Traffic Engineer to insure consistency. Requests for roundabout evaluation shall be made through the Region Traffic Engineer in collaboration with the Technical Services Roadway Manager.

6.25.2.1 Engineering Investigation

A comprehensive investigation of traffic conditions and physical characteristics of the location shall be made by the Region Traffic Engineer or applicant. Details of crash history, traffic volumes, analysis of roundabout operation, and other safety concerns should be included. The investigation should include comparisons of alternative intersection control, i.e., stop controlled, signal control, both operational aspects and other considerations. A discussion of nearby land use issues, access management issues, operational issues and local support for the roundabout are desirable. For normal STIP projects use a 20-year design life from the date of construction, for development review a minimum 10-year design life will be used. The State Traffic Engineer must approve exceptions to the minimum design life.

A scale drawing of the proposed roundabout should be included to assure appropriate geometry and layout elements can be obtained. Horizontal and vertical geometry must be clearly identified. Surrounding topography and approximate R/W should also be included.

6.25.2.2 Evaluation of Proposals

The following recommendations will be used in evaluating proposed roundabout locations:

- Should meet acceptable v/c ratios for the appropriate design life.
- Should have posted speeds 60 km/h (35 mph) or less.
- Should have normal circular geometry
- Should have similar or balanced volumes on all approach legs
- Should be at an intersection of two highways with roughly the same functional classification or no more than one level of difference (i.e., arterial to arterial, arterial to collector)
- Should be mostly commuter and local traffic.
- Should not have more than 4 approach legs.
- Should not have high pedestrian volumes.
- Should not have high volumes of large trucks.
- Should not be located within an interconnected signal system.

- Should not be in locations where exiting vehicles would be interrupted by queues from signals, railroads, drawbridges, ramp meters, or by operational problems created by left turns, accesses, etc.

- Should not be located where grades or topography limit visibility or greatly complicate construction.

Refer to ODOT *Highway Design Manual* for further information regarding geometric design requirements and considerations. Also refer to FHWA publication *Roundabouts: An Informational Guide*.

6.25.2.3 Process and Approval

Once the State Traffic Engineer receives a request, Traffic—Roadway Section staff will coordinate review with other Technical Services staff and will make a recommendation to the State Traffic Engineer. If the information provided is insufficient or not appropriate methodology (as determined by ODOT) the State Traffic Engineer may request further analysis. The State Traffic Engineer will make the final decision whether the roundabout will be approved.

File Code: TRA 16-10

6.26 Rumble Strips

Rumble strips are an engineering treatment designed to alert drivers of a lane departure through vibration and noise created when a vehicle's tires contact the rumble strip. Rumble strips may be placed on the shoulders, between opposing travel lanes (centerline), or in the travel lanes (transverse). Rumble strips are considered a traffic control device and require the approval of either the State Traffic Engineer or Region Traffic Engineer depending on the type of application (See Delegated Authorities of the State Traffic Engineer). ODOT policy for each installation is described in the sections below. Standard details and specifications for each installation are maintained by the Traffic Standards and Asset Management Unit.

Rumble strips may be constructed in three ways: rolled, milled, or formed. ODOT has experimented with several designs of milled-in and rolled-in rumble strips. Formed strips in new concrete pavement have not been used by ODOT. Rolled-in strips that were installed on new bituminous pavement with the use of a static and vibratory roller had limited success. In ODOT tests, penetration by the roller was minimal in the open graded "F" mix asphalt surface, which is the primary surface course now being used on our highways. Milled-in rumble strips have been successfully installed by ODOT on many miles of highway. Studies have shown that this design is very effective and uses less shoulder width for installation than previous designs. This design in terms of depth, width, length, and spacing is used in all of the various ODOT designs (except for transverse rumble strips). As an alternative, profiled durable pavement markings can be used to provide a "rumble" effect. However, they are much more expensive and their effectiveness compared to milled-in rumble strips is not known.

6.26.1 Shoulder Rumble Strips (SRS)

Run-off-road (ROR) crashes account for over a third of all fatal and serious injuries each year on Oregon highways. The purpose of shoulder rumble strips (SRS) is to reduce the occurrence of ROR vehicles by alerting inattentive drivers to lane departures. They are a possible countermeasure when driver fatigue or inattention is the suspected cause of ROR crashes, particularly on tangent roadway sections. Driver inattention comes in many forms, including fatigue or drowsiness, daydreaming, competing thoughts or actions, visual distractions, and alcohol or drug impairment.

Many studies have demonstrated the effectiveness of shoulder rumble strips in reducing ROR crashes. Rumble strips will not eliminate all ROR crashes especially those caused by excessive speed, sudden turns to avoid on-road collisions, or high-angle encroachments. Because they are intended to alert drivers "drifting" off the road, shoulder rumble strips are most effective when installed near the edge line adjacent to relatively wide shoulders. This placement provides motorists leaving the traveled way at a shallow angle with both time and space to steer back onto the roadway safely. Long sections of relatively straight roadways that make few demands on motorists are the most likely candidates for the installation of shoulder rumble strips.

6.26.1.1 Guidelines for SRS installation

All installations on new or existing bituminous shoulders shall be continuous milled-in SRS. To retrofit SRS on existing bituminous pavement, it must be in sufficiently good condition to effectively accept the milling process without raveling or deteriorating. Otherwise, the pavement should be upgraded prior to milling. Currently, ODOT does not have a design for formed rumble strips on new concrete shoulders.

Installations of SRS should leave approximately 4 feet (1.2 m) of useable paved shoulder for bicycle use as measured from the outside edge of the rumble strip to the shoulder edge. Regardless, input from the ODOT Bicycle-Pedestrian Program Manager will be requested on all proposed installations, especially in high bicycle use areas. For narrower shoulders, ODOT has experimented with a milled edge-line rumble strips where the paved shoulder was less than 6 feet. This design is approximately ½ the width of standard SRS and the edge (fog) line is painted over the rumble strip. Contact the Traffic—Roadway Section for more information. Another alternative is profiled durable markings.

Do not install SRS:

- On bridge decks;
- Where the distance between the fog line and obstructions such as barrier or guardrail is 4 feet (1.2 meters) or less;
- In sections with horizontal curvature except where the data indicate a significant single vehicle ROR problem;

- In the area between 300 feet (90 m) before the exit ramp and 300 feet (90 m) after the last entrance as measured from the point where the fog stripe departs and rejoins the mainline;

- Within 200 feet in advance of an intersection with a public road or 50 feet after the intersection or as directed by the Region or State Traffic Engineer;

- On urban highways, including Interstates, unless approved by the State Traffic Engineer based on an engineering investigation addressing the safety benefits and noise impacts to surrounding residential areas.

For maintenance reasons, consider the use of durable striping in conjunction with milled-in rumble strips. Some of the equipment that ODOT owns for painting has difficulty in areas where the milled-in rumble strips exist because the wheel track of the sprayer hits the rumble strips. Please contact the Region Traffic Engineer or Striping Supervisor to verify the striping equipment available.

No deletion shall be considered unless there is a clear and documented problem. Inform the Region Traffic Engineer and State Traffic Engineer of decisions to delete existing rumble strip installations.

6.26.2 Centerline Rumble Strips (CLRS)

Head-on crashes that didn't occur at intersections account for almost 20% of fatal crashes each year on Oregon highways. The purpose of centerline rumble strips (CLRS) is to keep vehicles in their lane and prevent head-on and sideswipe meeting crashes where a median barrier was not feasible. ODOT has installed CLRS on rural highways in both a 4-16 foot (1.2-4.9 m) striped median. ODOT has also experimented with placing rumble strips on centerline pavement markings in both passing and no-passing zones when a median can not be added. While a median is desirable because of the separation of opposing traffic it is not always feasible.

The effectiveness of SRS in reducing road departure crashes led many states to apply the same principle between opposing travel lanes. Experience by other states indicates that CLRS are effective at reducing head-on and sideswipe meeting crashes. The primary concern with the installation is the effect on a driver making a legal passing maneuver or attempting to pass in the area where the rumble strips are installed. Initial experimental application was only in no-passing zones. In the summer of 2003, CLRS were placed in a passing zone with a modified standard SRS spacing in attempt to limit the impact to driver’s legally crossing the centerline in passing areas. In altering the traditional continuous SRS design, it is important to monitor that there will still be enough noise and vibration to alert the driver.

CLRS will not eliminate all cross-over crashes especially those caused by excessive speed, loss of control, and most weather related crashes. Because they are intended to alert drivers "drifting" over the center, rumble strips should be used where crash data indicate that type of driver error is prevalent. In addition to CLRS, some head-on crashes may be mitigated by improvements to the shoulder since many head-on crashes are a result of a driver overcorrecting after their vehicle has departed the roadway to the right.

The use of CLRS is still considered experimental. ODOT will monitor our existing installations with a before-and-after crash study as well as national studies on the topic to better understand their effectiveness. To be approved for installation, Region Traffic must submit an investigation to the State Traffic Engineer that documents a safety problem correctable with the use of milled-in centerline rumble strips. All guidelines below must be met, or a justification for deviation included.

6.26.2.1 Guidelines for CLRS installation

Milled-in centerline rumble strips (CLRS) can be used on new or existing bituminous pavement where crash history indicates a large number of head-on or sideswipe-meeting crashes would be treatable with CLRS. To retrofit CLRS on existing pavement, the pavement should be in sufficiently good condition to effectively accept the milling process without raveling or deteriorating. Otherwise the pavement should be upgraded prior to milling any desired CLRS.

For highways with painted medians, a minimum median width of 4 feet (1.2 m) is needed for installation. For medians 4 feet (1.2 m) in width, place the rumble strips in the center of the median. For medians greater than 4 feet (1.2 m) in width, place the rumble strips 12 inches (300 mm) inside of each median stripe.

For highways without painted medians and where passing is allowed, contact the Traffic Standards and Asset Management Unit for the allowable CLRS pattern and spacing standards.

Do not install CLRS:

- On bridge decks;
- In the area of intersections with public roads. Stop CLRS 25 feet (7.6 m) in advance of intersections;
- On urban highways unless approved by the State Traffic Engineer based on an engineering investigation addressing the safety benefits and noise impacts to surrounding residential areas.

CLRS should not be placed in areas with short distances between access points. If installed in a passing section, consider the noise impacts to rural residential areas nearby.

For maintenance reasons, consider the use of durable striping in conjunction with milled-in rumble strips. Some of the equipment that ODOT owns for painting has difficulty in areas where the milled-in rumble strips exist because the wheel track of the sprayer hits the rumble strips. Please contact the Region Traffic Engineer or Striping Supervisor to verify the striping equipment available.

No deletion shall be considered unless there is a clear and documented problem. Inform the Region Traffic Engineer and State Traffic Engineer of decisions to delete existing rumble strip installations.

6.26.3 Transverse Rumble Strips

Transverse rumble strips are placed perpendicular to the travel direction in the travel lane. Their primary purpose is to enhance other traffic control devices to warn drivers of an unusual situation. Transverse rumble strips should not be overused. Potential adverse effects of rumble strips in the roadway include the noise generated by vehicles continuously passing over them, the possibility that drivers may be tempted to go around them by driving into the opposing lane, maintenance concerns with their durability and concerns by motorcyclists who do not like the rumble strips.

Experience has shown that transverse rumble strips have been effective when used to warn drivers on the approaches to intersections with poor compliance with STOP signs. They should be limited to those areas that have a documented history of crashes and where more conventional treatments have proved ineffective. Other countermeasures such as oversize signs, higher intensity sign sheeting, STOP-AHEAD legend on the pavement, and increasing the stop bar width should be tried. Studies have shown that rumble strips are generally not effective as speed control devices. Rumble strips in conjunction with speed limit signing were found to be ineffective at increasing speed zone compliance.

ODOT has, on limited occasions, used the built-up type of rumble strip across the traveled way for warning drivers of a work zone. Portable rumble strips have been approved for use in ODOT highway work zones. Their application should be used when special circumstances justify the need for them. More recently, grooved rumble strips have been used to warn drivers of changes in the roadway, such as detours or alignment changes. Typically they have been used to alert drivers to the possible need to take some action and signing is usually used in conjunction with the rumble strips. Their placement is strictly for temporary applications.

To be approved for installation, Region Traffic must submit an investigation to the State Traffic Engineer that documents a safety problem correctable with the use of transverse rumble strips. All guidelines below must be met, or a justification for deviation included.

6.26.3.1 Guidelines for transverse rumble strip installation

Permanent milled-in transverse rumble strips can be used on new or existing bituminous pavement where crash history indicates a large number of intersection crashes that would be treatable with transverse rumble strips. To retrofit transverse rumble strips on existing pavement, the pavement should be in sufficiently good condition to effectively accept the milling process without raveling or deteriorating. Otherwise the pavement should be upgraded prior to milling. If installed near residential areas, consider the noise impacts.

For temporary work zone applications, contact the Traffic Standards and Asset Management Unit for design standards and specifications of raised transverse rumble strips or approved proprietary products that could be used in a work zone.

The State Traffic Engineer must approve all transverse rumble strip applications (both permanent and temporary) on State Highways.

File Code: RES 08-02

6.27 Safe Speed on Curves

Safe speed on curves is determined by Region Traffic using the ball-bank indicator method as described in the Sign Policy and Guidelines for the State Highway System. The safe speed is determined in each direction.

ODOT standard practice is to post horizontal alignment signs for a curve when a recommended safe speed is less than the posted speeds. An advisory speed plaque on the sign assembly is required if the recommended safe speed is 10 MPH or more below the posted speed.

Warning signs for curves with a recommended safe speed equal to the posted speed may be posted depending on an engineering investigation including road geometry, crash history, and other factors, and is not required to include the speed rider (See also Manual on Uniform Traffic Control Devices Sections 2C.06, 2C.07, and 2C.46).

Curve signs are used for recommended safe speeds above 30 MPH. Turn signs are used for recommended safe speeds of 30 MPH or less.

For a full discussion of horizontal alignment signs and their use, see the Manual on Uniform Traffic Control Devices Sections 2C.06 through 2C.11. The standard signs including freeway signing can be found in the warning sign and construction sign sections of the Sign Policy and Guidelines for the State Highway System.

File Code: PLA 10-01-04-02

6.28 Safety Corridors

Safety Corridors are stretches of state and local highway with a history of higher traffic crash rates than the statewide average for similar roadways. These may be signed as "Safety Corridors" or "Truck Safety Corridors". In the case of "Truck Safety Corridors", the incidence of commercial vehicle involvement is high, due to either truck or passenger vehicle error.

Typical actions taken in safety corridors to increase safety include more frequent enforcement, low cost engineering improvements and education efforts such as media events, brochures and poster distribution. Drivers are asked to pay extra attention and carefully obey all traffic laws when driving in these areas. The intent is to apply a broad spectrum of immediate and low-cost effort and improvements until the crash rate is reduced below the statewide average.

Typically a Safety Corridor is designated based on a consensus decision by the Transportation Safety Division, Traffic—Roadway Section and the local ODOT Region and District. The Transportation Safety Division is responsible for program and policy development, law enforcement coordination and oversight as well as media coordination and driver education. The Traffic—Roadway Section participates in the data analysis and tracking. The Region Traffic Unit conducts engineering investigations for any engineering measures that may be appropriate and coordinates with the local ODOT District on the selection and implementation of the engineering measures. Safety Corridor coordination is also the responsibility of the Region Transportation Safety Coordinator. They play a key role in bringing stakeholders together for decisions involving the safety corridor effort as well as coordination of overall implementation.

Analysis of the safety corridor occurs every year. The corridor is evaluated to determine its average crash rate. A safety corridor designation is meant to be an interim solution until such time that the crash rate can be reduced and sustained, or until major improvements are funded. If enforcement becomes unavailable or a substantial commitment from local agencies is not maintained the safety corridor may be removed.

For further information regarding the ODOT Safety Corridor Program contact the Transportation Safety Division.

6.29 Sight Distance

Sight distance is necessary to ensure safe vehicle operations required for stopping, intersection movements and passing situations. Simply defined, it is the length of roadway visible to the driver, either ahead or on intersecting roads. The AASHTO publication, *A Policy on the Geometric Design of Highways and Streets,* details the processes for determining sight distances for stopping sight distance, decision sight distance, passing sight distance, and intersection sight distance.

Stopping sight distance is the distance required for a driver to recognize an object which requires a stop, plus the distance required to stop the vehicle. *Decision sight distance* is the distance required for a driver to detect and recognize a situation, make a navigation decision and complete the maneuver. *Passing sight distance* is the distance necessary to safely complete normal passing maneuvers. *Intersection sight distance* is the unobstructed line of sight sufficient to allow approaching drivers to anticipate and avoid potential conflict situation at intersections. Improving intersection sight distance can be one of the most effective safety improvements for intersections with poor sight distance.

