Oregon Temporary Traffic Control Handbook

FOR OPERATIONS OF 3 DAYS OR LESS

Prepared by the Oregon Department of Transportation
These standards were adopted by the Oregon Transportation Commission on July 20, 2005 as the standard for all temporary traffic control in place for 3 days or less on Oregon public roads per ORS 810.200.

The development of this handbook has been a cooperative effort of the Oregon Department of Transportation, the Oregon Traffic Control Devices Committee and its subcommittee including representatives from the following agencies and businesses:

- Oregon Department of Transportation Office of Employee Safety
- Oregon Department of Transportation Maintenance Districts
- Oregon Occupational Safety and Health (OR-OSHA)
- Oregon Department of Transportation Rail Division
- Marion County Public Works
- Deschutes County Public Works
- City of Salem Public Works
- City of Portland Public Works
- City of Eugene Public Works
- Central Coast Public Utility District
- Springfield Utility Board
- Evergreen Public Utility District
- Portland General Electric
- Northwest Natural Gas
- Pacific Power
- National Electrical Contractors Association (NECA)
- Comcast Communications Corp.
- Electrical Construction Company (ECC)
- Wildish Construction
- Morse Bros. Inc.
- North Santiam Paving
- K & D Traffic Safety Services
- D & H Flagging Inc.
- Northwest Traffic Control Inc.
- Northwest Trafficcontractors
- Mama Jo’s Traffic Control Services
- D & D Safety, Inc.

Oregon Department of Transportation Traffic Engineering and Operations
DATE:  August 1, 2005

TO:  Handbook Users

We are pleased to bring you this revision to the Temporary Traffic Control Handbook. The many changes and added information have been thoughtfully reviewed by representatives of those who work on and along Oregon roads and highways. We gratefully acknowledge their time, expertise and energy in bringing this handbook revision together.

Within these pages, you can find the guidance to apply the 2003 Manual on Uniform Traffic Control Devices to your work needs. This handbook and related information can be accessed via the internet in the Publications listing on the Traffic Engineering and Operations web site under the Highway Division of the Oregon Department of Transportation.

By cooperative agreement with ODOT, the Training & Economic Development Center of Chemeketa Community College in Salem provides handbooks, training classes and certification of Flagger cards through the ODOT Work Zone Traffic Control and Flagging Program. They also can supply additional handbook copies. Their phone number is (503) 399-5181.

Ed Fischer
State Traffic Engineer
## Table of Contents

### GENERAL STANDARDS AND PRINCIPLES ................................. 9
- Scope .............................................................................. 9
- Application ................................................................. 10
- Coordination of Work Zone Authority .............................. 10
- Worker Safety Apparel .................................................. 11
- Bicycle and Pedestrian Considerations .............................. 12
- Active Traffic Control ..................................................... 13
- Roundabouts .................................................................. 13
- Night Operations .......................................................... 14
- Pavement Markings ....................................................... 14
- Unattended Work Sites .................................................. 15
- Temporary Traffic Control Zone Components ................... 16

### SETTING UP THE WORK ZONE ............................................ 18
- Tapers ........................................................................... 18
- Signs ............................................................................. 22

### EQUIPMENT SPECIFICATIONS ........................................... 25
- Signs ............................................................................. 25
- Barricades, Cones, Tubular Markers & Drums ..................... 26
- Truck-mounted Attenuators (TMAs) .................................. 27
- Lights and Lighted Signs ................................................ 27
  - Arrow Panels ................................................................ 27
  - Floodlights ................................................................... 28
  - Portable Changeable Message Signs (PCMS) ................... 28
  - Warning Lights (Flashers & Steady-burn) ....................... 29

### TYPICAL APPLICATIONS .................................................... 31
- Section 000 – Detail Drawings ......................................... 34
- Section 100 – Mobile Operations ...................................... 40
- Section 200 – Shoulder Work ......................................... 52
- Section 300 – Work on 2-Lane, 2-Way Roads .................... 56
- Section 400 – Work on 3-Lane, 2-Way Roads .................... 70
- Section 500 – Work on Multi-Lane Roads .......................... 78
- Section 600 – Intersection Operations .............................. 82
- Section 700 – Work on Freeways & Expressways ............... 95

### INCIDENT & EVENT TRAFFIC CONTROL ......................... 112
- Detours ......................................................................... 112
- Event Traffic Control ..................................................... 112
- Emergency Traffic Control ............................................. 113
- Emergency Response Example ......................................... 116
Table of Contents (continued)

APPENDIX A: Glossary of Terms_________________________ 118

APPENDIX B: Active Traffic Control____________________ 122
  Flaggers/Flagging..........................................................122
  Spotter Guidelines.......................................................126
  Pilot Car Operation....................................................127
  Portable Traffic Control Signals.....................................128

APPENDIX C: ODOT Short Term Traffic Control Plan____ 130

CHECKLIST FOR WORK ZONE LAYOUT & OPERATION__ 132

LIST OF FIGURES & TABLES

The following list of Figures & Tables in this handbook is included for a quick reference:

<table>
<thead>
<tr>
<th>Figures</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1</td>
<td>General Details of a Temporary Traffic Control Zone</td>
</tr>
<tr>
<td>Figure 2</td>
<td>Cone Spacing Detail</td>
</tr>
<tr>
<td>Figure 3</td>
<td>Emergency Response Example</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tables</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Taper Length and Channelizing Device Chart</td>
</tr>
<tr>
<td>Table 2</td>
<td>Sign Spacing</td>
</tr>
<tr>
<td>Table 3</td>
<td>Minimum Arrow Panel Sign Sizes</td>
</tr>
</tbody>
</table>
LIST OF DIAGRAMS

The following is a list of the diagrams in this handbook. As an aid to finding the most appropriate diagram for your work, it is organized by the portion of roadway that will be impacted.

**Work area on the shoulder**

Diagram:
- 002: Pedestrian Layout Details
- 100: Mobile Operations on the Shoulder
- 200: Shoulder Occupation with Brief Road Work
- 210: Work on Shoulder
- 300: Minor Road Encroachment
- 710: Freeway Shoulder Work

**Work area with lane closure(s), non-intersection:**

Diagram:
- 001: Detail Sheet (Extended Traffic Queues/PCMS/Bicycles)
- 003: Rail Grade Crossing Detail
- 110: Mobile Operation on a 2-Lane, 2-Way Road
- 120: Mobile Operation on a Multi-Lane Road
- 125: Rolling Slowdown
- 130: Line Marking on 2-Lane, 2-Way Road
- 135: Line Marking on Multi-Lane Road
- 310: 2-Lane Traffic Diversion Using Shoulder
- 320: Lane Closure with Flagging on 2-Lane, 2-Way Road
- 330: Lane Closure with Traffic Control Signals
- 340: Lane Closure with Pilot Car on 2-Lane, 2-Way Road
- 350: Self-Regulating Lane Closure on 2-Lane, 2-Way Road
- 360: Work in Center of Low-Speed Road
- 400: 2+1 Travel Lanes - Work in Single Lane Direction
- 410: 2+1 Travel Lanes - Work in Two-lane Direction
- 420: Work in a Continuous Left Turn Lane
- 430: Diversion into a Continuous Left Turn Lane Section
- 500: Right Lane Closure on a Multi-Lane Road, Non-freeway
- 510: Interior Lane Closure on a Multi-Lane Road, Non-freeway
- 700: Freeway Mobile Operations
- 720: Freeway Lane Closures

**Work area near Intersections**

Diagram:
- 600: Lane Closure – Near Side of Intersection
- 605: Left Turn Refuge Closure
- 610: Lane Closure – Far Side of Intersection
- 620: Lane Closure at Intersection with Flagging
- 630: Work in Center of an Intersection
- 640: Work in a Roundabout
Work area near Freeway Ramps
Diagram:
730: Work Near an Exit Ramp
740: Work On an Exit Ramp
750: Exit Ramp Closure
760: Work Near an Entrance Ramp – Right Side of Entry
770: Work Near an Entrance Ramp – Left Side of Entry
GENERAL STANDARDS AND PRINCIPLES

Scope

This handbook provides a quick reference for the traffic control principles and standards for temporary traffic control zones in place for 3 days or less on public roads in Oregon. It is based on the principles set forth in Part 6 of the Manual on Uniform Traffic Control Devices [MUTCD] and is an Oregon Supplement to the 2003 MUTCD. For work that will take longer than 3 days at a site, a site specific traffic control plan based on the principles in Part 6 of the MUTCD is required.

The 2003 MUTCD and the Oregon Supplements are adopted by rule as the statewide traffic control standards under ORS 810.200 Uniform Standards for Traffic Control Devices. All traffic control standards adopted under this statute must conform to Oregon law.

The primary function of temporary traffic control is to provide for the reasonably safe and efficient movement of road users through or around temporary traffic control zones while protecting workers, responders to traffic incidents, and equipment.

A temporary traffic control zone is an area of a public road where road user conditions are changed because of work activities or an incident through the use of traffic control devices, uniformed law enforcement officers, or other authorized personnel.

A work zone is an area of a public road with construction, maintenance, utility or other work activities. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device.

An incident area is an area of a public road where temporary traffic controls are imposed by authorized officials in response to a traffic or other incident, natural disaster, or special event. It extends from the first warning device (such as a sign, light, or cone) to the last temporary traffic control device or to a point where road users return to the original lane alignment and are clear of the incident.

Planned and Emergency Activities

Planned activity includes any work that is a routine maintenance, repair or new installation of road or roadside hardware, whether road-related or not. The traffic impacts from planned work can be anticipated and the proper equipment stocked as the crew heads out to work. This is true even if the work function is to survey and perform general clean-up and repairs as needed along a stretch of road.
Emergency activities are unique unanticipated events that can only be generally prepared for and require an immediate response to control traffic for responder safety and/or road user safety. Emergency activities include any unforeseen event which impacts the roadway, including immediate situations arising from road or utility work.

In emergency situations, the responder may use any available devices or equipment, whether in compliance with this handbook or not, to control and guide traffic through the incident response area. As soon as practical, devices and equipment that comply with this handbook should be placed to control traffic.

**Application**

This handbook contains the standards and guidance for use in temporary traffic control zones of 3 days or less in duration on all public roads in Oregon for all work, event and emergency response activities along or within the roadway. A local road authority may supplement or restrict temporary traffic control standards for these applications, and the road authority should be consulted before beginning work within their jurisdiction.

There are safety concerns for the workers in setting up and taking down a traffic control zone. As the work time gets shorter, the time during which road users are affected is significantly increased by the installation and removal of additional devices. Considering these factors, it is generally held that simplified control procedures are warranted for shorter term activities. This principle is the core concept for this document. Any reduction in the number of devices may be offset by the use of other more dominant devices such as high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles. Devices having greater mobility such as signs mounted on trucks or that are larger, more imposing, or more visible can be used effectively and economically.

**Coordination of Work Zone Authority**

When working on a public road, there are multiple authorities for various functions and activities within your temporary traffic control zone. This handbook sets out the standards and guidance for adaptation of the MUTCD standards to your traffic control. In addition, OR-OSHA has the authority to set and enforce worker safety standards depending on your work activity.

The local road authority may also supplement or restrict the guidelines and standards in this handbook on their roads. Periodically check with the road maintenance office or public works department for an update on any special agency requirements.

Separate crews may have concurrent work in close proximity requiring some coordination of their temporary traffic control zones. Each agency is responsible for the determination of their own traffic control needs based upon the nature of their work and the standards and principles of the
MUTCD and this handbook. Consider the following guidelines in determining the optimum resolution of any conflicts or confusion of temporary traffic control zones.

**Guidance:**

A. Cooperation, courtesy and coordination are the most effective tools for finding satisfactory solutions.

B. Communication is the key to safe and effective resolution. Inform and consult with the scheduling and assignment authority within your own agency of the conflict, including coordination between different departments of the same agency. This can include the road authority if one or any of the work crews are working under a permit or contract.

C. Emergency work generally takes precedence over routine maintenance. If there is any hazard such as an open excavation to road users or workers as a result of activity already in place when the agency responding to an emergency repair arrives, the crew with the original work zone should coordinate the traffic control with the emergency work temporary traffic control such that all hazards are adequately protected.

D. For maintenance activities, consider moving to work in a nearby area or revising the order of work to include a non-conflicting activity until the earlier crew has completed their work and moved on.

E. Consider rescheduling work if there will be other conflicting activity for the remainder of that day.

**Worker Safety Apparel**

All workers exposed to the risks of moving roadway traffic or construction equipment should wear high-visibility safety apparel meeting the requirements of the ANSI/ISEA High Visibility Safety Apparel guidelines, or equivalent revisions, and labeled as ANSI 107-1999 or later for standard performance for class 1, 2 or 3 risk exposure.

A competent person designated by the employer to be responsible for the worker safety plan within the activity area of the job site should make the selection of the appropriate class of garment. As used in this paragraph, a competent person means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

The compliance period for meeting the ANSI/ISEA High Visibility Safety Apparel guidelines extends to 3 years from the effective date of the federal Final Rule for the 2003 MUTCD. The compliance period ends Dec. 22, 2006.
Bicycle and Pedestrian Considerations

The needs and control of all road users (motorists, bicyclists, and pedestrians within the public road, including persons with disabilities) through a temporary traffic control zone shall be an essential part of public road construction, utility work, maintenance operations, and the management of traffic incidents. The accommodation of persons with disabilities shall be in accordance with the American With Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130 and its revisions.

Pedestrian and bicycle traffic can be expected on all facilities except freeways where prohibited. All temporary traffic control areas must accommodate the safe passage of non-motorized traffic, depending on the type of facilities permanently available. Appropriate signing and traffic control should adequately accommodate safe pedestrian use at all times, including pedestrians with disabilities.

- Be sure pedestrians are not led into conflict with work site vehicles, equipment and operations.
- Be sure pedestrians and cyclists are not put in conflict with motorized traffic around the work site.
- Be sure any alternate pedestrian detour routes are useable and likely to be used.
- Provide advance signing appropriate to the duration of work activity for bicyclists and pedestrians with some means for warning sight impaired pedestrians.
- Provide minimum clear lane widths of 4 feet for bicycles and/or 3 feet for pedestrians when work impacts existing bicycle lane or sidewalk and the bike lane or sidewalk can’t be closed.
- Provide accessibility accommodations at the same level as the existing facility and in compliance with the current Americans with Disabilities Act standards and guidelines.
- Be sure no work equipment or traffic control device protrudes into the pedestrian or bicyclists area below adult eye level.
- If the area normally used by cyclists is closed by the work zone add BICYCLES ON ROADWAY signs to the advance warning when appropriate for the work duration. Whenever possible, keep cyclists off of pedestrian facilities they wouldn’t normally use.

Active Traffic Control: Flagging, Pilot Car & Portable Signals

Flaggers, temporary signals and pilot cars provide active traffic control through the work area. When one direction of the road is closed and road users must alternately share the open portion for both travel directions,
flagging, portable signal or pilot car operation must be used for the safety of workers and road users, including cyclists and pedestrians.

Flaggers may be used when needed for more variable traffic control past a closed area. Portable signals may be used when a regulated two-way traffic movement is adequate for the work. Pilot cars are used to direct traffic around and past long work areas. A pilot car operation uses flaggers at each end of the one lane, two-way section.

FLAGGING OPERATIONS AND FLAGGER REQUIREMENTS: Appendix B has the requirements for flagger training, safety clothing and operations.

NOTE: ONLY UNIFORMED POLICE OFFICERS MAY CONTROL TRAFFIC BY FLAGGING IN CONFLICT WITH NORMAL INTERSECTION TRAFFIC SIGNAL CONTROL UNDER OREGON LAW. See ORS 811.265 Failure to obey traffic control device. This means that flaggers can't direct traffic to proceed through the intersection when facing a red traffic signal light or STOP sign, nor stop traffic when their traffic signal light is green. Conflicting displays or signs must be turned off.

PILOT CAR OPERATIONS: Appendix B has the requirements for pilot car operations. Use a pilot car to guide traffic safely past work or emergency area with a long one lane section under two-way traffic. Consider a pilot car any time the work area is out of sight of the beginning of the lane closure unless interim flaggers can be stationed to keep traffic in the desired travel path.

TEMPORARY TRAFFIC CONTROL SIGNALS: Appendix B has the requirements for temporary traffic control signal operations. Temporary traffic control signals may be used to control traffic through a one lane, two-way section on a two-lane, two-way road. The maximum length of lane closure for one-way operation under temporary traffic signal control is determined by the capacity required to handle the peak demand.

Roundabouts

Roundabouts are becoming a more common intersection treatment in Oregon. They pose special problems when work or incident management must be done in the vicinity of a roundabout. It is a recommended practice to plan work during the hours of low traffic volumes within the available work shifts.

A roundabout is not designed to hold stopped traffic. Consider the entire roundabout as the center of an intersection and keep it clear of standing traffic. Any stationary work which blocks the circular section of roadway will require detour signing or flagging at all entrances.
Night Operations

During darkness, the available visual cues are reduced and there is a higher likelihood of poor driver response due to fatigue and other impairment. Setting up good traffic control for the whole work zone and duration of exposure becomes even more critical.

Basic Principles

Working at night when there is less traffic on the road can be the only practical time period in some areas. However, the low light levels available mean that road users are missing cues they have in daylight and so road conditions and hazards are harder to decipher. Any time drivers must use their headlights for visibility should be considered the same as night conditions. Use the following basic principles for adjusting your traffic control for night conditions:

- Use enough lighting to provide a safe work environment without creating too much glare in the path of road users.
- Signs, cones and worker safety attire used at night should be kept in like new condition. Retroreflective devices are required.
- If pedestrian facilities are present, check that the path provided for them is lit well enough for people to see any obstructions or surface hazards in their way.
- If traffic control devices marking a boundary for pedestrians are in place, they should be clearly visible.
- In residential areas, try to avoid floodlights or glare aimed into homes or yards.

Pavement Markings

For purposes of this handbook, where visible permanent markings are inconsistent with the intended travel paths, use highly visible temporary devices such as signs and cones or tubular markers to clearly show the appropriate path. All devices and markings that must be visible at night shall be retroreflective. The intended vehicle path should be defined in day, night, and twilight periods and under both wet and dry pavement conditions. Removable, nonreflective preformed tape may be used where markings need to be covered temporarily.

If re-surfacing or other work covers or removes the pavement markings for a distance longer than 2 skip markings or 80 feet measured along the centerline, they must be replaced before the road is re-opened to traffic. If pavement markings are covered or removed for any distance in critical areas such as problem horizontal curves, vertical curves, or weaving areas, they must be replaced before the road is re-opened to traffic. Temporary pavement markings may be used until the earliest date it is practical and possible to install permanent pavement markings.

Temporary pavement markings should not be allowed to remain in place for more than two weeks unless justified by an engineering study. They
shall meet the requirements in the MUTCD and match the markings at both ends of the work zone.

When in place for 3 days or less, for a two or three-lane road, no passing zones may be identified by using DO NOT PASS and PASS WITH CARE signs rather than pavement markings. These signs may also be used instead of pavement markings on low volume roads for longer periods in accordance with the road authority’s policy.

Follow the road authority’s policy for layout of temporary pavement markings. For use on state highways, see the ODOT Construction Specifications Temporary Traffic Control Sections 220 and 225.

If raised pavement markers are used to substitute for pavement markings in work zones, their application shall meet the requirements of the MUTCD for the line type they are replacing.

### Unattended Work Sites

All warning signs and channelization devices must be in place before opening the road to traffic if a work site will be left unattended before the work is completed and the road returned to permanent condition. Equipment left at the work site should be off the shoulder of the road if possible. If equipment must be left on the shoulder or in a closed lane, the equipment must be delineated and protected with cones and barricades the same as a PCMS.

