South Carolina



Work Zone Safety Guidelines

— 2026 —

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Policy Updates

SCDOT has adopted new practices for some items that are not yet reflected in this handbook or other manuals. The following items may be considered at the Engineer's discretion. These items are expected to be reflected in updates of future drawings.

On multi-lane routes:
Portable plastic drums are acceptable for use as the traffic control device in the transition area (merging taper) of lane closures in place of Type II Barricades. Type II Barricades are still permissible for use in this application. Do not use Type II Barricades and portable plastic drums together in the same taper or in multiple tapers in the same travel direction (when applicable for closing more than one lane).

R4-7 ("keep right") and R4-8 ("keep left") signs may be omitted in the transition area (merging taper) of lane closures.

R4-1 ("do not pass") signs may be omitted in the advance warning area for lane closures. Spacing adjustments of the remaining signs, excluding those that provide a specific distance, may be considered.

R4-1 ("do not pass") signs may be added along the activity area when traffic in that direction is reduced to a single open lane.

During Nighttime Flagging Operations: All flaggers shall wear properly retroreflectorized hard hats and high visibility safety apparel consisting of a safety vest and safety pants that meet the ANSI/ISEA 107 Performance Class 3 requirements.

Introduction

The primary function of temporary traffic control (TTC) is to facilitate movement of road users through or around TTC zones while protecting road users, workers, responders to traffic incidents, and equipment. A concurrent objective of the TTC is the efficient construction and maintenance of the highway.

The purpose of this handbook is to present basic guidelines for Work Zone TTC installation and maintenance. This handbook complies with the basic requirements of the *Manual on Uniform Traffic Control Devices* (*MUTCD*), *Part 6*, latest edition, which contains the National Standards for Work Zone traffic control and the South Carolina Department of Transportation (SCDOT) specifications with particular emphasis on Short-Term work sites on roads and streets in rural and small urban areas. **This handbook is not intended for TTC applications on Interstate Routes.**

This handbook presents information and gives examples of TTC applications for Work Zones on two-lane and multi-lane Primary & Secondary Routes. This information is intended to illustrate the principles of proper Work Zone traffic control, but is **not** a standard.

This handbook does **not** cover Flagging Operations. Work Zones involving Flaggers are addressed in the *South Carolina Flagger's Handbook*, latest edition. Both of these handbooks should be used together to increase safety for workers and road users in Work Zones.

This handbook is **not** applicable to work performed under contract to the SCDOT. All Work Zones installed and maintained for SCDOT contract work **shall** comply with the typical traffic control standard drawings of the *Standard Drawings for Road Construction*.

Definitions

Flagger – A person who ensures the safety of workers and road users by using clear, positive directions to actively control the flow of road users into and/or through a temporary traffic control zone.

High-Speed – Consider a high-speed road to have a posted regulatory speed limit of 55 MPH or greater.

Intermediate-Speed – Consider an Intermediate-Speed road to have a posted regulatory speed limit of 40 MPH to 50 MPH.

Low-Speed – Consider a low-speed road to have a posted regulatory speed limit of 35 MPH or less.

Low-Volume – As a general rule, a low-volume road can be considered one on which the average daily traffic (ADT) volume does not exceed 400 vehicles per day. If the traffic volumes are not known, the following rule of thumb can be used.

> ***Rule of Thumb*** – Count the number of vehicles that pass a single reference point over a 5 minute period. If not more than 3 vehicles pass the reference point in that period, then the road can be considered low-volume.

Special attention should be given to local, nearby facilities, such as schools, manufacturing plants, etc., that cause special traffic generation. Consideration should also be given as to whether the Work Zone location is subject to peak-hour traffic increases. Peak hours are usually 7 AM9 AM and 4 PM6 PM, but will vary in different areas.

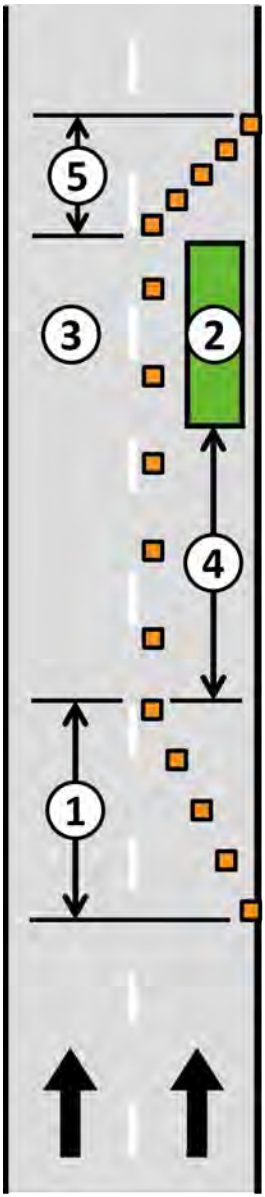
Minor Urban Street – A low-volume, low-speed, two-lane urban street.

Spotter – An individual who observes traffic either for the Flagger or for the worker who is performing work in the Work Area.

Urban Street Conditions – These streets are characterized by relatively low speeds, pedestrian activity, intersections, and frequent driveways for businesses and houses. While urban Work Zones usually will be on a city or town street, a Work Area does not need to be within a municipality's corporate limits to be considered an urban condition.

Four Areas of a TTC Zone

The TTC Zone is the area between the first Advance Warning Sign and the point beyond the Work Space where traffic is no longer affected. Below is a diagram showing the Four Areas of a TTC Zone.



Termination Area

lets traffic resume normal operations

may include: **5.** Taper

Activity Area

space for workers, equipment, material storage, and Shadow Vehicle, if used

includes: **2.** Work Space

3. Traffic Space

may include: **4.** Buffer Space

Transition Area

moves traffic out of its normal path

includes: **1.** Taper

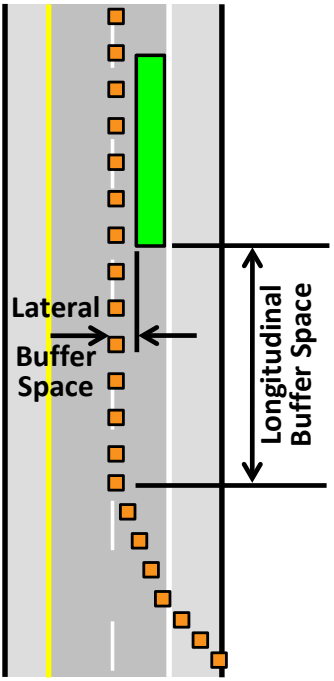
Advance Warning Area

tells traffic what to expect ahead

includes: Advance Warning Signs

Buffer Space

The Buffer Space is an optional part of the TTC Zone. It serves to separate road user flow from the Work Space or an unsafe area, and might provide some recovery space for an errant vehicle. Neither work activity nor storage of equipment, vehicles or materials should occur in this area.



The table below is taken from the *MUTCD* and provides guidelines for Longitudinal Buffer Space in a TTC Zone based on speed. These lengths are for normal conditions and may need to be adjusted due to vertical and horizontal curves that obstruct sight distance, driveways, intersecting roadways, etc.

A Lateral Buffer Space may also be used to separate passing traffic from the Work Space. Its use and width are based on engineering judgment considering conditions at the work site.

Guidelines for Buffer Space Lengths

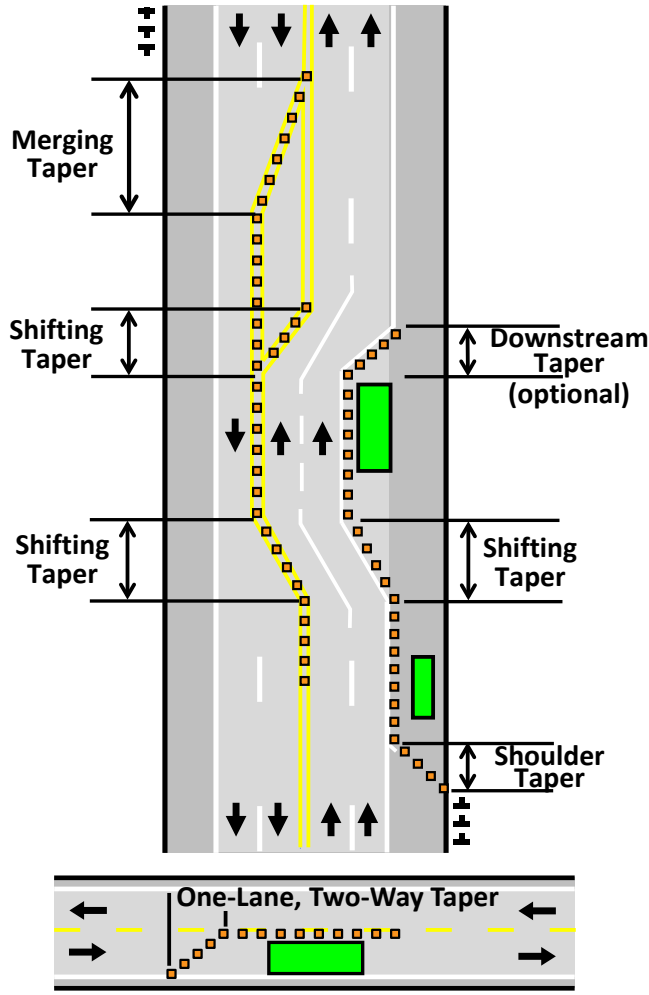
Speed	Length	Speed	Length
0 MPH	115'	50 MPH	425'
25 MPH	155'	55 MPH	495'
30 MPH	200'	60 MPH	570'
35 MPH	250'	65 MPH	645'
40 MPH	305'	70 MPH	730'
45 MPH	360'	75 MPH	820'

SCDOT recommends that a Buffer Space be a part of every TTC Zone when space is available, and when one is used it shall be 200’ to 400’ in length.

Tapers for Work Zones

Tapers are created by using a series of channelizing devices and/or pavement markings to move traffic out of or into the normal path. There are 5 types of tapers used in TTC Zones. The length of Merging, Shifting, and Shoulder Tapers is based on formulas using the posted regulatory speed limit of the roadway prior to beginning the work and the width of the offset (or lane width). The length of a taper may require adjustments due to field conditions such as hills, curves, intersecting roads, etc.

Types of Tapers



Taper Lengths

The tables below list the 5 types of tapers and their lengths used in TTC Zones as well as the formulas used to calculate the length of Merging, Shifting, and Shoulder Tapers.

Type of Taper	Taper Length
Merging Taper	At least L
Shifting Taper	At least ½ L
Shoulder Taper	At least ⅓ L
One-Lane, Two-Way Taper	50’ Min. to 100’ Max.
Downstream Taper (*use is optional*)	50’ Min. to 100’ Max.

Posted Regulatory Speed Limit	Formula
40 MPH or Less	$L = \frac{WS^2}{60}$
45 MPH or Greater	L = WS
L = Taper Length in feet W = Width of offset in feet S = Posted Regulatory Speed Limit, off-peak 85th percentile speed prior to starting work, or anticipated operating speed in MPH	

Traffic Control Devices (TCDs)

All TCDs shall comply with *AASHTO Manual for Assessing Safety Hardware* (*MASH*) and *NCHRP Report 350* requirements. To be effective TCDs should meet the following basic requirements.

- Fulfill a need.
- Command attention.
- Convey a clear, simple meaning.
- Command the respect of the road user.
- Give adequate time for a proper response.

The following are the 4 types of TCDs used in Work Zone traffic control:

- Signs.
- Channelizing Devices.
- Lighting Devices.
- Pavement Markings.

Signs

TTC Zone signs convey both general and specific messages by means of words, symbols, and/or arrows and have the same three categories as all road user signs – Regulatory, Warning, and Guide. The overall effectiveness of traffic signs is based on target value, priority value, visibility, legibility, and illumination.

Regulatory Signs

Regulatory Signs impose legal restrictions and may not be used unless authorized by the public agency having jurisdiction. These signs are normally rectangular shaped, having a black symbol or message on a white background. Exceptions include the STOP, YIELD, DO NOT ENTER, and WRONG WAY signs that have a white symbol or message on a red background.





Guide Signs

Guide Signs commonly show destinations, directions, and distances. These signs are normally rectangular shaped, having a white symbol or message on a green background, but may have a black symbol or message on an orange background when used in a TTC Zone.





Warning Signs

Permanent Warning Signs have a black symbol or message on a yellow or fluorescent yellow background. In SC, the following signs are to be Type XI microprismatic fluorescent yellow sheeting:

- Horizontal Alignment (W1 Series).
- Advisory Speed Plaques (W13 Series).
- Advance Traffic Control (W3-1, W3-2, W3-3) (Stop Ahead, Yield Ahead, Signal Ahead).
- Intersection Warning Signs (W2 Series & W1-7, W4-4P, W4-4aP, W4-4bP).

Permanent Warning Signs may remain in the TTC Zone if they are still applicable.



Yellow **Fluorescent Yellow**

Temporary Warning Signs give notice of conditions that might not be readily apparent to road users. These signs are normally diamond shaped, having a black symbol or message on an orange background.



While Regulatory Signs, Guide Signs, and Warning Signs can appear in Work Zones, Temporary Warning Signs are by far the most extensively used, and therefore are the focus of this handbook.

Temporary Warning Signs

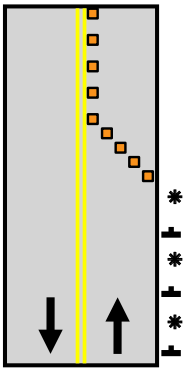
Construction and Maintenance Warning Signs are used extensively in street and highway Work Zones. As a general rule, these signs are located on the right-hand side of the street or highway but may be located on both sides for some typical applications (e.g., four-lane multi-lane roads with grass medians).

Roll-up type material signs, or an approved composite type sign, may be used on portable sign supports. **Mesh signs are not allowed**.

Sign Spacing

Distances shown in the table below are approximate. Sign spacing should be adjusted for curves, hills, intersections, driveways, etc., to improve sign visibility so road users can read the sign, understand it, and take the necessary action before being presented with the next sign. In addition, judgment should be used for good visibility (e.g., if blocking view of an existing sign).

Advance Warning Sign Spacing	
Speed Limit	✱
Low-Speed 35 MPH or Less	**200'**
Intermediate-Speed 40 MPH – 50 MPH	**350'**
High-Speed 55 MPH or Greater	**500'**



Spacing between the signs can be determined by using one of these 4 methods:

- Distance Measuring Instrument (DMI) mounted on the dash of the vehicle.
- Measuring wheel.
- Odometer (one-tenth of a mile is approximately 500').
- Skip lines – length of skip line is 10' and spacing between skip lines is 30' for a total of 40'.

Sign Size

The standard size for Advance Warning Signs in TTC Zones generally is 48” x 48”. For moderately low speeds and volumes, a minimum size of 36” x 36” may be used (see *MUTCD, Part 6,* latest edition for sign sizes).

Sign Illumination and Retroreflectorization

All signs used during the hours of darkness shall be made of retroreflective material or shall be illuminated. Street or highway lighting is not regarded as meeting the requirements for sign illumination.

Reflectorize all orange Advance Warning Signs and any orange areas of a multi-colored advance sign with a fluorescent orange-colored prismatic reflective sheeting.

Sign Mounting

Mount the Advance Warning Signs on either U-Channel or square steel tube posts (permanent supports), approved temporary sign supports, or approved Type 3 barricades. A High-level Warning Device (Flag Tree) can also be used to mount signs. However, this device is used to supplement other TCDs in Short-term Operations.

Mount rigid signs on ground-embedded sign supports.

Mount portable sign supports straight and level with the face of the signs perpendicular to the roadway surface.

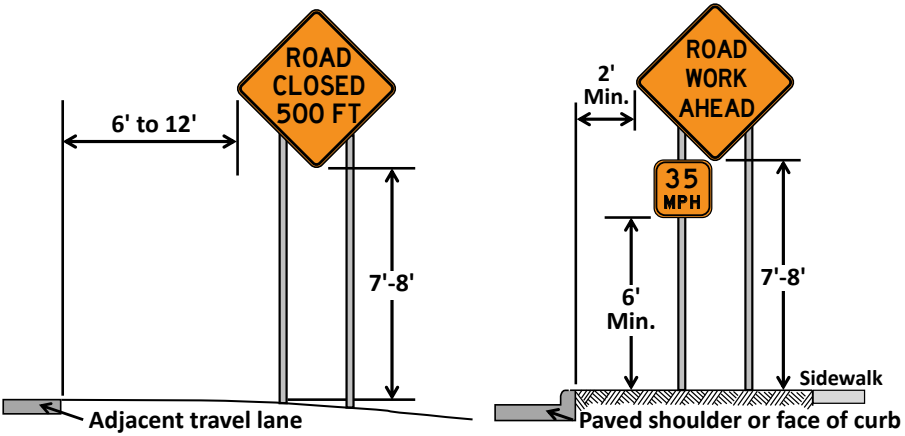
When mounting signs on multiple ground-embedded sign supports, ensure that each post is of the same type. Combining and installing both ground-embedded U-Channel and square steel tube posts within the same sign assembly is **prohibited**.

Ground-Embedded Supports

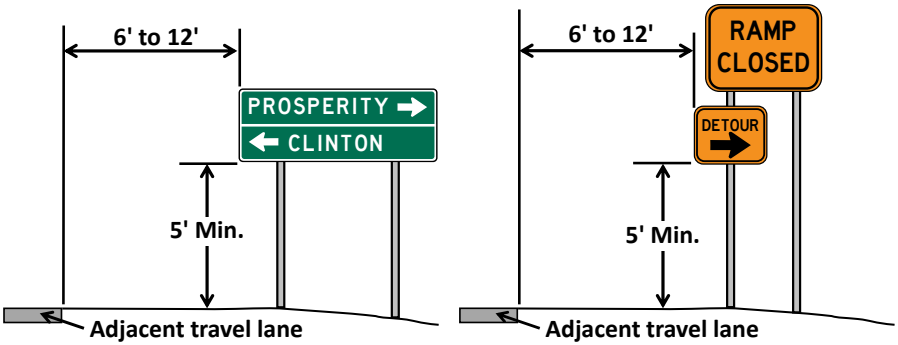
When sufficient shoulder space is available, install signs mounted on ground-embedded sign supports 6’ to 12’ from the near edge of an adjacent travel lane to the nearest edge of the sign if no paved shoulder is present. Where paved shoulders are present, install these signs no less than 2’ from the near edge of the paved shoulder. Where curb and gutter is present, install these signs no less than 2’ from the face of the curb.

The mounting height for Regulatory Signs or Advance Warning Signs erected on a groundmbedded U-Channel or square steel tube post is no less than 7’ nor no greater than 8’ from the bottom edge of the sign to the grade elevation of the near edge of the adjacent travel lane or sidewalk when a sidewalk is present.

The minimum mounting height of a secondary sign mounted on the same assembly is 6’ from the bottom edge of the secondary sign to the grade elevation of the near edge of the adjacent travel lane or sidewalk when a sidewalk is present unless otherwise specified. The secondary sign shall not overlap or encroach upon the face of the primary sign.



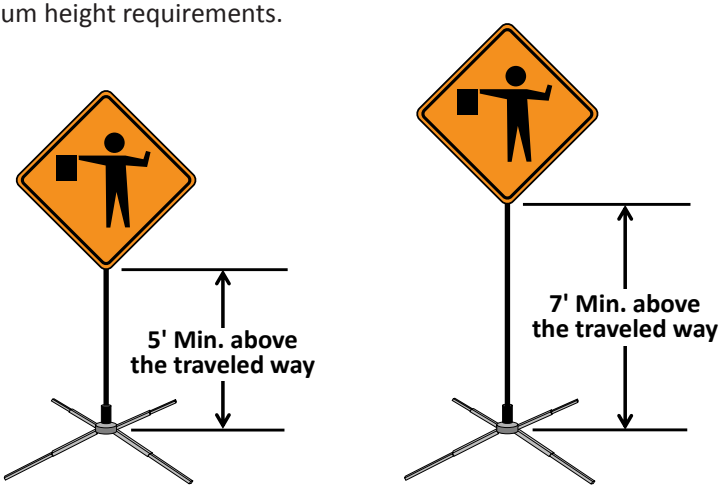
The minimum mounting height for Guide Signs, including Detour Sign assemblies with multiple sign panels, erected on ground-embedded



U-Channel or square steel tube posts should be no less than 5’ from the grade elevation of the near edge of the adjacent travel lane to the bottom of the route sign or the Detour Sign panel (M4-9) unless otherwise directed by the Owner.

Portable Sign Supports

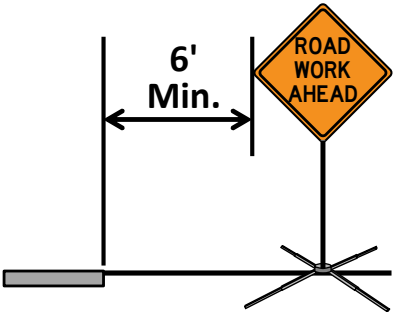
The minimum mounting height of signs mounted on portable sign supports is 5’ from the ground to the bottom edge of the sign. However, in locations where the minimum sign height is specified to be 7’, utilize portable sign supports capable of providing the minimum mounting height of 7’ from the ground to the bottom edge of the sign in these locations. The legs on the sign supports should be flat on the ground and not in a raised position to achieve the minimum height requirements.



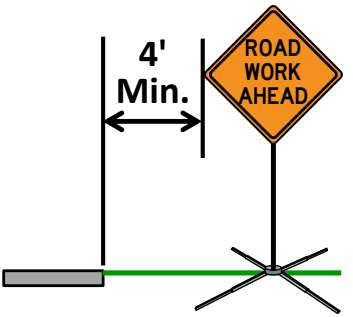
If 7' minimum is specified

NOTE: The legs on the sign supports should be flat on the ground and not in a raised position to achieve the minimum height requirements.

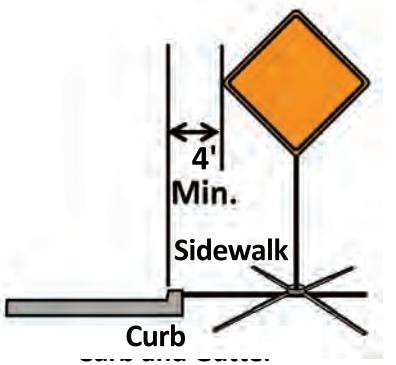
Install signs mounted on portable sign supports with the lateral offsets depicted on this page. Do not place signs within sidewalks or bike lanes if they are otherwise open to travel. Where sidewalks remain open maintain a minimum 4’ sidewalk width.



Paved Shoulder

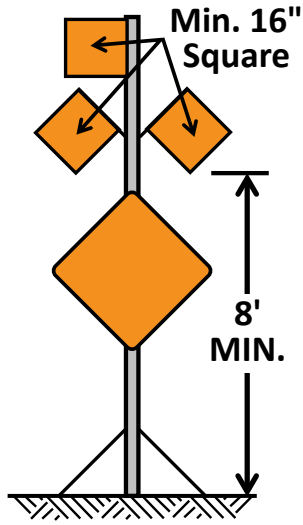


Earth Shoulder



High-Level Warning Device (or Flag Tree)

- Designed to be seen over the top of typical passenger cars.
- Used primarily in high-density road user situations to warn road users of Short-term Operations.
- Used to supplement other TCDs.
- Shall consist of a minimum of 2 flags with or without a Type B High-intensity Flashing Warning Light.
- Distance from the roadway to the bottom of the lens of the light and to the lowest point of the flag material shall not be less than 8’.
- The flag shall be 16” square or larger and shall be orange or fluorescent red-orange in color.



- An appropriate Advance Warning Sign may be mounted below the flags.

Signs Currently Not In Use

Ground-Embedded Signs

When Advance Warning Signs mounted on ground-embedded U-Channel posts or square steel tube posts are not in use, cover the signs in their entirety with an opaque material or remove them from the Work Area.

When covering signs with opaque materials, do not attach a covering material to the face of the sign with tape or a similar product or any method that may leave a residue on the retroreflective sheeting.

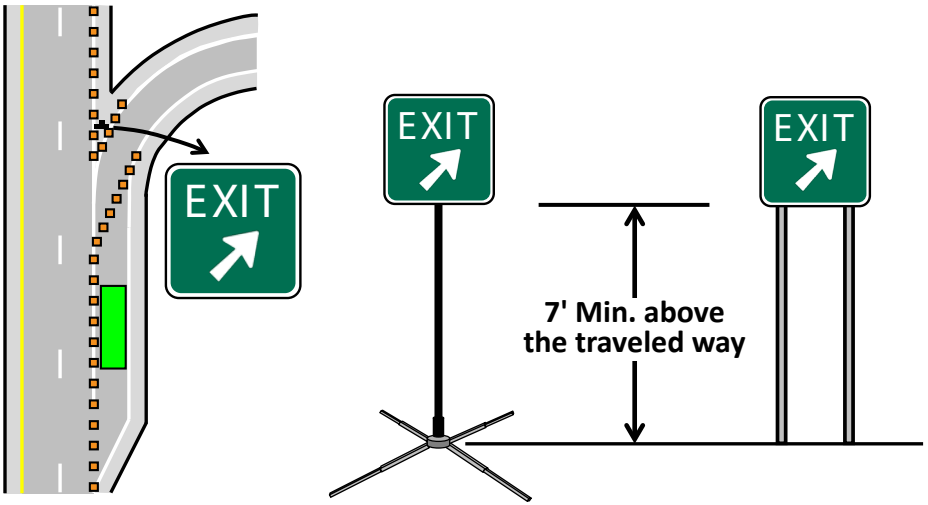
Portable Signs

When Advance Warning Signs mounted on portable sign supports are not in use, remove and relocate the portable sign supports to a location beyond 15’ from the near edge line of a Primary & Secondary travel lane.

Ensure that all portable sign supports lie flat with the legs in a retracted position when not in use. **Do not redirect a sign when not in use.**

Temporary EXIT Signs

Mount temporary EXIT signs (E5-1) located within temporary Gore Areas during Lane Closures on **multi-lane roadways** at a minimum height of 7’ from the ground to the bottom edge of the sign in accordance with the requirements of the *MUTCD*, latest edition. The minimum mounting height of 7’ for a temporary EXIT sign applies to installation on ground-embedded UChannel posts, square steel tube posts, and portable sign supports. The EXIT sign is required to be green with white legend and border.



