Work Zone Traffic Control for Local Roads
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by

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Preface

The purpose of this workbook is to provide the fundamental concepts of work zone traffic control and proper flagging techniques. Guidelines included here are designed to cover the basic requirements of The Manual on Uniform Traffic Control Devices (MUTCD). In New York State, the MUTCD is the combination of the National MUTCD with the NYS Supplement to the National MUTCD. This workbook emphasizes short-term work sites on rural and small urban roads and streets. The information is meant to illustrate basic principles, but is not a standard. The MUTCD contains the state standards for work zone traffic control.

This information was developed to accompany a one-day training course, Work Zone Traffic Control for Local Roads. The NYS LTAP Center - Cornell Local Roads Program offers the course statewide to local highway officials and others who are responsible for controlling traffic and protecting workers in areas where road construction, maintenance, and utility repair occurs. A full understanding of the concepts presented in the course cannot be learned merely by reading this workbook.

We acknowledge the assistance of the Governor’s Traffic Safety Committee in providing a grant to develop this workbook, the course, and other teaching materials. An Advisory Committee guided these efforts throughout 1997 and 1998. The Committee members were:

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The information in this manual was researched using the MUTCD and the Vehicle and Traffic Law. Tom Hager, P.E., led this effort. Paul Cooney, P.E., L.S., also reviewed the material and provided valuable guidance.

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1 - Introduction: Liability

Municipalities have a duty under highway law to provide a reasonably safe highway for a reasonable driver. Employers have a duty to provide a reasonably safe work place for employees. Failure to accomplish these duties can expose the persons and the municipalities to liability for damages to injured parties. These damage awards can be substantial, sometimes in the millions.

Generally, municipalities carry liability insurance and worker’s compensation insurance to defend and indemnify themselves from these lawsuits. The cost of this insurance varies in accordance with the experience of the municipality. A good safety program will pay for itself in savings realized in insurance premiums and reduced lost time.

Large expenditures due to a lawsuit or high insurance premiums reduce the amount of money available for highway work. Additionally, you can be sued personally if you are negligent in performance of your duties.

Working in or near traffic is the single greatest exposure to accidents and, hence, liability. Courts have generally held that municipalities have a duty to warn motorists of known road hazards. This warning is usually done using signs in advance of hazards. In many accident cases there have been disagreements as to whether the hazard was, or should have been, known. When your own forces are the hazard, there is no argument — you are the hazard. Therefore, it is of utmost importance to conduct this work in a way that minimizes personal and municipal liability. How is this done?

First, traffic control measures must be in place and they must conform to the Manual on Uniform Traffic Control Devices (MUTCD). The National MUTCD and NYS Supplement to the National MUTCD together make up the MUTCD as used in New York State. This conformance is required by the Vehicle and Traffic law of anyone working in the roadway. References to the Vehicle and Traffic law are shown in the front of the NYS Supplement. In the event of an accident, you will be required to demonstrate, in court, that this was done. If you cannot, you lose.

The best prevention is not to have an accident. If an accident does occur, then you will need documentation to show that proper measures were in place. This would be in the form of a written traffic control plan, work site inspection checklist, diary entries, accident investigation photos, etc.

The following chapters contain guidance on preparing a traffic control plan in accordance with the MUTCD.
2 - Work Zone Safety

The number one safety problem that highway work involves is traffic. As a highway official, it is your responsibility to protect your employees from injuries due to traffic. You also must protect the traveling public from injury, and keep disruption of traffic to a minimum. It is a difficult job to keep traffic out of the work area, to keep your crew and equipment out of the traveled way, and still accomplish the work that must be done.

Accidents caused by traffic hitting someone or something in the work area usually happen because drivers didn’t see the hazard, or didn’t see it in time to react, or didn’t know what to do when they did see it. Highway departments must use devices that are highly visible. This is why traffic safety devices use bright colors and flashing lights. The warning should be in advance of the activity and repeated, because it is very easy for drivers to miss one sign. You must allow plenty of time for drivers to absorb the message and react to it. The next to last thing you want is a panic response. The last thing you want is an accident.

