CITY OF BEND

SIGNING AND MARKING MANUAL

Version: March 2022

Contents

Attachment 1 - Selected Tables for Evaluating Level of Traffic Stress
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PURPOSE

The City of Bend (COB) follows the Manual of Uniform Traffic Control Devices (MUTCD) practices and principles that govern the use of traffic control devices and the 2009 Oregon Department of Transportation supplement to the MUTCD. Additionally, the following documents guide signing, pavement marking, and traffic control design practices within the City

- City of Bend Design Standards and Specifications including Standard Drawings
- ODOT Traffic Signal Design Manual, 2020 Edition
- ODOT Traffic Line Manual, 2021 Edition
- ODOT Traffic Sign Design Manual, 3rd Edition 2018
- ODOT Pavement Marking Design Guide, 2021 Edition
- Oregon Guide to School Area Safety, 2017
- Oregon Speed Zone Manual, 2020
- FHWA MUTCD Interim Approvals and Oregon statewide approvals
- NCHRP 562 Improving Pedestrian Safety at Unsignalized Crossings and FHWA-ICT-016 Establishing Procedures and Guidelines for Pedestrian Treatments at Uncontrolled Locations

This manual serves as a supplement to the MUTCD, ODOT documents, and City Standards to provide City specific practices and guidelines where items are not included in those documents or when there are options. The manual is created to support consistent and safe traffic control installations. Where there is a conflict between ODOT documents and the City of Bend Design Standards, Specifications, and Drawings; the City standards shall generally take precedence. Contact the City engineering department if clarification is needed.

The City aims to use the least number of signs necessary that can covey the needed message quickly and simply, prioritizing regulatory and warning signs. Limiting signs helps keep focus on the most critical messages, the street conditions, and street users including vulnerable pedestrians and bicyclists.

Signing and Marking Coordination - While signing and marking elements are listed separately in this document, signing and marking may both be required. New and modified signs and marking shall be coordinated. Additional signing and marking modifications may be required outside of project limits to update signs and marking to infrastructure changes made with a project.

Symbols – To better facilitate all users, including people with different languages and comprehension levels, the City of Bend uses the symbol legend instead of the text legend where available.

Signing and Marking Plans – Signing and marking plans are required as part of the design approval for all new construction and reconstruction for private development, capital projects, and pavement preservation and are approved by the appropriate reviewing department. See City of Bend Part II – Design Standards section 2-3 for more detail. Signing and marking plans for traffic operations projects vary by the scale of project, are approved by the TMD Assistant City Engineer and are documented in the City's work order system.

Applicability – This manual applies to all public streets and alleys, and private streets and alleys open to public travel. Existing signs within project limits that are not in compliance with these requirements in terms of offsets, siting, physical condition, and applicability shall be updated to bring them into compliance.

SIGNS

SIGN BASICS

Sign Jurisdiction

Signs on streets within the City of Bend may fall within the jurisdiction of other entities. Confirm sign is within City public right-of-way and managed by the City. Other jurisdictions may include:

- Canal Companies – signs within canal easements are subject to canal company approval
- ODOT – signs and marking on state highways and approaches, contact ODOT (ex. SH 97, US 20, Business 97)

- Rail Companies – signs and marking within the railroad right-of-way are subject to approval by the Railroad
- Cascade East Transit (CET) – The City has an intergovernmental agreement with CET that requires CET to install and maintain transit related signs.
- Bend Parks and Recreation (BPRD) – BPRD maintains trail related signs located within the right-of-way. The City has an intergovernmental agreement with BPRD for trail maintenance.
- Highway Guide Signs – The City has an intergovernmental agreement with the Oregon Travel Information Council for highway guide signs located on City streets.
- Private Streets – Signs on private streets are managed by private entities. Private streets are subject to the provisions of the MUTCD, and private signs and markings should follow the same provisions for public streets.

Sign Posts

Ground mounted signposts shall be breakaway in compliance with the current AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with interim revisions. City of Bend uses the following standard sign posts:

- 2” perforated 12-gauge Telespar post with 2 ¼” perforated 14 gage sleeved breakaway base – see COB Standard Drawing R-7 PSST Anchor Base Foundation.
- 2” perforated 12-gauge Telespar post with slip breakaway base for signs (typically yield (R1-2) and keep right (R4-7)) on the splitter islands at roundabouts and other locations subject to higher risk of damage – see COB Standard Drawing PSST Slip Base Foundation R-7A)
- 2 ½” perforated 12-gauge Telespar post with slip breakaway base for school flashers, RRFBs and other signs where 2” does not serve wind load (unless 2-inch posts are sleeved or otherwise mitigated). See ODOT Triangular Slip Base drawing TM 688
- Wood post used only for temporary construction traffic control signing per ODOT standard drawing TM 821

Where sign size requires alternate sign posts, post size to be confirmed by City Engineer. Utility locates are required for all below ground sign post installations. In limited cases signs may be mounted on utility poles or traffic signal poles. Utility pole signs must be approved

by the appropriate utility. Traffic signal pole signs must be approved by the City Engineer in coordination with ODOT.

Sign Sheeting

Standard sign sheeting shall be high intensity prismatic (HIP) retroreflective sheeting with anti-graffiti coating; diamond grade is used on S1-1 signs, overhead signs, and may be considered for arterial pedestrian crossings with limited lighting or at other locations with unique site characteristics or crash patterns that would be enhanced by higher grade sheeting.

Standard aluminum sheeting thickness shall be 0.08 gauge. Extruded sheeting may be required for street name signs longer than 4 ft or other larger surface area signs

Sign Size

Sign sizes follow the single and multi-lane sizes per the MUTCD unless otherwise listed in this manual. Minimum sign sizes may be considered in limited cases where unique geometric or site conditions prevent installation of standard sign sizes. See COB Standard Drawing R-8 for Street Name sign sizes.

Sign Design

Detailed drawings of standard signs and alphabets are shown in the Federal Highway Administration (FHWA) Standard Highway Signs 2004 Edition with 2012 Supplement, and the ODOT Sign Policy and Guidelines, 2018. Those guidelines shall be followed for sign dimensions, colors, messages, letters, numerals, spacing, borders, etc.; except as otherwise provided in City standards and specifications. Drawn-to-scale drawings for nonstandard signs shall be included in the construction plan set for City approval prior to fabrication.

Sign Visibility / Placement

Signs shall be located to minimize conflicts and overlaps with other signs or obstructions (existing and proposed) and where they are not screened by landscaping (current or future growth). Signs located within sidewalks shall be located to the street side and provide an ADA compliant pedestrian access route to not block or interfere with pedestrian movements.

For arterial and collector roadways, the signs shall be visible from, at a minimum, the stopping sight distance of the roadway for the design speed (AASHTO). This requires that street name

signs not be placed too far around curb returns on side streets to meet the visibility requirements. Existing and proposed site features shall be reviewed to ensure that there are no existing or proposed obstructions to sign visibility within this required sight distance. Signs for private streets at intersections with public streets (i.e. Stop sign/street name sign installations) shall be installed within public right-of-way.

Horizontal and Vertical Clearance

Sign installations shall comply with the most current edition of the MUTCD and City of Bend Standard Drawings. Vertical and horizontal clearance to the sign face shall be maintained for vehicular and non-motorized traffic.

Custom Signs

Custom signs not identified in the special signs section of this manual shall be approved by the City Engineer prior to ordering and installing.

Obsolete Signs

Signs that are obsolete (no longer meeting MUTCD, ODOT, or City standards) shall be evaluated for removal or replacement as required by the current MUTCD, ODOT, or City standards. Signs are removed or replaced in conjunction with capital projects or development projects that make improvements or changes to the streets where the signs are located. Obsolete signs may also be removed/replaced with pavement preservation projects, as identified during the periodic retro-reflectivity survey, or with a work order as part of routine maintenance.

Enhanced Conspicuity of Signs

Temporary flags are typically added to new stop signs on existing streets, new traffic circle signs, new roundabout signs, or lowered speed limit signs to provide enhanced notification of the traffic control change. Traffic control change or lane change ahead signs are also used as applicable. The flags should be removed as soon as practical after a minimum of 30 days. Enhanced conspicuity signs are generally not used for other applications.

INDIVIDUAL SIGNS

Sign, size, material, location, and additional criteria is listed in this manual where there are clarifications, additions, or site-specific uses to supplement the MUTCD, City standards, and guide documents.

Regulatory Signs

R1-1 Stop

Size: MUTCD standard 30”x 30” on single lane street, 36” x 36” on street with more than one approach lane

Location: See COB Standard Drawing R9- Standard Street Sign Placement

Additional Criteria: New stop sign installations shall be based on an engineering evaluation following the MUTCD. Stop signs are installed to assign right-of-way and are not a traffic calming or speed control device. Upon engineering review, stop signs are typically installed on local streets or major private driveways open to the public at the intersection with an arterial or collector street. Stop signs are not installed on alley approaches. The MUTCD allows for intersections, particularly low volume local street intersections or tee intersections, to exist without stop signs under certain conditions (MUTCD 2B.04). Stop signs will be reviewed per the MUTCD and may be installed on the lower volume street of low volume local street intersections if:

- All or most surrounding intersections are signed
- Cul-de-sac/ dead end accesses five or more properties
- Visibility is restricted and other MUTCD conditions are met

New All Way stop – In addition to the MUTCD criteria, the City review for all-way stop signs considers the provisions in the NCUTCD revisions recommendations 15B-RW-02.

Stop Sign Modification: Where traffic volumes are nearly equal there is sufficient visibility, and other MUTCD conditions are met; existing stop signs may be flipped (changed from one or one set of approach(es) to the adjacent approach or set of approaches to allow free flow of traffic along a designated, constructed neighborhood greenway. If a stop sign on a greenway is

proposed to be flipped, adjacent intersections shall also be reviewed to evaluate if additional stop sign flipping is appropriate to create consistent driver expectations and traffic flow across the local area network. Flipping the stop sign can only be permitted where accessible curb ramps are not made non-conforming (PROWAG – Stop controlled intersections must have 2 percent max cross slope at crossing. Non-stop controlled legs of an intersection can have up to 5 percent cross slope at a crossing).

R1-5b Stop Here for Pedestrians

Additional Criteria: Used in conjunction with stop lines in advanced of an approved marked crosswalk at an uncontrolled multi-lane approach. Note the state of Oregon requires stopping for pedestrians (ORS 811.028), do not use yield signs. R 1-5c with word pedestrians not used. See Marking Crosswalks for installation criteria. If used, confirm location does not block pedestrian/school crossing warning sign. Where used on multi-lane lane roads is typically only used on right side of the street unless geometric or sight constraints support use of a second left side sign in the median. Stop lines and Stop Here for Pedestrian signs not generally used on multi-lane roundabouts due to insufficient spacing to other required, higher priority signs; sign clutter on the approaches reducing time for reacting to pedestrians, and blocking of the pedestrian crossing sign.

R1-6a In-Street State Law Stop for Pedestrian

Size: 12” x 36”. Material: single sided Aluminum sign

Location: At end of median nose taper or typically 4 ft back from end of traffic separator in front of the crosswalk (oncoming direction). Use 2 signs (one each direction) on one post for shorter medians (typically less than 40 ft). May mount on keep right sign post or use in place of the OM-3 object marker. On longer medians or traffic separator where OM-3 object marker used on median end away from the crosswalk, offset object marker and delineators if needed to prevent obscuring this sign.

Additional Criteria: Use only on the median of an approved marked crosswalk on an arterial or collector street in accordance with the section on Marking Crosswalks. The State of Oregon requires stopping for pedestrians, do not use yield signs. Use yellow signs for pedestrian and pedestrian/ bike crossings. (Fluorescent yellow-green used for approved school crossings only.) Also approved for use on College Way within campus area at intersections with marked pedestrian crossings; some locations without a median. The in-street (no median) signs on College Way signs may be removed if continuously damaged by vehicles or in the winter to facilitate plowing.

R1-2 Yield

Size: 36 x36 x 36” for single lane and 36 x 36 x 36” for multilane where speeds less than 40 mph and double posted. 30 x 30 x 30” used for traffic circles

Location: In addition to MUTCD applications, used at neighborhood traffic circles

SPEED LIMITS AND SPEED LIMIT SIGNS

Speed Limit Signs

R2-1 Speed Limit

Location: Speed limit signs are posted where there is a change in the designated or statutory speed limit and on arterials and collectors after intersections with arterials or collectors. Speed limit signs are not posted on local streets because the context of the residential development serves as notice that the statutory speed limit of 25 mph applies. Exceptions for signing speed limits on local streets include a) City may post speed limits at each end of the primary neighborhood local-collector street near intersection with an arterial street with a speed limit of more than 25 mph where the local street is more than 3 blocks long, is used as a cut thru to the arterial street, and has documented incidence of speeding; or b) constructed and designated greenways that are posted 20 mph at each and intermittently after an arterial or collector intersection. Speed limit signs are not posted in alleys.

Additional Criteria: City standards identify the required design speed for streets, and the Oregon Revised Statutes (ORS) specify how speed limits are set for streets. Speed limits are managed by the TMD department and approved by the TMD Assistant City Engineer. There are three types of speed limits statutory, designated, and temporary:

Statutory Speed Limits – For streets that qualify for statutory speed limits under the provisions in ORS 811.111, the speed is the statutory limit identified for that type of street. Within the City this includes 15 mph in an alley, 20 mph in a business district and 25 mph in a residence district where ORS 801.170 defines "Business district" as the territory contiguous to a highway when 50 percent or more of the frontage thereon for a distance of 600 feet or more on one side, or 300 feet or more on both sides, is occupied by buildings used for business, and ORS 801.430 defines "residence district" as territory not comprising a business district that is contiguous to a highway that: (1)Has access to property occupied primarily by multifamily dwellings; or (2)Has an average of 150 feet or less between accesses or approaches to a)Dwellings, churches, public parks within cities or other residential service facilities; or (b)Dwellings and buildings used for business).

Designated Speed Limits – Streets that require designated speed limits (any street that does not meet criteria for statutory speed limit) require a speed study conducted by ODOT per ORS810.180 under the provisions of OAR 734-20-015. This includes most segments of arterial and collector streets within the City and some local streets. Requests for designated speed limits shall be submit to the TMD Assistant City Engineer for review, approval, and submittal to ODOT. TMD will track and implement the results of the speed zone request. The following procedure is used by the City to process speed zone requests:

1. Request: Written request is received by TMD Assistant City Engineer through the Citizen Service Request, PDED project engineer, or EIPD project engineer. (Note citizens or other agencies cannot directly request speed limit changes on City streets, they must be submitted by the City)
2. Review: TMD performs a preliminary engineering review to determine if the requested speed can be reasonably obtained under the ODOT speed study process, is consistent with the context and use of the street as existing, and supports the future use identified in the Transportation System Plan.

3. Boundary check: TMD will confirm the boundaries of the speed zone area and confirm that signs can be installed at the limits or within the ODOT accepted tolerance distance.
4. Enforcement Coordination: TMD will coordinate with the Police Traffic Control Sergeant to also consider current compliance and Police support for enforcing the proposed speed limit.
5. Submit request: If the review meets the criteria noted above, TMD will submit the request to ODOT to begin the designated speed setting process. If the review does not meet the criteria, the request will be denied and not resubmitted until the conditions change such that they do meet the criteria.
    a. For speed reduction requests, note that simply installing a lower speed limit sign may not reduce the speed and in some cases additional mitigation measures may be needed. In that case, the mitigation measures must be completed before ODOT can do the speed study.
    b. For new streets, the speed study cannot be conducted until the street is completed and in use. See temporary speed limits for setting the speed limit before the street opens to traffic.
6. ODOT Study: It typically takes 6 months to 1 year for ODOT to complete a speed zone study and issue the draft speed order. When the draft speed zone order is received by the City it will be reviewed and if supported TMD will issue a letter of concurrence for the speed zone order to be issued. In the rare case where the draft speed zone order is not supported, the City will work with ODOT to resolve the issue. If the issue cannot be resolved the City may elect to present its case to the Speed Zone Review Panel.
7. Speed Order Issued: ODOT sends the City the agreed upon speed zone order or the direction from the Speed Zone Review panel. TMD creates a work order to install signs for the new speed limit and remove any conflicting speed limit signs within the order area. Where a speed is reduced, flags will be added to the new speed sign for at least three weeks to provide enhanced conspicuity of the speed change.
8. Speed Asset Management and Notification: Speed Zone orders are logged into the City's master speed zone inventory, a notice is sent to TMD supervisors, City

Manager, City Council and PD Traffic Patrol Sergeant. A public notice is generally issued for speed reductions.

Temporary Speed Limits –There are two types of temporary speed limits a) construction advisory speed limits and b) temporary speed limits by order.

a) Construction Advisory Speed Limits – Construction advisory speed limits may be used on shorter term construction projects or where conditions for temporary construction speed zone order do not apply and conditions support an advisory speed reduction versus an enforceable temporary speed zone order. Construction advisory speeds shall not be used indiscriminately and require an engineering study to document the need to advise drivers of a lower speed condition. Advisory plaques shall be fluorescent orange and in 5 mph increments and set based on engineering evaluation. Advisory speeds less than 10 mph below the existing posted speed limit shall be avoided. Advisory speed reductions do not reduce the design speed for traffic control measures or the traffic control plan. Examples include:

Advisory speed zones for EIPD City capital projects, PDED development projects, Utility projects, or Streets projects are reviewed and executed by the respective department project managers as part of the approved traffic control plan.

b) Temporary Speed Limits by City Order – Temporary speed orders may be established for specific time periods to protect the public, workers, or streets (ORS 810.180(8)). Temporary speed limits for EIPD City capital projects, PDED development projects, Utility projects, or Streets projects are executed by the respective the Project Manager with confirmation from the TMD Assistant City Engineer. Temporary speed limits are approved by the City Engineer using the City's standard temporary speed limit form.

Temporary speed limits are primarily used for:

1) ***Road Damage***: Where lower speeds are needed where there is severe road damage that will take longer than a month to repair.

2) ***Temporary New Street Speed Limit:*** For new arterial and collector streets a temporary speed limit may be posted by the City while ODOT is conducting the speed study. The speed posted shall be the speed requested following the criteria for the ODOT speed study process.

3) ***Temporary Construction Speed Limits:*** During construction projects longer than one month where detours can only be designed for slower speeds due to geometric/ right-of-way constraints, or when other measures are not feasible for work to be conducted a safe distance from the travel lane due to site constraints such as limited detour or road width.

Generally temporary speed zone reductions are not warranted when activities are more than 10 feet from the edge of the travel way, or activities require an intermittent or moving operation on the shoulder. The following conditions are considered in the evaluation of applying a temporary construction speed zone:

- High existing or potential crash rate within the work zone
- Workers present for extended periods within 10 feet of the traveled way unprotected by barriers
- Posted speed limit more than 25 mph
- Traffic control devices encroaching on a lane open to traffic or within a closed lane but within two feet of the edge of the open lane and can't be moved to a safer location
- Barrier or pavement edge drop off within two feet of the traveled way
- Horizontal curve with a safe speed of 10 mph or more lower than the posted speed.
- Reduced design speed for detour transitions (radius of curvature, super elevation, and sight distance) when the distance between restrictions is less than ¼ mile.

- Shared bike/ travel lane configurations where the existing Level of Traffic Stress is LTS 1 or LTS 2 and construction conditions reduce it to LTS 3, and LTS 1 or 2 can be maintained if the speed is reduced and Bikes on Road signs are used.

The City does not post temporary speed limits where a speed zone change has been requested on an existing street. For speed limit changes, the new speed limit will be posted when the speed order is received.

R2-1 with Plaque on Constructed Greenways

Size: 30” x 36” with 30” x 10” Greenway Plaque

Location: Signs are posted at the start and end of the greenway route and at interim locations after arterial or collector intersections.

Additional Criteria: Where conditions of ORS 810.180 (10) are met, the City may post designed and constructed greenways with 20 mph speed limits. (Refer to City standards for current criteria such as on the LSN Figure 5-1 of the TSP, designated as greenway, volumes less than 2,000 vehicles per day, an 85th percentile speed that does not exceed 30 miles per hour, markings for people walking or biking, and appropriate traffic calming.) Greenway speed limits are approved by the TMD Assistant City Engineer as part of the capital project plan review or PDED as part of development review and the 20-mph speed is e established through a City Ordinance processed by the capital project manager or PDED per the provisions of the ORS.

Stationary Radar Speed Sign

Location/Additional Criteria: The City installed stationary speed radar signs at the urban/ rural interface on arterial streets as education tool to remind users of the change from higher rural speed limits to lower urban area city speed limits. Additional stationary speed radar signs were installed on Portland Avenue, Archie Briggs Road, and Mount

Washington Drive as part of a pilot project. New stationary speed radar signs are not being considered at this time. The appropriate R2-1 speed limit sign shall be mounted on the same post as the stationary radar sign.

Moveable Neighborhood Speed Radar Sign

Location/Additional Criteria: The City has a fleet of moveable speed radar signs to provide speed education and collect speed and volume data. The signs are operated by the TMD from May through October. Citizens may request signs through their Neighborhood Association (NA). Each year the NA prioritizes and submits requests to the TMD. The TMD schedules and deploys the radars. More information and results from the Neighborhood Speed Radar Sign Program can be found on the City's website (Speed Radar Program).

R3-9 Two-Way Left Turn Lane

Additional Criteria: Not used, typically not used to supplement the two way left turn marking that is required per COB Standard Drawing R-44.

R6-1 One Way /

R3-1 Turn Prohibition

Location: Use combination on raised median opposite a t street intersection where only right turns are permitted. Mount the one-way sign on the raised median and the turn prohibition sign below the stop sign.

R7 and R8 Series No Parking signs

Sign: City of Bend uses the no parking symbol with directional arrow when parking prohibitions are signed. Use left, two-way, and right arrows to define the limits of the no parking zone as appropriate. Add “this side” when parking is only restricted on one side. For cul-de-sacs add “In Circle”

Location: No parking signs are installed at start and end of the prohibition area. A mid segment sign is required where blocks are 300 feet or longer. For extend sections signs are located at approximately 150 foot spacing. Where used at a corner just the start sign is used. When used for a cul-de-sac, one sign is placed facing the approach on the right side of the street.

Additional Criteria: Areas of parking prohibition are approved by PDED a part of the development plans, as part of capital project engineering review, or by TMD Assistant City Engineer or Parking Manager through a TMD work order. On-street parking is allowed as per the COB Design Standards.

Use No Parking with directional arrow signs for a) less than full block prohibitions, typically <300ft, b) at intersections with curb ramps and sidewalk where there is a history of crashes related to sight distance resolved by parking prohibitions and there are no curbs or other geometric reason why curb paint (the preferred option) cannot be used, c) at intersections with curb ramps and sidewalk where there is a high volume of repeated noncompliance (parking within 20 ft of the crosswalk) in a high turnover location, or d) where other unique sight constraints or PD enforcement challenges support signing instead of curb paint. The standard intersection restriction is 20 ft per corner with option to increase to 50 ft in limited cases where engineering evaluation shows additional sight distance needed. (Note neither signs nor curb paint are required, state law (ORS 811.550) prohibits parking 20 - 50 ft from crosswalk, but may be used as additional reminder when the conditions above are met.) Use the no parking This side for cases where the road width prevents parking on one side only and for more than half a block. For full block use of no parking this side arrows are not required.

No parking signs are not used in front of mailboxes. There is no City code, state, or federal law prohibiting parking in front of mailboxes and mail delivery is a short duration activity. No parking signs are not used in front of fire hydrants. State law and City code

prohibit parking in front of fire hydrants. Red curb painting may be used in certain cases (See curb paint).

No parking sign removal – No parking signs may be considered for removal if they are a) on streets built after 2000 where the street meets the dimensions for on-street parking and there is no unique location constraint or vision restriction that warrants parking restrictions or b) on a street built in phases that had parking restrictions as a partially built street where the street is now completed and meets widths to allow on street parking,

New parking restrictions for streets constructed prior to 2000 require review and approval of the TMD Assistant City Engineer and Parking Manager after evaluation of circulation, parking impacts, development approvals for on-street parking, emergency vehicle impacts, yield street applicability, and a public process of neighborhood coordination prior to implementing parking restrictions.

R7-107A No Parking Bus Stop

Additional Criteria: Installed in coordination with CET at bus stop locations where no parking is required to create the bus stop and provide access to the curb. Requires request from CET and Parking Manager approval. Per an intergovernmental agreement with Cascade East Transit, CET is responsible for installing and maintaining signs related to transit stops. This does not include no parking signs that are the responsibility of the City.

R 7-9a No Parking Bike Lane

Location: Varies by parking location issue, typically 50 ft downstream of block start.

Additional Criteria: Use adjacent to an on-street bicycle lane in limited locations where demonstrated, repeated non-compliance and high parking density, or adjacent to schools based on requests of the police department. Bike lane is designated by the 8" stripe and sign is not required. Confirm that bike symbols are installed per standard as alternate mitigation measure prior to installing sign.

No Parking in Alley

Additional Criteria: May be installed at the start of an alley setback a minimum of 15 feet from the driveway apron and sidewalk. May also be installed along with 15-minute loading/ unloading signs in downtown alleys. City of Bend code 6.20.005(b) prohibits blocking an alley and signs are not needed to prohibit parking.

No parking loading/ zone

Additional Criteria: Private use of the public right-of-way for individual property loading is not permitted. The City may create loading zones with no time limit or with time limits in managed parking districts where there is a program to provide enforcement. All public right-of-way loading zones require the approval of the Parking Manager. See green loading zone signs when the loading zone has a time limit

R7-108 modified - Time Limit Parking Loading Zone.

Additional Criteria: Use R7-108 modified green sign if time limit loading zone. Use R7-6 modified no parking (symbol) red sign if no limit. Loading zone signs are used at Downtown Alleys as part of alley sign cluster (do not enter, one way loading zone) at each end or in downtown or other commercial/business district loading zones as approved by the Parking Manager.

R 7-108 modified –Time Limit Parking

Additional Criteria: Time restricted parking limits are used in managed parking districts with Parking Manager approval. Contact Parking Manager for current time restricted parking program time limits, restrictions, and zones. Parking program signs to be approved by the Parking Manager and City Engineer. Timed parking sign frequency is in the process of being reduced to generally one to two per block; existing areas may have higher frequencies of signs that can be reduced.

Pay Parking and Park Mobile

Additional Criteria: Pay parking and Park mobile or other parking management system signs are used in managed parking districts with Parking Manager approval. Contact Parking Manager for current pay parking, park mobile, or other managed parking program sign details.

Permit Parking

Additional Criteria: Permit parking signs are used in managed parking districts with Parking Manager approval. Contact Parking Manager for current permit parking sign details.

Accessible Parking

Location: Use where accessible parking required. Install signs per COB Standard Drawing R-29 Accessible Parking.

R-10 Traffic Signal Signs – Traffic signal signs vary by intersection and are included with traffic signal design plans for City Engineer approval. City signals require audible countdown pedestrian signals with R10-3b signs.

R11-2 Road Closed

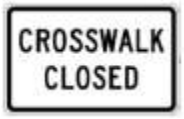
Additional Criteria: Use on type III barricades where roads are not completed to an intersection for temporary closures less than 6 months/ one construction season. For closures longer than 6 months or on stub streets (that will be connected with future development), install OM4-1 road closed object markers, except where a higher level of visual queue is needed such as at a curve, on a road with speeds over 25 mph, or where the end of the roadway precedes a non-traversable slope or major obstruction. Type III barricades, with appropriate road closed signage, shall be installed at the end of the traveled way when the pavement continues but travel is restricted beyond a certain point. The barricades shall effectively block traffic.

Truck Route – R12/ R 14

Additional Criteria: Not used, the city has not established freight routes on city streets. There is no current plan to identify freight routes. Establishing freight routes requires an evaluation of benefits/ impacts of different routes, coordination with the public, and funding for signing and enforcement prior to installation.

OR22-11 Unmuffled Engine Braking Prohibited

Additional Criteria: Limited use of engine brake signs at rural/ urban interface where there is high truck traffic with multiple, documented noise complaints and grades or speed changes that require braking. Site the sign as close to the city limit adjusting if needed to locate prior to grades and curves where brakes will be used. There are existing signs on Mt Washington near Awbrey Road, Century Drive near the city limit, and Shevlin Park near the city limit. No other locations currently approved.



Crosswalk Closed

Additional Criteria: Limited use when crosswalk closed. Requires mounting on a detectable sign base. See Guide for Crosswalk Marking for closure conditions.

Warning Signs

W2-2 Intersection Warning

Additional Criteria: Generally, not used within City limits where frequent multiple access points are typical and expected. May be used in limited cases where the minimum sight distance for the posted speed is not provided where grade, non-removable vegetation, or other conditions exist on an approach without a turn bay to the intersecting street or other streets in the vicinity such that there is not reasonable expectation that an intersection is present.