Temporary Steel Plates

Install STEEL PLATE AHEAD signs (W8-24-48) in advance of an area of roadway where temporary steel plates are present. Install these signs no further than 300’ in advance of locations where steel plates are present.



GROOVED PAVEMENT Signs

Install GROOVED PAVEMENT signs (W8-15-48) supplemented with the “Motorcycle” plaque (W8-15P-30) in advance of milled or surface planed pavement surfaces. Install these signs no further than 500’ in advance of the beginning of this pavement condition on Primary Routes.



Channelizing Devices

Channelizing devices are used to warn and alert drivers of hazards in Work Zones, to protect workers, to separate traffic from the Work Space, and to guide and direct road users as well as pedestrians past the hazards. Channelizing devices include:

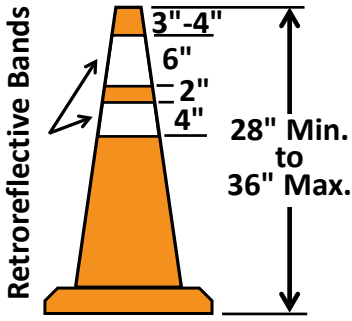
- Standard Traffic Cones.
- 42” Oversized Traffic Cones.
- Drums.
- Barricades.
- Vertical Panels.

Standard Traffic Cones

Standard traffic cones are the most common channelizing device used in Work Zones.

Standard traffic cones shall be predominately orange in color and a minimum of 28” in height.

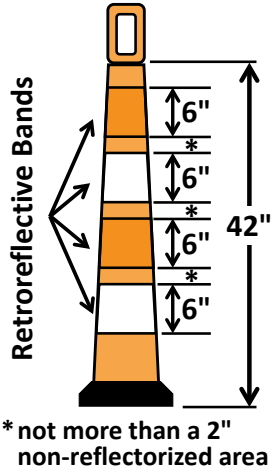
Standard traffic cones used at night shall be a minimum of 36” in height and shall have 6” and 4” retroreflectorized white collars.



42” Oversized Traffic Cones

The 42” oversized traffic cones (also known as channelizer cones) are permitted for use during Flagging Operations on two-lane, two-way roadways, Lane Closures on multi-lane roadways, Daytime Shoulder Closures, and to mark specific hazards.

The 42” oversized traffic cones are unacceptable for delineation of a pavement edge. Portable plastic drums are required for delineation of a pavement edge.



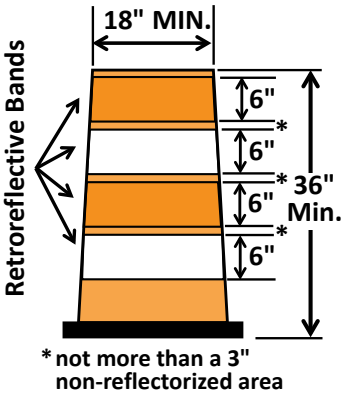
Reflectorize the 42” oversized traffic cones with Type IV or higher flexible retroreflective sheeting. Retroreflectorized bands, 2 orange and 2 white, shall be 6” wide and installed in an alternating pattern placing a fluorescent orange stripe at the top. Separate each retroreflective band with not more than a 2” non-reflectorized area.

Ensure that each cone has a handle-type structure on top of the cone to facilitate relocation, installation, and removal operations.

Drums

Portable plastic drums may be utilized to develop taper sections and channelize traffic into Lane Closures, channelize traffic through the tangent section or Activity Area of a Lane Closure, delineate travel lanes, delineate Shoulder Closures, delineate the pavement edge of a roadway and delineate excavations and structures.

Portable plastic drums are the preferred TCD for channelization and delineation of a travel way during the hours of darkness.



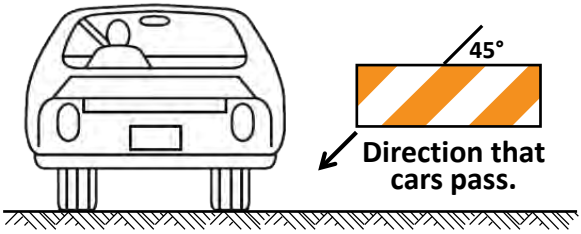
Reflectorize portable plastic drums with Type IV or higher flexible retroreflective sheeting. Ensure each drum has a minimum height of 36” and minimum width of 18”. Reflectorized bands shall consist of 6” wide alternating bands, 2 orange and 2 white, with the top band always being fluorescent orange. Ensure that any non-reflectorized area between the orange and white retroreflective bands does not exceed 3”.

Barricades

A barricade is a portable or fixed device having from 1 rail to 3 rails with appropriate markings and is used to control road users by closing, restricting, or delineating all or a portion of the right-of-way.

A warning light is optional unless required by the drawing.

Stripes on barricade rails slope downward at an angle of 45° in the direction traffic is to pass (see below). Reflectorize all barricades with Type IX or Type XI microprismatic retroreflective sheeting.



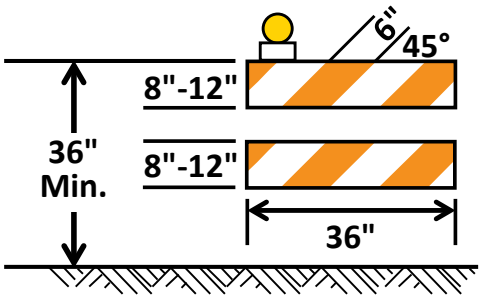
Ballast shall not be placed on top of any striped rail. Barricades shall not be ballasted by non-deformable objects such as rocks or chunks of concrete. Devices used on High-Speed roadways and in other situations where they are susceptible to overturning in the wind should be ballasted with sandbags placed at or near ground level.

Type 1. SCDOT **prohibits** the use of Type 1 barricades in TTC Zones.



Type 2. Type 2 Barricades are used to develop taper sections and channelize traffic into Lane Closures, delineate travel lanes, and delineate excavations and structures.

Type 2 barricades shall have 2 horizontal chevron rails that shall be 36” long and shall be 8”12” wide. The rail stripe width shall be 6”. The top of the top rail shall be a minimum of 36” above the surface level.

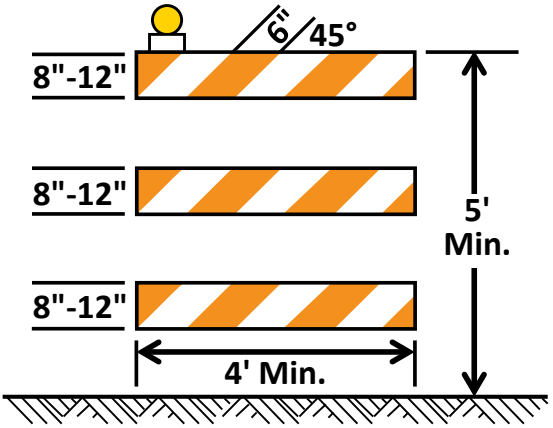


NOTE: A warning light is optional unless required by the drawing.

Type 3. Type 3 barricades are used to close a roadway to traffic and to prevent traffic from entering a Work Area rather than channelizing traffic around or away from a potential hazard.

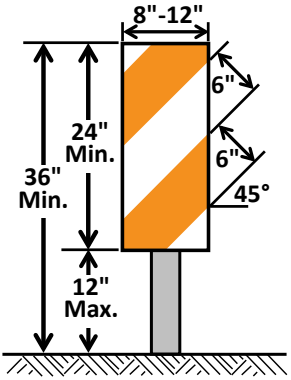
Type 3 barricades should be a minimum length of 4’; have 3 horizontal chevron rails that are 8”12” wide; and stripes shall be 6”wide. The top of the top rail shall be a minimum of 5’ above the surface level.

Type 3 barricades may be supplemented with Advance Warning Signs fabricated from either an approved roll-up retroreflective fabric material or an approved rigid aluminum laminate composite substrate. These signs should not cover more than 50 percent of the top 2 rails or 33% of the total area of the 3 rails.



NOTE: A warning light is optional unless required by the drawing.

Vertical Panels



Vertical panels are narrow devices with a width of 8” to 12” and at least 24” in height. They shall have orange and white diagonal stripes. The dimensional characteristics, color, and meaning of the sloping pattern of the reflective panel are identical to those of a Type 2 barricade panel. Vertical panels shall be mounted on a single light-weight post with the top a minimum of 36” above the roadway.

Vertical panels are used on a very limited basis by SCDOT.

Device Spacing

Channelizing devices should be spaced so that it is apparent that the roadway or Work Space is closed to traffic. There are several rules of thumb that can be used to guide you in the proper spacing of channelizing devices:

- The maximum spacing between devices in a taper should not exceed a distance, in feet, equal to the posted regulatory speed limit in MPH. For example, if the taper is on a street with a 35 MPH posted regulatory speed limit, the devices may be spaced up to 35’.
- All tapers should be made up of at least 5 channelizing devices.
- The spacing between devices in a Buffer Space or Work Space should not exceed a distance, in feet, of 2 times the posted regulatory speed limit in MPH; however, the spacing should not exceed 100’. For example, if the street has a posted regulatory speed limit of 35 MPH, the devices in the Buffer Space and Work Space may be spaced up to 70’.
- In urban areas shorter spacing between devices in the Buffer Space and Work Space may be more appropriate. For example, the spacing used in tapers could also be used in the Buffer Space and Work Space.

Lighting Devices

Lighting devices for Short-Term Work Zones are designed to supplement the retroreflective signs, barriers, and channelizing devices used in these zones.

During normal Daytime Maintenance Operations supplemental lighting may be provided by high-intensity rotating, flashing, oscillating, or strobe lights on a Maintenance Vehicle.

In areas where work is being performed during the hours of darkness, furnish, place, and maintain lighting facilities capable of providing light of sufficient intensity to facilitate good workmanship and proper inspection at all times. Arrange the lighting so that it does not produce glare or diminish the road user's visibility.

Illuminate the Work Area by any combination of portable lights, standard electric lights, existing streetlights, etc., that provides the necessary illumination.

Warning Lights

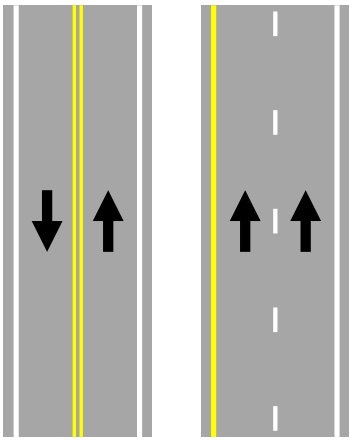
The principal types and uses of warning lights are listed below:

- Low-Intensity Flashing Lights (Type A) – used at night to warn of an isolated hazard and must be visible from a distance of 3000'.
- High-Intensity Flashing Lights (Type B) – used both day and night to warn of an isolated hazard or draw attention to Advance Warning Signs and must be visible from a distance of 1000'.
- Low-Intensity Steady-Burn Lights (Type C) – used in a line to delineate the traveled way through and around obstructions in the Transition Area, Buffer Space, Work Space, and Termination Area of the TTC Zone and must be visible from a distance of 3000'.

The minimum mounting height of a warning light is 30" from the bottom of the lens of the light to the travel lane surface when placed in a roadway or to the grade elevation of the near edge of the adjacent travel lane when placed adjacent to a roadway.

All warning lights, including Types A, B, and C, must be lightweight and may not exceed 3.3 pounds in accordance with the requirements of *AASHTO MASH* and *NCHRP Report 350*.

Pavement Markings



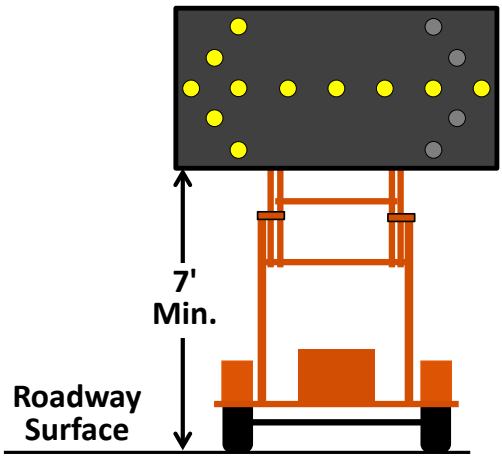
For Long-Term Stationary projects, follow the guidelines of the *MUTCD, Part 6,* latest edition in placing and removing pavement markings. The colors of temporary pavement markings and delineators follow the same standard as permanent markings.

White is specified along both sides of two-way roadways and the right side of one-way roadways. Yellow is used on the left side of one-way roadways. Centerlines and lane lines are yellow when separating opposing directions of traffic and white when separating lanes of the same direction. Where existing pavement markings conflict with the temporary travel path, additional signing and channelizing devices are appropriate.

Arrow Boards

An arrow board shall be a sign with a matrix of elements capable of either flashing or sequential displays. This sign shall provide additional warning and directional information to assist in merging and controlling road users through or around a TTC Zone. Arrow boards have the following requirements:

- Panel face shall be non-reflective.
- Shall be legible from a distance of ½ mile.
- Elements shall be yellow in color.
- Elements shall be capable of at least a 50% dimming from full brilliance during nighttime hours.
- Should provide a minimum height of 7’ from the bottom of the sign to the surface of the roadway.
- Can remain stable in winds up to 80 MPH when in operating position.



Trailer mounted arrow boards shall remain stationary when operating. Towing an operating trailer mounted arrow board in place of utilizing a truck mounted arrow board when a truck mounted device is required is **prohibited**.

Truck mounted arrow boards shall be a permanent fixture on the truck. Do not mount a trailer mounted arrow board on a truck.

The minimum sizes for each arrow board type are shown in the table below.

Arrow Board Type	Minimum Size	Minimum Legibility Distance	Minimum Number of Elements
A	48" × 24"	½ Mile	12
B	60" × 30"	¾ Mile	13
C	96" × 48"	1 Mile	15

For Mobile Operations on high-speed roadways Type B (60” x 30”) Arrow Boards may be used.

Changeable Message Sign (CMS)

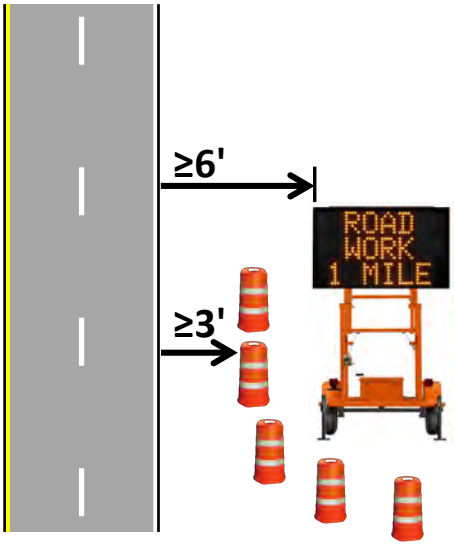
The primary purpose of a CMS in a TTC Zone is to advise the road user of unexpected situations. The CMS should consist of no more than 2 phases, and a phase should consist of no more than 3 lines of text and provide capital characters with a height of not less than 18”. The message panel should have adjustable display rates so that the entire message can be read at least twice at the posted regulatory speed limit. Ensure that the sign panel provides a minimum height of 7’ from bottom of the sign panel to the surface of the roadway when raised into its operating position.



A CMS should provide clear and legible messages from a distance of 1,000’ and should be visible halfamile under both day and night conditions. The sign panel should be approximately 76” vertically and 113” horizontally. A CMS shall remain stationary when operating.

Location of CMS

The CMS should be placed on the shoulder of the roadway not less than 6’ from the edge of the sign to the near edge of the adjacent travel lane when space is available. When the space of 6’ or right-of-way is unavailable, place the CMS at the greatest possible distance from the near edge of the adjacent lane.



Supplement the sign location with not less than 5 portable plastic drums placed between the sign and the adjacent travel lane for delineation of the sign location. Do not use standard traffic cones or 42” oversized traffic cones as a substitute for the portable plastic drums. Install and maintain the drums not closer than 3’ from the near edge of the adjacent travel lane. The spacing between the portable plastic drums is approximately 3’ to 5’.

When non-operational for more than 72 hours, remove completely from the roadway.

Truck Mounted CMS

Utilize a truck mounted CMS for slowmoving work activities and for the initial Shadow Vehicle encountered by road users during Mobile Operations. Use truck mounted CMSs to supplement stationary Lane Closures on high-volume, high-speed Primary **multi-lane** facilities with paved shoulders as directed by the Owner.

Ensure that the truck mounted CMS has the capability to provide clear and legible messages from a distance of 850’. The sign panel should be approximately 42” vertically by 76” horizontally. Do not mount a trailer mounted unit on a truck.

Truck Mounted Attenuator (TMA)

There are 2 types of attenuators used in TTC situations. With the first type, the attenuator is physically mounted to the truck. With the second type, the attenuator is mounted to a trailer that is towed behind the truck. While manufacturers typically refer to these as Truck Mounted Attenuators and Trailer Mounted Attenuators, in this handbook the terminology that has been adopted by the SCDOT is used. Therefore, in this handbook, the terms for the two types of attenuators will be Direct Mounted TMA and Trailer Towed TMA.

Use an *AASHTO MASH* and *NCHRP Report 350* Test Level 2 or Test Level 3 TMA based on the posted regulatory speed limit of the roadway prior to the presence of Work Zones, temporary speed limits, or unforeseen roadway hazards.

Test Level 2 TMAs are approved for roadways with posted regulatory speed limits of 45 MPH or less.

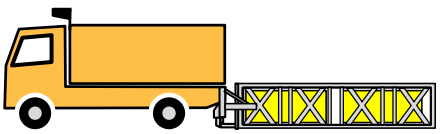
Test Level 3 TMAs are approved for roadways with posted regulatory speed limits of 50 MPH or greater. Test Level 3 TMAs are acceptable for use on all roadways.

Direct Mounted TMA

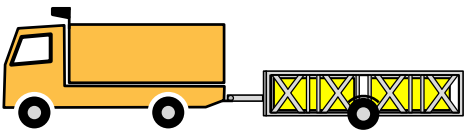
A Direct Mounted TMA is mounted and attached to brackets or similar devices connected to the frame of a truck. Attach each direct mounted TMA to the rear of a truck with a minimum gross vehicular weight (GVW) of 15,000 pounds (actual weight). If ballast is needed to supplement the weight of the vehicle, contain the ballast material within a structure constructed of steel.

Trailer Towed TMA

A Trailer Towed TMA is towed from behind and attached to the frame of a truck via a standard pintle hook hitch. Attach each Trailer Towed TMA to the rear of a truck with a minimum GVW of 10,000 pounds (actual weight). If the addition of supplemental weight to the vehicle as ballast is necessary, contain the material within a structure constructed of steel.



Direct Mounted TMA



Trailer Towed TMA

Ballast

Construct this steel structure to have a minimum of 4 sides and a bottom to contain the ballast material in its entirety. A top is optional. Bolt this structure to the frame of the truck. Utilize a sufficient number of fasteners for attachment of the steel structure to the frame of the truck to ensure the structure will not part from the frame of the truck during an impact upon the attached TMA. Utilize either dry loose sand or steel reinforced concrete for ballast material within the steel structure to achieve the necessary weight. The ballast material shall remain contained within the confines of the steel structure and shall not protrude from the steel structure in any manner.

Work Vehicles

It is essential that Work Vehicles are highly visible at all times, and can be readily identified as Work Vehicles. In addition, Work Vehicles at all times should travel as safely as possible due to unexpected conditions that may be present within the TTC Zone.

Auxiliary Warning Lights

Supplement all vehicles and equipment that must operate within or adjacent to a roadway within the highway right-of-way in an active Mobile Operation or stationary Work Zone with auxiliary warning lights. Also, this requirement shall include vehicles that must operate within the roadway or on a roadway shoulder at reduced speeds.

All auxiliary warning lights supplementing vehicles and equipment within active Work Zones shall be amber or yellow in color. All auxiliary warning lights shall be high-intensity rotating, flashing, oscillating or strobe lights.

Mount all auxiliary warning lights on vehicles and equipment in conspicuous locations to provide good visibility to approaching road users. Auxiliary warning lights should be mounted to ensure 360-degree visibility. Two rotating auxiliary warning lights provide good visibility from every direction, even if one light is not in view.

Standard vehicle hazard warning lights are only permitted as a supplement to the auxiliary warning lights.

Travel Direction

When Work Vehicles operate within travel lanes open to traffic, the Work Vehicles shall travel in the same direction of roadway traffic.

When Work Vehicles operate within a closed travel lane or a closed Shoulder Area, they may travel in either direction as necessary. However, when operating within a closed travel lane or a closed Shoulder Area during the hours of darkness, the Work Vehicles should minimize travel in the opposite direction of roadway traffic. This is due to visibility limitations of road users due to darkness and the unpredictable reactions road users may have from seeing opposing headlights in an area where opposing traffic is not anticipated by road users.

On Primary & Secondary Routes, when Work Vehicles are required to cross from one side of a roadway to the other side of the roadway, utilize Flaggers to control the Work Vehicles entering or crossing the travel lanes of the roadway.

Consider sight distance, vertical and horizontal curves of the roadway, prevailing speeds of traffic, frequency of the Work Vehicles entering or crossing the roadway and other site conditions that may impact the safety of the workers and road users when determining the necessity of Flaggers.

Ensure Flaggers do not stop traffic, cause traffic to change lanes or affect traffic in any manner.

The Work Vehicles may not disrupt the normal flow of traffic or enter the travel lane of the roadway until a sufficient gap is present.

Duration of Work

Work duration is a major factor in determining the number and types of devices used in TTC Zones. As a general rule, the longer the operation will last, the more TCDs will be needed.

- **Long-Term Stationary** – Work that occupies a location more than 3 days.
- **Intermediate-Term Stationary** – Work that occupies a location from 12 hours to 3 days.
- **Short-Term Stationary** – Daytime work that occupies a location from 1 to 12 hours.
- **Short-Duration** – Work that occupies a location up to 1 hour.
- **Mobile** – Work that moves intermittently or continuously.

Location of Work

Location of work is another major factor in determining the number and types of devices used in TTC Zones. As a general rule, the closer the work is to traffic, the more TCDs will be needed.

- **Outside the shoulder** – greater than 15’ from edge of pavement.
- **On the shoulder with no encroachment** – 1’ to 15’ beyond edge of pavement.
- **On the shoulder with minor encroachment**.
- **Within the median.**
- **Within the roadway.**

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Drawings

The numbered drawings in this handbook represent examples of the application of principles and procedures for safe and efficient traffic control in Work Zones but are not intended to be standards. *MUTCD, Part 6,* latest edition is the National Standard for Work Zone traffic control. It is not possible to include illustrations to cover every situation which will require Work Area protection. These typical layouts are not intended as a substitute for engineering judgment and should be altered to fit the conditions of a particular site.

In addition to the drawings, notes and tables are presented which provide important information for the user. **Read** all notes **before** using the drawings.

The information presented in the drawings and tables are generally minimums for standard street and highway conditions. Also, the condition of the area should be considered during application of these drawings.

The Work Zone setup should be based upon anticipated vehicle speeds and rural versus urban conditions instead of the posted regulatory speed limits or a municipality's corporate limits.

These drawings are **not** intended for application to Interstate Routes. For further information, consult the SCDOT, Director of Traffic Engineering.

NOTE: Taper lengths in the drawings are based upon 12' lanes and 10' shoulders.

Legend

The following symbols are used in the drawings that follow.

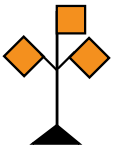

Cone


Drum


Flagger


Sign Support


Type 2 Barricade


High Level Warning Device

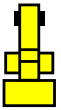

Warning Sign


Travel Direction

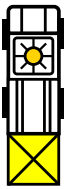

Work Area

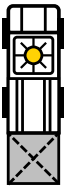

Type 3 Barricade


Type 3 Barricade with Sign


Road Machinery


Work Vehicle or Shadow Vehicle with Auxiliary Warning Light


Shadow Vehicle with Auxiliary Warning Light, TMA Required


Work Vehicle or Shadow Vehicle with Auxiliary Warning Light, TMA Optional



Truck Mounted Arrow Board



Truck Mounted CMS



Trailer Mounted Arrow Board



Trailer Mounted CMS

Closures

In a Work Zone there are several types of closures that may be used based on the specific work activity. These include Lane Closures, Shoulder Closures, and Road Closures. Each type of closure has its own traffic control requirements.

Lane Closure

A typical Lane Closure is an installation of a specific array of TCDs to temporarily reduce the number of travel lanes on a **multi-lane roadway** through channelization and relocation of traffic from the closed travel lane into the remaining adjacent travel lane(s) open to traffic. The TCDs function to channelize the traffic and provide delineation of the separation of the travel lane(s) closed to traffic and the travel path open to traffic.

Shoulder Closure

A standard Shoulder Closure is an installation of a specific array of Advance Warning Signs and TCDs to temporarily close the Shoulder Area of a roadway to vehicular and pedestrian traffic. When the work activity is conducted within 15’ or less of the near edge of the adjacent travel lane, Advance Warning Signs and TCDs are required for a standard Shoulder Closure. When the work activity is conducted beyond 15’ from the near edge of the adjacent travel lane, only Advance Warning Signs are required for a standard Shoulder Closure.

Road Closure

A Road Closure is designed to eliminate the exposure of road users to Work Zones and workers to traffic by temporarily closing a facility for rehabilitation or maintenance. During a Road Closure, traffic is detoured, allowing workers full access to roadway facilities.