Work zone safety is important because it:

• Protects employees
• Protects the public
• Improves productivity
• Saves money
• Reduces liability
• Improves your image

As a general guide for work zones you should:

• Have a plan
• Keep disruption to a minimum
• Make it a short duration
• Remember image
• Keep it simple

The common reasons for drivers hitting something in a work zone are:

• Driver didn’t see
• Driver didn’t know what to do
• Driver didn’t know where to go
• Driver didn’t have time to react
• There was a worker or equipment in the traffic lane
THE MUTCD
The National MUTCD (Manual on Uniform Traffic Control Devices) establishes a nationwide standard so that drivers can learn one set of rules that don’t change every time they cross a state line. The MUTCD is the accepted standard of the highway industry. Failure to comply with it greatly increases your legal liability in the event of an accident.

In New York State, the standard is the combination of the National MUTCD and NYS Supplement. Every municipality should have a copy of the National MUTCD and NYS Supplement, see page 28 for ordering information. Section 1A.09 of the MUTCD, suggests that while it provides standards for design and application of traffic control devices, it is not intended to rule out the use of sound traffic engineering.

SHALL, SHOULD, MAY
When using the MUTCD, it is important to understand the use of the words shall, should, and may. Should is most commonly used, and means if you don’t comply with a rule, you must justify why not.

The words “shall,” “should,” and “may,” as used in this manual with respect to the design, application, and placement of traffic control devices, have the following meanings:

- SHALL – A mandatory condition. In the design, application, or location of devices requirements having “shall” stipulations are mandatory. No discretion in following them is allowed.

- SHOULD – An advisory condition. Where “should” is used in relation to a provision, that provision is recommended, and normally is to be followed, but is not mandatory. Deviation from such provisions is permissible if, and to the extent, there is justifiable cause to do so.

- MAY – A permissive condition. No requirement for redesign or application is intended.

STANDARD DEVICES
In order that drivers know what to do, we must use standard devices. This is critical. Non–standard devices take much longer for drivers to understand, and may result in confusion. Devices must be placed and used in accordance with a standard, and that standard for New York State is the MUTCD. Work zone traffic control devices must have the respect of drivers. To maintain this respect, it is crucial that highway workers remove work zone safety devices or cover them when an operation is completed. Drivers must be able to rely on these signs and know that they are in effect, not out of date.

Traffic control devices must not be a hazard themselves. They should be designed and placed so that, if struck, they do not cause injury or damage.

Work Zone Traffic control devices fall into seven categories.

1. Signs
2. Traffic signals/control lights
3. Pavement markings
4. Delineation devices
5. Channelization devices/barrels
6. Hand signaling devices
7. Lighting devices, warning flags

All traffic control devices used must:

• Fulfill a need
• Be visible
• Be standard
• Give one clear message
• Command attention
• Command respect
• Not mislead the driving public
• Not be a hazard

For further information read the general provisions for traffic control devices in the MUTCD, Chapter 1A, General.

It is important to remember that in addition to using a standard device, it must be placed and used in a standard manner. A standard device in a non–standard location may cause driver confusion.

SIGNS

Signs are the most important devices used in the work zone. Signs regulate, warn, and guide. Each of the three primary categories of signs provides important information to the driver.

Regulatory signs

Regulatory signs control driving practices. They inform motorists of some traffic regulations or rules that they must obey. The conditions under which some regulatory signs may be used are stipulated in the Vehicle and Traffic Law. You should check its provisions before using this type of sign. Authority to use these devices is given to various municipalities by state law. Not all municipalities have authority to post all types of devices.

For example, counties and most towns cannot establish a permanent speed zone. That right is generally reserved by the state. Towns and counties may, however, legally erect STOP signs. The Vehicle and Traffic Law specifically provides the authority of a flagger to stop traffic using a STOP/SLOW paddle.

Black and white regulatory signs may be used in conjunction with highway maintenance or construction. This requires legislation by a municipality or the state. Regulatory signs generally are rectangular in shape, and are found in the MUTCD Chapter 2B and Part 6. Examples include "Bridge Closed 1/2 Mile Ahead" and "Road Closed" (see illustrations on page 6).
Warning signs

Warning signs are the most widely used traffic control devices in work zones (MUTCD, Chapter 2C and Part 6). The purpose of these signs is to give drivers advance notice of a hazard or condition ahead that may require special action. It is important to give notice to drivers far enough in advance to allow time for understanding and reaction.

If the sign is denoting how far it is to the hazard, specific feet (nearest 500 feet) or miles (nearest quarter mile) can be used. It is desirable to keep at least 200 feet between signs. This requirement is to allow drivers time to recognize one sign before seeing another.