File Code: DES 03

6.30 Signs

6.30.1 Sign Policy and Guidelines for the State Highway System

The Oregon Department of Transportation is responsible for furnishing and maintaining directional, regulatory, warning, and informational signs on the state highway system. The Department's sign policy is a combination of Oregon Revised Statutes (ORS), Oregon Administrative Rules (OAR), Federal Highway Administration (FHWA) rules and guidelines, and engineering judgment. The Oregon Transportation Commission (OTC) has adopted the Manual on Uniform Traffic Control Devices, Oregon Supplement to the MUTCD, and Oregon Temporary Traffic Control Handbook as the sign manuals for the State of Oregon. The Sign Policy and Guidelines for the State Highway System deal exclusively with items not included in the Manual on Uniform Traffic Control Devices or items that need further clarification with respect to their use on the state highway system. The ODOT Sign Engineer prepares policy changes and presents them to the Oregon Traffic Control Devices Committee (OTCDC) for their concurrence. Revisions are distributed to holders of the Sign Policy and Guidelines for the State Highway System via updates posted to the Traffic—Roadway Section internet site. If a policy exists and a sign meets necessary criteria, the sign will be erected only when there is adequate space along the highway or freeway, and only if the designated locations generate a large enough traffic volume to justify placement of the sign. Existing signs that are not in conformance with the Manual on Uniform Traffic Control Devices and the Sign Policy and Guidelines for the State Highway System should be brought into compliance on a replacement basis or as part of construction projects. Sign requests should be sent to the Region Traffic Unit with the exception of the following:

- Tourist Oriented Directional Signs (TODS), Specific Service signs (logo signs), and Off-Interstate Historical and Cultural signs to the Director, Travel Information Council, 229 Madrona Avenue SE, Salem, Oregon 97302.

- Historical and Cultural signs on Interstate Highways to Outdoor Advertising Sign Permits, ODOT Right of Way Project Administration, Transportation Building, RM 409, Salem, OR 97301-3871.

- Signs located off of state right of way that are visible from state highways to Outdoor Advertising Sign Permits, ODOT Right of Way Project Administration, Transportation Building RM 409, Salem, OR 97301-3871.

6.30.1.1 Sign Orders

The Region Traffic Unit reviews and designs special signs requested by their District sign crew supervisors. The Region Traffic Unit approves orders and sends them to the sign shop for fabrication.

6.30.1.2 Signing for City Ordinances

ODOT practice is to not install signs for local city ordinances on state highways. Examples include but are not limited to the following:

- Signs prohibiting certain commercial vehicle operations such as engine braking
- Signs displaying noise restriction ordinances
- Signs displaying loitering ordinances such as those aimed at prohibiting "cruising" in a downtown district

It is sometimes, however, the desire of a local road authority to install these signs. Agencies wishing to install signs for city ordinances on state highways within their jurisdiction are required to submit a copy of the specific city ordinance and proposed wording for the sign to the Region Traffic Manager/Engineer for review. After review, the Region Traffic Manager/Engineer will forward the request to the State Traffic Engineer for consideration of approval. The State Traffic Engineer will use the following criteria to determine if the sign will be approved:

- The proposed wording on the sign shall not conflict with existing Oregon laws or rules established in the Oregon Revised Statutes (ORS) or Oregon Administrative Rules (OAR).
- The State Traffic Engineer, in consultation with the ODOT Sign Engineer, shall have final authority over the design and wording of the sign in accordance with standards set forth in the Manual on Uniform Traffic Control Devices and the Sign Policy and Guidelines for the State Highway System.
- The location of the sign shall not conflict with the visibility of another traffic control device or violate the sign spacing standards found in the Manual on Uniform Traffic Control Devices or Sign Policy and Guidelines for the State Highway System.

Upon approval, the local jurisdiction will be required to enter into an Inter-Governmental Agreement with ODOT to assume responsibility for all costs associated with the sign including sign design, installation, and maintenance. ODOT reserves the right to remove the sign at any time if the sign is not properly maintained or conflicts with the visibility of another traffic control device.

File Code: TRA 16-23-26

6.30.2 Right-Turn Permitted Without Stopping (RTPWS)

"Right-Turn Permitted Without Stopping" (RTPWS) signs have been used in Oregon since the 1950's. Research has shown that the RTPWS signs do not contribute to an increase in crashes and are a viable and safe method of reducing delay at stop sign controlled intersections with a predominant right-turn movement. The demonstrated safe operation justifies its use to reduce delay at appropriate stop controlled intersections. Motorists increasingly disregard traffic controls more restrictive than necessary for the situation. Allowing free movement for the predominant move will improve the credibility of stop signs where they are needed for safe operation.

In some cases the consideration of a YIELD sign may be appropriate (see Manual on Uniform Traffic Control Devices Section 2B.09), where there is a separate or channelized right-turn lane or the conflicting movements are uncontrolled.

Engineering judgment, based on an engineering study, is an important part in the determination of the location for establishing RTPWS. Consideration may be given to RTPWS at intersections where the higher volume approaches are at right angles to each other and the conflicting movements are generally stop controlled. The intersection volumes should generally be less than 18,000 ADT and conflicting movements to the RTPWS should be predominantly local traffic. Generally, a RTPWS sign should be used only when the approach has a separate right-turn lane.

All the following criteria should be met when considering the RTPWS (volume criteria generally refers to daily volumes):

1. If the intersection approach with the right-turn is a single lane approach (right, through and left from a single lane) the right-turn volume should be at least 50% of the total volume for that approach. No minimum volume is necessary if the approach has a separate right-turn only lane.

2. The right-turn volume should be at least twice the volume of all conflicting movements.

3. The existing right-turn volume should be 25% or more of the total intersection entering volume within any eight hours of a day.

4. An engineering study must support the installation of an RTPWS.

A RTPWS sign requires the approval of the State Traffic Engineer for installation at an intersection on a State Highway. If the intersections volumes or movements change significantly the use of the RTPWS sign should be reconsidered. Refer to the Sign Policy and Guidelines for the State Highway System for further information.

6.30.3 STOP Sign Applications

The State Traffic Engineer has been delegated the authority, in consultation with the Region Manager, to approve installation or removal of STOP signs at intersections of state highways with any other highway, road, or street. STOP signs should only be used where justified. The Manual on Uniform Traffic Control Devices contains guidelines and criteria for the use of STOP signs in Sections 2B.04 through 2B.07. STOP signs are normally posted on the minor street to stop the lesser flow of traffic. The multi-way stop installation is useful as a safety measure at some locations. It should be used where volumes are approximately equal.

Requests for installation of STOP signs on state highways should originate from the Region Traffic Manager. Requests should include an investigation stating warrants for the STOP control crash history, safety concerns, alternatives or any other considerations concerning the proposed installation.

The Region Traffic Manager/Engineer may approve the installation or removal of STOP signs on roads intersecting a state highway (i.e., city streets, county roads, or private roads). STOP signs on a state highway, multi-way stop applications, or modifications to stop configurations should be approved by the State Traffic Engineer.

File Code: TRA 16-04-0801

6.30.4 Variable Message Signs

A variable message sign (VMS) is a traffic control device (permanent or portable) whose message can be changed to provide motorists with information about traffic congestion, traffic crashes, maintenance operations, adverse weather conditions, roadway conditions, organized events, or other highway features. Installation and location of VMS on state highways requires the approval of the State Traffic Engineer. With the approval of the State Traffic Engineer, permanent signs may be used to display public service messages.

There are several items that should be considered when choosing the location for a permanent or portable VMS. Signs should be placed far enough in advance of a decision point (e.g. interchange, major intersection, merge section at the end of a passing lane, etc.) to allow drivers enough time to read and understand the message before having to refocus their attention on the driving task. The availability of power and communications is another concern for permanent VMS installations. As a general rule, signs should be located at least 1 mile in advance of decision points on non-freeway installations and 1 ½ to 3 miles for freeway installations.

The Intelligent Transportation Systems Unit prepares project plans, cost estimates, standard drawings and specifications for variable message signs and other special fiber optic and LED signs.

According to OAR 734-020-0410 and the letter of authority, the State Traffic Engineer is responsible for exercising authority with respect to the use of traffic control devices. Since variable message signs are traffic control devices, their operation is under the authority of the State Traffic Engineer.

The Traffic—Roadway Section publication, *Guidelines for the Operation of Variable Message Signs on State Highways*, establishes responsibilities for message selection; provides guidance for displaying, altering, and removing messages; and clarifies conditions of use. Sample messages are included as well.

Each Region Traffic Engineer or Traffic Manager has the responsibility to approve messages to be displayed on variable message signs in his or her region, however the State Traffic Engineer has retained the authority to approve public services messages which may be displayed on permanent variable message signs only.

File Code: TSO 04 and 05

6.30.5 Wrong Way Treatments

Wrong way movements are fairly rare and sporadic. The Manual on Uniform Traffic Control Devices Section 2E.50 provides guidance in the placement of signs to discourage wrong way driving. A combination of ONE-WAY, DO NOT ENTER, and WRONG-WAY signs is recommended. The Manual on Uniform Traffic Control Devices also allows for lane use arrows and markings.

If a freeway on-ramp or other road is suspected of frequent wrong way movements the following steps should be taken:

- Verify the extent of the problem by reviewing the crash history, looking primarily for head on or side swipe collisions.
- Check signing to ensure that Manual on Uniform Traffic Control Devices guidelines are met.
- Determine if additional signing either at the ramp or on the approach to the ramp or intersection could provide additional guidance.
- Evaluate the geometric design of the intersection: (i.e. Entrance radii, offset ramp terminals) and determine if modifications should be considered. (See Highway Design Manual for further discussion).
- Consider the need for additional illumination in the area.
- Consider installing large directional pavement arrows or other approved traffic control devices.
- Exit and entrance ramp terminals on the crossroad should be offset to encourage drivers to use the entrance ramps and discourage wrong way moves. (See Highway Design Manual for further discussion).
- Consider installation of red reflectors on the backside of guideposts in situations where sign and illumination improvements have not been effective.
- Due to limited success and maintenance costs of bi-directional raised pavement markers, consider use of these markers only in exceptional circumstances. These markers require the approval of the State Traffic Engineer, in consultation with the Region Manager.

File Code: TRA 03-01-26 General Information / TRA 16-02-04-04 Striping & Markings / TRA 16-04-76 Signs

6.30.6 YIELD Sign Applications

The State Traffic Engineer has delegated authority, in consultation with the Region Traffic Engineer, to approve installation or removal of YIELD signs on state highways. The Region Traffic Engineer may authorize the installation or removal of YIELD signs on cross street that are not state highways. Yield signs can be used to assign right-of-way at low volume intersection where a stop sign is not necessary at all times. Yield signs should be placed in accordance with Sections 2B.09 and 2B.10 of the Manual on Uniform Traffic Control Devices. The Traffic—Roadway Section encourages the use of yield signs instead of stop signs where appropriate.

Engineering judgment, based on an engineering study, is an important part in the determination of when to use a yield sign. There should be sufficient sight distance on the minor street approach to allow a vehicle to take appropriate action at the intersection. Sight triangles for turning left or right from the minor street and for crossing the major street need to be investigated. Chapter 9 of the AASHTO *A policy on Geometric Design of Highways and Streets*, 2001 contains methods for calculating sight triangles at intersections. In addition to looking at the sight distance for an intersection, traffic engineers should also consider the volumes on the major and minor streets, the approach speeds of the intersection, and the crash history of the intersection.

6.30.6.1 Yield Line Pavement Markings

See 6.22.4

6.31 Special Events

Special events held on state highway right-of-way require a permit, issued by the ODOT District office with jurisdiction and in accordance with criteria established by OAR 734-056-0030. The applicant shall, at their expense, provide a traffic control plan that complies with current standards of the Manual on Uniform Traffic Control Devices and with the Oregon Supplement to the MUTCD. Signs used in conjunction with special events must also comply with the Sign Policy and Guidelines for the State Highway System. The Traffic—Roadway Section may be asked to review or provide assistance.

File Code: TRA 23-37

6.32 Speed Zones

6.32.1 Overview

Speed limits are covered in ORS 810.180 (Designation of speed limits), and ORS 811.100 through ORS 811.111. The establishment of speed zones under normal conditions is described in OARs 734-020-0014, -0015, -0016, and -0017. The rules for establishing Interstate Speeds are covered under OAR 734-020-0010. Those speeds are defined in OAR 734-020-0011. (See Construction Speed Zones, School Speed Zones, and Safe Speed on Curves.)

Establishing speed zones in Oregon requires an engineering investigation. These investigations are in accordance with nationally accepted traffic engineering standards and procedures, which have been established through years of research and experience.

A major factor in speed zoning is the 85th percentile, the speed at or below which 85 percent of the vehicles are traveling. This is an indication of what most drivers feel is reasonable and safe. The procedure provides Oregon with a consistent and uniform application of techniques to establish safe and proper speed zoning. Other factors taken into consideration are crash history, roadside culture, traffic volumes, and roadway alignment, width and surface.

In Oregon, the decisions regarding speed zones are made jointly by the Department of Transportation and the road authority, for example, a city or county.

The Department of Transportation has the responsibility to investigate roads for establishing new speed zones or changing existing speed zones. These investigations are performed at the request of a city, a county, an agency with a road authority or a private citizen if the request is for a rural state highway. For rural state highways, requests for an investigation should be made in writing to the Region Traffic Engineer.

If the recommended speed is of mutual agreement between the Department and the local road authority, the speed zone is established. If mutual agreement cannot be reached, the speed zone decision is referred to the Speed Zone Review Panel.

When the Traffic-Roadway Section approves and distributes a permanent or a short-term speed zone order on a state highway, those who have responsibility for sign installation and removal (including private consultants) must notify the Traffic-Roadway Section when the signs are installed and removed.

File Code: TRA 07-02

6.32.2 Construction Speed Zones

6.32.2.1 Overview

Extensive national research has shown that retaining the posted speed (i.e., no speed reduction) through work zones results in the fewest crashes. This holds true except in some limited conditions. Speeds may be reduced in areas where more than one of the following conditions exists:

- Substandard lane widths
- No shoulder
- Work activity adjacent to travel lanes without a positive barrier
- One-lane, two-way operation
- Short detour with a reduced safe speed on the end curves of 10 mph or more, or
- Unique situations unfamiliar to drivers that severely restrict normal travel speeds

Speed zone orders for construction and other temporary travel restrictions are written specifically for the conditions of restriction. These may include a 'rolling' order following the active work zone or time of day restrictions.

The State Traffic Engineer has the approval authority for a reduced speed in a work zone or other temporary situation with the above restrictions. Requests may be sent to the Traffic—Roadway Section, and should include the Region Traffic review, the Worksheet for Determining the Need for a Reduced Speed Zone for Work Zones and a copy of the project plans with traffic control plans.

6.32.2.2 Process for obtaining a Speed Reduction for construction

The request to lower the speed zone for a construction project may be made during project design or after construction begins. In all cases, the Region Traffic Engineer should be consulted for their recommendation. Submit the written request, Worksheet, traffic control plans and Region Traffic Engineer comments to the State Traffic Engineer.

6.32.2.3 Requesting a speed reduction during project design

If the request is made during project design, the resulting recommendation will be issued as a letter of support for the design. This letter is not a speed zone order and cannot be used to place signs on the project. The intent of the letter is to notify the Designer that they may proceed with their TCP design and anticipate the incorporation of a speed zone reduction.

Since any reduced speed is based upon the traffic control plans, the project should be at least at the Preliminary plans before submitting a request. The letter of support issued will be specifically tied to the plans as submitted, and provides the basis for including signs for a reduced speed in the quantities. Include the Unique Special Provision "00225 – Temporary Speed Zone Reduction" in the project Special Provisions. The signs are not shown on the plans, although a note directing the contractor to request a written speed zone order prior to posting signs can be on the appropriate plan sheet(s).

Once the contract is awarded and the contractor and project manager have agreed on the staging and traffic control to start the project, a written speed zone order can be requested. If there has been any change in the temporary traffic control or staging since the plans date in the letter of support, a new set of traffic control plans showing the changes must be submitted with the request for a speed zone order. Speed zone signs may be posted as soon as the written order is received by the contractor and project manager.

6.32.2.4 Requesting a speed reduction during construction

When a reduced speed is desired for a project already under construction, the Region Traffic Engineer should be consulted for their recommendation. The resulting decision will be a written speed zone order based on the traffic control in place and the staging plans for the life of the project. The written request, temporary traffic control plans including any revisions as-posted, and Region Traffic Engineer comments are submitted to the State Traffic Engineer. Signs may be posted as soon as the written Speed Zone Order is received by the contractor and project manager.

6.32.2.5 Construction Speed Zone Order

A copy of the Construction Speed Zone Order will be sent to the Region Traffic Engineer, project manager and the contractor. A copy of any construction Speed Zone Order is also sent to the nearest State Police office. If any other enforcement agencies will be patrolling the project, a copy should be given to them as well.

When normal shoulder and lane use or width are restored for a period of time longer than four consecutive calendar days, the Construction Speed Zone Order shall be suspended. Temporary speed zone signing shall be turned, covered, or removed.

6.32.3 School Speed Zones

Each road authority (state, county, or city) determines within their own jurisdiction, by performing an engineering study, whether a school speed zone is appropriate and the limits of that zone. The school speed zone should be established as per the provisions of ORS 811.111 subsection 1(e) and ORS 810.200.

The road authority with jurisdiction establishes all school speed zone exceptions in statutory and basic speed zones. On local jurisdiction roadways the road authority may establish school speed zones, including those roadways covered by a speed zone order. School speed zone exceptions on local jurisdiction roadways are no longer included in the speed zone orders.

On State Highways inside city limits the local jurisdiction or school district must request the school speed zoning in writing. For state highways outside city limits, the request usually comes through the District Manager. The request should include a copy of the school district's Pedestrian Route Plan, as described in the Manual on Uniform Traffic Control Devices. The complete report submitted to the State Traffic Engineer shall include:

- The original correspondence requesting the school zone exception.
- An engineering study, including an evaluation of the pertinent information. (see A Guide to School Area Safety)
- The entire rewording necessary for the new speed zone order.
- A map showing the existing speed zone and the new school zone (if applicable).
- Photographs showing the area from beginning to end. Including sight distance or other roadway conditions that would impact the decision to approve the exception.