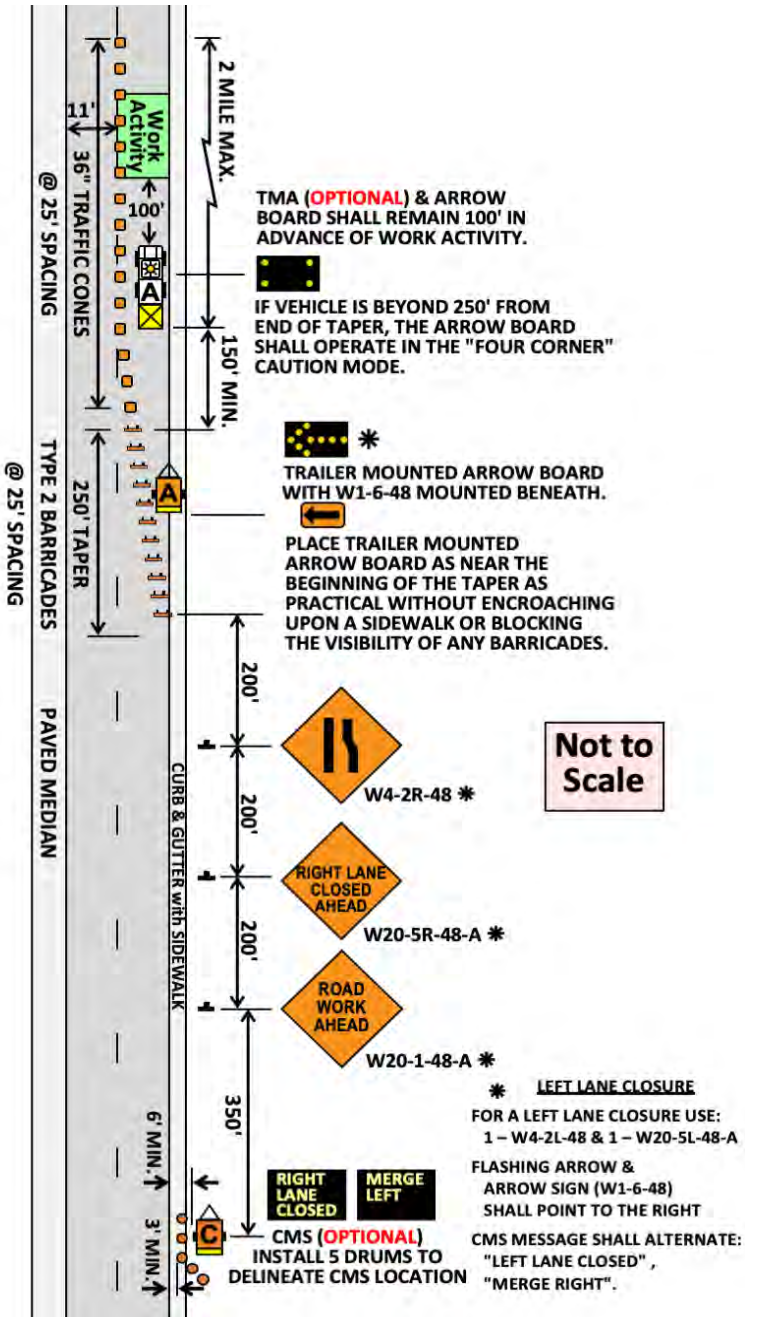
While not suitable for all construction situations, use of a Road Closure can result in positive public sentiment, increased productivity, reduced project duration, increased safety and/or a shortened risk period, and, in some cases, cost savings.

Drawing 1. Lane Closure Daytime Urban Low-Speed (≤ 35 MPH)

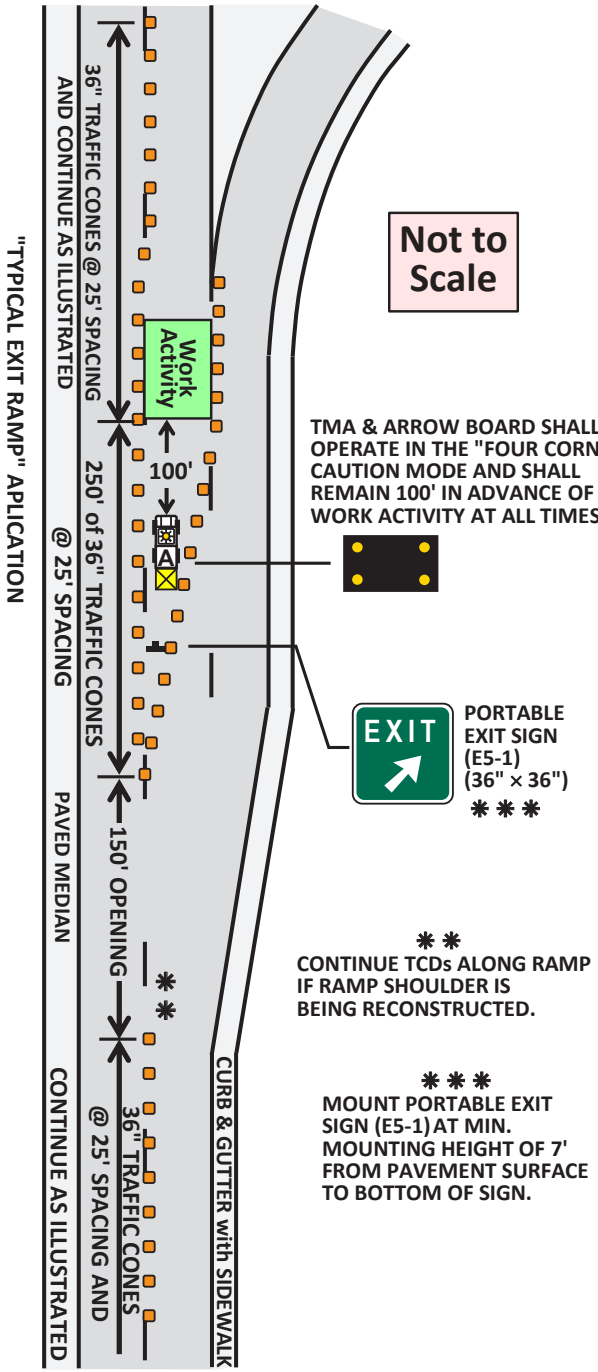
1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or double-faced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the "Four Corner" Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the "Flashing Bar" or the "Alternating Diamond" is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the same travel lane under two separate Lane Closures on a low-speed urban roadway, separate the two Lane Closures by no less than 1 mile from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
7. If work is being conducted simultaneously at two different locations in the same direction but within different travel lanes under two separate Lane Closures on a low-speed urban roadway, separate the two Lane Closures by no less than 2 miles from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
8. Type 2 barricades shall have a minimum width of 3' unless otherwise directed by the Owner.
9. When using a TMA, locate it 100' in advance of the Work Area unless otherwise specified.
10. Supplement the shadow vehicle and work vehicle with an approved advanced warning arrow panel operating in the "Four Corner" Caution Mode.

11. Utilize a trailer mounted arrow board with a Secondary Arrow (W1-6-48) Sign mounted beneath it.
12. All arrow boards shall be 48” x 96” with a minimum legibility distance of 1 mile.
13. Place the trailer mounted arrow board as near the beginning of the taper as practical without encroaching upon the Shoulder Area when a sidewalk is present or blocking the visibility of any barricades within the taper.
14. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.
15. Mount the portable EXIT Sign (E5-1) at a minimum mounting height of 7’ from the pavement surface to the bottom of the sign.
16. Continue TCDs along ramp if ramp shoulder is being reconstructed.

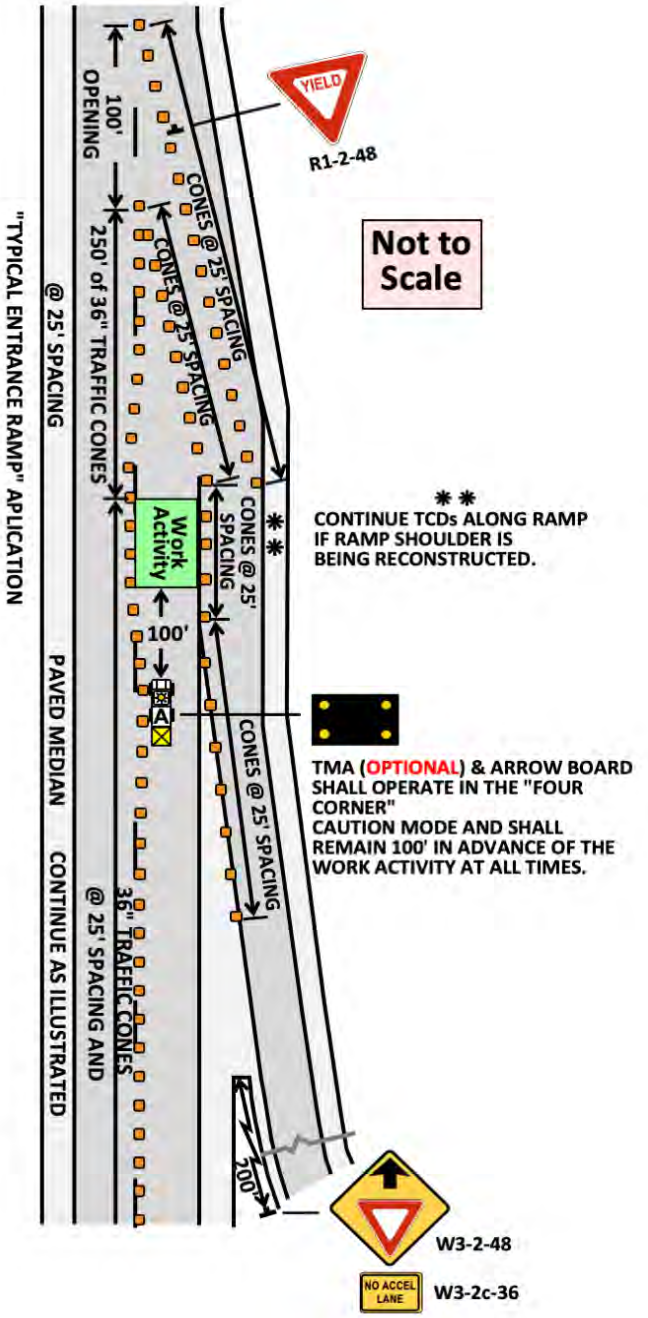
Drawing 1A. Lane Closure Daytime Urban Low-Speed (≤ 35 MPH)



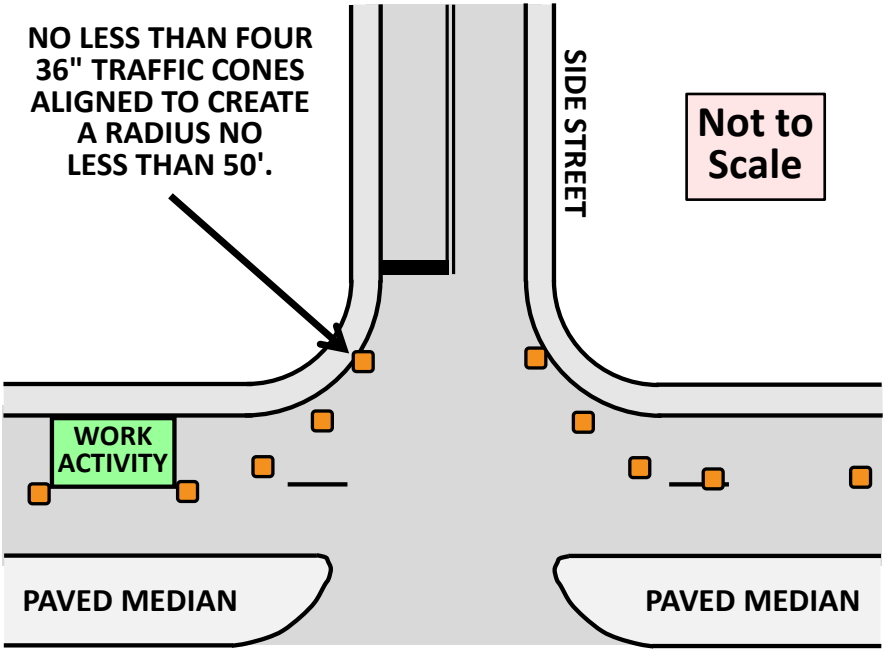
Drawing 1B. Lane Closure Daytime Urban Low-Speed (≤ 35 MPH)



Drawing 1C. Lane Closure Daytime Urban Low-Speed (≤ 35 MPH)



Drawing 1D. Lane Closure Daytime Urban Low-Speed (≤ 35 MPH)



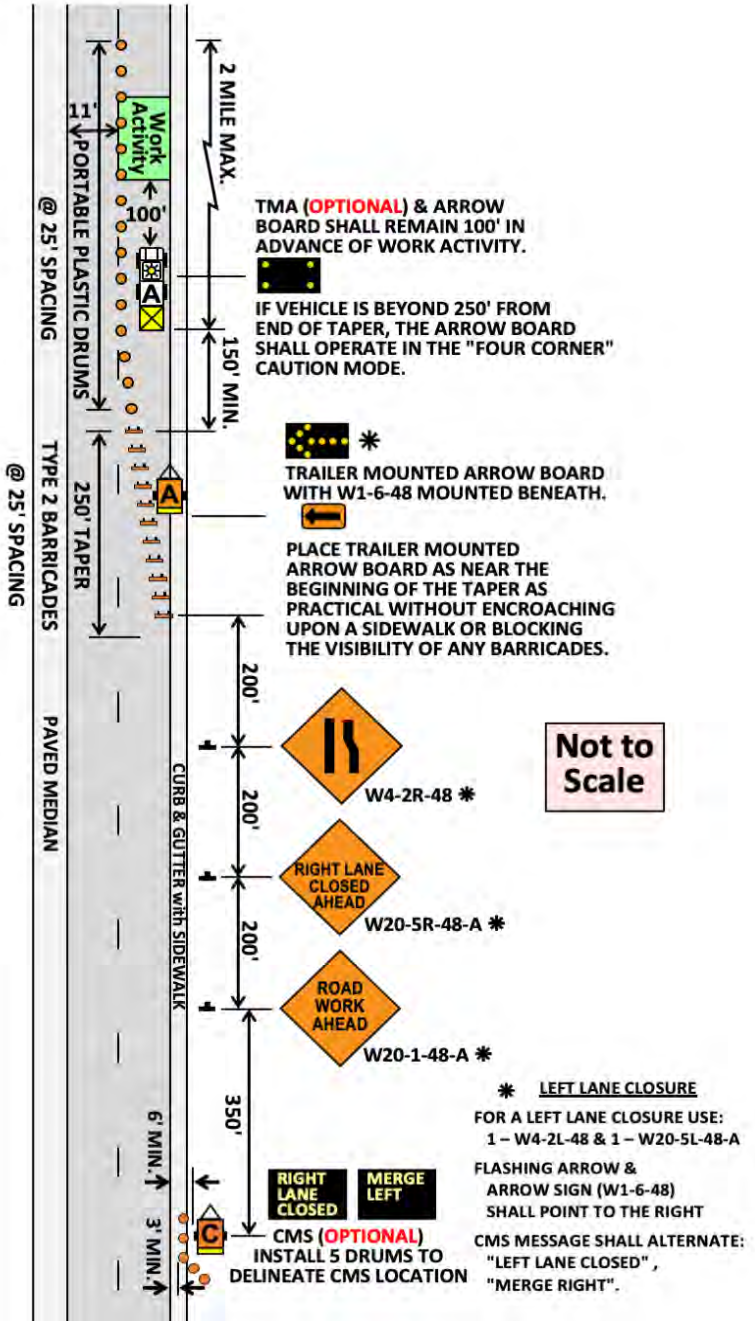
"TYPICAL SIDE STREET" APPLICATION

Drawing 2. Lane Closure Nighttime Urban Low-Speed (≤ 35 MPH)

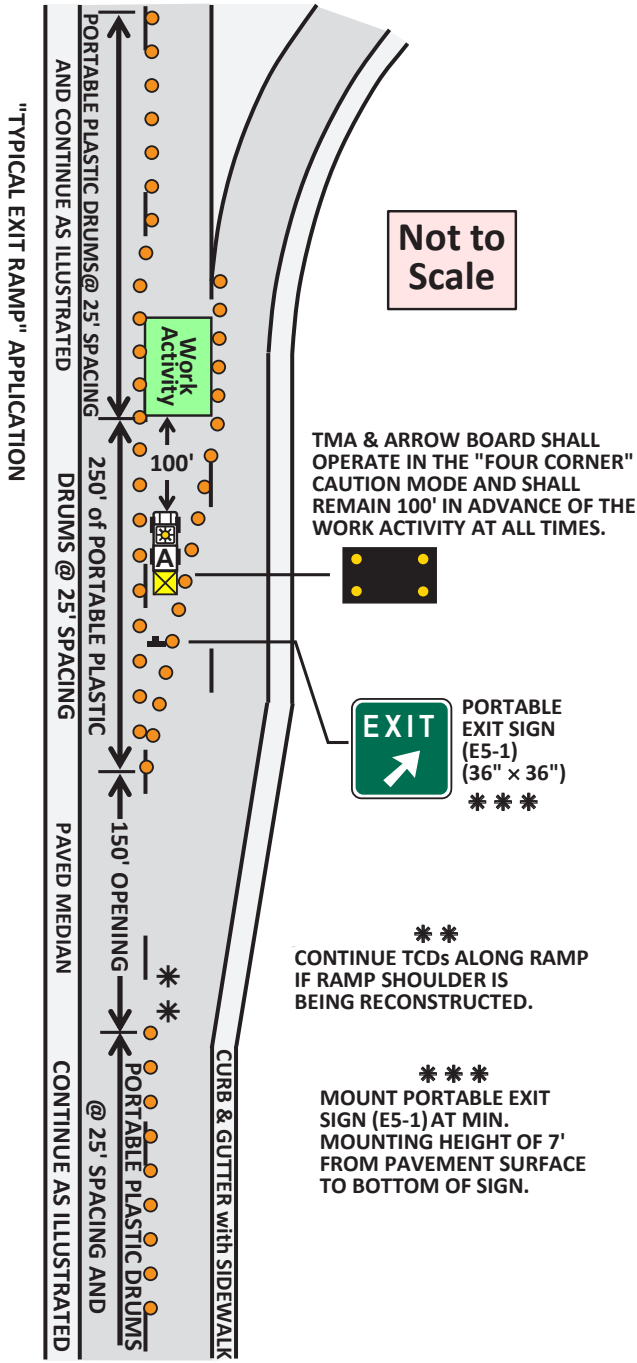
1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or double-faced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the "Four Corner" Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the "Flashing Bar" or the "Alternating Diamond" is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the same travel lane under two separate Lane Closures on a low-speed urban roadway, separate the two Lane Closures by no less than 1 mile from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
7. If work is being conducted simultaneously at two different locations in the same direction but within different travel lanes under two separate Lane Closures on a low-speed urban roadway, separate the two Lane Closures by no less than 2 miles from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
8. Type 2 barricades shall have a minimum width of 3' unless otherwise directed by the Owner.
9. When using a TMA, locate it 100' in advance of the Work Area unless otherwise specified. Supplement the shadow vehicle and work vehicle with an approved advanced warning arrow panel operating in the "Four Corner" Caution Mode.

10. Utilize a trailer mounted arrow board with a Secondary Arrow (W1-6-48) Sign mounted beneath it.
11. All arrow boards shall be 48” x 96” with a minimum legibility distance of 1 mile.
12. Place the trailer mounted arrow board as near the beginning of the taper as practical without encroaching upon the Shoulder Area when a sidewalk is present or blocking the visibility of any barricades within the taper.
13. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.
14. Mount the portable EXIT Sign (E5-1) at a minimum mounting height of 7’ from the pavement surface to the bottom of the sign.
15. Continue TCDs along ramp if ramp shoulder is being reconstructed.

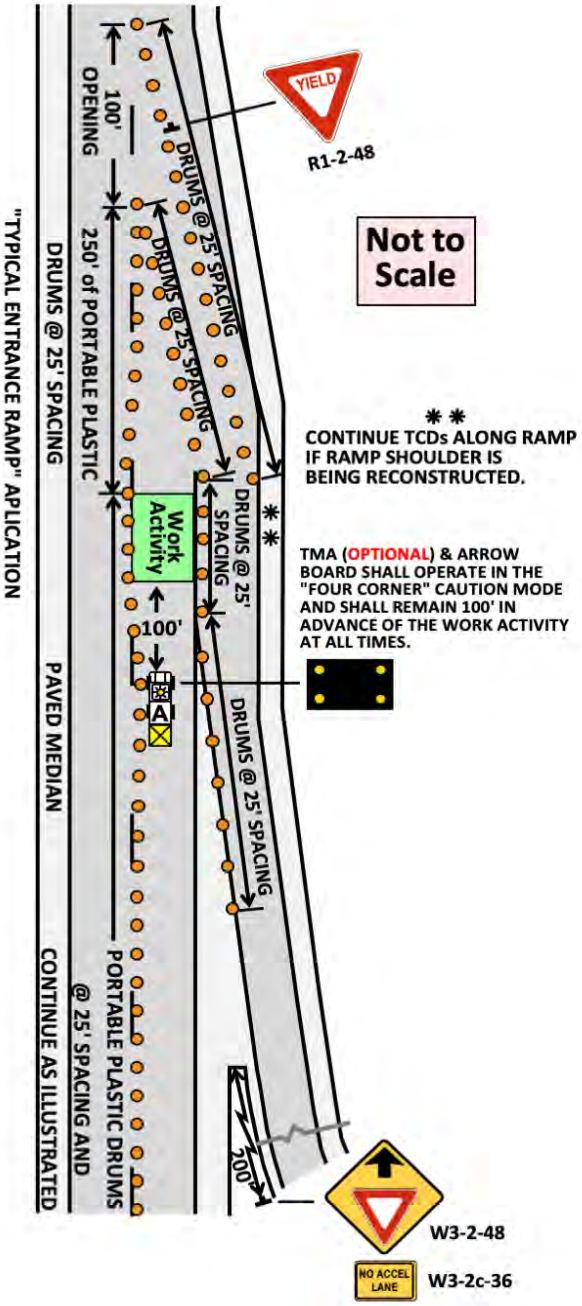
Drawing 2A. Lane Closure Nighttime Urban Low-Speed (≤ 35 MPH)



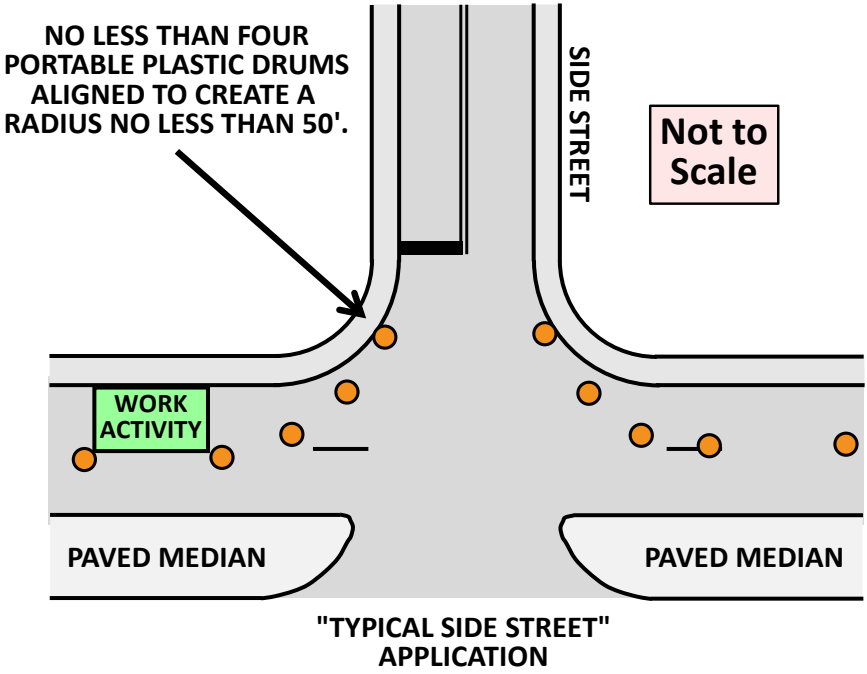
Drawing 2B. Lane Closure Nighttime Urban Low-Speed (≤ 35 MPH)



Drawing 2C. Lane Closure Nighttime Urban Low-Speed (≤ 35 MPH)



Drawing 2D. Lane Closure Nighttime Urban Low-Speed (≤ 35 MPH)



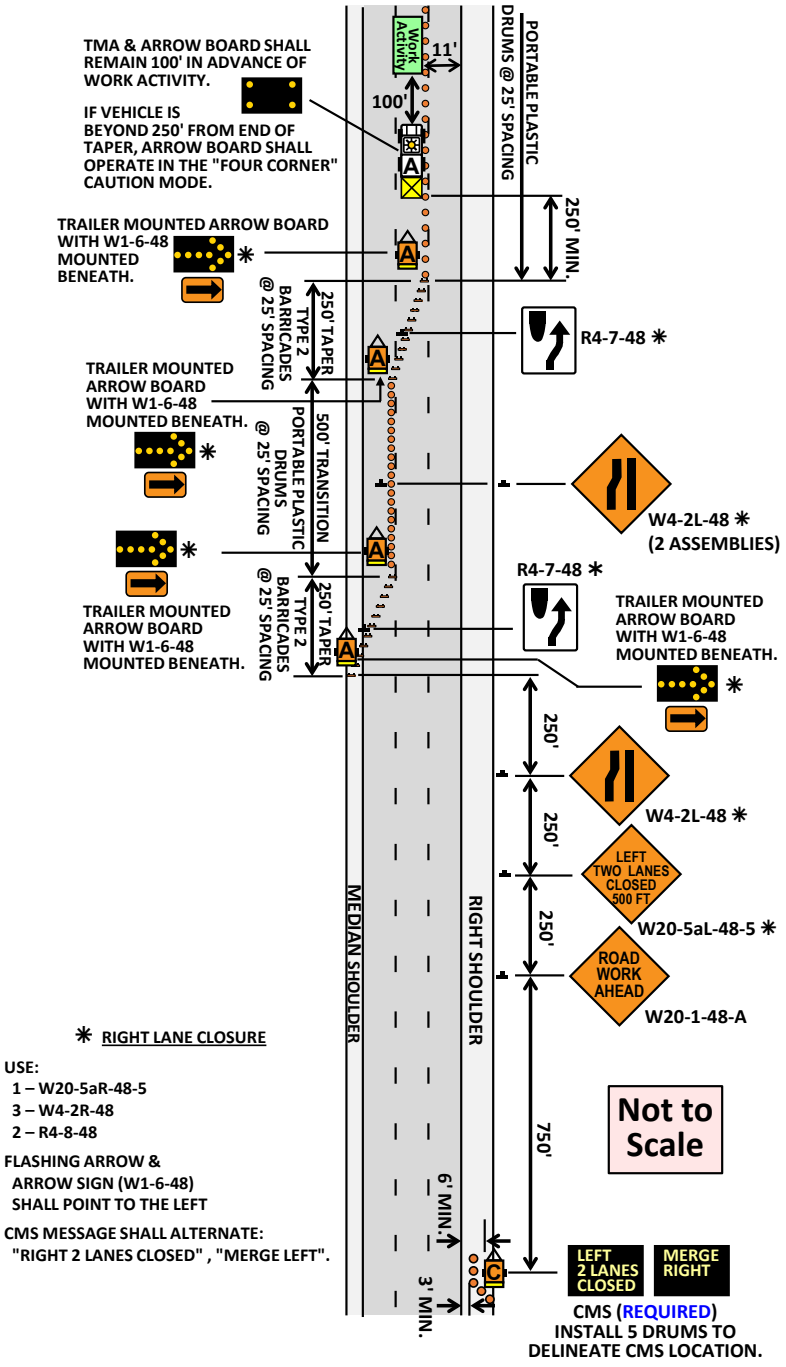
"TYPICAL SIDE STREET" APPLICATION

Drawing 3. Dual Lane Closure Urban Low-Speed (≤ 35 MPH)

1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or double-faced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the "Four Corner" Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the "Flashing Bar" or the "Alternating Diamond" is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the same travel lane under two separate Lane Closures on a low-speed urban roadway, separate the two Lane Closures by no less than 1 mile from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
7. If work is being conducted simultaneously at two different locations in the same direction but within different travel lanes under two separate Lane Closures on a low-speed urban roadway, separate the two Lane Closures by no less than 2 miles from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
8. Type 2 barricades shall have a minimum width of 3' unless otherwise directed by the Owner.
9. Locate the TMA 100' in advance of the Work Area unless otherwise specified. If vehicle is advanced beyond 250' from the end of the taper, the truck mounted arrow board shall operate in the "Four Corner" Caution Mode.