Warning signs are diamond shaped (see below). The work zone color is black on orange. The proper size for two–lane applications is 36” x 36”. For other situations, see Part 6 of the MUTCD.

Warning signs are organized into four groups: Condition A, Condition B, Work Zone Advance Posting, and those that have no specific condition requirement.

Condition A signs are used for speed reduction and lane changes in heavy traffic. They are not typically used on low-volume or two-lane roads. Table 1 (page 7) includes the advance posting distance for Condition A signs, such as the following example:
<table>
<thead>
<tr>
<th>Posted or 85th-Percentile Speed (mph)</th>
<th>Condition A: Speed reduction and lane changing in heavy traffic&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Advance Placement Distance (ft)&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Condition B: Deceleration to the listed advisory speed (mph) for the condition&lt;sup&gt;4&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0&lt;sup&gt;3&lt;/sup&gt;</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>410</td>
<td>115</td>
<td>110</td>
</tr>
<tr>
<td>25</td>
<td>515</td>
<td>155</td>
<td>160</td>
</tr>
<tr>
<td>30</td>
<td>620</td>
<td>200</td>
<td>205</td>
</tr>
<tr>
<td>35</td>
<td>720</td>
<td>250</td>
<td>255</td>
</tr>
<tr>
<td>40</td>
<td>825</td>
<td>305</td>
<td>320</td>
</tr>
<tr>
<td>45</td>
<td>930</td>
<td>360</td>
<td>380</td>
</tr>
<tr>
<td>50</td>
<td>1030</td>
<td>425</td>
<td>455</td>
</tr>
<tr>
<td>55</td>
<td>1135</td>
<td>495</td>
<td>530</td>
</tr>
<tr>
<td>60</td>
<td>1280</td>
<td>570</td>
<td>605</td>
</tr>
<tr>
<td>65</td>
<td>1365</td>
<td>645</td>
<td>670</td>
</tr>
<tr>
<td>70</td>
<td>1445</td>
<td>730</td>
<td>785</td>
</tr>
<tr>
<td>75</td>
<td>1545</td>
<td>820</td>
<td>880</td>
</tr>
</tbody>
</table>

Notes:

1. The distances have not been modified to account for sign legibility.
2. Typical conditions are locations where the road user must use extra time to adjust speed and change lanes in heavy traffic because of a complex driving situation. Typical signs are Merge and Right Lane Ends. The distances are taken from the 2001 AASHTO Policy, Exhibit 3-3, Decision Sight Distance, Avoidance Maneuver E.
3. Typical condition is the warning of a potential stop situation. Typical signs are Stop Ahead, Yield Ahead, Signal Ahead, and Intersection Warning signs. The distances are taken from the 2001 AASHTO Policy, Stopping Sight Distance, Exhibit 3-1.
4. Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are Turn, Curve, Reverse Turn, or Reverse Curve. The distances are determined by providing a 2.5 second PIEV time and a vehicle deceleration rate of 10 ft/second<sup>2</sup>.
Condition B signs are used when a vehicle needs to decelerate to a given advisory speed. Table 1 on page 7 includes the advance posting distances for Condition B signs, such as the following two examples:

If the driver may need to stop (as is true for a Stop Ahead sign), the assumed speed after deceleration is 0 mph (stopped). For an approach speed of 55 mph, the advance posting is 495 ft. In some cases, the advisory speed is greater than 0 mph, such as a curve sign. In these cases, the advance posting distance depends upon both the prevailing speed and the advisory speed. As an example, a 35 mph curve on a 55 mph road would have an advance posting distance of 400 ft.

Advanced Work Zone signs are placed at distances based upon the type of roadway and the speed along the road. This is discussed in more detail in Chapter 2.

Signs not covered by Condition A or B or that are not part of the advance signs for a work zone are placed as needed according to the information listed with the sign in the MUTCD.

Often you will use advisory speed plaques (see examples below). Speed advisory plaques are used in conjunction with hazard warning signs. They transmit information to guide drivers in the roadway. **Work zone advisory speed signs are rectangular, black on orange**, and are used in conjunction with a warning sign. Speed advisory signs are not enforceable as a speed limit. They are only suggested safe speeds. Section 2C.06 of the MUTCD gives guidance on determining these safe speeds for various approach speeds, curve radii, and pavement superelevation.
Guide signs
These signs are used to transmit information to drivers. Route markers and destination direction are two very common examples of guide signs. They are covered in Chapter 2D of the MUTCD.