The engineering study does not necessarily have to include speed checks but should establish the school ground or school crossing boundaries according to the standards adopted by the state. (See the Sign Policy and Guidelines for the State Highway System and A Guide to School Area Safety)

On state highway segments covered by speed zone order, the school speed zone must be approved by the State Traffic Engineer and included on the speed zone order. On state highway segments not covered by speed zone order (i.e., statutory speed or basic rule sections), school speed zones may be approved by the Region Traffic Manager.

6.32.3.1 <u>A Guide to School Area Safety</u>

ODOT has prepared a publication entitled "A Guide to School Area Safety" to assist in the placement of traffic controls in school areas. This guide is available on the internet from the Traffic—Roadway Section web site.

6.32.4 Speed Displays in conjunction with Speed Limit or School Speed Limit signs

The 2003 Edition of the Manual on Uniform Traffic Control Devices added the option of using changeable message signs in conjunction with a Speed Limit Sign (See Manual on Uniform Traffic Control Devices Section 2B.13) or a School Speed Limit Assembly (See Manual on Uniform Traffic Control Devices Section 7B.11) to display the speed at which approaching drivers are traveling. The installation of Speed Displays on State Highways may be approved by the Region Traffic Engineer.

6.32.4.1 <u>Considerations for installing Speed Displays in conjunction with Speed Limit or School Speed Limit signs</u>

Speed Displays used to alert drivers of their speeds may be considered where a greater emphasis of prevailing speeds is desired. The following considerations should be taken into account for possible installation of Speed Displays on state highways:

1. Crash experience within the past three years

2. 85^{th} percentile speed within the area (Note: For proposed Speed Displays in conjunction with School Speed Limit signs, the 85^{th} percentile speed should be measured during the hours children are arriving or leaving school grounds.)

3. Other pertinent factors such as pedestrian activity, roadside character, and land use within the area.

6.32.4.2 <u>Installation</u>

1. When a Speed Display ("YOUR SPEED XX" sign) is used in conjunction with a posted speed or School Speed Limit on State Highways, the sign and installation shall be in compliance with the Manual on Uniform Traffic Control Devices and prior approval of the Region Traffic Engineer shall be obtained.

2. When a Speed Display sign displaying speeds of approaching drivers is installed, the sign shall be mounted in conjunction with the Speed Limit sign and the of

the Speed Display sign shall be yellow legend on black background or the reverse of these colors.

3. Speed Display signs that display messages other than speed or are controlled through an operations center should be evaluated by the Intelligent Transportation Section of the Maintenance and Operations Division.

4. When Speed Display signs are used in conjunction with School Speed Limit signs they will generally be more effective if speeds are displayed only when children are scheduled to arrive and leave school, but may operate in conjunction with specific periods that the School Speed Limit is in effect.

5. A Speed Display may be installed by a local jurisdiction on a state highway if the local jurisdiction agrees to enter into an Inter-Governmental Agreement with ODOT and assumes responsibility for all costs associated with the Speed Display including installation and maintenance.

File Code: TRA 16-05-01

6.33 Traffic Calming

Traffic calming techniques can be used effectively to encourage drivers to operate their vehicles at appropriate speeds. The selection of traffic calming strategies must consider the nature of the street or roadway, adjacent land use, driver population, emergency vehicle concerns, ease of implementation and other site specific factors. If used appropriately, the techniques can encourage drivers to drive at desired speeds, improve the appearance of the roadway, and improve the comfort of pedestrians crossing the roadway and facilitate other modes use of the facility.

Traffic calming for neighborhood streets may include speed bumps, speed humps and traffic circles. While these may be effective in reducing speeds, they create additional neighborhood noise, driver discomfort and hardships for emergency response. Street closures may also be used, but this forces traffic onto other streets. Traffic calming should be designed to encourage driving at the legally established speeds. They should not be designed to physically restrict motorists to slower speeds, in effect establishing an illegal speed limit and posing a hazard to the motoring public.

Traffic calming on state highways, primarily arterial streets, involves different types of changes to the roadway environment to cue drivers to the mixed-use environment, of pedestrians, bicycles and transit. These changes include such items as pedestrian islands, curb bulb-outs, wide sidewalks, and streetscaping. Roundabouts, used in the right places, are another strategy for improving driver behavior on arterial streets (see Roundabouts). Traffic calming techniques will be different for downtown areas versus transition areas (see *Main Street Handbook*).

Using traffic control devices such as signals or stop signs for traffic calming is discouraged, as these are generally ineffective. Inappropriate use of traffic control devices may cause safety problems and may increase conflicts and speeds due to driver frustration or indifference. Non-uniform application of devices causes confusion among pedestrians and vehicle operators, prompt wrong decisions, and can contribute to crashes. Vehicular, pedestrian and bicycle safety depends in large measure upon public understanding and acceptance of uniform methods for efficient traffic control.

Strategies such as narrowing lanes and adding on-street parking may result in lower speeds, but they often increase safety concerns. On-street parking increases conflicts between the parking vehicles and bicyclists, as well as other vehicles. It also limits the sight distance and visibility of vehicles entering the roadway from side streets and other accesses. While on-street parking can present safety concerns, it can also act as a buffer between the travel lanes and the sidewalk. Bulb-outs can be used to make pedestrians more visible to the motorists at crossing points. On-street parking is appropriate for most downtown business areas, but may not be appropriate in other areas such as transition areas.

Posting a lower speed may be requested by some communities seeking to increase safety. These are viewed as unrealistic by drivers and can lead to enforcement problems and disrespect for speed limits. Simply posting a lower speed does not guarantee the desired change or increase in safety. By applying some of the softening affects of pedestrian amenities and landscaping, the motorists' natural speeds are often slowed due to the perception of a changing road culture. Striving to lower vehicular speeds naturally using the methods described above is desirable. When a lower speed appears reasonable to the motorist it is more readily accepted. This results in lower speeds, reduces enforcement problems, and increases safety.

6.34 Traffic Signals

6.34.1 Approval Process

The State Traffic Engineer has been delegated the authority through Administrative Rule to approve the installation of traffic control devices on state highways. The traffic signal approval process is established in OAR 734-020-0400 through 734-020-0500. All traffic signals to be installed on state highways including those in the STIP or in an OTIA project require the approval of the State Traffic Engineer.

All submittals for approval of a traffic signal on a state highway should come through the Region Traffic Manager. The Region Traffic Manager should submit a Traffic Signal Approval Request Form with an Engineering Investigation to the State Traffic Engineer.

Traffic—Roadway Section staff will review the request. One or more of the eight Warrants identified in Section 4C of the Manual on Uniform Traffic Control Devices must be met unless the traffic signal meets the criteria for special applications. The satisfaction of a warrant or warrants, however, is not in itself justification for a traffic signal. The Engineering Investigation must indicate that the installation of a traffic signal will improve the overall safety and operation of the intersection. See Warrants for more information about warrants and the criteria for special applications.

If approved, the named intersection will be added to the Traffic Signal Approval List and the Region Traffic Manager will receive a letter of approval signed by the State

Traffic Engineer. The letter will include guidance regarding the proposed lane configuration and phasing. The Traffic—Roadway Section must still approve the signal plans and specifications for all work on State Highways. If a traffic signal is not constructed at an approved location within five years after being put on the Traffic Signal Approval List, the intersection will be removed from the list.

6.34.1.1 Engineering Investigation

To determine the need for a traffic signal, a comprehensive Engineering Investigation should be undertaken. Region Traffic staff or the applicant requesting the traffic signal may complete the investigation and Traffic Signal Approval Request Form. All submittals of the Engineering Investigation to the State Traffic Engineer should come from the Region Traffic Manager.

The following does not represent an exhaustive list of considerations but contains the essential elements that should be included in the Engineering Investigation.

Justification

According to the Manual on Uniform Traffic Control Devices, the traffic signal warrants are minimum conditions under which installing traffic signals might be justified. A traffic control signal should not be installed unless the Traffic Signal Engineering Investigation indicates that installing a traffic signal will improve the overall safety and/or operation of the intersection. Examples of a justification statement are:

- The signal will reduce lengthy and unacceptable queues;
- The signal will reduce intersection delay;
- The signal will reduce the crash rate or severity.

In the above examples, the justification for the signal installation should be supported by appropriate queuing analysis, capacity analysis, or crash analysis, respectively.

Since vehicular delay and the frequency of some types of crashes are sometimes greater under traffic signal control than under STOP or YIELD control, consideration should be given to providing alternatives to traffic signals even if one or more of the warrants and other minimum conditions are satisfied. See Chapter 4B of the Manual on Uniform Traffic Control Devices for a list of possible alternatives. The range of alternatives should address the primary justification for consideration of a traffic signal.

Traffic Volumes

Using a diagram of the intersection as it currently exists, provide vehicular and pedestrian volumes for the intersection for which the traffic signal is being requested and intersections in the surrounding area. Peak AM and PM traffic volumes, based on 14-hour count data should be provided. Describe the traffic that is actually present or certain to be present when the traffic signal is operational. Estimate future traffic for at least a 15-year period

Warrants Analysis

Include the results of a traffic signal warrants analysis (for warrants see Section 4C in the Manual on Uniform Traffic Control Devices). Satisfaction of each Manual on Uniform Traffic Control Devices warrant should be evaluated. Warrants 1-8 should be evaluated for existing conditions and traffic that is actually present or certain to be present when the traffic signal is operational. Satisfaction of Warrant 7, Crash Experience, should be based on the three most recent calendar years for which crash data is available. Only those crash types susceptible to correction by traffic signal control should be considered. The Traffic Signal Warrant Analysis form should be utilized.

When a traffic signal is part of a roadway improvement project, the request should be based on projected volumes provided or approved by the ODOT Transportation Planning Analysis Unit or the region's transportation analysis unit. The Preliminary Traffic Signal Warrant Analysis form should be utilized. The analysis should demonstrate that Warrant 1 would be met within three years after construction.

See Warrants for a description of Manual on Uniform Traffic Control Devices warrants and additional considerations that may support installation of a traffic signal for special applications.

Conceptual Design

Include a diagram or plan of the proposed intersection layout with identifying landmarks, unique physical constraints and appropriate lane widths, curb radii, etc. Include the following:

- Proposed lane usage and signal phasing based on analysis of current and projected volumes, traffic patterns, and safety and operational considerations. Refer to the ODOT Traffic Signal Policy and Guidelines.
- Current and expected posted speed after construction.
- Sight distances.
- Bicycle and pedestrian facilities.
- Conflicting accesses to be moved or closed.
- Current and proposed land uses of the area adjacent to the proposed traffic signal.
- Railroad or light rail within 500 feet.

Safety Analysis

Identify any safety concerns and explain how they will be resolved, e.g., sight distances, alignment, prevailing speeds (design speed for new construction or posted speed if on system), crash histories, railroad crossings, nearby access movements, etc.

Operational Analysis

Consider the effect of the proposed signal on existing and future traffic signals and signal systems and existing levels of service. Consider the need to accommodate transit and light rails and the need for a railroad interconnect.

If the proposed traffic signal is within 500 feet of a highway-rail grade crossing, provide information on the impacts of the signal to the crossing. This should include a traffic impact analysis of present and future traffic queues affecting the crossing. Current requirements for crossing safety improvements can be obtained from the Rail Division, Crossing Safety Section. The Rail Division should be contacted early in project development.

If the proposed location is within ½ mile of an existing or possible future traffic signal include a traffic signal progression analysis as described in OAR 734-020-0480.

Elements of a proper traffic signal progression analysis include the following for each requested time period:

- A diagram showing the volumes used at each intersection with the year of the projection and the hour covered

- A time space diagram labeled with the cycle length, the distance between traffic signals, the year of projected volumes, and the hour covered. The diagram should show the green bands for the highway and the progression speeds.

- Supporting documentation showing the green splits and v/c ratio for each of the movements at each of the traffic signals in the system. The inputs such as saturation rate, heavy vehicles, etc. should also be available. This information should be labeled to correspond with the correct time space diagram.

- A statement of the results of the study.

Transportation Plan Consistency

Provide information from pertinent transportation plans (local, regional, and state) to demonstrate consistency between the plan and the proposed traffic signal installation. Explain discrepancies between the plans and the proposed traffic signal installation.

Other Agency Support

Provide evidence of support of other agencies for the proposed traffic signal installation. Provide a description of the proposed funding and maintenance agreements. Include a description of the public input process and any key correspondence with local jurisdiction representatives.

Application for State Highway Approach

If the request is for a traffic signal to be constructed at a location subject to Division 51 administrative rules relating to state highway access, include a copy of the Application for State Highway Approach, a statement regarding the status of the application, and a copy of the Traffic Impact Study, if one is required.

6.34.1.2 Modifications

Traffic Signal modifications requiring the approval of the State Traffic Engineer should be requested using the Traffic Signal Approval Request Form. An Engineering Investigation that includes the applicable elements required to support the request should be submitted. Traffic Signal Modifications approved by the Region Traffic Manager (see Region Traffic Manager/Engineer Authority) should be documented and a copy of the documentation forwarded to the State Traffic Engineer.

6.34.1.3 Removal

A request to remove an existing traffic signal should be submitted using the Traffic Signal Approval Request Form. Removal of a signal requires a review of warrants, public notification and interim control of the intersection. Other conditions may be applicable. Details are discussed in the ODOT Traffic Signal Policy and Guidelines.

6.34.1.4 Warrants

The Section 4C of the Manual on Uniform Traffic Control Devices establishes traffic signal warrants as follows:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing
- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network

Details are provided in the Manual on Uniform Traffic Control Devices on the analysis required to demonstrate compliance with these warrants. One or more of the eight warrants must be met unless the traffic signal meets the special applications criteria.

The Manual on Uniform Traffic Control Devices and ODOT Traffic Signal Policy and Guidelines provide for the installation of traffic signals that meet criteria for special applications. These applications include providing access to fire and other emergency vehicles, regulating the flow of traffic at a freeway ramp, controlling traffic at a drawbridge or at a one-lane facility, and temporary installations for construction projects.

6.34.1.5 Temporary Traffic Signals

Temporary traffic signals are intended to be short-term installations, yet in their appearance, design, and operation must be held to the same standards as permanent signals. The State Traffic Engineer must approve temporary signals. The installation of temporary signals must meet all applicable Manual on Uniform Traffic Control Devices and ODOT standards. Refer to the Traffic Signal Design for guidance.

6.34.2 Traffic Signal Operations

6.34.2.1 Accessible Pedestrian Signals

The Region Traffic Engineer may approve accessible pedestrian signals. Policies set forth in the ODOT Traffic Signal Policy and Guidelines should be strictly followed. The State Traffic Engineer must approve exceptions to the policy.

Accessible pedestrian signals may be installed at existing or approved signalized intersections upon receipt of a request by a user needing such devices and an engineering study that considers unique intersection characteristics, safety, noise level, and neighborhood acceptance. The Americans with Disabilities Act (ADA) do not require accessible pedestrian signals; they should be considered with respect to other funding priorities.

Accessible pedestrian signals, when provided, should be activated by a pedestrian signal pushbutton. A one-second minimum delay to activate the accessible signal should be provided. The accessible signal should be a “cuckoo” for north-south crossings and a “peep” for east-west crossings. A pushbutton instruction sign with a raised arrow should be included with the pushbutton for the signal.

6.34.2.2 Traffic Signal Design Manual

Whether ODOT staff or a consultant under contract to ODOT or another public or private entity designs a signal, all signals to be constructed on a state highway must meet all applicable Manual on Uniform Traffic Control Devices and ODOT standards. The signal design must be consistent with specific elements outlined in the signal approval or signal modification letter. A preliminary design must be submitted to the Traffic Standards and Asset Management Unit for review. That unit must approve the final design.

The ODOT Traffic Signal Policy and Guidelines provide guidance on standard and optional practices relating to signal design and operations. The Traffic Signal Design Manual provides specific guidance on plan layout including standard drawings, and checklists. An electronic copy of the manual can be found on the internet at the ODOT Traffic—Roadway Section web site.

6.34.2.3 Maintenance

The ODOT Traffic Systems Services Unit generally maintains traffic signals on state highways. Services include annual preventive maintenance inspections of all ODOT maintained traffic signals. Inspection checklist items guide technicians through a systematic evaluation of the traffic signal control cabinet and its operational components that include; field sensors, poles, signals, pushbuttons, signs and striping. Checks inside the cabinet include; power management components, controller timing and operation including communication, sensor operation, signal output relays, and safeguards to prevent equipment malfunctions. Equipment inventories are updated and entered into the Traffic Systems Information Systems (TSIS) database, which is used to determine fleet age and locations of features such as those slated for obsolescence.

Signals on state highways within city limits or county boundaries are maintained in accordance with agreements between the ODOT and the city or county. The agreements define which agency is responsible for maintenance costs. Signals installed by a private organization are maintained in accordance with an agreement or permit.

Some cities do not have the capability to maintain traffic signals. At the request of the signal owner, ODOT may provide regular maintenance for these signals.

See also *2002 Policy Statement for Cooperative Traffic Control Projects*

6.34.2.4 Timing

Initial timing of traffic signals and any subsequent change in permanent timing is the responsibility of the Region Traffic Manager and his/her staff. Staff of the Traffic—Roadway Section may assist if requested. Signal timing should be reevaluated on a regular basis. Reviews should be conducted approximately every three years or more frequently if significant development has occurred, if new signals in the immediate area have been added, or if complaints are received from the public or ODOT staff.