10. Utilize a trailer mounted arrow board with a Secondary Arrow (W1-6-48) Sign mounted beneath it at the beginning and end of each of the two Merging Tapers.
11. All arrow boards shall be 48” x 96” with a minimum legibility distance of 1 mile.
12. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.

Drawing 3. Dual Lane Closure Urban Low-Speed (≤ 35 MPH)

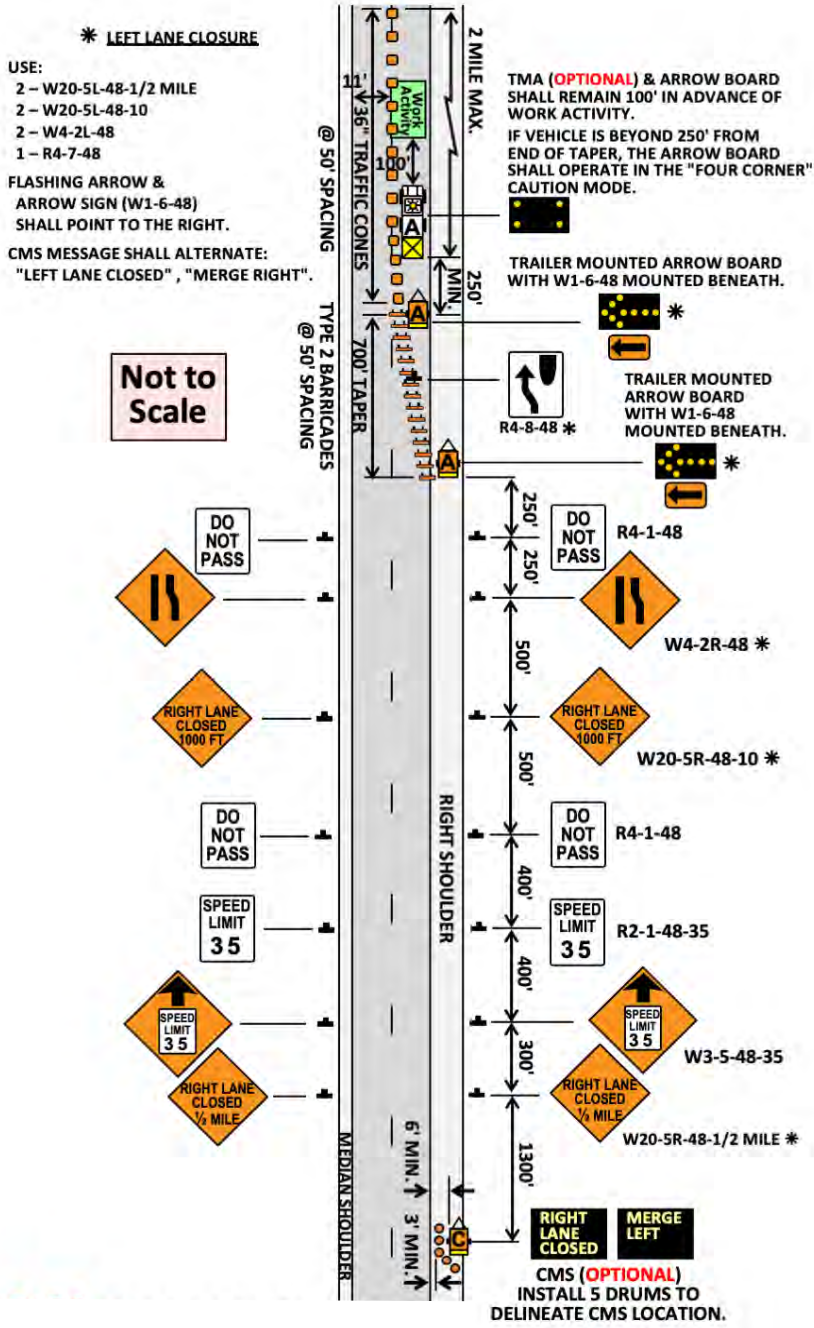


Drawing 4. Lane Closure Daytime Multi-lane Primary Routes

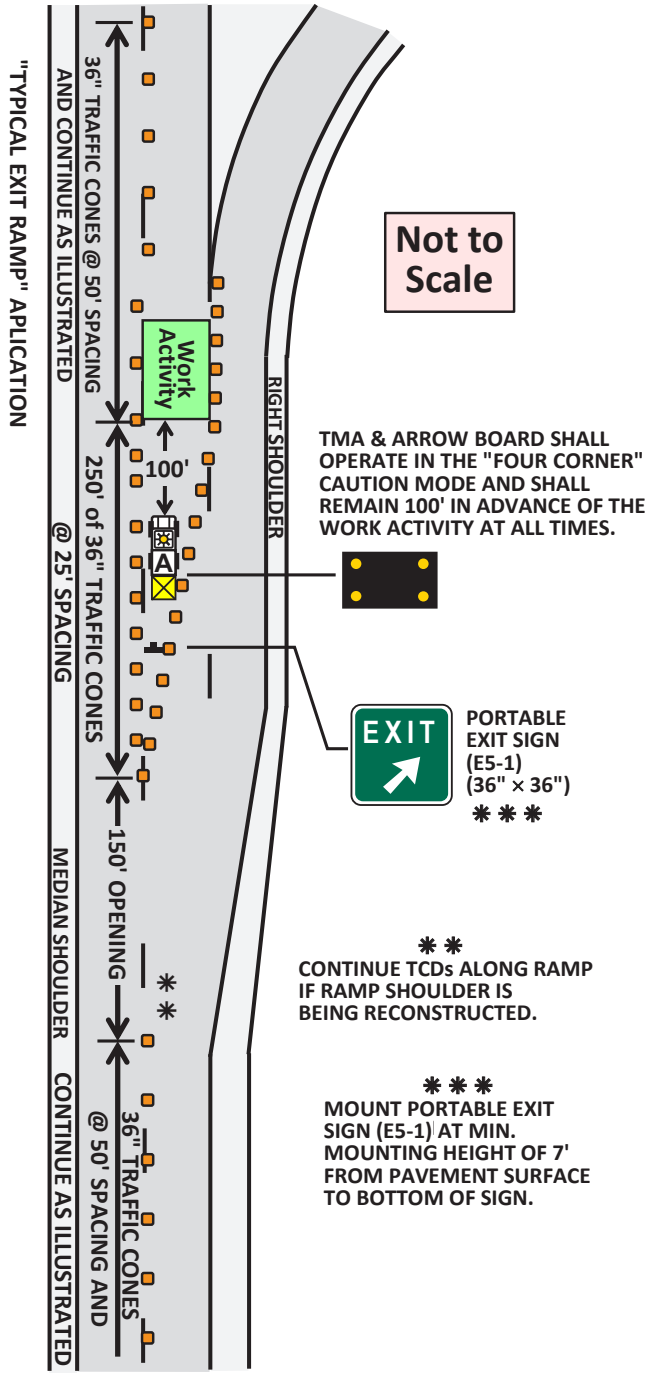
1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or double-faced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the “Four Corner” Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the “Flashing Bar” or the “Alternating Diamond” is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the same travel lane under two separate Lane Closures on a Primary Route with a posted regulatory speed limit of 40 MPH or greater, separate the two Lane Closures by no less than 2 miles from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
7. If work is being conducted simultaneously at two different locations in the same direction but within different travel lanes under two separate Lane Closures on a Primary Route with a posted regulatory speed limit of 40 MPH or greater, separate the two Lane Closures by no less than 4 miles from the end of the first closure that a road user will encounter to the beginning of the second closure.
8. Type 2 barricades shall have a minimum width of 3’ unless otherwise directed by the Owner.

9. When using a TMA, locate it 100’ in advance of the Work Area unless otherwise specified. Supplement the shadow vehicle and work vehicle with an approved advanced warning arrow panel operating in the “Four Corner” Caution Mode.
10. Utilize a trailer mounted arrow board with a Secondary Arrow (W1-6-48) Sign mounted beneath it at the beginning and end of the Merging Taper.
11. All arrow boards shall be 48”x 96” with a minimum legibility distance of 1 mile.
12. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.
13. Mount the portable EXIT Sign (E5-1) at a minimum mounting height of 7’ from the pavement surface to the bottom of the sign.
14. Continue TCDs along ramp if ramp shoulder is being reconstructed.

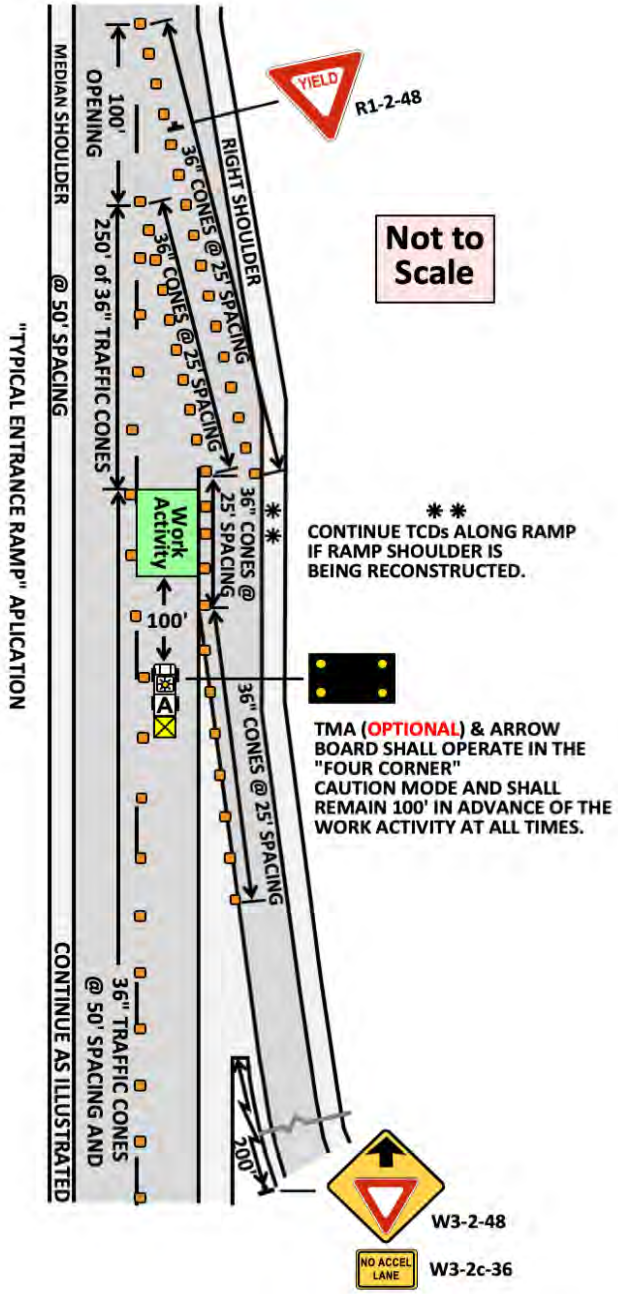
Drawing 4A. Lane Closure Daytime Multi-lane Primary Routes



Drawing 4B. Lane Closure Daytime Multi-lane Primary Routes



Drawing 4C. Lane Closure Daytime Multi-lane Primary Routes

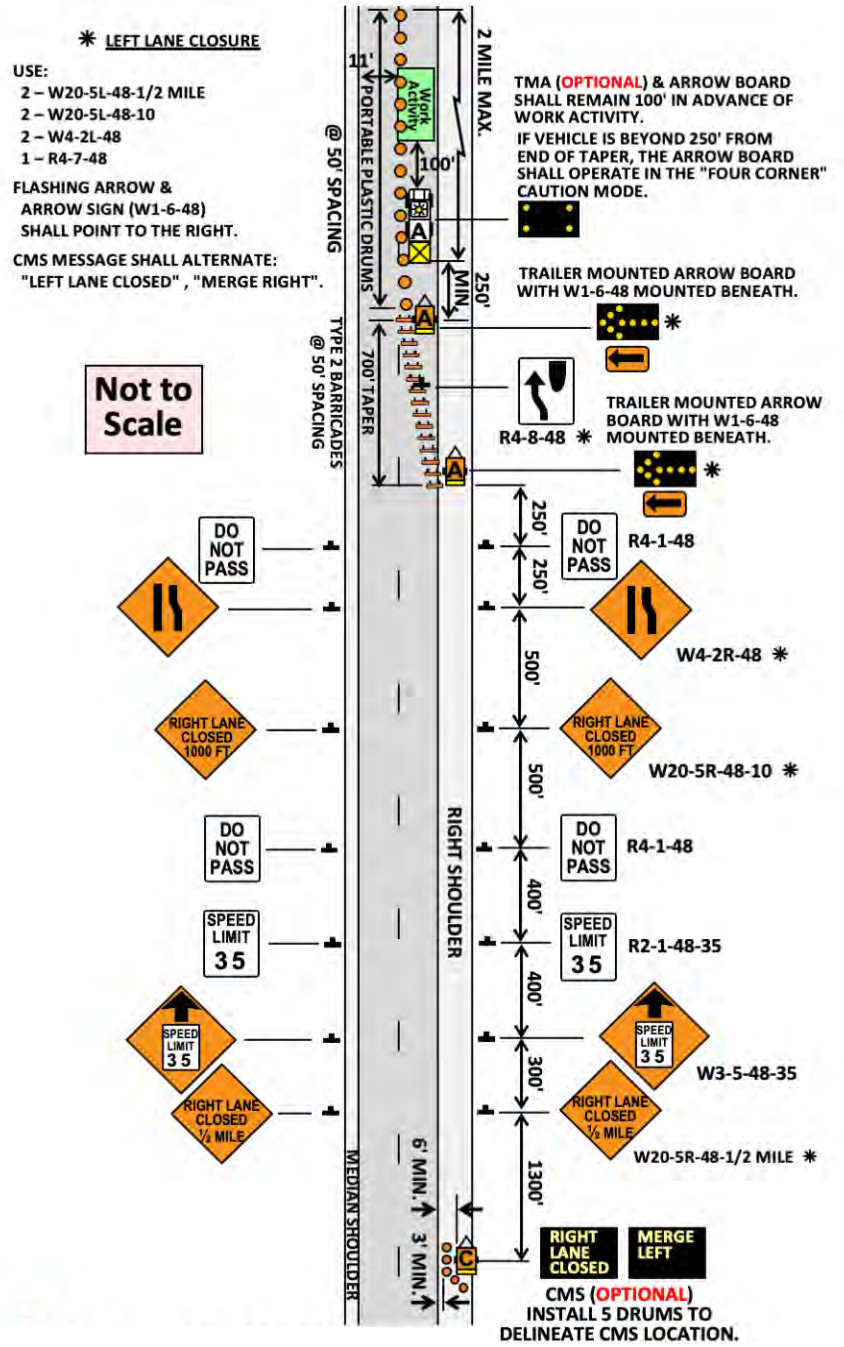


Drawing 5. Lane Closure Nighttime Multi-lane Primary Routes

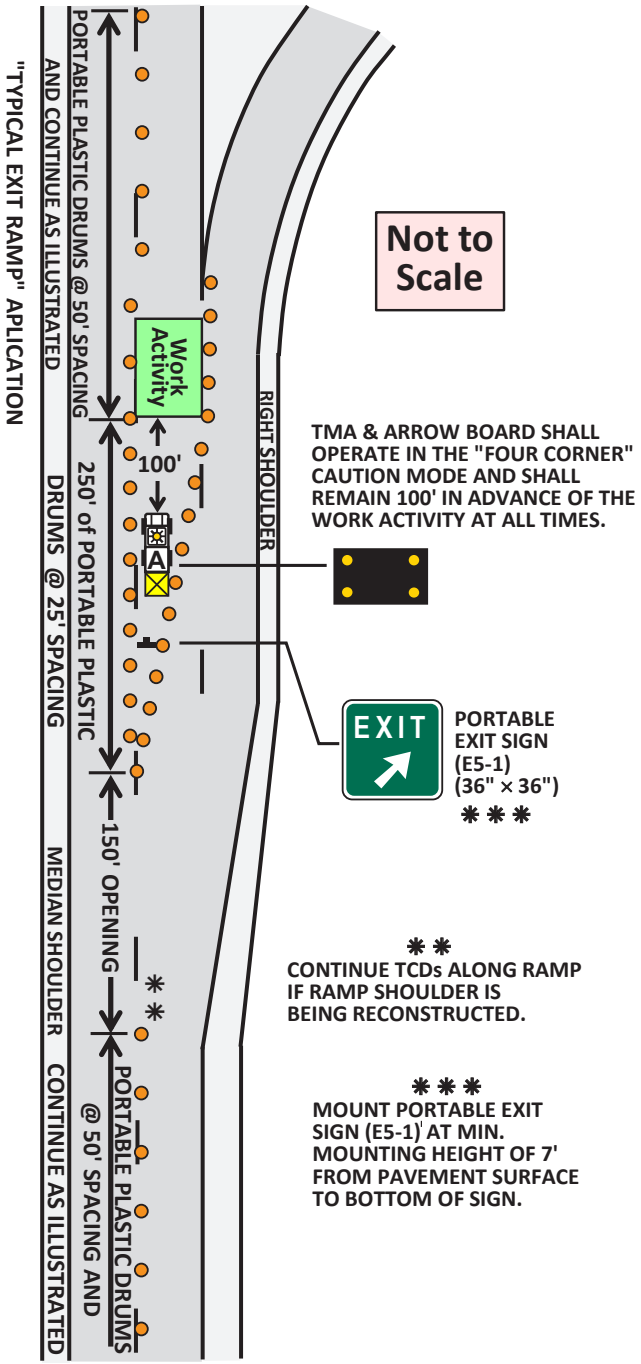
1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or double-faced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the "Four Corner" Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the "Flashing Bar" or the "Alternating Diamond" is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the same travel lane under two separate Lane Closures on a Primary Route with a posted regulatory speed limit of 40 MPH or greater, separate the two Lane Closures by no less than 2 miles from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
7. If work is being conducted simultaneously at two different locations in the same direction but within different travel lanes under two separate Lane Closures on a Primary Route with a posted regulatory speed limit of 40 MPH or greater, separate the two Lane Closures by no less than 4 miles from the end of the first closure that a road user will encounter to the beginning of the second closure.
8. Type 2 barricades shall have a minimum width of 3' unless otherwise directed by the Owner.

9. When using a TMA, locate it 100’ in advance of the Work Area unless otherwise specified. Supplement the shadow vehicle and work vehicle with an approved advanced warning arrow panel operating in the “Four Corner” Caution Mode.
10. Utilize a trailer mounted arrow board with a Secondary Arrow (W1-6-48) Sign mounted beneath it at the beginning and end of the Merging Taper.
11. All arrow boards shall be 48” x 96” with a minimum legibility distance of 1 mile.
12. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.
13. Mount the portable EXIT Sign (E5-1) at a minimum mounting height of 7’ from the pavement surface to the bottom of the sign.
14. Continue TCDs along ramp if ramp shoulder is being reconstructed.

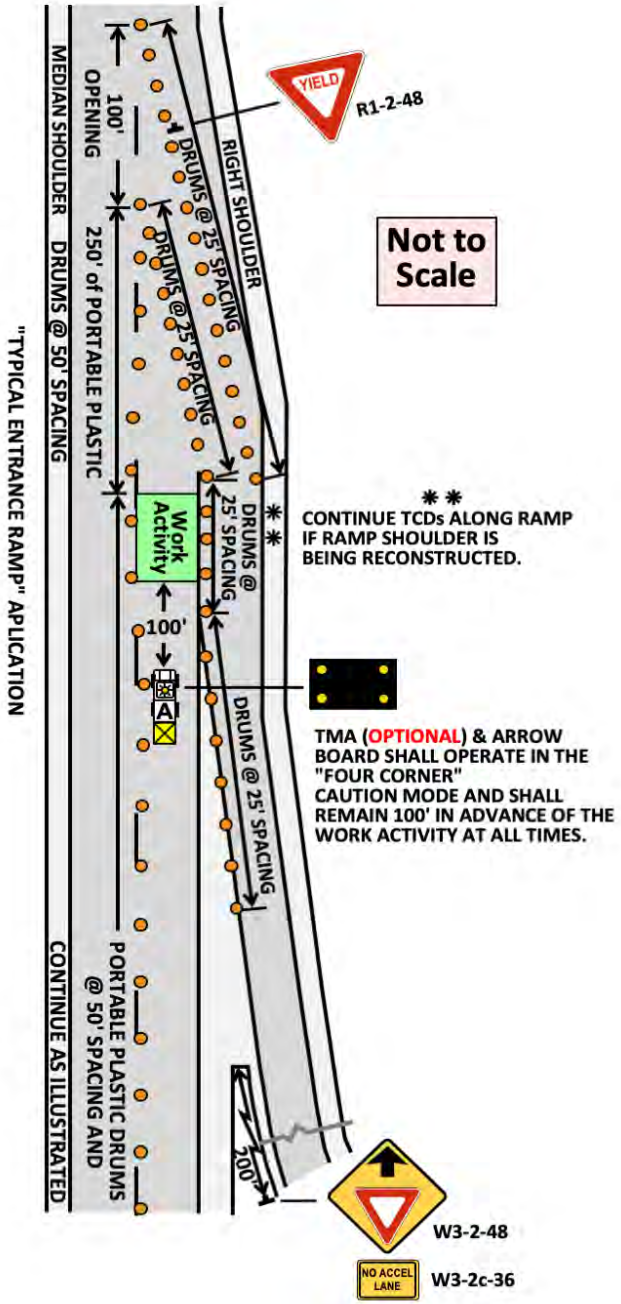
Drawing 5A. Lane Closure Nighttime Multi-lane Primary Routes



Drawing 5B. Lane Closure Nighttime Multi-lane Primary Routes



Drawing 5C. Lane Closure Nighttime Multi-lane Primary Routes

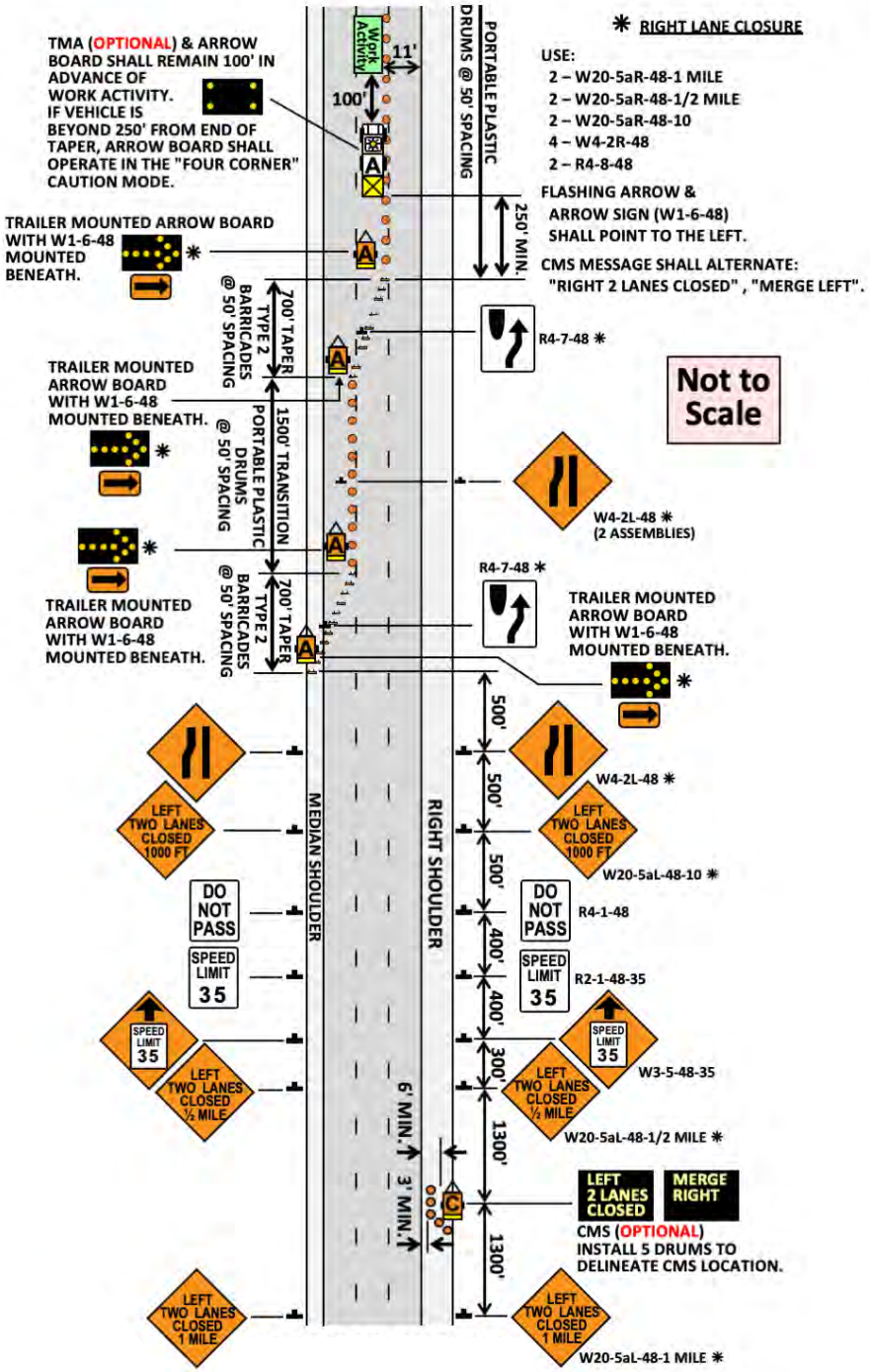


Drawing 6. Dual Lane Closure Multi-lane Primary Routes

1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or doublefaced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the “Four Corner” Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the “Flashing Bar” or the “Alternating Diamond” is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the same travel lane under two separate Lane Closures on a Primary Route with a posted regulatory speed limit of 40 MPH or greater, separate the two Lane Closures by no less than 2 miles from the end of the first closure that a road user will encounter to the beginning of the taper of the second closure.
7. If work is being conducted simultaneously at two different locations in the same direction but within different travel lanes under two separate Lane Closures on a Primary Route with a posted regulatory speed limit of 40 MPH or greater, separate the two Lane Closures by no less than 4 miles from the end of the first closure that a road user will encounter to the beginning of the second closure.
8. Type 2 barricades shall have a minimum width of 3’ unless otherwise directed by the Owner.