SIGN PLACEMENT
Sign placement is important. Usual requirements are listed in the MUTCD, Section 2A. Signs need to be high enough so that vehicles do not obstruct them. Post–mounted signs should be at least 5 feet to the bottom of the sign. Normal lateral placement is 12 feet from the edge of the pavement or 6 feet from the edge of the shoulder, whichever is greater.

Figure 1 - Sign placement  (Source: MUTCD, Figure 2A-1)
In short duration work zones, signs may be placed on the shoulder or on the pavement as appropriate. The \textit{minimum} height of signs on temporary supports is one foot. Signs and sign supports should be made of materials and placed in such a manner as to minimize the impact damage should they be struck by traffic. Visibility is the guiding principle. When work zones are of short duration, it may be desirable to attract attention to the signs by using flashing lights or fixed flags.

**OTHER DEVICES**

Channelizing devices include barricades, drums, cones, vertical panels, and tubular markers. The devices are used to mark a path for traffic and physically separate it from that portion of the highway not to be used for travel. Refer to Part 6 of the MUTCD for guidance on the proper use of these devices.

Cones shall be orange. A 28-inch height is standard for all applications, although 18-inch-high cones may be used on low-speed roads (less than 40 MPH) during the day. The 36-inch cone is used where extra visibility is needed. At night, cones greater than or equal to 28 inches high and reflectorized by at least two white stripes shall be used.

Drums shall be at least 36 inches high, and consist of orange and white reflectorized stripes. These stripes shall be between 4 inches and 6 inches wide. The minimum width when viewed from any direction shall be 18 inches.

Channelizing devices are used to divert traffic from its normal path and to guide traffic through the work zone and back to normal flow patterns. The spacing should be in accordance with Table 4 (below).

### Table 2 - Maximum longitudinal space (in feet) between channelizing devices used in a series to form a taper

<table>
<thead>
<tr>
<th>Condition</th>
<th>Posted speed limit for approaching traffic (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Separation or target channelization</td>
<td>20</td>
</tr>
<tr>
<td>Any taper</td>
<td>20</td>
</tr>
</tbody>
</table>

In a taper, space cones at a distance in feet equal to the approach speed in mph. After the transition area, cones used to guide traffic through the work zone can be at a greater distance, up to the distance in feet equal to two times the approach speed limit.
3 - Preparing a Traffic Control Plan

A traffic control plan (TCP) is a specific plan for a specific site. Its purpose is to communicate to workers the proper placement of traffic control devices for a particular operation. It is very important that the various devices be used in a standard manner as prescribed by the MUTCD.

The work zone can be divided into five areas (Figure 2). Note that Figure 2 is for one direction of traffic past the work zone. For two–way traffic, the same areas would apply for both directions.

Figure 2 - Five parts of a work zone (Work Zone Safety for Rural Local Agencies, John E. Tidwell, P.E., University of North Carolina)
Your TCP should:

- Give advance notice
- Allow for driver error/inattention
- Move traffic away from hazards
- Move traffic away from workers

**THE ADVANCE WARNING AREA**

The advance warning area is the most important area since it tells the driver what to expect. The advance warning area:

- Gets the public’s attention
- Provides the driver time to react
- Is repeated using three signs
- In rural areas, allows 500 feet between signs
- In urban areas, allows 100-350 feet between signs
- Can be adjusted for field conditions

For lane closure of long duration on a fairly busy high-speed road, the advance warning signs would be a sequence of three. The first is a general warning, such as road work ahead. The second sign gives more specific information about the hazard, such as one-lane road ahead or right lane closed ahead. The third sign would give drivers information about what action they must take, such as flagger ahead, or merge left. The spacing of these signs would usually be approximately 500 feet. This would provide an advance warning distance of 1500 feet. Advance signs include:

- General warning
- Specific warning
- Specific instructions

For other situations, such as shorter durations, less traffic, urban, etc., the number and spacing of signs may be adjusted in accordance with good engineering judgment. Table 3 provides guidance.