W11-2/ W16-7p/ 16-9P Pedestrian Warning/ Advance Pedestrian Warning

Additional Criteria: Used at marked pedestrian crosswalks per the section on Marking Crosswalks. Yellow signs are used for pedestrian crossings. Where there are marked crosswalks on both sides of an intersection, a double sign (one sign on each side of the post) is installed on the right side of the street on the first approach in each direction.

W11-15/W16-7P Pedestrian/ Bike Warning with Down arrow

Additional Criteria: Used at marked multi-use trail crossings of the major trails: Deschutes River Trail, Haul Road Trail, and COHC trail and arterial or collector streets. (Trail name sign

may be placed on top of the W11-15.) Also used at marked Greenway crossings of arterial streets. Yellow signs (not fluorescent yellow green) are used. Fluorescent yellow may be used at five lane arterial crossings or other crossings where additional mitigation for substandard visibility is required. See section on Marking Crosswalks.

W 11-3 Non-Vehicular Warning, Wildlife (Deer, etc.)

Additional Criteria: Wildlife warning signs are not used. City logs show that deer injuries occur on all street types throughout the city and not in any one concentrated area. The Oregon Department of Fish and Wildlife supports not using wildlife signs as they do not demonstrate a change in driver behavior that reduces crashes. Any existing signs are removed as they become damaged or need replacing.

W11 varies, W15-1 Special condition Non-vehicular warning signs (playground, wheel chair, etc.)

Additional Criteria: Not used. Children at play also not used, it is not an MUTCD approved sign.

W12-2 or W12-2a Low Clearance

Additional Criteria: Low Clearance signs on City streets are posted on overhead structures that are less than 15’3” in height to account for the 14 ft maximum legal vehicle height, 1 ft of buffer and 3 inches for frost heave. The posted value shall not include the 3 inches of frost heave. For example, a 13’ 7” structure as measured at the lowest point of the travel way and shoulder in non-freezing conditions would be posted at 14’ 4”, or a structure measured at 15’3” would be posted at 15”. For low clearance signs on state highways, see ODOT; the signs typically are required to accommodate taller vehicle clearances.

W14-1, W 14-2 Dead End/ No Outlet

Additional Criteria: Limited use where the end of road cannot be seen from the last intersection and there is no cul-de-sac or public turnaround; or where there is a cul-de-sac or turnaround but the road is the only dead end in an area with through streets such tat traffic frequently attempts to cut through. Use no outlet instead of dead end if there are multiple streets with no outlet from the marked intersection. Use left or right arrow as appropriate. Standard is the rectangle sign mounted on the street sign. The diamond sign may be used if no sign post is available or the standard post location is not visible to oncoming traffic.

W17-1 Speed Hump

Additional Criteria: Use on streets with speed humps that have speeds greater than 25 miles per hour. On other streets, may be used where speed humps are not in series or are otherwise unexpected. Not used on greenways. Speed bump sign not used.

W3-X5 Traffic Control Change Ahead

Additional Criteria: Used in advance of intersections where stop signs, traffic circles, or roundabouts added or when stop control is changed to different approaches. Consider adding flags for enhanced conspicuity. New traffic pattern ahead (W23-2) is used where traffic patterns such as lane usage changes. Place signs simultaneously with the traffic control or traffic pattern change and leave in place for a minimum of thirty days.

Sidewalk Ends

Additional Criteria: Use where sidewalk ends midblock at a slope hazard or trip hazard. Where development is required to build a sidewalk that doesn't end at an intersection, the standard treatment is to construct a transition to the street level. Where that is not feasible and the sidewalk does not end flush with the existing ground or there is a slope or trip hazard near the termination this sign is used. Mount with a detectable post or mailbox support (ODOT Standard Drawing RD-100) if approved by City Engineer.

OM 4-1 Object Markers – End of Street

Additional Criteria: Use on an incomplete streets where the street temporarily ends (OM4-1 Red sign with red reflectors) spaced a max of 9 ft apart. (For streets 24 feet or less use two signs centered in the travel lanes. For streets 32 – 36 ft wide use 3 signs with one in the center and the others offset approximately 8 ft.) Additional mitigation such as berms or temporary fencing may be required if stub street has potential for attracting use as cut thru or access to vacant property. Type III barricades may be used for temporary closures within six months/one construction season instead of object markers

Guide and Other Signs

General Service (hospital, info, etc.) and Special Guide

Additional Criteria: New signs are reviewed on a case by case basis by the City Engineer in conjunction with the planning department. Generally, the minimum number of signs on primary route connections will be used. Existing signs will be reviewed for current applicability when signs need replacing or when identified as no longer relevant.

Highway Services/ Business Advertising

Additional Criteria: New business advertising signs are not permitted in the public right-of-way. The City does have an existing Intergovernmental Agreement (IGA) with the Oregon Travel Information Council (OTIC) for the OTIC to manage and maintain a set of existing

business advertising signs on select City streets. Under this agreement, the OTIC permits and maintains advertising signs per their policy. The signs are only permitted for businesses directly accessed from the street where directed by the initial sign location. While the OTIC will allow signs for indirectly accessed businesses, they require supplemental signs on the city street; and the City of Bend code does not allow the off-site supplemental signs. Only businesses with direct access to the street signed are permitted on the OTIC signs. Contact OTIC directly for sign availability, fees, and permitting requirements (503.378.4508/www.oregontic.com).

Visit Bend Parking, Info, and Guide Sign Program

Additional Criteria: In the mid-2000s a parking, information center, and major destination sign plan was developed and implemented in the downtown core area. Existing signs will be replaced as needed. This program is not being expanded. A future project is needed to upgrade the program including identifying a more visible, legible, and longer lasting color scheme than the current purple/ yellow scheme.

Recreation and Cultural Interest

Additional Criteria: These signs are limited in use and reviewed on a case-by-case basis by the City Engineer in conjunction with the planning department.

D3-1 Street Name. See COB Standard Drawing R-8 Street Name

Additional Criteria: Street name signs facing the street they name shall be installed at each street intersection for all streets. See COB Standard Drawing R-9 - Street Sign Placement. In business districts and on collector and arterial streets, street name signs shall be placed in at least two locations, on diagonally opposite corners so they are on the far right side of the intersection for traffic on the major street. On local streets and in residential areas, street name signs shall be placed in at least one location for each intersection. Where there is a stop sign and visibility requirements are met, the street name sign shall be co-llocated with the stop sign.

Street name signs at signalized intersections shall be mounted overhead on the traffic signal mast arms. In limited cases for retrofitting older signals, the street name sign may be located on the signal pole. As noted in the street name sign detail, the standard intersection street

name sign configuration includes a two back-to-back mounted single sided signs on the bottom (the cross -street) and one double-sided sign on the top (the mainline street).

Street name signs shall have a white border along the outside edge of the sign and white lettering. The colored background shall be green.

Street name signs for private streets shall be installed on private property, outside of the public right-of-way and are to be privately maintained. A supplemental private drive sign facing the public street and mounted below the private street name is required where the private street connects to a public street. (See Private Drive signs).

OW 14-3 Private Street Name–Custom

Additional Criteria: Signs for private streets at intersections with public streets shall be installed within the public right-of- way. Any private street name sign at public street intersections must meet City street name sign standards and have the black on yellow Private Street placard added. While owners may vary the private street name design outside of public right-of-way, it is recommended that private streets utilize the City standard for street name signs. (Private streets are also under the jurisdiction of the MUTCD that limits street name design options.) It is up to the private street to establish their street name design and confirm compliance with the MUTCD. Where existing non-conforming private street name signs are located in the right-of-way, they will be replaced with City standard sign assemblies when they need to be replaced (age, damage, etc.).

Trail Name

At major trail crossings of arterial streets, a brown sign with white legend with the trail name may be added to the top of the S11-15 sign. Major trails are the Haul Road Trail, Deschutes River Trail, and Central Oregon Historic Canal Trail. Another sign color may be used instead of brown if part of a city-wide wayfinding sign program approved by the City Engineer.

Delineators: Flex stake SM 750 series tubular surface mount delineator with reflective strip is used.

Additional Criteria: Use dual reflective strip with 36" installed on curb (4 ft on grade). Color yellow or white per MUTCD based on location. Used on median ends, traffic separators, and curb extensions. (See COB standard drawings for placement guidelines).

Delineators are considered guide devices rather than warning devices and provide hazard marking for street users and plow operations. They are used:

a) on the leading ends of median ends (COB Standard Drawing R 25 Median End Detail), on traffic separators, and on the leading ends of curb extensions,
b) At the leading ends of curbs where curbs start mid-block or after an intersection where there is no curb,
c) in limited cases with City Engineer approval where the alignment may be confusing or unexpected such as at lane reduction transitions and curves where there have been run off the road or lane violation crash patterns, or
d) to guide traffic or separate bike lanes and shared paths from moving traffic. City Engineer to approve type and extent of delineators used for separated bike lanes.

Neighborhood Association (NA)

Location: The sign locations are generally established with no additions or relocations; however, signs may be moved with TMD approval in limited instances such as when streets are extended and the NA limits expand.

Additional Criteria: Each of the City's thirteen neighborhood associations are assigned designated neighborhood association sign locations. TMD maintains the current location

inventory and coordinates with the NAs when signs are faded or damaged and need to be replaced. Replacement signs are funded by the NA, and replacement posts and labor are furnished by TMD. The NAs are responsible for contacting the designated sign vendor, placing and paying for the sign order, and dropping the signs off at the TMD shop. TMD will install the replacement signs. Check with the City Neighborhood Association coordinator prior to ordering new signs to confirm the current design will be used, a sign update is being evaluated.

OD413,413A Welcome to Bend Sign with bend logo and population placard.

Location: At existing designated locations at the city limits

Additional Criteria: The TMD updates the Welcome sign in conjunction with ODOT who may fund the main sign replacements with City funding for the population placard. The population placard is considered for updating when population changes by 10,000 or more. The population data is provided by Portland State University and reviewed and approved by the Bend Metropolitan Planning Organization. Signs were last updated in August 2020.

Bus Stop Sign

Additional Criteria: Per an intergovernmental agreement with Cascade East Transit, CET is responsible for installing and maintaining signs related to transit stops. This does not include no parking signs that are the responsibility of the City (see no parking bus stop sign). Contact CET for bus sign standards and specifications. The City of Bend and CET coordinate on transit stop locations. Stop locations should consider locations that are easily accessible by the surrounding neighborhood, major transit rider generators, and intersecting transit services. Transit stops should be located where there is access to appropriate crosswalk enhancements for the street conditions and not where sight distance of crossing pedestrians is limited. Midblock stops are not desirable, stops should be located at the far side of an intersection.

Neighborhood Watch

Additional Criteria: There is no City program for neighborhood watch signs (24” x 18”). Neighborhoods may elect to use the signs if they comply with any COB sign code

requirements, do not alter the message, locate signs outside of the right-of-way on private property, meet MUTCD height and location requirements if within public access travel way, and are privately maintained. Signs can be purchased from the national neighborhood watch institute making sure to use Police Department, not Sheriff, in the sign text. Contact the Police Department Community Liaison for more information on starting a neighborhood watch program and safety tips.

Slow Down Yard Signs (18" x 24")

Additional Criteria: There is no City program for neighborhood slow down signs. Citizens can check with the Neighborhood Leadership alliance who has sponsored signs in the past or install signs independently. If used the signs must be privately funded and maintained, comply with any COB sign code requirements, be located outside of the right-of-way on private property, and installed securely. Signs may not be installed on existing traffic signs, utility poles, mail boxes or other locations in the right-of-way. Signs messages must not be offensive or contain traffic control messages. Signs must be temporary and not installed on permanent posts.

Bend Beautification/ Adopt a Road

Size: 24" x 24" plus 24" x 24" plaque with adopter name)

Additional Criteria: See the Bend Beautification program outlined on the City website at https://www.bendoregon.gov/community/volunteer-program/bend-beautification-program for program details, application, and approval process. This program allows individuals or groups to adopt streets or public spaces for on-going clean-up, and signs are posted to recognize their efforts. For single or limited day clean-up events, the Bend Beautification program may approve sandwich boards/ type II barricades with sponsor information for use only during the event.

School Area Signs


S1-1 School Zone

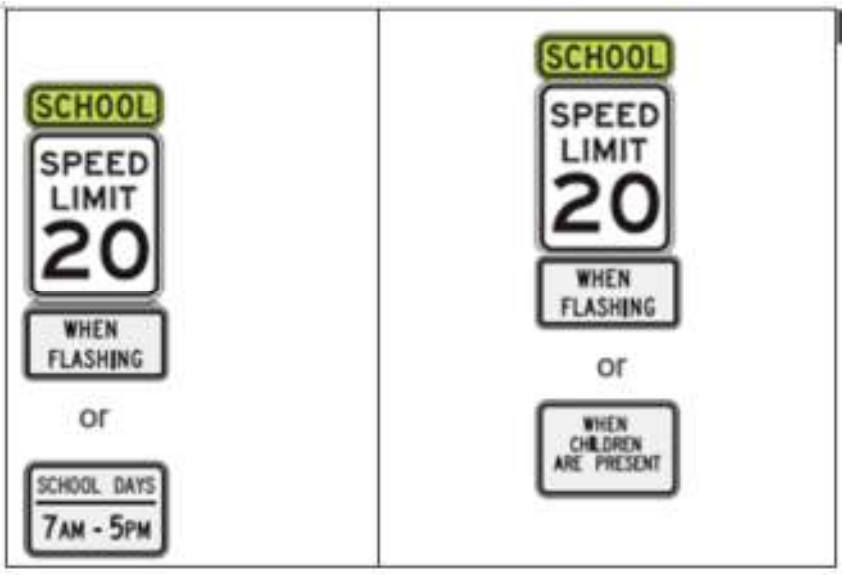
S1-1/ W 16-9P School Ahead

S1-1/ W 16-7P School Crossing

Size: standard size is 30” x 30”; use 36” x 36” for speeds over 40 mph and for multilane with speeds over 25 mph

Additional Criteria: In school zones or school crossings approved by the City Engineer. Use S1-1/ W16-9P School Ahead sign in advance of the school speed sign assembly. Use the S1-1/ W16-7P School Crossing sign at approved school crosswalks. See Guide for Crosswalk Marking.

School Speed Sign Assembly S4-3P/R2-1/S4P/ S1P custom or S4-2P



Location: At the start of school zones approved by the City Engineer. Preceded by an S1-1/W 16-9P School ahead sign

Additional Criteria: School Area signs are installed following the ODOT Guide for School Area Safety and the provisions in ORS 811.111 for condition A (school zones adjacent to school grounds) and condition B (crosswalks not adjacent to school grounds). School speed zones are not established indiscriminately and need evaluation to identify the shortest segment that serves crossing and access. There are two types of school zones. Condition A – school zone located on a street adjacent to school grounds where there is direct access to the school entry/exit, there are facilities for biking and walking, and facilities are connected to neighborhoods with children attending the school. Condition B is a school zone at an approved safe route to school crossing on an arterial or collector that is staffed with crossing guards. The school zone evaluation needs to consider how the school zone will function within a corridor. School speed zones are as short as they can be to accommodate the closest school access routes, generally within 200 ft of the school property or less. School frontages with no facilities or that are fully fenced with no school access or crossings are not posted with school speed zones. Roundabouts are not typically included in the school speed zones, but may have a school crossing.

School signs are fluorescent yellow-green. Use three individual signs in the school speed sign assembly, not one combined sign. See also School legend that may be required with school speed sign and school ahead sign that is also required. When static signs are used, Oregon statute requires the time to read “school days 7 am to 5pm”, alternate school times are not permitted. Solar powered school flashing beacons are required for new school speed signs on arterial or collector streets with speeds more than 30 miles per hour, except for school zones at roundabouts. The standard school flashing beacon is the Carmanah R829G with appropriately sized solar panel and the Applied Information AI-500-70© remote management hardware. Flashing beacons may be considered case by case on 25 mph arterial or collector streets with consideration for prevailing speed and impact of flashing sign on adjacent residences. Static signs are used, not flashers, on local streets.

On residential local side streets in a grid street network that intersect a street within a posted school zone adjacent to school property, instead of the school ahead and school speed

assembly signs, the S1-1 school zone sign alone is used. School speed zones are not used on greenways that are posted 20 miles per hour, the school zone sign is used.

School speed zones are not used for day care facilities or pre-schools with younger kids that typically have adults accompanying them. School speed zones may be considered at private schools if there is demonstrated volume of more than twenty students biking /walking, there are pedestrian and bike facilities connecting the school to the adjacent neighborhoods where enrolled students live, there is a marked crosswalk, and the school agrees to supply trained crossing guards.

R1-6c In Street Stop for School Crossing.

Additional Criteria: Use where there is a median suitable for mounting signs at a marked school crossing (See Marking Crosswalks.). Use yellow green color for approved school crossing. Moveable R1-6c may be used on centerline of street in a marked crosswalk as supplemental sign by school crossing guard if placed at beginning of shift and removed at end of shift during school arrival and departure times and street is wide enough to place the cone and maintain two 10 ft minimum travel lanes.

R10/R11 School Fines Higher - Not used.

School Bus Stop Ahead – Not used. Existing signs may be removed as they need to be replaced or as stops change.

Bicycle Signs

R3-17 Bike Lane – Sign not used. 8-inch stripe signifies bike lane

R3-17/R 3-17Pb Bike Lane Ends – existing signs

OBW1-9 – use for new and replacement applications

Size: Use 30 x 30 on streets with speeds 35 mph or less

Additional Criteria: Bike lanes should be designed and built to end at intersections and not mid-block. Used where the bike lane ends midblock or at an intersection where it does not continue at intersection. See also bike lane ends striping. Not used at roundabouts or intersections with bike exit ramps to multi-use paths.

Scenic Bikeways

Additional Criteria: The City has an IGA with Oregon Parks and Recreation (IGA 8193 effective 1/23/18 – 2024) for the City to install and maintain signs on certain scenic bikeways. Contact the TMD for information on location and installation of these signs.

Bike Destination Guide

Additional Criteria: Signs may be used if a bicycle wayfinding sign program is developed and approved by the City Engineer that identifies program elements such as citywide major destinations, criteria for determining which routes will have signs, and a map and inventory of sign locations.

Pavement Markings

GENERAL

Design

Pavement markings are designed in conformance with the City of Bend Design Standards and approved via development review, capital projects, or operational projects. Refer to the Design Standards for information on lane widths, cross-sections, lane alignment, auxiliary lanes, speed limits, and other design characteristics that support pavement markings. See COB Standard Drawings for details related to pavement markings. Additional general pavement marking notes include:

- Marking designs shall show and identify a minimum of 300 feet of existing marking beyond the project to ensure proper tie-in to existing marking. Where project limits occur within 500 feet of existing pavement or striping tapers, limits of marking plans shall be extended to include the full taper. Plans shall show and identify all existing marking and include all marking removal necessary to implement new marking as shown.
- Extension of lane lines at driveways/break of lane lines at streets: Bike lanes and edge lines shall continue through driveways and alleys. Parking lane lines shall stop before driveways and alleys according to the appropriate no parking offset. Longitudinal lane lines shall break at street intersections (public or private) and higher volume commercial driveways that function similar to streets. Where buffered parking is used at high volume commercial driveways a) the buffer can terminate either side of the driveway or b) a curb side dash white line (WD) may be used.
- Lane widths: Mark lane widths per the approved design plans and standard cross-sections.
- Median striping/ shy line: Used adjacent to medians on divided streets. Mark a minimum of 1.5 ft from the median curb. For yellow striping diverging around a median follow the taper length requirements in the standards on the median approach and departure taper.

- Left turn lane transitions – where painted center medians transition to left turn lanes, gaps are preferred over reverse curves

Signing and Marking Materials

- Longitudinal pavement markings
    - Longitudinal markings – new arterial streets: Standard is inlaid thermoplastic, 120 mils, no profiled, grooved, extruded. This is a durable marking material with a longer service life and the inlay provides a) additional protection from plows and b) guide for restriping and when worn. Option for using methyl methacrylate,40 mils non-profiled, surface or groove, extruded or sprayed with City Engineer approval. All lines minimum 1.5 ft from edge of parallel curb (limitation of paint truck).
    - Longitudinal markings – collector and local streets: Use waterborne traffic paint
- Parking lane line on arterial and streets: Use inlaid thermoplastic, 120 mils, non-profiled, grooved, extruded; on collector streets use of thermoplastic is preferred (inlaid or flush based on the selection for the other longitudinal markings) and waterborne traffic paint is acceptable.
- Parking tics (P): Use waterborne traffic paint
- Curb paint (CY, CR, or CG): Curb paint shall be high performance latex traffic paint designed to be applied on concrete, asphalt, slurry seal, chip seal, crack seal street surfaces meeting federal specification TT-P-01952E, Type II. Colors must meet Traffic Standards for traffic white, traffic yellow, and safety red. Examples of common colors and their FED0STD 595 color chip are yellow # 33538 and red # 31136.
- Legends (Stop Bar, Lane Arrows, School, RR, Sharrow, Bike Symbol, Bike Lane Dash (WD-2), WRAB, SB, etc.): Use Type BHS, preformed thermoplastic (inlaid where applied on concrete)
- Green bicycle lane: Confirm material with TMD Assistant City engineer, typical material is methyl methacrylate (See Also FHWA Interim approval IA-14 Green-colored Pavement for bike lanes and Oregon statewide approval)

- Median curb ends paint: Median and traffic separator curb ends shall be painted with yellow reflectorized traffic paint from the nose back 10 ft or to where the taper ends. See COB Standard Drawing R-25, raised pavement markers and delineators also required.

Marking/ Legend Removal

- Per the MUTCD, markings need to be obliterated and completely removed not just covered up to avoid driver confusion, particularly at night and in wet conditions. If removal is needed during cold weather when conditions are not favorable for remarking, markings may be temporarily masked with black traffic tape, not paint, until they can be removed or obliterated within 6 months. The preference is to delay the remarking until conditions for removal are favorable, especially if the remarking is for lane lines. Hydro blasting is the preferred method of removal for longitudinal paint lines, and grinding is acceptable for legends and short (less than 100 ft of longitudinal lines). Special provisions are needed for the removal of markings on chip seal or slurry seal due to the potential for damage to the seal, contact the Streets Pavement Preservation manager for current methods. Marking for Streets

The following clarifications are provided for street markings (See COB Standard Drawings including R40 through 43 Pavement Markings):

- Striping and pavement markings shall be provided on all arterial and collector streets and on local streets as applicable
- Centerline, crosswalk, and stop bars are required to be inlaid for new concrete roadways
- WCB – white with contract black background may be approved for inlaid longitudinal striping applications by TMD Assistant City Engineer
- NDW Narrow Double White/ No Lane Change: Use on multilane approach to an RRFB
- YB Yellow Broken: No longer used as centerline, existing YB lines will be replaced with associated street work (pavement preservation, development, capital projects, or striping maintenance).
- NDY narrow double yellow: Used as standard when double yellow line required.
- S stop bar: White. Stop bars installed at stop-controlled side street approaches on arterials or collectors. Not used in front of a marked crosswalk. May be used on local

streets in limited cases where visibility, grades, or other site constraints support installation per MUTCD. See COB Standard Drawing R-45 – Intersecton pavement Marking Layout.

- E- Varies Lane Use Arrows, White: Use elongated arrows on streets with speeds less than 40 mph in left and right turn lanes. Use in thru or thru/ right lanes only when lane is offset for through traffic or other unique constraint supports striping. See COB Standard Drawing R-44 – Turn Lane Marking Layout.
- SB. Speed Hump Marking, White: Used on all asphalt speed humps. (Concrete raised crossings use conventional or staggered crosswalk based on traffic control.) See COB Standard Drawings R-32 and R-33 for location of speed hump marking and offsets from curb.
- WRAB: Marking for circulating lane line at intersection approaches in roundabouts; used instead of yield lines.
- YLD: Yield lines. Not used at roundabouts (use WRAB). May be used at traffic circles such as to identify yield location relative to sight distance, circulating pathway, or unmarked pedestrian crossing alignment. Not used if crosswalks marked. (COB Standard Drawing R-34)
- Word Message on Pavement: Not used. Exception see School legend.
- Raised Pavement markings: Not used on street surface (Signs and other markings not as susceptible to snow plow damaged are used instead.) Used on medians.
- Median islands: Leading ends of raised medians and islands shall be painted yellow or white as applicable, in conformance with the MUTCD. Reflective RPM’s of the same color shall be placed on the top of the curb around the leading ends of medians and islands. In addition, surface-mounted tubular markers shall be installed as shown in City’s Standard Drawing R-25 for median end treatments.
- Fixed Obstruction approach - Where a fixed obstruction is present within a paved roadway, such as a raised median preceded by a painted median or two-way-left-turn-lane, the approach area shall be marked with Transverse diagonal lines and no passing lines, unless otherwise provided in Section 3 of the MUTCD.

MARKING FOR PARKING

General

- W Parking lane line,4 inch white: A 4-inch white parking lane line is used to delineate the parallel parking lane when it is curbside adjacent to a bike lane on arterial streets. Parking lines are required for parking–protected bike lanes. Parking lane lines are used to delineate each angled parking space. Where there is no adjacent bike lane, the parking lane line is not used to delineate a parallel parking lane. Parallel parking lanes on local streets are not striped.
- P Parking Tic: Parking tics are used within the downtown managed parking zone and in other business districts with approval from the Parking Manager. When parking tics are used, an ADA parking space evaluation must be conducted and ADA spaces provided as needed.
- Accessible Parking: See Standard Drawing R-29 Accessible Parking Angle. Optional blue background for accessible parking legend is used only on concrete. Accessible spaces are required when painted parking stalls are installed per section 208 of the ADA standard for Accessible Design and ORS 447.233

Curb Painting

Additional Criteria: Oregon revised statute 811.550 prohibits parking within ten feet of a fire hydrant, within twenty feet of an intersection crosswalk, or up to fifty feet on the approach to a signal, stop sign, or traffic control device where parking blocks the device. The Bend Code 6.20.005 prescribes the following colors for parking restrictions

- yellow curb paint (CY) = no parking any time
- green (CG)= loading zone
- red (CR) = fire or special security area

The State statute and City code specify parking prohibitions, and parking restrictions can be enforced even if the location is not signed or marked. It is impractical to mark all curbs, and the following targeted curb paint criteria are identified:

1) Red Curb: Red curb paint is used for 20 ft in front of fire hydrants, 10 feet on either side of the hydrant. Where a fire hydrant is within or less than 22 feet (one parking space) from an area that

meets the criteria for yellow curb, the area 10 ft either side of the fire hydrant is painted red and yellow curb paint shall extend to the red curb paint to create a continuous no parking zone from the intersection.

   a. Signs are not used to restrict parking at fire hydrants
   b. Red curb paint is not used on public streets for no parking fire lane; for parking restrictions see No Parking signs.

2) Green Curb: The curb at loading zones is painted green to supplement loading zone signs. See Loading Zone signs.
3) Yellow curb: Yellow curb is used in lieu of signs, or in limited cases in conjunction with signs to indicate parking restrictions as follows:
   a. May be used in target areas to reinforce the 20 ft parking restriction in ORS 811.550-16 at street intersection crosswalks where there are ADA ramps on both sides and connecting sidewalks. Target areas are locations with high on-street parking demand, high incidents of non-compliance per the Parking manager or Police Traffic Sergeant, and commercial, multifamily, or school land uses. This includes areas such as downtown, commercial districts (Galveston, Newport), multifamily, St Charlies Medical Center Complex and surrounding medical center areas, adjacent to schools in coordination with the school district, and in high demand parking zones adjacent to the colleges (OSU and COCC).
   b. Commercial driveways are not typically painted. Exception, commercial driveways may be painted 5 feet either side of the driveway in the target areas noted in 1a where multiple safety factors exist such as i) crash history attributed to sight distance, ii) the driveway is a primary multi-family /major commercial driveway with no alternative exits, iii) speeds are over 25 mph, iv) traffic volumes are over 1200 vehicles per day, v) there are grades or curves that further restrict visibility of oncoming traffic, or vi) the street is not wide enough for two cars to pass.
   c. Curb painting is not used for driveways in residential areas, alleys, or mailboxes - there is no ORS/ COB code parking restriction for mailboxes, alleys, or driveways.
   d. Curb painting may also be used and is the preferred choice in lieu of no parking signs for short sections of on street parking restrictions typically less than half a block. See No Parking signs.
   e. Curb Extensions are not typically painted or signed as they serve as the no parking indicator. Curb extensions may be painted where the streetscape is inconsistent and the parking bay is not easily discerned or the curb extensions are isolated.

Existing Non–Compliant curb painting. Existing curb painting not installed by the City or City installed curb paint that no longer meets current practice will be reviewed for removal by overpainting with grey traffic paint).