Changes in road surface such as rough pavement, excavations or raised plates in the road must have the appropriate advance warning signs in place. Advance warning signs also must be in place for any such obstructions. The obstruction must be delineated and protected by cones, drums or barricades.

When work is suspended, temporary traffic control devices that are no longer appropriate shall be removed or covered.

All unattended work sites with traffic control left in place should be routinely inspected day and night by a knowledgeable person for adequate compliance, visibility and condition of the traffic control devices. Devices left in place must be appropriate for all expected or anticipated conditions such as daylight, darkness and twilight, and wet or dry conditions.
Temporary Traffic Control Zone Components

The temporary traffic control zone as shown in Figure 1 has four parts and includes the entire section of roadway from the first advance warning signs through the last traffic control device to where traffic may return to its normal path and conditions.

Figure 1
A) **Advance Warning Area:** The advance warning area may vary from a series of signs starting a mile or more in advance of the work area to a single sign or flashing lights on a vehicle. An advance warning area is necessary for all traffic control zones because road users need to know what to expect and have enough time to alter their travel patterns accordingly.

a) **Consideration for non-motorized users** is necessary when setting up the work zone and the advance signing. If pedestrian or bicycle traffic can be expected, signing and traffic control should adequately provide for their safe use. Allowances for pedestrians with disabilities appropriate to the level of normal pedestrian facilities must be provided. Blocking of bicycle and pedestrian traffic is discouraged.

b) The **advance warning** area should give road users enough time to respond to any changes in the transition area. The length of the advance warning area should be one-half to one mile for freeways and 1,500 feet for most other open public road conditions. The distance can be restricted to one block for urban streets with low speeds.

c) **Extended traffic queues** require additional advance warning. Whenever the traffic queue extends beyond sight distance of the initial advance warning signs, signing should be added. If queue lengths frequently change significantly, consideration should be given to use of a portable changeable message sign up to \( \frac{1}{2} \) mile in advance of the work zone signing, especially on high speed roads.

B) **Transition Area:** In a transition area, traffic is channelized from normal public road lanes to the path required to move traffic around the work area. The transition area contains the tapers which are used to close the lane(s).

C) **Activity Area:**
   a) **Buffer Space:** The buffer space is a short section of clear roadway between the cone taper and the work area which can provide an extra margin of safety for both traffic and workers. The buffer space should be kept clear of vehicles, equipment, materials and personnel to provide a clear recovery area. The buffer space is optional but should be provided when space is available.

   b) **Work Space:** The work space is that portion of the road which contains the work activity. Work space is closed to traffic and set aside exclusively for workers and equipment.

D) **Termination Area:** The termination area provides a short distance for traffic to clear the work area and return to normal operation. Like the buffer space, the downstream cone taper is optional. An END CONSTRUCTION or END ROAD WORK sign is optional.
SETTING UP THE WORK ZONE

This section provides guidelines and procedures for setting up work zone, event or emergency response traffic control. Each element is discussed with a table for determining the needed dimensions.

Tapers

Taper lengths shown in the table and by formula are minimum taper lengths. Longer tapers may be necessary for drivability, for instance around curves or on a steeply cross-sloped lane. Longer tapers are not necessarily better than minimum tapers. The real test for adequate length is observing driver performance once the traffic control is put into place.

There are 5 types of tapers:

- **Merging Taper**: moves two traffic lanes in the same direction into one lane
- **Shifting Taper**: moves traffic from one path to another with the same number of lanes
- **Shoulder Taper**: closes the shoulder to traffic use
- **Two-way Traffic Taper**: closes all lanes leaving only one lane open for alternating directions of traffic
- **Downstream Taper**: guides the motorist back into previously closed lanes.

Length of taper by type of Taper:

<table>
<thead>
<tr>
<th>Type of Taper</th>
<th>Minimum Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merging taper</td>
<td>L</td>
</tr>
<tr>
<td>Shifting taper</td>
<td>½ L</td>
</tr>
<tr>
<td>Shoulder taper</td>
<td>1/3 L</td>
</tr>
<tr>
<td>One-Lane, Two-way Traffic taper</td>
<td>50 foot min. - 100 foot max.</td>
</tr>
<tr>
<td>Downstream taper</td>
<td>100 feet</td>
</tr>
</tbody>
</table>

Work Zone Taper Length Formulas

Table 1 shows taper lengths by posted speed.

- Posted or statutory speed = 40 MPH or less: \( L = \frac{W S^2}{60} \)
- Posted or statutory speed = 45 MPH or more: \( L = W \times S \)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Taper length in feet</td>
</tr>
<tr>
<td>W</td>
<td>Width of total lane width offset in feet</td>
</tr>
<tr>
<td>S</td>
<td>Posted speed</td>
</tr>
</tbody>
</table>
**TABLE 1: Taper Lengths**

Taper Length and Channelizing Device Chart

<table>
<thead>
<tr>
<th>Lane Widths</th>
<th>10 Feet</th>
<th>11 Feet</th>
<th>12 Feet</th>
<th>Shoulder ( \frac{1}{3} )</th>
<th>Tapers</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPH</td>
<td>Merge</td>
<td>Cone</td>
<td>Shift</td>
<td>Merge</td>
<td>Cone</td>
</tr>
<tr>
<td>20</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>25</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>30</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>35</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>40</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>45</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>50</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>55</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>60</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>65</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>70</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

All taper lengths are rounded up to the nearest 5 feet.
Shoulder taper is figured on a ten (10) foot shoulder width.

Cone spacing is 20 feet for speeds of 40 and below
Cone spacing is 40 feet for speeds of 45 and above

---

**Cone Spacing**

- **Taper Spacing**: The longitudinal distance between cones in the taper should equal 20 feet for posted speeds of 40 MPH or less and 40 feet for posted speeds of 45 MPH or more. On rural freeways and expressways, the taper cone spacing may be equal to the posted speed in feet.

- **Offset**: The offset will vary with the lane width and length of the taper. The required number of cones to make the taper length should be evenly offset over the lane width. Table 1 includes the number of cones for each taper.

- **One-Lane/Two-way & Downstream**: Cones in one-lane/two-way and downstream tapers should be spaced at 20 foot intervals. A one-lane/two-way taper is a minimum of 50 feet and a maximum of 100 feet. A downstream taper is 100 feet per closed lane. If applied, a minimum of 6 cones shall be used for a downstream taper.

- **Buffer & Work Area Cones**: Cone spacing alongside the buffer and work area in feet equals twice the taper spacing. Spacing is 80 feet for 45 MPH and above; 40 feet for 40 MPH and below. On rural freeways and expressways, the tangent cone spacing may be equal to the twice the posted speed in feet.
Cone Placement

1) **Determine the taper length and cone spacing** using the Taper Length Table and cone spacing guidelines.

2) **Place the first cone** starting at the activity area, pace off the taper length along the road edge or fog line. Place the first cone at the outside lane or fog line for merging and shifting tapers, at the road edge for shoulder work.

3) **Place the second cone in the taper** by starting back towards the work area, walking along the road edge or fog line a distance equal to the selected cone spacing. Then move over the required offset and place the second cone.

4) **Place the third cone** by moving towards the work area a distance equal to the selected cone spacing, move over twice the required offset and place the third cone.

5) **Place the remaining cones in the taper** by continuing to move back towards the work area a distance equal to the selected cone spacing, and over into the lane until reaching the distance equaling the required offset past the last cone.
Cone Spacing

Cone spacing is twice the spacing in taper

Cone #11: 10 feet from fog line

10 foot offset

Spacing equals:
- 20 ft @ 40 mph or less
- 40 ft @ 45 mph or greater

Cone #1, on fog line

Taper Length

Cones spaced evenly throughout taper

Figure 2
Signs

Choosing Signs: The most effective work zone signing tells the road user what action or direction to take. Avoid general warning signs without any specific action or condition. For instance, follow a SHOULDER WORK AHEAD by SHOULDER CLOSED sign rather than by a CAUTION sign. The initial warning signs <I> should give an indication of the type of work the driver can expect. Typical signs include, but are not limited to:

- ROAD WORK AHEAD
- SHOULDER WORK
- BRIDGE WORK AHEAD
- LITTER CREW
- UTILITY WORK
- INCIDENT AHEAD
- WORKERS ON ROADWAY
- SURVEY CREW
- WRECK AHEAD

A distance may be substituted for AHEAD on any warning sign, or may be added as a rider.

Use accurate signs to indicate the work being performed. Only the most commonly used signs are listed; the list does not exclude other signs.

Work zone signs shall:
- be clean, fully legible and in good condition.
- be mounted so that the bottom of the sign is not less than one foot above the roadway.
- allow pedestrians and/or cyclists an unobstructed travel path.

The following signing enhancements may be used:
- Larger signs than the minimum standard may be used any time. Larger signs can be more effective when the visual landscape is crowded or traffic volumes are high.
- High-intensity sheeting may be used for the advance work signs. Consider upgraded sheeting for visibility in dim conditions such as rain, fog or tree shadow.
- Add a flashing warning light to advance signing, if the sign/light/support combination has passed crash testing.

To keep the road users’ respect and maintain credibility, unnecessary work zone signs must be covered, turned or removed. If “FLAGGER” SIGNS ARE IN PLACE, A FLAGGER MUST BE ACTIVE, even if just as a warning.

Placement: Sign spacing and placement as shown in this handbook are the standards for open, unobstructed roadway conditions. Placement
should adequately control traffic and protect the work area. The layout may be modified as necessary to provide visibility, allow safe passage of pedestrians and cyclists and avoid interference with physical features such as curves, hills, intersections, driveways or other traffic control devices. Consider the following when determining sign layout:

- Place the initial work advance sign such as ROAD WORK AHEAD before entering a horizontal curve or before the crest of a hill if needed to provide adequate sight distance. Adequate sight distance means you can see the sign on your approach for at least 660 feet at 55 MPH and 1,000 feet at speeds greater than 55 MPH on approach. Space the remaining signs leading up to the work close enough together to maintain road user awareness and still maintain the minimum sign spacing for the posted speed. Signs may be spaced as far apart as twice (2X) the minimum sign spacing.

- If a sign spacing needs to be adjusted, keep all the sign spacing distances similar to maintain driver expectancy.

- If a driveway comes in between the last work zone sign and the work, but the work zone is not apparent from the driveway approach, use a sign or cones at the driveway to alert users.

- If vegetation overhangs and obscures a sign, move the sign out of the way.

- Alter the sign spacing distances slightly when necessary to provide a level area for sign placement. If no level placement is available, make sure the sign is stable and the message is fully visible to approaching drivers.

**Signs at Night:** When working at night, signs need to be highly conspicuous and legible from as far away as possible. Consider the following guidelines for signs used at night.

1. Use standard message signs as much as possible.
2. Use signs larger than the standard size for greater visibility.
3. Use only retroreflective regulatory and warning signs in good condition.
4. Add extra guidance to offset conflicts with permanent signs and markings which can’t be removed or screened.
5. Steady-burn or flashing warning lights can be added to a sign for more visibility if the combination has been successfully crash tested. Signs and lights can be placed on Type II barricades for this purpose.
6. Do not place flashing warning lights in a closely spaced series as this can make other traffic control or work zone elements hard to see.
**Standard Sign Spacing:** Sign spacing and placement set forth in this handbook is a guide intended for open and unobstructed roadway conditions. Placement should be modified if necessary to:

- control traffic,
- allow safe passage of pedestrians and cyclists,
- protect the work area,
- provide good visibility of the sign and
- to avoid interference with physical features such as intersections, driveways or other traffic control devices.

Placement may be modified based on good judgment and traffic patterns. If one sign spacing in a sequence needs to be lengthened, all the sign spacing distances should be proportionately changed.

Distance C is the distance from the initial warning sign to the next sign in the sequence.

Distance B is the distance between signs in the middle of a sign sequence.

Distance A is the distance from the last warning sign to the taper or work area if there is no taper. If only one sign is used, the placement will be based on distance A.

**Table 2: Sign Spacing**

<table>
<thead>
<tr>
<th>Posted Speed*</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Suggested Buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 MPH or less</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>50 - 100</td>
</tr>
<tr>
<td>35 MPH - 40 MPH</td>
<td>350</td>
<td>350</td>
<td>350</td>
<td>250</td>
</tr>
<tr>
<td>45 MPH - 55 MPH</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>350</td>
</tr>
<tr>
<td>60 MPH and higher ^</td>
<td>1000</td>
<td>1500</td>
<td>1500 - 2600</td>
<td>550</td>
</tr>
</tbody>
</table>

* All distances in feet
^ Posted speed or statutory speed if not posted
  Includes all freeways and expressways, regardless of posted speed
EQUIPMENT SPECIFICATIONS

All traffic control devices used on state highways shall be listed on the ODOT Qualified Products List.

**Signs**

Unless otherwise noted, all warning signs used for temporary traffic control shall have standard black legends and borders on an orange, fluorescent red-orange or fluorescent yellow-orange background except that signs for emergency response may be black legends and borders on fluorescent pink. Temporary regulatory and guide signs have the same shapes and colors as the permanent signs.

All warning and regulatory signs used for temporary traffic control shall be retroreflective. Non-retroreflective signs in good or better condition may be used during daylight hours until July 2008 to allow for replacement based on useful life.

Only flexible signs may be used on portable sign supports. Rigid signs may be used on barricades or when mounted on a vehicle. Existing rigid signs used only in unexpected emergency situations may be used through their life cycle. They must be replaced with the current standard. The exception does not apply to signs used for regularly occurring flooding, slides, or similar situations that can be expected in a particular location.

Standard size of the diamond-shape advance warning signs is 36" x 36" except on freeways and expressways.

Standard size of the diamond-shape advance warning signs on freeways and expressways is 48" by 48".

Except on state highways, 30" x 30" warning signs may be used on low volume roads or less with the permission of the road authority.

Signs on portable supports shall have two fluorescent orange or orange-red flags at least 16 inches square mounted at the top of the sign. Flags shall be mounted so that the entire sign legend is visible.

All signs must have been crash tested as a combination with the sign support and/or any warning light attached and met the federal crash worthiness requirements. This can be researched on the Federal Highways Administration web site, or through the ODOT Qualified Products List.

**Sign Supports:** Sign supports shall be crashworthy. Signs may be mounted on portable sign supports or barricades. For frequently moving work, signs may be placed on a vehicle. Place ballast on portable sign supports or barricades only on the bottom feet or frame. Sign supports or barricades shall not be ballasted by non-deformable objects such as rocks or concrete blocks.
Barricades, Cones, Tubular Markers & Drums

**BARRICADES:** Barricades are classed as Type I, Type II, or Type III. They have from one to three rails with alternating orange and white strips sloping downward at an angle of 45 degrees in the direction road users are to pass. The minimum length for Type I and Type II barricades shall be 24 inches and the minimum length for Type III barricades shall be 48 inches. The sides of barricades facing traffic shall have retroreflective rail faces.

Barricades should be crashworthy per NCHRP 350 requirements. Ballast may be placed on the lower parts of the frame or stays. Do not place ballast on top of any striped rail. Do not use non-deformable objects such as rocks or chunks of concrete as ballast.

Signs and flashers may be installed on barricades. The combination of sign and/or flasher and barricade should have been tested and meet NCHRP 350 requirements.

**CONES:** Standard cone height is 28 inches. Cones used only during daylight and on low speed roads may have a minimum height of 18 inches. Cones shorter than 28 inches may not be used on roads with speeds of 45 MPH or greater or at night. All cones must have a weighted base and be capable of remaining upright and in place during normal traffic flow and wind conditions common to the area.

Cones used at night shall be retroreflectorized. Twenty-eight (28) inch cones shall have a minimum 6-inch wide retroreflectorized band 3 to 4-inches below the top and a 4-inch wide band a minimum of 2 inches below the 6-inch band. Cones may be equipped with lighting devices for maximum visibility. The combination of cone and light should meet NCHRP 350 requirements.

**DRUMS (BARRELS):** Drums used for traffic control shall be constructed of lightweight, flexible, and deformable materials; be a minimum of 36 inches in height; and have at least an 18-inch minimum width, regardless of orientation. The markings on drums shall be horizontal, full circumference, alternating orange and white retroreflective stripes 4 to 6 inches wide. Each drum shall have a minimum of two orange and two white stripes. Any non-retroreflective spaces between horizontal orange and white stripes shall not exceed 2 inches wide. Drums shall have closed tops that will not allow collection of roadwork or other debris.

Drums should not be used to mark pedestrian paths unless they are continuous between individual devices and detectable to users of long canes. Metal drums shall not be used.

**TUBULAR MARKERS:** Tubular markers are cylindrical in shape with a weighted base. The tube shall be a minimum of 2 inches wide facing traffic. Standard tubular marker height is 28 inches. Tubular markers used only during daylight and on low speed roads may have a minimum height of 18 inches. Tubular markers shorter than 28 inches may not be used on roads with speeds of 45 MPH or greater or at night.
Tubular markers used at night shall be retroreflectorized. Twenty-eight (28) inch tubular markers shall have two 3-inch wide bands no more than 2 inches below the top with no more than 6 inches between bands.

Non-cylindrical tubular markers may be used only if they will be secured in a way which ensures that the width facing traffic meets the minimum requirements.

**Truck-mounted Attenuators (TMAs)**

Truck-mounted attenuators (TMAs) are crash cushion systems that lower the severity of a rear-end hit by an oncoming vehicle. When used, they are located to protect the work vehicle(s) and workers ahead of the vehicle with the TMA.

TMAs are designed for use on different classes of vehicles and for specific travel speed ranges. The manufacturer's rating must be considered in choosing equipment for any particular job site. TMAs used on freeways and expressways should be rated for high speeds and used on the appropriate class of vehicle. Use of a TMA/vehicle combination rated for less than the posted speed where you will be working should only be considered when more appropriate equipment is not available.

When traveling to or from the work site, the TMA shall be in an upright position. When used, the attenuator should be in the full down and locked position.

For stationary operations, the TMA-equipped vehicle's parking brake should be set, and when possible, the front wheels turned to direct the vehicle away from the work site if hit and into a safe area.

For moving operations, the shadow vehicle with a TMA shall be positioned far enough in advance of the workers or work equipment being protected so that there will be sufficient distance for run-out from impact but not so far that errant vehicles can travel around the protecting vehicle, re-enter the work vehicle array and strike the protected workers or equipment. If only one TMA is used in a mobile work train, the shadow vehicle with the TMA should be the first vehicle exposed to traffic in the travel lane. In this case, a hazard assessment conducted by the supervisor will determine which vehicle should be equipped with the TMA.

**Lights and Lighted Signs**

**ARROW PANELS:** Sign panels conforming to the requirements of the MUTCD with a matrix of lights capable of either flashing or sequential display of directional mode arrows or chevrons or non-directional (caution) mode. Caution mode consists of a four-corner display or mid-position full horizontal bar, and can be steady or flashing on and off. Caution mode when flashing shall not show any sequential movement.

- Arrow panels in the directional mode are required for use on freeway lane closures, and are suggested for use on multi-lane roadways to help warn of lane closures requiring merging of travel lanes.
• For shoulder closure, arrow panels are only used in the caution mode. The use of arrow panels in caution mode is recommended for shoulder closure on freeways.
• On two-way, two-lane roadways, arrow panels shall be used in the caution mode only except for centerline operations.

For lane closures, the arrow panel should be located on the shoulder at the beginning of the cone taper. Where the shoulder is too narrow, they may be placed in the lane being closed. For closure of more than one lane, an arrow panel should be used per each additional closed lane.