Temporary timing changes can be made by certified ODOT personnel to compensate for sudden changes in traffic conditions or malfunctioning traffic signal equipment that cannot be repaired or replaced immediately. All temporary timing changes are to be recorded on the timing sheet in the cabinet. The Region Traffic Manager is to be notified of any temporary timing changes as soon as possible.

The official timing record is programmed in the controller in the cabinet at the intersection. The cabinet should have a timing sheet that reflects the current timing in the controller. A copy of the timing sheet should be at the Region and the Traffic—Roadway Section.

6.34.2.5 Portable

See Section 6.41.2

6.34.2.6 Traffic Signal Policy and Guidelines

The ODOT Traffic Signal Policy and Guidelines are for the use of individuals involved in the design, operation or maintenance of traffic signals on the state highway system. They are compiled and prepared by the Traffic—Roadway Section in cooperation with the Oregon Traffic Control Devices Committee (OTCDC). An electronic copy of the policy and guidelines can be found on the internet at the ODOT Traffic—Roadway Section web site.

6.34.2.7 Preemption Systems

Traffic signal preemption systems are traffic control devices that interrupt the normal operation of traffic signals to give priority or preference to special vehicles (trains, emergency vehicles, buses, etc.). Two types of preemption systems are employed in Oregon: failsafe systems and signal preemption device systems.

Failsafe systems are hard wired to the signal controller and operate independently of any other signal function. The default state of a failsafe system is preemption. These systems are used by heavy rail and drawbridge operations, and have priority over signal preemption device systems.

Signal preemption device systems require the installation of a signal preemption device at the intersection that reacts to a traffic control signal operating device fixed to, or carried within, a vehicle. The default state of a signal preemption device system is normal traffic signal operation. Emergency, transit, and traffic signal maintenance vehicles use signal preemption device systems.

Details can be found in the ODOT Traffic Signal Policy and Guidelines and OAR 734-020-0300 through OAR 734-020-0330.

6.34.2.8 Ramp Meters

Ramp meters may be provided at any freeway entrance ramp regardless of traffic volumes. The purposes of freeway entrance ramp control (ramp metering) include (1) reducing merge area turbulence by regulating vehicle flow entering the facility, and (2) regulating total freeway traffic flow through downstream bottlenecks.

There are currently no warrants for freeway entrance ramp traffic control signals, however the *Manual on Uniform Traffic Control Devices* identifies general guidelines for successful application of ramp control. It is recommended the engineering study for ramp meter installation include discussion of pertinent geometric elements; ramp and mainline traffic volumes; crash history; and operating speeds, travel time and delay on the freeway and alternate surface routes.

The Traffic Standards and Asset Management Unit must approve designs for ramp meters. The ODOT Traffic Signal Policy and Guidelines provide guidance on standard and optional practices relating to ramp meter design and operations. The Traffic Signal Design provides specific guidance on plan layout including standard drawings.

6.34.2.9 Certified Traffic Signal Inspectors (CTSI)

Effective April 1, 2005, all traffic signal and electrical construction on state highways will require construction inspection by personnel certified by ODOT as Certified Traffic Signal Inspectors (CTSI). The CTSI are in addition to and do not eliminate the need for certified electrical inspection in compliance with electrical permits issued by local agencies.

Background

ODOT Traffic—Roadway Section provides Traffic Signal Inspector Certification training to ODOT staff, local agency staff, and consultants. Those who successfully complete the class are certified for three years.

- Training is offered during February through April each year.
- Class locations vary according to demand, but typically classes are held in Salem, Portland, Roseburg, and LaGrande each year
- Typically 100 to 150 people are certified each year
- Each CTSI is given a laminated pocket card listing name, certifications, and expiration dates

A current listing of Certified Traffic Signal Inspectors (CTSI) can be found on the internet at the ODOT Technician Certification Program web site.

The Future

The CTSI certified project inspections combined with supplemental inspections from ODOT electricians has greatly increased the quality of electrical installations. The requirement for a CTSI inspection includes, but is not limited to, traffic signals, illumination, variable message signs, road and weather information systems, video camera systems, and other intelligent transportation systems.

Consultant inspected projects (Non-permit projects)

Consultant inspectors must be CTSI certified for electrical installations. The contract between ODOT and the Consultant should contain language requiring CTSI certified inspectors. Amendments to current contracts should be made to include this requirement.

Installations by Permit for Local Agencies and Developers

Local Agency or Consultant inspectors must be CTSI certified for electrical installations. This requirement should be included in the permit given by ODOT. The District Permitting Office shall verify this requirement prior to construction. The permit fee should be reviewed to cover the electrician's supplemental inspection.

6.34.2.10 Turn On

The turn on of new or modified traffic signals will be coordinated through the Traffic Systems Services Unit and the Region Traffic Manager. Following construction and prior to scheduling the turn-on, ODOT electricians and a Certified Traffic Signal Inspectors (CTSI) must complete an inspection of all signal and field wiring. Before turn on, the contractor will be responsible for all necessary corrections prior to the signal being placed in service.

The traffic signal turn on consists of a series of tests and checks to insure that the signal is ready to be activated. Once the tests are satisfactorily completed, timing data is installed and the signal is put into operation. Operation is observed during different traffic conditions and adjustments are made as necessary.

Each ODOT Region may have specific procedures with regard to signal turn on. Often, the Traffic—Roadway Section will provide preliminary and/or final timing. This may be provided on timing sheets or electronically installed on the "prom board" of the controller. Traffic—Roadway Section staff may also provide traffic signal system timing data. Regions are expected to provide sufficient advance notice to allow for the preparation of all timing.

Occasionally the Region Traffic Manager or Traffic Signal Manager will request the Traffic—Roadway Section to provide for the traffic engineering functions when a new traffic signal is placed in service. Such personnel should work closely with the Traffic Systems Services Unit technicians and project inspectors to assure all elements of the plans have been executed. This, in addition to proper signal timing, includes proper sign legends, correct sign placement, proper crosswalk locations, adequate pavement markings, etc. The correct operation of the signal should be observed for the appropriate period(s) of the day.

File Code: TRA 16-30-31

6.35 Traffic Impact Studies

The Traffic—Roadway Section may be asked to review Traffic Impact Studies (TIS) as part of the developmental review process. A TIS typically describes, in detail, how a specific development will affect local, or perhaps, regional, transportation systems. Many communities as well as ODOT require a TIS before highway approach permits are granted. A TIS may also precede zoning changes, approvals of site plans or subdivision maps, or the preparation of environmental documents. The Institute of Transportation Engineers recommends that a TIS be prepared for any project that generates more than 100 peak hour trips, or when a development is likely to cause other significant traffic flow impacts. ODOT has established rules covering access management issues. Specific detail on when a TIS is required and the necessary documentation can be found in OAR 734, Division 51, and in the Development Review Guidelines available on the internet from the ODOT Transportation Planning Section.

6.36 Truck Routes

The authority to designate truck routes or prohibit truck operation is given to the road authority under the provisions of ORS 810.040. On state highways the Oregon Transportation Commission (OTC) designates truck routes. The State Traffic Engineer has been given the authority to prohibit truck (large or heavy vehicles) operation under the provisions of ORS 810.030. Based on the outcome of a recent Supreme Court case, ODOT has established a procedure to guide staff and local jurisdictions in establishing truck routes.

6.36.1 Background

Prior to 2002, designation of local truck routes was allowed per ORS 810.040 Designation of Truck Routes. In general, the statute says that a road authority can designate any of its highways as a truck route and prohibit the operation of trucks upon any other of its highways that serves the same route or area served by the truck route designated.

As the result of a 2002 Supreme Court decision, ORS 810.040 has been preempted to the extent that in an addition to receiving a delegation of state authority to proceed, the local jurisdiction now has to also establish a bona fide safety reason to create the truck route and that burden was not created by ORS 810.040. For decision-making purposes, it is necessary to characterize "bona fide safety reasons" and determine how local jurisdictions can show that designation of a local truck route is warranted.

6.36.2 Procedure

To establish a truck prohibition, a request from the Region Manager must be forwarded to the State Traffic Engineer. The request must have the concurrence of the Motor Carrier Services Manager and have followed the procedure outlined by the Motor Carrier Transportation Division (MCTD). A summary of that procedure is outlined below.

6.36.2.1 <u>City inquires about a local truck route designation and submits letter of request</u>

City staff meets with Region staff to discuss the request. Region staff provides city staff with a Local Truck Route Request Packet from the MCTD which includes a flow diagram for OTC approval, templates used to collect data, Impacts to Consider Prior to Designating a Local Truck Route and Oregon Revised Statutes Pertaining to Truck Routes.

Any city requesting approval from ODOT for a local truck route that diverts trucks from a state highway shall submit a letter of request along with the completed templates. As stated in the Background section above, before the Department approves of a local truck route, the city must provide objective safety reasons for the designation of a local truck route. For the purpose of this procedure, the term "safety" shall pertain to safety associated with pedestrians, bicyclists and drivers but not structures. In the letter of request, the city must make a plausible argument that there is a prospective safety concern. In outlining its case, the city can refer to events and changes that occurred in the past (i.e. a trend in longer trucks, increase in percent of trucks) and events or changes that will occur in the future (i.e. installation of pedestrian medians to the highway or changes in land use). Legitimate safety issues may include factors such as crashes involving trucks and other reasons. A map or maps should also be included in the submittal that clearly shows the highway segment being diverted and the local street truck route.

6.36.2.2 <u>ODOT Region reviews application</u>

The roles and responsibilities at the Region pertaining to the review of the local truck route will be identified by the Region Manager. The Region needs to involve MCTD staff in their review process. The Freight Mobility Section of ODOT should have the opportunity to provide comments as well.

ODOT Region conducts initial screening of application. If the highway is on a State freight route, ODOT Region staff need be aware that an amendment to the OHP will be needed.

If application appears reasonable, the Region sends a memo to the city asking them to prepare an LTRIP (Local Truck Route Implementation Plan) which describes what improvements, if any, are needed to the local truck route. This effort needs to be coordinated with ODOT Region and MCTD staff. The LTRIP is a detailed description of all of the improvements needed to the local streets that need to occur prior to the opening of the local truck route. The LTRIP should include a schedule as to when the necessary street, intersection, signal improvements and truck route signage installation will occur. During development of the LTRIP, it may be appropriate for the city to do a limited outreach with stakeholders.

If the recommended improvements and schedule in the LTRIP are appropriate, the ODOT Region sends a memo to the city stating so.

6.36.2.3 <u>City meets with stakeholders to determine support for truck route</u>

It is very important to check in with stakeholders to determine if they support the proposal.

- Residents, local businesses
- Oregon Trucking Association
- County, MPO or other agency impacted
- Other appropriate stakeholders

6.36.2.4 <u>City holds public hearing</u>

City notifies public and holds a hearing on the proposed local truck route. The staff report should include a discussion on the need for the local truck route, the impacts of the truck route and a draft ordinance to implement the local truck route. Depending on the situation, a city may include in the staff report an amendment to the TSP contingent upon the OTC's approval of the truck route.

In the staff report, the city should indicate the reason for the local truck route and the impacts of the truck route. It would also be helpful to identify any cost associated with improvements needed for the truck route and estimated street maintenance costs due to the truck route.

A draft IGA between the city and ODOT needs to be prepared. The IGA should outline the issues to be addressed including LTRIP improvements, maintenance and enforcement issues.

If the city council does not approve of the truck route, the Region will notify the appropriate individuals and either file the truck route request or work with the city on resolving the outstanding issues that ODOT has responsibility for.

6.36.2.5 <u>Department conducts an informal check-in with stakeholders</u>

A summary of the city's action along with the information on the proposed local truck route is provided to ODOT stakeholders including the Oregon Trucking Association, county, MPO and others as appropriate.

6.36.2.6 <u>ODOT Region prepares packet for upcoming OTC hearing</u>

If there appears to be consensus on the request for a local truck route, the packet will be prepared as a consent calendar item. The packet should include a summary of the application, summary of the city's action, summary of discussion with the stakeholders and a map. If the highway involves a state highway freight route, an amendment to the OHP needs to be included in the packet.

6.36.2.7 <u>OTC approves or denies request</u>

The request for a local truck route designation is presented. As mentioned above, the OTC also needs to take action on the OHP amendment if the highway is part of the State Highway Freight System.

6.36.2.8 <u>City makes improvements to per LTRIP</u>

After the OTC approval, the city will (if needed) complete all street, intersection and signal improvements as described in LTRIP. Once these improvements are in place, Region staff will review and determine if they are consistent with the LTRIP.

6.36.2.9 <u>Truck route opens</u>

Truck route opens after public outreach including coordination with MCTD and OTA and truck route signage is installed. In some cases, the city may need to complete an update of its Transportation System Plan (TSP) so that the local truck route is consistent with the plan. Any requests for truck prohibition signing on the state highway would be forwarded from the Region Manager to the State Traffic Engineer for consideration.

File Code: TRA 18

6.37 Turn Lanes

6.37.1 Left-Turn Lanes

Left turning vehicles can cause delay, have a major impact on intersection operations, and be a source of conflict with other maneuvers. Left-turn treatments range from prohibiting such movements, to shared lanes, to exclusive left-turn bays and two way left-turn lanes. Left-turn treatments should be considered where turning volumes, crash experience or general safety is of concern. For safety reasons, exclusive left-turn bays should be considered at all high-speed rural intersections. Traffic studies have shown exclusive left-turn bays increase safety at most intersections. On rural facilities exclusive left-turn bays can greatly reduce rear end collisions and reduce delay to through traffic.

See ODOT *Highway Design Manual* and *Standard Drawings* for guidance on the design of turn treatments. The current ODOT Left Turn Lane Criteria is available on the internet from the Transportation Planning web site that presents criteria and considerations for when left-turn lanes may be appropriate.

The ODOT *Traffic Signal Policy and Guidelines* provide guidance for left-turn signalization and warrants for phasing at intersections (see Left-Turn Signal Warrants). Separate signal phases for left-turn movements reduce the amount of green time available for other movements and so requires careful analyses. Also refer to sections on Multiple Turn Lanes, Right-Turn Lanes, and Two-Way Left Turn Lanes.

Single left-turn lanes at unsignalized intersections, that meet the following, have standing approval of the State Traffic Engineer:

- conform to current criteria
- justification is provided by an engineering investigation performed by Region Traffic
- the Region Traffic Engineer has approved the installation

File Code: TRA 07-08-02

6.37.2 Multiple Turn Lanes

General policy and criteria for multiple right or left turns at highway intersections are provided in OAR 734-020-0135 and OAR 734-020-0140 respectively. Such turns will only be authorized on the basis of an engineering study to review any accident or safety problems that might result. The study may include the following:

1. A capacity analysis that clearly demonstrates an improved level of service with multiple turning movements and/or with other considerations not to lower the level of service.

2. An assessment of the vehicle delay or queuing on the approach under consideration without implementation of multiple turn lanes. The approach may be that of the local agency street or roadway system at the intersection of the state highway.

3. Consideration of truck or other wide turning path vehicles and adequate multiple turning lane widths.

4. Consideration of special striping or raised pavement markers (RPM) to delineate the multiple turning movement and placement of advance signing as required.

Other considerations include the following:

- Roadway Design requires the receiving roadway to have a minimum receiving width of 30 feet (9.1m), a width of 36 feet (11m) is preferred.

- In most cases multiple left turn lanes require protected-only left-turn phasing.

- The design of multiple turn lanes and their interaction with pedestrian crosswalks should be carefully considered. Such consideration may include special traffic signal displays, non-conflicting phase assignments or crosswalk closure.

- The local jurisdiction should be notified of any multiple turn lane proposals involving roadways under their jurisdiction.

The installation of multiple turn lanes requires the approval of the State Traffic Engineer. The Traffic—Roadway Section maintains files on all new approved locations. Proposed locations involving traffic on the side streets at the approach to state highways will have as a part of the file a written notification of intent to the local agency.

ORS 810.130(4) allows the Oregon Transportation Commission (as the road authority) to require and direct that a different course than that specified for usual turning movements, be traveled by vehicles at or proceeding through intersections. To make this effective, appropriate traffic control devices (such as signs and/or pavement markings) must be placed within or adjacent to the intersection. The usual course for turning movements is specified in ORS 811.340, 811.345, and 811.355. Also refer to sections on Left-Turn Lanes, Right-Turn Lanes, and Two-Way Left Turn Lanes.

File Code: TRA 07-08-02-03

6.37.3 Right-Turn Lanes

Right-turn lanes are often considered in the geometric design of intersections. Such lanes provide storage as well as a deceleration area for vehicles to safely negotiate the turn. The storage function is particularly useful at railroad grade crossings during preemption of the traffic signal by rail operations. Right-turn improvements are commonly categorized by three designs:

1. Conventional right-turn lane without a channelizing island or a separate right-turn roadway,

2. Channelizing island for traffic turning right without a separate right turn lane, and

3. Separate right-turn lane and a channelizing island or provision of a channelized free right-turn roadway.

A direct taper (a taper without any full width turn lane) may be sufficient where through traffic volume is moderate and turning volumes are low. This treatment is not generally used at signalized intersections. Standard design of taper offsets and lengths are based on traffic speeds. Research has shown that a direct taper will not measurably decrease the speed differential. It will however, reduce the exposure time for which following vehicles will be exposed to the high-speed differential.