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Distance Between Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>500 feet</td>
</tr>
<tr>
<td>Urban, 45 mph or more</td>
<td>350 feet</td>
</tr>
<tr>
<td>Urban, 35-40 mph</td>
<td>200 feet</td>
</tr>
<tr>
<td>Urban, 30 mph or less</td>
<td>100 feet</td>
</tr>
<tr>
<td>Freeway/Expressway</td>
<td>See MUTCD</td>
</tr>
</tbody>
</table>
THE TRANSITION AREA

The transition area moves traffic out of its normal path. Cones or barrels are often used to force traffic out of its normal path. Traffic must shift laterally a certain amount due to narrow pavement, reduction of the number of lanes, or a lane closure. The area where the actual shift is made is called the taper. The length of the taper is dependent on approach speed and the width of the shift. The transition area should:

- Move traffic out of the normal path/flow
- Provide clear directions so that drivers know where to go
- Usually involve tapers
- Vary with speed and distance

Table 4 gives values of the merging taper length (L) for various speeds (S) and shift widths (W).

<table>
<thead>
<tr>
<th>Lateral shift of traffic flow path, in feet (W)</th>
<th>85 percentile approach speed, in miles per hour (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>8</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>14</td>
<td>95</td>
</tr>
<tr>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>16</td>
<td>110</td>
</tr>
</tbody>
</table>

For taper widths not shown, Table 5 (Table 6C-4 from the MUTCD) provides a formula for determining the taper length:

<table>
<thead>
<tr>
<th>Speed Limit(s)</th>
<th>Taper Length (L) in Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mph or less</td>
<td>L = WS^2/60</td>
</tr>
<tr>
<td>45 mph or more</td>
<td>L = WS</td>
</tr>
</tbody>
</table>

This length is for a merging situation, when you have two lanes merging into one without stopping. The merging situation requires the longest transition length for a given travel speed.
The various tables in the MUTCD denote approach speed as the speed limit. The posted speed limit, 85th percentile approach speed, or anticipating operating speed may be used. “Eighty-fifth percentile speed” is a statistically determined speed which can be obtained by actually measuring the approach speed of a sampling of vehicles. The important thing is to use a speed appropriate to the actual location of the work site.

Other types of tapers require less distance as shown in the following table:

<table>
<thead>
<tr>
<th>Type of taper</th>
<th>Transition length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merging taper</td>
<td>L</td>
</tr>
<tr>
<td>Reduction in number of lanes in that travel direction</td>
<td></td>
</tr>
<tr>
<td>Shifting taper</td>
<td>L/2</td>
</tr>
<tr>
<td>Same number of lanes, but must move over</td>
<td></td>
</tr>
<tr>
<td>Shoulder taper</td>
<td>L/3</td>
</tr>
<tr>
<td>Work area on shoulder only</td>
<td></td>
</tr>
<tr>
<td>Two–way traffic taper</td>
<td>50-100 feet max.</td>
</tr>
<tr>
<td>Typical application with flagger controlled traffic</td>
<td></td>
</tr>
<tr>
<td>Downstream taper</td>
<td>100 feet/lane</td>
</tr>
<tr>
<td>Use is optional</td>
<td></td>
</tr>
</tbody>
</table>

Note that when two–way traffic is directed by flaggers into one lane, the transition length is only 50-100 feet, with a maximum of 100 feet.

As a rule of thumb, the spacing of the channelization devices in a taper is a distance in feet equal to the approach speed in miles per hour. The spacing required to keep traffic out of the work area is site-specific. In normal situations, spacing in feet of two times the speed limit is adequate. Drums can be farther apart than cones.

In the lane reduction example, assuming an approach speed of 55 mph and a shift width of 12 feet, L is 660 feet. Since this is a merging situation, the taper length is also 660 feet. The cone spacing in the taper is equal to the approach speed of 55 mph or 55 feet.

THE BUFFER AREA

The buffer area (Figure 2, page 11) is an unoccupied space between the transition area and the work area itself. This area is to be free of all equipment, vehicles, and construction materials. This buffer area provides room to stop for drivers who don’t see or don’t follow the sign or flagger guidance. The length of this area should be such to provide the adequate stopping distance as measured from the end of the transition area to the beginning of the work area. Note that the distances in table 7 are the stopping sight distances needed to allow a vehicle travelling at a given speed to react and stop.
Table 7 - Guidelines for buffer lengths (Source: MUTCD, Table 6C-2)