<table>
<thead>
<tr>
<th>Panel Type</th>
<th>Minimum Size (Inches)</th>
<th>Minimum Legible Distance</th>
<th>Min. # Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Urban</td>
<td>48 x 24</td>
<td>½ mile</td>
<td>12</td>
</tr>
<tr>
<td>B Standard</td>
<td>60 x 30</td>
<td>¾ mile</td>
<td>13</td>
</tr>
<tr>
<td>C Freeway</td>
<td>96 x 48</td>
<td>1 mile</td>
<td>15</td>
</tr>
<tr>
<td>D Truck-Mounted Only</td>
<td>48 x 24</td>
<td>½ mile</td>
<td>12</td>
</tr>
</tbody>
</table>

Type B arrow panels are appropriate for intermediate speed facilities and for maintenance or mobile operations on high speed roadways or freeways.

Type D arrow panels are arrow shape.

Arrow panels used for night operations shall be capable of 50% dimming from their full rated lamp voltage.

FLOODLIGHTS: Floodlights should be used to illuminate the work area, flagger stations, equipment crossings and other areas such as nearby intersections during nighttime operations. Flagger stations must be illuminated separately from the work area. You must ensure that each setup doesn’t aim excessive light into the eyes of oncoming drivers or produce excessive glare making it difficult to see beyond the main illuminated area. The best way to determine if floodlighting is well placed is to drive through the set up after dark from each approach direction.

Research indicates that 50 lux (5 foot candles) is a desirable nighttime illumination level where workers are active. If everything in the light appears in full color, the lighting level is satisfactory. Sidewalks or pedestrian detours should be included in the lighted perimeter.

PORTABLE CHANGEABLE MESSAGE SIGNS/PCMS: Also described as portable variable message signs. PCMS include a message sign panel, control system, power source and mounting and transporting equipment. They shall conform to all requirements in the MUTCD and shall be listed on the Qualified Products List for use on state highways. PCMS are used mainly as a supplement to and not as a substitute for conventional signs, pavement markings and lighting. Standard messages and abbreviations should be used whenever possible. See the ODOT Guidelines for
Operation of Variable Message Signs on State Highways for information on standard messages.

Per MUTCD 2A.07, variable message signs may be used in lieu of a required warning or regulatory sign for frequently changing situations. PCMS may not be used for STOP or YIELD signs. For moving work zones, a series of truck-mounted PCMS displaying the advance warning messages and moving with the work is recommended for all roads and required on freeways.

The display of a PCMS should be visible from ½ mile away under both day and night conditions. Choose a location such that the entire message can be read at least twice by approaching drivers.

A message may contain up to three lines per panel, although less is best. Display may be one or two panels when posted speeds are 55 MPH and above. The display rate shall be set so that the entire message can be read at least twice when approached at the posted speed. It is appropriate to consider the operating speed if it is much higher than the posted speed when setting the display rate.

If three panels are required for the entire message, a second PCMS unit should be set up at the appropriate sign spacing so that drivers have the opportunity to see the entire message twice.

PCMS shall be mounted a minimum of 7 feet above the roadway when in operating mode. PCMS should be placed on the shoulder of the roadway or, if practical, further from the travel lane. The installation should not block pedestrian facilities. The face of the sign should be located and angled to be legible to approaching traffic for the needed distance.

Trailer-mounted PCMS shall be delineated by a shoulder taper of 6 cones or barrels minimum at 20 foot maximum spacing. Barrels should be used if space allows for greater visibility. For work lasting more than 8 hours, one or more Type III barricade(s) should be placed at an angle facing traffic, in front of the equipment and behind the cones or barrels, and 40 feet in front of the sign. The total face length of the barricades should be adequate to fully cover the width of the trailer.

**WARNING LIGHTS (FLASHERS & STEADY-BURN):** Warning lights may be added to signs or channelizing devices such as cones, drums or barricades as an effective means to attract road users’ attention in difficult areas or at night.

When warning lights are used, they shall be mounted on signs or channelizing devices in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield. The combination of sign, sign stand and light or drum/barricade, mounting device and light must have been crash-tested and approved as crashworthy under NCHRP 350 guidelines. Proof should be required from the vendors and/or manufacturers of successful crash-testing as approved by FHWA.

Type A, Type B, Type C and Type D 360-degree warning lights are all portable, powered, yellow, lens-directed, enclosed lights. Type A is the
Low-Intensity Flashing warning light. Type B is the High-Intensity Flashing warning light. Type C is the flat lens Steady-Burn warning light, and Type D is the 360-degree Steady-Burn warning light. All types shall be in accordance with the current ITE “Purchase Specification for Flashing and Steady-Burn Warning Lights”.

Type A, Type C and Type D shall be maintained so they can be visible on a clear night from a distance of 3,000 feet. Type B shall be maintained so they can be visible on a sunny day from a distance of 1,000 feet.

Type A: use to warn road users during night time hours of a potentially hazardous area. Mount on channelizing devices or barricade.

Type B: use the same as Type A except may be used during daylight hours. These are designed to operate 24 hours per day, on a sign or independent support.

Type C/Type D: use at night to delineate the edge of the traveled way. When used along a curve section, only use these devices on the outside of the curve.

Flashing warning lights shall not be used for delineation, as a series of flashes fails to identify the desired vehicle path. The maximum spacing for warning lights should be the same as the channelizing device spacing requirements. All types shall have a minimum mounting height of 30 inches from the ground to the bottom of the lens.
TYPICAL APPLICATIONS

Traffic Control for Mobile Operations

Mobile operations include work activities such as sweeping and line marking where workers and equipment move continuously along the road at speeds of greater than 3 MPH. The advance warning area moves with the work area. Mobile work does not include stopping in the travel lane to perform the work.

Mobile operations will usually provide for safe traffic control by signs on the work vehicles. This requires at least one shadow vehicle except on low speed roads. On freeways and expressways, at least 2 shadow vehicles are required.

The work zone can be bordered by advance signing to alert road users to the presence of the slow moving work train ahead, covering a distance that includes the location of the work area for a significant period of time. Care must be taken that the road user is still alert to the hazard by the time they reach the active work area. This can be achieved with a NEXT X MILES rider on the advance warning sign and occasional cones along the shoulder of the road with interim signing.

The Mobile Operations Typical Applications show the minimum work zone traffic control for mobile operations.

Traffic Control for Stationary Work

Stationary work includes work that will be in place for up to three days, including short duration work that will be in one place for an hour or less.

Stationary work can take just a few minutes in one place while changing signal lenses or filling a pot hole, or can be for a paving operation taking an entire day. The activity can be off the traveled portion of the road or occupy one or more travel lanes and directions. Work may proceed without any disruption of normal traffic flow, or may require traffic to stop and alternate direction of flow through the work area. Accordingly, the Typical Application diagrams for all stationary operations are arranged by the location of the work on the road, the extent of traffic control needed and the time required by the work activity or emergency response.

Typical Application diagrams don’t cover every possible situation. Please refer to the principles described in this handbook as well as the Manual on Uniform Traffic Control Devices when applying the diagrams to your situation.

Lane Closures, Diversions and Detours: Lane use changes should be well marked and the alternate path made clear to the traveling public. Extended traffic queues may result from the loss of road capacity, increasing the chance of collisions. Know the likely traffic volumes and
conditions as well as you can and be prepared to install additional signing when needed.

Onsite conditions may vary requiring modification to the minimum distances shown in the Typical Applications and Standards if the work is on a curving or hilly section of road. Look for a balance between giving warning in time, keeping the work signs free from other roadside clutter and having too much distance between the advance warning and the work so that road users are otherwise distracted or have forgotten the warning.

**Pedestrians and Cyclist Requirements:** Provisions for pedestrians and cyclists are particularly important during work that occupies a location for longer than 1 hour. Base the level of accommodation on the type of facility normally available on the section of road you are occupying. If there is sidewalk, then a pedestrian pathway or detour must be provided for work in place longer than one work shift. If the shoulder evidently has pedestrian traffic even though it is unpaved, provide alternate pedestrian accommodations that do not put pedestrians in traffic.

Follow the same principles in providing for pedestrians with disabilities. If the area you are working in generally has pedestrian facilities that can accommodate pedestrians with disabilities, expect to provide any temporary pathway or detour with the same standards.

**Survey and Similar Work:** There are safety concerns for the crew in setting up and taking down a traffic control zone. Since survey work uses only light, portable equipment and typically involves a single vehicle, portability and quick deployment are important to the traffic control. Similar work includes such activities as utility marking and manhole inspection.

Modification of the typical diagrams should include consideration of the speed, geometry and traffic volumes on the road. Reduced warnings and visibility of the work may be offset by the use of more dominant devices such as special lighting units on the work vehicle. The work vehicle can be positioned as a protection or shadow vehicle depending on the situation. Use of a spotter for unprotected work in the roadway is recommended when the attention to the work activity interferes with the worker’s ability to monitor and respond to traffic. Advance warning signs should be used to alert road users to the possibility of work activity in the roadway.

**Intersection Work:** Traffic on all approaches needs to be given advance warning. Use the diagrams as guidelines and prepare a specific plan showing the lanes and turning movements at the work location.
TYPICAL APPLICATION DIAGRAMS

The diagrams are organized into sections by the type of roadway and area of work. The first page in each section is tabbed.

SECTION 000: Detail Drawings. This section contains detail drawings which can apply in any situation. The details shown are added to the traffic control setup shown in the typical application for the work. These include bicycle signing, extended traffic queues, PCMS setup, pedestrian signing and work near rail grade crossings.

SECTION 100: Mobile Operations. This section applies to continuously moving operations not on freeways or expressways.

SECTION 200: Shoulder Operations. This section contains the typical applications for work or equipment on the shoulder, not on freeways or expressways.

SECTION 300: Work on 2-Lane, 2-Way Roads. This section applies to 2-lane, 2-way roads with or without a closed median, and in any area.

SECTION 400: Work on 3-Lane, 2-Way Roads. This section applies to any section with a continuous two-way left turn lane, or with an added passing lane. The minimum number of lanes would be three.

SECTION 500: Work on Multi-Lane Roads. This section applies to road sections with two or more lanes in each direction, with or without a closed median, and in any area.

SECTION 600: Intersection Operations. This section applies to work in or near any intersection in any area.

SECTION 700: Work on Freeways & Expressways. This section applies to work on controlled access roads including the entrance and exit ramps.
Diagram No. 001 shows the details for the typical setup of traffic control for extended traffic queues, bicycle traffic and the standard setup for a PCMS.

**Extended Traffic Queues:** Note that the ROAD WORK AHEAD (or equivalent) sign is moved when setting the additional extended queue signs. This sign is always the first sign the road user sees and is seen only once per approach to the work zone.

**PCMS Installation:** The trailer-mounted PCMS requires a shoulder taper with 6 cones, with a barricade placed as shown 40 feet in front of the trailer.

**Bicycle Signing:** The BICYCLES ON ROADWAY sign is added to the typical signs in any work zones when cyclists must share the roadway due to the work zone. The detail drawing shows an example of the use of this sign. The BICYCLES ON ROADWAY signs are required only if a marked bicycle facility will be closed to bicycle traffic.
Detail Sheet

Portable Changeable Message Sign (PCMS) Installation

Bicycle Signing

Extended Traffic Queues

Diagram No. 001
Pedestrian Layout Details

This diagram covers closure or diversion of the sidewalk on an urban street. Use in combination with any other diagram when pedestrian traffic must be moved from normal sidewalk use. Signs and channelization may not be needed for work in place for an hour or less.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles that need to be at the work area. Otherwise park vehicles away from the sidewalk and work area.
2. If the work will impact the sidewalk, pedestrian area or bicycle lane, pedestrian and cyclist needs must be accommodated in a manner appropriate to the activity.
3. Use advance warning signs for vehicle traffic, cyclists and pedestrians.
4. Do not divert pedestrians into the travel lanes.
5. The sidewalk should be closed at the nearest crosswalk on each side of the work area when a safe path around the work area of the width of the sidewalk or 4 feet, whichever is less, is not available. Where there are business destinations between the nearest crosswalk and the work area close the sidewalk at the nearest business access.
6. Maintain a 10 foot travel lane if pedestrians are diverted onto the road.
7. Consider advance warning signs when there is poor sight distance to the work area.
8. For work in place longer than one hour, the work area should be protected from pedestrian intrusion and provided with a Type I or II barricade and SIDEWALK CLOSED or DETOUR signing.
9. Stay alert for pedestrians and accommodate safe passage for them as needed.

Near an intersection:
10. Provide advance warning for pedestrians. Close crosswalks/sidewalks as necessary when safe passage can’t be maintained.
11. Don’t block intersection signing with work vehicles or signing. This includes signs such as NO RIGHT TURN or RIGHT TURN ONLY, stop/yield advance signs, or any regulatory sign or advance warning for a regulatory condition. Maintain visibility of destination, street and directional signs as much as possible.
12. Maintain access to a transit stop or clearly close the transit stop with cones, Type I or Type II barricade as appropriate.
### Rail Grade Crossing Detail

This diagram covers work in the travel lanes near an at-grade public road-rail crossing. This drawing should be consulted whenever work traffic control may cause traffic queues to form up to and/or across the rails.

1. Minimize the possibility that vehicles may be stopped within the rail crossing, defined as being 15 feet either side of the closest and farthest rail. Position the work or shadow vehicle to keep traffic from stopping near the rails if work will be in place for just a few minutes.

2. If any permanent DO NOT STOP ON TRACKS sign is obscured or if none are posted, a regulatory DO NOT STOP ON TRACKS sign shall be placed on the approach to the tracks. Place the sign on the right and near the stop bar if there is one, or at least 8 feet from the tracks if there is no stop bar. On multi-lane roads, a left side sign may be needed especially if there are three or more lanes in a direction.

3. If the queuing of vehicles across rail tracks can’t be avoided, a law enforcement officer or flagger shall be provided at the crossing to prevent vehicles from stopping within the rail crossing, even if automatic warning devices are in place.

4. The BE PREPARED TO STOP sign may be eliminated on low speed roads. The ONE LANE ROAD sign may be used instead of BE PREPARED TO STOP.

5. Maintain pedestrian access across the tracks or close the pathway. Use cones or Type II barricade and a SIDEWALK CLOSED sign if your work needs to impact the pedestrian crossing. Place the closure where pedestrians are directed to an alternate safe passage.

6. Flashing warning lights and/or flags may be used to call attention to the advance warning signs.

7. Lighting should be provided as needed to adequately illuminate flagger stations during night work.

8. When work will be done within the railroad right-of-way, the railroad should be notified. The ODOT Rail Divisions Railroad Contact list can be found at [http://www.oregon.gov/ODOT/RAIL/docs/freightrr.pdf](http://www.oregon.gov/ODOT/RAIL/docs/freightrr.pdf) to locate the contact information for the railroad.
Rail Grade Crossing Detail

Diagram No. 003

For A, B & C see Table 2
(Sign Spacing)
Section 100 – Mobile Operations

Mobile Operation on Shoulder

Diagram No. 100 covers a typical continuous moving operation on the shoulder not on a freeway or expressway. A continuous moving operation moves along the road at an average speed of 3 MPH or more.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights. Arrow panels in the caution mode or PCMS may be used.

2. For work on roads with a posted or statutory speed of 25 MPH or less, a single vehicle may be used without signs if the vehicle displays the high visibility lights.

3. If the work equipment has to be partially in the travel lane, maintain a lane width of 10 feet or occupy the adjacent travel lane and use the appropriate mobile lane closure diagram. On low volume roads, a minimum lane width of 9 feet may be allowed.

4. Stationary warning signs may be used covering up to 5 miles with a distance on the sign, or an advance PCMS giving the distance may be used.

5. Signs shall be mounted on the vehicle(s) facing the rear so that the entire sign face is visible at all times. A PCMS may be used. Use SHOULDER WORK (AHEAD), SHOULDER CLOSED (AHEAD) or other work-appropriate signs. Minimum sign size is 36”.

6. When used, a shadow vehicle may replace the advance warning signs. The shadow vehicle should maintain a minimum trailing distance equal to the advance warning sign distance (500 feet at 55 MPH). A shadow vehicle should be used when:
   a. Sight distance is periodically less than 750 feet, or
   b. Airborne dust, fog or other low visibility conditions reduces sight distance to less than 500 feet.
   c. The posted speed or statutory speed if not posted is 45 MPH or higher.

7. When the work vehicle is traveling alone, a TMA should be considered.

8. A fluorescent yellow border may be added to the truck-mounted signs to enhance their visibility.

9. For night work, work lights should be provided on the work vehicle, shadow vehicle or both, depending on the nature of the work operation. Both vehicles should be equipped with warning lights with 360° visibility.
Diagram No. 100

Mobile Operation on Shoulder

- Work Vehicle
- Shadow Vehicle (Optional)
- Truck-mounted Attenuator (Optional)
- Should Work
- Maximum Distance 5 Miles
- Road Work Ahead (Optional)

PCMS
Diagram No. 110 covers a typical continuous slow-moving operation in the travel lane of a two-lane, two-way road. It does not include a layout for every possible work situation, but shows the minimum requirements for this type of operation.

1. Use truck-mounted high-intensity rotating, flashing, oscillating or strobe lights.

2. For work on roads with a posted or statutory speed of 25 MPH or less, a single vehicle may be used without signs if the vehicle displays the high visibility lights.

3. Arrow panels in the caution mode or PCMS may be used. Minimum arrow display is Type B, 60" x 30".

4. A trailer or truck-mounted PCMS may be placed at the beginning of the section of road to warn traffic of the obstruction ahead. If left in place at the beginning of the work section, the sign should state the type of work on panel 1 and NEXT X MILES on panel 2. The distance should be limited to 5 miles or less. The sign should be moved during the day to stay within the stated distance of the work.

5. A shadow vehicle or vehicles may be used. The trailing shadow vehicle should maintain a position along the shoulder as much as possible.

6. A shadow vehicle should be used when:
   a. Sight distance is less than 750 feet, or
   b. Dust created by the operation, fog or other low visibility conditions reduce the sight distance to less than 500 feet.
   c. The posted or statutory speed is 45 MPH or higher.

7. Signs shall be mounted on the shadow and work vehicle facing the rear so that the entire sign face is visible at all times. Use ROAD WORK, SWEEPER or other work-appropriate rear mounted sign with a minimum size of 36". When there will be limited opportunity for passing, the sign may be a black-on-white, rectangular YIELD TO ONCOMING TRAFFIC or DO NOT PASS sign. A sign is optional on the work vehicle if a shadow vehicle is used.

8. A shadow vehicle operator shall adjust the trailing distance to maintain adequate sight distance for approaching vehicles. The minimum trailing distance should be the advance warning sign distance (500 feet at 55 MPH). The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.

9. Shadow vehicles may be equipped with an attenuator. If a TMA(s) is used, the first TMA should be on the first shadow vehicle that will be exposed to traffic in the travel lane.

10. Where practical and when needed, the work and shadow vehicles should pull over periodically to allow motor vehicle traffic to pass.

11. For night work, work lights should be provided on the work vehicle and may be on the other vehicles as well if needed. All vehicles should be equipped with warning lights with 360° visibility.
Mobile Operation on 2-Lane, 2-Way Road

Diagram No. 110
Diagram No. 120 covers mobile operations occupying one lane of a multi-lane one-way road not an expressway or freeway. Work should normally be done in off-peak hours on high speed or high volume roads.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights. Arrow boards or portable changeable message signs (PCMS) are desirable.

2. Shadow vehicles may be eliminated if the posted or statutory speed is 30 MPH or below. More than one shadow vehicle is optional.