9. When using a TMA, locate it 100’ in advance of the Work Area unless otherwise specified. Supplement the shadow vehicle and work vehicle with an approved advanced warning arrow panel operating in the “Four Corner” Caution Mode.
10. Utilize a trailer mounted arrow board with a Secondary Arrow (W1-6-48) Sign mounted beneath it at the beginning and end of each of the two Merging Tapers.
11. All arrow boards shall be 48” x 96” with a minimum legibility distance of 1 mile.
12. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.

Drawing 6. Dual Lane Closure Multi-lane Primary Routes

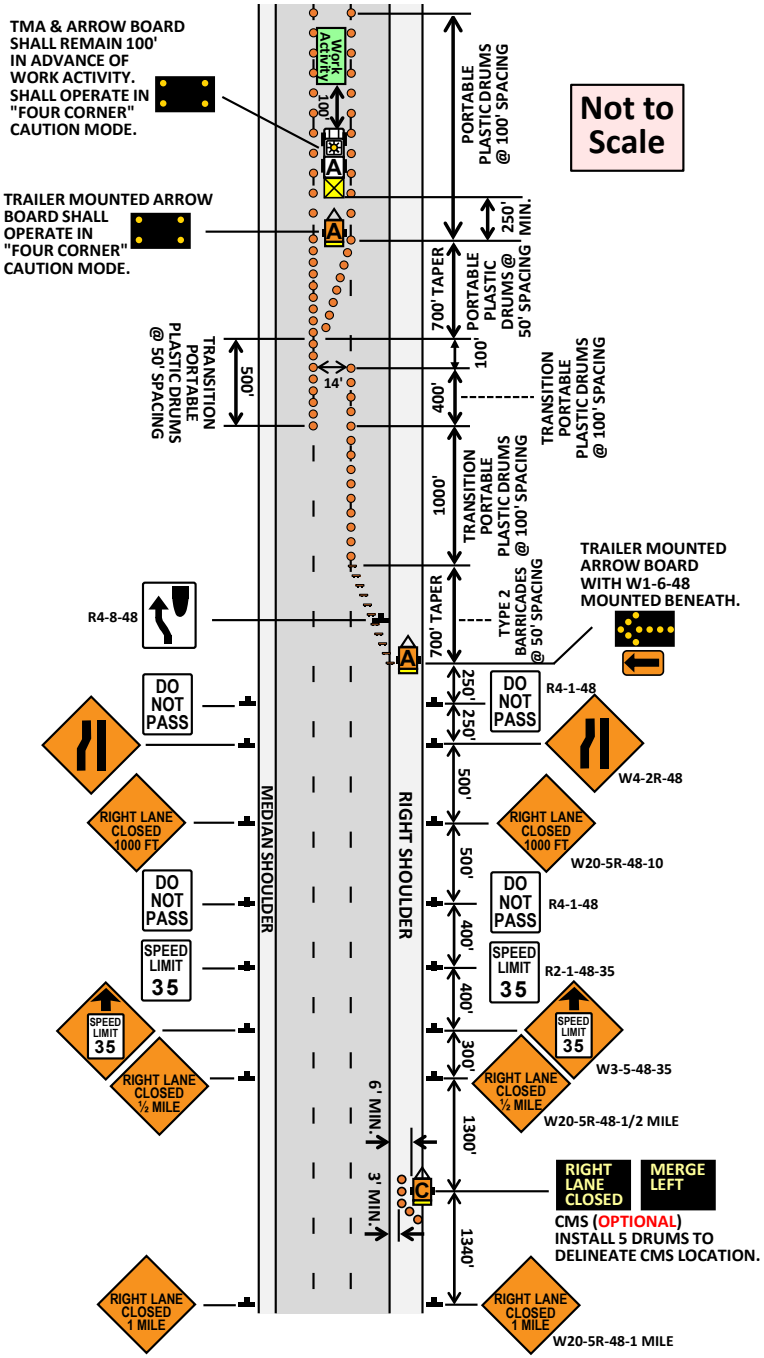


Drawing 7. Center Lane Closure Multi-lane Primary Routes

1. Measure all advance warning sign locations from the beginning of the taper. Work limits for the project will be determined by the Owner.
2. Any special sign mounting assemblies and hardware that may be necessary for installing and mounting signs in areas of concrete median barrier, bridge parapet walls or doublefaced guardrail shall be provided and utilized.
3. When an arrow board is required to operate in the caution mode, the arrow board shall display the “Four Corner” Caution Mode with one lamp in each corner. Display of any other type of caution mode such as the “Flashing Bar” or the “Alternating Diamond” is **unacceptable** and **prohibited**.
4. Conduct the work in such a manner that will minimize encroachment of TCDs, equipment, personnel, materials or any work related vehicles onto an adjacent travel lane open to traffic. Install, maintain and adjust the TCDs as necessary to ensure proper delineation of the Work Area.
5. Lane Closures are restricted to maximum lengths of 2 miles unless otherwise directed by the Owner.
6. If work is being conducted simultaneously at two different locations within the central travel lane under two separate center Lane Closures on a Primary Route, separate the two Lane Closures by no less than 4 miles from the end of the first closure that a road user will encounter to the beginning of the second closure.
7. Type 2 barricades shall have a minimum width of 3’ unless otherwise directed by the Owner.
8. Locate the TMA 100’ in advance of the Work Area unless otherwise specified. Supplement the shadow vehicle and work vehicle with an approved advanced warning arrow panel operating in the “Four Corner” Caution Mode.
9. Utilize a trailer mounted arrow board in the “Four Corner” Caution Mode placed within the center Lane Closure.
10. All arrow boards shall be 48” x 96” with a minimum legibility distance of 1 mile.

11. Utilization of a CMS is optional with this traffic control setup. However, when a CMS is utilized, install the sign as illustrated on this drawing unless otherwise directed by the Owner.

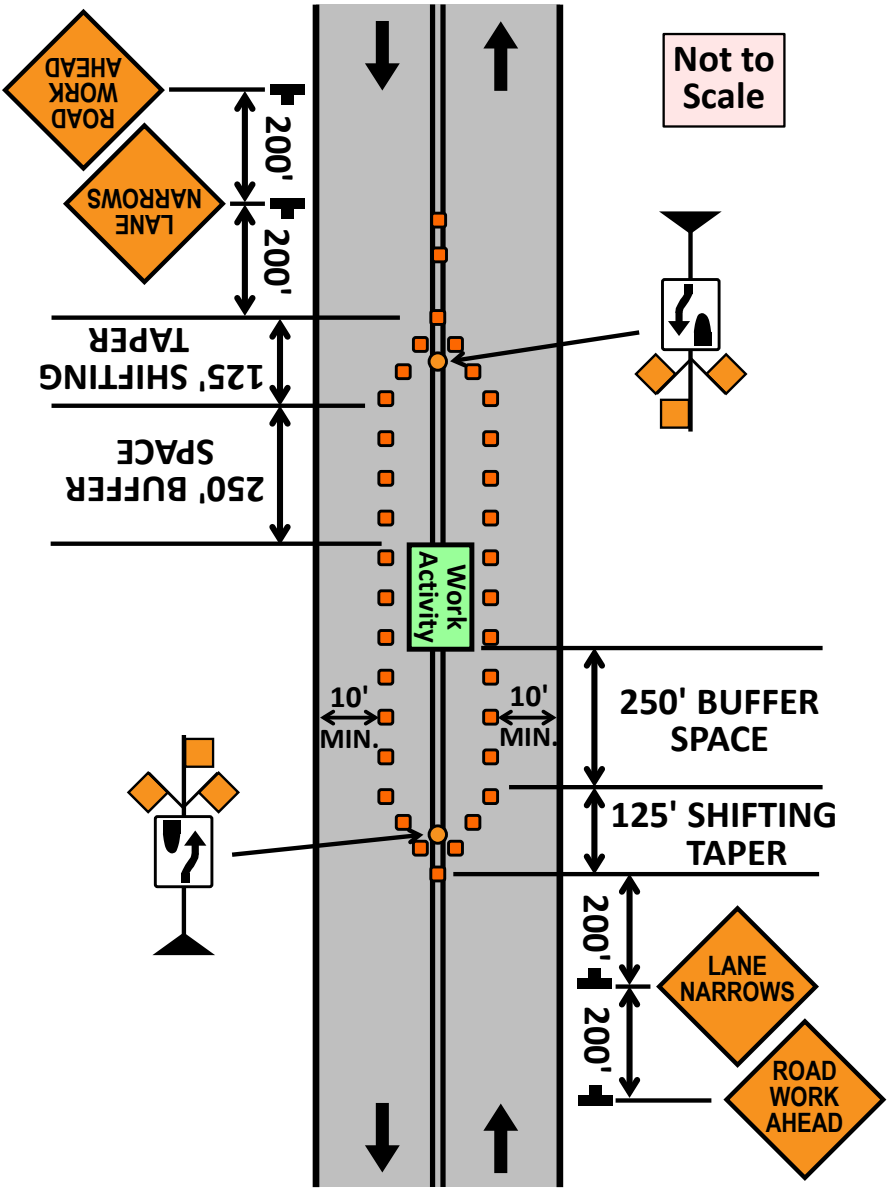
Drawing 7. Center Lane Closure Multi-lane Primary Routes



Drawing 8. Work in Center of a Minor Urban Street, 35 MPH or Less, Maintaining Two-Way Traffic

1. This typical application applies to Low-Volume, low-speed conditions (35 MPH or less) **only**.
2. Maintain a minimum lane width of 10’ in both directions. Measure from the near edge of the channelizing devices to the edge of pavement to determine the lane width.
3. Maintain the “Keep Right” symbol sign at the beginning of the taper as illustrated.
4. For low-speed conditions (35 MPH or less), a 200’ sign spacing may be used.
5. An array of 2 Advance Warning Signs is required in each direction. These sign arrays will include ROAD WORK AHEAD and LANE NARROWS.

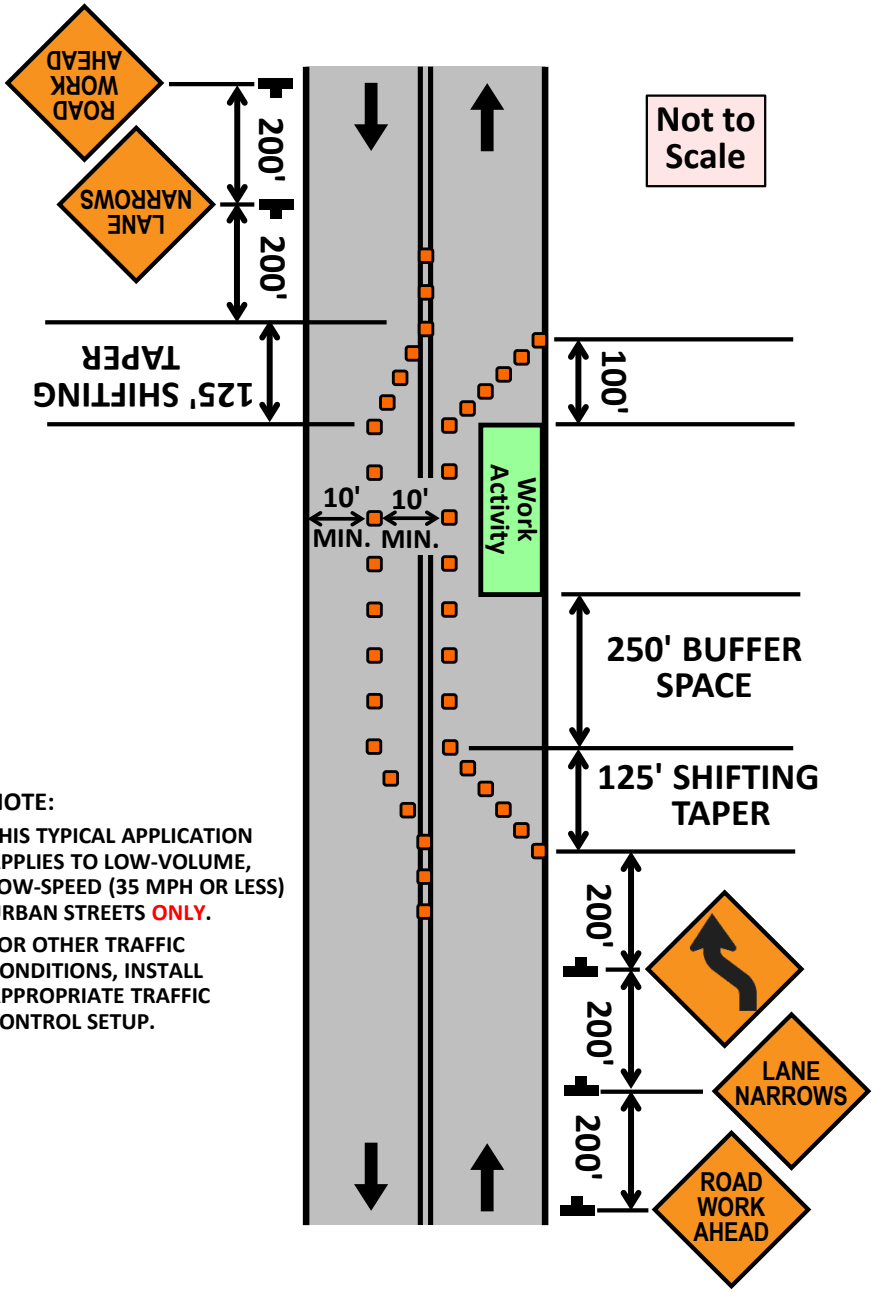
Drawing 8. Work in Center of a Minor Urban Street, 35 MPH or Less, Maintaining Two-Way Traffic



Drawing 9. Work in Travel Lane on a Minor Urban Street, 35 MPH or Less, Maintaining Two-Way Traffic

1. This typical application applies to Low-Volume, low-speed (35 MPH or less) urban streets **only**. For other traffic conditions, install appropriate traffic control setup.
2. A minimum lane width of 10’ is required in both directions, measured between the lines of channelizing devices and measured from the line of channelizing devices separating the opposing travel lanes to the edge of pavement.
3. For low-speed conditions (35 MPH or less), a 200’ sign spacing may be used.
4. In the travel lane of the work, an array of 3 Advance Warning Signs is required. This sign array will include ROAD WORK AHEAD, LANE NARROWS, and “Reverse Curve”.
5. In the opposing travel lane, an array of 2 Advance Warning Signs is required. This sign array will include ROAD WORK AHEAD and LANE NARROWS.

Drawing 9. Work in Travel Lane on a Minor Urban Street, 35 MPH or Less, Maintaining Two-Way Traffic



NOTE:

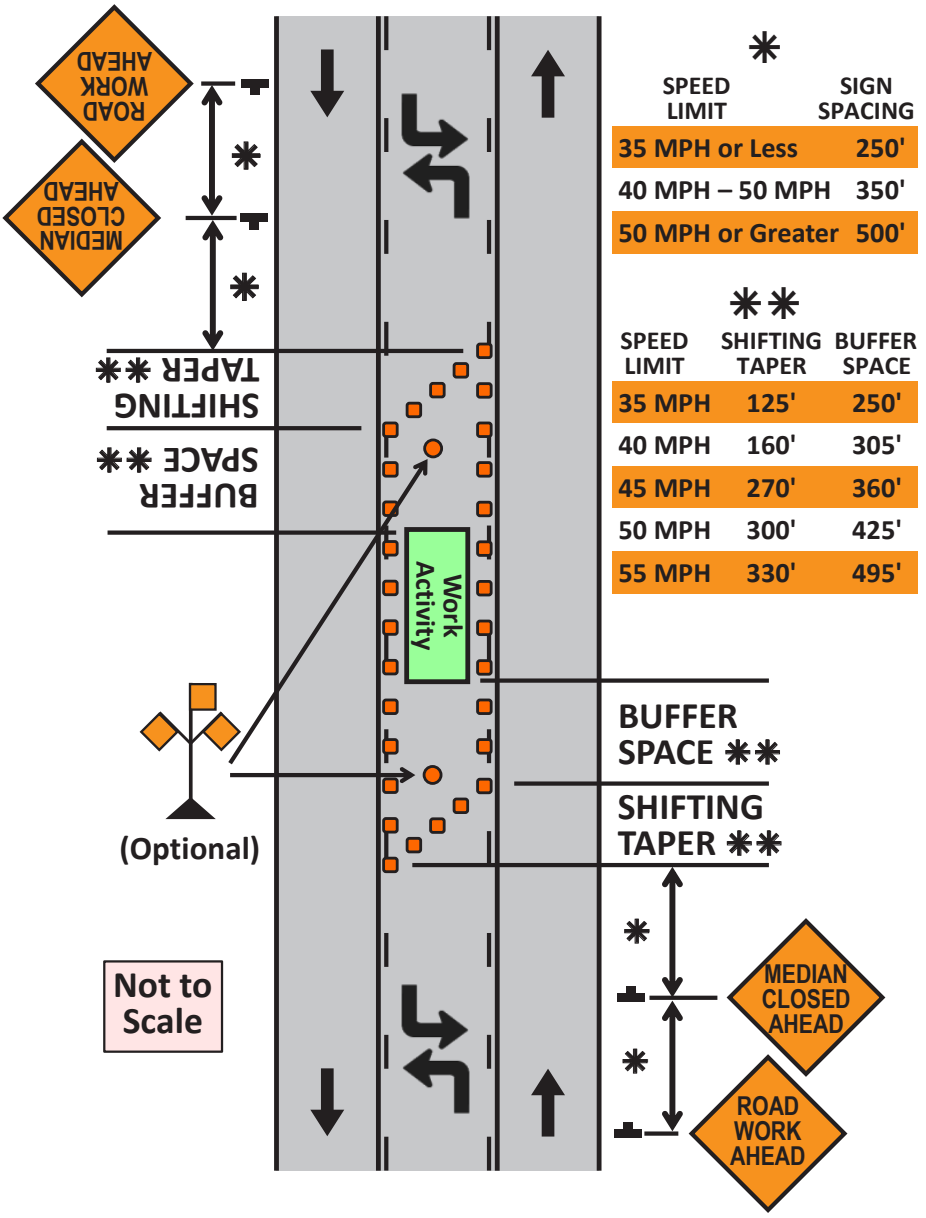
THIS TYPICAL APPLICATION APPLIES TO LOW-VOLUME, LOW-SPEED (35 MPH OR LESS) URBAN STREETS ONLY.

FOR OTHER TRAFFIC CONDITIONS, INSTALL APPROPRIATE TRAFFIC CONTROL SETUP.

Drawing 10. Center Turn Lane Closed on a ThreeLane, Two-Way Road

1. For low-speed (35 MPH or less) conditions, a 200’ sign spacing may be used. For speeds of 40 MPH to 50 MPH a 350’ sign spacing may be used.
2. HighLevel Warning Devices (Flag Trees) may be used for added visibility.
3. An array of 2 Advance Warning Signs is required. This sign array will include ROAD WORK AHEAD and MEDIAN CLOSED AHEAD signs.

Drawing 10. Center Turn Lane Closed on a Three-Lane, Two-way Road



*

SPEED LIMIT	SIGN SPACING
35 MPH or Less	250'
40 MPH – 50 MPH	350'
50 MPH or Greater	500'

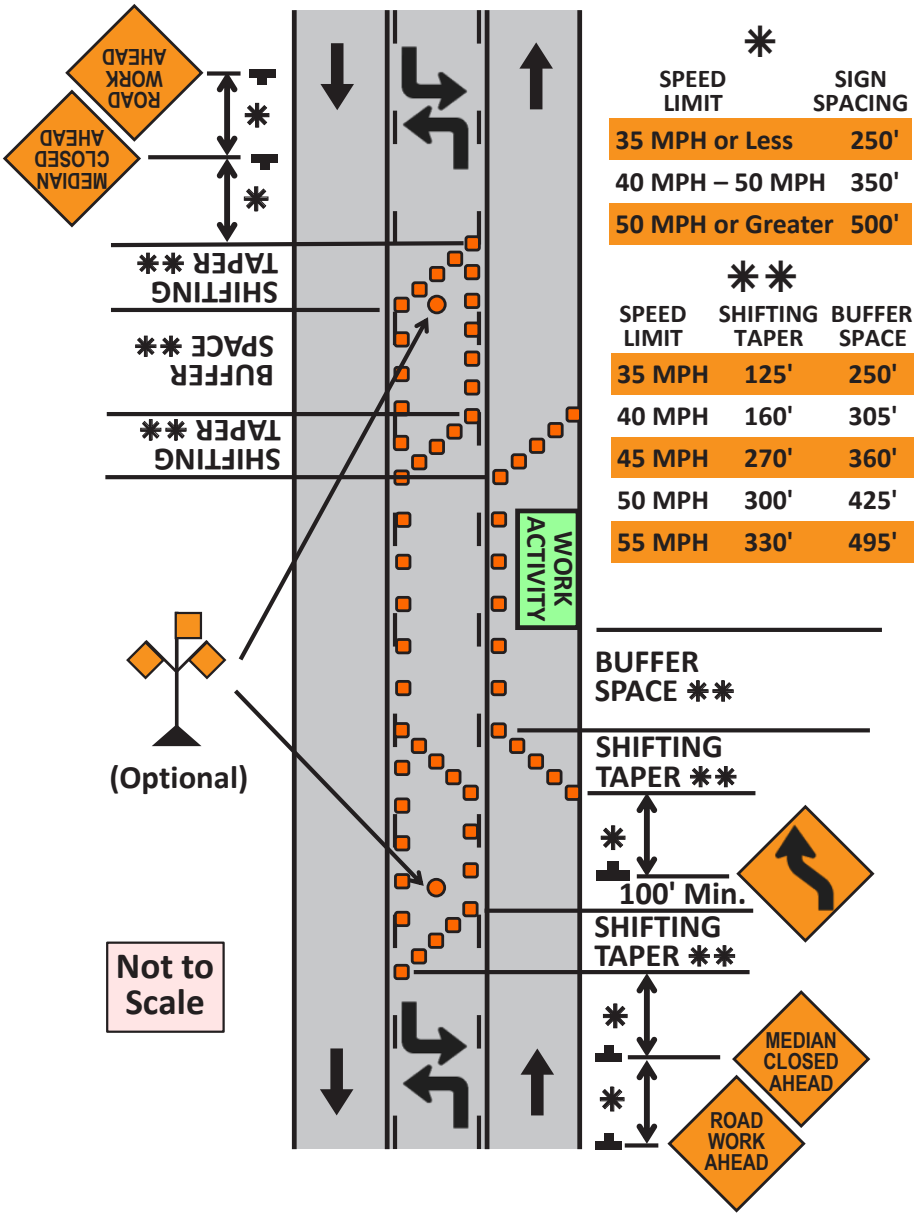
**

SPEED LIMIT	SHIFTING TAPER	BUFFER SPACE
35 MPH	125'	250'
40 MPH	160'	305'
45 MPH	270'	360'
50 MPH	300'	425'
55 MPH	330'	495'

Drawing 11. Lane Shift on a Three-Lane, Two-way Road

1. For low-speed (35 MPH or less) conditions, a 200’ sign spacing may be used. For speeds of 40 MPH to 50 MPH a 350’ sign spacing may be used.
2. High-Level Warning Devices (Flag Trees) may be used for added visibility.
3. In the travel lane of the work, an array of 3 Advance Warning Signs is required. This sign array will include ROAD WORK AHEAD, MEDIAN CLOSED AHEAD, and “Reverse Curve”.
4. In the opposing travel lane, an array of 2 Advance Warning Signs is required. This sign array will include ROAD WORK AHEAD and MEDIAN CLOSED AHEAD.
5. Install the “Reverse Curve” sign a minimum of 100’ from the end of the Shifting Taper.