Adding right-turn lanes reduces crashes and the time motorists are delayed in traffic. Regions are encouraged to add right-turn lanes at signalized intersections where excessive pedestrian clearance times will not result. An engineering investigation should be conducted for each site where a right-turn lane is being considered. The investigation should include a crash history and identification of the type of crash that might be occurring, as well as an examination of prevailing speeds, pedestrian volumes and crossing times, and the percent of turning traffic in the total approach volume. Sight distance, alignment and cross-section of the roadway may also be factors to consider. Turning volumes, functional class of vehicle, and expected queue length in the through travel lane(s) are the main consideration for the queue storage length of the turn lane.

The use of right-turn acceleration lanes, especially in urban areas, is normally discouraged due to the fact that drivers using these lanes must look back over their shoulders to complete the merging move in a relatively short distance. This may be less than half a city block, if an upstream right-turn deceleration lane exists.

See the Highway Design Manual and Standard Drawings for guidance on the design of turn treatments. The ODOT Right-Turn Lane Criteria that presents criteria and considerations for when right-turn lanes may be appropriate is available on the internet from the ODOT Transportation Planning web site. The Traffic Signal Policy and Guidelines provides guidance for right turn signalization and warrants for phasing at intersection (see Right Turn Signal Warrants). Also refer to sections on Left-Turn Lanes, Multiple Turn Lanes, and Two-Way Left Turn Lanes.

6.37.4 Right-Turn Acceleration Lanes

6.37.4.1 Policy overview

The Traffic—Roadway Section issued a technical bulletin in November 2007 to provide guidance to project delivery teams and Region Access Management Engineers (RAME) concerning criteria for consideration of right-turn acceleration lanes on state highways as part of Statewide Transportation Improvement Program (STIP) and Oregon

Transportation Investment Act (OTIA) projects and access management issues associated with the development review process.

6.37.4.2 Definitions of key terms

Right-Turn Acceleration Lane: An added lane for right-turning vehicles joining the traveled way of the highway from a side street for the purpose of enabling drivers to make the necessary change between the speed of operation on the highway and the lower speed of the turning movement.

Rural Expressway: A subset of state highway classifications that are defined in the Oregon Highway Plan and located outside of city limits. Their purpose is to provide for high speed, high volume travel between cities and connections to ports and major recreation areas with minimal interruptions.

Volume to Capacity (V/C) Ratio: The ratio of traffic flow rate to capacity of the road to handle that traffic flow, calculated using the ODOT Analysis Procedures Manual methodology

6.37.4.3 Explanation of policy

The Oregon Transportation Commission, through ODOT's Chief Engineer has delegated the State Traffic Engineer and State Roadway Engineer with the authority to install traffic control devices (State Traffic Engineer) and determine roadway design standards (State Roadway Engineer) on state highways. The Traffic Operations Leadership Team (TOLT) and Roadway Leadership Team (RLT) have become concerned that project teams have been requesting design exceptions for non-standard acceleration lanes as part of STIP and OTIA projects. Additionally, developers have been requesting right-turn acceleration lanes as mitigation to traffic impacts associated with residential and commercial development along state highways.

6.37.4.4 Action required

In response to these concerns, both the TOLT and RLT, in consultation with the Transportation Planning Analysis Unit, have developed the following criteria for when right-turn acceleration lanes can be considered (all of the criteria must be satisfied):

1. The posted speed on the main highway shall be 45 MPH or greater.

2. The V/C ratio of the right-turn movement without the acceleration lane shall exceed the maximum value listed in Tables 6 and 7 of the OHP for the corresponding highway category and location.

a. Exception 2a: If trucks represent at least 10% of all right-turning vehicles entering the highway, then the V/C criteria may be waived.

b. Exception 2b: If substandard sight distance exists at an intersection or right-turning vehicles must enter the highway on an ascending grade of greater than 3%, then the V/C criteria may be waived.

c. Exception 2c: If crash data in the vicinity of the intersection shows a history of crashes at or beyond the intersection attributed to right-turning vehicles entering the highway, then the V/C criteria may be waived.

3. The peak hour volume of right-turning vehicles from the side street onto the state highway shall be at least 10 vehicles/hour for Rural Expressways and 50 vehicles/hour for all other highways.

4. No other access points or reservations of access shall exist on either side of the highway within the design length, taper, and downstream from the end of the taper within the decision sight distance, based on the design speed of the highway.

a. Exception 4a: If positive separation between opposing directions of traffic exist such as raised medians or concrete barriers, then access control is only needed in the direction of the proposed acceleration lane.

The State Traffic Engineer shall determine if a right-turn acceleration lane proposal meets the above criteria. Proposals should be submitted to the State Traffic Engineer and include an engineering investigation with data supporting the above criteria and a drawing encompassing the intersection and design length of the acceleration lane showing all access points and reservations of access to the highway. Only proposals for right-turn acceleration lanes from public streets will be considered. If the State Traffic Engineer determines that a right-turn acceleration lane proposal meets the above criteria, the proposal will be forwarded to the State Roadway Engineer for consideration of design standards. All right-turn acceleration lane proposals shall require the joint approval of the State Traffic Engineer and State Roadway Engineer.

Special consideration should be given to cyclists and pedestrians. Acceleration lanes create an unexpected condition for both pedestrians and cyclists. Every reasonable effort should be made to create conditions that make the crossing safer and easier for pedestrians and cyclists. The acceleration lane shall be designed in accordance with the drawing “Right Turn Acceleration Lane From At Grade Intersection” found in the Highway Design Manual.

The signing and pavement markings for the acceleration lane shall be according to standards found in the Traffic Line Manual.

Free-flow acceleration lanes may be considered in rural or suburban areas provided the turning radius is tightened and the angle of approach is kept as close to a right angle as possible. These combined elements will force right-turning drivers to slow down and look ahead, where pedestrians and bicyclists may be present, before turning and accelerating onto the roadway.

6.37.4.5 Implementation of policy

The implementation of this policy will be closely monitored by Traffic—Roadway Section staff, the TOLT, and RLT. Any revisions will be based on feedback from the Region Technical Centers, the TOLT, and RLT.

File Code: TRA 16-04-08

6.37.5 Shared (or combined) Bike and Right-Turn Lane

Several cities in Oregon have been using shared bike and right-turn lanes with good results, and ODOT has been experimenting with them. Shared bike and right turn lanes are used where widening an intersection is not possible due to physical, right-of-way or financial constraints. The use of the shared lanes is generally limited to locations where right-turn speeds and volumes are fairly low. In locations with higher volumes and speeds of turning vehicles, widening the intersection to include bike lane to the left of the right-turn lane may be necessary.

On preservation projects with bike lanes, where it may be outside the scope of the project to widen the intersection, shared lanes may be considered to carry the bicycle lane through the intersection. A shared lane is not the preferred design, but it provides some direction to both motorists and bicyclists. Decisions regarding the use of shared bike lanes should be made only after a careful examination of the facts. The following factors need to be considered:

- The shared lanes may not be suitable for use at signalized intersections and should not be used where there is separate right-turn signalization.

- The use of the shared lanes should be limited to locations where turning vehicle speeds are close to the speed of the bicycles.

Shared lanes at state highway intersections require Region investigation and approval by the State Traffic Engineer.

6.37.6 Two-Way Left Turn Lanes and Painted Medians

6.37.6.1 Definitions

A two-way left turn lane (also known as a TWLTL, special left turn lane or continuous two-way left-turn lane, CTWLTL) is a type of median reserved for the exclusive use of vehicles turning left. The TWLTL shall not be used for passing and overtaking or travel by a driver except to make a left turn (ORS 811.345 and 811.346).

A painted median or continuous median island is similar in appearance to a two-way left turn lane except the median or island is formed by two sets of double solid yellow lines separating travel in opposite directions. The two sets of double solid yellow lines designating a painted median or continuous median island provide guidance to drivers that vehicles are not to use the median or island for turning movements or as a travel lane. (See Manual on Uniform Traffic Control Devices Section 3B.03)

6.37.6.2 Practices

TWLTL's are used in areas where crashes, primarily caused by left turning vehicles, are correctable or where turning movements from the through lane are decreasing capacity of the facility. These areas are usually characterized by frequent accesses. If TWLTL's are considered in higher speed areas, caution should be taken to assure that vehicles using the TWLTL are unlikely to meet head-on at high speeds (spacing and location of accesses are critical). TWLTL's emphasize access and can encourage direct connections to the highway. A non-traversable median with openings at select local streets can encourage private access to the local street system. See the Highway Design Manual for further discussion of medians.

In most cases a non-traversable (curbed or depressed medians) are superior to a TWLTL in terms of safety and operation. On arterials with higher volumes (above 20,000 ADT) and frequent access, it may be advantageous to consider a non-traversable median, rather than a TWLTL. On higher volume or higher speed roadways the TWLTL loses much of its safety advantage, which the non-traversable medians retain.

On facilities with existing TWLTL's, the median should not be converted to a painted median until all private accesses have been removed. This is generally only true on limited access highways.

Also refer to sections on Left-Turn Lanes, Multiple Turn Lanes, and Right-Turn Lanes.

File Code: TRA 07-08 / LEG 10

6.37.6.3 Pavement Markings

See 6.22.4

6.37.6.4 Signs

See Sign Policy and Guidelines for the State Highway System

6.38 Turn Prohibitions

The State Traffic Engineer, in consultation with the Region Manager, has been delegated the authority to approve turn prohibitions involving the use of traffic control devices. This includes designating intersections where turns are prohibited in any direction, signalized or unsignalized, but does not include intersections where raised medians are used as a positive means of enforcing the allowable movements. An engineering investigation is required. OAR 734-020-0020 describes the warranting conditions for turn prohibitions and section 2B.19 in the Manual on Uniform Traffic Control Devices describes the use of turn prohibition signs.

Posting of advance public notice of an impending traffic control change is suggested when making changes to existing intersections. Installing a sign in advance of the prohibited turn is critical.

Candlesticks (28" Tubular Markers) may be installed along a centerline at a five-foot spacing to further discourage a turn movement or direct crossing of the centerline. Expect higher maintenance if the candlesticks are not placed on a mountable curb or there is not a raised median in place.

6.39 U-turns at Signalized Intersections

In Oregon U-turns are prohibited at signalized intersection unless otherwise posted. The State Traffic Engineer has been delegated the authority to designate specific signalized intersections at which U-turns may be permitted. Refer to ORS 810.130(3), ORS 811.365, Sign Policy and Guidelines for the State Highway System, OAR 734-020-0025, and Delegated Authority in this manual for guidelines and criteria. Investigations into permitting U-turns at signalized intersections should be provided by ODOT Region offices. The investigation should be based on the above criteria and forwarded to the Traffic—Roadway Section for consultation and approval.

Criteria required to be met by OAR 734-020-0025 include the following:

- The turning radii are adequate.
- The signal operation consists of three or more phases, with protected only left turn phasing.
- The turning movement is possible with a reasonable degree of safety.
- A traffic engineering investigation shows the need for the U-turn movement.

In December, 1996, the following policy was adopted in accordance with ORS 810.130(3), ORS 810.200, and ORS 811.365:

- U-turns may be permitted for all vehicles at a signalized intersection if a 62-foot (18.9 meter) width (measured from the right edge of the left turn lane to curb) for turning exists. This requires approval of the State Traffic Engineer. Each location shall be posted with sign number OR3-12, "U TURN PERMITTED."
- U-turns may be permitted for all vehicles except trucks at a signalized intersection if a 52 to 61.5 foot (15.8 to 18.7 meter) width (measured from the right edge of the left turn lane to curb) for turning exists. This requires approval of the State Traffic Engineer. Each location shall be posted with sign number OR 3-12, "U TURN PERMITTED" and sign number R5-2, the No Trucks symbol sign.
- U-turns may be permitted at other locations upon approval by the State Traffic Engineer. Signing for these signalized intersections will be determined by the State Traffic Engineer.

(Source: Sign Policy and Guidelines for the State Highway System)

U-turns are often considered in areas where access management goals require closure of highway medians. Provision for U-turns can minimize out-of-direction travel.

6.40 Visibility

Visibility distance for traffic control devices is closely related to sight distance and the primary consideration for placement of traffic control devices. The Manual of Traffic Control Devices (Manual on Uniform Traffic Control Devices) contains visibility requirements for many traffic control devices. Although there are some set criteria for visibility of traffic control devices, it is still more of an art than a science.

There are many considerations when placing traffic control devices. Critical elements are vertical and lateral placement, as determined by typical driver eye position. The geometry of the roadway, including vertical and horizontal alignments, design speed for the facility and obstructions should all be considered. Where requirements of the Manual on Uniform Traffic Control Devices cannot be met, suitable supplemental devices may be used to warn the approaching traffic. Traffic control devices should be placed so that they do not obscure each other or are hidden by obstructions. Traffic control devices requiring decisions by the driver should be visible from a sufficient distance or placed sufficiently prior to the decision point so the required decision may be made and safely acted upon.

6.41 Work Zones

6.41.1 Analysis

6.41.1.1 Overview

The Traffic—Roadway Section serves as an internal consultant for ODOT construction projects by providing recommendations on lane usage, detours, signal timing, staging, and feasibility of project plans.

The following topics are typical of work zone questions:

- How many lanes will be required to accommodate existing traffic?
- What is the maximum closure length permitted?
- When will lane closures be permitted?
- Will night work be necessary?
- Can a roadway be closed?
- If a roadway can be closed, during what times and for how long?
- What detours are available and acceptable?

- What time of the year can a project be undertaken?

- What impact will a construction project have on the local infrastructure?

As one may assume from the topics listed above, Project Teams (PT) will generally require some traffic analysis, no matter how small the project. Traffic—Roadway Section duties as an internal consultant become a major concern on all projects where staging and/or detours become necessary.

For such projects, delays can be reduced by the PT requesting an analysis at early stages of the design process. For example, construction projects between Salem and Portland on Interstate 5 must contend with high Average Daily Traffic (ADT), resulting in complicated staging, which will in turn require extensive analysis to determine if the staging will work without lengthy and costly delays to the traveling public.

6.41.1.2 <u>Procedures</u>

There are a number of questions that arise where standard traffic analysis methods do not give either meaningful or practical answers. Any questions that can be answered by standard analysis techniques are detailed under the Capacity Analysis section of this manual and will not be dealt with here.

The *Highway Capacity Manual* is used where applicable, but little concrete research has been done on traffic flow patterns and capacities under construction conditions. Those studies that have been undertaken apply only to freeway conditions. Further, since the individual geometric characteristics of each project and the traffic conditions of the surrounding area are all unique to each project, it is doubtful that any fixed standard will ever be available.

Theoretic calculations for some common conditions have been made and may be used as a starting point for analysis and are listed below:

Lane Capacity

1. Freeways, 1400 PCE (Passenger Car Equivalents)

2. Multi-lane, 1400 PCE

3. Rural (By Closure Length)

    a. 2 miles, (3.2 km), 550 PCE

    b. 1 mile, (1.6 km), 750 PCE

    c. ½ mile, (0.8 km), 900 PCE

Temporary Closures

Maximum of 75 cars in queue or 20 minutes duration. (Refer to *Standard Specifications for Highway Construction*)

Self-Regulating One Way Operations:

Maximum ADT of 500 vehicles.

Standard Holiday Restrictions:

Standard Holiday Restrictions are required on all highways that typically show an increase in traffic due to holiday associated activities. Such restrictions are typically required for roadways that show high seasonal fluctuations. The standard holidays are as follows:

- New Years Day
- Memorial Day
- Independence Day
- Labor Day
- Thanksgiving Day
- Christmas

Holidays that fall on a Monday have restrictions from the preceding Friday at noon through midnight of the following Monday/Tuesday evening. Holidays that fall during the workweek have restrictions that run from the noon of the day before to midnight of the holiday. For those holidays that fall on a Friday, restrictions extend from noon the Thursday before, to midnight of the following Sunday/Monday evening.

Standard Weekend Restrictions

Standard weekend restrictions are required on those highways that show a strong weekend, recreational character. Such restrictions are generally required by those roadways that serve recreational attractions. Work restrictions run from Friday at noon to midnight of the following Sunday/Monday evening.

Standard Commuter Restrictions

Standard commuter restrictions are required on highways that are used as commuter routes. Work restrictions run from 7:00 - 9:00 AM and 4:00 - 6:00 PM.

6.41.2 Portable Traffic Signals

A portable traffic signal is a temporary signal that can be set up without a permanent foundation. There are several types of installations, including temporary poles, trailer-mounted units and self-supporting units. They may be powered by electrical hook-up, battery, solar or some combination of power sources. For portable signals approved for use, by type of use, see the ODOT Qualified Products List (QPL) published by the ODOT Construction Section.

6.41.2.1 Construction/Overnight Use

A device that complies with the adopted guidelines for portable traffic signals found in OAR 734-020-0034 may be used at intersections or for construction projects or other situations where a temporary signal is needed for 24 hours or longer. Use of a portable signal requires the approval of the State Traffic Engineer. All such devices are subject to testing by the Traffic Systems Services Unit and shall be certified as having passed ODOT laboratory tests. Timing of all signal intervals must be approved by the Region Traffic Engineer, State Traffic Engineer or designated representative.

6.41.2.2 Temporary Work Zone Use

A device that meets the specifications for temporary portable signals for work zones in TM Drawings No. 113, 114, and 115 and the policy and guidelines contained in the Oregon Temporary Traffic Control Handbook may be used for controlling a lane closure on two-lane, two-way highways in work zones or other areas where use is limited to less than 24 hours at a time. This is a pilot program at this time. Only approved devices on the QPL may be used. A special permit is required for contractor or utility use on state highways. The timing and inspection of the signal installation is subject to the specifications and the terms of the permit. For state forces work, the Region Traffic Engineer or designated representative will approve the timing and installation. The specifications and drawings are available from the Traffic—Roadway Section.