3. Shadow vehicle #1:
   a. should be equipped with an arrow display or PCMS. An appropriate lane closure sign should be placed on the vehicle so as not to obscure the arrow display. A truck-mounted attenuator (TMA) is optional.
   b. should travel at a varying distance from the work operation so as to provide adequate sight distance for traffic approaching from the rear. The minimum trailing distance should be the advance warning sign distance (500 feet at 55 MPH).
   c. should not protrude into traffic any further than the vehicle being protected.

4. Shadow vehicle #2, if used, should be equipped with an arrow display. An appropriate lane closure sign should be placed on vehicle #2 so it does not obscure the arrow display. On high speed or high volume roads, consider adding a TMA.

5. Additional shadow vehicles may be used. The trailing vehicle should be on the shoulder so there is one shadow vehicle on the shoulder, one straddling the edge line and the other vehicles in the closed lane. An enforcement vehicle may be used for the trailing shadow vehicle.

6. When the work vehicle occupies an interior lane (not the far right or far left) of a one-directional roadway with a shoulder with of 10 feet or more, a third shadow vehicle should drive the right shoulder with a sign indicating that work is taking place in the interior lane. Alternately, a PCMS may be used to give warning of the lane closure.

7. Minimum standard arrow display is Type B, 60” x 30”.

8. A portable changeable message board (PCMS) may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. If left in place at the beginning of the work section, the sign should state the type of work on panel 1 and NEXT X MILES on panel 2. The distance should be limited to 5 miles or less. The sign should be moved during the day to stay within the stated distance of the work.

9. For night work, work lights should be provided on the work vehicle as needed to illuminate the work operations, and may be provided on other vehicles as needed. All vehicles should be equipped with warning lights with 360° visibility.
Diagram No. 120

Mobile Operation on Multi-Lane Road

- Work Vehicle
- Shadow Vehicle 1
  - Truck-mounted Attenuator (Optional)
- Shadow Vehicle 2
  - Truck-mounted Attenuator (Optional)
- LANE CLOSED (Optional)
- LEFT LANE CLOSED
- PCMS (Optional)
A rolling slowdown provides short road closures for such activities as cleaning debris from the roadway, pushing disabled vehicles to the shoulder or pulling power lines across the roadway. Although rolling slowdowns are typically done on freeways, they may be used on other limited access roads as well. The diagram shows the standard configuration for performing a rolling slowdown.

1. The slowdown should be scheduled during off-peak traffic periods except in emergencies. Inform all local enforcement offices of the slowdown.
2. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on all traffic control vehicles.
3. The slowdown should be planned to maintain at least 15 MPH. If the work is progressing more slowly than planned, the traffic queue can be slowed further as needed. The queue should not stop completely at any time.
4. Advance warning is required at least ½ mile before the start of the slowdown. Changeable messages signs, either portable or permanent, are required at least as the first sign.
   a. A typical message sequence would be SLOW TRAFFIC AHEAD / ALL LANES (or ROLLING SLOWDOWN)
   b. The slowdown may be announced in advance on changeable message signs. Consider announcement when there is local traffic.
   c. Start the sign displays as soon as the traffic control vehicles are ready to enter the road and continue until the traffic speeds are close to normal travel speeds.
5. Advance signing shall be at every approach to each entry ramp except when not practical for emergency operations.
6. All ramps and entrances to the roadway between the moving blockade and the work area must be temporarily closed using traffic control equipment and personnel.
7. Enough blockade control vehicles to block all traffic lanes are required. One blockade control vehicle per lane should be used. Each vehicle shall have an arrow panel in caution mode and DO NOT PASS black-on-white regulatory sign. A truck-mounted PCMS (DO NOT PASS / ROLLING SLOWDOWN) may take the place of the arrow panel and sign.
8. A chaser vehicle follows the last free-moving vehicle through the work area to give the signal it is safe to begin work.
   a. The chaser vehicle notifies flaggers when to stop traffic.
   b. The blocking traffic control vehicles notify flaggers when to release traffic.
9. Traffic is held at every entrance until after the rolling slowdown passes.
   a. The chaser vehicle notifies flaggers when to stop traffic.
   b. The blocking traffic control vehicles notify flaggers when to release traffic.
10. Assign a competent person at the job site to keep in contact with the slowdown vehicles. This person makes sure the road is open and clear before the slowdown arrives at the work site and advises of speed adjustments needed to allow the work to be completed and keep traffic moving.
11. Good communication is essential among all traffic control vehicles, flaggers, chaser vehicle and the competent person at the job site.
Diagram No. 130 covers striping operations on a 2-way, 2-lane road. The left-hand drawing illustrates a typical layout when using paint equipment, which marks up to 2 lines from the side of the equipment. The right-hand drawing illustrates a typical layout when the paint equipment straddles and marks a single line at a time. These drawings cover any equipment configuration which accomplishes the applicable marking operation.

1. Turn off arrow panel displays when traveling to and from work areas.
2. Use appropriate signs for the activity being done. All signs should be black legend and border on orange background.
3. Arrow panel displays should be in caution mode. A truck-mounted PCMS may be used. Arrow mode displays should not be used unless you are directing traffic out of their travel lane. On a PCMS, the message WET PAINT/KEEP RIGHT (LEFT) or WET PAINT/PASS TO RIGHT (LEFT) is appropriate.
4. The number of vehicles and vehicle spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately to take traffic without smearing. However, the spacing should not encourage traffic to travel in the space between work vehicles. This may be the deciding factor in how many vehicles to use.
5. A vehicle with truck-mounted PCMS may shadow the work array on the right shoulder as advance warning. This vehicle may be the service truck for the paint machine.
6. A truck or trailer-mounted PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The sign should state the type of work on panel 1 and NEXT X MILES on panel 2. The distance should be limited to 5 miles or less. The sign should be moved during the day to stay within the stated distance of the work.
7. For night work, work lights should be provided on the striper to illuminate the work operations, and may be provided on other vehicles. All vehicles should be equipped with warning lights with 360° visibility.
Line Marking on 2-Lane, 2-Way Road
Diagram No. 130

Line Marking
OR PCMS

10' min. line widths

Paint Machine with flashing caution

Shadow Vehicle 1 with flashing caution

WET YELLOW PAINT
OR PCMS

Shadow Vehicle 2 with flashing caution

Advance Vehicle with flashing caution

Paint Machine with flashing caution

Shadow Vehicle 1 with flashing caution

WET YELLOW PAINT
OR PCMS

Shadow Vehicle 2 with flashing caution

See Note 5

PCMS
Diagram No. 135 covers line marking operations on a one-direction, multi-lane road not a freeway or expressway.

1. Maintain at least a 10 foot lane in the adjacent travel lanes.

2. When striping the center lane of a three lane or more highway, advance warning must be placed on the right shoulder. The trailing shadow vehicle in the array may travel the right shoulder. A truck-mounted PCMS is preferable for signing in this situation since it can be seen from all lanes with a specific message. If a PCMS is not available, an overhead mounted ROAD WORK sign should be used. Do not use an arrow display on the shoulder advance vehicle in this situation.

3. The vehicle array and spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately without smearing. However, the spacing should not encourage traffic to travel in the space between work vehicles. This may be the deciding factor in how many vehicles to use.

4. Use of TMAs is optional. On roads with a posted speed of 45 MPH or more, use of at least one TMA is recommended. If used, the TMA should be the first vehicle exposed to traffic in the travel lane. In this case, a hazard assessment conducted by the supervisor will determine which vehicle should be equipped with the TMA.

5. A vehicle with truck-mounted PCMS may shadow the work array on the right shoulder at a distance of up to ½ mile as advance warning. This vehicle may be the service truck for the paint machine.

6. A portable changeable message board (PCMS) may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. If left in place at the beginning of the work section, the sign should state the type of work on panel 1 and NEXT X MILES on panel 2. The distance should be limited to 5 miles or less. The sign should be moved during the day to stay within the stated distance of the work.

7. Work lights should be provided on the striper as needed to illuminate the work operation at night, and may be provided on other vehicles. All vehicles should be equipped with warning lights with 360° visibility.
Diagram No. 135
Section 200 – Shoulder Work

**Shoulder Occupation with Brief Road Work**  
Diagram 200

This diagram covers activity in the roadway of 15 minutes or less. Typical work includes debris removal, tagging of survey markers, or marking utility lines. Work in the roadway coincides with gaps in the traffic, so that traffic does not normally need to be stopped.

1. Do not use this diagram if the work in one place will take more than 15 minutes.

2. Do not use this diagram if traffic must be controlled to gain safe access to the work area due to conditions such as high travel speeds or traffic volumes. Use the appropriate lane closure or mobile work zone layout.

3. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights.

4. The work vehicles should be parked as far off the travel lanes as possible.

5. If 10 feet of clearance between the work vehicle and the centerline can't be maintained, a lane closure is needed. Refer to the appropriate lane closure diagram. On low volume roads, a truck-mounted PASS WITH CARE sign may be used instead of a lane closure when 10 feet of clearance can't be maintained.

6. The advance work sign shall be used if the sight distance is less than 750 feet or if the vehicle encroaches into the travel lane. The sign may be omitted on low volume roads.

7. A spotter\(^a\) may be used to warn workers of approaching traffic. This is especially appropriate when sight distances are limited or speeds are high.

8. High visibility apparel meeting ANSI Class 2 or Class 3 High Visibility standards is recommended to offset the lack of signing.

9. If the work will impact the sidewalk, pedestrian area or bicycle lane, pedestrian and cyclist needs must be accommodated in a manner appropriate to the activity.

10. For night operations, a truck-mounted spotlight or floodlight or the vehicle headlights may be used to adequately illuminate the work area. The lights should be positioned so that the lighting doesn’t result in glare that interferes with the driving or work tasks.

\(^a\) For spotter guidelines, see Appendix B: Active Traffic Control
Shoulder Occupation with Brief Road Work

Diagram No. 200

Vehicle mounted arrow panel (Optional)

ROAD WORK

(Vehicle mounted)

1 mile maximum

* 3 or more cones may be placed behind vehicle for added visibility

Initial Warning Sign

ROAD WORK AHEAD
## Work on Shoulder

Diagram No. 210 covers stationary work with work operations and/or parked equipment on the shoulder. This diagram does not cover work on a freeway shoulder.

1. Vehicles should be parked as far off the roadway as practical.

2. If equipment operation and activities are more than 15 feet from the fog line or completely off the improved or usable shoulder regardless of distance, signs and cones are not required.

3. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights.

4. For work that will take less than an hour, all signs and devices may be eliminated if truck-mounted high-intensity, rotating, flashing, oscillating, or strobe lights are used.

5. For work in place for more than one hour, it is recommended that a minimum of 2 signs be used regardless of posted speed.

6. If the work is close to the travel way, cones placed parallel to the traffic may be used to delineate the work area.

7. If the work will impact the sidewalk, pedestrian area or bicycle lane, pedestrian and cyclist needs must be accommodated in a manner appropriate to the activity.

8. Arrow panels flashing in caution mode are recommended for work on roads with posted speeds of 45 MPH or greater and high traffic volumes.

9. If the shoulder is completely closed and cyclist activity can be expected, BICYCLES ON ROADWAY signs should be installed after the initial warning signs. Signs shall be posted if there is a marked bicycle lane which will be closed by work in place for an hour or more.

10. For night operations, it is essential that workers on foot are visible to approaching traffic and work vehicles and equipment involved in the operation. Work lighting should be placed and aimed so that they do not result in glare that interferes with the driving or work tasks.
Minor Road Encroachment

This diagram covers work which will extend into a travel lane not on a freeway or expressway. When the work area including cones will leave at least a 10 foot lane, this diagram may be used. Use the appropriate lane closure diagram when traffic can’t safely pass by in both lanes simultaneously.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights.
2. If a 10-foot minimum travel lane can’t be maintained, use the appropriate lane closure diagram.
3. If the posted speed is 45 MPH or higher, opposing traffic lanes must be separated by a line of cones or tubular markers. Consider channelization for opposing traffic whenever traffic volumes are high or the travel path is curved.
4. Place cones along the length of the work area.
5. For work in place an hour or less, the taper and tangent devices may be omitted if a protection vehicle with activated high-intensity rotating, flashing, oscillating, or strobe lights is used.
6. Use BICYCLES ON ROADWAY warning signs after the initial warning signs when cyclists can be expected.
7. An arrow panel in caution mode or truck-mounted PCMS with SHOULDER WORK or other appropriate message is recommended for higher visibility.
8. For night operations, it is essential that workers on foot are visible to approaching traffic and work vehicles and equipment involved in the operation. Work lighting should be placed and aimed so that it does not result in glare that interferes with the driving or work tasks.

Note: A lane closure may be needed for other conditions as well, such as high traffic volumes, not enough approach sight distance at one or both ends of the work area, or the impact of heavy vehicles near an excavation with workers.
Minor Road Encroachment

Diagram No. 300

For A & B See Table 2
(Sign Spacing)
Diagram No. 310 covers shifting traffic lanes on a two-lane, two-way roadway around the work site with one lane partially or fully on the shoulder.

1. Shoulder must be adequate in width and surfacing to carry the traffic.
2. Two advance warning signs are required.
3. Cones are required as shown. Cones along the far edge of travel lane may be added to clearly mark the travel path.
4. Use BICYCLE ON ROADWAY warning signs after the initial warning signs when bicycles can be expected.
5. A protection vehicle may be placed inside the closed area. When used, the protection vehicle should be positioned so there is an adequate buffer space between the vehicle and the work area.
6. For night operations, it is essential that workers on foot are visible to approaching traffic and work vehicles and equipment involved in the operation. Work lighting should be placed and aimed so that it does not result in glare that interferes with the driving or work tasks.
2-Lane Traffic Diversion Using Shoulder

Diagram No. 310
Diagram No. 320 covers closure of one lane of a 2-lane, 2-way roadway using flaggers. The right-hand drawing illustrates the use of two flaggers, one for each approach. The left-hand drawing illustrates the use of a single flagger to control both lanes of traffic on low speed roads with good sight distances as discussed below.

1. Except for short interruptions such as for work vehicles to enter or leave the work area, continuous one-way traffic is maintained.

2. Only the advance warning sign and the FLAGGER AHEAD sign are required for any of the following conditions:
   a. Work that will close a portion of road for 15 minutes or less; or
   b. Roads with a posted or statutory speed of 40 MPH or below

3. Placing 1 to 3 cones on the shoulder at an angle in front of the flagger station will help to draw attention to the flagger (not shown).

4. Flaggers at each approach are required if any of the following conditions exist:
   a. Night Operations
   b. Work area over 200 feet in length.
   c. Sight distance is less than 750 feet from each approach through the lane closure.

5. Flaggers should be stationed within sight of the active work area except at curves or crests on the road. Station flaggers for best visibility for the situation.

6. Communications must be maintained between flaggers. Where sight distance is limited, a pilot car should be considered.

7. The distance from the FLAGGER AHEAD sign to the flagger station should not exceed 1000 feet in length.

8. The length of the work zone between the flagger signs shall not exceed 1 mile in length.

9. When the FLAGGER AHEAD sign is more than 1000 feet from the advance warning signs, additional advance sign(s) is needed. Maintain consistent sign spacing.

10. On streets with a posted or statutory speed of 25 MPH or less, the Self-Regulating Single Lane Closure diagram may be used.

11. Cones placed alongside the travel lane are required if traffic can’t see which lane to travel in. Cones are recommended when posted or statutory speeds are over 45 MPH, when working under heavy traffic and when travel lanes are narrower than 11 feet.

12. You can add signs and/or adjust timing when queues reach the FLAGGER AHEAD sign. Extended queue signing should be added when approaching traffic can’t see the advance warning sign in time to stop.

13. When flagging close to, but not at, an intersection be sure traffic entering from the side road(s) sees a FLAGGER AHEAD sign. Place additional signs on side roads if necessary to be sure all approaching traffic sees the full sign sequence.

14. For night operations, adequately illuminate the flagger station to make the flagger visible to approach traffic, and positioned far enough from the work area to be clearly visible.
Lane Closure with Traffic Control Signals

This diagram covers a lane closure on a two-lane, two-way road using portable traffic control signals. The length of the closed lane should be less than 1,000 feet.

**Single Head Signal Unit Option:**
In each direction, place one signal unit on each shoulder directly across from each other on a line perpendicular to the line of sight on the approach.

**Dual Head Signal Unit Option:**
Place one dual-head unit each direction with the overhead signal head between the center of the approach lane and centerline, and the pole mounted signal head on the shoulder.

**Both Options:**
1. Cone tapers are required as indicated below.
2. Cones may be placed along the work area to ensure traffic stays in the intended lane.
3. Maintain line of sight at all times between stop bars.
4. The second advance signal symbol sign is optional and may be omitted in short urban blocks.
5. The signal timing should be set by the traffic engineering staff of the road jurisdiction. The red light time shall allow sufficient time for all vehicles to clear the work area completely before opposing traffic is released. Consider cyclist or pedestrian traffic when relevant.
6. Place enough sets of warning signs to provide adequate warning for traffic approaching the end of the traffic queue. It may be necessary to use a second set of signs or adjust the placement during the day. There must be a Signal Ahead warning sign at distance A from the stop bar.
7. A temporary stop bar is required for work that will be in place for more than one hour.
8. The closest edge of the signal head on the pole must be at least 2 feet back from the edge of travel lane.
9. The bottom of each signal head on the pole should be 12 feet with a minimum of 8 feet of clearance from the sidewalk or road surface if there is no sidewalk. Adjust the bottom of the overhead signal head to the standard of 17 feet from the road surface if possible, 15 feet clearance minimum. Adjust the height for approaches on a grade to maintain optimum visibility of the signal indication.
10. Direct each head for maximum visibility of the lens to vehicles approaching at 550 feet in rural areas to a minimum of 200 feet on low speed urban streets.
11. Portable traffic control signals may be either single head units (one signal face mounted on the pole) or dual head signal units (one signal face mounted on the pole and one mounted on a mast arm over the travel lane).
Lane Closure with Pilot Car Option

Diagram No. 340 covers closure of one lane of a 2-lane, 2-way road for longer than 1000 feet, for surfacing or other operations. This diagram includes pilot car operation.

1. A pilot car should be used for night operations.
2. Cones along the work area are optional with pilot car operations.
3. Radio, cell phone or other reliable communications must be maintained between flaggers and the pilot car if used.
4. All side accesses shall be controlled. Low traffic volume accesses may be posted with FOLLOW PILOT CAR signs in lieu of flaggers if side street traffic can see the work zone. If residents can be contacted, arrangements can be made for residential driveways so that flaggers are not needed.
5. If two-way traffic will be allowed without a marked centerline, use DO NOT PASS and PASS WITH CARE signs at the start and end of no-pass zones.
6. Pedestrian and cyclist needs must be accommodated in a manner appropriate to the activity and existing facilities. If there is a marked bicycle facility that is closed by the work zone, the BICYCLES ON ROADWAY sign should be used in advance of the taper.
7. For night operations, adequately illuminate the flagger station to make the flagger visible to approach traffic, and positioned far enough from the work area to be clearly visible.
8. Oiling and chip sealing operations:
   a. When traffic is allowed on loose gravel, the following black-on-orange, diamond-shape signs or their equivalent should be used: CONSTRUCTION SPEED 35 (suggested - use appropriate speed for conditions) LOOSE GRAVEL
   b. Signs should remain in place until the majority of the loose rock is removed.
   c. The sign sequence should be repeated every ½ to 1 mile throughout for both directions of traffic.
Self-Regulating Lane Closure  

Diagram No. 350 covers closure of one lane of a low speed two-lane, two-way road.