Drawing 11. Lane Shift on a Three-Lane, Two-way Road



*

SPEED LIMIT	SIGN SPACING
35 MPH or Less	250'
40 MPH – 50 MPH	350'
50 MPH or Greater	500'

**

SPEED LIMIT	SHIFTING TAPER	BUFFER SPACE
35 MPH	125'	250'
40 MPH	160'	305'
45 MPH	270'	360'
50 MPH	300'	425'
55 MPH	330'	495'

Drawing 12. Right Shoulder Closure (Case I / Case II) Primary Routes

1. The primary TCDs utilized for Daytime Shoulder Closures are 36" standard traffic cones. The primary TCDs utilized for Nighttime Shoulder Closures are portable plastic drums. During Daytime Shoulder Closures, 42" oversized traffic cones may be substituted for 36" standard traffic cones. During Nighttime Shoulder Closures, 42" oversized traffic cones are prohibited for use. If this traffic control setup extends into the hours of darkness, replace all 36" standard traffic cones or 42" oversized traffic cones, with portable plastic drums.

2. Conducting work on Primary & Secondary Routes within 1' of the near edge of the adjacent travel lane under a Shoulder Closure is prohibited. All work that may require the presence of equipment, personnel, materials or Work Vehicles within 1' of the near edge of the adjacent travel lane shall be conducted under a Lane Closure.

   Case I: Whenever any portion of the Shoulder Area within 15' but not closer than 1' of the near edge of the adjacent travel lane must be occupied by equipment, personnel, materials or Work Vehicles to conduct the work, install and maintain signing and TCDs as illustrated.

   Case II: Whenever the work is conducted beyond 15' but within 30' of the near edge of the adjacent travel lane, including the presence of equipment, personnel, materials or Work Vehicles, install and maintain the signing and traffic control as illustrated.

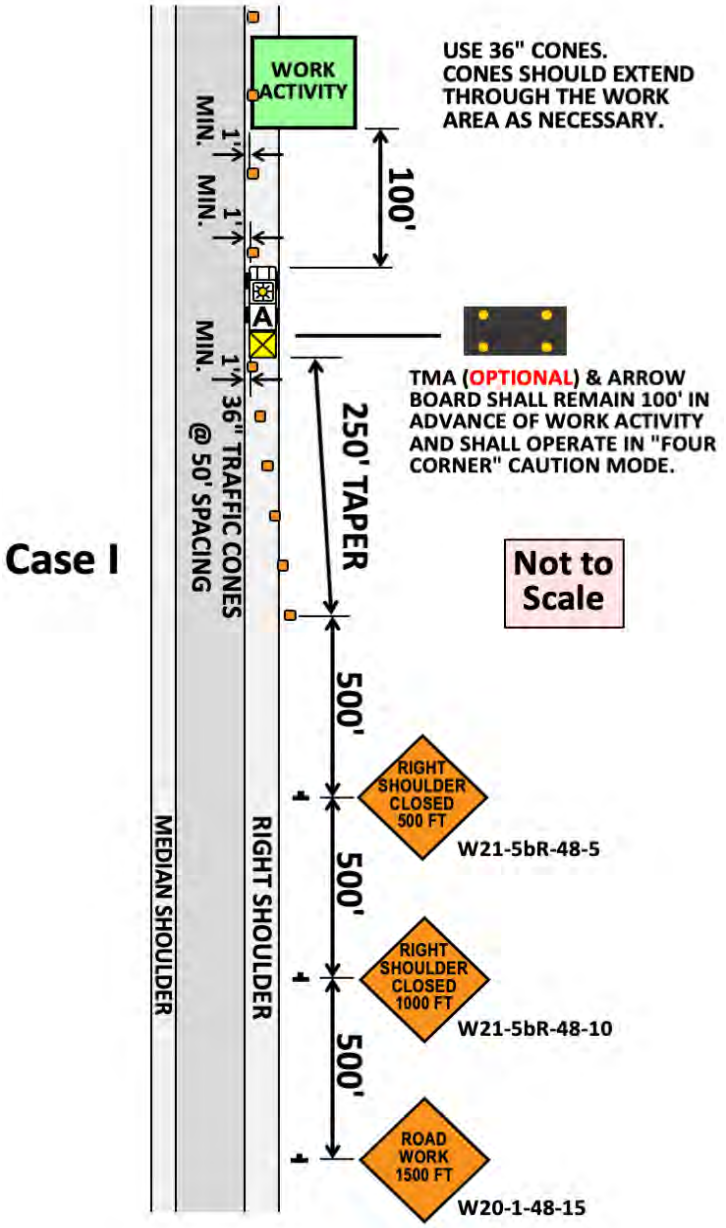
3. Conduct the work in such a manner that will not require encroachment of TCDs, equipment, personnel, materials or any work related vehicles within 1' of the near edge of the adjacent travel lane.

4. When using a TMA, locate it 100' in advance of the Work Activity and no closer than 1' from the near edge of the adjacent travel lane.

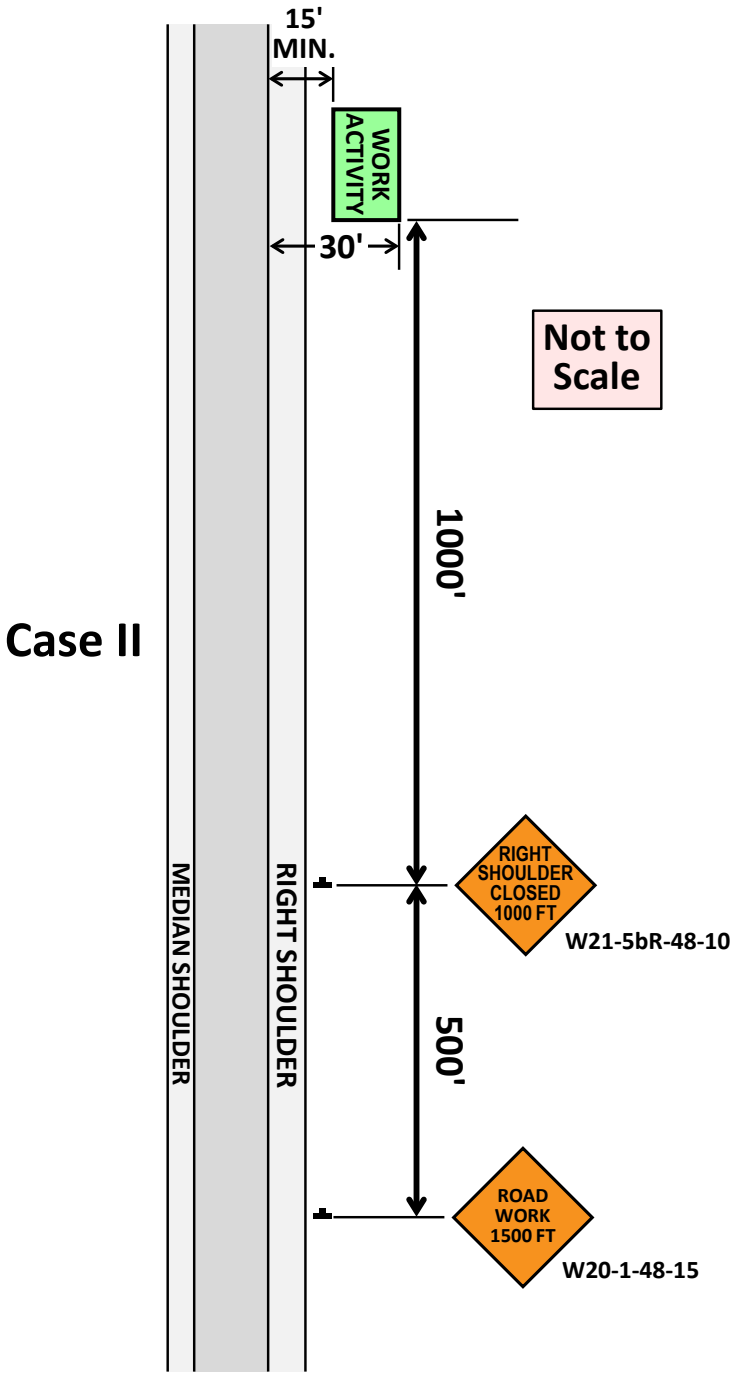
5. For a **Case I** scenario in the Right Shoulder Area, adjust the taper as necessary to fit the width of the shoulder while maintaining the required 250' taper length.

6. If work is being conducted simultaneously at two different locations at the same time under **Case I** Shoulder Closures, separate the two locations by no less than 1 mile from the end of the first **Case I** closure that a road user will encounter to the beginning of the taper of the second **Case I** closure. A minimum separation distance of ½ mile is recommended between Shoulder Closures when one or both Shoulder Closures is a **Case II** closure.

Drawing 12A. Right Shoulder Closure (Case I / Case II)
Primary Routes



Drawing 12B. Right Shoulder Closure (Case I / Case II) Primary Routes

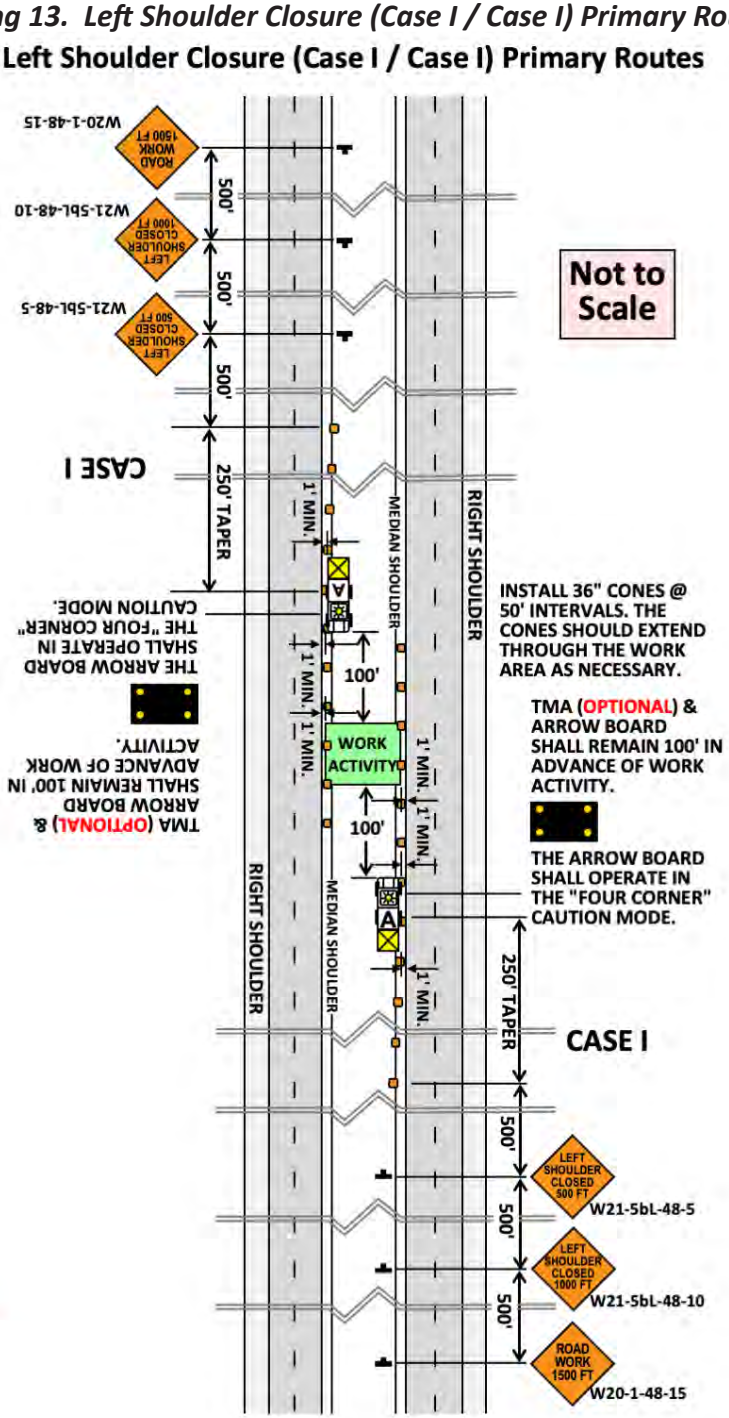


Drawing 13. Left Shoulder Closure (Case I / Case I) Primary Routes

1. The primary TCDs utilized for Daytime Shoulder Closures are 36” standard traffic cones. The primary TCDs utilized for Nighttime Shoulder Closures are portable plastic drums. During Daytime Shoulder Closures, 42” oversized traffic cones may be substituted for 36” standard traffic cones. During Nighttime Shoulder Closures, 42” oversized traffic cones are **prohibited** for use. If this traffic control setup extends into the hours of darkness, replace all 36” standard traffic cones or 42” oversized traffic cones, with portable plastic drums.
2. Conducting work on Primary & Secondary Routes within 1’ of the near edge of the adjacent travel lane under a Shoulder Closure is prohibited. All work that may require the presence of equipment, personnel, materials or Work Vehicles within 1’ of the near edge of the adjacent travel lane shall be conducted under a Lane Closure.

   Case I: Whenever any portion of the Shoulder Area within 15’ but not closer than 1’ of the near edge of the adjacent travel lane must be occupied by equipment, personnel, materials or Work Vehicles to conduct the work, install and maintain signing and TCDs as illustrated.
3. Conduct the work in such a manner that will not require encroachment of TCDs, equipment, personnel, materials or any work related vehicles within 1’ of the near edge of the adjacent travel lane.
4. When using a TMA, locate it 100’ in advance of the Work Activity and no closer than 1’ from the near edge of the adjacent travel lane.
5. For a **Case I** scenario in the Left Shoulder Area, adjust the taper as necessary to fit the width of the shoulder while maintaining the required 250’ taper length.
6. If work is being conducted simultaneously at two different locations at the same time under **Case I** Shoulder Closures, separate the two locations by no less than 1 mile from the end of the first **Case I** closure that a road user will encounter to the beginning of the taper of the second **Case I** closure.

Drawing 13. Left Shoulder Closure (Case I / Case I) Primary Routes



Drawing 14. Left Shoulder Closure (Case I / Case II) Primary Routes

1. The primary TCDs utilized for Daytime Shoulder Closures are 36" standard traffic cones. The primary TCDs utilized for Nighttime Shoulder Closures are portable plastic drums. During Daytime Shoulder Closures, 42" oversized traffic cones may be substituted for 36" standard traffic cones. During Nighttime Shoulder Closures, 42" oversized traffic cones are **prohibited** for use. If this traffic control setup extends into the hours of darkness, replace all 36" standard traffic cones or 42" oversized traffic cones, with portable plastic drums.

2. Conducting work on Primary & Secondary Routes within 1' of the near edge of the adjacent travel lane under a Shoulder Closure is prohibited. All work that may require the presence of equipment, personnel, materials or Work Vehicles within 1' of the near edge of the adjacent travel lane shall be conducted under a Lane Closure.

   Case I: Whenever any portion of the Shoulder Area within 15' but not closer than 1' of the near edge of the adjacent travel lane must be occupied by equipment, personnel, materials or Work Vehicles to conduct the work, install and maintain signing and TCDs as illustrated.

   Case II: Whenever the work is conducted beyond 15' but within 30' of the near edge of the adjacent travel lane, including the presence of equipment, personnel, materials or Work Vehicles, install and maintain signing and traffic control as illustrated.

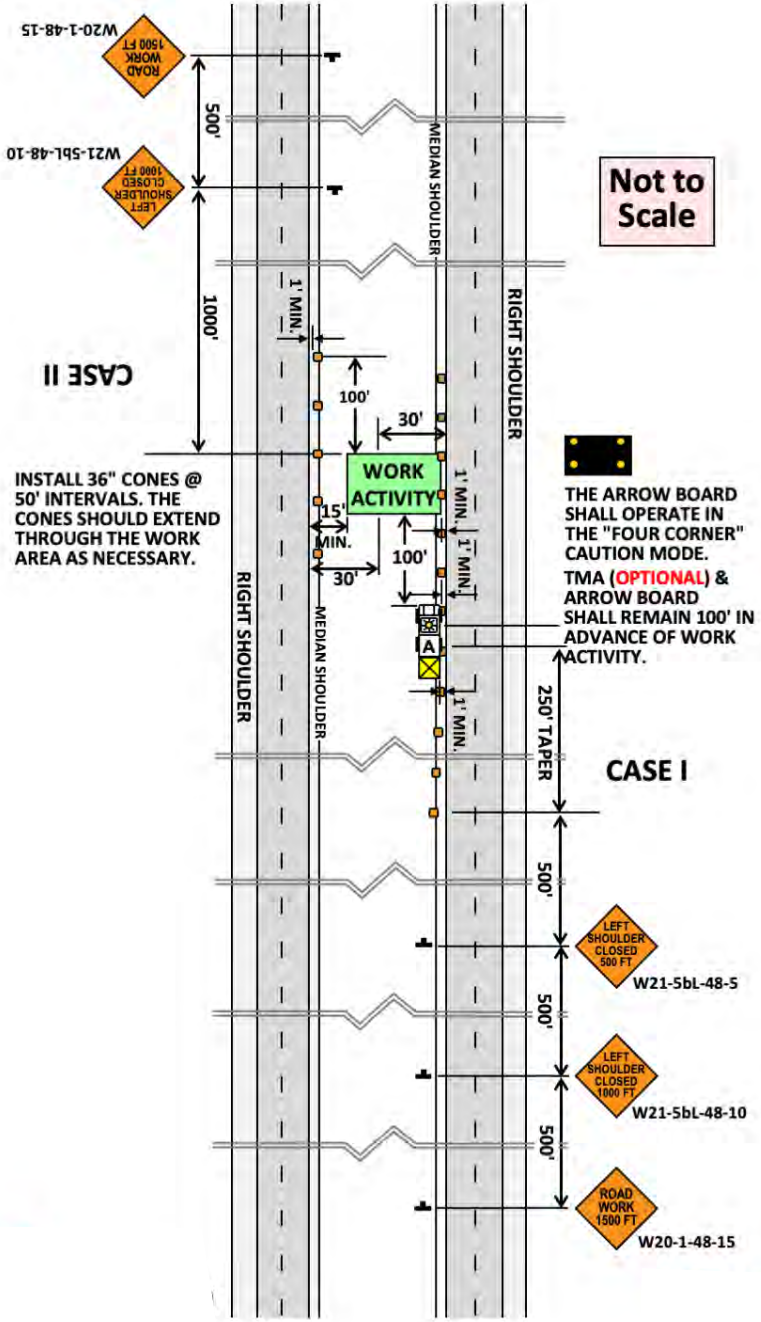
3. Conduct the work in such a manner that will not require encroachment of TCDs, equipment, personnel, materials or any work related vehicles within 1' of the near edge of the adjacent travel lane.

4. When using a TMA, locate it 100' in advance of the Work Activity and no closer than 1' from the near edge of the adjacent travel lane.

5. For a **Case I** scenario in the Left Shoulder Area, adjust the taper as necessary to fit the width of the shoulder while maintaining the required 250' taper length.

6. If work is being conducted simultaneously at two different locations at the same time under **Case I** Shoulder Closures, separate the two locations by no less than 1 mile from the end of the first **Case I** closure that a road user will encounter to the beginning of the taper of the second **Case I** closure. A minimum separation distance of one-half mile is recommended between Shoulder Closures when one or both Shoulder Closures is a **Case II** closure.

Drawing 14. Left Shoulder Closure (Case I / Case II) Primary Routes



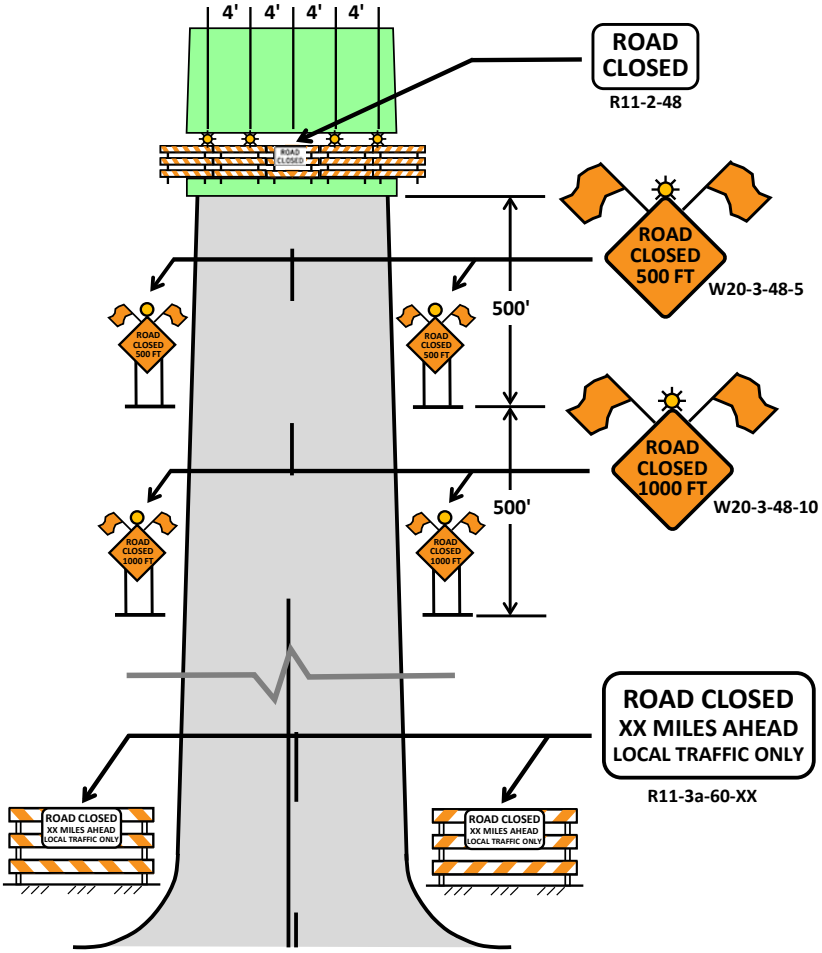
Drawing 15. Extended Road Closure of Roadway

1. Measure all Advance Warning Sign locations from the limits of the Work Area.
2. Install Advance Warning Signs mounted on portable sign supports no less than 4’ from the near edge of the sign to the near edge of an adjacent travel lane on roadways with grass shoulders and no less than 6’ from the near edge of the sign to the near edge of an adjacent travel lane on roadways with paved shoulders. When curb & gutter is present, install the sign no less than 2’ from the near edge of the sign to the face of the curb.
3. The Advance Warning Sign placement intervals indicated on the illustration are for normal conditions. Adjustments to the distance intervals between the signs may be necessary due to sight distance restrictions such as curves and hills.
4. The minimum mounting height of signs mounted on portable supports during a traffic control set up for a road closure is 5’ from the ground to the bottom edge of the sign. The mounting height of signs mounted on ground mounted posts during a traffic control set up for a road closure is 7’ to 8’ from the bottom edge of the sign to the grade elevation of the near edge of the adjacent travel lane.
5. When utilizing U-Channel posts, the ground support (stub) is always between oncoming traffic and the sign support. Attach the sign support to the ground support (stub) on the side of the ground support (stub) opposite of oncoming traffic. Install the breakaway system to function in accordance with the direction of traffic in the adjacent travel lane.
6. All supplemental signs attached to Type 3 barricades shall be constructed of an approved retroreflective roll-up material or an approved aluminum laminate composite rigid sign substrate material such as “Alpolic”, “Dibond”, or “Reynolite”. Other rigid sign substrates such as 0.08 and 0.10 aluminum sign blanks are **prohibited** for attachment to a Type 3 barricade.
7. The traffic control set up illustrated applies to only one approach to the work area. Each approach shall require duplication of this traffic control set up as illustrated.

8. See the table below for the traffic control device quantities.

TCDs	Quantity
Type 3 Barricades	7 @ 6’ each
Permanent Construction Signs (Ground Mounted)	4 @ 48” each
Permanent Construction Signs (Barricade Mounted)	1 @ 48” x 30” each 2 @ 60” x 30” each
Type B High-Intensity Flashing Warning Lights	8 each
16” x 16” Orange Flags	8 each

Drawing 15. Extended Road Closure of Roadway



LEGEND

TYPE 3 BARRICADE (6')

WORK AREA

TYPE "B" HIGH-INTENSITY FLASHING WARNING LIGHT

16" ´ 16" ORANGE FLAGS

GENERAL NOTES:

1. THIS TRAFFIC CONTROL SETUP ILLUSTRATES AND SPECIFIES THE TRAFFIC CONTROL REQUIREMENTS FOR INSTALLING AND MAINTAINING AN EXTENDED ROAD CLOSURE OF A PRIMARY OR SECONDARY ROADWAY.
2. THE TRAFFIC CONTROL SETUP ILLUSTRATED APPLIES TO ONLY ONE APPROACH TO THE WORK AREA.

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Mobile Operations

Mobile Operations are work activities that move along the road intermittently or continuously. Safety for Mobile Operations should not be compromised by using fewer devices simply because the operation will frequently change its location.

For Mobile Operations to be successful, the Advance Warning Area for these operations must move with the Work Area or be repositioned periodically to provide warning for the road user.

Portable devices should be used. Reflectorize all orange Advance Warning Signs with fluorescent orange-colored prismatic retroreflective sheeting. Appropriately marked vehicles with amber or yellow rotating, flashing, or strobe lights mounted on top of each vehicle, perhaps augmented with signs, arrow boards, or CMSs, may be used in place of stationary signs and channelizing devices.

Shadow Vehicles **may be** required in Intermittent Mobile Operations, but **are** required for Continuously Moving Mobile Operations within the roadway. Shadow Vehicles also should be considered for shoulder work activities when Shoulder Areas are inadequate for equipment to operate without encroaching on the adjacent travel lane.

Maintain functional two-way radio communication between all vehicles when more than 1 vehicle is utilized.

Intermittent Mobile Operations

Intermittent Mobile Operations (such as litter cleanup, pothole patching, or utility operations) often involve frequent short stops, and are similar to Stationary Operations. With operations that move slowly (less than 3 MPH), it may be feasible to use stationary signing that is periodically retrieved and repositioned in the Advance Warning Area.

Intermittent Mobile Operations may be performed by a Single Work Vehicle which may be a car or truck type vehicle or a single piece of equipment, or a Vehicle Train that typically includes no more than 2 vehicles to include either 1 Work Vehicle or 1 piece of equipment and a Shadow Vehicle. However, additional Shadow Vehicles may be utilized when deemed necessary by the Owner.