MARKING FOR PEOPLE WALKING

- CW –SC (Staggered Continental) or CW (Conventional) Crosswalks. See COB Standard Drawing R47- Crosswalk Markings. Use White Type B-HS Preformed Thermoplastic. (inlaid where applied on concrete); black contrast may be approved by TMD Assistant City engineer

Additional Criteria: See Marking Crosswalks for when to mark. When used, use conventional markings on stop-controlled approaches and staggered continental markings on uncontrolled approaches and roundabouts.

MARKING FOR PEOPLE ON BICYCLES

New streets and reconstructed streets are required to provide bicycle facilities that achieve Level of Stress (LTS) 1 or LTS 2 if they are identified on the Transportation System Plan low stress network map or as otherwise required in the Design Standards.

Bicycle Markings

Refer to Standard Drawings including COB R-43 and R-44 for bicycle related pavement marking details.

- W-2 Bike Lane - Use where bike lanes provided.
- WD-2 Bike Lane Dash – Use where bike lanes end at a length identified based on street speed per table in COB Standard Drawing R-44B. Also used at bike exits/entrances at roundabouts per the roundabout design guide. See also bike lane ends signs.
- BUF. Painted buffer Bike lanes. Use where buffered bike lane approved on development, capital improvement, or operation design plans on arterial or collector low stress bike routes. Not used on local streets. Minimum buffer is 2 ft. No cross hatches are used for width less than 3 feet. Where used cross hatches are used, place at 45 degrees and space 40 ft on center. May be used as standard installation between travel lane and bike lane or as parking protected (between bike lane and parking lane). Next

to the travel lane an 8-inch white line is used, and next to parking a 4-inch white line is used.

Guidance for use of Vertically separated bike buffers include:

- Parking Separated Bicycle Lanes – Parking separated bicycle lanes are a standard tool for providing a physical buffer between people riding bicycles and the vehicle travel lane. Design parameters to consider for using parking separated bike lanes includes:
  - Generally, maintains the alignment of the bicycle travel path with no sharp deflection around the parking space
  - There is access control (limited driveways)
  - Coordination with transit stops and loading zones
  - There are no horizontal or vertical curves that block visibility of exiting bicyclists
  - A 2-foot buffer (for the door zone) is provided
  - Parking can be removed if needed to provide sight distance for entering/exiting bicycles. Example distances are:

	Near/ Leading side	Far side
Intersections	60 feet	20 feet
Driveways	30 feet	20 feet
Bus Stops	10:1 taper (typ 100 feet)	5:1 taper (typ 60 ft)

- Delineator Separated Bicycle Lanes – Delineator separated bike lanes (delineators, bollards, concrete barriers, planters, parking stops, “armadillos”, or other low vertical elements, or similar raised elements) may be considered with confirmation of maintenance funding (personnel, materials, and equipment) and approval of the City Engineer. City Engineer to confirm specifications for bike lane delineators.

- GRN and BLE-G FHWA granted Oregon interim approval for the optional use of green colored pavement within marked bike lanes. Green color must meet specifications for chromaticity and luminance per the MUTCD interim rule and shall be material that minimizes bicycle traction loss. Retroreflective green is not used. Check with TMD Assistant City Engineer for current material preference. Reference OCOT QPL for material options.
    - Green Supplemented Bike Lane Solid Lane (COB Standard Drawing R-44A) is limited to locations at low stress network approaches to five lane arterials and protected intersections.
    - Green Supplemented bike Lane Dotted line Extension (COB Standard Drawing R-44A) also referred to as cross-bike when used at marked crossing with CW-SC. May be used on TSP Figure 5-1 low stress routes or major trail (Deschutes River Trail, COHC Trail, and Haul Trail) routes at protected intersections and enhanced low-stress crossings of arterial and high volume/ major collector streets.
    - Green Supplemented Bike Lane at Dropped Right turn lane (COB Standard Drawing R-44A or Added right turn lane may be used in conjunction with protected bike routes or on multi-lane arterial streets
    -
- WD2/BC-ZG. Bike Marking Extension Through Intersection. Generally, not used. May be used with City Engineer approval where through alignment shifts or unique lane alignment where additional direction to cyclists is needed to identify travel path.
- BS Bike Lane Symbol with Arrow. White, Type BHS Preformed Thermoplastic. COB Standard Drawing R-43. Use at the start or continuation of bike lanes after each street intersection where on-street bike lanes are present. See detail for standard distance from intersection to avoid wear from turning vehicles. Use appropriate arrow for the direction (left, thru, right, combined).
- SLM. Shared Lane Marking. White, type B-HS Preformed Thermoplastic. Use on designated, constructed greenways, in shared right turn lanes, and on short (1 – 2 block) gap sections of otherwise continuous bike lanes. Offset shared lane marking in

the travel lane based on street widths and presence of parking according to the table in COB Standard Drawing R-32. Typically spaced every 250 feet. Adjust shared lane marking spacing to have legend upstream from intersections, not in the turning vehicle path at driveways, not in or within 50 feet of crosswalks, not within 20 feet of speed humps, not over utilities (manholes, valve boxes, etc.), and to be visible where there are horizontal/vertical curves. Use appropriate arrow for the direction (left, thru, right, combined).

- Intersection Bicycle Box or Two-Stage Turn Bicycle Box. Used in limited cases with engineering study and City Engineer approval. Engineering study to include evaluating the following at a minimum:
    - Location is a signalized intersection on streets with bike lanes,
    - There is sufficient space to locate an appropriately sized box out of the through traffic,
    - All approach streets have bike lanes or the receiving street is a constructed, marked greenway,
    - High volumes of bicycle turns exist or are expected in short term to travel on connecting bike facilities for extended travel (more than a few blocks),
    - High volumes of traffic and speeds over 30 mph, where heavy volumes and queues make movement into the turn lane difficult for the bicyclist or where used to connect to a constructed greenway, and
    - FHWA interim approval conditions are met.
- Y Shared Use Path Centerline – typically not used. May be used in limited cases where unique site constraint is mitigated by directionally channelizing users at crossings, sharp curves, or directional changes immediately before or after an undercrossing.

MARKING FOR SCHOOLS

- SCH. School Legend. White, Type B-HS, Preformed Thermoplastic. Use in line with school speed limit signs at the start of the school speed limit on arterial and collector roads. Not used on local streets.

MARKING CROSSWALKS

Background

In Oregon,[1] crosswalks exist across each street at intersecting streets, whether the crosswalk is marked or unmarked. Pavement markings are only required by law to designate a crosswalk at mid-block locations. Oregon drivers are required[2] to stop and remain stopped to allow a person in any crosswalk (marked or unmarked) to cross. The law covers anyone within the crosswalk including people on foot, using a mobility aid such as a wheelchair, cane or walker, and using a bicycle.

Crosswalks may be marked to define and delineate a preferred crossing location and indicate to drivers the potential for conflicts with people crossing. The decision to mark a crosswalk differs for controlled, uncontrolled, and midblock approaches and is based on site specific characteristics. Some streets, especially those with more travel lanes, higher speeds, more vehicles, and higher bicycle and pedestrian use, may need improvements in conjunction with marking to provide safe, comfortable crossings.

Another aspect of crosswalks is the level of comfort for people using the crossing. The Level of Stress (LTS) is a measure used to rate different comfort levels for different types of crossings, traffic volumes, speeds, and street classifications. Targeting lower stress level infrastructure can encourage increased biking and walking by people of all ages and abilities. The City of Bend TSP Action Items 40 -49 target providing complete streets and low stress pedestrian and bicycle routes and crossings. Low Stress crossing locations are identified in the Engineering Design Standards, on Low Stress Routes Map (shown on TSP Figure 5-1) and the Connector Routes and Crossings Map (Attachment to the Engineering Design Standards), and as required by the City Engineer. As detailed in the standards, the City targets LTS 1 adjacent to schools and parks and LTS1 (preferred for all ages use) or LTS 2 at other crossings. The following guidelines are intended to provide a consistent procedure for determining when a crosswalk is marked.

[1] 2017 Oregon Revised Statutes 801.220
[2] 2017 Oregon Revised Statutes 811.028

Crosswalk Marking Legend

CW (COB Standard Drawing R-42A) - Conventional crosswalk markings are used on controlled approaches

CW-SC (COB Standard Drawing R-42A) - Staggered Continental crosswalk markings are used on uncontrolled approaches.

Marking One Side of an Intersection

The City interprets ORS 801.220 consistent with ODOT Technical Services Bulletin RD21-01B that a marked crosswalk at an intersection does not change the existence of any other crosswalk at that intersection. Each approach is evaluated individually for marking.

Where the engineering evaluation identifies that one leg of an intersection will be marked; the adjacent legs need no action and the opposing leg will be:

a) Marked if the engineering evaluation identifies that the opposing leg also meets the criteria for marking and required enhancements, or
b) Remain unmarked if the engineering evaluation identifies that the opposing leg does not meet the criteria for marking or does not have the required enhancements, and it does not meet the conditions for closure, or
c) Signed and closed and any ADA ramps removed if the leg meets the very limited conditions for closure

Controlled Approaches and Roundabouts

The standard practice for marking crosswalks at controlled approaches and Roundabouts is:

- Traffic Signals – Install marked crosswalks on all approaches to a traffic signal that have a sidewalk and curb ramps or an unimpeded shoulder area.
- All-Way Stop intersection –Install marked crosswalks on all approaches of an all-way stop intersection that have pedestrian facilities (sidewalk and curb ramps). Street or pedestrian crosswalk lighting is required for new marked crosswalks.
- Two-Way Stop intersection – Marked crosswalks are not typically marked on the controlled approach of a two way stop intersection. For marking the controlled approach on two-way stop intersections see the uncontrolled approach section.
- Roundabouts (Standard, urban compact, mini) – Install marked crosswalks on all approaches of a roundabout. RRFBs are required for enhanced treatment of multi-lane lane pedestrian crossings at roundabouts. At mini roundabouts and traffic circles, follow the crosswalk marking policy for uncontrolled approaches. Pedestrian crossing signs are not used in conjunction with markings on controlled approaches or single lane roundabout approaches. School signs may be used on crossings of one or two legs of a roundabout when approved by the City Engineer as part of an approved safe route to school plan.

Uncontrolled Approaches

Crosswalk markings on uncontrolled approaches require an engineering evaluation and are not to be installed indiscriminately. At uncontrolled approaches crosswalks may be marked to help pedestrians find their way across a complex intersection, direct pedestrians to the shortest route across traffic and/or the route with the least exposure to vehicle traffic and traffic conflicts, or direct pedestrians to the alignment where they are best seen by approaching traffic. Crossing enhancements may be required to reduce crossing risks for pedestrians, the most vulnerable road user, and to achieve the target level of traffic stress on designated low stress routes or enhanced crossing locations identified on the Connector Routes and Crossings map.

Mid-block crosswalks are a specific type of uncontrolled approach. Mid-block crossing locations should be avoided and alternate routes to intersections provided. There are times

there is no feasible alternate route for major trail crossings. Where an engineering evaluation demonstrates that the crosswalk criteria can be met and the required enhancements are constructed, mid-block trail crossings may be permitted with City Engineer approval. Where permitted, mid-block crossings are signed, striped, illuminated and enhanced per these guidelines.

The City of Bend crosswalk marking at uncontrolled crossings is based on FHWA-ICT-17-016 Establishing Procedures and Guidelines for Pedestrian Treatments at Uncontrolled Locations to provide enhanced crossing treatments to facilitate pedestrian crossing safety and accommodate target pedestrian Level of Stress (LTS) levels.

LOCATION EVALUATION

For a crosswalk to be marked at an uncontrolled approach the following minimum criteria must be met at the proposed location

- **Minimum vehicle volume -** Arterial or Collector street with an average daily traffic of more than 4,000 vpd. (At lower volumes there are sufficient gaps in traffic for pedestrians to cross.)
- **Posted speed 40 mph or less** – If speed more than 40 mph do not install an uncontrolled crossing. Crossings at 40 mph require City Engineer approval. Target posted speed at uncontrolled crossings is 35 mph or less.
- **Connecting sidewalk and compliant ADA ramps** – There is a continuous sidewalk or paved multi-use path/trail that is connected to pedestrian destinations and compliant ADA ramps on both approaches to the marked crossing. (Note for unpaved trail crossings there is an asphalt mat for a minimum of 10 – 20 feet, grades meet ADA requirements, and compliant detectable warnings are installed).
- **Adequate Visibility** – Sight distance for the posted speed limit is met. Vegetation blocking the crosswalk sight distance should be removed instead of just trimmed to avoid on-going sight distance issues.
- **Illumination** – The crosswalk location is illuminated. Lighting design per City standards.
- **Separation Between Crosswalks** – a) crosswalk location is not within 600 feet of a controlled crosswalk that can be utilized, or b) crosswalks are generally a minimum of ¼ mile or more apart (existing or future planned/potential). Streets with 25 mph speeds or

less downtown or within designated business districts may have crosswalks marked more frequently. Crosswalk locations must consider existing and future potential for adjacent crossing locations and select the location that maximizes use and serves the more continuous travel path.

- **Street Type** – The location is on an arterial or collector, crosswalks are typically not marked on local streets.
- **Crossing Demand –** There is demand for people to cross, typical target of 20 or more pedestrians per hour (actually or reasonably expected based on proposed facilities and development). The crossing location meets at least one of the following criteria:
    - Is an arterial or collector crossing on a designated low stress route (TSP Figure 5-1) or the Connector Routes and Crossings map (Standards Part VI Appendix c) and has constructed pedestrian and bicycle facilities
    - Connects a major pedestrian attractor (commercial centers, area parks, civic facility, etc.)
    - City approved school crossing adjacent to the school or at primary arterial or collector crossing to access school that is a) on an official safe route to school plan, b) staffed with a crossing guard during arrival/ departure (locations away from the school), and c) 10 or more school aged pedestrians per hour use or are estimated to use the crossing.

Other Considerations – Prior to identifying a crosswalk to be marked, the following considerations shall also be evaluated and the design modified as feasible:

- Crossing distance: Consider reducing the crossing distance with curb extensions, lane reconfigurations, or a median.
- Crash history: Evaluate the pedestrian crash history and consider adjusting the location, modify the enhancement type, or provide increased notice to vehicles reduce crashes.
- Alignment: Modify the crossing location to directly align with the pedestrian path of travel or provide a minimal detour. This may require changes to the crosswalk approaching infrastructure.
- Coordination with Transit: Locate marked crosswalks to also serve transit stops where feasible. However, transit stops alone are not a reason to install a marked crosswalk. CET is encouraged to coordinate with City to site transit stops at appropriate crossing

locations that will serve multiple crossing needs. Coordinate with CET to adjust transit stops if needed to coordinate with new marked crossing locations to more directly serve transit riders and the other crossing demands.

- Active Park access: TSP action item 46 supports the City coordinating with BPRD to provide enhanced access to parks within ¼ mile of all neighborhoods. City Engineer may approve an exception to mark a crosswalk on a local "collector" street that serves as the main access to a neighborhood, has volumes over 1500 ADT, the crosswalk serves a park, 85 percentie speeds are over 30 mph, and there is cut thru traffic for crossings to an active (versus passive use) BPRD area park.

CROSSWALK TREATMENTS

Once the proposed location is identified as meeting the location evaluation criteria, the appropriate level of treatment for the location based on lanes, volumes, and speeds to achieve the target level of stress for the crossing location must be determined. Low Stress routes identified on the TSP target LTS 1 or 2. Crossings adjacent to a school or park target LTS 1. Where identified crossing treatments can be provided, the crosswalk can be considered for marking. Where identified crossing treatments cannot be installed, the crosswalks are not marked. Crosswalk treatments are selected following NCPRH 562 and FHWA-ICT-016 Establishing Procedures and Guidelines for Pedestrian Treatments at Uncontrolled Locations (2017) as modified on Table 1 Summary of Minimum Treatments at Uncontrolled Pedestrian Crossings. The following types of crosswalk are used:

Basic Treatment (BT) Signing and marking

The basic crosswalk treatment includes high visibility crosswalk markings (CW-SC staggered continental) with W11-1 pedestrian sign, S1-1 School Crossing, or W11-16 pedestrian/bicycle warning sign and the corresponding W16-7p downward arrow on each crosswalk approach based on the type of crosswalk being provided. (See School Crossing sign or Pedestrian/ Bicycle Crossing sign for when each sign is used.) Advanced signing may also be required if visibility is limited or the crosswalk is located in an area where it may be unexpected.

Evaluate parking and as appropriate restrict on-street parking at the marked crosswalk for twenty feet (typical) or fifty feet (higher speeds or additional visibility restrictions). Parking is

not restricted where parking is within a curb extension where the curb extension provides the buffer and allows the crossing sign to be placed closer to the travel lane.

Median/Island

Median refuge islands are constructed in the middle of two-way streets to provide a place pedestrians can stand and wait for drivers to stop. They reduce the crossing distance and split crossings into two parts, allowing people crossing to focus on traffic from a single direction at a time. The standard pedestrian crossing median is ten feet and includes compliant ADA crossings. On existing streets with developed frontage built to the standard street cross-section where a ten-foot median cannot be accommodated, a six to eight-foot median may be approved by the City Engineer. Where a six to eight-foot median is used, the LTS is reduced by one..

In-Street Crossing Sign on Median

To provide enhanced conspicuity and lower the LTS (lowers by 1), the In-street Stop for Pedestrian (R1-6a) sign is used. This sign is installed on a median or traffic separator and not directly on the pavement.

Raised Island with In Street Pedestrian Sign (RI)

Where there is no center median, a 6 – 8 ft raised island with an In-Street pedestrian sign is used to provide a staging area for pedestrians to cross only one or two lanes at a time instead of three or more lanes. The standard raised island is required on new streets or existing streets with undeveloped frontage and acquirable right-of-way. On existing built-out streets where additional right-of-way or widening is unobtainable, the City Engineer may approve a narrower width raised island. The narrower islands do not provide a pedestrian refuge, but do provide enhanced conspicuity of the crosswalk with the addition of an in-street sign and limits movements of vehicles near the crossing zone. Raised islands are located to accommodate design vehicle turning movements from the adjacent streets.

Advance Crossing Warning Sign

An advanced crossing warning sign (W11-2, S1-1, or W11-16) may be used to provide enhanced conspicuity and advance notice.

Advance Stop Line and Sign (ASLS)

The advance stop line and sign (R1-b or c) indicate where drivers must stop to improve sight lines at multi-lane crosswalks. Advance stop bars may be used on streets with two through lanes. On streets that have on-street parking without curb extensions, restrict on-street parking his same distance to maximize sight lines to the crosswalk.

The MUTCD requires R1-5 signs when stop lines are used in advance of a crosswalk on an uncontrolled multi-lane approach, and Oregon requires the stop not yield message. Signs shall be located so they do not block the crosswalk warning signs and are typically used only on the right side of the street.

Rapid Rectangular Flashing Beacons (RRFB)

RRFBs should only be considered for multi-lane streets with higher volumes and speeds where they are recommended in Table 1. New RRFBs require approval of the City Engineer. In the event sight distance approaching the crosswalk where an RRFB is used is less than required, an additional RRFB may be installed on that approach in advance of the crosswalk. See COB Standard Drawing R-35. The standard RRFB used by the City is the JSF solar powered RRFB system with an Applied Information AI-500-30 low power monitor to connect the RRFB to the City's Glance sign maintenance system. (COB Standard Drawing R-35)

RRFB installations are considered experimental by the FHWA and must meet MUTCD conditions for Interim Approval 21 (issued March 2018). RRFBs cannot be coordinated with traffic signals or other RRFBs and must be sufficiently offset, a minimum of 600 feet or more depending on queue impacts from adjacent devices. Additionally, driver interaction of the green traffic signal light and the RRFB flashing light shall be reviewed and mitigated as needed. If RRFBs are located at marked crosswalks on both sides of an intersection along a street, the RRFBs should be located facing the nearside crosswalk only in each direction of travel. Provide accessible pedestrian push buttons at both crosswalks that trigger both sets of RRFBs when actuated. Where an RRFB is installed on a median, evaluate the visibility of the pedestrian warning signs(W11-2) in relation to the keep right (R4-7) or no left turn (R3-2) sign and adjust or offset those signs as needed.

The multi-lane RRFB enhanced crossing approach includes a narrow double white lane line (NDW) extended to the length required per the table below based on the AASHTO safe stopping sight distance for the posted speed limit of the street:

Posted Speed (mph)	Distance (feet)
20	125
25	150
30	200
35	250

Pedestrian Hybrid Beacon (PHB)

Pedestrian hybrid beacons are an enhancement tool that is used for higher volumes of pedestrians (more than 20 pedestrians per hour) on streets with higher ADTs (more than 9,000 vpd), and higher speeds of 35 to 40 mph. At this time PHBs are not used as current conditions do not generally meet minimum criteria for consideration: high number of pedestrians, uncontrolled crossing to a pedestrian attractor with no controlled crossing in close proximity, and three or more through lanes in a given direction to cross. Refer to MUTCD criteria for PHB. PHB installation requires City Engineer approval.

Pedestrian Traffic Signal

Pedestrian traffic signals are a tool that could be considered at locations with very high volumes of pedestrian crossings in accordance with the criteria in the MUTCD. These signals are typically considered when there are over 130 pedestrians an hour crossing a street. Pedestrian Traffic Signals require City Engineer approval.

Overcrossing /Undercrossing

An overcrossing or undercrossing are encouraged where feasible on higher volume major pedestrian/bicyclist routes across arterial streets or even collector streets with traffic volumes and speeds over 30 mph that do not provide sufficient gaps for driver yielding or where the volume and frequency of pedestrians/ bicyclists crossing adversely impacts the operation of the street (ex. excessive queuing or rear end crashes). Overcrossing or under crossings require approval of the City engineer and require additional design evaluation. The crossings

must be in line with the pedestrian/ bicycle travel path and minimize out of direction switchbacks or travel to facilitate use. Overcrossings and under crossings are encouraged at canal trail crossings and should be reviewed for feasibility when new canal bridges are installed.

OTHER MITIGATION TOOLS

Raised Concrete Crosswalk

Raised crosswalks may be used on a local street uncontrolled marked crossing location that serves as the main pedestrian/ bicycle access to a school and/or public park where approved by the City Engineer. Raised crosswalks are not allowed on arterials or collectors.

Curb Extensions/ Curb Radius Modifications

Curb extensions extend the sidewalk past the parking lane to shorten the crossing distance and increase visibility for all users.

Tighter curb radius – Tighter curb radii can improve sight lines between driver and pedestrian, shorten the crossing distance, bring crosswalks closer to the intersection, and slow turning vehicles. See City of Bend Design Standards for details on minimum curb radii.

Left turn restrictions/ Use of left turn shadow area

In areas where the street network provides alternate locations for left turns the restriction of left turns with a raised island to create a pedestrian refuge may be considered where a raised island is a required enhancement for a marked crossing. This alternative requires a traffic evaluation and City Engineer approval. Additionally, at a tee intersection, the area in the shadow of the left turn may be used for the crosswalk and a raised island added as required.

Lane Reduction

In limited cases where supported by the TSP future transportation network plan and traffic volumes, and approved by the City Engineer, a lane reduction can be considered. Lane reductions may also be considered where there are right or left turn lanes that do not meet volume warrants. A traffic analysis is required to evaluate the feasibility of lane reduction.

Lane change restrictions – uncontrolled marked crosswalks should not be located in areas where vehicles are changing lanes as drivers may be distracted from looking for pedestrians.

On multi-lane streets, lane change restrictions are required for marked crosswalks at uncontrolled approaches.

Flashing pedestrian Warning sign

LED Bordered or other flashing beacon pedestrian warning sign not currently used

Speed reduction - for locations where the speed is 40 mph or greater consider corridor street design modifications that would support the reduction of the speed limit to 35 mph or less. Speed limits are governed by Oregon State law, and per the ORS speed limits must match the context.

Textured or colored crosswalks

The MUTCD requires crosswalk marking and notes that pavement color or patterns do not serve to mark a crosswalk. Crosswalks are marked with CW or CW-SC standard markings only. Textured or colored crosswalks are not currently used.

School Crosswalks

Where a crosswalk meets the criteria for marking, is a major crossing to a school that is identified in a Safe Routes to School plan approved by the school district and City Engineer, and for arterial streets with speeds at 35 mph the school has indicated a commitment to provide crossing patrols for the location, the location may be marked as a school crossing. (Crossings above 35 mph will not be marked as school crossings.) School crossings shall be installed based on a request from the BLSD school administration/City coordinator. If a school crosswalk on a street with a speed limit over 35 mph is not patrolled by a school crossing guard during school arrival and departure, it may be converted to a pedestrian crosswalk or removed. At roundabouts up to two crossings may be considered for marking as school crossings.

Crosswalk Closure – Crosswalks should only be closed in the very limited cases where the intersection geometry or signal operation is such that closing the crosswalk would improve pedestrian safety. Where a crosswalk approach is closed, accommodations must be made on other approaches or in close proximity to provide an alternate crossing to accommodate pedestrian mobility. On existing crosswalks, the lack of crosswalk

enhancements to lower the crossing level of stress alone is not a reason for closure. Crosswalk closures must consider the stipulations of PROWAG and may be considered in limited cases such as:

- on the opposing leg of multi-lane intersection from the leg with a marked crosswalk enhanced with an RRFB, PHB, or pedestrian signal
- on approaches where, pedestrian visibility is obstructed for approaching vehicles and the obstruction cannot be reasonably removed. (Consider complete obstruction or less than half the AASHTO sight distance).
- at skewed/ offset intersections where crosswalks may conflict or have longer, less preferred crossings and closure of an approach would result in a shorter, better identified crossing location to serve the same pedestrian movements
- there is an undercrossing or overcrossing within 300 – 600 feet (example 3rd Street/ Mt Washington)
- there is a physical barrier (natural rock outcropping, wall, etc.) or other hazard on one side of the crossing that prevents pedestrian access
- there is no pedestrian generator adjacent to the crossing, there is a crossing within one block (300 to 600 ft) and the topography of the streets make constructing a crossing and ADA ramps infeasible

The City Engineer must approve all crosswalk closures with the review of the City's Accessibility Manager. A request for crosswalk closure must supported by an engineering evaluation including the following information:

- Engineer Information: engineer name, company, contact information
- Project Information: Project name, crosswalk location (N-S street/E-W street), type of control (uncontrolled/ controlled)
- Reason for Closure:
    - Safety (inadequate sight distance, crash history of pedestrian conflicts that can't otherwise be mitigated, other (describe)
    - Conflict (crossing blocked on one side, other (describe))
    - Adjacent Crossing has RRFB
    - Other (describe)

- Description of Site Characteristics and Supporting Information: describe site characteristics and provide supporting documentation and photos/plans.

Closed crosswalks shall be posted with a crosswalk closed sign mounted on a detectable post or mailbox support (ODOT Standard Drawing RD-100) if approved by City Engineer. Closed crosswalk posting may not be required where the sidewalk is detached, separated from the travel way by a non-transversable barrier, and there is no ADA curb ramp that serves the crossing.

Crosswalk Removal

Crosswalk enhancement needs may change over time if traffic conditions change. Crosswalks may be considered for removal when the primary factor for crosswalk installation (such as trail, bus stop, school, sidewalk) closes, is removed, or relocates such that the crossing demand is removed or significantly reduced. Marked crosswalk locations are reviewed in conjunction with capital, development, and pavement preservation projects and may also be reviewed based on complaints.