1. Use this diagram only if all of the following are true:
   a. Work area is less than 200 feet.
   b. The speed, posted or statutory, is 40 MPH or less.
   c. Average Daily Traffic (ADT) is less than 400.
   d. Sight distance (in feet) is more than 750 at each end.

2. Cones are required for work in place for more than one hour.

3. A LANE CLOSED sign may be placed inside the cone taper for more emphasis. The sign may be mounted on a Type II barricade providing the combination is listed as passing NCHRP 350 crash testing.

4. Use truck-mounted high-intensity, rotating, flashing, oscillating, or strobe lights on work vehicles.

5. For work in place less than one hour, a truck-mounted or single portable PASS WITH CARE sign may be used.

6. The YIELD TO ONCOMING TRAFFIC sign is a regulatory, black-on-white sign of the appropriate size for the road.

7. Use BICYCLES ON ROADWAY warning signs after the initial warning signs when cyclists can be expected.

8. The Type B flashing warning lights may be placed on the ROAD WORK AHEAD and the ONE LANE ROAD AHEAD signs whenever a night lane closure is necessary. The sign, support and light unit must have been crash tested and found crashworthy. Type I or II barricades may be used as sign supports.

9. YIELD sign option: a Yield Ahead symbol advance warning sign and a YIELD sign may be used with the ROAD WORK AHEAD sign. For use on portable supports, a retroreflective YIELD sign on a diamond-shape white or black non-reflective background may be used instead of the inverted triangle YIELD sign. The advance warning sign shall have the red-on-white YIELD logo on a retroreflective orange, red-orange or fluorescent red orange background with black border.
Self-Regulating Lane Closure

Diagram No. 350

For A, B, C & D see Table 2 (Sign Spacing)
This diagram covers work in the center of a two-way, two-lane street when there is sufficient lane width and shoulder to allow a 10 foot travel lane on each side of the work area. Use this diagram only on streets with a posted speed of 40 MPH or less.

1. When work vehicle(s) are in the work area, use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights. Allow a sufficient buffer between the vehicle and work activity for safe run out if the vehicle is struck.

2. Cones are required. A strobe or flashing warning light mounted on Type II barricade may be used just inside the end of the closed section. The Pass to Right sign may be mounted on the barricade if the total combination has been successfully crash tested.

3. When a minimum 10-foot travel lane can't be maintained, use the appropriate lane closure diagram.

4. Use BICYCLES ON ROADWAY warning signs after the initial warning signs when vehicles may encroach on the right paved shoulder and cyclists can be expected.
Work In Center of Low-Speed Road

Diagram No. 360
Section 400 – Work on 3-Lane, 2-Way Roads

2 + 1 Travel Lanes – Work in Single Lane Direction

This diagram shows work in the single lane direction of a 3-lane, 2-way road with two travel lanes in one direction and a single travel lane in the opposing direction. Use the diagram as shown for a continuous section with 2 travel lanes in one direction.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles that need to be at the work area.
2. An advance PCMS is recommended, especially for closure of a passing lane.

If this is an added passing lane section:
3. Close the entire passing lane if there will be less than 1000 feet of passing lane remaining beyond the lane closure.
4. The passing lane should be closed at the beginning, keeping traffic in one lane each direction until past the work area. Closing a lane part way through the added lane section puts the merge conflicts near your work area.
5. In addition to the signing shown, cover or place a CLOSED rider across the face of the permanent advance passing lane signs. These can include PASSING LANE 1 MILE, a Lane Transition sign and KEEP RIGHT EXCEPT TO PASS.
6. Replace the Left Lane Ends symbol sign shown on the diagram with a black-on-white DO NOT PASS or KEEP RIGHT (+ arrow) sign. Alternately, the advance lane closure sign may be black-on-orange PASSING LANE CLOSED AHEAD.

On the single lane approach:
7. Extending the cones across the shoulder in a shoulder taper (L/3) is recommended.
8. Consider using Chevron or Large Arrow signs within the leading taper, especially if the alignment makes visibility of the change in lane use difficult. These signs may be mounted on portable supports, or on Type II barricade if the sign/barricade combination is crashworthy. If Chevron signs are used, approaching road users must be able to see at least two of them through the curve.
9. The use of 3 to 6 cones on centerline in advance of the leading closed area is recommended at posted or statutory speeds of 45 MPH or above to emphasize the passing lane closure and provide an extra measure of separation for opposing traffic.
10. The leading channelization may be only the shifting taper for the single lane traffic when the statutory speed is 40 MPH or less.
This diagram shows work in the dual lane direction of a 3-lane, 2-way road with two travel lanes in one direction and a single travel lane in the opposing direction.

**Use the diagram as shown for a continuous 3-lane, 2-way section.**

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles that need to be at the work area.
2. An advance PCMS is recommended, especially for closure of a passing lane.
3. For a middle lane closure, 3 to 6 cones on centerline in advance of the closed area in the single lane direction may be used especially at posted or statutory speeds of 45 MPH or above to emphasize a passing lane closure and provide an extra measure of separation for opposing traffic.
4. For a right lane closure, centerline cones through the work area may be used if lanes are narrow, sight distances are limited or the extra separation is needed for other conditions.
5. For night operations, work lights should be provided on both work and protection vehicles as needed to illuminate the work area. Both vehicles should also be equipped with warning lights with 360° visibility. Lighting devices should provide adequate illumination and not result in glare that interferes with the driving or work tasks.

**If this is a passing lane section:**

6. Close the required lane of the passing lane section at the beginning, keeping traffic in one lane each direction until past the work area.
7. Close the required lane through the entire passing lane if there will be less than 1000 feet of passing opportunity remaining beyond the lane closure.
8. In addition to the signing shown, cover or place a CLOSED rider across the face of the permanent advance passing lane signs. These can include PASSING LANE 1 MILE, a Lane Transition sign and KEEP RIGHT EXCEPT TO PASS.
9. Replace the Right/Left Lane Ends symbol sign as shown on the diagram with a black-on-white DO NOT PASS or KEEP RIGHT (+ arrow) sign. Alternately, the advance lane closure sign may be black-on-orange PASSING LANE CLOSED AHEAD.

**On the single lane approach:**

10. Cover any passing lane signs such as YIELD CENTER LANE TO UPHILL TRAFFIC.
Work in a Continuous Left Turn Lane

This diagram shows work in the 2-way left turn lane of a 2-way road with 3 or more lanes.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work and traffic control vehicles.
2. When protection vehicles are used and the posted or statutory speed is 45 MPH or more, use of a TMA on the protection vehicle is recommended.
3. For stationary operations of 15 minutes or less, signs and cones are not required.
4. For stationary operations of one hour or less, including work that will relocate intermittently, each taper may be replaced by a protection vehicle.
5. Tapers are required when work will take longer than an hour. Cones are required as shown when posted or statutory speeds are 45 MPH or more and work will take longer than an hour. Cones should be used along the work zone any time the closed area looks open to traffic entry.
6. Especially when using only one vehicle, the use of a spotter(s) is recommended to warn workers of approach traffic.
7. For night operations, work lights should be provided on both the work and protection vehicle, if used, to illuminate the work area. Both vehicles should also be equipped with warning lights with 360° visibility. Lighting devices should provide adequate illumination and not result in glare that interferes with the driving or work tasks. Aiming the light sources away from both workers and drivers and so that the source doesn’t intersect the normal line of vision at a flat angle reduces the glare effect.
**Diversion into a Continuous 2-Way Left Turn Lane**

This diagram shows work in the travel lane(s) next to a continuous two-way left turn lane with one direction of traffic diverted into the continuous two-way left turn lane.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work and traffic control vehicles.

2. When protection vehicles are used and the posted or statutory speed is 45 MPH or more, use of a TMA on the protection vehicle is recommended.

3. A shifting taper (L/2) may be added in the diverted traffic direction across the continuous 2-way left turn lane to emphasize the area that is closed to turning traffic. The taper starts on the diversion direction centerline and ends on the opposing traffic centerline. The end of the taper should be a distance 2L back from the beginning of the diversion. This option is recommended when the posted or statutory speed is 45 MPH or more.

4. When two or more travel lanes are reduced to a single lane before the diversion, each lane shall be closed separately. A longitudinal distance equal to 2L is required between each lane closure.
Section 500 – Work on Multi-Lane Roads

**Right Lane Closure on a Multi-Lane Road**

This diagram covers work which will block the right lane(s) of a multi-lane street not a freeway.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.

2. The diagram shows the option of flagging within the work zone. Traffic must be in a single lane approaching the flagger. Close all adjacent lanes as needed. The layout for closing more than a single lane is shown in the Lane Closures on Freeway diagram.

3. When the posted or statutory speed is 40 MPH or less, the RIGHT LANE CLOSED AHEAD signs may be omitted.

4. On streets with a posted or statutory speed of 45 MPH or higher, advance warning signs should be placed in the median as well as on the shoulder. If there is no median room for signs, consider use of a trailer or truck-mounted TMA in advance of the work zone.

5. Protection vehicle(s) with or without a TMA may be used to protect the workers and work space. If used, the vehicles should be parked far enough from the work space to come to a stop, if hit, before intruding into the work activity or travel lanes.
Interior Lane Closure on a Multi-Lane Road

This diagram covers work which will block the left lane(s) of a multi-lane street not a freeway.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.

2. The closure of the adjacent interior lane in the opposing direction may not be necessary, depending upon the activity being performed and the work space needed for the operation. If the adjacent lane is not closed, cone off the work space placing the cones in the median if there is one.

3. Cones may be placed as shown on centerline in advance of the work to better gain the attention of motorists.

4. When the posted or statutory speed is 40 MPH or less, the LEFT LANE CLOSED AHEAD signs may be omitted.

5. On streets with a posted or statutory speed of 45 MPH or higher, advance warning signs should be placed in the median as well as on the shoulder. If there is no median room for signs, consider use of a trailer or truck-mounted TMA in advance of the work zone.

6. Work vehicle(s) with or without a TMA may be used to protect the workers and work space. If used, the vehicles should be parked far enough from the work space to come to a stop, if hit, before intruding into the work activity or travel lanes.
Section 600 – Intersection Operations

**Lane Closure – Near Side of Intersection**

This diagram covers closure of an intersection approach lane. Work vehicles may or may not be in the work area. Traffic movement timing is regulated only by the existing traffic control, whether stop or yield signs or traffic signals.

1. If any of the road approaches can’t access the intersection with the existing traffic control, consider closure of that road approach if there are alternate routes. Approval by the road authority is required to close an approach. If road closure is not an option, use an appropriate diagram showing flagging and do not use this diagram.

2. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.

3. For work in place for less than 15 minutes, a truck-mounted arrow panel or PCMS may be used in place of the required signs and cones as shown on the drawing and discussed below.

4. Cones are required to close the lane and protect the work area.

5. A minimum 36” LANE CLOSED sign is required at the closed lane. The sign may be truck-mounted, and may be a PCMS.

6. Advance warning signs are required. A cone may be placed next to a sign for extra visibility.

7. Install advance warning signs in the median on multi-lane roads when there is room, especially for left lane closures.

8. An arrow sign inside the taper may be added. If it is used, it may be mounted on Type II barricade for greater visibility. A flashing warning light may be mounted on the barricade.

9. For interior lanes on multi-lane approaches, additional cones may be required to guide traffic around the work area.

10. When an interior lane of three lanes or more in a direction will be closed, the leading taper shall move traffic into one or the other of the adjacent lanes but not both. The decision should be based on field conditions by a competent person on site.
Lane Closure - Near Slide of Intersection

Diagram No. 600

Vehicle mounted arrow panel (Optional)

LANE CLOSED
(Vehicle Mounted)

For A, B and C
See Table 2
(Sign Spacing)

* Use as appropriate
(See text)
This diagram covers work which will block a left turn refuge. When working in a left turn refuge, the entire refuge must be closed. Left turns will be lawful from the left-most travel lane unless there are regulatory signs prohibiting turns from that lane. The turn prohibition will require an advance warning sign as well. Check with the road authority before placing NO LEFT TURN regulatory signs.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.
2. For work in place less than 15 minutes, an arrow panel in caution mode or PCMS with the LANE CLOSED message may be used in place of the required signs and cones as shown on the drawing and discussed below.
3. Cones are required to close the lane and protect the work area.
4. A minimum 36" LANE CLOSED sign inside the cone taper or mounted on the work vehicle is required. The sign may be a PCMS.
5. Two advance warning signs are required.
6. If there is a continuous left turn lane or median greater than 4 feet wide, the median area must be closed with a one-lane, two-way taper at the entrance to the left turn lane in addition to the cones closing the left turn entry.
Left Turn Refuge Closure

Diagram No. 605

For A & B See Table 2 (Sign Spacing)

* May be mounted on vehicle
Lane Closure – Far Side of Intersection

This diagram covers work within the immediate downstream area of an intersection of two-way streets. Work vehicles may or may not be in the work area. Traffic movement timing is regulated only by the existing traffic control, whether stop or yield signs or traffic signals.

1. If any of the road approaches can’t access the intersection without added traffic control, consider closure of that road approach if there are alternate routes. Approval by the road authority is required to close an approach.

2. If left turns can’t be prohibited, a left turn lane may be set up after the lane closure by leaving an opening long enough for vehicles to enter. There should be a minimum of 20 feet of storage beyond the opening in the left turn lane. Adjust the length of the lane closure to accommodate the left turn lane. Place black-on-white, rectangular LEFT LANE MUST TURN LEFT signs on the right shoulder and inside the closed lane in advance of the opening, in place of the NO LEFT TURN sign(s).

3. For multi-lane approaches, additional cones may be required to guide traffic around the work area.

4. When an interior lane of three lanes or more in a direction will be closed, the leading taper shall move traffic into one or the other of the adjacent lanes but not both. The decision should be based on field conditions by a competent person on site.

5. Intersections of one-way streets are handled similarly with the exception of omitting the signing on the downstream intersection legs.
Lane Closure at Intersection with Flagging  

This diagram covers work within an intersection of two-lane, two-way streets when normal traffic control must be interrupted. Work vehicles may or may not be in the work area.

1. The preferred alternative is to close minor side streets if the closures are approved by the road authority. Use detour signs as needed.

2. Permanent traffic control signals must be turned off. Contact the road authority for assistance.

3. Reduce the entering traffic to a single lane on each approach on multi-lane approaches.

4. There should be one flagger for each approach. 1 flagger per 2 adjacent approaches may be used if sight distance, traffic path and flagger position allow for clear direction to motorists. For low traffic volume intersections, 1 flagger may control traffic.

5. Two warning signs are required when the posted or statutory speed is 40 MPH or lower and there are single approach lanes. An additional advance warning sign is required for multi-lane approaches with a posted or statutory speed of 45 MPH or higher. The additional advance sign may be a sign that is specific to the work or BE PREPARED TO STOP.

NOTE: The barricades as shown on the drawing are not required traffic control. The use of barricades or other protective devices should be appropriate for the work as determined by the competent person at the work site.
This diagram covers work within an intersection of two-way streets. Work vehicles may or may not be in the work area. Traffic movement timing is regulated only by the existing traffic control, whether stop or yield signs or traffic signals.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.

2. If any of the road approaches can’t access the intersection with the existing traffic control, consider closure of that road approach if there are alternate routes. Approval by the road authority is required to close an approach.

3. For multi-lane approaches, close sufficient lanes prior to the intersection to allow traffic to pass the work area without merging in the intersection.
   a. Close one lane at a time with a minimum tangent section between closures equal to the merging taper length requirement for the posted speed.
   b. On high volume urban sections when the posted speed is 30 MPH or less, the tangent sections between each lane closure may be shortened to a minimum of 50 feet.

4. Intersections of one-way streets are handled similarly except omit the signing on the downstream intersection legs.

5. When the operation will take less than one hour:
   a. Advance warning signs are required for all approaches unless the work will be in place for 15 minutes or less.
   b. For work in place less than 15 minutes, use arrow panels or PCMS. Arrow panels or PCMS are recommended at all times.
   c. If traffic must move out of a travel lane, cones are required.
   d. For multi-lane approaches, additional cones may be required to guide traffic around the work area.
   e. Pedestrian access must be maintained or coned off sufficiently to deter access to the work area.

NOTE: The barricades as shown on the drawing are not required traffic control. The use of barricades or other protective devices should be appropriate for the work as determined by the competent person at the work site.
Work in the Center of an Intersection

Diagram No. 630

For A See Table 2 (Sign Spacing)
Work in a Roundabout

This diagram covers work near and within a roundabout. Work vehicles may or may not be in the work area. The diagram shows closure of a portion of the roundabout with flagging control of alternating one-way traffic. Modifications for other traffic impacts are below.

1. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles.

2. If any of the road approaches can’t access the intersection due to the work area, a detour is required. Approval and the detour route is provided by the road authority. For short closures of 20 minutes or less, traffic may be held in place.

3. Traffic should not be allowed to queue through the next intersection, railroad crossing or traffic control signal nor held for more than 20 minutes except in an emergency.

4. For work in the roundabout island, initial advance warning signs are required on each approach leg. If the work and all work vehicles are off of the travel lanes and island apron, a single sign per approach is all that’s required. If the island apron will be impacted by the work or equipment, treat it as a shoulder closure for the length of work.

5. Because of large vehicle off-tracking, it usually isn’t possible to maintain traffic on the lane inside the roundabout through the work area.

6. For multi-lane roundabouts, if work can be done without closing both travel lanes, flaggers may not be needed. Appropriate signs for the lane closure at each entry are required.

7. Cones may not be needed along the splitter islands on the approaches if these are raised islands. In such cases, the flagger may have to move far enough ahead on the approach of the splitter island so that traffic can maneuver into the roundabout.

8. If the lane closure with flagging is on an approach leg, flaggers may not be needed on the other entering legs. However, the ROAD WORK AHEAD and BE PREPARED TO STOP signs would still be required at each entry, with a FLAGGER AHEAD sign placed before the exit into the lane closure. In a small roundabout, the signing shown may still be needed.

9. If a travel lane width of at least 10 feet can be maintained for shoulder work on an approach lane, the lane can remain open to traffic. Close the work area with a shoulder taper and longitudinal cones. An initial advance sign and a SHOULDER (SIDEWALK) CLOSED sign are required unless the work will take less than 15 minutes.

NOTE: The barricades as shown on the drawing are not required traffic control. The use of barricades or other protective devices should be appropriate for the work as determined by the competent person at the work site.
Section 700 – Work on Freeways & Expressways

FREeways & EXPRESSways

Freeways and expressways are defined by separation of traffic directions, high speed road design and controlled accesses. Freeways have only separated grade interchanges with exit and entrance ramps which are considered part of the freeway. Expressways may have at-grade intersections, which will be signalized and may also have free-flow entrance and/or right turn exit ramps.

The high speeds and normally uninterrupted flow on freeways and expressways increases the risks for workers and road users. More visibility, better protection and earlier advance warning is needed for freeway work areas than on other roads.

The paved shoulder on a freeway or expressway may be an auxiliary travel lane, available to traffic unless closed. For this reason, tapers are required when a 12 foot lane width can’t be maintained on the shoulder.
Freeway Mobile Operations

This diagram covers mobile operations occupying one lane of a freeway or expressway. Work should normally be done in off-peak hours.

1. Vehicles used for these operations should be made highly visible with appropriate equipment, such as flashing light, rotating beacons, flags, reflective tape and arrow displays.

2. Two shadow vehicles are required and 3 are recommended. All shadow vehicles will be equipped with an arrow display. An appropriate sign should be placed on the vehicle so as not to obscure the arrow display.