Work activities during the hours of darkness should be minimized and avoided when possible. However, in the case of an emergency when Nighttime Intermittent Mobile Operations are required and a Lane Closure is not feasible, a minimum TTC Zone setup SHALL include a Shadow Vehicle(s) supplemented with a TMA.

A minimum number of 2 persons in the Work Vehicle is recommended so that one person may act as Spotter while the other person performs the work.

Flaggers may be used, but caution must be exercised so they are not exposed to unnecessary hazards. Shadow Vehicles should be considered in areas with limited sight distance due to horizontal or vertical curvature of the roadway.

Stopping Sight Distance

Consideration for utilizing a Shadow Vehicle is based on the availability of adequate Stopping Sight Distance. The Stopping Sight Distance is the length of roadway necessary for a typical vehicle to **stop** before reaching a **stationary** object in its path. The Stopping Sight Distance for any specific location is determined by the posted regulatory speed limit of the roadway.



When a Shadow Vehicle is utilized, adequate Stopping Sight Distance between the Shadow Vehicle and the road user should be maintained. Field adjustments to the location of the Shadow Vehicle may be necessary to ensure it is not positioned in a location that may create a hazardous situation due to limited Stopping Sight Distance in regard to a prudent driver being able to recognize the presence of the Shadow Vehicle.

The table below indicates the Stopping Sight Distance to be used for “Cars” and “Trucks”. Consideration should be given to using the distances that are designated as “Truck” on roadways with high truck volumes.

Posted Regulatory Speed Limit	Stopping Sight Distance, Car	Stopping Sight Distance, Truck*	Variable Distance Interval (VDI)
35 MPH or Less	250'	350'	50' – 250'
40 MPH – 55 MPH	500'	750'	75' – 500'
60 MPH or Greater	750'	1100'	100' – 750'

* Consider using the distances designated as "Truck" on roadways with high truck volumes.

Variable Distance Interval (VDI)

The distance between the Work Vehicle and the Shadow Vehicle is referred to as the Variable Distance Interval (VDI).



The VDI is determined by the posted regulatory speed limit of the roadway as indicated by the table above. The VDI between the vehicles may require adjustments to compensate for sight distance obstructions created by hills and curves and any other conditions that may obstruct the sight distance between the vehicles. However, adjustments to the VDI between the vehicles should be maintained within the range of the VDI indicated in the above table, which also appears on Drawings 16-20.

Supplement the Work Vehicles and the Shadow Vehicles with amber or yellow auxiliary warning lights that **shall** be high-intensity rotating, flashing, oscillating or strobe lights. Standard vehicle hazard warning lights are only permitted as a supplement to the auxiliary warning lights.

The vehicles also may be supplemented with truck mounted arrow boards and TMAs.

When operating on Primary & Secondary Routes:

- The Work Vehicle and Shadow Vehicle shall utilize the Shoulder Areas as much as practical when stopped.
- The maximum time duration of a stop is 15 minutes if the Work Vehicle and/or a Shadow Vehicle must encroach upon a travel lane more than 2'.
- The maximum time duration of a stop is 30 minutes if the Work Vehicle and/or a Shadow Vehicle remain in the Shoulder Area in their entirety or encroaches upon a travel lane no more than 2'.

Drawing 16. Intermittent Mobile Operations Low-Volume, Intermediate-Speed to High-Speed, Primary & Secondary Routes

1. Roadway characteristics such as type, speed classification and volume classification shall determine the traffic control requirements for Intermittent Mobile Operations.
2. Evaluate the potential sight distance restrictions, such as vertical and horizontal curves, and the posted regulatory speed limits prior to deployment of a work detail to determine the minimum Vehicle Train requirements.
3. A Shadow Vehicle shall accompany the Work Vehicle when the Stopping Sight Distance between the Work Vehicle and an approaching road user is unavailable based upon the posted regulatory speed limit of the specific location and/or the work is conducted during the hours of darkness.
4. A Shadow Vehicle may not be necessary during daytime hours when adequate Stopping Sight Distance is available.
5. A truck mounted arrow board operating in the "Four Corner" Caution Mode is optional on the Work Vehicle and the Shadow Vehicle.
6. A TMA is optional on the Work Vehicle and Shadow Vehicle.
7. On low-volume, low-speed roadways, Intermittent Mobile Operations may be conducted with one person in the Work Vehicle. However, a minimum number of 2 persons in the Work Vehicle is recommended so that one person may act as a Spotter while the other person performs the work.
8. Shadow Vehicles may be optional for Work Operations on Low-Volume, low-speed roadways provided the Work Vehicles and/or equipment is equipped with amber or yellow high-intensity rotating, flashing, oscillating or strobe auxiliary warning lights.
9. On Low-Volume, Intermediate-Speed to High-Speed roadways, Intermittent Mobile Operations may be conducted with one person in the Work Vehicle. However, a minimum number of 2 persons in the Work Vehicle is recommended so that one person may act as a Spotter while the other person performs the work.
10. The Work Vehicle and Shadow Vehicle should utilize and remain within the Shoulder Area as much as practical.

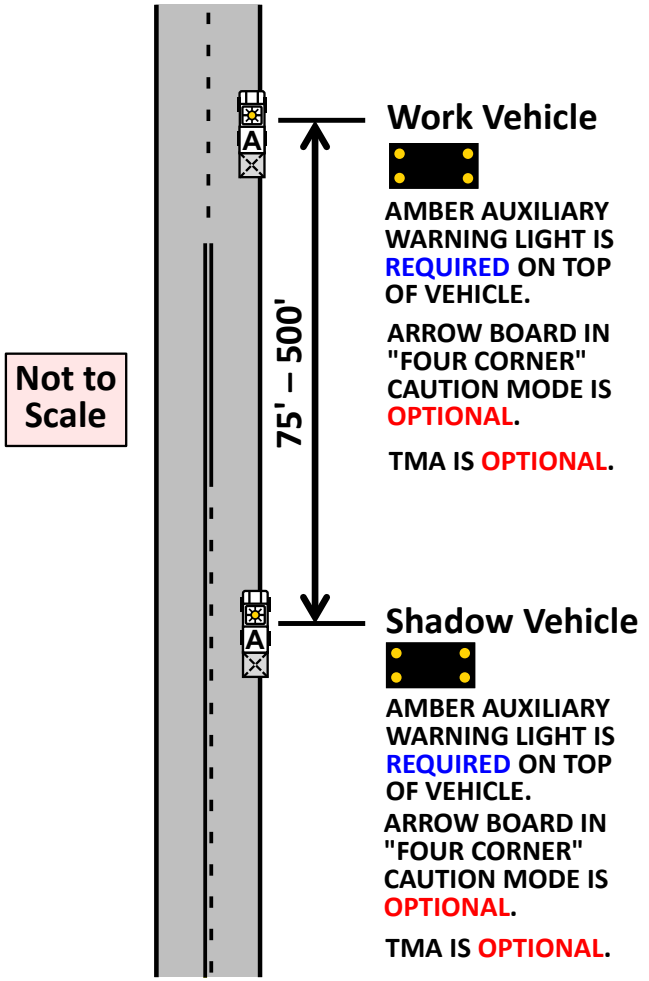
11. When a Single Work Vehicle is utilized on **two-lane, two-way roadways**, the Single Work Vehicle may be supplemented with a truck mounted arrow board operating in the "Four Corner" Caution Mode.
12. When a Vehicle Train is utilized on **two-lane, two-way roadways**, either or both the Work Vehicle and the Shadow Vehicle, may be supplemented with a truck mounted arrow board operating in the "Four Corner" Caution Mode.

Drawing 16. Intermittent Mobile Operations Low-Volume, Intermediate-Speed to High-Speed, Primary & Secondary Routes

STOPPING SIGHT DISTANCE REQUIREMENTS

Posted Regulatory Speed Limit	Car Distance	Truck Distance*	Shadow To Work Vehicle (VDI)
≤ 35 MPH	250'	350'	50' – 250'
40 MPH – 55 MPH	500'	750'	75' – 500'
60 MPH – 70 MPH	750'	1100'	100' – 750'

* Consider using the distances designated as "Truck" on roadways with high truck volumes.



Drawing 17. Intermittent Mobile Operations High-Volume, Low-speed, Interior Travel Lane, Primary & Secondary Routes

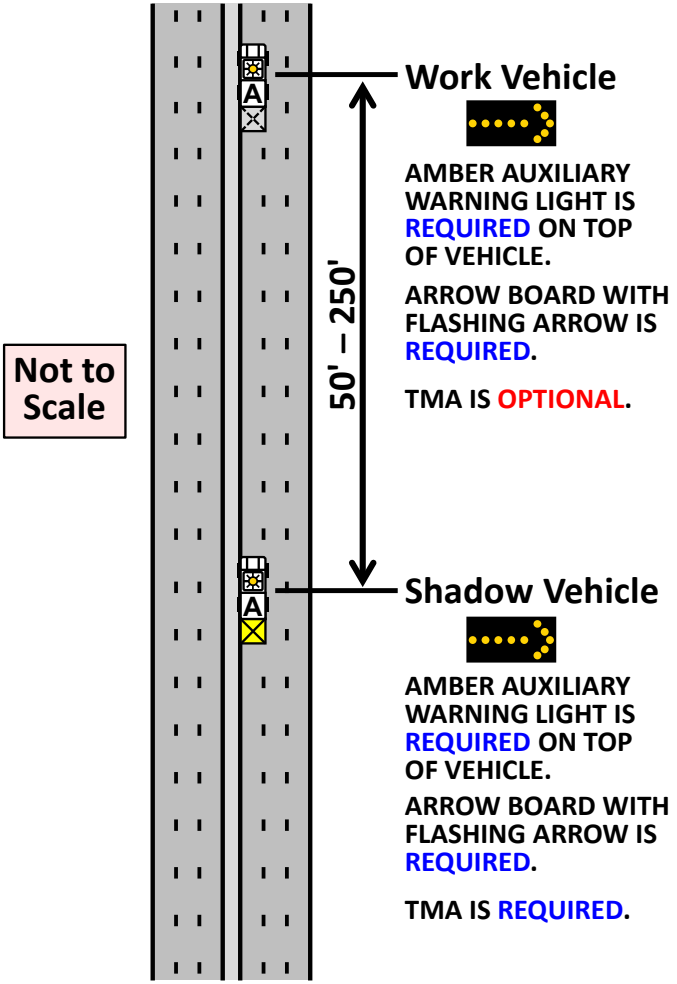
1. Roadway characteristics such as type, speed classification and volume classification shall determine the traffic control requirements for Intermittent Mobile Operations.
2. Evaluate the potential sight distance restrictions and posted regulatory speed limits of these roadways prior to deployment of the work detail to determine the minimum Vehicle Train requirements.
3. A Shadow Vehicle is **required** and **shall** accompany the Work Vehicle during ALL Intermittent Mobile Operations conducted within an **interio**r travel lane.
4. The Shadow Vehicle should operate at close range behind the Work Vehicle while maintaining adequate Stopping Sight Distance to minimize encroachment by road users between the Work Vehicle and the Shadow Vehicle when operating in an **interior** travel lane.
5. Depending upon the **interior** lane in which work is being conducted, a truck mounted arrow board operating in the Flashing Arrow Mode or the Flashing Double Arrow Mode is **required** on the Work Vehicle and the Shadow Vehicle.
6. A TMA is optional on the Work Vehicle but a TMA is **required** on the Shadow Vehicle.
7. When the Vehicle Train operates within an **interior** travel lane adjacent to a shoulder (i.e., Left Travel Lane; Left Shoulder), the Work Vehicle and the Shadow Vehicle should utilize and remain within the Shoulder Areas as much as possible.
8. The maximum time duration of a stop is 15 minutes when the Vehicle Train operates within an **interior** lane.
9. On High-Volume, low-speed roadways, conduct Intermittent Mobile Operations with no less than 2 persons in the Work Vehicle. One person shall act as a Spotter while the other person performs the work.
10. When a Vehicle Train including a Work Vehicle and Shadow Vehicle is utilized on **multi-lane roadways** in an **interior** travel lane as illustrated in this traffic control setup, supplementation of both the Single Work Vehicle and the Shadow Vehicle with a truck mounted arrow board operating in a Flashing Arrow Mode or a Sequential Chevron Mode is REQUIRED.

Drawing 17A. Intermittent Mobile Operations High-Volume, Low-speed, Interior Travel Lane, Primary & Secondary Routes

STOPPING SIGHT DISTANCE REQUIREMENTS

Posted Regulatory Speed Limit	Car Distance	Truck Distance*	Shadow To Work Vehicle (VDI)
≤ 35 MPH	250'	350'	50' – 250'
40 MPH – 55 MPH	500'	750'	75' – 500'
60 MPH – 70 MPH	750'	1100'	100' – 750'

* Consider using the distances designated as "Truck" on roadways with high truck volumes.

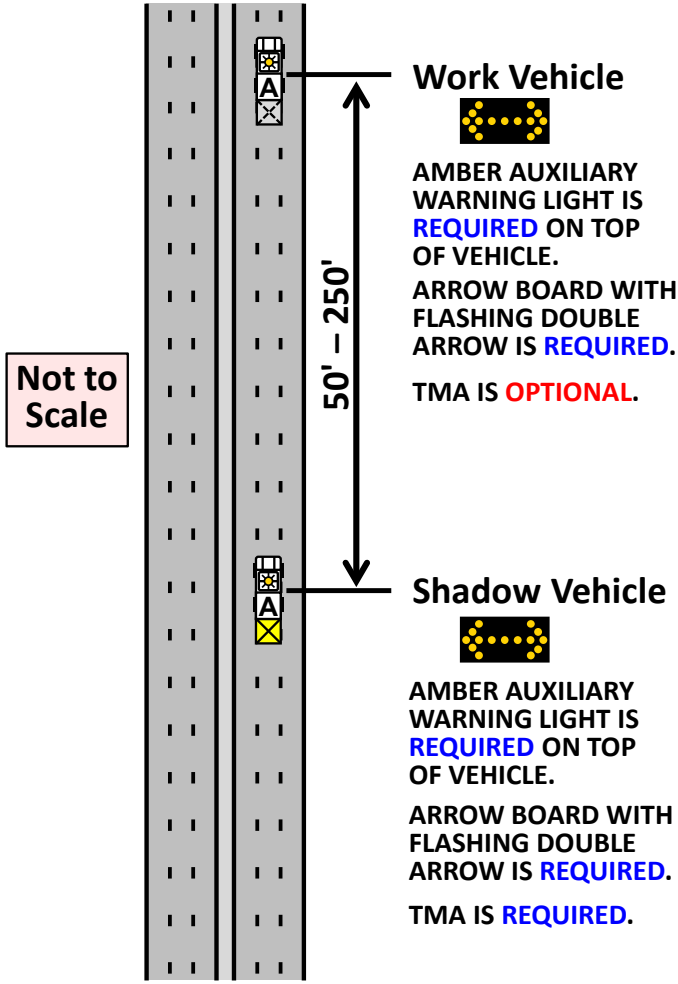


Drawing 17B. Intermittent Mobile Operations High-Volume, Low-speed, Interior Travel Lane, Primary & Secondary Routes

STOPPING SIGHT DISTANCE REQUIREMENTS

Posted Regulatory Speed Limit	Car Distance	Truck Distance*	Shadow To Work Vehicle (VDI)
≤ 35 MPH	250'	350'	50' – 250'
40 MPH – 55 MPH	500'	750'	75' – 500'
60 MPH – 70 MPH	750'	1100'	100' – 750'

* Consider using the distances designated as "Truck" on roadways with high truck volumes.



Drawing 18. Intermittent Mobile Operations High-Volume, Intermediate-Speed to High-Speed, Primary & Secondary Routes

1. Roadway characteristics such as type, speed classification and volume classification shall determine the traffic control requirements for Intermittent Mobile Operations.
2. Evaluate the potential sight distance restrictions and posted regulatory speed limits of these roadways prior to deployment of the work detail to determine the minimum Vehicle Train requirements.
3. A Shadow Vehicle shall accompany the Work Vehicle when the Stopping Sight Distance between the Work Vehicle and an approaching road user is unavailable based upon the posted regulatory speed limit of the specific location and/or the work is conducted during the hours of darkness.
4. A Shadow Vehicle may not be necessary during daytime hours when adequate Stopping Sight Distance is available.
5. If the Work Vehicle is not supplemented with a truck mounted arrow board, then a truck mounted arrow board is required on the Shadow Vehicle.
6. A TMA is optional on the Work Vehicle and the Shadow Vehicle.
7. On High-Volume, Intermediate-Speed to High-Speed roadways, conduct Intermittent Mobile Operations with no less than 2 persons in the Work Vehicle. One person shall act as a Spotter while the other person performs the work.
8. When a Single Work Vehicle is utilized on **two-lane, two-way roadways**, the Single Work Vehicle may be supplemented with a truck mounted arrow board operating in the “Four Corner” Caution Mode.
9. When a Vehicle Train is utilized on **two-lane, two-way roadways**, either or both the Work Vehicle and the Shadow Vehicle, may be supplemented with a truck mounted arrow board operating in the “Four Corner” Caution Mode.
10. When a Single Work Vehicle is utilized on **multi-lane roadways**, the Single Work Vehicle may be supplemented with a truck mounted arrow board operating in in a Flashing Arrow Mode or a Sequential Chevron Mode.

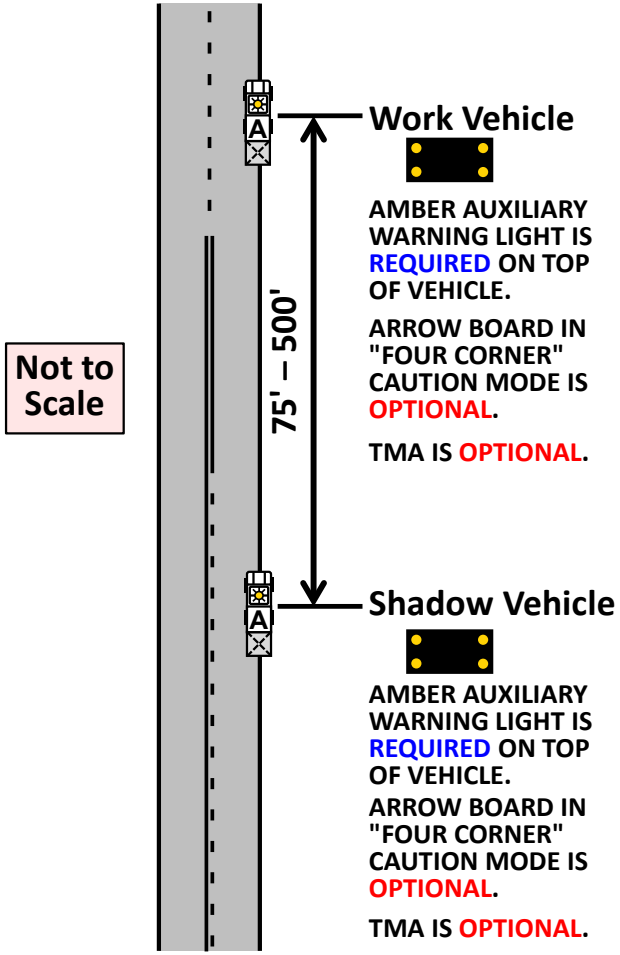
11. When a Vehicle Train is utilized on **multi-lane roadways**, supplement no less than **one** of the vehicles in the Vehicle Train with a truck mounted arrow board operating in a Flashing Arrow Mode or Sequential Chevron Mode. A truck mounted arrow board is recommended but not required on the Work Vehicle. However, if the Work Vehicle is **not** supplemented with a truck mounted arrow board, then a truck mounted arrow board operating in a Flashing Arrow Mode or Sequential Chevron Mode is **required** on the Shadow Vehicle.

Drawing 18A. Intermittent Mobile Operations High-Volume, Intermediate-Speed to High-Speed, Primary & Secondary Routes, two-lane, Two-way Roadways

STOPPING SIGHT DISTANCE REQUIREMENTS

Posted Regulatory Speed Limit	Car Distance	Truck Distance*	Shadow To Work Vehicle (VDI)
≤ 35 MPH	250'	350'	50' – 250'
40 MPH – 55 MPH	500'	750'	75' – 500'
60 MPH – 70 MPH	750'	1100'	100' – 750'

* Consider using the distances designated as "Truck" on roadways with high truck volumes.

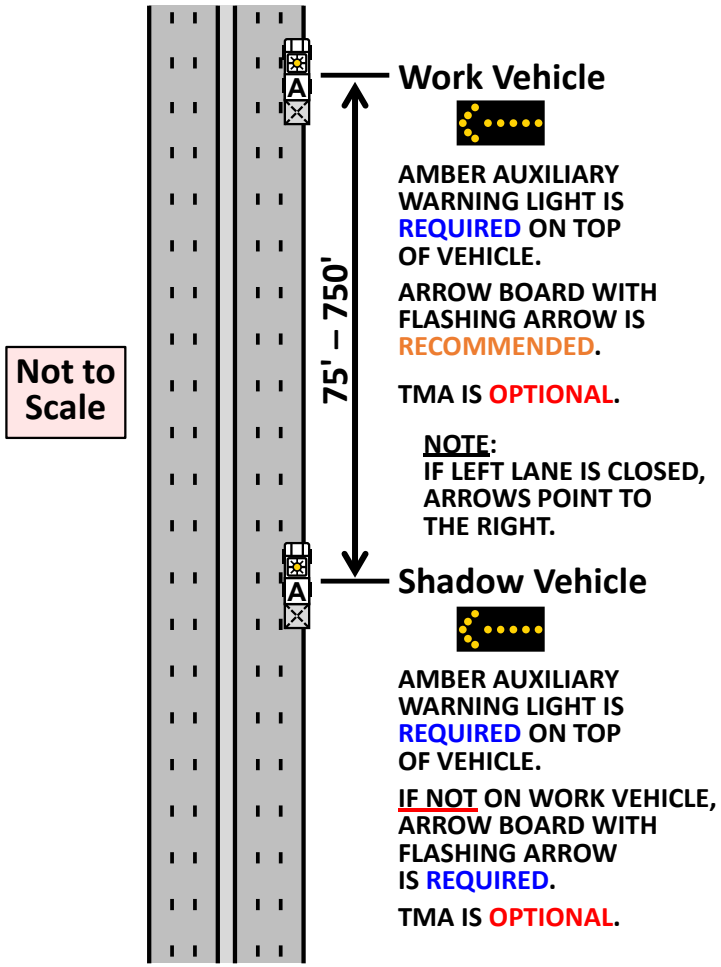


Drawing 18B. Intermittent Mobile Operations High-Volume, Intermediate-Speed to High-Speed, Primary & Secondary Routes, Multi-lane Roadways

STOPPING SIGHT DISTANCE REQUIREMENTS

Posted Regulatory Speed Limit	Car Distance	Truck Distance*	Shadow To Work Vehicle (VDI)
≤ 35 MPH	250'	350'	50' – 250'
40 MPH – 55 MPH	500'	750'	75' – 500'
60 MPH – 70 MPH	750'	1100'	100' – 750'

* Consider using the distances designated as "Truck" on roadways with high truck volumes.



Continuously Moving Mobile Operations

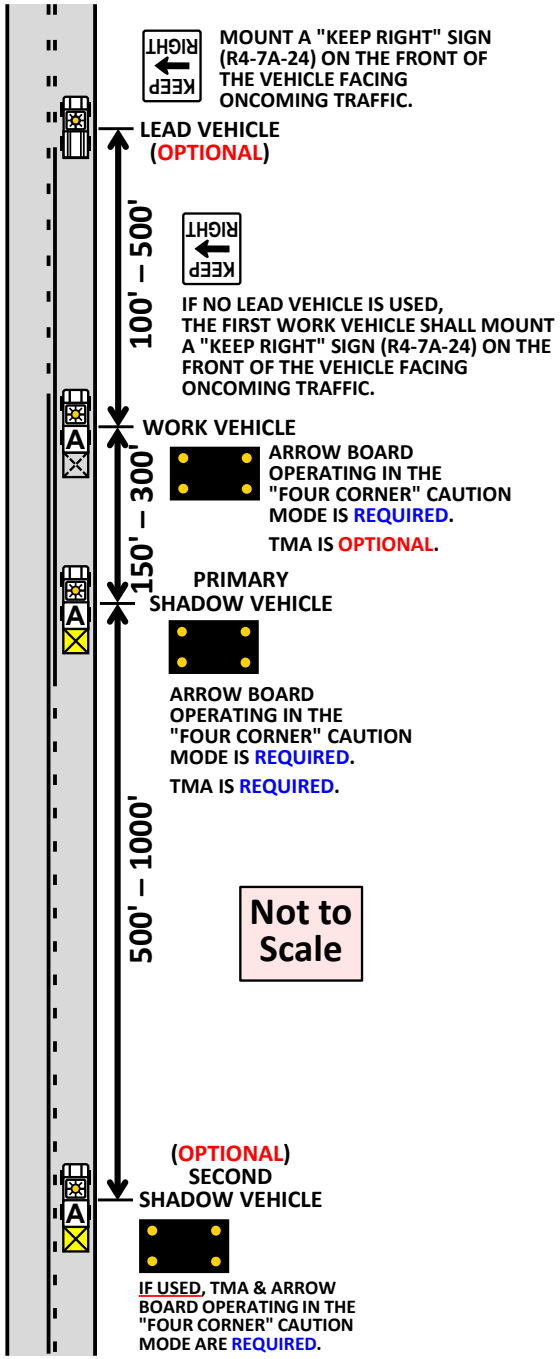
These Mobile Operations include work activities in which workers and equipment move along the road without stopping (e.g., pavement striping, street sweeping, or herbicide spraying), usually at speeds greater than 3 MPH. On low-volume, low-speed roadways, a well-marked and well-signed vehicle may suffice. On all other roadways, Shadow Vehicles are required so that the Advance Warning Area moves with the Work Area.