<table>
<thead>
<tr>
<th>85th Percentile approach speed (mph)</th>
<th>Buffer space length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>115</td>
</tr>
<tr>
<td>25</td>
<td>155</td>
</tr>
<tr>
<td>30</td>
<td>200</td>
</tr>
<tr>
<td>35</td>
<td>250</td>
</tr>
<tr>
<td>40</td>
<td>305</td>
</tr>
<tr>
<td>45</td>
<td>360</td>
</tr>
<tr>
<td>50</td>
<td>425</td>
</tr>
<tr>
<td>55</td>
<td>495</td>
</tr>
<tr>
<td>60</td>
<td>570</td>
</tr>
<tr>
<td>65</td>
<td>645</td>
</tr>
</tbody>
</table>

The length of the buffer can be increased to allow placement of the flagger or traffic taper in a visible location rather than on a curve, in the shade, etc. Cones should be spaced at two times the speed in the separation areas.

Remember, the buffer area is:

- A safety factor in case a driver doesn’t stop
- The place where you can adjust for hills and curves
- A place where vehicles and/or equipment are not allowed

**THE WORK AREA**

The *work area* (Figure 2, page 11) is that part of the travel lane where your workers and equipment are located. Channelizing devices are used throughout the area at a spacing of twice the speed limit. Their purpose is to keep traffic in the non–work lane.

Some other work zone area safety suggestions follow:

- Keep your construction traffic moving *with* the normal flow
- Remind your workers to keep themselves and equipment out of travel lanes
- Use caution to avoid drifting into the travel lane
- In some situations, as in a long work area (paving for example) you may need a flagger at the paver to control slow traffic
- Be sure to deal with side roads, especially in the long work area situations

In summary, the work area should:

- Delineate to keep traffic out
- Delineate to keep workers in
- Deal with side roads
THE TERMINATION AREA

The **termination area** (Figure 2, page 11) advises drivers that they are past the work site and may resume normal driving. It is good practice to put an END ROAD WORK sign in this area. A short downstream taper is also recommended. Five cones in 100 feet are fine.

The termination area:

- Lets drivers know the work zone is over
- Is usually a short taper
- Needs an END ROAD WORK sign if it is not obvious

TRAFFIC CONTROL PLAN

Combining the five parts of the work zone results in a traffic control plan (TCP) for your operation. The TCP must address both directions of travel when appropriate. There are over 40 typical applications provided in the MUTCD. Some commonly used typical applications are provided in this workbook, see Figures 3-7 on pages 17-21.

Figure 3 on page 17 shows what the TCP should look like for long duration, two-lane, two-way situations with a high volume of 55 mph traffic.

Figure 5 on page 19 shows a typical on-site diversion layout. The plans shown are for average conditions and can and should be adjusted to fit the specific operation for each day.

For low-volume, low-speed situations, you could eliminate one advance sign. For high-speed, high-volumes, you may need more signs, or you may need to position signs farther in advance of the work area. In urban situations, the spacing of the advance signs may be reduced.

The NYS LTAP Center - Cornell Local Roads Program has produced a publication, entitled 'Work Zone Safety, Guidelines for Construction, Maintenance and Utility Operations', known as the 'Work Zone Pocket Guide' for short, which contains many of the most common typical applications.

A second pocket guide, the 'Flaggers Handbook', contains additional useful information about advance warning signs and work zone traffic control, focusing in particular on flagging safety, procedures and equipment. To acquire copies of these pocket guides for your crews, contact NYSLTAP-CLRP. See the title page of this workbook for contact information.
Figure 3 - Lane closure, two-lane, two-way traffic
(55 mph for high speed, high volume, long duration)
Figure 6H-11. Lane Closure on Two-Lane Road with Low Traffic Volumes

Distances A, B and C depend on speed and road type. See Table 3, page 12.

Figure 4 - Typical lane closure, two-lane, two-way road with low traffic volumes (MUTCD, Chapter 6H, Figure 6H-11)
Figure 5 - Typical traffic diversion, two-lane, two-way
(MUTCD, Chapter 6H, Figure 6H-7)

Distances A, B and C depend on speed and road type. See Table 3, page 12.
Figure 6H-17. Mobile Operations on Two-Lane Road (TA-17)

Note: See Tables 6H-2 and 6H-3 for the meaning of the symbols and/or letter codes used in this figure.