3. A PCMS may be used instead of an arrow panel and sign.

4. Each shadow vehicle should vary the trailing distance from the next shadow or work vehicle to provide adequate sight distance for traffic approach from the rear.

5. A truck-mounted attenuator (TMA) is required on the first vehicle exposed to approaching traffic in the travel lane. The supervisor on the work site determines the appropriate vehicle for the conditions. TMAs designed for high speed impact should be used unless not available. TMAs may be used on other shadow vehicles as well.

6. Shadow vehicle #1 is in the closed lane covering the working equipment. Shadow vehicle #1 displays a truck-mounted SLOW MOVING VEHICLE or similar sign facing the rear so that the full message can be read by oncoming traffic.

7. Shadow vehicle #2 displays a truck-mounted appropriate LANE CLOSED or similar sign facing the rear so that the full message can be read by oncoming traffic.

8. Shadow vehicle #3 displays a truck-mounted appropriate LANE CLOSED or similar sign facing the rear so that the full message can be read by oncoming traffic. When adequate shoulder width is not available, shadow vehicle #3 should stay as far left as possible and not protrude into traffic any further than necessary.

9. Minimum standard arrow display is Type B, 60" x 30".

10. A PCMS may be placed at the beginning of the work section. Panel 1 should give warning of the type of work with NEXT X MILES on panel 2. The sign should be moved during the day to stay within 5 miles of the work.

11. When there is no room for a left side sign in the median, an additional truck-mounted advance PCMS may be used in place of the left side advance sign. The truck and PCMS keeps a position within 1/2 mile of the work train.
Freeway Mobile Operations

Diagram No. 700

* For TMA Requirements
   See Note 5

PCMS (optional)
**Freeway Shoulder Work**

This diagram covers stationary work with work operations and/or parked equipment on the shoulder and not encroaching on the travel lanes.

1. Vehicles should be parked as far off the roadway as practical.

2. If equipment operation and activities are more than 15 feet from fog line or completely off the paved shoulder, whichever comes first, signs and cones are not required.

3. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights.

4. It is recommended that a minimum of 2 signs be used regardless of work duration.

5. The shoulder should be closed as shown if the sight distance is reduced to less than 750 feet or if 12 feet of clearance between the work vehicle and the fog line can't be maintained.

6. The advance work sign or a truck-mounted work sign shall be maintained within 1500 feet of the work. If work is in the median, there must be left side signing or at least 2 sets of advance signs on the right shoulder. One advance sign in such cases should be a PCMS.

7. For work that moves frequently and is in one place less than one hour, advance signing may be placed to cover a distance that includes all work locations for a significant period of time to reduce the risk exposure in placing signs. Maintain an advance warning truck-mounted sign or PCMS within 1000 to 1500 feet in advance of the work.

8. Arrow panels in caution mode or truck-mounted PCMS are recommended for active shoulder work on freeways and expressways.
Freeway Shoulder Work

Diagram No. 710

For A, B & C see Table 2
(Sign Spacing)

Road Work Ahead

Right Shoulder Closed

Right Shoulder Closed (Optional)

Page 99 of 142
Freeway Lane Closures

The diagram covers lane closures on a freeway. It is recommended that lane closures only be in place during off peak hours. The traffic control should be placed during the lowest traffic volume period available.

1. A minimum of 3 advance warning signs is required.
2. Use truck-mounted high-intensity rotating, flashing, oscillating, or strobe lights on any vehicles less than 15 feet off the fog line.

3. Signs on both the right and left hand sides of the road are required. A mobile lane closure is recommended to cover the placement of signs in the median. Where there is insufficient room for a 48" sign mounted on barrier, a 36" sign may be used. When only the right lane is closed, median signs may be omitted.

4. If there is not enough room for a truck to stop on the median shoulder in order to place signs, duplicate advance warning signs including at least one PCMS may be placed on the right shoulder. There should be at least 1500 feet between each advance sign sequence. This option should not be used for work in place longer than one work shift or for sections with four or more lanes.

5. When an interior lane must be closed, close the adjacent lanes from the shoulder out. Start from the closest shoulder to minimize the number of closed lanes. Extra attention should be given to advance warning and good sight exposure for the transition areas when closing lanes from the median side.

6. An arrow panel or PCMS is required in arrow mode for each lane closure. Only one arrow panel per lane closure may be used. If an arrow panel is placed near the work activity in the closed lane, it shall be set in caution mode.

7. Distances may be lengthened as needed to provide for safe transition movements in unusual situations such as crest or horizontal curves.

8. An downstream taper may be used at the end of the lane closure(s) to transition traffic back to normal lane use.

9. A PCMS located at least 1/2 mile before the initial advance warning sign is recommended. The distance should be determined by a competent person on site based on field conditions. The PCMS should give the closed lane information (RIGHT, LEFT, LANE or 2 LANES) and the distance ahead of the closure.

10. Use extended queue signing if traffic backs up beyond the initial advance warning signs.
Work Near an Exit Ramp  

Diagram No. 730 covers work that affects the approach to an exit ramp. The drawing shows work in the gore area. Similar traffic control would be placed for work near the entry area and shoulder. Traffic control should make the exit path clear to approaching motorists.

1. Use enough cones, barricades or tubular markers to provide a clear, smooth exit for motorists.

2. A white-on-green EXIT/arrow sign is required if the exit point must be moved or re-shaped on either side and the permanent sign is obscured or directs traffic inappropriately.

3. A temporary black-on-orange EXIT OPEN sign with an arrow or a PCMS, trailer or truck-mounted, may be used to indicate the point of exit in advance.

4. For multi-lane approaches, keep exiting vehicles to one lane until past the work area.

5. Park equipment and vehicles inside the coned off area, leaving good sight distance for exiting traffic to easily determine the correct travel path. Consider using a TMA on equipment that can’t be on the shoulder.

6. Traffic may be diverted to the paved shoulder on the ramp if at least 14 feet of travel path width can be maintained.
Work On an Exit Ramp

Diagram No. 740 covers work that encroaches on the travel lane of an exit ramp.

1. Use the partial closure when a minimum 10 foot of travel lane can be maintained. Traffic may be diverted to the paved shoulder if at least 14 feet of travel lane width can be maintained.

2. For a partial closure, use enough cones, barricades or tubular markers to provide a clear, smooth exit for motorists. Use a temporary EXIT sign with an arrow or an arrow panel, trailer or truck-mounted, to indicate the point of exit.

3. Cone off a buffer area before the work space, closing the freeway shoulder if necessary. Post SHOULDER CLOSED advance signs in this case.

4. Park equipment and vehicles inside the coned off area, leaving good sight distance for exiting traffic to easily determine the correct travel path. Consider using a TMA on equipment that can’t be on the shoulder.

5. For multi-lane approaches, keep exiting vehicles to one lane until past the work area.
Work On the Exit Ramp

For A & B See Table 2
(Sign Spacing)

Diagram No. 740
Diagram No. 750 covers full closure of an exit ramp.

1. Cone off a buffer area before the work space, closing the freeway shoulder if necessary. Post SHOULDER CLOSED advance signs in this case.

2. Use cones across the exit with barricades. Black-on-white EXIT CLOSED rectangular signs must be posted on the barricades. Two sets of advance signs, one of which is recommended to include PCMS, are required for a stationary exit closure.

3. For work in place less than an hour, the exit may be closed with one advance sign indicating the exit is closed and placement of Type III barricade and cones across the entry and gore areas with a black-on-white, rectangular EXIT CLOSED sign on the barricade.
Diagram No. 760 covers work on or near the right-hand side of a freeway entrance ramp. Traffic on the freeway is moved out of the right lane to create an adequate merge area. Ramp traffic is carried onto the freeway in the closed lane to merge with freeway traffic beyond the work area.

1. If the freeway merge distance can’t be maintained, consider closing the ramp. Advance signing of the closure will be needed on the cross road in all approach directions.

2. Move the entry point downstream or upstream as necessary to allow for good sight distance for both freeway traffic and entering traffic at the merge area. Make sure work activity and equipment don’t block freeway and merging vehicles from seeing each other in time.

3. The ramp should be restricted to one through lane. Flagging may be considered when work will sometimes use the entire width of the ramp. If flagging will impact traffic beyond the ramp, work and flagger advance signs must be placed on the appropriate approaches.

NOTE: Many freeway interchanges have restricted merge designs. Engineered traffic control plans should be prepared for routine work at freeway entrances, especially when merge distances are short or there are restricted sight distances. The traffic control plans should be updated if the interchange is reconstructed or the freeway is changed.
Work Near an Entrance Ramp - Right Side

Diagram No. 760

For A, B & C See Table 2 (Sign Spacing)
Diagram No. 770 covers work on or near the gore area of a freeway entrance ramp. Traffic on the freeway is moved out of the right lane to clear the work area. The right lane remains closed until past the entry merge area.

1. Move the entry point downstream as necessary to allow for good sight distance for both freeway traffic and entering traffic where the lanes come together. Make sure work activity and equipment don’t block freeway and merging vehicles from seeing each other in time.

2. The ramp should be restricted to one through lane. Ramp metering may take the place of lane closures to restrict entering traffic to a single lane.

3. Flagging may be considered when work will sometimes use the entire width of the ramp. If flagging on the ramp will impact traffic above the ramp, work and flagger advance signs must be placed on the appropriate approaches.
Work Near an Entrance Ramp - Left Side

Diagram No. 770

For A, B & C See Table 2 (Sign Spacing)
INCIDENT & EVENT TRAFFIC CONTROL

Temporary traffic control measures can be required for any number of incidents, including both emergency and planned events. Emergencies can be road-related, such as a traffic crash, or non-road-related, such as a wildfire. Planned events are one time or periodically recurring special events.

**Detours:** A combination of traffic engineering and enforcement operations is needed when a detour is used. The road authority and enforcement authority will:

- determine the detour route
- install signing to designate the route
- maintain the detour route
- remove temporary traffic control devices when the detour is no longer needed.

Consideration for large trucks must be made if they are being routed from a designated truck route onto a local highway or street network. It may be necessary for large trucks to follow a separate detour route.

If traffic will be detoured onto roads under a different road authority than the original road, the road authority for the detour route and the road authority for the original road will work together to provide the detour route. Pre-planned detour routes and procedures are encouraged for high traffic roads and freeways.

**Event Traffic Control:** Events are planned activities that will impact the flow of traffic. They can be one time or recurring. The traffic impact of an event should be assessed as well as possible given the expected traffic volumes, entry and exit locations and operation, and normal traffic characteristics. For events that will need traffic control for less than 3 days, the guidance and typical applications in this handbook may be used.

Each road authority may have permit or other requirements for events with traffic impacts on their roads. The road authority should be contacted as part of the event planning for their assistance and approval of the temporary traffic control.
**Emergency Traffic Control:** In emergency situations where immediate response must be taken to control traffic, the responder may use any available devices or equipment to secure the response scene and guide traffic through the incident area until proper equipment is available, and as long as the devices themselves do not create additional hazards. As soon as practical, devices and equipment that comply with the current MUTCD and this handbook should be used to control traffic.

A traffic incident can be, but is not limited to, any roadway or traffic-related emergency, a natural disaster, or other unplanned event that affects or impedes the normal flow of traffic.

A traffic incident management area is the area of highway where temporary traffic controls are placed in response to a traffic incident. The incident management area extends from the first warning device such as a sign or cone, to the last temporary traffic control device or to where vehicles return to their normal travel path beyond the incident.

An essential part of fire or rescue response, hazardous material clean-up, highway agency and enforcement activities is the safe and effective control of traffic through the incident management area. The main objective of the traffic control plan is to:

- protect responders, victims, and other personnel at the site
- provide reasonably safe traffic flow,
- prevent secondary traffic crashes, and
- manage the impact to the surrounding local road system.

The incident traffic control should follow as closely as possible the requirements and guidelines in this manual. Use the appropriate diagram in laying out the needed traffic control devices. In determining the appropriate layout, consider the expected duration of the incident response activity. Duration includes the removal of response vehicles and equipment and any clean-up activities needed before normal traffic can be restored.

The incident management area may include a staging area for arrival and placement of emergency response vehicles. This staging area may be set up in advance of or beyond the activity area. The staging area may include space for the storage of emergency vehicles, incident command, and/or an enforcement vehicle to monitor and respond to traffic violators. A buffer space is recommended before any staging area. No equipment or worker activity should be within the buffer space.

**Safety Apparel:** It is important that all personnel exposed to traffic be visible and recognizable as a person to road users as soon as possible. In addition, emergency response personnel are often acting in multiple roles and need to be identifiable as fire, EMT or enforcement officials as well as traffic control. When a fire or police officer is flagging, a uniform, coat or vest should be worn which maintains the official identify of the flagger and otherwise meets the ANSI/ISEA High Visibility Safety Apparel guidelines, or equivalent revisions, for standard performance for Class 2 risk exposure.
Retroreflective apparel that identifies the wearer as a person is recommended for all personnel exposed to traffic while working at night.

**Incident response needs** are classified into three general categories of duration. An initial assessment and communication of traffic control needs in an incident response should be made within 15 minutes of arrival on-scene. The assessment of traffic control duration should extend to the clean-up and immediate road and utility repairs that will continue the impact to traffic beyond the clearance of the original incident. The incident duration categories are:

A. Major – expected duration of more than 2 hours;
B. Intermediate – expected duration of 30 minutes to 2 hours; and
C. Minor – durations under 30 minutes.

If the incident is anticipated to last more than 24 hours, a site specific assessment and traffic control layout should be implemented by the road authority.

The duration categories should be used as a guideline for mobilizing traffic control response for an incident. Other factors such as traffic volumes, speeds, roadway geometry or complexity of the response activities can affect the extent and type of traffic control needed. Consult the applicable diagram for options.

When flares or similar emergency devices such as glow sticks are used to initiate temporary traffic control at emergency incidents, longer-term traffic control devices should replace them as soon as practical. Both the flare and any supporting device should then be removed from the roadway.

**Major Traffic Incidents** typically involve closing all or part of a roadway facility for a period exceeding 2 hours. Contact the road authority that will be carrying the additional traffic as well as the road authority on the original road.

Temporary traffic control for Major Incidents will often include:

- Adequate advance warning signs
- Additional advance warning for approaching traffic to anticipate the end of traffic queues
- Properly signed detour route(s)
- Proper shoulder and/or lane closures
- Standard traffic control devices to guide traffic past the incident area
- Media contact

If manual traffic control is needed, it should be provided by qualified flaggers or uniformed law enforcement officers.
**Intermediate Traffic Incidents** typically affect travel lanes for a time period of 30 minutes to 2 hours and usually require traffic control on-scene to guide road users past or around the incident. Full roadway closures may be needed for short periods during clearance operations. Before establishing any detour, contact the road authority that will be carrying the additional traffic as well as the road authority on the original road.

Temporary traffic control for Intermediate Incidents will often include:
- Adequate advance warning signs
- Advance warning for approaching traffic to anticipate the end of traffic queues
- Proper shoulder and/or lane closures
- Standard traffic control devices to guide traffic past the incident area

If manual traffic control is needed, it should be provided by qualified flaggers or uniformed law enforcement officers.

**Minor Traffic Incidents** typically result in lane closures of less than 30 minutes if at all. On-scene responders typically include law enforcement, highway agency vehicles and towing companies. Diversion of traffic into other lanes is often not needed or is needed only briefly. It is not generally possible or practical to set up a lane closure with traffic control devices for a Minor Incident. Traffic control is the responsibility of on-scene responders.
Figure 3 – Emergency Response Example

The diagram shows an example of modifying a typical application from this handbook for temporary traffic control for emergency response activity. Note that the layout and placement of all resources for incident response is determined by the incident command.

The layout has been adapted from the MUTCD typical application for closing one direction of a two-way, multi-lane road. The added elements include an incident command post, staging area, heavy engine protection vehicle and police presence.

The layout shown is not intended to be interpreted as a standard layout. Not all elements will be present, and there can be additional elements needed. For instance, the incident command post may be set up outside the incident work area, on a side road, ramp or other location that allows for best function. It can be advantageous to have more than one staging area so that incoming vehicles are positioned for easy and safe access where needed.

The diagram shows police presence placed both before and after the incident. Either, both or no extra police presence may be included in the incident response. The placement will vary.

An additional PCMS, not shown, may be placed in advance of the work area in the opposite travel lanes.

An Arrow sign may be placed inside the lane shift taper between the first and second cones to help traffic understand the movement needed.
Emergency Response Example

**Figure 3**

- **Transition Area**: Traffic resumes normal operation.
- **Activity Area**: Where work takes place.
- **Advance Warning Area**: Tells traffic what to expect ahead.
- **Protection Vehicle**: Ensures safety.
- **Chase Vehicle**: Monitors the scene.
- **Work Space**: Designated area for work.
Appendix A
Glossary of Terms

ADT: Average Daily Traffic volume (average number of vehicles per day).

ARROW PANELS: Lighted sign panels conforming to the requirements of the MUTCD with a matrix of lights capable of either flashing or sequential display of directional mode arrows or chevrons or non-directional (caution) mode. [also called arrow boards.]

BEACON (TRUCK-MOUNTED): A yellow rotating flashing light or strobe light mounted on a vehicle.

BARRICADES: A portable device having from one to three rails with appropriate markings, used to control traffic by closing, restricting or delineating all or a portion of the roadway.

BLOCKADE VEHICLE: A traffic control vehicle used to control the speed of following traffic in a rolling slowdown. A blockade vehicle is made highly visible with high-intensity rotating, flashing, oscillating, or strobe lights, an arrow panel and sign or PCMS.

BUFFER SPACE: An open space between the end of the transition area or traffic separation channelization and the work space. The buffer space does not include any equipment, stored materials, work activity or service vehicles.

CHASER VEHICLE: The vehicle that enters the roadway first in a rolling slowdown. The chaser vehicle moves forward with traffic in front of the rolling blockade, positioning behind the last through vehicle before entering the work area. The chaser vehicle indicates to the work crew that work can begin.

CLEAR ZONE: The unobstructed area provided beyond the edge of the travel lane(s) for the recovery of errant vehicles, including any shoulders or auxiliary lanes. The clear zone ends where obstructed by guardrail, curb, steep side slope, fence, trees, non-stabilized ground or other non-traversable features. The clear zone does not extend beyond the road right-of-way.

CONE SPACING: The offset and in-line distances between channelizing devices in a cone taper or along the work and buffer areas.

CONE TAPER: A series of channelizing devices (i.e. cones) placed at an angle to the roadway to guide traffic out of its normal path.

CONES: Cones are cone-shaped channelizing devices with a weighted base. Cones are used in tapers and along closed areas to move and maintain traffic in the desired travel path.
DRUMS (BARRELS): Drums are lightweight, flexible, and deformable barrel-shape channelizing devices a minimum of 36 inches in height and 18-inches in diameter. Steel drums shall not be used.

EXTENDED TRAFFIC QUEUE: An extended traffic queue results when the line(s) of traffic slowed or stopped in a work zone extends past the first advance warning sign.

FLAGGER: A person who has completed a flagger training course as outlined in this manual, wears required clothing and uses a minimum 18 inch octagonal shape STOP/SLOW sign paddle to assist with traffic control.

ADVANCE FLAGGER: An additional flagger(s) stationed ahead of a flagger stopping traffic in the same direction. The advance flagger is preceded by the flagger sign sequence. The advance flagger does not stop traffic, and uses the SLOW side of a minimum 18-inch octagonal shape STOP/SLOW sign paddle or a 24” x 24” red flag on a 3 foot long staff to slow traffic in advance of a work zone.

HIGH SPEED: A designated (posted) speed of 45 MPH or above.