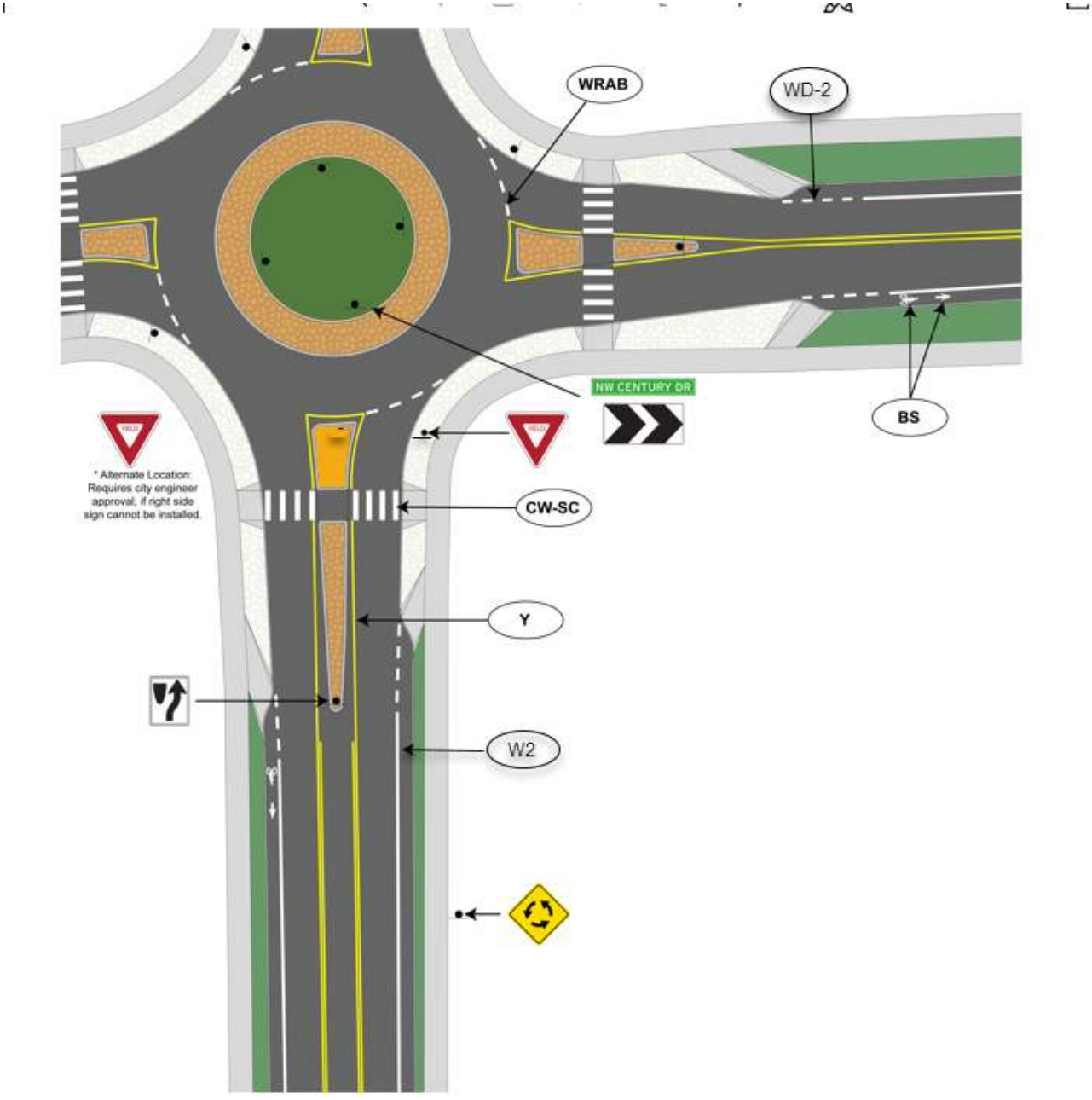
Signing and Marking for Mobility Points

Signing and marking for mobility points varies based on the services provided. Typical layouts for various sized mobility points are shown on COB Standard Drawing R-50 and include the City's standard delineator posts to demark the perimeter. Include an information kiosk/ wayfinding sign using the format identified by the City Engineer.

Signing and Marking for Roundabouts and Traffic Circles

SINGLE LANE ROUNDABOUT

Example Signing and Marking Layout



Pavement Marking

Y Yellow centerline used around splitter islands

Circulating marking Dash (WRAB)– use inlaid thermoplastic, 8 inch by 3 ft with 3 ft gap; For circulating marking yield triangles are not used.

Bike lane start – use solid 8-inch white line, W-2 for the start of a bike lane after a roundabout

Bike lane end – use dash 8-inch white line, WD-2 See COB Standard Drawing R-44B for length

Crosswalks – CW-SC inlaid thermoplastic

Signs

Pedestrian W11-2 or Pedestrian/Bicycle W11-15 warning signs are not used on single lane roundabout approaches. Exception school warning sign S1-2 may be used on one or two approaches of designated school crossings. See School Crosswalk.

R1-2 Yield. Standard location on right side and not on splitter island. If placed on splitter island, use PSST slip base foundation (COB R-7A).

R6-4 Double Chevron. Use double chevron with street name sign (COB Standard Drawing R-8) in center of roundabout island aligned with the approaching lane.

W2-6 Roundabout Warning. Use in advance of roundabout for all approaches. W 16-7P street name not used on single lane roundabouts. Speed warning signs not typically used.

 R4-7 Keep Right. Use on splitter islands.

Delineators. Use on upstream edge of splitter island, offset to right, downstream curb after crosswalk and downstream curb after bike ramp

MULTI-LANE ROUNDABOUT

Pavement Marking

Y Yellow centerline used around splitter islands

Circulating marking Dash (WRAB) and W – use inlaid thermoplastic, 8 inch by 3 ft with 3 ft gap for WRAB. For circulating marking yield triangles are not used.

Bike lane start – use solid 8-inch white line, W-2 for the start of a bike lane after a roundabout

Bike lane end – use dash 8-inch white line, WD-2 See COB R-44B for length

Crosswalks – CW-SC inlaid thermoplastic. Pedestrian W 11-2 or Pedestrian/Bicycle W 11-15 warning signs not used. Exception school warning sign S1-2 may be used on one or two approaches of designated school crossings. See School Crosswalk.

Elongated Lane Arrows – used for lane assignment

Signs

R1-2 Yield. For signs on splitter islands use PSST slip base foundation (COB Standard Drawing R-7A)

R6-4a triple chevron, also R 6-4b Quadruple chevron. Use minimum triple chevron with street name sign (COB Standard Drawing R-8) in center of roundabout island aligned with the approaching lane. Install on triangle baseplate (COB R-7A).

W2-6 Roundabout Warning. Use in advance of roundabout for all approaches. May use W 16-7P street name placard on multi-lane approaches. Speed warning signs not typically used.

R4-7 Keep Right. Use on splitter islands.

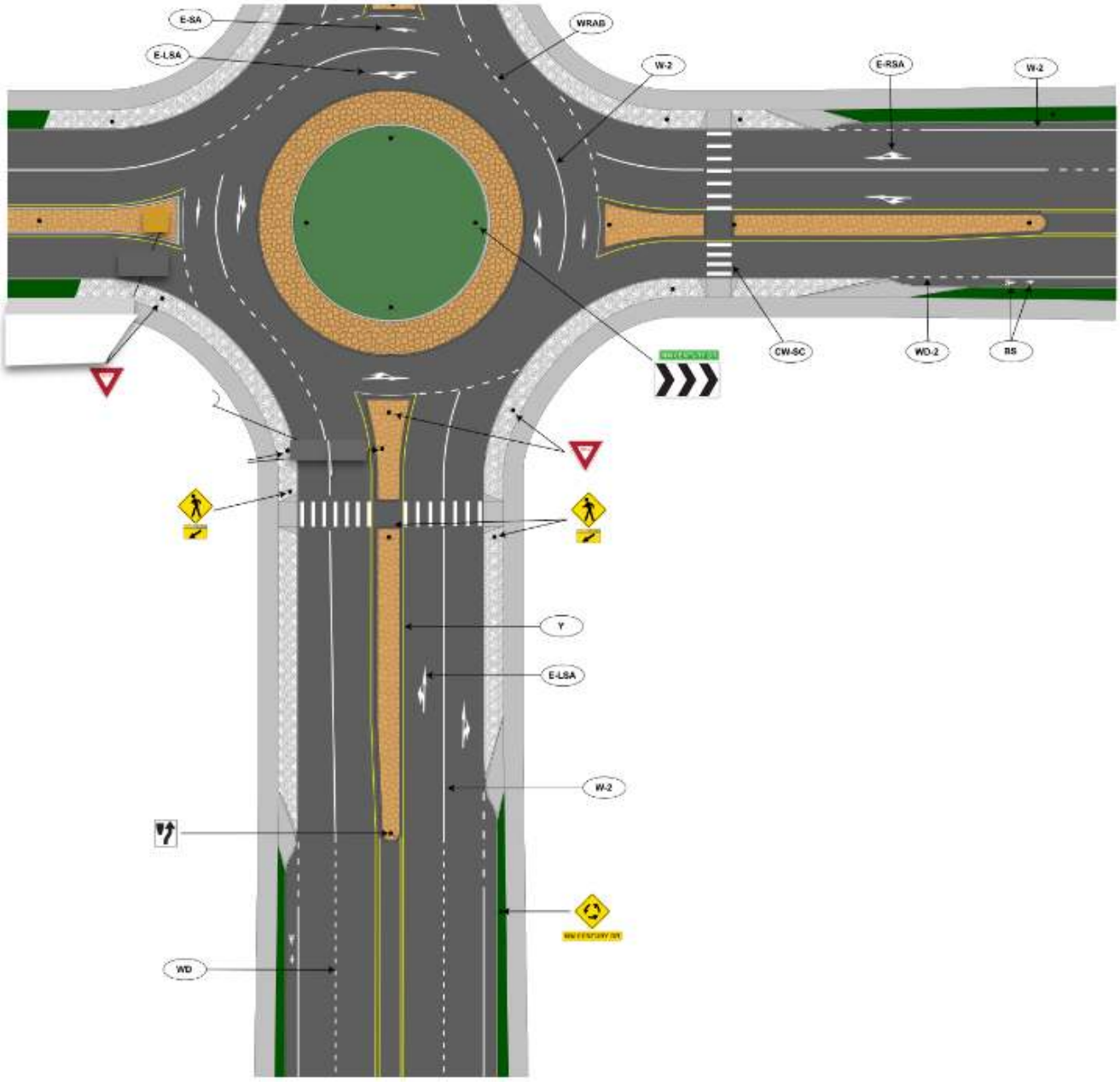
Delineators. Use on upstream edge of splitter island, offset to right, downstream curb after crosswalk and downstream curb after bike ramp

R3 series Lane control signs. Use standard R3 series lane control signs and not fishhook arrow signs.

Pedestrian crossing signing and enhancement evaluation needed for multi-lane crosswalks. Signing and RRFBs are required on multi-lane approaches.

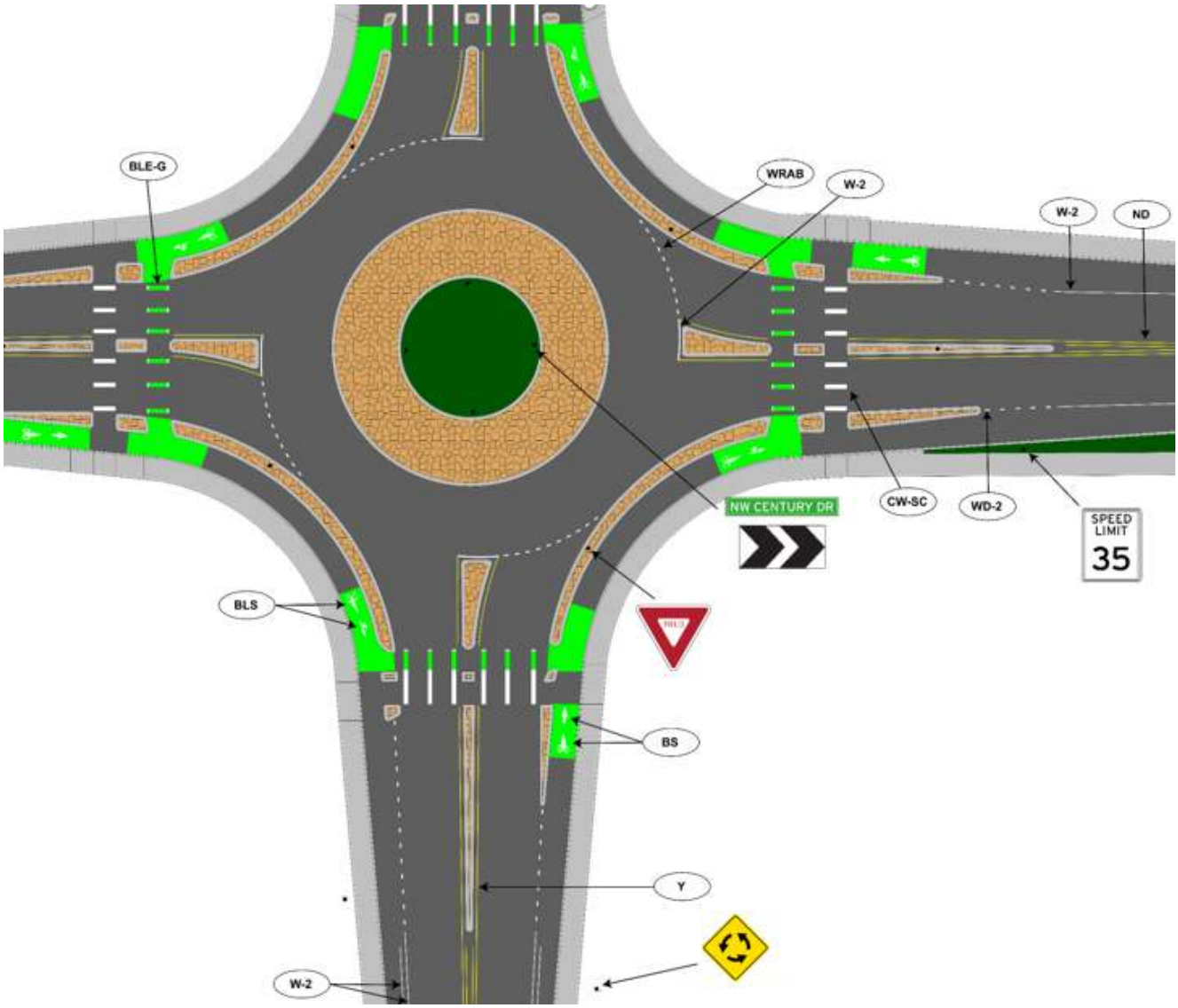
OR4-22 Do Not Drive Beside Trucks. Post at entrances to multi-lane approaches to serve as required notice of potential hazard of driving next to trucks per ORS 810.247

Example Multi-Lane Roundabout Signing and Marking Layout



PROTECTED ROUNDABOUT

Example Protected Roundabout Signing and Marking Layout.



TRAFFIC CIRCLE

R1-2 Yield.

R 6-5p 30 “x 30”

Yield sign with Circulating arrows mounted below is used at the intersection approaches at a traffic circle. Stop control may be installed at traffic circles with insufficient circulating diameter or sight distance obstructions that cannot be mitigated.

Where yield sign with circulating arrows is used, install yellow OM1-1 sign double mounted in each of the two directions on the same post in the center island. An example is shown below

Where a stop sign is used, a R6-4 double chevron is used instead of the OM1-1 in the center island.

Crosswalks at traffic circles are typically not marked. See Marked Crosswalks.

Table 1 - Summary of Minimum Treatments at Uncontrolled Pedestrian Crossings

based on providing lower levels of traffic stress for people biking and walking

	Recommended Treatment (LTS)															
	ADT ≤ 8,000[a]				8,0000 ≤ ADT ≥ 12,000				12,0000 ≤ ADT ≥ 25,000				>25,000			
Lane Configuration[c]	**25**	**30**	**35**	**40**	**25**	**30**	**35**	**40**	**25**	**30**	**35**	**40**	**25**	**30**	**35**	**40**
2 lane street <u>without</u> raised median	BT (LTS2)	BT (LTS3)	AS or RI (LTS2)	Modify/ Not recc[b] (LTS4)	BT (LTS3)	BT (LTS3)	AS or RI (LTS3)	Modify/ Not recc[b] (LTS4)	AS or RI (LTS2)	AS or RI (LTS2)	AS or RI (LTS3)	Modify/ Not recc[b] (LTS4)	BT/AS or RM/BTI (LTS 1)	BT/AS or RM/BTI (LTS 1)	Modify/ Not recc[b] (LTS4)	Modify/ Not recc[b] (LTS4)
2 lane street with raised median	BT (LTS1)	BT (LTS2)	In Street Sign (LTS1)	Modify/ Not recc[b] (LTS3)	BT (LTS1)	BT (LTS2)	In Street Sign (LTS1)	Modify/ Not recc[b]	In Street Sign (LTS1)	In Street Sign (LTS1)	In Street Sign (LTS1)	Modify/ Not recc[b] (LTS3)	In Street Sign (LTS1)	In Street Sign (LTS1)	Modify/ Not recc[b] (LTS4)	Modify/ Not recc[b] (LTS4)
3 lane street <u>without</u> raised median	BT (LTS3)	BT (LTS3)	RI (LTS2)	Modify/ Not recc[b] (LTS4)	BT (LTS3)	BT (LTS3)	Modify/ Not recc[b] (LTS4)	Modify/ Not recc[b] (LTS4)	RI (LTS3)	Modify/ Not recc[b] (LTS4)	Modify/ Not recc[b] (LTS4)	Modify/ Not recc[b] (LTS4)	Modify/ Not recc[b] (LTS4)			
3 lane street with raised median	BT (LTS2)	BT (LTS2)	In Street Sign (LTS1)	Modify/ Not recc[b] (LTS3)	BT (LTS2)	BT (LTS2)	In Street Sign (2)	Modify/ Not recc[b] (LTS4)	In Street Sign (LTS1)	In Street Sign (LTS1)	In Street Sign (LTS2)	Modify/ Not recc[b] (LTS4)	In Street Sign (LTS1)	In Street Sign (LTS1)	Modify/ Not recc[b] (LTS3)	Modify/ Not recc[b] (LTS4)
4 lane street with raised median	In Street Sign (LTS1)	In Street Sign (LTS1)	ASLS (LTS2) if add InStreet Sign (LTS1)	RRFB (LTS2)	In Street Sign (LTS1)	ASLS (LTS2) if add InStreet Sign (LTS1)	ASLS(3) if add In street Sign (2), or RRFB (2)	RRFB (LTS3)	RRFB (LTS1)	RRFB (LTS1)	RRFB (LTS2)	RRFB (eval PHB/ Ped signal warrants) (LTS3)	RRFB (LTS1)	RRFB (LTS1)	Modify/ Not recc (eval PHB/Ped signal warrants) (LTS2)	Modify/ Not recc (eval PHB/Ped signal warrants) (LTS2)
5 lane street with raised median	In Street Sign (LTS1)	In Street Sign (LTS1)	ASLS(LTS3) if add In Street Sign (LTS2)	RRFB (LTS3)	In Street Sign (LTS1)	In Street Sign (LTS1)	ASLS(3) if add In street Sign (2), or RRFB (2)	RRFB (LTS3)	RRFB (LTS2)	RRFB (LTS2)	RRFB (LTS3)	RRFB (eval PHB/ Ped signal warrants) (LTS3)	RRFB (LTS2)	RRFB (LTS2)	Modify/ Not recc (eval PHB/Ped signal warrants)(LTS3)	Modify/ Not recc (eval PHB/Ped signal warrants)(LTS3)
4 or 5 lane street <u>without</u> raised median	Modify/ Not recc[2]															

Notes
DetermIne existing target stress level for crossing and apply enhancements as needed to meet target LTS
a. Crosswalks not typically marked if volumes less than 4,500 ADT
b. Guidance document list ped activated FB or RRFB, city using RRFB on multi-lane roads; provide median or other mitigation to limit crossing to 1-2 lanes
c. Lane Configuration = travel lanes both directions; left turn lane present counts as a travel lane
d. Assumes crosswalk will have illumination; without illumnation LTS is increased by 0.5
e. Median (raised) - standard median is 9 ft; narrower median (6 - 8 ft) reduces LTS by 1
f. A marked, uncontrolled crossing is not recommended at or above 40 mph
g. Based on FHWA-ICT-17-016 Establishing Proc edures and Guidelines for Pedestrian Treatments at Uncontrolled Locations
h. Source uses 9,000 and 15,000 instead of 8,000 and 12,000, COB reduced values to correspond with ODOT APM LTS thresholds
i. LTS based on ODOT Analysis Procedure Manual Version 2 (7/18) for Pedestrian Crossing, Figures 14-25 to 29 for arterial and collector streets,> 5,000 ADT
1)
k. LTS shown was includes reductino by 1 from guidance lanes/ volume/speed rating where RRFB added and where in-street signs added per ODOT APM Table 14-22 .

Treatment Type	
Basic Treatment	Basic Treatment = Mark (CWSC for uncontrolled) and Sign (W11-2/ S1-1/ W 11-16)
In Street	Basic Treatment and Instreet Stop for Pedestrian Sign (R1-6a)
RI	Basic Treatment and 8 ft Raised Median Island with Instreet Stop for Pedestrian Sign (R1-6a). Narrower raised island may be peRItted by City Engineer on existing /built out street with limited ROW; where new street, available ROW, or undeveloped street frontage widening required to provide 8 ft raised median
AS	Advance Pedestrian Warning Sign (W11-2/ S1-1/ W 11-16)
ASLS	Advance Stop Line and sign (R1-5b or c)
RRFB	Rectangular rapid flashing beacon with advanced stop line and sign (ASLS)
Modify	Reconfigure to provide median (if none), lower speed, reduce lanes, under/over crossing, or relocate crossing to achieve appropriate enhancement level and providing target LTS
Crosswalk Warning Sign	Use W11-2, S1-1, or W 11-16 per Signing and Striping Manual based on crossing type

Level of Pedestrian Traffic Stress		
LTS level	**color in table**	
LTS1	white	most comfortable
LTS2	green	
LTS3	orange	
LTS4	blue	least comfortable
See LTS notes i,j, k		

ATTACHMENT 1 - Selected Tables For Evaluating Level Of Traffic Stress

See the current ODOT Analysis and Procedures Manual Chapter 14 for current tables and supporting evaluation information. The following is from Version 2 dated October 22, 2020.

Exhibit 14-3 BLTS Criteria for Segment with Bike Lane and Adjacent Parking Lane

Prevailing or Posted Speed	1 Lane per direction			≥2 lanes per direction	
	≥ 15' bike lane + parking	14' – 14.5' bike lane + parking	≤ 13' bike lane + parking or Frequent blockage[1]	≥ 15' bike lane + parking	≤ 14.5' bike lane + parking or Frequent blockage[1]
≤25 mph	BLTS 1	BLTS 2	BLTS 3	BLTS 2	BLTS 3
30 mph	BLTS 1	BLTS 2	BLTS 3	BLTS 2	BLTS 3
35 mph	BLTS 2	BLTS 3	BLTS 3	BLTS 3	BLTS 3
≥40 mph	BLTS 2	BLTS 4	BLTS 4	BLTS 3	BLTS 4

[1]Typically occurs in urban areas (i.e. delivery trucks, parking maneuvers, stopped buses).

Exhibit 14-4 BLTS Criteria for Segment with Bike Lane, no Adjacent Parking Lane

Prevailing or Posted Speed	1 Lane per direction				≥2 lanes per direction	
	≥ 7' (Buffered bike lane)	5.5' – 7' Bike lane	≤ 5.5' Bike lane	Frequent bike lane blockage[1]	≥ 7' (Buffered bike lane)	<7' bike lane or frequent blockage[1]
≤30 mph	BLTS 1	BLTS 1	BLTS 2	BLTS 3	BLTS 1	BLTS 3
35 mph	BLTS 2	BLTS 3	BLTS 3	BLTS 3	BLTS 2	BLTS 3
≥40 mph	BLTS 3	BLTS 4	BLTS 4	BLTS 4	BLTS 3	BLTS 4

[1]Typically occurs in urban areas (i.e. delivery trucks, parking maneuvers, stopped buses).

Exhibit 14-5 Criteria for Urban/Suburban Mixed Traffic Segment – 30 mph or less

Number of Lanes	ADT (vph)[1]	Functional Class	Posted or Prevailing Speed (mph)		
			≤20	25	30
Unmarked Centerline	≤750	Local	BLTS 1	BLTS 1	BLTS 2
	750 - ≤1,500	Local /Collector	BLTS 1	BLTS 1	BLTS 2
	1,500 - ≤3,000	Collector	BLTS 2	BLTS 2	BLTS 2
	>3,000	Arterial	BLTS 2	BLTS 3	BLTS 3
1 through lane per direction	≤750	Local	BLTS 1	BLTS 1	BLTS 2
	750 - ≤1,500	Local /Collector	BLTS 2	BLTS 2	BLTS 2
	1,500 - ≤3,000	Collector	BLTS 2	BLTS 3	BLTS 3
	>3,000	Arterial	BLTS 3	BLTS 3	BLTS 3
2 through lanes per direction	≤8,000	Arterial	BLTS 3	BLTS 3	BLTS 3
	>8,000	Arterial	BLTS 3	BLTS 3	BLTS 4
3+ though lanes per direction	Any ADT	Arterial	BLTS 3	BLTS 3	BLTS 4

[1]ADT is both directions for two-way streets. For one-way streets use 1.5*ADT.

Exhibit 14-10 BLTS Criteria for Unsignalized Intersection Crossing Without a Median Refuge[1]

Prevailing Speed or Speed Limit (mph)	Total Through/Turn Lanes Crossed (Both Directions)[2]					
	≤ 3 Lanes			4 -5 Lanes		≥ 6 Lanes
	Functional Class/ADT (vpd)					
	Local	Collector	Arterial	Arterial		Arterial
	≤ 1,200	1,200 - ≤3,000	>3,000	≤ 8,000	>8,000	Any ADT
≤ 25	BLTS 1	BLTS 1	BLTS 2	BLTS 3	BLTS 4	BLTS 4
30		BLTS 1	BLTS 3	BLTS 3	BLTS 4	BLTS 4
35		BLTS 2	BLTS 3	BLTS 4	BLTS 4	BLTS 4
≥ 40		BLTS 3	BLTS 4	BLTS 4	BLTS 4	BLTS 4

[1]For street being crossed.
[2]For one-way streets use Exhibit 14-11.

Exhibit 14-11 BLTS Criteria Unsignalized Intersection Crossing With a Median Refuge[1]

Prevailing Speed or Speed Limit (mph)	Maximum Through/Turn Lanes Crossed per Direction			
	1 Lane	2 Lanes	3 Lanes	4+ Lanes
≤ 25	BLTS 1[2]	BLTS 2[2]	BLTS 2	BLTS 3
30	BLTS 1[2]	BLTS 2	BLTS 3	BLTS 3
35	BLTS 2	BLTS 3	BLTS 4	BLTS 4
≥ 40	BLTS 3	BLTS 4	BLTS 4	BLTS 4

[1]For street being crossed.
[2]Refuge should be at least 10 feet to accommodate a wide range of bicyclists (i.e. bicycle with a trailer) for BLTS 1, otherwise BLTS=2 for refuges 6 to <10 feet.

Pedestrian – sidewalk condition and width impacts LTS, sidewalks 5 ft or less in poor condition are LTS 3 or lower.

Exhibit 14-22 PLTS based on Physical Buffer Type

Physical Buffer Type				
Buffer Type[1]	Prevailing or Posted Speed			
	≤25 MPH	30 MPH	35 MPH	≥40 MPH
No Buffer (curb tight)	PLTS 2	PLTS 3	PLTS 3	PLTS 4
Solid surface	PLTS 2[2]	PLTS 2	PLTS 2	PLTS 2
Landscaped	PLTS 1	PLTS 2	PLTS 2	PLTS 2
Landscaped with trees	PLTS 1	PLTS 1	PLTS 1	PLTS 2
Vertical				

[1]Combined buffers: If two or more of the buffer conditions apply, use the most appropriate, typically the lower stress level.
[2]If street furniture, street trees, lighting, planters, surface change, etc. are present then the PLTS can be lowered to PLTS 1.

Exhibit 14-23 PLTS based on Total Buffering Width

Total Number of Travel Lanes (both directions)	Total Buffering Width (ft)[1]				
	<5	≥5 to <10	≥10 to <15	≥15 to <25	≥25
2	PLTS 2	PLTS 2	PLTS 1	PLTS 1	PLTS 1
3	PLTS 3	PLTS 2	PLTS 2	PLTS 1	PLTS 1
4 - 5	PLTS 4[2]	PLTS 3	PLTS 2	PLTS 1	PLTS 1
6	PLTS 4[2]	PLTS 4[2]	PLTS 3	PLTS 2	PLTS 2

[1]Total Buffering Width is the summation of the width of buffer, width of parking, width of shoulder and width of the bike lane on the side same side of the roadway as the pedestrian facility being evaluated.
[2]Sections with a substantial physical barrier/tall railing between the travel lanes and the walkway (like might be found on a bridge) can be lowered to PLTS 3.

Exhibit 14-25 PLTS on Collector & Local Unsignalized Intersection Crossing [1, 2, 3, 4]

Prevailing Speed or Speed Limit (mph)	No Median Refuge		Median Refuge Present
	Total Lanes Crossed		Maximum One Through/Turn Lane Crossed per Direction
	1 Lane	2 Lanes	
≤ 25	PLTS 1	PLTS 1	PLTS 1[5]
30	PLTS 1	PLTS 2	PLTS 1
35	PLTS 2	PLTS 2	PLTS 2
≥ 40	PLTS 3	PLTS 3	PLTS 3

[1]For street being crossed.
[2]Minimum PLTS 3 when crossing lacks standard ramps.
[3]Use Exhibit 14-28 or Exhibit 14-29 for one-way streets, when ADT exceeds 5,000, or total number of lanes exceeds two.
[4]Street may be considered a one-lane road when no centerline is striped and when oncoming vehicles commonly yield to each other.
[5]Refuge should be at least 10 feet for PLTS 1, otherwise use PLTS 2 for refuges 6 to <10 feet.