6.41.3 Oregon Temporary Traffic Control Handbook

This Oregon Temporary Traffic Control Handbook provides a reference for the principles and standards for temporary traffic control zones in place continuously for three days or less on public roads in Oregon. It is based on the principles set forth in Part 6 of the Manual on Uniform Traffic Control Devices and is an Oregon Supplement to the MUTCD.

For work requiring devices in place longer than three days, a site specific traffic control plan based on the principles in Part 6 of the MUTCD is required. In addition, OR-OSHA has the authority to set and enforce worker safety standards.

This handbook is applicable to all public roads in Oregon. Each road jurisdiction (City, County, or State) may have additional or more restrictive requirements, and will generally require permits to work in their public right of-way. The appropriate road jurisdiction should be contacted prior to planning or beginning any work within their jurisdiction.

The primary function of temporary traffic control is to provide safe and efficient movement of road users through or around work zones while protecting workers and emergency response personnel. There are safety concerns for workers while setting up and taking down traffic control zones. As a result, this document is based on the premise that simplified traffic control procedures are warranted for shorter term activities.

7 APPENDICES

7.1 Definitions

Ball-bank Indicator - A curved level, which is used to determine the safe speed around a curve, as indicated by trial speed runs. The indicator measures the centrifugal force on the vehicle. The ball-bank indicator is designed to show the combined effect of the vehicle body roll angle, the centrifugal force, and the superelevation angle of the roadway.

Bench Repair - Repairs made to signal control equipment in a shop that specializes in the repair and testing of traffic signal control equipment.

Bicycle lane - [ORS 801.155] That part of the highway, adjacent to the roadway, designated by official signs or markings for use by persons riding bicycles except as specifically provided by law.

Bicycle path - [ORS 801.160] A public way, not part of a highway, that is designated by official signs or markings for use by persons riding bicycles except as specifically provided by law.

Bottleneck - A link (or section) in a transportation system having a maximum carrying capacity significantly less than the adjoining links. A link represents a continuous section between major nodes. Major nodes may include interchanges (or specific entrance or exit ramps) on controlled access highways and transitways, public road intersections on non-controlled access highways, and guideway junctions on fixed guideway systems. Major nodes on any system may also be defined as a point of geometric change, such as in vertical or horizontal alignment, lane width, etc., which results in significantly reduced operating characteristics. The capacity of the link downstream from the bottleneck must be equal to, or greater than that of the upstream link.

Capacity - The maximum number of vehicles (vehicle capacity) or passengers (person capacity) that can pass over a given section of roadway or transit line in one or both directions during a given period of time under prevailing roadway and traffic conditions.

Category - Used to prioritize emergency traffic signal maintenance response consistent with intersection Level of Service (LOS) on file when traffic signal is in flash condition. The LOS is calculated using the Department's unsignalized intersection capacity analysis program UNSIG10 or determined by the region traffic manager based on prior experience with operations under flash conditions at the intersection. Categories are as follows:

Category 1: (Highest level of response) Intersections operating at LOS F when in flash condition during the 8th highest hour of the day. This condition requires a high priority response to a trouble call.

Category 2: (Intermediate level of response) Intersections operating at LOS F when in flash condition during the peak traffic hour but not during the 8th highest hour of the day. This condition requires a response to a trouble call after all Category 1 emergency responses and before any Category 3 emergency responses.

Category 3: (Lowest level of response) Typically remote location intersections operating at LOS E or better in flash condition during the peak traffic hour of the day. Response to a trouble call will be made after all higher priority (Category 1 or 2) emergency responses.

Commercial vehicle - [ORS 801.210] A vehicle that: (1) is used for the transportation of persons for compensation or profit; or (2) is designated or used primarily for the transportation of property.

Crossover - A roadway crossing the median and located generally at right angles to, between and connecting the inside or median shoulders of the separate through roadways of a freeway.

Crosswalk - [ORS 801.220] Any portion of a roadway at an intersection or elsewhere that is distinctly indicated for pedestrian crossing by lines or other markings on the surface of the roadway that conform in design to the standards established for crosswalks under ORS 810.200. Whenever marked crosswalks have been indicated, such crosswalks and no other shall be deemed lawful across the roadway at that intersection. Where no marked crosswalk exists, a crosswalk is that portion of the roadway described in the following:

(1) Where sidewalks, shoulders or a combination thereof exists, a crosswalk is the portion of a roadway at an intersection, not more than 20 feet (ED. approximately 6 meters) in width as measured from the prolongation of the lateral line of the roadway toward the prolongation of the adjacent property line, that is included within:

(a) The connections of the lateral lines of the sidewalks, shoulders or a combination thereof on opposite sides of the street or highway measured from the curbs, or in the absence of curbs, from the edges of the traveled roadway; or

(b) The prolongation of the lateral lines of a sidewalk, shoulder or both, to the sidewalk or shoulder on the opposite side of the street, if the prolongation would meet such sidewalk or shoulder.

(2) If there is neither sidewalk nor shoulder, a crosswalk is that portion of the roadway at an intersection, measuring not less than six feet (ED. 1.8 meters) in width, that would be included within the prolongation of the lateral lines of the sidewalk, shoulder or both on the opposite side of the street or highway if there were a sidewalk.

DUII - Driving Under the Influence of Intoxicants. (See Impaired Driving Victim Memorial Signing.)

Emergency - For traffic signal maintenance, a situation that seriously impedes the flow of traffic or is a serious hazard to the public. Listed below are some examples that should be classified as emergency situations. These are high priority responses.

- Traffic signal knock down (poles, cabinet, etc.)
- All signal indications out
- Confusing indications
- Category 1 intersections in flash operation

Emergency Call Out - For traffic signal maintenance, a high priority response.

Emergency vehicle - [ORS 801.260] A vehicle that is equipped with lights and sirens as required under ORS 820.350 and 820.370 and that is any of the following:

1. Operated by public police, fire or airport security agencies.
2. Designated as an emergency vehicle by a federal agency.
3. Designated as an emergency vehicle by the Director of Transportation.

Failsafe preemption system - preemption systems that are hard wired to the signal controller and operate independently of any other signal function. The default state of a failsafe system is preemption.

Freeway - A fully access controlled throughway.

Freeway Median - The space between inside shoulders of the separated one-way roadways of a divided highway (typically separating opposing directions of travel).

Highway - [ORS 801.305] Every public way, road, street, thoroughfare and place, including bridges, viaducts and other structures within the boundaries of this state, open, used or intended for use of the general public for vehicles or vehicular traffic as a matter of right.

Intersection - [ORS 801.320] The area of the roadway created when two or more roadways join together at any angle, as described in one of the following:

(1) If the roadways have curbs, the intersection is the area embraced within the prolongation or connection of the lateral curb lines.

(2) If the roadways do not have curbs, the intersection is the area embraced within the prolongation or connection of the lateral boundary lines of the roadways.

(3) The junction of an alley with a roadway does not constitute an intersection.

(4) Where a highway includes two roadways 30 feet (ED. 9.1 meters) or more apart, then every crossing of each roadway of the divided highway by an intersection highway is a

separate intersection. In the event the intersection highway also includes two roadways 30 feet (ED. 9.1 meters) or more apart, then every crossing of two roadways of such highways is a separate intersection.

Median – A continuous divisional island which separates opposing traffic and may be used to separate left turn traffic from through traffic in the same direction as well. Medians may be designated by pavement markings, curbs, guideposts, pavement edge or other devices. (See also **Non-Traversable Medians** and **Traversable Medians**)

Non-Emergency - For traffic signal maintenance, a situation, which does not seriously impede the flow of traffic and does not appear to pose a serious problem to the public as determined by the Region Traffic Manager. These are regular work priority responses and are responded to as resources are available. Listed below are some examples that should be classified as non-emergency situations.

- A single indicator of a dual indication movement burned out
- Damaged signal hardware (intersection still functioning)
- Stuck pedestrian push button
- Malfunctioning vehicle detector

Non-Traversable Medians – Medians that are designed to impede traffic from crossing the median. Examples include curbed medians or concrete barrier medians, also included are depressed grass or landscaped medians.

Occupancy - (1) The amount of time motor vehicles are present in a detection zone expressed as a percent of total time. This parameter is used to describe vehicle density, a measure of highway congestion.

(2) The number of passengers in a vehicle, which when used in conjunction with vehicular volume, provides information on the total number of persons accommodated on a transportation link or within a transportation corridor.

On Call - Personnel designated by the TSSU manager, Region Traffic manager, District manager, or Region manager to be on call and prepared to respond to traffic signal trouble calls 24 hours a day 7 days a week.

OR Route - A Route system established and regulated by the Oregon Transportation Commission to facilitate travel on main highways throughout the state. Not all OR Routes are on state highways and not all state highways have an OR route number.

Principal Arterial (Urban, Controlled Access) - A street or highway in an urban area which has been identified as unusually significant to the area in which it lies in terms of the nature and composition of travel it serves. The principal arterial system is divided into three groups: Interstate freeways; other freeways and expressways; and other principal arterials (with no control of access).

Principal arterials should form a system serving major centers of activity, the highest traffic volume corridors, and the longest trip desires; and should carry a high proportion of the total urban area travel on a minimum of mileage.

Qualified Personnel - ODOT personnel are certified for the types of signal work being performed in the control cabinets. There are four levels of certification administered by TSSU that are required in order to perform work on traffic signal control equipment in the field. A higher level certification qualifies a person to perform the maintenance and operations functions of a lower level certification.

Region Traffic Engineer / Manager - Registered Professional Engineer, or person working under direct supervision of a Registered Professional Engineer, responsible for traffic operations in the Region. Actual position titles may vary from region to region.

Region Electrical Supervisor - Person responsible for electrical maintenance in the Region or District.

Road authority - [ORS 801.445] The body authorized to exercise authority over a road, highway, street or alley under ORS 810.010.

Roadway - [ORS 801.450] The portion of a highway that is improved, designed or ordinarily used for vehicular travel, exclusive of the shoulder. In the event a highway includes two or more separate roadways the term "roadway" shall refer to any such roadway separately, but not to all such roadways collectively.

Signal mounted preemption systems - Preemption systems that require the installation of a traffic signal-structure-mounted preemption detector, which reacts to a remote triggering device. The default state of a signal-mounted system is normal signal operation.

Shoulder - [ORS 801.480] The portion of a highway, whether paved or unpaved, contiguous to the roadway that is primarily used by pedestrians, for the accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

Special Event - Any planned activity that brings together a community or group of people for an expressed purpose, including, but not limited to, parades, bicycle races, road runs and filming activity that may result in total or partial closure of state highways or state highway sections.

State Highway - The State Highway System as designated by the Oregon Transportation Commission, including the Interstate system.

State Highway Index Number – An Oregon Transportation Commission approved identifier assigned to a highway. Every state highway has a state highway index number, commonly referred to as a **State Highway Number**.

State Highway Name – An Oregon Transportation Commission approved name used in conjunction with a State Highway Index Number to identify a state highway.

Throughway - [ORS 801.524] Every highway, street or roadway in respect to which owners or occupants of abutting lands and other persons have no legal right of access to or from the same except at such points only and in such manner as may be determined by the road authority having jurisdiction over the highway, street or roadway.

Traffic control device - [ORS 801.540]

1. Any sign, signal, marking or device placed, operated or erected by authority under ORS 810.210 for the purpose of guiding, directing, warning or regulating traffic.

2. Any device that remotely controls by electrical, electronic, sound or light signal the operation of any device identified in subsection (1) of this section and installed or operated under authority of ORS 810.210.

3. Any stop sign that complies with specifications adopted under ORS 810.200 that is held or erected by a member of a highway maintenance or construction crew working in the highway.

Traffic Management Program - A systematic process that collects and analyzes traffic operation information on a real time basis and provides for implementation of one or more of the following, reasonably available operational management strategies:

- Traffic surveillance and control systems
- Motorists information systems
- Transit information systems
- Freeway ramp metering
- Traffic control centers
- Computerized traffic signal systems
- High Occupancy Vehicle (HOV) ramp meter bypass lanes
- Bus bypass (queue jump) lanes
- Park and ride facilities
- Access management techniques
- Incident management systems and equipment

Traversable Medians – Medians that are typically built to provide a separation between opposing traffic but do not impede traffic from crossing the median. Examples include painted islands such as two-way left-turn lanes.

Trouble Call - A call from an emergency response center, the police, a citizen, etc., reporting a malfunctioning traffic signal.

US Route - A Route system established by the US Congress to facilitate travel on main highways throughout the nation. This route system is regulated by an AASHTO committee.

7.2 Forms

Previous editions of the ODOT Traffic Manual included various forms in the Appendix of the manual. The ODOT Traffic—Roadway Section is in the process of automating many of its forms and posting them on the internet to the ODOT Traffic—Roadway Section web site. For specific information about a particular form, check the information listed below. If the form is not listed, contact the ODOT Traffic—Roadway Section for more information.

7.2.1 Signs

The ODOT Roadside Inventory Form for "Signs" (F) is available on the internet in the Highway Design Manual, Appendix D published by ODOT Technical Services.

7.2.2 Preliminary Traffic Signal Warrant Analysis

Contact the Traffic Operations Engineer in the ODOT Traffic—Roadway Section for a copy of this form.

7.2.3 Traffic Signal Warrant Analysis

Contact the Traffic Operations Engineer in the ODOT Traffic—Roadway Section for a copy of this form.

7.2.4 Traffic Signal Approval Request Form

This form is available on the internet from the ODOT Traffic—Roadway Section web site.

7.2.5 Worksheet for Determining the Need for a Reduced Speed Zone for Work Zones

This form is available on the internet from the ODOT Traffic—Roadway Section web site.

7.2.6 Parking Prohibition Request Form

This form is available on the internet from the ODOT Traffic—Roadway Section web site.

7.3 Files

The Administrative Management Section maintains files for use by the Traffic—Roadway Section. These files include Subject Files with appropriate coding to differentiate between files. The two main codes used for Traffic—Roadway Section documents in the Subject Files are TRA (Traffic Engineering and Safety) and TSO (Transportation Systems Operations). The major codes in these files are listed below. Individual files often contain extensive additional levels of code beyond those listed.

Code		**Topic**
TRA 01		Traffic Engineering Policies and Procedures
TRA 02		Highway Information Tracking Systems
TRA 03		Accident Analysis
TRA 04		Traffic Accidents – Monthly Accident Data-State Police
TRA 05		Traffic Congestion Management System (CMS)
TRA 06		Load Limitations
TRA 07	TRA 07-01	Parking
	TRA 07-02	State Speed Control Board (SSCB)
	TRA 07-08	Channelization
	TRA 07-11	Crosswalk and Safety Islands
	TRA 07-12	Railroad Crossings
	TRA 07-13	School Crossings
	TRA 07-14	Walkways/Sidewalks/Footpaths
TRA 08		(Not Active)
TRA 09		Photo-log System/Road Log
TRA 10		Traffic Safety
TRA 11		National Trails
TRA 12		Special Equipment
TRA 13		Traffic Operations Program

Code		**Topic**
TRA 14		Vehicle Miles and Ton Miles
TRA 15		Traffic Studies
TRA 16	TRA 16-01	Illumination
	TRA 16-02	Pavement Markings
	TRA 16-03	Curb Markers
	TRA 16-04	Traffic Control Signs
	TRA 16-05	Speed Zoning
	TRA 16-06	Signals
	TRA 16-07	Testing and Research of Traffic Control Devices
	TRA 16-08	Median/Shoulder Barriers
	TRA 16-09	Manual on Uniform Traffic Control Devices
	TRA 16-10	
	TRA 16-11	Barricades
TRA 17		Highway Map Revisions
TRA 18		Road Inventory
TRA 19		Road Life Studies
TRA 20		Vehicle Safety and Equipment
TRA 21		Vehicle Inspections
TRA 22		Vehicle and Traffic Safety
TRA 23		Directional and Informational Signing
TRA 24		Logo Signing
TRA 25		TODS
TRA 26		Interstate Cultural and Historical Signs
TRA 27		Brown Sign Program

Code		Topic
TRA 28		Southern Oregon Regional Signing Study
TRA 29		Travel Publications
TRA 30		Grants of Access
TSO 01		Intelligent Transportation Systems (ITS) – General
TSO 02		ITS Reference Material – General
TSO 03		ITS Organizations
TSO 04		ITS Standards and Specifications
TSO 05		ITS Vendor Information
TSO 06		ITS Planning
TSO 08		ITS
TSO 09		ITS
TSO 10		ITS Projects

7.4 Crash Analysis

Note: the Traffic—Roadway Section is currently working on a "Safety Investigations Manual" that will replace this Appendix with more updated and useful material.

7.4.1 Overview

Crash analysis is an important traffic engineering tool used to answer questions and to determine what questions to ask. The choice and arrangement of the data depend heavily upon the nature of the question, availability of pertinent data, and time available.

The principle of crash analysis is to identify the patterns of crash types which will lead to identification of solutions. Dominant crash types provide the most reliable guide to the remedial action since they are likely to be indicative of some problem. Crashes are generally a rare event and the patterns exhibited by crash tend to vary greatly so statistical techniques are required to help differentiate between true differences in crash data and the routine variation that should be expected in normal operations.

References that are useful for crash analysis include:

1. Traffic Engineering Handbook, Institute of Transportation Engineers, 1992. This book includes a discussion of crash analysis and its applications. There are examples for some of the applications.