LOW SPEED: A designated (posted) speed of 40 MPH or below.

LOW VOLUME: An average daily traffic volume (ADT) of 400 vehicles per day or less.

MAY: Indicates an allowed alternative to a mandatory condition or action.

MOBILE OPERATION: Work activities when workers and equipment are moving along the road without any stopping at a speed of 3 MPH or more.

MULTI-LANE ROADWAY: A roadway with at least two lanes in one or both directions.

MUTCD: The national Manual on Uniform Traffic Control Devices published by the Federal Highway Administration and adopted as the statewide standard for traffic control devices by OAR 734-20-001 under the authority of ORS 810.200.

PILOT CAR: A four-wheeled vehicle no smaller than a compact pickup, identified by a 36” by 18” PILOT CAR FOLLOW ME sign mounted on the rear and equipped with a beacon and two-way radios or other communication devices. The communication devices must have a range suitable for the length and terrain of the project.

PORTABLE CHANGEABLE MESSAGE SIGN (PCMS): PCMS include a message sign panel, control system, power source and mounting and transporting equipment. They shall conform to all requirements in the MUTCD and shall be listed on the Qualified Products List for use of state highways.

PORTABLE TEMPORARY SIGNAL: A portable temporary signal is a self-contained, self-powered green-yellow-red traffic signal used for controlling
traffic through a short term traffic control section. Portable signals used on state highways must be on the Qualified Products List or Conditional Use List for use in short term work zones and have region traffic engineer approval.

**PROTECTION VEHICLE:** A vehicle strategically placed to protect the workers and work activity. The protection vehicle may be in a stationary work zone or be the vehicle immediately behind the work vehicle(s) in an array of mobile work vehicles. The protection vehicle is placed after the buffer space and sufficiently in advance of the work area protected to allow for run-out if hit but not so far in advance that traffic can enter the space before the work area.

**ROADWAY:** That portion of the road right-of-way that is improved, designed or ordinarily used for vehicular use, including paved shoulder, travel lanes and median.

**RUN-OUT:** The distance in front of a protection vehicle equal to the distance the vehicle is likely to move if hit. The length of the buffer space between a protection vehicle and the work activity should be at least equal to the run-out.

**SHADOW VEHICLE:** A trailing vehicle used as a warning and traffic control vehicle in a mobile work zone. Shadow vehicles provide both the advance warning area and any lane or shoulder closures for a mobile work zone. A shadow vehicle may also be a protection vehicle depending on the number of vehicles used in a mobile work zone.

**SHALL:** Indicates a mandatory condition or action.

**SHORT DURATION WORK:** Work activities that move along the road intermittently. Short duration work involves frequent short stops of up to one hour such as litter cleanup or pothole patching.

**SHORT TERM WORK ZONE:** A work area set up for one 8-hour shift or less in daylight conditions or one hour or less in dark conditions.

**SHOULD:** A should condition is the recommended option or action and is the standard treatment under normal conditions

**SHOULDER:** That portion of a roadway adjoining but outside of the normal travel lanes.

**SIGHT DISTANCE:** The length of roadway visible to the driver.

**SPOTTER:** A worker who takes a position near the work with a clear view of the work area and the roadway whose primary duty is to warn the other worker(s) of approaching traffic. A spotter does not control traffic.

**TRAFFIC CONTROL ZONE:** A section of road that begins with the first advance warning of the work activity, includes all work activity and signing, and ends where traffic may resume normal operations.
**TRUCK-MOUNTED ATTENUATORS (TMA):** Truck-mounted attenuators (TMAs) are energy absorbing devices attached to the rear of a heavy vehicle. They are used on equipment located in advance of workers or work equipment to reduce the severity of rear-end crashes from errant vehicles. A TMA may be used on a work vehicle, protection vehicle or shadow vehicle.

**TUBULAR MARKERS:** Tubular markers are channelizing devices that are cylindrical in shape with a weighted base.

**WORK AREA:** That portion of the roadway which contains the work activity and equipment.

**WORK COMMENCEMENT:** The start of work activity in or along the roadway.
**APPENDIX B**

**Active Traffic Control Guidelines & Standards**

**FLAGGERS/FLAGGING**

**Flagger Training Requirements**
Flagger training requires a course of instruction in the following topics. Retraining must be completed every three years.

<table>
<thead>
<tr>
<th>Basic Flagger Course Outline:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Fundamental Principles from Part VI of the MUTCD</td>
</tr>
<tr>
<td>B) The Four Parts of Temporary Traffic Control Zones.</td>
</tr>
<tr>
<td>C) Main Traffic Control Devices</td>
</tr>
<tr>
<td>a) Signs</td>
</tr>
<tr>
<td>b) Cones</td>
</tr>
<tr>
<td>c) Barricades</td>
</tr>
<tr>
<td>d) Arrow Panels</td>
</tr>
<tr>
<td>e) Portable Changeable Message Signs (PCMS)</td>
</tr>
<tr>
<td>D) Location/Spacing of Devices</td>
</tr>
<tr>
<td>E) Flagging Principles</td>
</tr>
<tr>
<td>a) Qualifications</td>
</tr>
<tr>
<td>b) Clothing</td>
</tr>
<tr>
<td>c) Tools</td>
</tr>
<tr>
<td>d) Positions</td>
</tr>
<tr>
<td>e) Use of Hand-Signaling Devices</td>
</tr>
<tr>
<td>f) Pilot Car Operations</td>
</tr>
</tbody>
</table>

**Flagging Principles:**

1. Flaggers shall be used only when other traffic control methods are inadequate to safely guide traffic through a work area or assure the safety of workers.
2. Flagger stations shall be located such that approaching road users will have sufficient sight distance to be able to stop at an intended stopping point.
3. Flaggers should stand alone, never permitting a group of workers to congregate around the flagger station. The flagger station should be kept clear of all equipment and vehicles, leaving the flagger an open escape route from approaching vehicles when necessary.
4. Under normal conditions, vehicles should not be delayed longer than 20 minutes, including travel time past the work area. In emergency situations or for clearing the road in operations such as blasting, longer delays may be allowed with advance signing. Every effort should be made through media communications to alert the public of long delays.

**Flagger Qualifications:**

1. Flaggers shall be trained as outlined in this handbook under Flagger
Training Requirements and shall show proof of such training upon
demand by a controlling authority.

2. Any person from another state with verification of flagger training
equivalent to the training required in this manual shall be deemed to
have met the flagger training requirement.

3. Flaggers should be able to satisfactorily demonstrate the following
abilities:
   a. Ability to receive and communicate specific instructions clearly,
      firmly, and courteously;
   b. Ability to move and maneuver quickly in order to avoid danger
      from errant vehicles;
   c. Ability to control signaling devices (such as paddles and flags)
      in order to provide a clear and positive guidance to drivers
      approaching a temporary traffic control zone in frequently
      changing situations;
   d. Ability to understand and apply safe traffic control practices,
      sometimes in stressful or emergency situations; and
   e. Ability to recognize dangerous traffic situations and warn
      workers in sufficient time to avoid injury.

4. Flaggers must be 18 years of age or older to work on roads with
traffic volumes greater than 400 ADT.

Flagging Signs & Equipment:
1. FLAGGER AHEAD signs shall precede flaggers at all times.
2. BE PREPARED TO STOP signs shall be used before the FLAGGER
   AHEAD sign when the posted speed or statutory speed is 45 MPH or
   above.
3. FLAGGER AHEAD signs shall be removed, covered or turned away
   from traffic when there is no flagging going on.
4. Flaggers shall use a minimum 18” x 18” octagon-shaped retroreflective
   STOP/SLOW paddle. At high speeds or in other situations where more
   visibility is needed, a 24” x 24” octagonal paddle is recommended. The
   paddle shall be made of light, semi-rigid material and the full face of the
   STOP and the SLOW sides must be visible and legible at all times when
   the paddle is in use.
5. Flaggers shall use only those hand signals approved in the Manual on
   Uniform Traffic Control Devices ANSI D6.1e89 as shown in Figure 6E-1
   on page 6E-3 of the 2003 MUTCD.
6. Advance flaggers may use a 24” x 24” red flag on a 3 foot staff or an 18”
   x 18” minimum octagon paddle with SLOW facing traffic.
7. Advance flaggers must be preceded by an additional set of appropriate
   signs.
8. If a staff or extended handle is used, the bottom of the paddle shall be a
   minimum of 5 feet above the pavement or just above the flagger’s eye
   level, whichever is higher. Any equipment, clothing or other objects
   attached to the staff must be well secured and not allowed to hang
   freely or loosely.
Flagger Attire:
1. While on duty, flaggers shall be fully clothed. No abbreviated clothing such as swimsuits, shorts, tank tops or halter tops shall be worn. Where flaggers work in hot, sunny conditions, technical clothing designed for maximum air flow, perspiration management and sun protection is available and should be considered.
2. Flaggers shall wear safety apparel meeting ANSI Class 2 risk exposure standard for high-visibility vest, shirt or jacket. The background material color shall be either fluorescent orange-red or fluorescent yellow-green as defined in the standard. The retroreflective materials shall be either orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors. The retroreflective clothing shall be designed to clearly identify the wearer as a person and shall be visible at a minimum distance of 1,000 feet. For nighttime flagging, ANSI Class 3 high visibility safety apparel should be considered.
3. The addition of a light colored hat, even when not required in the construction area, will enhance recognition of the flagger as a person. Hard hats shall be worn as required.

Flagging through intersections
Flagging through intersections is especially hazardous, both for road users and workers. All other alternatives should be considered first to accommodate the work without affecting normal intersection traffic control, including closing the intersection and diverting traffic.
1. **IT IS ILLEGAL TO CONTROL TRAFFIC BY FLAGGING IN CONFLICT WITH NORMAL INTERSECTION TRAFFIC CONTROL.** Under Oregon law, only a uniformed police officer has the authority to supersede the signal or stop sign. This means that traffic can’t be flagged to proceed through when facing a red traffic signal light or stop sign, nor stopped when the light is green.
2. Consider all other alternatives such as complete or half road closure with detours before flagging if you will be working at the intersection for more than 1 hour. Contact the road authority traffic office ahead of time for help in determining what closures or detours can be set up to minimize traffic movement through the intersection. Closures must be approved by the road authority.
3. Avoid flagging if at all possible during peak traffic times, especially on major commuter routes.
4. Brief flagging operations are acceptable if traffic facing a green light will neither be stopped nor instructed to move against a red light.

PROCEDURE WHEN FLAGGING AT A SIGNALIZED INTERSECTION:
If the work activity will interrupt normal traffic control and the intersection can’t be closed and traffic diverted, follow the procedures below:
1. Contact the road authority for permission to turn off the signal. This may mean coordinating with city/county or region electrical crew personnel or the local police. For work under ODOT permit, this should
be included in the permit.

2. All intersection control signs that will not be operated normally shall be covered. Intersection control signing includes all regulatory signs such as STOP, YIELD, or RIGHT TURN ONLY.
   a. Traffic signals must be turned off during flagging operations. To change the signal operation, you will need assistance from the road authority.
   b. In an emergency situation, request police assistance.

3. Flagging must continue until the signal is back in operation.

4. Close approach lanes that are not a major movement, such as right turn lanes with only occasional use. Prohibit left turns if there is work or obstruction within the intersection. Close through approach lanes to only one lane each direction.

5. If there are large turning movements and the space is available, dedicated lanes should be provided for those movements with appropriate signing such as RIGHT TURN ONLY. Non-conflicting turning movements can then be allowed concurrently with other movements to reduce congestion.

6. One flagger should control only one approach at unless the traffic volumes are low. Approach lanes should be reduced to a single through lane.

7. When more than one flagger is needed, designate one a control flagger. Effective means of communication such as radio devices should be used unless ambient noise levels allow voice communication at all times.

8. For low traffic volume intersections, a single flagger may be used if they can stand as close to the middle of the intersection as the work permits and be visible from all directions at all times. Use more than one flagger if full visibility can’t be maintained.

9. Flagger stations should be within closed lanes or on the shoulder or curb. Move to the center of the approach lanes only when traffic is stopped, to be visible to incoming traffic.

**Night Flagging:** The use of flaggers at night is discouraged. The MUTCD recommends the use of portable temporary signals for night time lane closures. When flaggers and/or pilot cars are necessary, the following additions and enhancements to the flagger principles apply.

1. Flagger stations must be illuminated, and illuminated separately from the work area.
2. The use of ANSI Class 3 high visibility safety attire should be considered.
3. Flagger clothing should fully identify the flagger as a person from 300 feet in low speed urban areas and 500 feet in high speed and rural areas. The addition of a light colored retroreflective hat aids recognition of the flagger as a person.
4. Consider using additional lights on the STOP/SLOW paddle as allowed by the MUTCD.
5. Flashing warning lights can be added to the advance warning signs, especially the Flagger Ahead sign.
6. Consider using a 24" x 24" STOP/SLOW paddle, as it is much more visible than the smaller signs.
7. The staff or extended handle of the STOP/SLOW paddle may have 2" reflective bands of white or alternating red and white diagonal stripes.
8. The use of small personal light devices that can be attached to the flagger's clothing can enhance the visibility of the flagger and the recognition of the flagger as a person.

Flagging on Bridges and Viaducts: Avoid setting up flagger stations on a bridge, viaduct or other road section where there is no feasible escape route. Most bridges and viaducts are short enough to include the entire bridge in the one lane section even though the actual work area is short. Alternately, the ends of the bridge or viaduct may have escape areas just over the bridge rail and these areas can be used if the entire bridge is too long. On very long bridges with high traffic where flagging can't be moved to the ends, leave a full length buffer space free of equipment and vehicles.

SPOTTER GUIDELINES:
There are circumstances where positive traffic control is not needed but workers must attend to duties which make it difficult for them to adequately pay attention to traffic. When workers are exposed to traffic in such circumstances, the use of a spotter may enhance the safety and efficiency of both road users and workers.

Purpose: To provide a clear set of expectations for the position of spotter and for the employee(s) being protected by the spotter.

Definition: A spotter is an employee whose sole duty is to provide immediate warning of approaching vehicles, equipment, or other hazards. A spotter does not control traffic.

Plan: A plan based on a risk assessment needs to be developed and documented by the crew or team before a spotter can be used.

Using a spotter: the need for spotters can be decided by assessing one or more factors for a given operation or task. These factors include but are not limited to the following:

1. Location of the work or task.
2. Type of highway
3. Vertical or horizontal alignment
4. Traffic volumes or speeds
5. The nature of the work activity
6. The extent of traffic controls used
7. The added safety for the workers
8. Vegetation, trees, roadside obstructions or other conditions that
might restrict sight distance or the safety of an employee.

**Location of the spotter:** A spotter must be within visual and/or verbal contact of employee(s) that are being protected. If restricted sight distance or other factors preclude such closeness, an air-horn, two-way radio, or other warning device must be used.

**Alerting Call or Device:** The ‘Alert Call’ (by voice or other means) needs to be clearly heard above all surrounding noise levels, when it appears than unplanned safety problem errant motorist, or equipment is slipping into the zone of protection. The Alert Call must be agreed upon by all affected parties prior to use of a spotter.

**Escape Route:** A predetermined escape route for each spotter and the protected employee(s) will be established prior to beginning work. The escape route shall be agreed upon by all affected parties.

**Commencement of work:** The spotter shall be in placed and be prepared to issue alerts before the work operation begins.

**Training:** All affected employees shall be trained in the duties and use of a spotter(s) and retrained every three years or when non-retention of the plan is observed.

---

**PILOT CAR OPERATION**

A pilot car should be used to guide traffic through a long section of one lane, two way road past the road sections closed for work activity. A pilot car shall be used if a driver can’t see from one end of the job to the other soon after entering the one lane section and there is opportunity to move into the closed lane. Alternately, the closed lane may be emphasized with longitudinal cones or other channelizing devices and occasional transverse barricade or cone taper inside the closed lane.

1. The pilot vehicle should have the name of the road authority or the contractor prominently displayed on the vehicle.
2. Operation of the pilot vehicle shall be coordinated with flagging operations or other active traffic control at each end of the one lane section.
3. The PILOT CAR FOLLOW ME sign shall be mounted in a conspicuous location on the rear of the vehicle. A PCMS may be used for the pilot vehicle sign.
4. Side roads and commercial driveways within the closed section shall have flaggers. If entering traffic is rare and the access can be monitored for wrong-way entries, a WAIT HERE FOR PILOT CAR sign may be used instead of a flagger.
5. The pilot vehicle guides traffic through the work zone by pulling out in front of the waiting traffic queue, maintaining a safe speed.
6. No vehicles should be allowed to pass the pilot vehicle except for work
vehicles.

7. Radio or other communications should be available between the pilot vehicle driver, the flaggers and the work superintendent or designated worker at all times.

8. The last vehicle following a pilot car in a queue may be identified by handing off a flag between driver and flaggers. Alternately, the last vehicle can be identified by communications between flaggers.

9. For night operations, the flagger stations shall be separately illuminated from the work operation. Retroreflective STOP/SLOW paddles are required at night. Consider STOP/SLOW paddles with warning lights as allowed under MUTCD 6E.03.

PORTABLE TRAFFIC CONTROL SIGNALS
This section covers the use of portable traffic control signals to control traffic through a one lane, two-way work zone.

1. Portable traffic control signals must be set up for line of sight from one end of the one-lane section to the other unless there is proven and reliable constant communications between signal controllers providing conflict monitoring and automatic correction.

2. Any intersecting roads or driveways within the one lane section must be controlled by flaggers or closed. Clearance of any side roads shall be coordinated with the signal operation.

3. An all-red interval is required that is long enough for road users to clear the one lane section.

4. The portable signal control equipment must have safeguards that eliminate the possibility of conflicting signal indications at each end of the traffic control zone.

5. Portable traffic signals must have vertically arranged 12 inch diameter signal lenses.

6. Each traffic control signal unit shall have at least one signal head mounted on a pole with the bottom of the signal head at least 8 feet above the sidewalk or, if there is no sidewalk, above the centerline of the road. At least one vehicle signal head must be located over the travel lane(s) with a minimum vertical clearance of 17 feet. Equipment with a single pole mounted vehicle signal head may be used if two units each direction are used with one unit placed on each shoulder of the road and aimed towards oncoming traffic.

7. Use of portable traffic control signals on state highways must be by permit. Equipment must be listed on the ODOT Qualified Products List (QPL).

Specifications - Lane Closure with Portable Traffic Signals
The use of dual head signal units is the preferred option. Single head portable signal units may be useful on sections with horizontal or vertical curves as the far side signal may improve visibility.
Figure No. 1B covers the operating requirements for using portable traffic signals as flagging devices.

<table>
<thead>
<tr>
<th>Approach Speed (mph)</th>
<th>Length of Yellow Interval (sec.)</th>
<th>Normal Approach Speed (mph)</th>
<th>Minimum Sight Distance (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 - 35</td>
<td>4</td>
<td>25</td>
<td>215</td>
</tr>
<tr>
<td>40 - 55</td>
<td>5</td>
<td>30</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40</td>
<td>390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55</td>
<td>625</td>
</tr>
</tbody>
</table>

### Closure Using Portable Signals

**Figure 1B**

<table>
<thead>
<tr>
<th>Length of One-Lane, Two-way Traffic Section Between &quot;STOP HERE ON RED&quot; Signs (ft)</th>
<th>Required Minimum Length of ALL-RED Clearance Interval (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>45</td>
</tr>
<tr>
<td>950</td>
<td>43</td>
</tr>
<tr>
<td>900</td>
<td>41</td>
</tr>
<tr>
<td>850</td>
<td>39</td>
</tr>
<tr>
<td>800</td>
<td>36</td>
</tr>
<tr>
<td>750</td>
<td>34</td>
</tr>
<tr>
<td>700</td>
<td>32</td>
</tr>
<tr>
<td>650</td>
<td>30</td>
</tr>
<tr>
<td>600</td>
<td>27</td>
</tr>
<tr>
<td>550</td>
<td>25</td>
</tr>
<tr>
<td>500</td>
<td>23</td>
</tr>
<tr>
<td>450</td>
<td>20</td>
</tr>
<tr>
<td>400</td>
<td>18</td>
</tr>
<tr>
<td>350</td>
<td>16</td>
</tr>
<tr>
<td>300</td>
<td>14</td>
</tr>
</tbody>
</table>
These pages can be copied and enlarged as needed. An enlargement of 150% will fit a sheet of standard letter size paper. These plan sheets along with blank diagrams are also available on the internet on ODOT Traffic Section’s web site under Publications/Work Zone Related.