Exhibit 14-26 PLTS on Arterial Unsignalized Intersection Crossing Without a Median Refuge [1, 2]

Prevailing Speed or Speed Limit (mph)	Total Lanes Crossed (Both Directions)[3]					
	2 Lanes			3 Lanes		
	<5,000 vpd	5,000-9,000 vpd[4]	>9,000 vpd	<8,000 vpd	8,000-12,000 vpd[4]	>12,000 vpd
≤ 25	PLTS 2	PLTS 2	PLTS 3	PLTS 3	PLTS 3	PLTS 4
30	PLTS 2	PLTS 3	PLTS 3	PLTS 3	PLTS 3	PLTS 4
35	PLTS 3	PLTS 3	PLTS 4	PLTS 3	PLTS 4	PLTS 4
≥ 40	PLTS 3	PLTS 4	PLTS 4	PLTS 4	PLTS 4	PLTS 4

[1]For street being crossed.
[2]Minimum PLTS 3 when crossing lacks standard ramps.
[3]For one-way streets, use Exhibit 14-11and Exhibit 14-29. Use PLTS 4 for crossings of four or more lanes.
[4]Use these columns when ADT volumes are not available

Exhibit 14-27 PLTS Adjustments for Arterial Crosswalk Enhancements[1]

Treatment[2]	Adjustment	Treatment	Adjustment
Markings[3]	-0.5	In-street signs	-1.0
Roadside signage[3]	-0.5	Curb extensions	-0.5
Illumination	-0.5	Raised crosswalk	-1.0
PAB (e.g. RRFB)	-1.0	Standard 12" flashing beacon	-0.5

[1]2.0 Maximum reduction or PLTS 2.
[2]Pedestrian hybrid beacons (PHB) are considered to be equivalent to signalized crossings.
[3]Not applicable for roadways with pedestrian median refuges as crosswalk markings and roadside signage assumed as part of the basic installation.

Exhibit 14-28 PLTS Arterial Unsignalized Intersection Crossing (1 to 2 lanes) with a Median Refuge [1, 2]

Prevailing Speed or Speed Limit (mph)	Maximum Through/Turn Lanes Crossed per Direction			
	1 Lane	2 Lanes		
	Any	<5,000 vpd	5,000-9,000 vpd[4]	>9,000 vpd
≤ 25	PLTS 1[3]	PLTS 1[3]	PLTS 2	PLTS 2
30	PLTS 2	PLTS 2	PLTS 2	PLTS 2
35	PLTS 2	PLTS 2	PLTS 2	PLTS 3
≥ 40	PLTS 3	PLTS 3	PLTS 3	PLTS 4

[1]For street being crossed.
[2]Minimum PLTS 3 when crossing lacks standard ramps.
[3]Refuge should be at least 10 feet for PLTS 1, otherwise use PLTS 2 for refuges 6 to <10 feet.
[4]Use these columns when ADT volumes are not available.

Exhibit 14-29 PLTS Arterial Unsignalized Intersection Crossing (3 or more lanes) with a Median Refuge [1, 2]

Prevailing Speed or Speed Limit (mph)	Maximum Through/Turn Lanes Crossed per Direction			
	3 Lanes			4+ Lanes
	<8,000 vpd	8,000-12,000 vpd[4]	>12,000 vpd	Any
≤ 25	PLTS 1[3]	PLTS 2	PLTS 3	PLTS 4
30	PLTS 2	PLTS 2	PLTS 3	PLTS 4
35	PLTS 3	PLTS 3	PLTS 4	PLTS 4
≥ 40	PLTS 4	PLTS 4	PLTS 4	PLTS 4

[1]For street being crossed.
[2]Minimum PLTS 3 when crossing lacks standard ramps.
[3]Refuge should be at least 10 feet for PLTS 1, otherwise use PLTS 2 for refuges 6 to <10 feet.
[4]Use these columns when ADT volumes are not available.

ATTACHMENT 2 – A Guide To School Area Safety, Oregon Department Of Transportation, January 2017 And Example School Speed Zone Layout For Condition A And Condition B

January 2017

A GUIDE TO SCHOOL AREA SAFETY

A publication of the
Oregon Department of Transportation
Traffic-Roadway Section and
Transportation Safety Division

Oregon Department of Transportation

INTRODUCTION TO SCHOOL AREA SAFETY

The guidebook is intended to provide citizens, road authorities, school staff, and other officials throughout the state with a comprehensive reference on school zones and safe travel to and from school. It does not establish policy or standards for the Oregon Department of Transportation or other road authorities in the state.

The guidebook is based on the Federal Highway Administration's 2009 *Manual on Uniform Traffic Control Devices* and the *Oregon Supplements to the MUTCD*. It is updated as needed to maintain current information for the community of people, government, and schools involved in the effort to keep children safe going to, from, and at school. This revision incorporates changes to the *MUTCD*, Oregon laws, and information related to resources available for school area safety.

The guidebook is organized for quick reference. The first section provides a general overview of the various school area designations. The next section presents the statutes and rules for school area safety. The third section gives information on the Safe Routes to School comprehensive approach to planning and implementing improvements for student safety traveling to and around each school and school district. An overview of street design tools that can be used to enhance safety in school zones is presented in the next section. The fifth section gives guidance on the use of specific traffic control devices within school areas. The Resources section lists recognized sources for traffic safety and engineering aspects of safe routes to school plus a number of other programs, resources, and publications for further information.

Your participation in ensuring the usefulness and relevance of this guidebook is invited. The contact information for the guidebook is listed below. The guidebook is available on the ODOT Traffic Roadway Engineering website *(https://www.oregon.gov/ODOT/HWY/TS/Pages/publications.aspx)*.

Traffic Laws and Operations

Traffic-Roadway Section, Oregon Department of Transportation
Traffic Services Engineer
Phone: 503-986-3594
E-mail: teos.info@odot.state.or.us

Safe Routes to School, Traffic Safety Education and Enforcement

Transportation Safety Division, Oregon Department of Transportation
Safe Routes to School Program Manager
Phone: 503-986-4196

School Transportation and Traffic Safety Patrol Programs & Training

Oregon Department of Education
Assistant Superintendent
Phone: 503-947-5702

TABLE OF CONTENTS

SECTION I - SCHOOL ZONES

What is a school zone?

A school zone is a section of roadway adjacent to a school or a school crosswalk where signs designating school activity are present. School zones are created by posting *School signs* identifying the school site or crossing. Oregon law includes some *criteria* regarding the definition of "school" that applies.

Why focus on school zones?

School zones represent an opportunity to address safety concerns in areas with potentially high concentrations of especially vulnerable bicyclists and pedestrians. Safer conditions for these users can lead to safer conditions for all travelers in the area and can help agencies meet goals related to improved public health, higher rates of walking and biking, more affordable mobility, and reduced air pollution.

What is a school speed zone?

A school speed zone is a special 20 mph speed zone for schools allowed by statute and defined by school speed signs. The school speed zone begins at the SCHOOL SPEED LIMIT 20 sign and ends at the END SCHOOL SPEED LIMIT sign or END SCHOOL ZONE sign.

School speed zones should begin a minimum of 200 feet from the school property line or school crosswalk, whichever is determined to be most appropriate. Ideally, school speed zones should be kept short to enhance driver compliance. When school property frontage along the roadway is lengthy and/or fenced, consider focusing the school speed zone on the school crosswalk, potential crossing areas, or unfenced portions.

What is not a school speed zone?

Not all school zones are posted with a SCHOOL SPEED LIMIT 20 sign. There may be areas adjacent to school grounds where the need for reduced school speeds may be deemed unnecessary. For instance, residential streets on the side or back of a school may not need a reduced speed if travel speeds are already slow. A school along a street that is already safe and comfortable for bicycling and walking or a school with no students who regularly walk or bike may have no need for a reduced speed. A school crosswalk away from the school controlled by a traffic signal may have no need for a reduced speed. Unless a school area or crossing has SCHOOL SPEED LIMIT 20 signs, the area is not considered a school speed zone; it is, however, considered a school zone if a *SCHOOL sign* is posted.

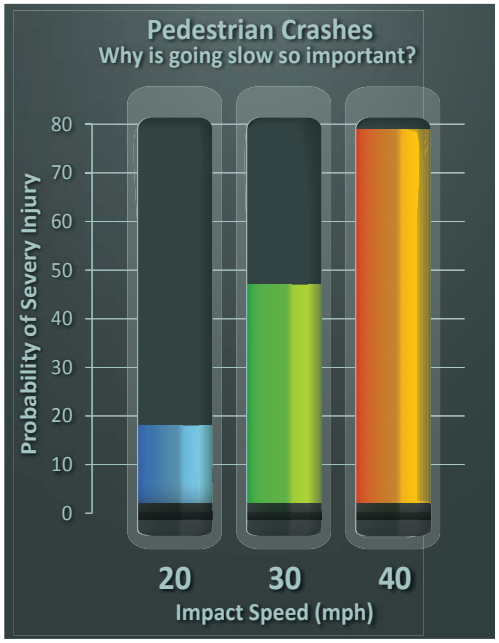
Who determines that a school zone or school speed zone is appropriate?

Each road authority (state, county, or city) determines where school zones and school speed zones are located along roadways under their jurisdiction. Locations and limits for school zones and school speed zones should be determined on the basis of an *engineering study* that includes relevant

data and needs identified by school or community members. School zones and school speed zones should be established as per the applicable sections of the Manual on Uniform Traffic Control Devices and other adopted policies.

The engineer for the road authority is encouraged to use these guidelines to help determine the need for a school speed zone. A local jurisdiction that does not have the engineering expertise is encouraged to contact their local region ODOT traffic engineering office for assistance or hire a consulting engineer with experience in school zoning. School districts and local traffic safety committees should request a school speed zone study through the local road authority. More information regarding the process for the establishment of a school speed zone may be found in *ODOT's Speed Zone Manual*.

Why is going 20 mph so important?



Slower speeds provide more reaction time to unexpected actions of a child. Any collision at a lower speed will generally cause less injury, as well. The severe injury rate for pedestrians or bicyclists struck by a vehicle at higher speeds is much greater than at lower speeds (see chart to right)[1]. A pedestrian struck by a vehicle at 40 mph is almost certain to have severe[2] or life-threatening injuries. If the vehicle is going 30 mph, a pedestrian still has nearly a 50 percent chance of dying or facing life-altering injuries. Crash survivability is significantly better when vehicle speeds are less than 20 mph. Even 5 mph can make a big difference to the pedestrian.

Where are school speed zones encouraged?

Where all the following conditions exist, a school speed zone is recommended when supported by an engineering study:

- The roadway is adjacent to the school grounds (not limited to front of school buildings).
- There is at least one marked school crosswalk within the proposed school zone which is not protected by a signal or STOP sign.
- The property houses a public or private elementary or middle school (grades K-8).
- The posted speed is 40 mph or below.

An engineering study should establish the need for a school speed zone. If there are children walking to school on a high-speed or high traffic volume road, the road authority should first consider providing improved pedestrian facilities for greater safety for the students. A reduced school speed may also be considered as part of those improvements. A school speed zone provides

[1] Tefft, Brian C. Impact Speed and Pedestrian's Risk of Severe Injury or Death. AAA Foundation for Traffic Safety, 2011. *https://www.aaafoundation.org/sites/default/files/2011PedestrianRiskVsSpeed.pdf*

[2] Severe injury crashes defined as AIS 4 or higher on the 1990 Abbreviated Injury Scale from the Association for the Advancement of Automotive Medicine, 1990.

the greatest margin of safety on high-speed or high volume roads when implemented along with other pedestrian improvements such as sidewalks, crosswalk bulb-outs, and crossing guards.

Where do school speed zones require further justification?

The benefits of a school speed zone may be limited where any of these conditions exist:

- The school is a public or private high school.
- The school is a publicly funded early childhood education program housed in a building that is or was previously owned by a school district.
- The marked school crosswalk is at a signalized intersection.
- The marked school crosswalk is at a STOP sign.
- The marked school crosswalk is on a roadway segment not adjacent to the school grounds.
- Children walking on the school's Safe Routes to School Plan do not cross the roadway in this area.

The engineering study should address the relevance of these factors in the decision to implement a school speed zone in these areas.

Where are school speed zones discouraged

School speed zones may not be appropriate where:

- The speed is posted at 45 mph or above and other means or routes are available to school children.
- All children are bused or driven to school, even short distances. The road authority should verify whether or not children currently do or desire to walk or bike to school. Some children, especially middle school students, may prefer walking or biking to school even when buses are available.

At schools adjacent to the roadway where there is no pedestrian or bicycle traffic, a school zone may be established with signs indicating the presence of the school area, but it is generally not appropriate to establish a school speed zone. Rural school areas are often treated in this fashion. A school speed zone is not intended to be used to address motor vehicle safety concerns. In lieu of establishing a school speed zone, a school sign (establishing a school area without a reduced speed) may serve to warn motorists approaching the school area.

On roadways where the speed is posted 45 mph or more and school speed zones are justified by an engineering study, a range of options to reduce prevailing speeds and improve pedestrian safety should be evaluated in conjunction with the installation of the school speed zone. Consider the following:

- Flashing beacons should be used to notify drivers of when the school speed zone is in effect.
- A REDUCED SCHOOL SPEED LIMIT AHEAD sign should be used in advance of the school speed zone.,
- Improvements such as curbs, sidewalks, narrowed travel lanes, and/or median islands may be used to reduce prevailing speeds.

A speed zone study may be undertaken after the school speed zone and related improvements are in place to see if a reduced posted speed for the roadway is appropriate.

Guidance for rural school areas Rural school areas are typically characterized by higher speed roadways, absence of students that walk or bike to school, lack of pedestrian and bicycle facilities, and few nearby residences. Rural roads that are otherwise low volume may have short periods of congestion at the school driveways. These characteristics may warrant a different set of treatments than more conventional urban school areas.

Example of rural school zone.

School speed zones are intended to address bicycle and pedestrian-related safety concerns, not motor vehicle safety concerns that typically arise in rural school areas. Other treatments may more successfully address the safety concerns related to motor vehicle school activity. At the school driveway entrance/exit, consider illumination, warning signs, or turn restrictions as low-cost safety measures. More extensive measures such as an urban roadway design, roundabout, or a transition treatment may help drivers better anticipate school-related activity and conflicts. Some of the treatments listed in *Section IV: Street Design Elements* of this document may be appropriate in rural school areas. For more guidance on transition treatments, see *NCHRP 737: Design Guidance for High-Speed to Low-Speed Transition Zones for Rural Highways*.

What is an engineering study?

An engineering study is a documented analysis and evaluation of site specific information, and includes the application of appropriate engineering principles and standards. Considerations in the engineering study may include, but are not limited to:

- Crash history.
- Traffic volumes.
- Gap study of the frequency and duration of crossing opportunities in traffic flow.
- Number of students walking or bicycling to/from school.
- Number of pedestrians utilizing the school crossing.
- Speed study for all directions of travel at the proposed location.
- Examination of conditions adversely affecting pedestrian and bicycle safety (i.e., availability of sidewalks and bike lanes, presence of curb ramps, location of bicycle parking, horizontal and vertical sight distance).
- Examination of the school's drop-off and pick-up operations, including on-street parking controls and off-street parking facilities and their use.
- Examination of the school's Safe Routes to School Plan including a review of planned adult crossing guards.
- Input in the engineering study by the school district, traffic safety committees, and other community representatives (including participation in data collection).

There are places where traffic control devices are in use but may not have been adequately investigated. These controls may not only be unnecessary, expensive to maintain, and ineffective, but more importantly, they may lessen respect for similar traffic control devices that are used in appropriate locations. Traffic controls in school areas should be applied based on sound guidelines and engineering studies.

SECTION II - LAWS AND RULES ABOUT SCHOOL AREAS

Traffic control devices

The Oregon Department of Transportation adopts uniform standards for traffic control devices, including signs and pavement markings for all streets open to the public in Oregon as required by statute (ORS 810.200). These standards must be largely in agreement with national standards. ODOT has adopted the federal *Manual on Uniform Traffic Control Devices* to meet this requirement. Part 7, Traffic Controls for School Areas, contains the standards for traffic control in school areas.

The concern for the safety of children on their daily journey to and from school continues to generate community interest in traffic control devices that protect children from the negative impacts of traffic. Communities look to more police and adult guards for school duties, more traffic signals and more signs and pavement markings as the way to provide the desired environment. Such measures, however, are limited by available resources and must be used judiciously within the framework established by the *MUTCD*. Unnecessary measures can be costly and ineffective, and they may lessen the respect for controls that are needed. The *MUTCD* offers this rationale for following a uniform application of traffic control devices: (Section 7A.01):

> Regardless of the school location, the best way to achieve effective traffic control is through the uniform application of realistic policies, practices, and standards developed through engineering judgment or studies.
>
> Pedestrian safety depends upon public understanding of accepted methods for efficient traffic control. This principle is especially important in the control of pedestrians, bicycles, and other vehicles in the vicinity of schools. Neither pedestrians on their way to or from school nor other road users can be expected to move safely in school areas unless they understand both the need for traffic controls and how these controls function for their benefit.
>
> Procedures and devices that are not uniform might cause confusion among pedestrians and road users, prompt wrong decisions, and contribute to crashes. To achieve uniformity of traffic control in school areas, comparable traffic situations must be treated in a consistent manner. Each traffic control device and control method described in Part 7 fulfills a specific function related to specific traffic conditions.
>
> A uniform approach to school area traffic controls assures the use of similar controls for similar situations, which promotes uniform behavior on the part of motorists, pedestrians, and bicyclists.

This update to the *Guide to School Area Safety* is based on the standards and guidance contained in the latest version of the *MUTCD* (2009) available at the time of publication. Readers are encouraged to review the latest *MUTCD* at: *http://mutcd.fhwa.dot.gov/.*

An engineer must ultimately take responsibility for engineering decisions involving traffic control devices. Traffic engineers should follow the principles and practices as contained in the *MUTCD*

and other applicable engineering guidance. Engineering decisions should support the safety, health, property, and welfare of the public.

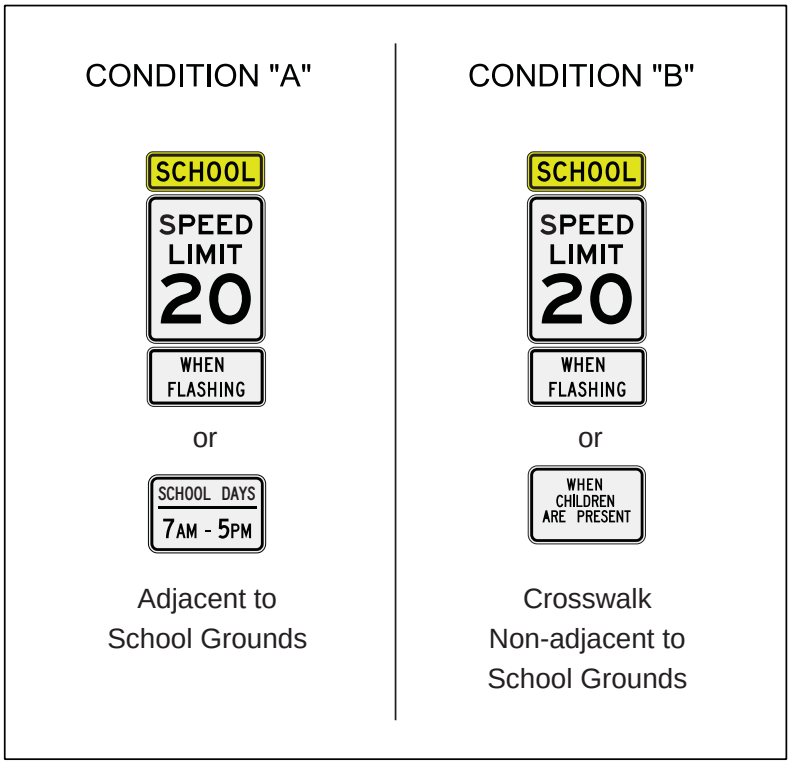
Oregon Revised Statutes

The definitions and authorities for school zones in Oregon are established by Oregon Revised Statutes and Oregon Administrative Rules. Both school zones and school speed zones are statutory. A school zone is defined by *ORS 801.462* as one of two types: a segment of highway that is adjacent to the school grounds or a segment of highway that includes a school crosswalk that is not adjacent to the school grounds. School zones are created by posting school signs identifying the school site or crossing. A school zone does not automatically have a 20 mph school zone speed limit.

Examples of where a school zone would not necessarily have a school speed zone include crossings at signalized intersections, since all traffic is fully controlled, and schools where no children might regularly walk or bike to school.

ORS 801.462 also defines the term "school" for the purposes of regulating school zones. The ORS states that a "school" means a public or private educational institution for one or more levels kindergarten through grade 12 or a publicly funded early childhood education program located in a building currently or previously owned by a school district as defined in ORS 330.005. The Oregon Revised Statutes are available *online*.

ORS 811.111 describes school zone speed limits. School speed zones are defined for the two types of school zone areas: those adjacent to school grounds (Condition A) and crosswalks not adjacent to school grounds (Condition B). If the school speed zone is in Condition A, adjacent to school grounds, the school speed is in effect when a flashing light indicates when children are coming to or leaving the school or, if there is no flashing light, between the hours of 7 a.m. and 5 p.m. on a day when school is in session. For Condition B, at a crosswalk away from school grounds, the school speed limit is in effect with either the flashing light or when children are present as



described in ORS 811.124. Each road authority (state, county, or city) determines where school speed zones are located.

ORS 811.124 defines "when children are present" as when children are occupying or waiting to cross in the crosswalk or when there is a traffic patrol member at the crosswalk. Note that "when children are present" applies only at a crosswalk away from the school grounds and applies at any time and on any day.

ORS 810.243 allows for the operation of flashing lights as traffic control devices to indicate children are traveling to or from school. When used for this purpose, the lights may be operated only at times when children are scheduled to arrive or leave school. There is an exception that allows flashing lights to operate from 7 a.m. to 5 p.m. if the school has a parking lot located across the street from the school and the street has a posted speed of 45 mph or greater.

ORS 811.235 establishes the condition of increasing fines in school zones when signs giving notice of increased fines are posted. The area of increased fines is from the sign indicating increased fines to a sign indicating the end of increased fines or the end of the school zone. The law allows increasing of fines at school zones when lights are flashing or, for a crosswalk away from the school grounds, when the definition of "when children are present" is met. The fines are higher for specified offenses which include:

- All Class A or Class B traffic violations (such as failure to obey a traffic patrol member, not yielding to a pedestrian in a crosswalk or not stopping at a STOP sign or traffic signal).
- Class C or Class D violations relating to exceeding a legal speed.
- Reckless driving as defined by law.
- Driving while under the influence of intoxicants (DUII).
- Failure to perform the duties of a driver involved in an accident or collision as required by law.
- Driving with a suspended or revoked license.
- Fleeing or attempting to elude a police officer.

ORS 810.245 establishes the ability of road authorities to install signs giving notice of increasing fines in school zones. These signs must be posted as per ORS 811.235 to enforce higher fines in school zones.

ORS 811.550 identifies places where stopping, standing, and parking are prohibited, such as a bike lane, on a crosswalk, or within 20 feet of a crosswalk at an intersection. Some exemptions permitted in ORS 811.560 are applicable for pickup and discharge of passengers.

ORS 810.180 gives the Oregon Department of Transportation the authority to designate speeds (i.e., speeds different from statutory speeds) on many of the public roadways in Oregon. These designated speeds are established by a written order after an investigation. Decisions on designated speeds are made jointly by ODOT and the city, county, or other agency with road authority.

ORS 811.020 prohibits drivers from overtaking another vehicle that is stopped at a crosswalk to permit a pedestrian to cross the roadway.

ORS 811.025 requires drivers to yield to pedestrians on a sidewalk

ORS 811.028 requires drivers to stop and remain stopped for a pedestrian in a crosswalk.

ORS 195.115 requires city and county governing bodies to work with school district personnel to identify barriers and hazards to children walking or bicycling to and from school. The cities,

counties, and districts may develop a plan for the funding of improvements designed to reduce the barriers and hazards identified.

ORS 332.176 requires school districts to evaluate potential safety improvements within 1 mile of an elementary school (and 1.5 miles of a secondary school) in conjunction with large, (over $1 million) publicly-bonded construction projects.

Traffic Patrol Laws

ORS 339.650 "Traffic patrol" defined. As used in ORS 339.650 to 339.665, "traffic patrol" means one or more individuals appointed by a public or private school to protect pupils in their crossing of streets or highways on their way to or from the school by directing the pupils or by cautioning vehicle operators.

ORS 339.655 Traffic patrols authorized; medical benefits; rules. (1) A district school board may do all things necessary, including the expenditure of district funds, to organize, supervise, control or operate traffic patrols. A district school board may make rules relating to traffic patrols which are consistent with rules under ORS 339.660 (1).

(2) The establishment, maintenance and operation of a traffic patrol does not constitute negligence on the part of any school district or school authority.

(3) A district school board may provide medical or hospital care for an individual who is injured or disabled while acting as a member of a traffic patrol.

ORS 339.660 Rules on traffic patrols; eligibility; authority. (1) To promote safety, the State Board of Education, after consultation with the Department of Transportation and the Department of State Police, shall make rules relating to traffic patrols.

(2) A member of a traffic patrol:

(a) Shall be at least 18 years of age unless the parent or guardian of the member of the traffic patrol has consented in writing to such membership and ceases to be a member if such consent is revoked.

(b) May display a badge marked "traffic patrol" while serving as a member.

(c) May display a directional sign or signal in cautioning drivers where students use a school crosswalk of the driver's responsibility to obey ORS 811.015.

ORS 339.665 Intergovernmental cooperation and assistance in connection with traffic patrols.

(1) The Department of Education and the Department of Transportation shall cooperate with any public, private or parochial school in the organization, supervision, control and operation of its traffic patrol.

(2) The Department of State Police, the sheriff of each county, or the police of each city may assist any public, private or parochial school in the organization, supervision, control or operation of its traffic patrol.

ORS 811.015 Failure to obey traffic patrol member; penalty. (1) The driver of a vehicle commits the offense of failure to obey a traffic patrol member if:

(a) A traffic patrol member makes a cautionary sign or signal to indicate that students have entered or are about to enter the crosswalk under the traffic patrol member's direction; and

(b) The driver does not stop and remain stopped for students who are in or entering the crosswalk from either direction on the street on which the driver is operating.

(2) Traffic patrol members described in this section are those provided under ORS 339.650 to 339.665.

(3) The offense described in this section, failure to obey a traffic patrol member, is a Class A traffic violation.

ORS 811.017 Failure to yield to traffic patrol member; penalty. (1) The driver of a vehicle commits the offense of failure to yield to a traffic patrol member if the driver fails to stop and yield the right of way to a traffic patrol member who:

(a) Has entered a crosswalk for the purpose of directing students who have entered or are about to enter the crosswalk; and

(b) Is carrying a flag or wearing something that identifies the person as a traffic patrol member.

(2) For purposes of this section, "traffic patrol" has the meaning given that term in ORS 339.650.

(3) The offense described in this section, failure to yield to a traffic patrol member, is a Class A traffic violation.

School zone Administrative Rules

OAR 734-020-0005 adopts the MUTCD as the uniform system of marking and signing highways in Oregon, as required under ORS 810.200, including school area signing and marking.

OAR 734-020-0015 is related to designating speeds by establishing speed zones other than statutory speeds (but does not apply to school zones). The OAR describes the process for establishment of speed zones on public roads.

OAR 581-021-0100 establishes the operation and authorities for School Traffic Patrols. The *Oregon Traffic Patrol Manual* published by the Oregon Department of Education is adopted as the operational guide. The Department is also responsible for distribution of equipment, establishing, assisting and training patrols. The school districts are responsible for requesting patrol training and assistance. School districts may also opt to operate school traffic patrols by district guidelines that are approved by the State Superintendent of Public Instruction as meeting or exceeding the standards in the *Oregon Traffic Patrol Manual.*

Oregon Administrative Rules are available online at: *http://arcweb.sos.state.or.us/banners/rules.htm*

Other guidelines

The Oregon Department of Transportation has adopted other guidelines which relate to school zones. These include the *Speed Zone Manual, ODOT Traffic Manual*, and the *Sign Policy and Guidelines*. The *Speed Zone Manual* discusses the speed zone investigation process. The *ODOT Traffic Manual* discusses the use and application of related traffic control devices. The *Sign Policy and Guidelines* identifies the signs authorized for school areas along with guidelines on their location. The above are available online at: *http://www.oregon.gov/ODOT/HWY/TS/Pages/publications.aspx*

SECTION III - SAFE ROUTES TO SCHOOL PROGRAMS

Safe Routes to School programs are a collection of efforts, typically at the local school or community level, to help assess and make safety changes around schools, educate students on traffic safety for all modes of travel, and encourage students to walk and bicycle to and from school safely. SRTS programs facilitate the planning, development, and implementation of projects and activities that improve health, safety, and reduce traffic, fuel consumption, and air pollution in the vicinity of schools. SRTS brings together city public works, planning, and police staff, school administrators, teachers, support staff, parents, students, neighbors, and health and other community service providers in a School Team and Community Task Force. Programs are typically implemented at elementary and middle schools in an effort to improve travel options and ensure the safety of these especially vulnerable populations.