Drawing 19. Mobile Operations Two-Lane, Two-Way, Primary & Secondary Routes

1. The Vehicle Train for this Mobile Operation shall require a Work Vehicle and a Shadow Vehicle. A Lead Vehicle and a Second Shadow Vehicle are optional but recommended on high-volume roads with intermediate-speed or high-speed conditions.
2. Where VDIs are indicated on the drawing, adjust the VDIs between the vehicles to compensate for horizontal and vertical curves and any other conditions that may hinder or obstruct sight distance between the vehicles. However, adjustments are restricted to the range of VDIs indicated on the drawing.
3. Maintain two-way radio communication between all vehicles in the Mobile Operation Train.
4. Supplement all vehicles and equipment operating in this Vehicle Train with amber or yellow high-intensity rotating, flashing, oscillating or strobe type auxiliary warning light devices. Standard vehicle hazard warning lights are only permitted as a supplement to the auxiliary warning lights.
5. Reflectorize all orange Advance Warning Signs with approved fluorescent orange-colored microprismatic retroreflective sheeting. Reflectorize all regulatory signs with approved white microprismatic retroreflective sheeting.
6. Supplement each Shadow Vehicle with a TMA commensurate with the prevailing speeds of the traffic.
7. If the Lead Vehicle is used, it shall maintain a distance interval of 100’ to 500’ ahead of the Work Vehicle. The Lead Vehicle shall display a 24”x 30” KEEP RIGHT (R4-7a-24) sign mounted on the front of the vehicle facing oncoming traffic.

8. The Work Vehicle is required to have an approved arrow board in the “Four Corner” Caution Mode display facing traffic approaching the Work Vehicle from the rear. Also, the Work Vehicle may be supplemented with an approved TMA.
9. If the Lead Vehicle is omitted, the Work Vehicle shall be supplemented with a 24” x 30” KEEP RIGHT (R4-7a-24) sign mounted on the front of the vehicle facing oncoming traffic.
10. The Primary Shadow Vehicle shall operate 150’ to 300’ behind the Work Vehicle and shall have an approved arrow board operating in the “Four Corner” Caution Mode display mounted on the top of the vehicle and an approved TMA.
11. When utilized, the Second Shadow Vehicle shall operate 500’ to 1000’ behind the Primary Shadow Vehicle and shall have an approved arrow board operating in the “Four Corner” Caution Mode display mounted on top of the vehicle and an approved TMA.

Drawing 19. Mobile Operations two-lane, Two-way, Primary & Secondary Routes



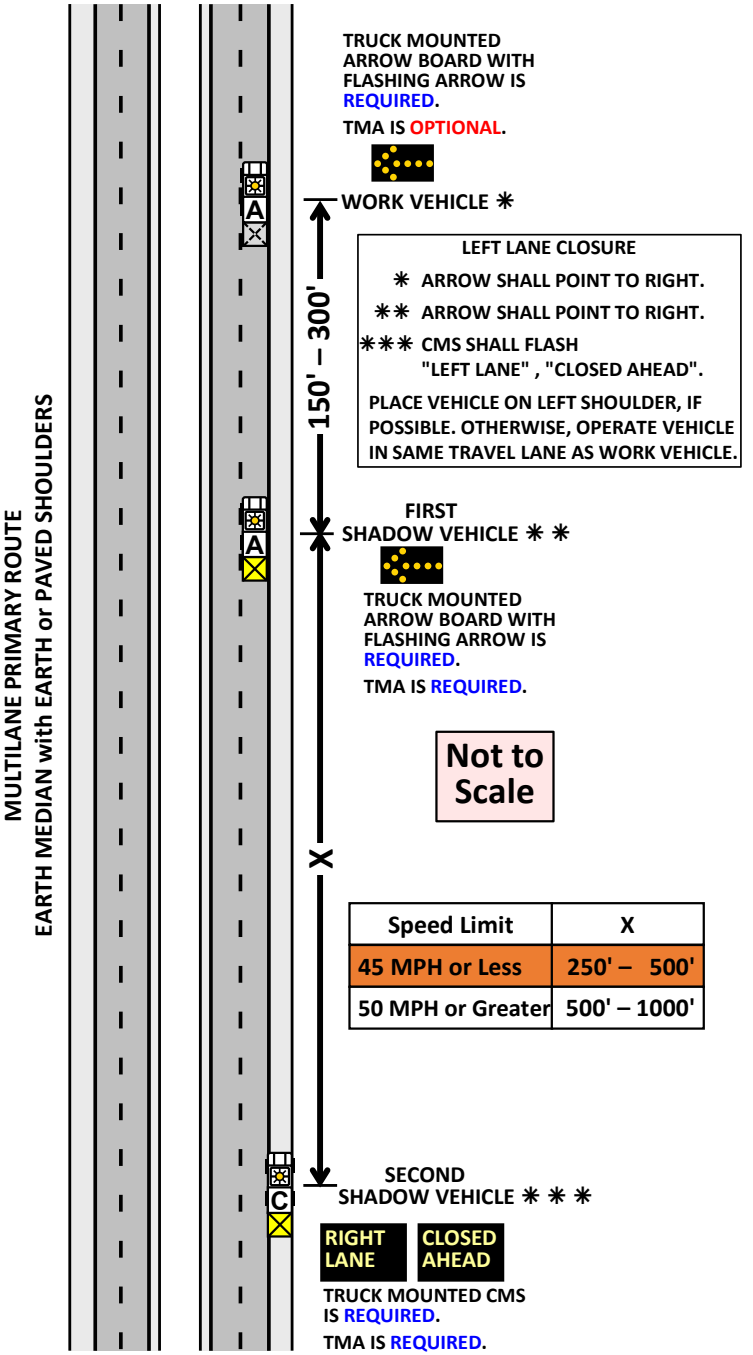
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Drawing 20. Mobile Operations Multi-lane Primary Routes

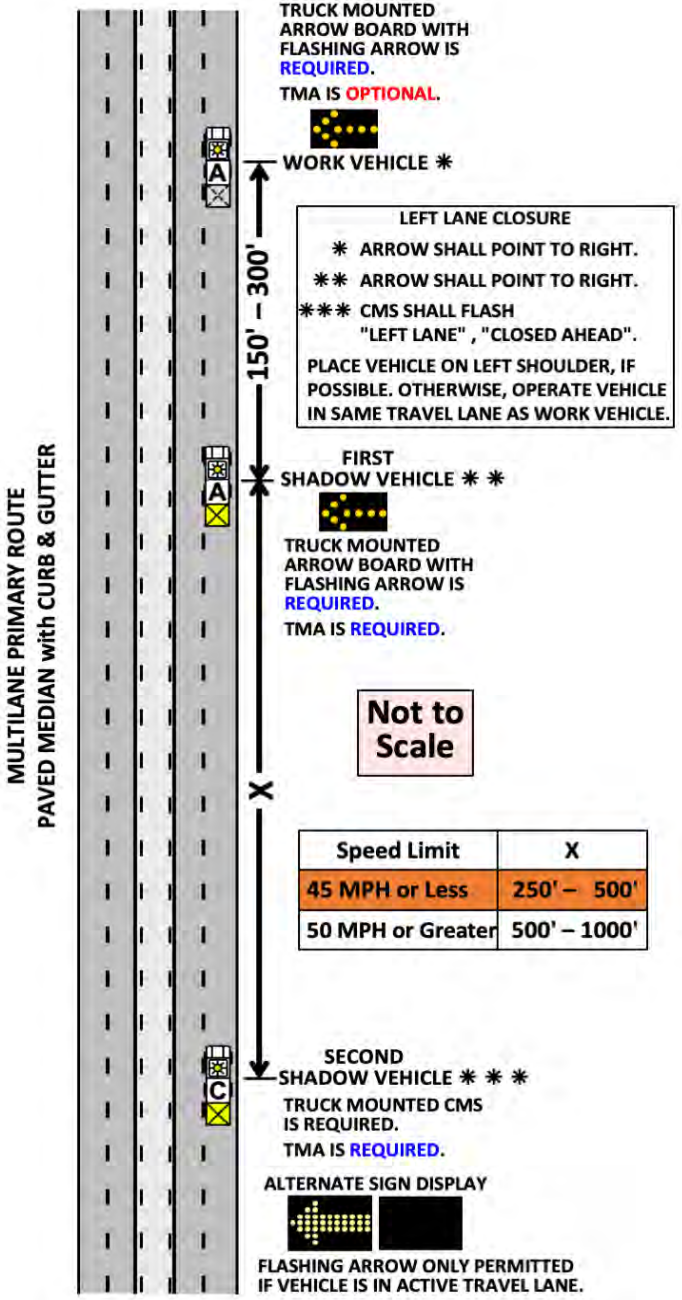
1. Where VDIs are indicated on the drawing, adjust the VDIs between the vehicles to compensate for horizontal and vertical curves and any other conditions that may hinder or obstruct sight distance between the vehicles. However, adjustments are restricted to the range of VDIs indicated on the drawing.
2. This drawing applies to Mobile Operations conducted on Primary roadways. Roadway speeds are broken down into two categories: 45 MPH or less and 50 MPH or greater.
3. The Vehicle Train for this Mobile Operation shall include the Work Vehicle and 2 Shadow Vehicles.
4. Supplement each Shadow Vehicle with a TMA commensurate with the prevailing speeds of the traffic. A TMA is optional for the Work Vehicle.
5. Supplement the Work Vehicle and the First Shadow Vehicle with approved truck mounted arrow boards.
6. Supplement the Second Shadow Vehicle with a truck mounted CMS capable of displaying two message lines of seven 18” characters.
7. Reflectorize all orange Advance Warning Signs with fluorescent orange-colored prismatic retroreflective sheeting.
8. The First Shadow Vehicle shall operate 150’ to 300’ behind the Work Vehicle and shall have an approved truck mounted arrow board and an approved TMA commensurate with the prevailing speeds of the traffic.
9. The Second Shadow Vehicle shall operate 250’ to 1000’ behind the First Shadow Vehicle based on the posted regulatory speed limit of the roadway.
10. The Second Shadow Vehicle shall have an approved truck mounted CMS and an approved TMA commensurate with the prevailing speeds of the traffic. The truck mounted CMS shall flash alternately to read RIGHT LANE, CLOSED AHEAD or LEFT LANE, CLOSED AHEAD as necessary. Also, the Second Shadow Vehicle shall operate on the adjacent shoulder where paved shoulders or earth shoulders wide enough to accommodate vehicles are present. However, the Second Shadow Vehicle shall operate within the travel lane when the shoulders are too narrow to accommodate vehicles, the shoulders are structurally inadequate, or curb & gutter is present.

11. The truck mounted CMS may display a Flashing Arrow when the Second Shadow Vehicle must operate in an active travel lane. The Flashing Arrow display on the truck mounted CMS is only permitted when the Second Shadow Vehicle operates in an active travel lane and is prohibited when the Second Shadow Vehicle operates on the shoulder.
12. Work normally should be done during off-peak hours.

Drawing 20A. Mobile Operations Multi-lane Primary Routes, Earth Median with Earth or Paved Shoulders



Drawing 20B. Mobile Operations Multi-lane Primary Routes, Paved Median with Curb & Gutter



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Mobilized Shoulder Operations

Mobilized Shoulder Operations are roadway Shoulder Area Work Zones with no more than 1 single equipment unit that progress along the roadway at a slow pace and may require the equipment to encroach upon a travel lane or a paved shoulder to various degrees. The single equipment unit must be accompanied by a Shadow Vehicle when the Stopping Sight Distance between the single equipment unit and an approaching road user is unavailable based upon the posted regulatory speed limit of the roadway.

Consider Mobilized Shoulder Operations for work activities that progress at speeds less than 3 MPH, do not comply with the requirements for Intermittent Mobile Operations, and do not fully warrant closure of the adjacent travel lane.

Work activities that require more than 1 single equipment unit, not including a Shadow Vehicle when one is necessary, **do not** comply with the requirements for Mobilized Shoulder Operations. Therefore, conduct work activities that require more than 1 single equipment unit under Lane Closures.

On **two-lane, two-way roadways**, Mobilized Shoulder Operations are unacceptable when the work activities require more than 1 single equipment unit, not including a Shadow Vehicle when 1 is necessary, to conduct the work activities. Conduct these work activities under Flagging Operations.

Due to the mobility of these operations, the traffic control requirements are usually limited to the installation of Advance Warning Sign assemblies for each approach that may be impacted by the work activities. Relocate the Advance Warning Sign assemblies as necessary as the Work Zone is advanced along the roadway.

Utilize Advance Warning Signs relative to the type of work activity being conducted. The various types of Advance Warning Sign assemblies that may be utilized shall include the MOWING sign (W21-9-48) supplemented with the supplemental sign NEXT 3 MILES (W7-3a-42) for Grass Mowing Operations.

When Pedestrian Workers are present, the “Worker” sign (W21-1-48) is required. The “Worker” sign (W21-1-48) may be installed in addition to those signs relative to work activities that may not require Pedestrian Workers. For example, the “Worker” sign (W21-1-48) may be installed in addition to the MOWING sign (W21-9-48) when appropriate.

Equipment / Vehicles

All travel lanes may remain open to traffic when Work Vehicles or equipment encroach upon an adjacent travel lane up to but not more than 2'. Brief encroachments by a single equipment unit or a Work Vehicle into an adjacent travel more than 2' are acceptable when necessary to bypass an obstacle such as a sign or utility pole.

On **two-lane, two-way roadways**, Mobilized Shoulder Operations are unacceptable when the work activities require more than 1 single equipment unit, not including a Shadow Vehicle when one is necessary, to conduct the work activities. Conduct these work activities under Flagging Operations.

On **multi-lane roadways**, Mobilized Shoulder Operations are unacceptable when the work activities require more than 1 single equipment unit, not including a Shadow Vehicle when one is necessary, to conduct the work activities. Conduct these work activities under Lane Closures.

Pedestrian Safety

When pedestrian travel paths (sidewalks or footpaths) are closed or disrupted by a Construction, Maintenance, or Utility Operation, then pedestrian traffic control is needed. This includes the use of signs, channelizing devices, flags, suitable fencing, devices to make the path detectable and traversable by persons with disabilities, etc., to direct pedestrian movement through or around the Work Zone. There are three major considerations in planning for pedestrian safety in Work Zones on streets and highways:

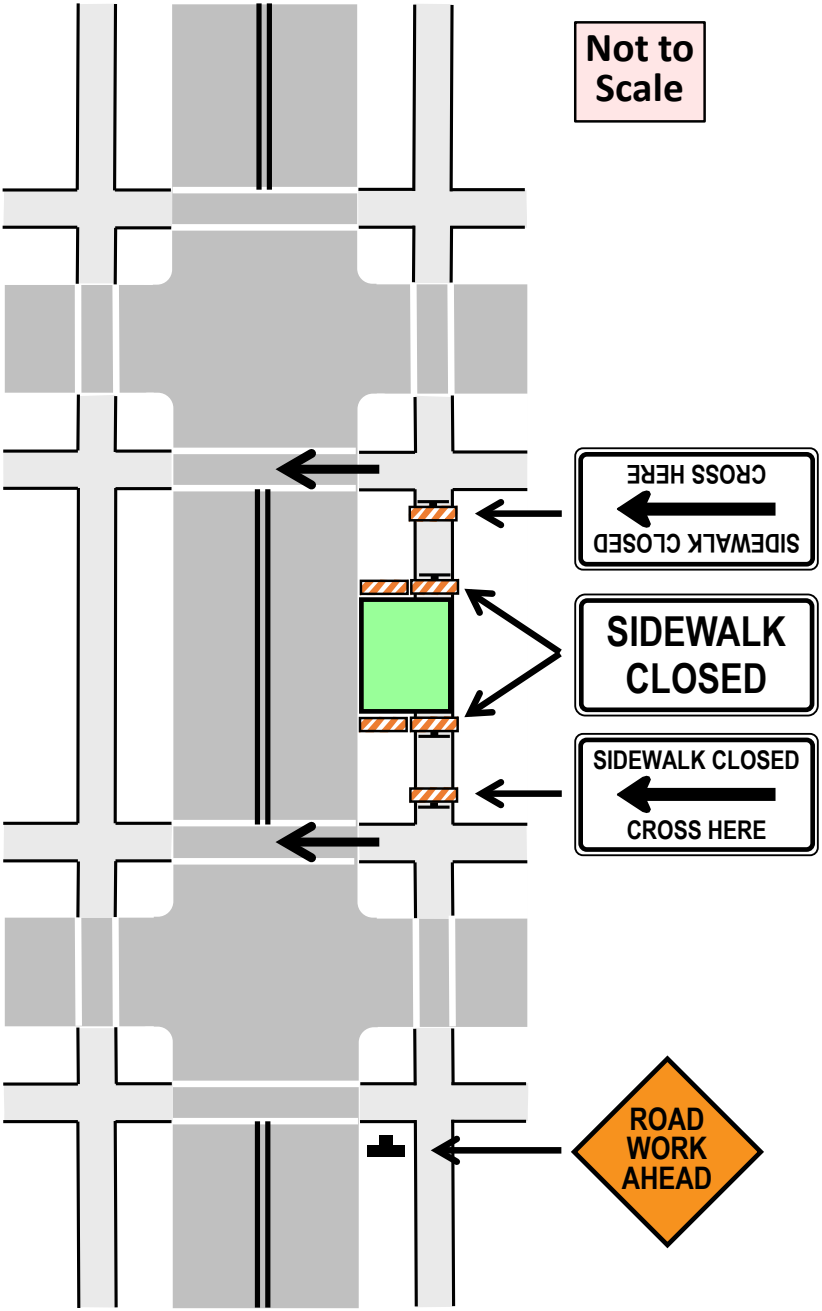
- Do not guide pedestrians into direct conflicts with work site vehicles, equipment, or operations.
- Do not guide pedestrians into direct conflicts with mainline traffic moving through or around the Work Zone.
- Provide pedestrians with a safe, convenient travel path that replicates as nearly as possible the most desirable characteristics of sidewalks or footpaths.

All pedestrians, including young, older and disabled, need protection from potential injury and a smooth, clearly defined travel path without abrupt changes in grade or terrain. Provide temporary facilities that are detectable and traversable by persons with disabilities and include accessibility features consistent with the features present in the existing or former pedestrian facility.

Drawing 25. Sidewalk Closure, Pedestrian Detour

1. Where sidewalks exist, make provisions for persons with disabilities. Refer to the MUTCD, Part 6, latest edition, for information on provisions.
2. Only the TCDs controlling pedestrian flows are shown. Other devices, such as Lane Closure signing or ROAD NARROWS signs, may be needed to control traffic on the streets.
3. For Nighttime Closures, Type A Flashing Warning Lights may be used on barricades that close sidewalks.
4. Temporary street lighting may also be considered.

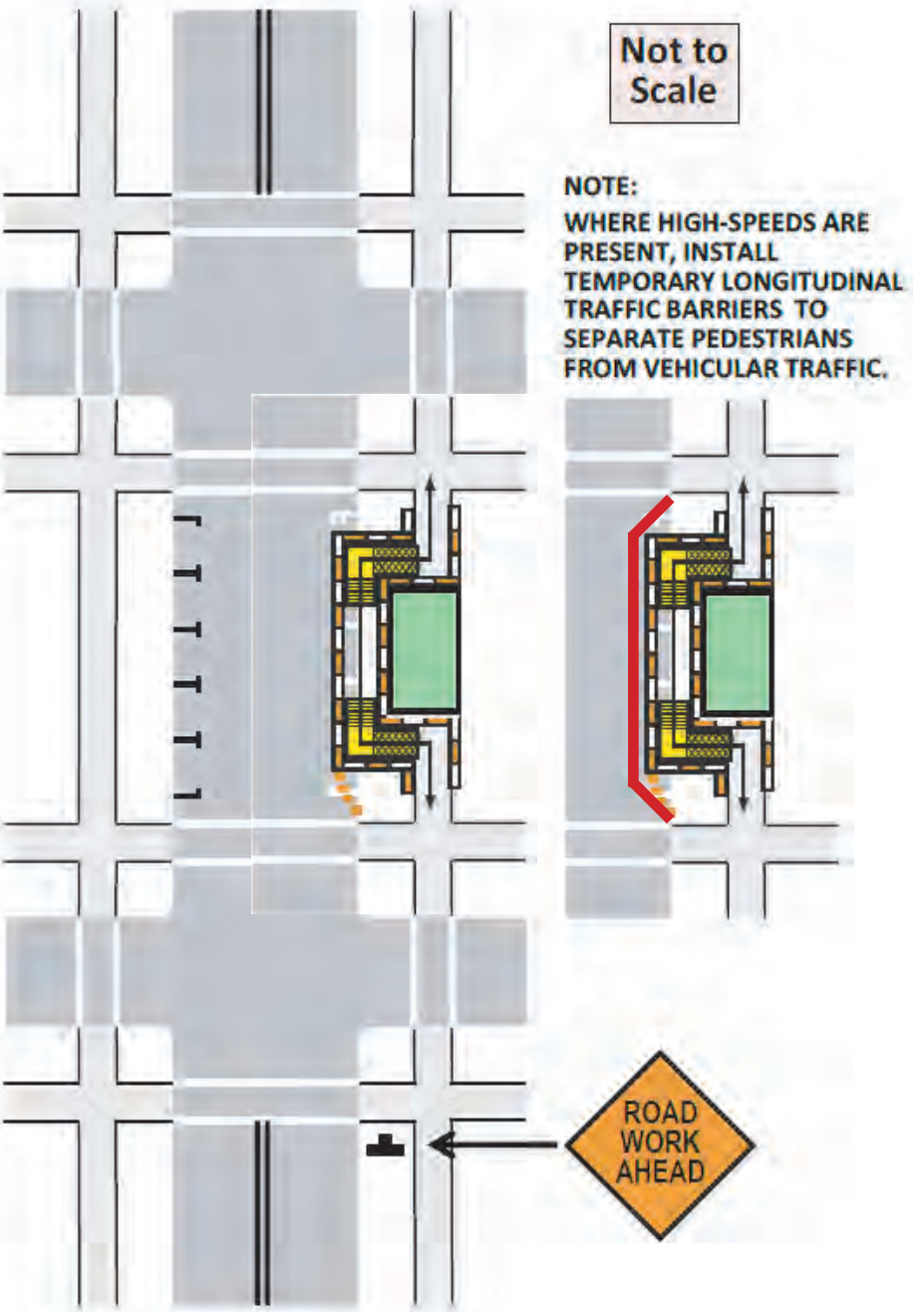
Drawing 25. Sidewalk Closure, Pedestrian Detour



Drawing 26. Sidewalk Closure, Pedestrian Diversion (or Bypass)

1. Where sidewalks exist, make provisions for persons with disabilities. Refer to the MUTCD, Part 6, latest edition, for information on provisions.
2. Only the TCDs controlling pedestrian flows are shown. Other devices, such as Lane Closure signing or ROAD NARROWS signs, may be needed to control vehicular traffic.
3. For Nighttime Closures, Type A Flashing Warning Lights may be used on barricades that close sidewalks.
4. Type C Steady-Burn Warning Lights may be used on channelizing devices separating the temporary sidewalks from vehicular traffic.
5. Where high speeds are present, install temporary longitudinal barriers to separate pedestrians from vehicular traffic. Refer to the SCDOT *Standard Specifications for Highway Construction*, latest edition, and to the *MUTCD, Part 6*, latest edition, for information on barriers. These temporary longitudinal barriers installed for pedestrian protection are in addition to temporary longitudinal pedestrian channelizing devices installed for pedestrian guidance.
6. Signs may be placed along a temporary sidewalk to guide or direct pedestrians. Examples include KEEP RIGHT and KEEP LEFT signs.
7. Temporary street lighting may also be considered.

Drawing 26. Sidewalk Closure, Pedestrian Diversion (or Bypass)



Worker Safety

The safety of workers in a work site is just as important as the safety of the public traveling through the Work Zone. The best protection for both is good Work Zone traffic control. All workers should be trained in how to work next to traffic in a way that minimizes their vulnerability. In addition, workers with specific traffic control responsibilities should be trained in traffic control techniques, device usage, and placement.

Work Safety Apparel

All persons on foot or workers that are on or within work equipment whose duties place them on highway rights-of-way and expose them to potential risks of moving roadway traffic or construction equipment SHALL wear Safety Apparel labeled as meeting the requirements for "High-Visibility Safety Apparel" of the latest revision of **ANSI/ISEA 107**, where ANSI is the American National Standards Institute and ISEA is the International Safety Equipment Association**.**

During Nighttime Flagging Operations, all flaggers SHALL wear properly retroreflectorized hard hats and high visibility Safety Apparel consisting of a safety vest and safety pants that meet the ANSI/ISEA 107 Performance Class 3 requirements.

Performance Class 3 Safety Apparel may be worn by all persons at all times to provide greater worker visibility. This includes, but is not limited to, (1) safety vest / safety pants combination, (2) coverall / jumpsuit, (3) jacket / parka / rainwear, or (4) short-sleeved jacket.

The apparel background (outer) material color SHALL be either fluorescent orange or fluorescent yellow-green, or a combination of the two as defined by the standard.

The retroreflective material SHALL be either orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and SHALL be visible at a minimum distance of 1,000'.

To further improve worker safety, consider the use of Shadow Vehicles, temporary traffic barriers, Law Enforcement Officers (LEOs), and road closures.

Steps to Minimize Liability

- Have a current traffic control plan.
- Follow the *MUTCD*, latest edition.
- Minimize traffic disruptions.
- Promptly remove TCDs.
- Train all personnel.
- Inspect Work Zone sites regularly for conformance.

Elements of a Good Inspection Program

- Routine schedule.
- Report form.
- Hazard identification.
- Adequate personnel and equipment inventory.
- Repair verification.
- Formal documentation.

Minimum Documentation

- Starting and ending time of work.
- Location of work.
- Type, condition, and position of TCDs.
- Names of personnel.
- Type of equipment used.
- Any change in temporary or permanent regulatory devices.
- Additional information should be gathered in the event of an accident.

Supervisor's Checklist

1. Follow of the *MUTCD*, *Part 6*, latest edition. It is the National Standard for Work Zone traffic control.
2. State and local manuals that supplement the *MUTCD* may need to be used.
3. Have a plan before going to the work site.
4. Remove the devices in a timely manner.
5. Ask yourself, "What is the driver's view as they are driving through the Work Zone?"

Important Notice

This booklet is provided by the South Carolina Transportation Technology Transfer Service (T^3S). To the best of our knowledge, the procedures shown in this booklet are consistent with SCDOT policies as of the date of publication of the booklet. This booklet has been reviewed by and approved by SCDOT.

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