2. Manual of Transportation Engineering Studies, Institute of Transportation Engineers, 1994. This book goes into much more detail that is useful for gathering and organizing data for analysis. Several useful examples are given for applying principles of statistics to traffic engineering. This may be a good reference for someone being introduced to the application of statistics.

Crash analysis data sources are discussed in Section 6.5.2. (Metric equivalents for information provided in the following discussion were not available.)

7.4.2 Crash Summaries

An easy way to diagnosis crash problems is to create tables that sort crashes into general types to help visualize driver's performance on part of a roadway. Crashes can be summarized according to a range of environmental or other characteristics such as:

- By type and or severity of crash
- By vehicle movements
- By contributing circumstances
- By environmental conditions
- Light, weather, surface condition

- By time of day

Various proportions, e.g., percentage of daytime crashes, can be compared to tallies such as in *Summary of Oregon Traffic Crashes*, and summaries generated by the SPIS Crash Summary Database for similar or extended sections of highway. The Traffic—Roadway Section has created a simple tool to create summaries of crash data on the ODOT intranet for any state highway.

7.4.3 Collision Diagrams

A collision diagram is a schematic representation of all crashes occurring on a simple plan view at a given location. Each collision at the site is represented by a set of arrows one for each vehicle or pedestrian involved and may display a variety of data about each crash such as:

- Date and time
- Environmental conditions
- Severity
- Vehicle directions and original position

The collision diagram is very helpful for identifying patterns or movements that are key problems at a location. The Transportation Data Section has developed a beta test version of a desktop collision diagramming software which should be available in the fall of 2003. Collision diagram can also be requested from the Crash Analysis and Reporting Unit.

7.4.4 Geographic Information Systems (GIS) Analysis

GIS has the ability to display spatial data in map format. Since the ODOT GIS Unit produces a map file of all crashes on the state highway system, it is possible to overlap a variety of other variables that are mapped and studied to recognize patterns correlating to the following attributes:

- Curves
- Speed limits
- Other road inventory or features
- Alcohol-related (bars)

Contact the Highway Safety Engineering Coordinator for more information on this topic.

7.4.5 Statistical Techniques

A variety of statistical techniques are available to estimate depending on the question that is to be answered. Please contact the Highway Safety Engineer for assistance.

7.4.6 Crash Rates

Section Crash Rates (CR) compares assorted highway locations with each other and typically requires some effort to standardize the data. Relatively simple ratios can be used, such as "crashes per mile per year." The most widely used ratio is the crash rate. This standardizes section length, time, and traffic volume. The most common crash rate for highway sections is derived as follows:

$$CR = \frac{(\text{Crashes})(1{,}000{,}000)}{(\text{ADT})(365)(\text{Length (mi)})(\text{Years})} = = \text{Crashes per million vehicle miles}$$

As section lengths approach zero, the crash rate can give unreasonable numbers. Evaluate crash rates for short sections by trying small changes in the number of crashes. If the changes in crash rate are dramatic, then either this type of crash rate should not be used, or its use should be accompanied with a warning.

Intersection Crash Rates (ICR) uses nearly the same equation as section crash rates.

$$ICR = \frac{(\text{Crashes})(1{,}000{,}000)}{(\text{ADT})(\text{Years})(365)} = \frac{(\text{Crashes})(1{,}000{,}000)}{\text{Total entering vehicles}} = \text{Crashes per million entering vehicles}$$

Length has been omitted, and the volume of the intersecting road has been included. The entering volume equals half the sum of the ADT's of all the legs. Some reports have been published stating that ODOT considers all intersection crash rates above 1.00 crashes/mev to be significantly high. There is no such department policy. A September 1994 memorandum from Eric Bonn to the Region Traffic Managers includes the results from a sample of 413 intersections on the state highway system. This sample may not fully represent highways in Oregon because it included only the intersections for which sufficient data were readily available. Several sub-groups of data were evaluated. Cutoff points for the top ten percent of crash rates were predicted at values ranging from 0.65 to 1.25 crashes / mev, depending upon the sub-group selected.

7.4.7 Comparing Crash Rates

Crash rates on the state highway system can be compared to statewide rates for similar sections. Simply exceeding the statewide rate should not be interpreted as proof that a section is "hazardous". The Rate Quality Control method was developed to identify sections that have a significantly high crash rate:

$R_c = R_a + K\sqrt{\frac{Ra}{m}} + \frac{1}{2m}$, where R_c = Critical rate (or the rate above which the local crash rate should be considered significant), R_a = Average rate which can be obtained from the State Highway Crash Rate publication by the Crash Analysis and Reporting Unit (e.g.

0.72 crashes/mvm on urban, primary, freeways in 2001), K = multiplier based upon desired significance level. (K = 1.645 for 5% level of significance.), and m = millions of vehicle miles = [(ADT)(Miles)(Years)(365)]/1,000,000. Other values of K can be obtained from probability tables for the normal distribution in most statistics references. Caution should be used when selecting the average crash rate, since it is critical to calculation. For example, the statewide crash rates for urban highways may not be applicable to urban highways in eastern Oregon since the performance of these facilities is much different than urban highways in the Willamette Valley which make a majority of the highways used to calculate the average.

7.4.8 Estimating the Effectiveness of a Treatment

It is often of interest to estimate the effectiveness of engineering treatments on safety However, separating the true safety affects of an improvement for other factors such as changes in volume, weather, time trend variations (regression-to-the-mean), driver behavior, and a variety of other factors is a complicated task. If the evaluation is to be done correctly, unique expertise in appropriate estimation procedures and knowledge of the data sources are needed. Contact the Highway Safety Engineering Coordinator for guidance or assistance on this topic.

7.5 Traffic Engineering Programs

The Traffic—Roadway Section administers several traffic engineering related programs that are described below.

7.5.1 Blue Star Memorial Program

7.5.1.1 Background

At the request of the Oregon State Federation of Garden Clubs, the 1947 Oregon Legislature adopted a resolution designating certain state highways as Blue Star Memorial Drives. The legislature further resolved that ODOT shall erect along said highways suitable tablets and ornamentations to perpetuate the resolution.

This is a program put in place to honor and memorialize men and women of Oregon who served in the armed forces of the United States. This program began in the 1940's and was inspired by the blue stars that mothers put in their windows to signify that they had a son or daughter serving in WW II. The program is part of a national program that is sponsored by the National Council of State Garden Clubs, Inc. The original designation consisted of one transcontinental east and west route and seven north and south routes and was normally assigned one to a state. They were designated throughout their length, or for a considerable distance, generally involving more than one state. These were through routes rather than short sections in one state only.

7.5.1.2 List of Blue Star Memorial Highways

The following is a list of highways that have been adopted by the Oregon Transportation Commission and are referred to as Blue Star Memorial Highways. Included are the highway routes and their adoption dates by the commission.

Highway Name	**Route**	**Adoption Date**
Pacific Highway	OR 99	1948
Pacific Highway East	OR 99E	1948
Pacific Highway West	OR 99W	1948
The Dalles-California Highway	US 97	1959
Pacific Highway	I-5	1967
Columbia River/Old Oregon Trail Highway	I-84	1977
Oregon Coast Highway	US 101	1980
East Portland Freeway	I-205	2000

7.5.1.3 Establishment of Blue Star Memorial Highways

The Blue Star Memorial Highways are commemorated with a bronze marker mounted on a support post. The local garden club that sponsors the marker usually enhances the landscape with a small garden at the foot of the marker. The program currently has about 30 markers in place.

ODOT has historically been responsible for installing the marker and the Oregon State Federation of Garden Clubs has been responsible for the furnishing and maintaining the marker/ landscaping.

The site for new markers along these routes is to be worked out with the maintenance district. Common practice has been to place markers in areas of high visibility, such as a highway rest area, which promotes higher visibility and reduced vandalism. The landscaped areas provide rest and relaxation for the weary traveler.

7.5.2 Impaired Driving Victim Memorial Signing

7.5.2.1 Overview

Upon the request of the family of a victim of an impaired driving crash and when certain requirements are met, a sign can be installed on the State Highway System at the site of a fatality caused by an impaired driver.

7.5.2.2 Background

ODOT established its own Impaired Driving Victim Memorial Signing Program in 1995. The first sign was installed in October 1995 in Tillamook County. As of September 2004, 33 signs have been installed.

7.5.2.3 Guidelines

The following guidelines were approved by a program review committee on December 19, 2000:

1. A sign can be installed at the site of a fatal crash that was caused by a driver who has been convicted of Negligent Homicide or Manslaughter in the first or second degree and was driving under the influence of intoxicants (blood alcohol content of 0.08 or greater). A sign can also be installed at the site of a fatal crash that was caused by a deceased driver who had a blood alcohol content of .08 percent or greater.

2. Signs installed will be black on white, 36” X 48” with a legend which reads “DON’T DRINK AND DRIVE”, below which will be a 36” X 12” plaque with the message “IN MEMORY OF (Victim’s Name).” Normally up to three names can be listed, but more than one name will require a larger plaque.

3. Each successful applicant will be entitled to one sign assembly as described above, mounted on one side of the post only (no back-to-back signs), facing oncoming traffic, and only on the side of the road nearest the lane of that

oncoming traffic. In special situations where a sufficiently large turnout or wayside is available (as determined by Region Traffic Operations staff), and if acceptable to the applicant, a sign may be mounted parallel to the roadway rather than facing oncoming traffic.

4. Signs will normally be installed only in rural areas on state highways.

5. Signs will not be installed on the interstate system, freeways, or their ramps.

6. ODOT has no jurisdiction on county roads or city streets and thus cannot provide signs along these roadways.

7. The sign must be requested by the family of the victim or other sponsor and be paid for by the victim's family or the sponsor. The sponsor need not be a family member, but any proposed installation must include agreement with an appropriate member of the victim's family. If a given crash resulted in more than one fatality, and those fatalities were from different families, the applicant must contact the families of those other victims before application is made, in order to gain written concurrence on whether the sign should even be applied for, which names should appear on the sign, and how much each family will contribute toward the cost of the sign. Only one sign will be installed for any given crash.

8. Signs will cost $600. This amount is intended to cover expenses incurred, such as time spent on review of the application by the program coordinator, investigation of the proposed site by Region personnel, manufacture of the sign by the ODOT Sign Shop, and installation by the Maintenance District sign crew. Only one $600 check or money order will be accepted as payment for any successful application.

9. Region Traffic Operations staff will investigate all proposed installation sites and make a recommendation to the State Traffic Engineer regarding sign placement. If the investigation determines that a location other than the one requested in the application is more appropriate, a distance of as much as one half mile away will be acceptable, with variations as approved by the State Traffic Engineer. In no case, however, will the alternate location be on a highway other than the one on which the crash occurred.

10. The State Traffic Engineer will approve or deny requests received and sign an agreement with sponsors and family members on those that are approved.

11. Signs will remain in place until they are weathered (usually seven to ten years). At that time, they will be removed. If a sign in serviceable condition is stolen, vandalized, or otherwise badly damaged, it will be replaced one time at ODOT expense. After a sign has been removed due to weathering, the original applicant may renew installation of the original sign by paying another $600.

7.5.2.4 Application Procedure

Persons wishing to sponsor a memorial sign should submit a written request to:

State Traffic Engineer
Oregon Department of Transportation
355 Capitol Street NE, 5th Floor
Salem, OR 97301-3871

The request should include the following information:

1. Name, address, and telephone number of applicant and relationship to victim

2. A brief description of the crash

3. Date and location of the crash — This should include the highway name or route number, as well as direction and distance in feet from the nearest green milepost paddle, and distance and direction from any other nearby landmarks (such as an intersecting road, or a bridge over a named stream).

4. Names of all parties involved in the crash

5. Proof of conviction (unless driver is deceased) and blood alcohol or drug level of driver (from court, police, or Medical Examiner's records)

6. Name or names, as they should appear on the sign

7. Commitment to provide $600 for installation of sign — Payment will be requested once a sign is approved.

For more information, contact the program coordinator at 503-986-6644.

File Code: TRA 24-01-14

7.6 Legal Authority

References are made throughout this manual to Oregon Revised Statutes (ORS) and Oregon Administrative Rules (OAR). Several items of particular, general interest are highlighted below:

7.6.1 Crosswalks

ORS 801.220 defines crosswalks, **ORS 811.010 and ORS 814.040** also apply to crosswalks and pedestrians. ODOT contains guidelines for determining when it is appropriate to mark crosswalks.

7.6.2 Delegation of Authority

The Oregon Transportation Commission, pursuant to **ORS 184.635** and in order to provide for a more efficient and expeditious administration of the Department, delegates operations matters to the Chief Engineer (also called the Technical Services Manager). Matters dealing with traffic control devices are assigned to the State Traffic Engineer by letter of authority and by **OAR 734-020-0410**. Guidelines and policies for traffic signal design, traffic signal operation, highway sign type and placement, and variable message sign operation, among others, are items approved by the State Traffic Engineer in consultation with the Oregon Traffic Control Devices Committee (OTCDC).

7.6.3 Emergency Vehicle Preemption

The proper use of emergency vehicle preemption (traffic control signal operating) devices is described in **ORS 815.440**. The standards for installation, operation and use are defined in **OAR 734-020-0300 through 734-020-0330**.

7.6.4 Freeway Median Crossovers

The process and criteria for establishing freeway median crossovers is provided in **OAR 734-020-0100 through 734-020-0115**.

7.6.5 Incident Management

OAR 734-020-0145, OAR 734-020-0147, and OAR 734-020-0150 provide direction for the management of incidents or related activities**.** These OAR's establish procedures for removal of spilled vehicle loads and wrecked vehicles from the travel portion of state highways; procedures for the removal of disabled, abandoned, or otherwise unattended vehicles on state highways; and procedures for the closure of highways when weather or road conditions constitute a danger of highway damage or a danger to the driving public, respectively.

7.6.6 Jurisdiction

ORS 810.010 designates the bodies responsible for exercising jurisdiction over highways when the vehicle code requires the exercise of jurisdiction by the road authority. This section does not define maintenance responsibility.

7.6.7 Multiple Turns at Highway Intersections

The criteria for establishing multiple right and left turns at highway intersections are provided in **OAR 734-020-0135 through 734-020-0140**.

7.6.8 One-way Operation, Transit Exceptions

ORS 810.130 allows road authorities to designate specific lanes or highways where vehicle traffic must proceed in one direction at all times or at times indicated by traffic control devices. This section also allows the designation of locations where public transit vehicles may proceed in a direction prohibited to other traffic.

7.6.9 Parking Prohibitions

Each road authority has the authority to regulate, control and prohibit parking according to **ORS 810.160.** The process for establishing parking prohibitions or restrictions is defined in **OAR 734-020-0020 and OAR 734-020-0080 through 734-020-0090.**

7.6.10 Restrictions by Vehicle Type or Weight

ORS 810.030 allows the road authority to impose restrictions on highway use, by any or all vehicle types or weight classes, in order to protect the highway from damage or to protect the interest and safety of the general public. Restrictions or limitations imposed under this section must be imposed by proper order. This section does not grant authority to impose speed restrictions. Related administrative rules include **OAR 734-020-0045, OAR 734-020-0080, and OAR 734-020-0100 through 0115** which prohibit non-motorized vehicles on certain highways; establish restrictions on overnight parking (non-emergency) on state highways; and provide for the use of freeway median crossovers, respectively.

7.6.11 School Zones

ORS 810.180 and **ORS 811.111** cover the establishment of school speed zones. **ORS 811.124, ORS 811.106, and ORS 811.235** also apply to school speed zones. ODOT's A Guide to School Area Safety provides further information regarding school area safety.

7.6.12 Speed Zones

ORS 810.180, **ORS 811.100 through ORS 811.111** and **OARs 734-020-0014, -0015, -0016, and -0017** cover the establishment of speed zones in the State of Oregon (See also ODOT's Speed Zone Manual). Low volume roads and non-hard surfaced roads may be delegated to local jurisdictions.

7.6.13 Traffic Control Device, Appropriate Driver Responses

The appropriate driver response to traffic signal indications, including circular and arrow indications whether steady or flashing, lane direction control signals, stop signs and yield signs is provided by **ORS 811.260**. Turns made against a red indication are permitted under **ORS 811.360**. Appropriate responses to railroad crossing signals are provided by **ORS 811.455**.

7.6.14 Traffic Signal Approval Process

The Process that establishes consideration and approval for installation or removal of traffic signals on state highways is defined in **OAR 734-020-0400 through 734-020-0500**.

7.6.15 Transit and HOV Lanes

ORS 810.140 allows a road authority to designate bus or HOV lanes. Any restriction imposed must be imposed by proper order. **OAR 734-020-0035 through 734-020-0043** contain the orders establishing such lanes. The only order currently in effect is **OAR 734-020-0043** for the I-5 HOV Lanes in North Portland. Two such orders have been repealed - **OAR 734-020-0035** for the Barber Boulevard (US 99 W Portland) Transit Lanes in 1977 and **OAR 734-020-0040** for the Banfield (I-84 nee I-80N Portland) HOV Lanes in 1975. Both were repealed in September 1983. A third order – **OAR 734-020-0042** - establishing temporary HOV Lanes on I-5 and I-205 during emergency repairs to the Interstate Bridge in the summer of 1997 expired in October 1997.

7.6.16 Turn Prohibitions

A description of the warrants and criteria for establishing U-turns at signalized intersections and turn prohibitions are described in **OAR 734-020-0020**, this authority is derived from **ORS 810.210**.