Photo credit: Oregon Safe Routes to School Network

Developing a School Action Plan – The 6 E's

In Oregon, completion of the Safe Routes to School Action Plan is the initial step of a SRTS Program at a school. Creation of an Action Plan is recommended as a best practice. The plan requires forming a school SRTS team to collect student travel data, policy information, and other pertinent data to identify solutions that address the barriers and hazards to students walking and biking to/from school. The SRTS team considers the 6 E's of Safe Routes to School: Engineering, Education, Encouragement, Enforcement, Evaluation, and Equity when developing the Action Plan. With the conclusions drawn from the collected information, the team recommends priority projects and activities that the school, municipality, and community can advance to promote safe walking and bicycling to school. Instructions and a template for completing a SRTS Action Plan are available on the *Oregon Safe Routes to School website.* Development of a SRTS Action Plan is the responsibility of the local school district.[3]

Successful Safe Routes to School programs see remarkable changes in the way students and parents choose to travel to and from school. Oregon Safe Routes to School practitioners advise including the following activity elements.

Engineering Safe Routes

The development of an action plan includes an assessment of the existing routes that are available for children to walk or bike to school. The National Center for Safe Routes to School provides a comprehensive *Walkability Checklist* and a *Bikeability Checklist* to help guide a route assessment team. The recommended routes are shown on a map of the neighborhood streets within a 10-15 minute walk of the school. The City of Portland has worked with school and neighborhood

[3] While the development of the full SRTS Action Plan with all of the 6 E's is undertaken at the discretion of the local school district, ORS 195.115 directs city and county governing bodies to work with school district personnel to identify barriers and hazards to children walking or bicycling to and from school. The list of barriers and hazards is a key component of the larger SRTS Action Plan developed by the School Team.

representatives to publish a *Safe Route map* for each of the public elementary schools in the city. A sample is shown on the following page.

The school SRTS team and municipality may also use the walking and biking assessment and the Safe Route maps to plan for needed improvements. Preference is to improve the more direct intuitive routes when possible. Visibility improvements are some of the most effective and least costly means of improving safety in school zones. Local and county governing bodies can meet the requirements of ORS 195.115 (Reducing barriers for pedestrian and bicycle access to schools) by including needed improvements with land use action cases and in transportation system plan updates. See *Section IV – Street Design Elements* and *Section V – Traffic Control Elements* for more detailed guidance regarding physical street improvements.

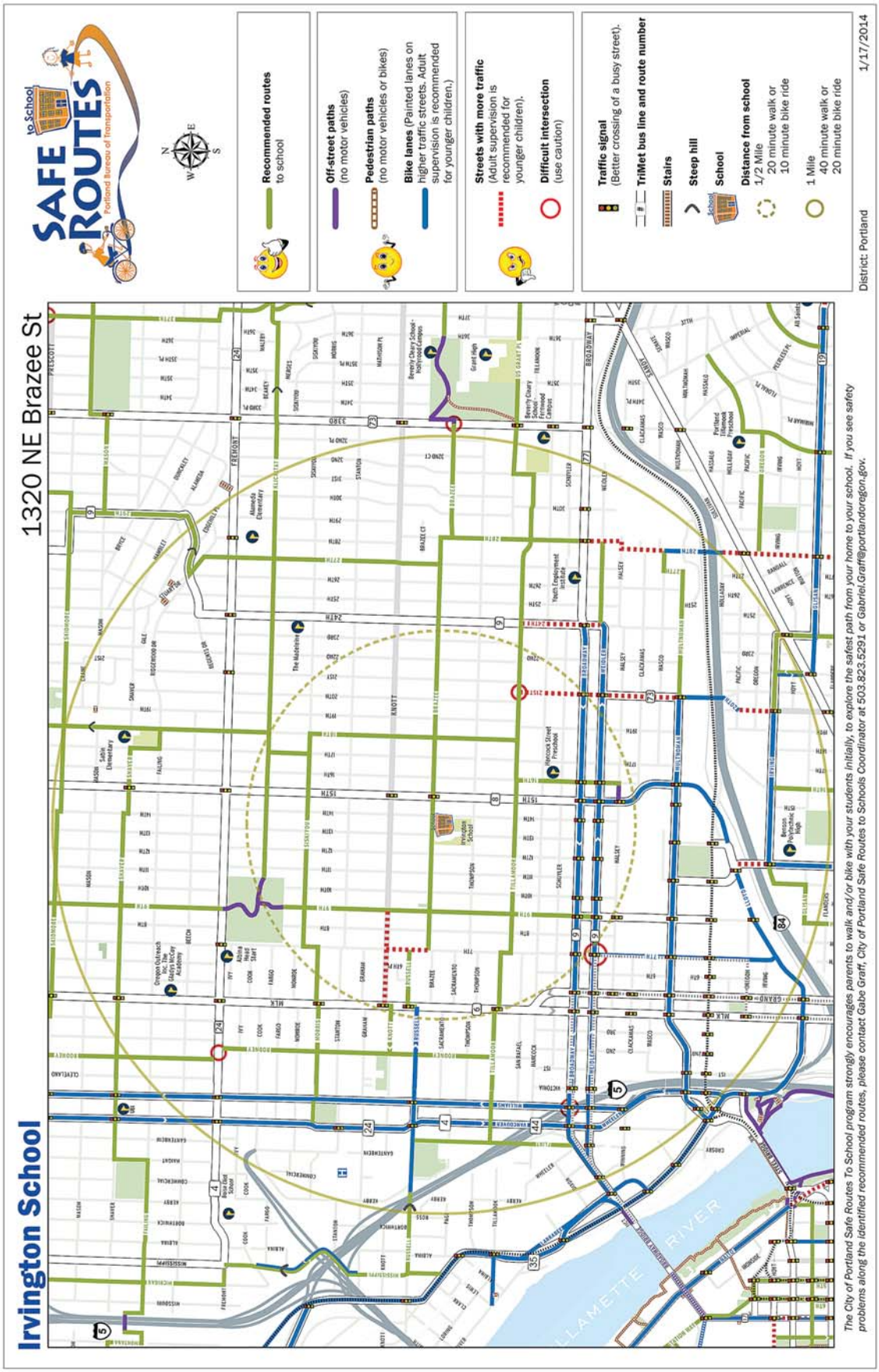
Engineering improvements in school zones should account for unique human factor issues associated with young students who may be walking or biking to school. These factors include:

- Because of their size, children have difficulty seeing and being seen by others.
- Greater difficult in assessing motor vehicle speed and distance, and they generally have a narrower field of vision than adults.
- Young children cannot easily pick out the direction of various sounds.
- They generally develop awareness that vehicles can cause serious injury between the ages of six and eight.
- Young children mix fantasy and reality. They may see cars as living creatures with eyes, nose and mouth. They can easily misinterpret drivers' intentions.
- They may assume that if they see a car, the driver sees them.
- Children don't understand complicated traffic situations well. For example, they may assume that if one car slows down to stop at an intersection, then cars in other lanes will do the same.
- They tend to focus on things of immediate interest and react spontaneously.
- Children have abundant energy. Their eagerness to be in motion can override their awareness of traffic.
- They learn by example and may imitate bad examples of adults or older children in traffic.
- Children may take risks because they overestimate their ability, knowledge, and strength.

Educational Programs

Educational programs are needed to supplement the engineering and enforcement efforts to effectively promote school area safety. In SRTS programs, education links classroom activities and academic achievement to the creation of a safe routes plan to effectively provide a youth-centered perspective, and provides a venue to teach motorists, pedestrians, and bicyclists about their responsibilities and about traffic rules. A number of materials and programs are in existence. These programs include school curriculum, banners, reader boards, internet resources, and work with local media and neighborhoods. These efforts should be continuous throughout the year, but especially strong at the beginning of the year.

SRTS educational programs often include distribution of a map of suggested walking and biking routes to/from the school such as that shown on the previous page. The map can be discussed with students, sent home to parents, and posted online.


Irvington School
1320 NE Brazee St
to School
SAFE ROUTES
Portland Bureau of Transportation
Recommended routes to school
Off-street paths (no motor vehicles)
Pedestrian paths (no motor vehicles or bikes)
Bike lanes (Painted lanes on higher traffic streets. Adult supervision is recommended for younger children.)
Streets with more traffic (Adult supervision is recommended for younger children).
Difficult intersection (use caution)
Traffic signal (Better crossing of a busy street).
TriMet bus line and route number
Stairs
Steep hill
School
Distance from school
1/2 Mile
20 minute walk or
10 minute bike ride
1 Mile
40 minute walk or
20 minute bike ride
District: Portland
1/17/2014
The City of Portland Safe Routes To School program strongly encourages parents to walk and/or bike with your students initially, to explore the safest path from your home to your school. If you see safety problems along the identified recommended routes, please contact Gabe Graff, City of Portland Safe Routes to Schools Coordinator at 503.823.5291 or Gabriel.Graff@portlandoregon.gov.

An important consideration in developing effective educational programs is recognition that child pedestrians perceive and react to traffic situations in predictable but different ways from adults. A pedestrian safety video that sheds light on these differences is *Children in Traffic.* Educators and traffic safety advocates can use this information to formulate more effective safety messages at school. Refer to the list of human factors in the previous section for topics that may be appropriate to address or consider within the educational component of a SRTS program.

The Oregon SRTS website has curriculum sets for grades K-3, 4-5, and 6-8 that address many of the relevant topics related to school area traffic safety. Known as *Neighborhood Navigators*, the curriculum focuses on travel options, pedestrian and bicycle safety, and urban design. Also, the *Bicycle Transportation Alliance* provides a 10-lesson series specifically related to bicycle safety and a 3-lesson series related to pedestrian safety; those lessons include guidance for a community ride and a community walk.

It's important to identify and utilize public and private service providers best suited to implement an effective school traffic safety education program. Pedestrian and bicycle advocacy groups, transit providers, school bus service providers, local transportation authorities or public works departments, state agencies, neighborhood and business associations, public health advocates, county health departments, and injury prevention professionals often have education and outreach materials and/or personnel available.

While many of the educational activities are typically oriented towards students, there are often opportunities to engage parents as well. Outreach efforts may include material such as ODOT's poster "*When Can My Child Safely Walk or Ride to School*?", instructions on drop-off/pick-up patterns, and reminders to obey speed limits and to turn off engines while waiting.

Encouragement Programs

The National Center for Safe Routes to School *Online Guide* recommends that encouragement strategies be about planning enjoyable activities and rewarding participation. Encouragement activities can be quick and easy to start, done with little funding, and they can generate enthusiasm for other strategies that require more investment in terms of time and funding. Attention to missing or inadequate bike parking facilities can encourage more bicycling by shielding bikes from inclement weather and guarding against theft. Ideas for encouragement programs include:

- *Walk + Bike to School Day* (First Wednesday in October in Oregon).
- *Walk + Bike to School Challenge Month* (May).
- Park and Stride programs where parents drop kids off at signed locations and school staff walk with students to school. (Helps reduce school-area congestion too.)
- Class participation in community events such as Kidical Mass and *Open Streets/Cyclovia* events.
- With a *walking or biking school bus*, children walk (or bike) to school in a group along a set route with adult supervision. Each 'bus' (group of students) walks (or bikes) along a set route with at least one adult 'driver' in front and an adult 'conductor' bringing up the rear.

Enforcement programs

Enforcement enlists the help of local law enforcement to focus efforts in problem areas and increase community awareness of school safety issues. Police departments recognize traffic safety as a major concern of the public they serve. They also acknowledge the interrelationship of school safety, crime prevention, crime resolution, traffic safety, and traffic enforcement.

Law enforcement can take a leading role in improving public awareness of existing traffic laws (e.g., stopping for pedestrians in marked crosswalks, not speeding in school areas, obeying parking controls, and stopping for school buses). Some law enforcement agencies have instituted school safety awareness programs and have a strong presence in the school they serve. Others have provided targeted enforcement at strategic locations to catch violators during peak school travel times of morning arrival and afternoon departure. Also, recent advances in automated enforcement such as photo radar (See ORS 810.438) are becoming effective traffic enforcement tools. In combination with engineering improvements and education programs, the enforcement program can be particularly effective. The *crossing guard program* at a school is typically considered to be an element of the Enforcement Program.

Possible traffic safety problems where enforcement is part of the solution include the following:

- Speeding.
- Illegal passing of school bus.
- Not stopping for pedestrians in a crosswalk.
- Parking violations – bus zone, crosswalks, and driveways, time restricted and fire lanes.
- Risks to pedestrians and bicyclists during drop-off and pick-up times.
- Unsafe pedestrian and bicycle practices.
- Other traffic law violations in school zone.
- Crisis management / incident response.

Oregon Safe Routes to School practitioners advise schools to design a communication process that encourages students and parents to notify the school and police of the occurrence of a crash or near-miss during school commute trips involving auto, bus, pedestrian, or bicycle transportation. Include your local transportation authority or public works department in this reporting system to help produce more valuable data and raise awareness.

Enlist the help of law enforcement with the following traffic safety activities:

- Enforcement of traffic laws and parking controls through citations and warnings.
- Enforcement of Oregon's school zone laws.
- Targeted enforcement of problem areas – an intensive, focused effort during the first two weeks of school and a strategy for the rest of the year.
- Participation in School Safety committees and Safe Routes to School task forces to help identify safety problems and solutions.

Evaluation

The SRTS Action Plan should include an assessment or evaluation component. Periodic student and/or parent surveys can help the school district, road authorities, and funders understand the impacts of recent projects and programs and to plan for future initiatives. Survey results can be a powerful tool for the promotion of the program. Pictures help connect the data to smiling faces. The *Oregon SRTS website* has a student hand tally form and a parent survey form which can be used to establish baseline and annual metrics related to a SRTS program.

Equity

The Engineering, Education, Enforcement, and Encouragement initiatives of the Action Plan should be viewed through an equity lens to ensure that these efforts benefit all demographic groups attending the school. It is important to recognize that different demographic groups may need different forms of communication or different incentive programs to all benefit from the SRTS programs.

SRTS funding

Sources of funding for the improvements and programs identified in the SRTS Plan should be identified if possible. Contact information for potential grant programs, local public works department, and local police department should be listed.

Non-infrastructure applications for Oregon SRTS funding for grades K-8 remain under the direction of ODOT's Transportation Safety Division. School or school district projects addressing Education, Encouragement, Enforcement and Evaluation must have either a completed SRTS Action Plan for benefiting schools, or a project that leads to the completion of the SRTS Action Plan. Awards of non-infrastructure projects address regional equity, potential to increase walking and bicycling to and from school, pedestrian and bicycling safety education among K-8 students, project readiness, and benefit to the community.

The best starting point for developing an infrastructure project and for locating the funding for that project is often the local public works department. The municipality or the local school district may have a process for selecting infrastructure projects for funding. *ORS 332.176* requires school districts to evaluate potential safety improvements within 1 mile of an elementary school and 1.5 miles of a secondary school when a large, publicly bonded school construction project (over $1million) is proposed.

Funding may also be available for infrastructure projects through ODOT's Statewide Transportation Improvement Program. The STIP selection process occurs every two to three years. Infrastructure proposals that primarily address safety concerns on state or local streets may be eligible for funding under ODOT's *All Roads Transportation Safety* Program. If a number of serious crashes have occurred at a specific intersection or short section of street, it may be good candidate for the ARTS Program.

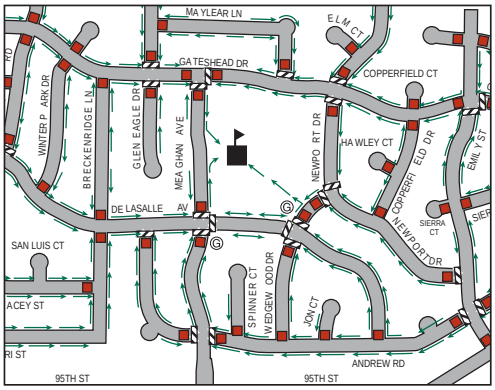
Infrastructure proposals that improve or expand multimodal accommodations on the state highway system may be eligible for ODOT "Enhance" funding. The Oregon Transportation Commission will select Enhance projects based on recommendations developed by governments, public agencies, and citizen representatives through a process conducted by the Metropolitan Planning Organizations where applicable, and the Area Commissions on Transportation. Contact an ODOT regional *STIP coordinator or related staff* for more information about project eligibility, funding levels, and the project selection process for both safety and modernization-type projects. While the applications for infrastructure projects do not require submission of a SRTS Action Plan, the community process and documented conclusions of a SRTS Action Plan effectively tell the story and support the need to improve the safety of students on the route to school.

For more information about funding for SRTS programs and initiatives, see the funding page for the *National Center for SRTS*.

SECTION IV – STREET DESIGN ELEMENTS

When assessing the safety of the immediate area surrounding the school building, it is important to consider elements of the school site and street design such as the provision of sidewalks, street widths, visibility at key locations, and design of pick-up and drop-off areas.

- Are there sight obstructions that should be corrected by restricting or removing parking or by trimming trees and shrubs?
- What accommodations have been made for children riding to school on bikes?
- Are the designated loading and unloading zones free from conflicts with other traffic?
- Are sidewalks needed to improve safety?



Example of School Route Map

A School Route Plan for each school serving elementary through high school students should be prepared to serve as the basis for identifying the desired walking and biking routes. Once problem areas are identified, then changes to the layout of the street, traffic control devices, and education and law enforcement activities can be identified and enacted.

Pedestrian network enhancements

Physical elements of the pedestrian network should be assessed for safety and comfort. This includes an assessment of features such as sidewalks, curb ramps, and crosswalks. Conflicts with motor vehicles at crosswalks and driveways should be assessed. Enhancements such as sidewalks, driveway relocations or consolidation, traffic calming, and improved sight distance may be identified. Keep in mind that simply marking a crosswalk may not improve safety; often, physical street improvements such as illumination, a pedestrian refuge island, or curb extension may also be needed to create a safe pedestrian crossing.


Example of continental crosswalk marking.

On state highways, the design of pedestrian facilities should follow the standards established in the *ODOT Highway Design Manual*. Further guidance is available in the *ODOT Bicycle and Pedestrian Design Guide,* American Association of State Highway and Transportation Officials *Guide for the Planning, Design and Operation of Pedestrian Facilities* and National Association of City Transportation Officials *Urban Street Design Guide*.


Example of pedestrian island.

Pedestrian islands and curb extensions

Pedestrian islands allow students to use existing gaps in traffic to split the crossing of the roadway into manageable parts. This is especially important where there are multiple travel lanes in each direction. Without enhancements such as islands, these roadways may not offer good opportunities for crossing and may encourage students to dash across the roadway during less than adequate gaps. Median islands are one of the most effective ways to increase safety and make crossing easier. While median islands generally provide significant safety benefits, their possible impact to vehicle turning movements should be assessed.

Example of curb extension.

The use of curb extensions (bulb-outs) can reduce crossing distances. These extensions also have the effect of increasing the visibility of the pedestrian. Where on-street parking is present, curb extensions should be considered.

Raised crosswalks

Example of raised crosswalk.

Pedestrian crosswalks may be combined with a speed table to increase pedestrian visibility and lower traffic speeds. A raised crosswalk typically involves raising the roadway to an elevation near that of the sidewalk. Even though curb ramps are usually eliminated with raised crosswalks, tactile warning stripes must be provided to warn visually impaired pedestrians of the interface with vehicular traffic. Raised crosswalks can be located midblock or at intersections, and they may be used in parking lots and across driveways. However, they may not be appropriate on arterials. If the street is frequently used by emergency response vehicles, it may not be appropriate to install raised crosswalks or it may be necessary to modify the design of the raised crosswalk.

Textured crosswalks

Example of colored/textured crosswalk. Photo by pedbikeimages.org / Dan Burden.

Textured crosswalks are generally discouraged due to their poor record for long-term durability and visibility. 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, walkers, or sight impairments. Textured and colored crosswalks are typically higher maintenance and some materials can become slick creating a slipping hazard.

ODOT's practice is to not install textured or colored crosswalks. It is sometimes, however, the desire of a local road authority to install them. If textured crosswalks are used, they should be made of durable materials, such as stamped concrete, with minimal beveling. Colored crosswalks should avoid the use of standard traffic control colors. All textured and/or colored crosswalks are required to have the standard transverse white lines or continental (longitudinal) white lines to ensure their visibility and recognition to motorists.

Bicycle network enhancements

Surrounding streets should be equipped with appropriate accommodations for students on bicycles and bicycle access should be available from all directions. Sidewalks, bikeways, and trails should connect to the school property. Consider improving linkages between surrounding neighborhoods to provide access such as between cul-de-sacs and school property. Bicyclists should have secure and separate parking facilities close to school entrances.

Bikeways are divided into three classifications:

- Separated bikeways such as cycle tracks, raised bike lanes, and shared use paths which offer an element of physical separation between motorized vehicles and bicycles.
- On-road bikeways such as shoulders, bike lanes, and buffered bike lanes which are located on the same curb-to-curb portion of the roadway as motor vehicles.
- Shared lanes with slow speeds (25 mph or less) and low traffic volumes where bicyclists ride in the travel lane with motor vehicles and special attention is given to the needs of the bicyclists (sometimes referred to as a bicycle boulevard or neighborhood greenway).

Example of cycle track. Photo by pedbikeimages.org / Carl Sundstrom.

Bicycle facilities need to be developed in a comprehensive manner to provide an uninterrupted network of comfortable routes to school. Separated bikeways are increasingly being recognized for their ability to enhance safety and attract new riders on streets where standard bike lanes may have been used in the past.

On state highways, the design of bicycle facilities should follow the standards established in the *ODOT Highway Design Manual*. Further guidance is available in the *ODOT Bicycle and Pedestrian Design Guide*, AASHTO's *Guide for the Development of Bicycle Facilities* and NACTO's *Urban Bikeway Design Guide* and *Urban Street Design Guide*.

Traffic calming measures

Traffic calming measures are intended to encourage drivers to drive at appropriate speeds. The selection of traffic calming strategies must consider the operational goals for the roadway, adjacent land use, and emergency vehicle operations. Treatments on local neighborhood and some collector streets may include:

- Speed humps, speed tables, or raised crosswalks.
- Traffic circles or diverters.
- Narrower street and intersection widths.
- Other geometric features or traffic control that may be aimed at reducing the speed and/or volume of traffic.

Example of a neighborhood street with gateway treatment.

On arterials and state highways, traffic calming treatments typically need to be more accommodating of larger vehicles, higher speeds, and higher volumes. Changes to the roadway environment can be used to reduce speeding and cue drivers to a mixed use environment of pedestrians, bicycles and transit, such as:

- Wider sidewalks.
- Streetscaping.
- Median islands.
- Pedestrian-scaled amenities.
- Roadway lane reconfiguring (such as a 4 lane to 3 lane "road diet" conversion).

Some calming devices, common to all types of streets, also help reduce crossing distance and may include:

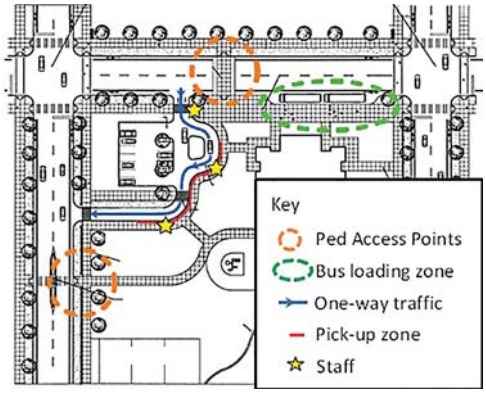
- Pedestrian refuges.
- Curb extensions.,
- Roundabouts.

See ODOT's *Main Street Handbook* or NACTO's *Urban Street Design Guide* for more information.

Example of traffic calming treatments on an arterial street. Notice curb extension, light post, trash barrel, hanging flower baskets, and other vertical elements near street. Image ©2016 Google.

Site layout and parking

Site layout and parking should be focused on reducing pedestrian, bicycle, and motor vehicles conflicts. A problem at many schools is the growing activity of parent pick-up and drop-off. When possible, consideration should be given to separating bus and parent drop-off/pick-up points. Redesign of parking areas to improve flow and reduce pedestrian/vehicle conflicts should be considered. School officials should work closely with public works (traffic engineering) representatives to evaluate traffic safety issues with site layout and parking.



Example of a school site circulation plan.

Morning traffic operations on a school campus usually operate safely and efficiently due to parent traffic arriving at a broader range of times. Afternoon traffic operations, however, are quite different because most often parents arrive well before the school dismissal and park adjacent to the school. The afternoon queue often results with vehicles stopped in the roadway or along the shoulder of a major through route, which increase the chances of collisions and similar traffic-related safety concerns.

According to California's Safe Routes to School Program, more children are hit by cars near school than at any other location. To help change this pattern, their program recommends some low-cost and easy-to-implement measures that schools, parents, and local governments can undertake. View their one-page document *Improving School Drop-Off and Pick-Up Zones*. There may be inexpensive options such as staggered release, valet assistance with loading/unloading children, or requiring the parent to park if the child cannot get in and out of the car unassisted. The Massachusetts Department of Public Health and WalkBoston have published an excellent *guidebook on school site design*.

SECTION V – TRAFFIC CONTROL ELEMENTS

Signs

The *MUTCD* promotes uniformity in design of signs to include shape, color, dimension, symbols, as well as uniform application of signs. Consistency in application increases compliance as signs are quickly recognized and the messages are easily understood. The following guidance is provided as a service to road authorities in Oregon; it does not create a standard or supersede requirements found in the *MUTCD* or other local policies. Some road jurisdictions may have more stringent standards about the application or size of the signs. Refer to the applicable road jurisdiction's standards for further information. The following guidance is based on the *2009 MUTCD* and the ODOT *Sign Policy and Guidelines*. *Chapter 7* of the ODOT *Sign Policy and Guidelines* contains several example school zone sign layouts.

Sign sheeting

The *2009 MUTCD* specifies that fluorescent yellow-green (FYG or strong yellow-green) background shall be used on all new school-related warning signs. Existing warning signs will be replaced with FYG-background signs as the current signs reach the end of their life or ODOT will change out the signs if the school district agrees to pay for the replacement. ODOT reserves the use of the fluorescent yellow-green (strong yellow-green or FYG) sheeting exclusively for school-related warning signs. The mixing of standard yellow and FYG background signs within a school area should be avoided. All school area signs should use high intensity sheeting or better.

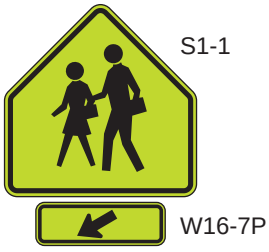
School Zone Sign Assembly

The beginning of a school zone is established by posting a SCHOOL sign (S1-1). The sign may be supplemented with a SCHOOL plaque (S4-3P) and/or, if appropriate, an ALL YEAR plaque (S4-7P).

School Crossing Assembly

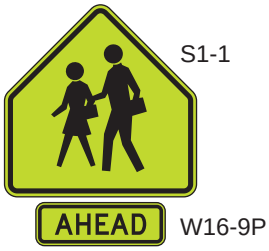
The School Crossing Assembly consists of a SCHOOL sign (S1-1) supplemented with a diagonal downward pointing arrow (W16-7P). The School Crossing Assembly may be used at uncontrolled school crossings that are adjacent to schools and along established school pedestrian routes. This sign assembly shall not be used at crossings controlled by STOP or YIELD signs.

This sign assembly should not be used at a signalized intersection unless justified by an engineering study. If used indiscriminately, drivers may lose respect for the sign and ignore it when it is used at uncontrolled intersections. A better option may be to enhance the visibility of the entry points into the school zone.



School Advance Crossing Assembly

The School Advance Crossing Assembly (S1-1 & W16-9P) is used in advance of the School Crossing Assembly. This sign may be omitted when preceded by a School Zone Sign Assembly.