**ODOT’S Short Term Traffic Control Plan**

### Task Information

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Date(s)</th>
<th>Start</th>
<th>Finish</th>
<th>Task Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Equipment/Safety Considerations/Personnel Required

<table>
<thead>
<tr>
<th>Equipment</th>
<th>No.</th>
<th>Safety &amp; Roadway Considerations</th>
<th>Personnel (Names)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loaders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweepers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Yd Trucks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Yd Trucks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Vests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER TRUCKS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grinders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machinists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Crane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flatbed Trucks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Use the Table and Diagram below to design your temporary traffic control plan. These plans should be maintained for a minimum of 1 year from the date of the maintenance operation.**

### Two Lane, 2-way Road Diagram – Page # from Temporary Traffic Control Handbook (______)

<table>
<thead>
<tr>
<th>Type of Signs Required</th>
<th>No.</th>
<th>Type of Signs Required</th>
<th>No.</th>
<th>Other Traffic Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flagger Ahead</td>
<td></td>
<td>Be Prepared To Stop</td>
<td></td>
<td>Road Narrows</td>
</tr>
<tr>
<td>Shoulder Work</td>
<td></td>
<td>Right Lane Ends</td>
<td></td>
<td>Shadow Vehicles</td>
</tr>
<tr>
<td>Survey Crew Ahead</td>
<td></td>
<td>Left Lane Ends</td>
<td></td>
<td>Flaggers</td>
</tr>
<tr>
<td>Road Work Ahead</td>
<td></td>
<td>Right Lane Ends</td>
<td></td>
<td>Arrow Boards</td>
</tr>
<tr>
<td>Road Closed</td>
<td></td>
<td>Road Machinery Ahead</td>
<td></td>
<td>Barricades</td>
</tr>
<tr>
<td>Right Lane Closed</td>
<td></td>
<td>Bridge Work Ahead</td>
<td></td>
<td>Portable Lighting</td>
</tr>
<tr>
<td>Left Lane Closed</td>
<td></td>
<td>Other:</td>
<td></td>
<td>Pilot Vehicle</td>
</tr>
</tbody>
</table>

Comments or revisions:
### Freeway/Multi-Lane, Road Diagram – Pg. # from Temporary Traffic Control Handbook (______)

<table>
<thead>
<tr>
<th>Type of Signs Required</th>
<th>No.</th>
<th>Type of Signs Required</th>
<th>No.</th>
<th>Other Traffic Control</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flagger Ahead</td>
<td></td>
<td>Transition</td>
<td></td>
<td>Cones</td>
<td></td>
</tr>
<tr>
<td>Be Prepared to Stop</td>
<td></td>
<td>Road Narrows</td>
<td></td>
<td>Signs</td>
<td></td>
</tr>
<tr>
<td>Road Work Ahead</td>
<td></td>
<td>Right Lane Ends</td>
<td></td>
<td>Shadow Vehicles</td>
<td></td>
</tr>
<tr>
<td>End Road Work</td>
<td></td>
<td>Left Lane Ends</td>
<td></td>
<td>Flaggers</td>
<td></td>
</tr>
<tr>
<td>Shoulder Work</td>
<td></td>
<td>Pilot Car Follow Me</td>
<td></td>
<td>Arrow Boards</td>
<td></td>
</tr>
<tr>
<td>Survey Crew Ahead</td>
<td></td>
<td>One Lane Ahead</td>
<td></td>
<td>Variable Message Signs</td>
<td></td>
</tr>
<tr>
<td>Road Closed</td>
<td></td>
<td>Road Machinery Ahead</td>
<td></td>
<td>Barriers</td>
<td></td>
</tr>
<tr>
<td>Right Lane Closed</td>
<td></td>
<td>Other:</td>
<td></td>
<td>Portable Lighting</td>
<td></td>
</tr>
<tr>
<td>Left Lane Closed</td>
<td></td>
<td>Other:</td>
<td></td>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

**Comments or revisions:**

---

### Intersection Road Diagram – Page # from Temporary Traffic Control Handbook (______)

<table>
<thead>
<tr>
<th>Type of Signs Required</th>
<th>No.</th>
<th>Type of Signs Required</th>
<th>No.</th>
<th>Other Traffic Control</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flagger Ahead</td>
<td></td>
<td>Transition</td>
<td></td>
<td>Cones</td>
<td></td>
</tr>
<tr>
<td>Be Prepared to Stop</td>
<td></td>
<td>Road Narrows</td>
<td></td>
<td>Signs</td>
<td></td>
</tr>
<tr>
<td>Road Work Ahead</td>
<td></td>
<td>Right Lane Ends</td>
<td></td>
<td>Shadow Vehicles</td>
<td></td>
</tr>
<tr>
<td>End Road Work</td>
<td></td>
<td>Left Lane Ends</td>
<td></td>
<td>Flaggers</td>
<td></td>
</tr>
<tr>
<td>Shoulder Work</td>
<td></td>
<td>Pilot Car Follow Me</td>
<td></td>
<td>Arrow Boards</td>
<td></td>
</tr>
<tr>
<td>Survey Crew Ahead</td>
<td></td>
<td>One Lane Ahead</td>
<td></td>
<td>Variable Message Signs</td>
<td></td>
</tr>
<tr>
<td>Road Closed</td>
<td></td>
<td>Road Machinery Ahead</td>
<td></td>
<td>Barriers</td>
<td></td>
</tr>
<tr>
<td>Right Lane Closed</td>
<td></td>
<td>Other:</td>
<td></td>
<td>Portable Lighting</td>
<td></td>
</tr>
<tr>
<td>Left Lane Closed</td>
<td></td>
<td>Other:</td>
<td></td>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>

**Comments or revisions:**

---
Check List for Work Zone Layout & Operation

Use the following check list for good practices in work zone layout and operations:

Each operation requires a work zone traffic control plan.
- Determine and note the relevant diagram(s) in the handbook.
- Note any special or unique traffic control needs and revisions to a diagram to accommodate the work and site conditions.
- Consult with a qualified person in your agency and/or the permitting agency for any changes not discussed in this handbook.
- All changes must meet the standards and guidelines of this handbook and the MUTCD.

Stay out of the travel lanes as much as possible.
- Maintain normal travel paths as much as possible while allowing for work area safety.
- The traffic control should be designed to move traffic past the area smoothly.

Do not tell drivers to break the law.
- This means being aware of regulatory signs and pavement markings as well as traffic signals that will conflict with your traffic control.
- Be sure you have road authority permission to override and cover any regulatory traffic movement signs and signals.
- For work in place less than an hour, emphasize your work activity by using a combination of highly visible signs, flashing/rotating beacons or light bar, arrow panel or truck-mounted PCMS.

Do not let traffic stop on or across the tracks or between the crossing markings and the tracks at a railroad crossing.
- Extend the work area if it’s close to the tracks to include the railroad crossing inside your traffic control zone.
- If the work site is away from the crossing but traffic queues may reach across the tracks, provide flaggers at the railroad crossing to prevent vehicles from stopping on or too near the tracks.

Always give advance warning.
- Use advance warning shown in this handbook for the type of work.
- Be sure that approaching drivers can see the work area in plenty of time to be able to pass by safely. Adjust the spacing of signs and tapers as necessary.
- Maintain a consistent distance between warning signs. If one distance needs to be adjusted, adjust all the distances similarly.

Delineate the work area and travel paths clearly with cones, tubes, barrels or barricades. Driver confusion = crashes.
- Chevrons, arrows, or flashers on cones may be added if needed.
- Too many devices can make the travel path hard to see on curved sections.
- Drive through the traffic control zone and then adjust if necessary.

Place signs where they will do their job properly.
• Keep at least the minimum spacing between signs from the sign spacing table.
• Keep sign spacing consistent for each approach to the work site.
• Maintain good sight distances:
  • for each sign,
  • for lane shifts and changes, and
  • for equipment and workers in the road or on the immediate shoulder. Use at least 3 cones placed near the work if the work isn’t visible from the nearest advance warning sign.
• Make sure the signs are placed in the driver’s line of sight and within the headlight beams if headlights are needed.
• Make sure signs are not blocked by parked vehicles, trees, utility poles or other roadside features. Adjust the sign spacing if necessary.

Remove signs, cones and barrels as soon as they are no longer appropriate.
• Keep in place only what is needed.
• Inappropriate signs and devices can confuse drivers or lead them into your work area.

Ensure that all workers are wearing high visibility clothing appropriate for the work.
• Safety attire must be clean and in good condition.
• Safety attire must be worn and function properly so that the reflective area has 360° visibility.
• The type of clothing must meet the minimum requirements for the work as determined by the employer and/or permit or contract.

Leave a safety clearance area or buffer.
• Maintain the buffer area clear of work vehicles, equipment, materials and activity.
• Leave as close to 5 feet or more as practical of clearance between your work area and the line of cones used to mark the edge of the travel lane.
• Allow for a leading buffer on the near traffic approach to the work area if possible. Consider closing off parking spaces if there is on-street parking.

For worker protection, you may position a work vehicle in an area closed to traffic and in front of the work.
• Leave enough buffer space to the work activity to allow for run-out if the vehicle is hit.
• Turn the vehicle wheels so that if it’s hit, the vehicle will move away from both traffic and the work activity.

Accommodate safe and convenient access for pedestrians and cyclists including pedestrians with disabilities. Consider any pedestrian and cyclist needs including accessibility when setting up the traffic control for a work area.
Oregon Temporary Traffic Control Handbook
List of Errata
Approved by Oregon Transportation Commission
December 13, 2005

Note: Clicking on ‘ERRATA’ will take you back to the body of the OTTCH

ERRATA – page 15, revise last sentence of first paragraph under “Unattended Work Sites”, so that the last sentence reads:
If equipment must be left on the shoulder less than 15 feet from the fog line or in a closed lane, the equipment must be delineated the same as a PCMS.

ERRATA – page 19, revise TABLE 1: Taper Lengths to reflect proper number of cones as follows:

<table>
<thead>
<tr>
<th>Lane Width</th>
<th>10 Feet</th>
<th>11 Feet</th>
<th>12 Feet</th>
<th>Shoulder Tapers</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPH</td>
<td>Merge</td>
<td>Cone</td>
<td>Shift</td>
<td>Merge</td>
</tr>
<tr>
<td>20</td>
<td>70</td>
<td>5</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td>105</td>
<td>7</td>
<td>55</td>
<td>4</td>
</tr>
<tr>
<td>30</td>
<td>150</td>
<td>9</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>35</td>
<td>205</td>
<td>12</td>
<td>105</td>
<td>7</td>
</tr>
<tr>
<td>40</td>
<td>270</td>
<td>15</td>
<td>135</td>
<td>8</td>
</tr>
<tr>
<td>45</td>
<td>450</td>
<td>13</td>
<td>225</td>
<td>7</td>
</tr>
<tr>
<td>50</td>
<td>500</td>
<td>14</td>
<td>250</td>
<td>8</td>
</tr>
<tr>
<td>55</td>
<td>550</td>
<td>15</td>
<td>275</td>
<td>8</td>
</tr>
<tr>
<td>60</td>
<td>600</td>
<td>16</td>
<td>300</td>
<td>9</td>
</tr>
<tr>
<td>65</td>
<td>650</td>
<td>18</td>
<td>325</td>
<td>10</td>
</tr>
<tr>
<td>70</td>
<td>700</td>
<td>19</td>
<td>360</td>
<td>10</td>
</tr>
</tbody>
</table>

All taper lengths are rounded up to the nearest 5 feet.
Shoulder taper is figured on a ten (10) foot shoulder width.

Cone spacing is 20 feet for speeds of 40 and below
Cone spacing is 40 feet for speeds of 45 and above

ERRATA – page 29, revise first sentence of first complete paragraph to read:
Per MUTCD 2A.07, variable message signs may be used in lieu of required warning signs for frequently changing situations (see Section 100 Mobile operations for typical applications).

ERRATA – page 40, revise note #2 to read:
2. For work on roadways with a posted or statutory speed of 25 MPH or less, signs mounted on the work vehicle are not required if the vehicle displays the high-visibility lights. For work on roadways above 25 mph, signs should be mounted on the work vehicle.

ERRATA – page 42, revise note #2 to read:
2. For work on roadways with a posted or statutory speed of 25 MPH or less, signs mounted on the work vehicle are not required if the vehicle displays the high-visibility lights. For work on roadways above 25 mph, a sign is optional on the work vehicle if a shadow vehicle is used.

ERRATA – page 54, revise note #2 to read
2. If equipment operation and activities are more than 15 feet from the fog line, signs and cones are not required.

ERRATA – page 54, revise note #5 to read
5. For work in place for more than one hour at least one sign is required and two signs are recommended.

ERRATA – page 55, revise Diagram No. 210 to change note with double asterisk to read:
**Recommended when work is in place longer than 1 hour

ERRATA – page 60, revise note #2 to read:
2. The BE PREPARED TO STOP sign is optional for roads with a posted or statutory speed of 40 mph or below.
ERRATA – page 60, revise note #10 to read:

10. On streets with a posted or statutory speed of 40 MPH or less, the Self-Regulating Single Lane Closure Diagram may be used.

ERRATA – page 60, revise note #11 to read:

11. Cones should be used to outline the work area when curves or other roadway alignments prevent clear direction for the motorists to pass by the work zone safely. Cones are recommended when posted or statutory speeds are 45 or over, when working under heavy traffic or when travel lanes are narrower than 11 feet. Cones are optional with a pilot car.

ERRATA – page 60, revise note #13 to read:

13. When flagging near an intersection, at least the FLAGGER AHEAD sign should be visible to traffic entering from the side road(s). Additional signs may be placed on the side road(s) so approaching traffic has the opportunity to view the advance warning sign and the FLAGGER AHEAD sign.

ERRATA – page 60, revise note #14 to read

14. See Section on Night Flagging in Appendix B.

ERRATA – page 61, revise Diagram No. 320 to reflect proper limits for 1 mile maximum distance on right portion of diagram and to clarify the protection vehicle is optional (see new Diagram No. 320).

ERRATA – page 64, revise note #4 to read:

4. Side accesses should be controlled. Low traffic volume accesses may be posted with FOLLOW PILOT CAR signs in lieu of flaggers. If residents can be contacted, arrangements can be made for residential driveways so that flaggers are not needed.

ERRATA – page 73, revise Diagram No. 410 to reflect new sign and proper locations (see new Diagram No. 410).

ERRATA – page 77, revise Diagram No. 430 to reflect correct order of signing and optional taper (see new Diagram No. 430).

ERRATA – page 78, revise note #4 to read:

4. On streets with a posted or statutory speed of 45 MPH or higher, advance warning signs should be placed in the median as well as on the shoulder. If there is no median room for signs, consider use of a trailer or truck-mounted PCMS in advance of the work zone.

ERRATA – page 80, revise note #5 to read:

5. On streets with a posted or statutory speed of 45 MPH or higher, advance warning signs should be placed in the median as well as on the shoulder. If there is no median room for signs, consider use of a trailer or truck-mounted PCMS in advance of the work zone.

ERRATA – page 82, revise note #3 to read:

3. When the posted speed is 40 mph or less and work in place for less than 15 minutes, a truck mounted arrow panel or PCMS may be used in place of required signs and cones as shown on the drawing and discussed below.

ERRATA – page 84, revise note #2 to read:

2. When the posted speed is 40 mph or less and work in place for less than 15 minutes, an arrow panel in caution mode or PCMS with the LANE CLOSED message may be used in place of the required signs and cones as shown on the drawing and discussed below.

ERRATA – page 88, revise note #4 to read:

4. There should be one flagger for each approach. One flagger may control two adjacent approaches if sight distance, low volumes on side roads and flagger position allows for safe operation and clear direction to motorists. For low traffic volume intersections one flagger may be used.

ERRATA - page 98, revise note #2 to read:

2. If equipment operation and activities are more than 15 feet from the fog line, signs and cones are not required.
ERRATA – page 98, revise note #5 to read:

5. The shoulder should be closed as shown if the sight distance is reduced to less than 750 feet or if 15 feet of clearance between the work vehicle and the fog line can’t be maintained.

ERRATA – page 98, revise note #7 to read:

7. For work that moves frequently and is in one place less than one hour, advance signing may be placed to cover a distance that includes all work locations for 5 miles to reduce the risk exposure in placing signs. Maintain an advance warning truck-mounted sign or PCMS within 1000 to 1500 feet in advance of the work.

ERRATA – page 100, revise note #3 to read:

3. Placement of signs in the median are required for left lane closures and any time when there is room for a truck to be parked on the left out of the travel lane to place the signs. For right lane closures when there is no room for a truck to be parked on the left, placement of signs in the median shall be optional for work that is less than four hours in duration. Smaller 36 inch signs may be used where there is not sufficient room for a 48 inch sign with a 1 to 2 foot shy distance to the fog line.

ERRATA – page 100, revise note #4 to read:

4. If signs are not used in the median, additional advanced warning devices will be used such as PCMS or ground mounted signs on the right shoulder to provide additional warning to the motorists.

ERRATA – page 101, revise Diagram No. 720 to reflect proper distances and change ROAD WORK 1 MILE to ROAD WORK AHEAD (see new Diagram No. 720).

ERRATA – page 106, revise note #3 to read:

3. For work in place less than an hour, the exit may be closed with one advance sign indicating the exit is closed, placement of cones across the exit and a black-on-white flexible rectangular EXIT CLOSED or ROAD CLOSED sign on the ramp.

ERRATA – page 107, revise Diagram No. 750 to reflect posting a ROAD CLOSED or EXIT CLOSED black-on-white flexible rectangular sign (see new Diagram No. 750).

ERRATA – page 109, revise Diagram No. 760 to reflect proper signs and cones (see new Diagram No. 760).

ERRATA – page 125, delete note #3 under Night Flagging.

ERRATA – page 127, revise first paragraph under Pilot Car Operation to read:

A pilot car should be used to guide traffic through a long section of one lane, two-way road past the road sections closed for work activity. A pilot car should be considered if a driver can’t see from one end of the job to the other after entering the one lane section and there is opportunity to move into the closed lane. Alternately, the closed lane may be emphasized with longitudinal cones or other channelizing devices and occasional transverse barricade or cone taper inside the closed lane.

ERRATA – page 127, revise note # 4 under Pilot car operation to read:

4. Side accesses should be controlled. Low traffic volume accesses may be posted with FOLLOW PILOT CAR signs in lieu of flaggers.

ERRATA – page 130, revise Appendix C - Traffic Control Plan to delete the sentence: “These plans should be maintained for a minimum of 1 year from the date of the maintenance operation.”
Work Near an Entrance Ramp - Right Side

Diagram No. 760

For A, B & C: See Table 2
(Sign Spacing)