7.6.17 Uniform Standards and Placement

ORS 810.200 and **ORS 810.210** provide for the establishment of uniform standards and placement of traffic control devices. The Oregon Transportation Commission adopts the Manual on Uniform Traffic Control Devices, the Oregon Supplement to the MUTCD, and the Oregon Temporary Traffic Control Handbook by **OAR 734-020-0005**.

7.6.18 U-turn Designations

A description of the warrants and criteria for establishing U-turns at signalized intersections are described in **OAR 734-020-0025**, this authority is derived from **ORS 810.130**.

8 REFERENCES

(See Chapter 3 for Publications prepared or distributed by the ODOT Traffic—Roadway Section)

Title	Author/Publisher	Date Published
A Policy on Geometric Design of Highways and Streets and other AASHTO Publications	AASHTO	2001
An Evaluation of the Safety Priority Index System (SPIS)	Dr. Robert Layton (Retired) , Oregon State University	
Bridge Log	ODOT Bridge Engineering Section.	
CalTrans Traffic Manual	California Department of Transportation	
Code of Federal Regulations (CFR)	Highways - Title 23	
Contract Plans and Development Guide	ODOT Construction Contracts Section	
Crash Listing	ODOT Crash Analysis and Reporting Unit	Various years
Crash Rate Tables, State Highway System	ODOT Crash Analysis and Reporting Unit	Various years
Delegation Orders and Subdelegations	ODOT Support Services Division	
Guide for the Development of Bicycle Facilities	AASHTO	
Highway Capacity Manual	TRB, Special Report 209	October 1994
Highway Capacity Manual and other TRB Publications	TRB	
Informational Guide for Roadway Lighting	AASHTO	
Intersection Channelization Design Guide	TRB, NCHRP Report 279	

Title	Author/Publisher	Date Published
Issues Surrounding Highway and Roadside Safety Management	TRB, Transportation Research Circular, No. 416	October 1993
Lighting Handbook, 8th Edition	IESNA	
Maintenance Guide	ODOT Statewide Office of Maintenance	
Manual on Uniform Traffic Control Devices	USDOT—FHWA	November 2004
National Electrical Code Handbook	National Fire Protection Association.	
National Electrical Safety Code	IEEE	
Navigational Lighting	Federal Register; U.S. Coast Guard.	
Obstruction Marking and Lighting	USDOT—FAA	
Oregon Administrative Rules	Oregon State Archives	
Oregon Bicycle and Pedestrian Plan	ODOT Traffic—Roadway Section	
Oregon Highway Plan	ODOT Planning Section	
Oregon Vehicle Code	ODOT Driver and Motor Vehicle Services	
Pedestrian Crosswalk Case Studies	R.L. Knoblauch, Center for Applied Research, FHWA	
Roadway Lighting Handbook	Addendum to Chapter 6, “Designing the Lighting System”; USDOT—FHWA	
Safety Effectiveness of Highway Design Features	USDOT—FHWA	November 1992
Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations	Charles V. Zegeer, University of North Carolina Highway Safety Research Center, Chapel Hill N.C	November 2000

Title	Author/Publisher	Date Published
Standard Alphabets for Highway Signs	USDOT—FHWA	
Standard Drawings	ODOT Roadway Engineering Section	
Standard Highway Signs	USDOT—FHWA	
Standards for Forest Service Signs and Posters	National Park Service.	
State Highway System Crash Rate Tables	ODOT Crash Analysis and Reporting Unit	
Synthesis of Safety Research Related to Traffic Control and Roadway Elements	USDOT—FHWA	December 1982
Traffic Engineering Handbook	ITE	
Traffic Practices Handbook for Local Roads and Streets in Oregon—Volumes 1 and 2	Mojie Takallou, Ph.D., PE, University of Portland	
Translink	Integrated Software Solutions, Inc.	May 1999
Transportation Volume Tables	ODOT Transportation Data Section	
Trip Generation, 5th Edition	ITE	
W7OSM User's Manual	Wapiti Micro Systems Corporation	
Walk Alert: The New National Pedestrian Safety Program	ITE Journal	August 1989
WSDOT Pedestrian Facilities Guidebook	Washington State Department of Transportation	
WSDOT Traffic Manual	Washington State Department of Transportation	

9 GLOSSARY

Acronym	Meaning
AAA	American Automobile Association
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AATMS	Advanced Areawide Traffic Management System (see ATMS)
ACVOS	Advanced Commercial Vehicle Operations Systems (see CVO)
ADA	Americans with Disabilities Act
ADT	Average Daily Traffic
AGT	Automatic Guideway Transit
AHC	Automatic Headway Control
AHS	Automated Highway System
AIDS	Automated Information Directory System
AMTICS	Advanced Mobile Traffic Information and Communication System
AOC	Association of Oregon Counties
API	Automatic Personal Identification (see PIN)
API	Applications Programmer Interface
APTS	Advanced Public Transit Systems
APTS	Advanced Passenger Transport Systems
AQMP	Air Quality Maintenance Plan
ASAP	As soon as possible
ASC	Automatic Steering Control
ASC	Actuated Signal Controller
ASCII	American Standard Code for Information Interchange
ASK	Amplitude Shift Keying (digital AM)

Acronym	**Meaning**
ASN	Abstract Syntax Notation
ATIS	Advanced Traveler Information Systems (formerly ADIS, for Driver)
ATMS	Advanced Traffic (Transportation) Management Systems
ATCS	Automated Traffic Control System (NEMA)
ATR	Automatic Traffic Recorder
ATS	Advanced Transportation Systems (Subcommittee of AASHTO)
AVC	Automatic Vehicle Classification
AVCS	Automatic Vehicle Control Systems
AVI	Automatic Vehicle Identification
AVL	Automatic Vehicle Location
AVLC	Automatic Vehicle Location and Control
AVM	Automatic Vehicle Monitoring
AWD	Average Weekday (Traffic) - also AWDT
BER	Bit Error Rate
BER	Byte Encoding Rate
BER	Basic Encoding Rules
BESI	Bus Electronic Scanning Indicator
BIU	Bus Interface Unit (NEMA)
Bit	Binary digit
BMS	Bridge Management System (ISTEA)
BPR	Bureau of Public Roads (see FHWA)
BPS	Bits Per Second
BRT	Bus Rapid Transit
CA	Controller Assembly (NEMA)

Acronym	**Meaning**
CAA(A)	Clean Air Act (Amendment)
CAD	Call / Active Display (Model 170 Microprocessor Traffic Controllers)
CAD	Computer Aided Design (Drafting)
CAD	Computer Aided Dispatching
CADD	Computer Aided Drafting and Design
CalTrans	California Department of Transportation
CAO	Chief Administrative Officer
CAR	Crash Analysis and Reporting
CAT	Countermeasure Analysis Tool
CBD	Central Business District
CCTV	Closed Circuit Television Camera(s)
CDL	Commercial Driver's License
CD-ROM	Compact Disk - Read Only Memory
CFR	Code of Federal Regulations
CHEMTREC	Chemical Transportation Emergency Center
CMAQ	Congestion Management Air Quality
CMS	Changeable Message Sign(s) (see VMS - preferred)
CMS	Congestion Management System (ISTEA)
COATS	California Oregon Advanced Transportation Systems
COP	City of Portland (Prineville)
COTS	Commercial Off-the-Shelf computer software and/or hardware
CPFF	Cost Plus Fixed Fee
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check

Acronym	**Meaning**
CTWLTL	Continuous Two Way Left Turn Lane
CU	Controller Unit (NEMA)
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
DBMS	Data Base Management System
DBS	Direct Broadcast Satellite
DCE	Data Circuit Terminating Equipment (typically a modem)
DLSAP	Data Link Service Access Point
DLSDU	Data Link Service Data Unit
DMS	Dynamic Message Sign (See VMS)
DMV	Driver and Motor Vehicle Services
DR	Dead Reckoning
DRIVE	Dedicated Road Infrastructure for Vehicle Safety in Europe
DSRC	Dedicated Short Range Communication
DTE	Data Terminal Equipment
DTR	Data Terminal Ready signal
DUII	Driving Under the Influence of Intoxicants
DW	"DONT WALK" pedestrian signal indication
EIA	Electronic Industries Association
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EMS	Emergency Medical Services
EPROM	Erasable Programmable Read Only Memory
ETTM	Electronic Toll and Traffic Management

Acronym	Meaning
FAA	Federal Aviation Administration
FAQ	Frequently Asked Questions
FARS	Fatal Accident Reporting System
Fax	Facsimile
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FDW	Flashing "DONT WALK" pedestrian signal indication
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FMCS	Fleet Management and Control Systems
FMOC	Freeway Management Operations Center (see TMOC)
FO	Fiber Optic
FONSI	Finding of Non Significant Impacts
FSK	Frequency Shift Keying
FTA	Federal Transit Administration (formerly UMTA)
FTMS	Freeway Traffic Management System
FTP	File Transfer Protocol
GIS	Geographic Information System
GIS-T	Geographic Information Systems for Transportation
GPO	Government Printing Office
GPS	Global Positioning System
GVW	Gross Vehicle Weight
HAR	Highway Advisory Radio
HCM	Highway Capacity Manual

Acronym	Meaning
HDLC	High-level Data Link Control
HDV	Heavy Duty Vehicles
HELP	Heavy vehicle Electronic License Plate
HOV	High Occupancy Vehicle
HSIP	Highway Safety Improvement Program
HUD	Head-Up Display
IIHS	Insurance Institute for Highway Safety
IM	Incident Management
IMS	Intermodal Management System (ISTEA)
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illumination Engineering Society of North America
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISMS	Information Safety Management System
ISO	International Standards Organization
ISTEA	Intermodal Surface Transportation and Efficiency Act
ITE	Institute of Transportation Engineers (pre-1971 formerly Institute of Traffic Engineers)
ITIS	Integrated Transportation Information System
ITS	Intelligent Transportation Systems (see IVHS)
ITS – America	Intelligent Transportation Society of America (see IVHS - America)
ITS - Oregon	Intelligent Transportation Systems for Oregon
ITWG	ITS Technical Working Group
IVHS	Intelligent Vehicle Highway System (see ITS)
IVHS-America	Intelligent Vehicle Highway Society of America (see ITS-America)

Acronym	Meaning
JPACT	Joint Policy Advisory Committee on Transportation
KSA	Knowledge, Skills and Abilities
LAN	Local Area Network
LCD	Liquid Crystal Display
LDT	Light Duty Trucks
LED	Light Emitting Diode
LLC	Logical Link Control
LOC	League of Oregon Cities
LOI	Level Of Importance
LOS	Level of Service
LRM	Local Ramp Meter (Controller software)
LRT	Light Rail Transit
LRV	Light Rail Vehicle
LVA	Linked Vehicle Actuated
MACS	Metropolitan Area Corridor Study
MDI	Model Deployment Initiative
MIB	Management Information Base
MIS	Management Information System
MMU	Malfunction Management Unit (NEMA)
MODEM	Modulate - Demodulate
MOVA	Modernized Optimized Vehicle Actuation
MPO	Metropolitan Planning Organization
MUTCD	Manual on Uniform Traffic Control Devices
NCAP	New Car Assessment Program

Acronym	Meaning
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research Program
ND	Negative Declaration
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NHTSA	National Highway Traffic Safety Administration
NIST	National Institute of Standards and Technology (Formerly the National Bureau of Standards of the U.S. Department of Commerce.)
NMS	Network Management System
NTCIP	National Transportation Communications for ITS Protocol
NTP	National Transportation Policy
NTSPS	National Transportation Strategic Planning Study
NVT	Network Virtual Terminal (also NVT-ASCII)
OAR	Oregon Administrative Rules
OBC	Onboard Computer
ODOT	Oregon Department of Transportation
OEDD	Oregon Economic Development Department
OERS	Oregon Emergency Response System
OHP	Oregon Highway Plan
OID	Object Identifier
ORS	Oregon Revised Statutes
OSI	Open System Interconnect
OSI-RM	Open System Interconnect – Reference Model (also RM-OS)
OSM	On Street Master (Controller software)
OSP	Oregon State Police

Acronym	Meaning
OSRM	On Street Ramp Master (Controller software)
OTC	Oregon Transportation Commission
OTCDC	Oregon Traffic Control Devices Committee
OTIA	Oregon Transportation Investment Act
OTIC	Oregon Travel Information Council (also TIC)
OTMS	Oregon Transportation Management System
OTP	Oregon Transportation Plan
PAM	Police Allocation Manual
PASSER	Progression Analysis and Signal System Evaluation Routine (Computer Software)
PCM	Pulse Code Modulation
PCOI	Pedestrian Clear-out Interval
PCU	Passenger Car Unit
PDT	Project Development (or Design) Team (also PT – Project Team)
PDU	Protocol Data Unit
PER	Packed Encoding Rules (a variation of BER for use with low bandwidth.)
PIN	Personal Identification Number
PROMETHEUS	Program for European Traffic with Highest Efficiency and Unprecedented Safety
PMPP	Point to Multi-Point Protocol
PMS	Pavement Management System (ISTEA)
PPP	Public/Private Partnership
PSMS	Project Safety Management System
PS&E	Plans, Specifications and Estimates
PT	Project Team (also PDT - Project Development Team)

Acronym	Meaning
PTMS	Public Transportation Management System (ISTEA)
PTR	Part Time Restriction
RACS	Road - Automobile Communications System
RADAR	Radio Detecting and Ranging
RAM	Random Access Memory
RAME	Region Access Management Engineer
RDC	Rural Development Center
RDSS	Radio Determination Satellite Services
RF	Radio Frequency
RFP	Request for Proposal
RFQ	Request for Qualifications
RFRS	Road Features Rating System
RLR	Red Light Running
RM-OS	See OSI-RM
ROM	Read Only Memory
ROR	Run-off-road
RSPA	Research and Special Projects Administration (USDOT)
RTP	Regional Transportation Plan
RTPWS	Right Turn Permitted Without Stopping
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SAP	Service Access Point
SCC	Surveillance Communication and Control

Acronym	Meaning
SCOOT	Split Cycle and Offset Optimization Technique
SDLC	Synchronous Data Link Control
SDO	Standards Development Organization
SDU	Service Data Unit
SGRC	Statewide Grant Review Committee
SHRP	Strategic Highway Research Program
SIP	Safety Improvement Program or State Implementation Plan (Air Quality)
SLG	Synchronous Longitudinal Guidance
SMS	Safety Management System (ISTEA)
SOV	Single Occupant Vehicle
SPIS	Safety Priority Index System
STA	Special Transportation Area
STE	State Traffic Engineer
STIP	Statewide Transportation Improvement Program
STMF	Simple Transportation Management Framework
SNMP	Simple Network Management Protocol (Version 2 – SNMPv2)
SP	Standards Publication
SPIS	Safety Priority Index System
SSVS	Super Smart Vehicle System
STIP	State Transportation Improvement Program
STMP	Simple Transportation Management Protocol
SZRP	Speed Zone Review Panel
TAC	Technical Advisory Committee
TBC	Time Based Coordination

Acronym	Meaning
TBC	Time Base Control (NEMA)
TCM	Transportation Control Measure (Air Quality)
TCP	Traffic Control Plans
TCP	Transmission Control Protocol
TDM	Time Division Multiplexing
TDM	Transportation Demand Management
TESU	Traffic Engineering Services Unit
TF	Terminals and Facilities (NEMA)
TFP	Technology For People
TIA	Telecommunications Industries Association
TIC	Travel Information Council (also OTIC)
TIP	Transportation Improvement Program
TIR	Traffic Impact Report
TIS	Transit Information System
TIS	Traffic Impact Study
TLV	Type, Length, Value encoding
TMA	Transportation Management Area
TMC	Traffic Management Center (see also TMOC and FMOC)
TMDD	Traffic Management Data Dictionary
TM-H	Traffic Monitoring for Highways
TMOC	Transportation Management Operations Center (see FMOC)
TOC	Traffic Operations Center
TOD	Transit Oriented Development
TODS	Tourist Oriented Direction Signs

Acronym	Meaning
TPAC	Transportation Policy Advisory Committee
TPAU	Transportation Planning and Analysis Unit
TPR	Transportation Planning Rule
TPST	Traffic Project Services Team
TRANSYT	Traffic Network Study Tool (Computer Software)
TRB	Transportation Research Board
TRL	Time Reference Line
TRRL	Transportation and Road Research Laboratory
TRS	Traffic—Roadway Section
TSAMU	Traffic Standards and Asset Management Unit
TSM	Technical Services Manager
TSM	Transitway Simulation Model
TSM	Transportation System Management
TSO	Telephone Service Order
TSO	Transportation System Operations
TSP	Transportation System Plan
TSSU	Traffic Systems Services Unit
TTI	Texas Transportation Institute
TWLTL	Two Way Left Turn Lane (or CTWLTL for Continuous Two Way Left Turn Lane)
UBA	Urban Business Area
UDP	User Datagram Protocol
UHF	Ultra High Frequency (300MHz to 3GHz)
UMTA	Urban Mass Transit Administration (see FTA)
USDOT	United States Department of Transportation (also DOT)

Acronym	Meaning
UTC	Urban Traffic Control
VCOI	Vehicle Clearout Interval
VHF	Very High Frequency (30 to 300MHz)
VICS	Vehicle Information Communication System
VIPS	Vehicle Identification and Priority System
VMS	Variable Message Sign (preferred – see also CMS, DMS)
VMT	Vehicle Miles of Travel (Vehicle Miles Traveled)
WAN	Wide Area Network
WIM	Weigh In Motion