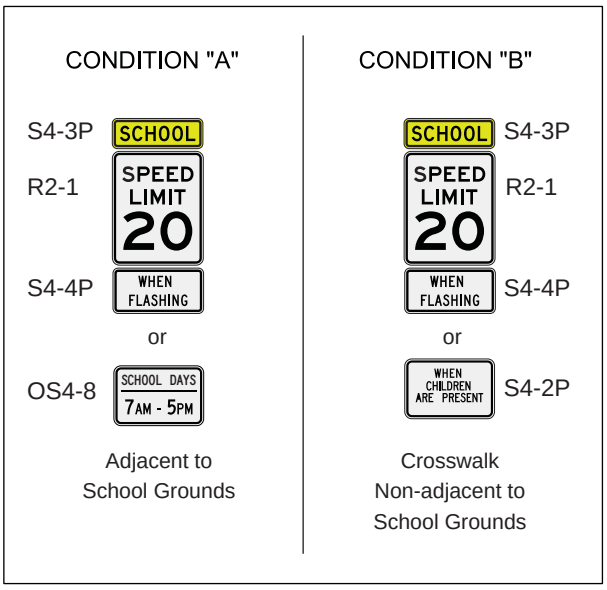
School speed signs

When a school speed zone is established, the School Speed Limit Assembly shall be used. The beginning of the school speed zone is indicated by the sign assembly which consists of a top plaque with the legend SCHOOL (S4-3), a SPEED LIMIT 20 sign (R2-1), and a bottom plaque indicating when the school zone is in effect. A School/Speed Limit 20 combination sign (OS5-5 in ODOT *Sign Policy and Guidelines*) may be used with a supplemental plaque in lieu of three separate signs.

As per ORS 811.111, possible bottom plaques include one of the following: WHEN FLASHING; SCHOOL DAYS/ 7 a.m. to 5 p.m.; or WHEN CHILDREN ARE PRESENT. If the WHEN FLASHING condition is used, the operation of the flashing units must meet the requirements of *ORS 810.243*. If a timeframe is used on the plaque, it must adhere to the 7 a.m. to 5 p.m. specifically stated in the ORS. The conditions meeting the definition of WHEN CHILDREN ARE PRESENT are defined in ORS 811.124.

School speed zones are categorized into one of two types; those on streets adjacent to school grounds (Condition A), and those for crosswalks that are not adjacent to school grounds (Condition B). If the school speed zone is in Condition A, the bottom plaque must be either WHEN FLASHING or SCHOOL DAYS/ 7 a.m. to 5 p.m. If the school speed zone is in Condition B, the bottom plaque must be either WHEN FLASHING or WHEN CHILDREN ARE PRESENT.

The choice between the bottom plaques should be based on a consideration of the site conditions, local practice, and school needs. Flashing units are generally more effective at reducing any confusion and getting driver attention for the school speed zone for warning drivers of possible school children, however, their added cost may not be justified in some situations or their added visibility may not be needed. Flashing units should especially be considered for higher speed approaches (35 mph or greater). See *Section 1* for guidance on where school speed zones are encouraged, where they require additional justification, and where they are discouraged.



Flashing Beacons for indicating children arriving or leaving school

The School Speed Limit Assembly, "SCHOOL SPEED LIMIT 20 WHEN FLASHING", must be accompanied by circular flashing beacon lights to indicate when children are scheduled to arrive at or leave from school.[4] Statute ORS 810.243 requires that the beacons flash only when children are scheduled to arrive or leave school unless a few very specific conditions are met.[5] Typical flashing periods are at the beginning and end of the school day. The general practice is to set the beacons to flash approximately 30 minutes prior to and 15 minutes after a scheduled arrival, and for 15 minutes prior to and 30 minutes after a scheduled departure. Flashing may also occur for half-day releases such as noon for half-day kindergarten release. The road authority may need to conduct field observations to determine the daily flashing schedule. The road authority typically maintains and programs the flashers according to the school-provided schedule for the school year.

School beacons should be placed on or immediately adjacent to the School Speed Limit sign assemblies with the "WHEN FLASHING" plaque. See *Section 4L.04 of the MUTCD*.

School flashers are not inexpensive; the estimated cost is $10,000 to $15,000 for a pair of side-mounted units or $50,000 for a pair of overhead units plus ongoing maintenance, management, and power costs. If a school district requests flashing beacons on state highways, the school district may be required to pay the installation and utility costs.

End school zone

The end of a school *speed* zone must be marked with either an "END SCHOOL ZONE" or "END SCHOOL SPEED LIMIT" sign. If the school speed zone includes FINES HIGHER signing, the END SCHOOL ZONE sign should be used; otherwise, the "END SCHOOL SPEED LIMIT" sign should be used. A standard Speed Limit sign alone is not an acceptable substitute to end a school speed zone, but may be used in conjunction with either sign above to indicate the underlying speed of the roadway.

School reduced speed zone ahead sign.

If the posted speed is 35 mph or higher, a School Reduced Speed Ahead sign (S4-5) should be used to inform drivers of a school speed zone ahead. Section 7B.16 of the *2009 MUTCD* details the sign. If used, the advance warning sign should be placed at least the required minimum distance for the posted speed per the MUTCD prior to the School Speed Limit Assembly.

S4-5

[4] See MUTCD Section 4L.04 for additional guidance on the design and operation of flashing beacons.
[5] ORS 810.243 contains an allowance for beacons to operate from 7 a.m. to 5 p.m. if the school has a parking lot located across the street from the school and the street has a posted speed of 45 mph or higher.

School bus stop ahead sign

SCHOOL BUS STOP AHEAD signs are used in advance of locations where school buses stopping to pick up or discharge passengers are not visible for a minimum distance of 500 feet and there is no opportunity to relocate the bus stop to a location with better visibility. The sign shall have a minimum 30" x 30" size. These signs are not intended to be used everywhere a school bus stops to pick up or discharge passengers but for use only where terrain and roadway features limit the approach sight distance and where there is no opportunity to relocate the stop to another location with adequate visibility. Stops posted with these signs should be reviewed periodically to determine if they are still used.

Bus stop locations may be reviewed through the guidance offered in the National Highway Transportation Safety Administration's publication *Selecting School Bus Stop Locations: A Guide for School Transportation Professionals.*

R2-6P

Traffic fines higher signs

The higher fine provision applies in school zones **only** if posted (as fines higher) **and** lights are flashing **or** the definition of "when children are present" is met (the definition of "when children are present" can only be met at crosswalks not adjacent to school property). Road jurisdictions are allowed under ORS 810.245 to post signs warning of increased traffic fines within school speed zones. A school district may request the road authority to install a BEGIN HIGHER FINES ZONE (R2-10) sign or a FINES HIGHER plaque (R2-6P) as described in Sections 2B.17 and 7B.10 in the 2009 MUTCD. The FINES HIGHER plaque (R2-6P), if used, should be placed on the School Zone Sign (S1-1) Assembly. The "TRAFFIC FINES DOUBLE IN THIS SCHOOL ZONE" (OR4-21) sign and the smaller version "TRAFFIC FINES DOUBLE IN SCHOOL ZONES" sign (used off state highways) may be used until signs reach their end of life.

Changeable message signs

Changeable message signs may be used in lieu of School Speed Limit assemblies, to inform drivers of the special school speed limit. The changeable messages signs may use blank-out signs in order to display school speeds only during periods it applies. Their basic shape, message, and layout should conform to the same standards as the fixed School Speed Limit assemblies.

A speed feedback sign is a type of changeable message sign that may be used to display the speed of approaching drivers. The sign may be portable or permanently installed in conjunction with the School Speed Limit Assembly. These signs have been shown to be quite effective in slowing the fastest violators in school speed zones.[6] Considerations for installing a permanent speed feedback sign include the following:

- Crash experience within the past three years.
- Prevailing travel speeds when children are arriving or leaving the school.
- Other pertinent factors such as installation and maintenance costs, public support, and the number of children who walk or bike to school at the entrances covered by the signs.

[6] FHWA lists several studies (here) that found significant reductions in the 85th percentile speeds when speed feedback signs were used in school speed zones with high rates of excessive speed. In these locations, the signs were associated with a reduction in the 85th percentile speeds of 4-9 mph.

Parking restrictions

Parking restrictions and other signs governing the stopping and standing of vehicles can be used to cover a wide variety of applications and can be a very effective tool for increasing school area safety. Visibility and control of traffic are some reasons for considering parking restrictions. Contact the road authority or local jurisdiction for regulations and any special requirements governing parking restrictions. Restrictions can include a variety of options including but not limited to the following: prohibiting parking at any time, limited-time parking, and restrictions based on vehicle type, day, or time of day. Yellow curb markings may be used to supplement the signs. ORS 811.550 (17) prohibits parking within 20 feet of any crosswalk regardless of whether or not a sign is posted.

In-street pedestrian signs

R1-6c

In-street Pedestrian Crossing signs are intended to be used to remind drivers of the laws regarding right of way of pedestrians at unsignalized pedestrian crossings. Guidance on using these signs is given in section 2B.12 and 7B.12 of the MUTCD. The "STOP FOR" legend must be used in Oregon.

Before installing signs, each location should be reviewed separately in terms of site conditions and pedestrian safety. Signs should be installed on the centerline and as close as practical to the marked crossing without placing it in the crosswalk, typically 1-5 feet in advance of the crosswalk.

These signs have proven to be very effective as traffic calming devices and at increasing motorist stopping compliance at crosswalks. They have been shown to achieve a level of stopping compliance similar to rectangular rapid flashing beacons in lower speed locations. They can be especially effective if placed and removed daily or only when crossing guards are present to indicate when children are arriving or departing from school. They can be an effective complement to school crossing guards.

The In-street Pedestrian Crossing signs shall not be placed at stop or signal controlled intersections. Where there is a high volume of turning movements (especially large vehicles), an in-street sign may need to be placed on a raised island to prevent the need for frequent replacement. Narrow streets may pose a problem as the signs may not allow enough room for larger vehicles or unskilled drivers to pass without hitting the sign.

Photo credit: bikewalklincolnpark.com

Pavement markings

Pavement markings have an important role to play in school area safety. They can be used to supplement the regulations or warnings of other devices such as traffic signs or they may obtain results that cannot be obtained by the use of any other device. However, pavement markings have definite limitations. They may be covered by snow, may not be clearly visible when wet, and may not be very durable when subject to heavy traffic. Pavement markings also require a higher degree of maintenance than other traffic control devices, resulting in recurring costs to the road jurisdiction.

Marked crosswalks

Marked crosswalks are commonly marked at locations where drivers are accustomed to stopping such as signalized intersections and all-way stop intersections. Where existing traffic controls are not available and it is not feasible to require children to walk out of direction, crosswalks may also

be marked in other uncontrolled locations. Locations for uncontrolled marked crosswalks should consider a School Route Plan, if available, as well as the need and ability to provide adult crossing guards and safety features such as illumination, median refuge islands, and curb extensions. In an effort to ensure that marked crosswalks are only placed where they are needed, communication with the school and/or school district and an engineering study are required before establishing marked crosswalks at locations other than signalized or stop controlled approaches to intersections. The number and age of the students using the crossing should be taken into consideration. See *FHWA Publication HRT-04-100* and ODOT's Criteria for Establishing Marked Crosswalks in the ODOT *Traffic Manual* for further guidance on the decision to mark or not mark a crosswalk. Additional treatments beyond pavement markings are often needed; see the ODOT *Traffic Manual* or *NCHRP 562: Improving Pedestrian Safety at Unsignalized Crossings* for guidance on the selection of additional treatments.

Example of continental crosswalk marking.

Longitudinal crosswalk markings (also called "continental") have been shown to be visible from significantly greater distances and require less maintenance than the transverse crosswalk markings, so their use is encouraged at uncontrolled marked crosswalks. ODOT has established a practice of marking uncontrolled crosswalks with longitudinal markings and marking signalized and stop-controlled crosswalks with transverse crosswalk markings without regard to whether or not the marked crosswalk is in a school zone. The convention of using continental-style markings at uncontrolled crosswalks and transverse lines at controlled crosswalks is intended to distinguish uncontrolled crosswalks (where drivers have an obligation to scan and stop for pedestrians intending to cross the street) from controlled crosswalks (where the driving task is dominated by a STOP sign or traffic signal) Some communities have adopted an alternative practice of using longitudinal crosswalk markings at all school crosswalks (signalized, stop controlled, or uncontrolled) as a means of distinguishing school crosswalks in the community.

Stop lines

Stop lines are solid white lines normally 12-24 inches wide extending across all approach lanes and indicate the point at which vehicles are required to stop in compliance with the STOP sign, traffic signal, or other legal requirement. Stop lines are not ordinarily used with signalized crosswalks in Oregon unless it is desirable to stop vehicles in advance of the nearest crosswalk line. When used, stop lines shall be placed as near as practical to the intersecting roadway but should not be closer than 4 feet to the traveled way or crosswalk line.

Advance stop lines

Advance stop lines are stop lines set in advance of uncontrolled marked crosswalks on multi-lane roadways in order to provide additional time and visibility for pedestrians to avoid vehicles not stopping in adjacent lanes (i.e. multiple threat crashes). Advance stop lines are strongly recommended to reduce multiple threat crashes whenever a crosswalk is marked across a street with more than one through lane in each direction. Advance stop lines (24-inch width) are typically

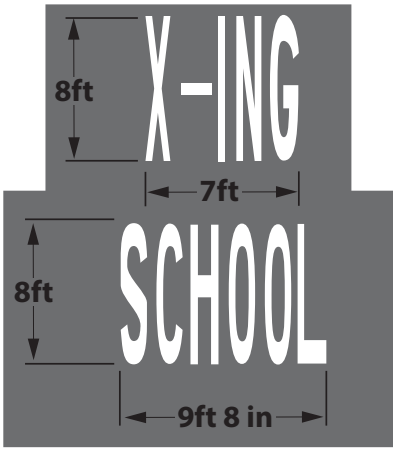
set back 20-50 feet in advance of uncontrolled marked crosswalks (20 feet is the minimum). A common practice is to place them a distance in feet equivalent to the posted speed. The STOP HERE FOR PEDESTRIANS (or pedestrian symbol) sign R1-5b or R1-5c must be used if an advance stop line is used for a pedestrian crosswalk. See "Advance Stop Lines" in the ODOT Traffic Manual for further guidance.

Parking restrictions

Road authorities may authorize curb markings (usually yellow) to supplement standard signs or to replace signs if permitted by local ordinance. ORS 811.550 (17) prohibits parking within 20 feet of a crosswalk regardless of whether or not the curb is marked.

Word and symbol markings

Word and symbol markings on the pavement may be used as a supplement, but are not a required marking. Markings in the travel lane require a high degree of maintenance and they should be used only as necessary. Letters and numerals should be white and 8 feet or more in height and if the message consists of more than one word, it should read up, i.e., the first word should be nearest to the driver. Where approach speeds are low, somewhat smaller characters may be used. Pavement messages should preferably be no more than one lane in width except school messages may extend to the width of two lanes. When a two lane width is used, the characters should be 10 feet or more in height. SCHOOL is one of the more commonly used markings. See Section 7C.03 of the MUTCD for further guidance.



Maintenance of signs and markings

Signs and pavement markings for school speed zones should be inspected routinely by the road authority. Preferably, inspections should occur before the beginning of each school year or towards the end of the school year to schedule maintenance during the summer. Damaged signs should be replaced. If use of the school building or traffic patterns change, the school district should notify the road authority. Zones which no longer meet the criteria for school areas should be removed (such as when the school permanently closes or the building use changes).

Supplemental Devices (i.e., Yellow Diamonds, RRFB's, PHB's)

Overuse of supplemental devices tends to erode their effectiveness as safety devices. To preserve their usefulness as warning devices, flashing lights and other attention-grabbers should be used in a selective manner only when warranted by an engineering study. ODOT has a policy to only use yellow diamonds to temporarily highlight a change in regulatory conditions such as a revised speed limit or a new traffic signal.

Reflective strips on sign posts

A supplemental device that seems to catch the attention of drivers is the addition of reflective strips the length of the sign post. This device is effective at grabbing the attention of drivers and is inexpensive to add to the post.

Example of reflective strip on sign post.

Photo credit: Carmanah Technologies Corp.

Rectangular rapid flashing beacons (RRFB)

RRFBs consist of two rapidly and alternately flashed rectangular yellow LED arrays located between the crosswalk warning sign and the supplemental downward arrow plaque. These devices have a significant effect on driver stopping compliance rates. There is evidence that they increase the distance at which motorists begin to slow for a pedestrian in a crosswalk. Because of their relatively high installation costs and ongoing maintenance costs, their installation should be limited to locations where they are justified after a thorough consideration of vehicle volume and speeds, number of pedestrians, length of crossing, and other relevant factors. RRFB's should only be considered after other proven pedestrian safety measures such as median refuge islands have been deemed inappropriate or insufficient. Crossing guards are also a good option.

RRFBs may only be used in conjunction with a Pedestrian or School Crossing Assembly and they may not be used with traffic signals, STOP signs, or YIELD signs. If used in a "WHEN FLASHING" school speed zone, care should be taken to locate the RRFB at a sufficient distance from the "WHEN FLASHING" beacon to avoid driver confusion. If placed too closely to a "WHEN FLASHING" beacon, some drivers may mistakenly believe the school speed zone is in effect when the RRFB is flashing; conflicts arise if other drivers continue at normal speeds. See the ODOT Traffic Manual section 6.6.7, and see Federal Highway Administration's July 16, 2008, *Interim Approval for the Optional Use of Rectangular Rapid Flashing Beacons* for further guidance on the use of these devices.

Warning signs

Rural school areas may have no students walking or biking to school but may have short periods of congestion near the school entrances. An optional "Congestion" sign may be used to warn drivers of the related school traffic and may be useful when a slower school speed is not warranted.

Pedestrian hybrid beacons (PHB)

The PHB is a relatively new traffic control device that may be used at midblock pedestrian crossings on arterial streets. The signal indications are dark until a pedestrian pushes a button that activates the device. Once activated, the PHB cycles through periods of flashing yellow, solid yellow, solid red, and then flashing red for traffic on the arterial street. The standard WALK, flashing DON'T WALK, and DON'T WALK messages are shown to pedestrians at the appropriate times. PHB's tend to be used where vehicle speeds are too high to permit pedestrians to safely cross the road or where gaps in traffic are not adequate to permit pedestrians to cross. They offer an efficiency advantage for motor vehicles over conventional traffic signals because traffic can proceed (after stopping) during the flashing red phase, and they generally cost less than a conventional traffic signal, especially if the PHB heads can be located along the side/median of the street instead of overhead. Red indications, as used in conventional traffic signals and PHB's, have been found to generally result in the highest rates of stopping compliance at marked crosswalks.

School area traffic signals

School signals are standard traffic control signals erected at established school crossings on the basis of the need to create adequate gaps in the vehicular traffic stream for pedestrian crossings. When properly designed, located, and operated under conditions that fully warrant their use, school signals may offer the following **ADVANTAGES** over other treatments:

- Traffic signals generally have a higher rate of driver compliance as compared to treatments that do not have a red indication such as flashing beacons or signs.
- Considering initial and operating costs, school signals may offer cost-savings as compared with police supervision or crossing guards over a period of several years.
- Under conditions of favorable spacing, signals can be coordinated with adjacent signals to provide for continuous or nearly continuous movement of vehicular traffic.

Example of signalized school crossing. Photo by pedbikeimages.org / Dan Burden

The following **DISADVANTAGES** for signals should be considered when choosing a specific means of crossing control:

- School signal control has a much higher initial cost than police supervision or crossing guards. It should only be considered for locations where several years use is expected.
- In some circumstances, the school signal control requires supplemental control by an adult, guard or school safety patrol (i.e., right turns on red).
- Signals can increase the frequency of some types of motor vehicle crashes (i.e., rear-end crashes).

A school signal may be warranted at an established school crossing when a traffic engineering study indicates that the number of adequate gaps in the traffic stream during the periods the children are using the crossing is less than the number of minutes in the same time period. Signals have the potential to increase some types of crashes; they should be used only after other less restrictive means to have students utilize existing gaps have been considered (i.e., pedestrian refuges, in-street signs). See Section 4C.06 of the *MUTCD* for more information on school signals.

School crossing guards and safety patrols

The *Oregon Traffic Patrol Manual For Schools* (Oregon Department of Education) recommends practices for the organization, operation, and administration of a crossing guard program in Oregon. The information below is essentially a summary of some of the key points of that document.

There are two types of school crossing supervision: control of pedestrians and vehicles with adult crossing guards or police officers, and control of pedestrians only with student safety patrols. School districts have the authority to use adults as safety patrol members or crossing guards. They can be an important element of the Traffic Patrol Program. Certain criteria should be used to determine at which location adult crossing guards are placed. The Department of Education suggests that generally, an adult crossing guard is needed when:

- The traffic situation at the school crossing is too hazardous to be navigated by children.
- The crosswalk is so far from the school that it cannot be monitored by school officials.
- It is difficult for children to observe traffic at all corners.

- The crossing is close to school and a great number of children make it difficult to control the crossing.
- When there is a high volume of turning traffic to and from an arterial.
- When there is a high volume of pedestrian traffic across an arterial.
- When there is not at least one safe gap in traffic per minute during the crossing time.

When any **ONE** of these conditions exist, adult supervision may be necessary to create gaps in traffic, caution the traffic turning over crosswalks, and safely assist groups of children across the street. Customarily, crossing guards are used in elementary schools. In particularly hazardous situations, middle schools may wish to utilize crossing guards as well.

Crossing guards should not be directing traffic. Instead, they should be selecting opportune times to create a safe gap. Crossing guards may be used to provide gaps in traffic at school crossings where an engineering study has shown that adequate gaps must be created. Crossing guards must wear a fluorescent yellow-green vest labeled as ANSI 107-2004 for class 2 risk exposure. They may also wear a fluorescent yellow-green hat and carry a school crossing flag or flagger paddle as recommended by the Oregon Department of Education. The Oregon Department of Education, Pupil Transportation has a 15 minute video, "Tips and Techniques for the Adult Crossing Guard" available upon request at 503-947-5737 or email at *buslicense@ode.state.or.us.*

Student safety patrols should be authorized by the local school board. They do not direct traffic but they do supervise children using a crossing. School authorities should be responsible for organizing, instructing and supervising student safety patrols with the assistance of the local police. They should be students from the fifth grade or higher and parental approval should be obtained in writing before a student is used as a member of the safety patrol. Student safety patrol members must wear a bright colored yellow, orange or strong yellow-green retroreflective ANSI Class 1 high-visibility safety vest. Student safety patrols carry a retroreflective 24" minimum square flag. The flag color may be yellow or strong yellow-green. The Oregon Department of Education, Pupil Transportation Program provides technical assistance for establishing student safety patrol programs. A 30-minute video to help train student safety patrols is available upon request at 503-974-5737 or email at *buslicense@ode.state.or.us*.

SECTION VI - SCHOOL ZONE SAFETY RESOURCES

National resources

The *National Center for Safe Routes to School* is a centralized resource of information on successful Safe Routes to School programs and strategies. Users of this site will find information on how to start and sustain a Safe Routes to School Program, case studies of successful programs as well as many other resources for training and technical assistance. A comprehensive *Online Guide* is available. This federally-funded program also provides educational resources related to SRTS, a listserv, and toll-free phone number. A *Walkability Checklist*, a *Bikeability Checklist, and an example school site assessment form* are also available.

The *Safe Routes to School National Partnership* is a non-profit organization that provides a wide range of materials, reports, webinars, and other information related to SRTS programs.

The **Safety Division of Federal Highway Administration** describes Safe Routes to School plans in *SRTS Program Guidance*.

The **Institute of Transportation Engineers** offers a variety of *Briefing Sheets* on matters related to school area safety, walking and bicycling audits, school site design, and traffic calming.

The national website for *Walk and Bike to School Day* offers resources for attracting wide support and momentum for your Safe Routes to School Program along with some fun. In *Oregon*, Walk and Bike to School Day is celebrated in October.

America Walks is a national coalition of local advocacy groups dedicated to promoting walkable communities. The organization works to foster the development of community-based pedestrian advocacy groups to educate the public about the benefits of walking and to act as a collective voice for walking advocates. America Walks offers advice about how to get started and how to work effectively with public officials and engineering and design professionals.

The *Pedestrian and Bicycle Information Center* is a clearinghouse for information about health and safety, engineering, advocacy, education, enforcement, and access and mobility. The PBIC serves anyone interested in pedestrian and bicycle issues, including planners, engineers, private citizens, advocates, educators, police enforcement and the health community. PBIC supports a *repository for digital image files*.

The Institute for Transportation Research and Education at North Carolina State University provides information on best practices for managing school campus traffic. Their *website* includes a Carpool (Pick-up and Drop-off Area) Decision Tree, a web-based support tool to be used by school staff to analyze and find recommendations on ways to improve school-related traffic.

Oregon Resources

Oregon's Safe Routes to School Program maintains a *website* with information related to creating School Safety Action plans, school newsletter ideas, examples of implementations of the 6E's, and links to numerous safety brochures, posters, and videos. The program coordinates the Walk+Bike Challenge Month (May) and the Walk+Bike to School Day (early October) offering a package of incentive giveaways, promotional flyers, and media materials for participating schools. The program

hosts a SRTS bi-annual conference and training workshop for school coordinators, a monthly information and resource sharing conference call, a listserve, and a quarterly newsletter related to walking and biking to school. Suggestions for school area site assessment are also provided. Individuals and organizations may join the associated SRTS Network (*website*) to collaborate with other city and school district contacts on SRTS programs.

The **Oregon Department of Education, Pupil Transportation Program** (*website*) provides technical assistance for establishing student safety patrol programs. The *Oregon Traffic Patrol Manual For Schools* recommends practices for the organization, operation, and administration of a crossing guard program in Oregon. Training videos for safety patrols are available by contacting ODE at *buslicense@ode.state.or.us*.

ODOT's Transportation Safety Section maintains a *Safe Routes to School website* that includes information related to establishing SRTS Action plans, pedestrian safety school curriculum, and informational videos and brochures. *A number of free brochures, posters, and other materials are available.* Another excellent resource is the *Community Traffic Safety Resource Guide.*

Oregon's **Transportation and Growth Management Program** provides information related to *school siting* and the role this decision has on walking and biking rates.

Also available from **ODOT** is the *Oregon Bicycle and Pedestrian Design Guide* which provides guidance for improving pedestrian and bicycle safety. Contact the ODOT Roadway Engineering Unit at *RoadwayEngineeringSection@odot.state.or.us* for questions related to this guide.

The Street Trust (formerly the Bicycle Transportation Alliance) runs a statewide bicycle safety education program that teaches youth grades 4-7 bicycle safety in a 10-hour comprehensive curriculum. The program includes training where students learn traffic rules and ride bicycles on the street. The Street Trust (*website*) brings resources such as bicycles, helmets, and *curriculum*, and will train teachers. More information is available at the program *website*.

The **Safe Kids Oregon Program** (*website*) is part of the national Safe Kids Campaign. The program is sponsored by the Oregon Child Development Coalition. Publications and videos related to helmet fitting and pedestrian safety are available on the program website. Information is available for low-cost helmets in the Portland area.

The **Trauma Nurses Talk Tough Program** at Legacy Emanuel Medical Center (*website*) offers presentations to elementary and junior high school students in the Portland metro area related to bicycle and auto safety. The center also offers below-retail cost helmets.

Local programs around Oregon

There are numerous local Safe Routes to School programs around Oregon, at the local, county, and regional level. Some of the largest or longest-running programs are listed below. Check Oregon's Safe Routes to School *website* for a complete list of ODOT-funded programs, or ask your local school, city, public health, or other community group about other activities that may not be listed here.

Clackamas County launched a safe routes program in 2003 to improve routes to local area schools. The County works with local schools to improve the safety of key routes to schools ranging from simple tasks such as roadside vegetation maintenance to school flashers and crosswalks. The Clackamas County Sheriff's Office also is a strong player in helping with enforcement around the school zones. For more information, contact the *Traffic Engineering program*.

Washington County (*website*) uses a comprehensive approach to school area safety including reader boards, targeted enforcement, crossing guard training, engineering approaches including enhanced signing, flashing lights and traffic calming, mapping safe routes to school, and consulting to schools in solving specific safety problems. In September 2013, Washington County was awarded a $150,000 non-infrastructure grant from the Oregon Safe Routes to School Program to fund a SRTS coordinator for three years. This coordinator will help boost the number of SRTS programs and activities throughout the county while building valuable SRTS partnerships among city and county agencies, schools, community organizations, and neighborhoods.

The **City of Ashland** has used a variety of strategies to increase bicycle and pedestrian safety. Public awareness and education are ongoing through a **Look Out for Each Other** campaign, banners, brochures and a crosswalk awareness week. They have used **Safety Chicken**, an adult in a giant chicken costume, to promote walking and biking safety to the students. Engineering improvements include pole-mounted active speed zone signs which are circulated through the school districts, providing materials for the KEEP KIDS ALIVE, DRIVE 25 Campaign, and applying different crosswalk treatments where greater visibility is needed.

School districts in **Lane County** support an active *Safe Routes to School Program*. As this is an urban area with multiple school districts, a *regional SRTS plan* was developed in 2012. The Lane Transit District's *School Solutions Program* provides families with fun, safe, and healthy ways to get to school through carpool, walking, biking, or transit. The program has created *walking route maps* for many of the schools in the area.

Information related to Safe Routes to School in the **Bend** area is available through the *Bend Commute Options Program*.

The **City of Milwaukie** (*website*) has developed a number of approaches to pedestrian safety. As part of their School Trip Safety Program, they have used speed humps and a neighborhood speed watch program that includes banners, radar feedback trailer, advisory letters to speeders and the media to slow drivers down in neighborhoods.

The **City of Portland** implemented a *safe routes program* in 2003 as part of its Community and School Traffic Safety Partnership. The city worked with the local school district to develop an easy-to-use mobile phone application that allows parents and staff to report safety and access issues through map-based technologies. Information is also available related to *"Walking School Buses" and "Bicycle Trains"*.

Other Resources

The Safe Routes to School National Partnership's *Pacific Northwest Regional Network* provides support and information related to efforts to improve conditions for walking and biking to school in the Portland, Vancouver, and Salem areas.

The *Safe Routes to School Program* of the **Washington State Department of Transportation** offers a how-to guide for developing school walk and bike route plans. Additional resources and information related to safety education is available from the *Washington Safe Routes to School Coalition*.

The **New Jersey Department of Transportation** provides extensive guidance on best practices for school zone design in their *New Jersey School Zone Design Guide*.

The **Ohio Department of Transportation** offers *School Travel Plan* development guidelines and templates.

Chicago's Active Transportation Alliance provides a *Safe Routes to School Toolkit* to help new Safe Routes to School initiatives get started.

ACKNOWLEDGMENTS

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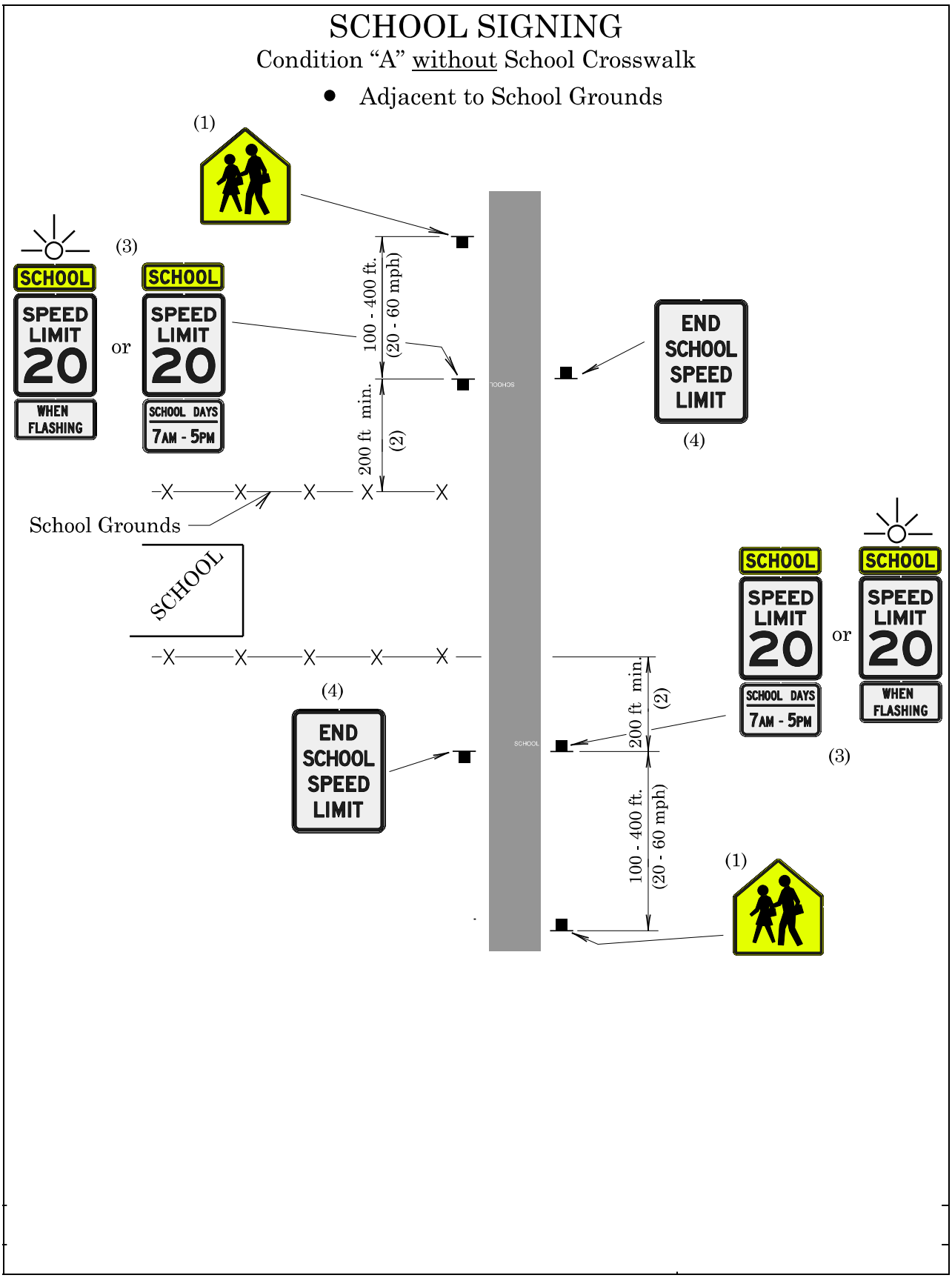
Example School Speed Zone Layout

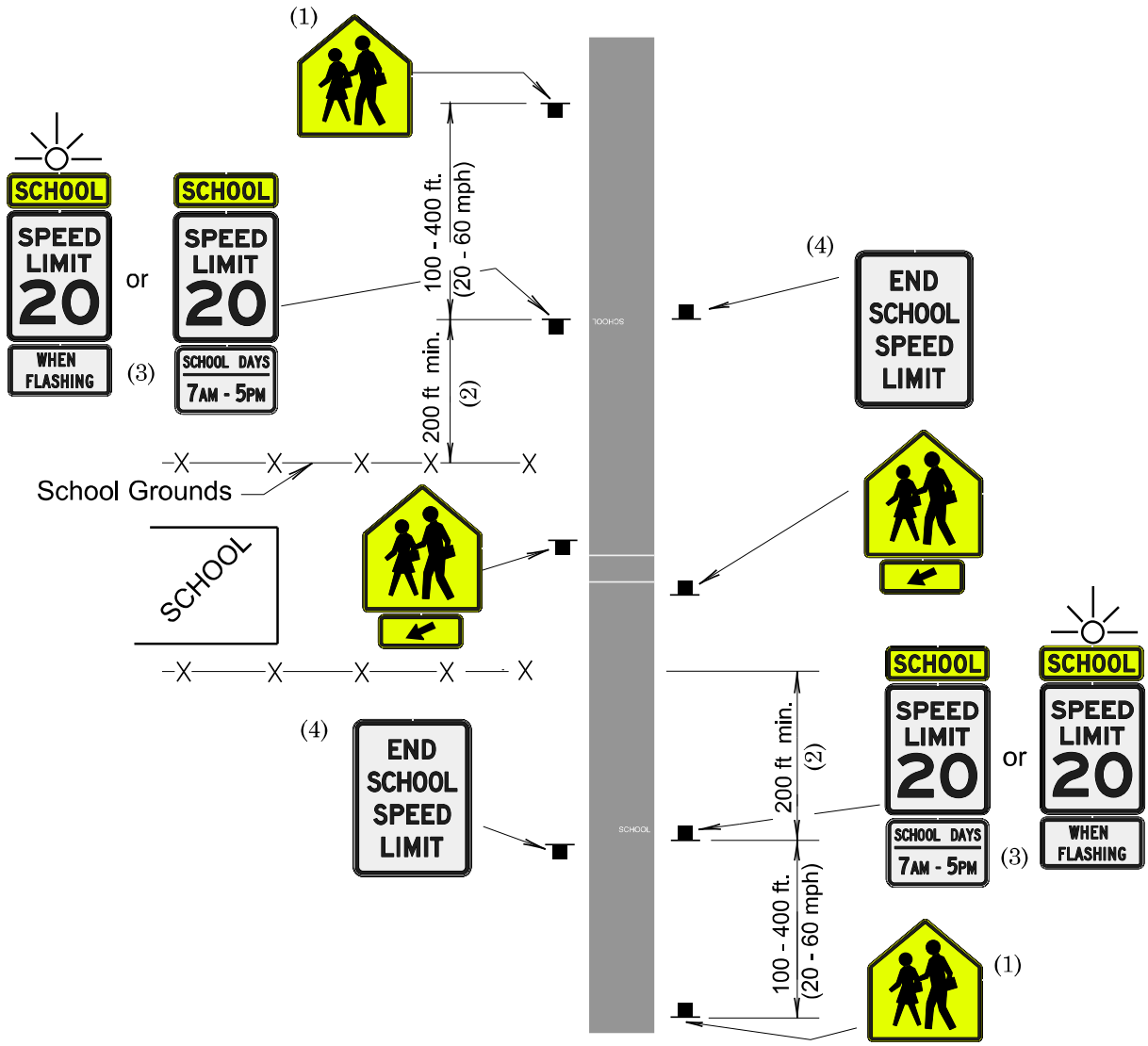


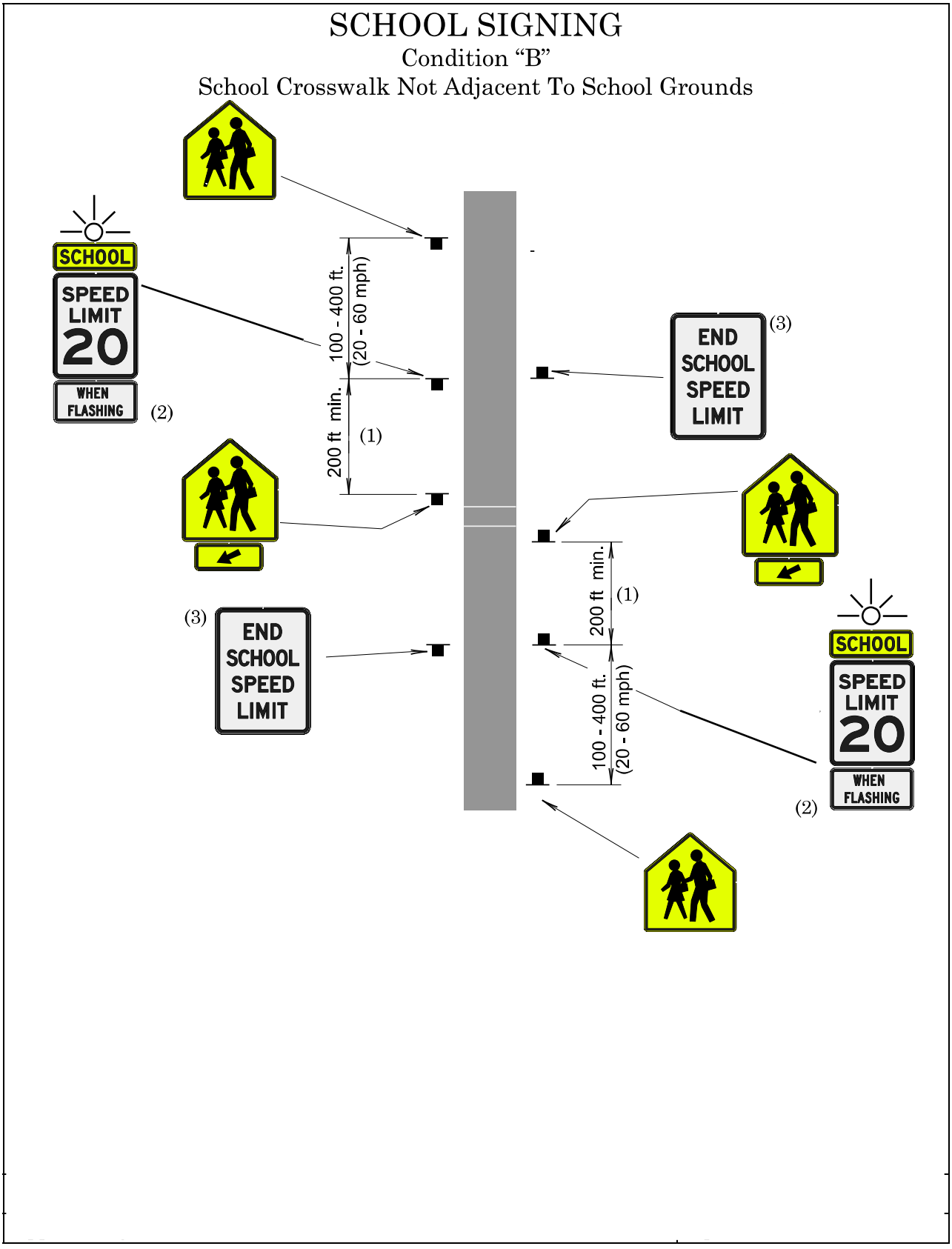
Example School Speed Zone Layout

SCHOOL SIGNING

Condition "A" with School Crosswalk

- Adjacent to School Grounds




SCHOOL SIGNING
Condition "B"
School Crosswalk Not Adjacent To School Grounds
SCHOOL
SPEED LIMIT 20
WHEN FLASHING
(2)
100 - 400 ft.
(20 - 60 mph)
200 ft min.
(1)
END SCHOOL SPEED LIMIT
(3)
END SCHOOL SPEED LIMIT
(3)
200 ft min.
(1)
100 - 400 ft.
(20 - 60 mph)
SCHOOL
SPEED LIMIT 20
WHEN FLASHING
(2)

ATTACHMENT 3 – FHWA Interim Approval 21 Rectangular Rapid Flashing Beacon

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Correction issued 3/21/2018

Subject: **INFORMATION:** MUTCD – Interim Approval for Optional Use of Pedestrian-Actuated Rectangular Rapid-Flashing Beacons at Uncontrolled Marked Crosswalks (IA-21)

Date: MAR 20 2018

From: Martin C. Knopp
Associate Administrator for Operations

In Reply Refer To: HOTO-1

To: Federal Lands Highway Division Directors
Division Administrators

Purpose: The purpose of this memorandum is to issue an Interim Approval for the optional use of Rectangular Rapid-Flashing Beacons (RRFB) as pedestrian-actuated conspicuity enhancements for pedestrian and school crossing warning signs under certain limited conditions. Interim Approval allows interim use, pending official rulemaking, of a new traffic control device, a revision to the application or manner of use of an existing traffic control device, or a provision not specifically described in the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD). State and local agencies must request and receive permission to use this new Interim Approval, designated IA-21, from the Federal Highway Administration (FHWA) in accordance with the provisions of Section 1A.10 of the MUTCD before they can use the RRFB, even if prior approval had been given for Interim Approval 11 (IA-11), now terminated. The issuance of this new Interim Approval does not reinstate IA-11 either in whole or in part.

Background: The Florida Department of Transportation has requested that the FHWA issue an Interim Approval to allow the use of RRFBs as pedestrian-actuated conspicuity enhancements to supplement standard pedestrian and school crossing warning signs at uncontrolled marked crosswalks. The RRFB does not meet the current standards for flashing warning beacons as contained in the 2009 edition of the MUTCD, Chapter 4L, which requires a warning beacon to be circular in shape and either 8 or 12 inches in diameter, to flash at a rate of approximately once per second, and to be located no less than 12 inches outside the nearest edge of the warning sign it supplements. The RRFB uses rectangular-shaped high-intensity light-emitting-diode (LED)-based indications, flashes rapidly in a combination wig-wag and simultaneous flash pattern, and may be mounted immediately adjacent to the crossing sign.

Research on the RRFB: The City of St. Petersburg, Florida, experimented with the RRFB at 18 pedestrian crosswalks across uncontrolled approaches and submitted its final report in 2008. In addition to "before" data, the city collected "after" data at intervals for one year at all 18 sites and for two years at the first two implemented sites. For the first two sites, the city collected data for overhead and ground-mounted pedestrian crossing signs supplemented with standard circular yellow flashing warning beacons, for comparison purposes, before the RRFBs were installed. The data showed higher motorist yielding rates at crosswalks where the RRFBs had been installed in comparison to lower rates for standard warning beacons. The higher yielding rates were sustained even after two years of operation, and no identifiable negative effects were found. The St. Petersburg data also showed that drivers exhibit yielding behavior much farther in advance of crosswalks with RRFBs than with standard circular yellow flashing warning beacons.

In addition to the St. Petersburg locations, experimentation with RRFBs was also conducted at other uncontrolled marked crosswalks in Florida and other States. Data from locations other than St. Petersburg was limited, but did show results similar to those found in St. Petersburg.

The Texas Transportation Institute (TTI) conducted a Federally funded research project[1] that developed and tested a new flash pattern for the RRFB that was shown to be at least as effective as the flash pattern that was initially tested in St. Petersburg, Florida, and that showed that mounting the RRFB unit above the sign was at least as effective as mounting the RRFB unit below the sign. In this project, the results were generally favorable, however there was a wide range of yielding rates, with some as low as 19 percent. This broad range indicates that there might be certain factors or characteristics of locations at which the RRFB might not be effective.

A separate project[2] conducted by TTI examined data from multiple projects to determine various factors that influenced driver yielding rates at RRFB locations. In this project, the researchers found that intersection configuration, presence of a median refuge, crossing distance, approach to the crossing, and one-way vs. two-way traffic significantly affected the rate of driver yielding. Additional factors including posted speed limit, mounting of the beacons (overhead or roadside), and the type of crossing and sign—Pedestrian (W11-2) or School (S1-1) sign compared with the Trail Crossing (W11-15) sign—were also significant.

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[1] Fitzpatrick, K., R. Avelar, M. Pratt, M. Brewer, J. Robertson, T. Lindheimer, and J. Miles. *Evaluation of Pedestrian Hybrid Beacons and Rapid Flashing Beacons*. Report No. FHWA-HRT-16-040, pp. 88-106. Texas Transportation Institute, College Station, Texas. July 2016. https://www.fhwa.dot.gov/publications/research/safety/16040/index.cfm

[2] Fitzpatrick, K., M. Brewer, R. Avelar, and T. Lindheimer. *Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon*. Report No. TTI-CTS-0010. Texas A&M Transportation Institute, College Station, Texas. June 2016. ~~https://www.fhwa.dot.gov/publications/research/safety/16040/index.cfm~~ https://static.tti.tamu.edu/tti.tamu.edu/documents/TTI-CTS-0010.pdf

3/21/2018

Correction issued this page 3/21/2018

FHWA Evaluation of Results: The Office of Transportation Operations reviewed the available data in 2008 and considered the RRFB to be highly successful for the applications tested (uncontrolled marked crosswalks). The RRFB offers significant potential safety and cost benefits because it achieves high rates of compliance at a low relative cost in comparison to other more restrictive devices that provide comparable results, such as full midblock signalization or pedestrian hybrid beacons.

The FHWA granted interim approval status to the RRFB on July 16, 2008, and designated that action as Interim Approval 11 (IA-11).

The FHWA was later informed that the concept of the RRFB had been patented by a private company. Because patented traffic control devices are not allowed to be included in the MUTCD, are not allowed to be given interim approval status, and are not allowed to be a part of an official experiment, the FHWA terminated Interim Approval 11 on December 21, 2017.

The FHWA has confirmed that the patents on the RRFB device that was the subject of Interim Approval 11 have been expressly abandoned and the concept of the RRFB is now in the public domain. Because of this action, the RRFB is once again eligible for interim approval status and the FHWA is issuing this new Interim Approval for the RRFB.

Interim Approval 11 (IA-11) remains terminated. Agencies that previously had been approved to use RRFBs under IA-11 are not covered by this new Interim Approval to install new RRFBs. If agencies that had approval under IA-11 wish to continue to install new RRFBs, then they must submit a new request to the FHWA and agree to comply with the terms and conditions of IA-21.

This Interim Approval does not create a new mandate compelling installation of RRFBs, but will allow agencies to install this traffic control device, pending official MUTCD rulemaking, to provide a degree of enhanced pedestrian safety at uncontrolled marked crosswalks.

Conditions of Interim Approval: The FHWA will grant Interim Approval for the optional use of the RRFB as a pedestrian-actuated conspicuity enhancement to supplement standard pedestrian crossing or school crossing signs at uncontrolled marked crosswalks to any jurisdiction that submits a written request to the Office of Transportation Operations. A State may request Interim Approval for all jurisdictions in that State. Jurisdictions using RRFBs under this Interim Approval must agree to the following:

- Comply with the Technical Conditions detailed in this memorandum;
- Maintain an inventory list of all locations at which the RRFB is installed; and
- Comply with all the conditions as listed in Paragraph 18 of Section 1A.10 of the MUTCD.

In addition, any agency that receives this approval must acknowledge agreement with the following:

- That an agency will furnish its list of locations where implemented if requested by FHWA;
- That FHWA has the right to rescind this Interim Approval at any time; and
- That issuance of this Interim Approval does not guarantee that the provisions, either in whole or part, will be adopted into the MUTCD.

1. General Conditions:

   a. Each RRFB unit shall consist of two rapidly flashed rectangular-shaped yellow indications with an LED-array-based light source, and shall be designed, located, and operated in accordance with the detailed requirements specified below.

   b. The use of RRFBs is optional. However, if an agency opts to use an RRFB under this Interim Approval, the following design and operational requirements shall apply, and shall take precedence over any conflicting provisions of the MUTCD for the approach on which RRFBs are used:

2. Allowable Uses:

   a. An RRFB shall only be installed to function as a pedestrian-actuated conspicuity enhancement.

   b. An RRFB shall only be used to supplement a post-mounted W11-2 (Pedestrian), S1-1 (School), or W11-15 (Trail) crossing warning sign with a diagonal downward arrow (W16-7P) plaque, or an overhead-mounted W11-2, S1-1, or W11-15 crossing warning sign, located at or immediately adjacent to an uncontrolled marked crosswalk.

   c. Except for crosswalks across the approach to or egress from a roundabout, an RRFB shall not be used for crosswalks across approaches controlled by YIELD signs, STOP signs, traffic control signals, or pedestrian hybrid beacons.

   d. In the event sight distance approaching the crosswalk at which RRFBs are used is less than deemed necessary by the engineer, an additional RRFB may be installed on that approach in advance of the crosswalk, as a pedestrian-actuated conspicuity enhancement to supplement a W11-2 (Pedestrian), S1-1 (School), or W11-15 (Trail) crossing warning sign with an AHEAD (W16-9P) or distance (W16-2P or W16-2aP) plaque. If an additional RRFB is installed on the approach in advance of the crosswalk, it shall be supplemental to and not a replacement for the RRFBs at the crosswalk itself.

3. Sign/Beacon Assembly Locations:

   a. For any approach on which RRFBs are used to supplement post-mounted signs,

at least two W11-2, S1-1, or W11-15 crossing warning signs (each with an RRFB unit and a W16-7P plaque) shall be installed at the crosswalk, one on the right-hand side of the roadway and one on the left-hand side of the roadway. On a divided highway, the left-hand side assembly should be installed on the median, if practical, rather than on the far left-hand side of the highway.

b. An RRFB unit shall not be installed independent of the crossing warning signs for the approach that the RRFB faces. If the RRFB unit is supplementing a post-mounted sign, the RRFB unit shall be installed on the same support as the associated W11-2, S1-1, or W11-15 crossing warning sign and plaque. If the RRFB unit is supplementing an overhead-mounted sign, the RRFB unit shall be mounted directly below the bottom of the sign.

4. Beacon Dimensions and Placement in the Sign Assembly:

a. Each RRFB shall consist of two rectangular-shaped yellow indications, each with an LED-array-based light source. The size of each RRFB indication shall be at least 5 inches wide by at least 2 inches high.

b. The two RRFB indications for each RRFB unit shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of at least 7 inches, measured from the nearest edge of one indication to the nearest edge of the other indication.

c. The outside edges of the RRFB indications, including any housings, shall not project beyond the outside edges of the W11-2, S1-1, or W11-15 sign that it supplements.

d. As a specific exception to Paragraph 5 of Section 4L.01 of the 2009 MUTCD, the RRFB unit associated with a post-mounted sign and plaque may be located between and immediately adjacent to the bottom of the crossing warning sign and the top of the supplemental downward diagonal arrow plaque (or, in the case of a supplemental advance sign, the AHEAD or distance plaque) or within 12 inches above the crossing warning sign, rather than the recommended minimum of 12 inches above or below the sign assembly. (See the example photo that is shown below.)

5. Beacon Flashing Requirements:

a. When actuated, the two yellow indications in each RRFB unit shall flash in a rapidly flashing sequence.

b. As a specific exception to the requirements for the flash rate of beacons provided in Paragraph 3 of Section 4L.01, RRFBs shall use a much faster flash rate and shall provide 75 flashing sequences per minute. Except as provided in Condition 5f below, during each 800-millisecond flashing sequence, the left and right RRFB indications shall operate using the following sequence:

The RRFB indication on the left-hand side shall be illuminated for approximately 50 milliseconds.
Both RRFB indications shall be dark for approximately 50 milliseconds.

The RRFB indication on the right-hand side shall be illuminated for approximately 50 milliseconds.
Both RRFB indications shall be dark for approximately 50 milliseconds.

The RRFB indication on the left-hand side shall be illuminated for approximately 50 milliseconds.
Both RRFB indications shall be dark for approximately 50 milliseconds.

The RRFB indication on the right-hand side shall be illuminated for approximately 50 milliseconds.
Both RRFB indications shall be dark for approximately 50 milliseconds.

Both RRFB indications shall be illuminated for approximately 50 milliseconds.
Both RRFB indications shall be dark for approximately 50 milliseconds.

3/21/2018 **Both RRFB indications** ~~**The RRFB indication on the right-hand side**~~ **shall be illuminated for approximately 50 milliseconds.**
Both RRFB indications shall be dark for approximately 250 milliseconds.

c. The flash rate of each individual RRFB indication, as applied over the full flashing sequence, shall not be between 5 and 30 flashes per second to avoid frequencies that might cause seizures.

d. The light intensity of the yellow indications during daytime conditions shall meet the minimum specifications for Class 1 yellow peak luminous intensity in the Society of Automotive Engineers (SAE) Standard J595 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005.

e. To minimize excessive glare during nighttime conditions, an automatic signal dimming device should be used to reduce the brilliance of the RRFB indications during nighttime conditions.

f. Existing RRFB units that use the flashing sequence that was specified in the Interim Approval 11 memorandum and a subsequent interpretation (the RRFB indication on the left-hand side emits two slow pulses of light after which the RRFB indication on the right-hand side emits four rapid pulses of light followed by one long pulse of light) should be reprogrammed to the flash pattern specified above in Condition 5b as part of a systematic upgrading process, such as when the units are serviced or when the existing signs are replaced.

6. Beacon Operation:

   a. The RRFB shall be normally dark, shall initiate operation only upon pedestrian actuation, and shall cease operation at a predetermined time after the pedestrian actuation or, with passive detection, after the pedestrian clears the crosswalk.

   b. All RRFB units associated with a given crosswalk (including those with an advance crossing sign, if used) shall, when actuated, simultaneously commence operation of their rapid-flashing indications and shall cease operation simultaneously.

   c. If pedestrian pushbutton detectors (rather than passive detection) are used to actuate the RRFB indications, a PUSH BUTTON TO TURN ON WARNING LIGHTS (R10-25) sign shall be installed explaining the purpose and use of the pedestrian pushbutton detector.

   d. The duration of a predetermined period of operation of the RRFBs following each actuation should be based on the procedures provided in Section 4E.06 of the 2009 MUTCD for the timing of pedestrian clearance times for pedestrian signals.

   e. The predetermined flash period shall be immediately initiated each and every time that a pedestrian is detected either through passive detection or as a result of a pedestrian pressing a pushbutton detector, including when pedestrians are detected while the RRFBs are already flashing and when pedestrians are detected immediately after the RRFBs have ceased flashing.

   f. A small pilot light may be installed integral to the RRFB or pedestrian pushbutton detector to give confirmation that the RRFB is in operation.

7. Accessible Pedestrian Features:

   a. If a speech pushbutton information message is used in conjunction with an RRFB, a locator tone shall be provided.

   b. If a speech pushbutton information message is used in conjunction with an RRFB, the audible information device shall not use vibrotactile indications or percussive indications.

   c. If a speech pushbutton information message is used in conjunction with an RRFB, the message should say, "Yellow lights are flashing." The message should be spoken twice.

Any questions concerning this Interim Approval should be directed to Mr. Duane Thomas at duane.thomas@dot.gov.

Figure 1. Example of an RRFB dark (left) and illuminated during the flash period (center and right) mounted with W11-2 sign and W16-7P plaque at an uncontrolled marked crosswalk.

Figure 2. View of pilot light to pedestrian at shared-use path crossing with median refuge. Enlargement of pilot light at right.

Figure 3. Example of pedestrian pushbutton and R10-25 sign with pilot light for pedestrian actuation.

cc:
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Chief Financial Officer
Directors of Field Services
Director of Technical Services