Figure 6 - Typical traffic control on two-lane roadway for slowly moving operations in an extended work zone (MUTCD, Chapter 6H, Figure 6H-11)
Distance $A$ depends on speed and road type. See Table 3, page 12.
HINTS AND HAZARDS

Your exposure to being hit is greatest when you are putting out or picking up traffic control devices, so be extra alert. When setting up the work zone signs, make sure that all devices are in place before you start any work. Put up the advance signs first, then position the flagger if there will be one, then the transition and work zone channelization. Pick them up in reverse order. Move with traffic whenever possible.

SUMMARY

A properly developed and implemented traffic control plan will increase the safety of your employees, facilitate safe, convenient passage of traffic through the work area, and greatly decrease your liability exposure in the event of an accident.

You should prepare a traffic control plan for each activity and should be prepared to justify the plan selected. Then you need to communicate the plan to your workers. It is a good idea to document its implementation and its maintenance. If you have developed a TCP, place your TCP with your other safety outlines and this manual into a file. Date it and indicate that you have discussed it with your crew. This way it becomes a permanent record.

A good time for refresher work zone safety training is just before your workers go out on the work site. A follow–up meeting can review successes or problems.
4 - Flagging

The job of flagging in the work zone is a very important and demanding job. Your flagger is the person who is preventing traffic from injuring workers as well as protecting the traveling public. Flaggers should be physically able, mentally alert, and capable of giving guidance to the motoring public. Flagging is an important job, and should be done with authority and dignity.

Flaggers need the *proper attitude*, including:
- Alertness
- Motivation
- Conscientious commitment

Flaggers need the *proper equipment*, including:
- Stop-slow paddle or red flag (red flags should be limited to emergency use only)
- High visibility vest, jacket or shirt (appropriate for day or night)
- Hard hat
- Suitable clothes/footwear
- Air horn or whistle
- Flagger Ahead signs

The stop-slow paddle is the preferred device and should be used wherever practicable. The flag should only be used for emergencies, single flagger operations where one flagger will need to stop traffic in two directions.

Flaggers need *proper training*.

The first rule of flagging is *do not stand in the travel lane*. The proper place to stand in order to stop traffic is at the edge of the road. That way, if the driver does not see the signal to stop or slow down, the flagger won’t get hit. It is preferable for drivers to hit the cones and stop in the buffer area than to hit the flagger.

To make sure drivers see your flaggers, remember these tips. Have them:
- Wear a clean vest
- Stand alone, away from other people
- Be alert
- Face traffic
- Do not stand in travel lane
- Pay attention

Position a flagger at the end of the advance warning area where the transition area begins. Make sure that the approaching sight distance is long enough to allow drivers time to see and react. Make sure there is an escape route if the flagger needs to get out of the way of a car that is not stopping.
Figure 8, page 25, shows the proper way to stop and release traffic. To stop traffic, stand on the edge of the road facing traffic. Hold up your left hand in stop mode, like a traffic cop. Hold the paddle out away from your body, the STOP side toward traffic. If you are using a flag, hold it out horizontally. Do not wave the flag, it confuses drivers. Make eye contact with the driver. After the first car has stopped you may go to the center of the road to stop succeeding cars.

To release traffic, step back to the shoulder of the road, turn your paddle to SLOW (or drop your flag by your side). With your free hand, motion traffic to proceed. As stated before, do not wave the flag, it confuses drivers.

To slow traffic, stand at the edge of the road, hold the paddle with SLOW facing traffic, and with your free hand motion palm downward to indicate slow down. (If using an emergency flag, slowly wave the flag in a sweeping motion of the extended arm from shoulder level to straight down without raising the arm above a horizontal position.)

It is important to train all flaggers to adhere to these standard signals. Non-standard actions will confuse drivers. To maintain flagger attention level and alertness, it is important to relieve them regularly.

**TWO-WAY FLAGGER COMMUNICATIONS**

Suppose that one flagger has stopped traffic, and the other is letting it through. It is crucial that they know when to release traffic from their ends. Flagger 1 must know when it is safe to let traffic through the work zone. To do this flagger 1 must recognize the last car that flagger 2 has let by. Conversely, especially in low-volume situations, flagger 1 must tell flagger 2 when to hold traffic. It is best to designate a chief flagger as the person who directs the other flaggers.

There are many ways to communicate between flaggers in the work zone. If flaggers have visual contact, they can use a signal, such as a wave of a hat. The receiving flagger should signal acknowledgment. However, if you are using a flag, do not use a flag to signal other flaggers! Doing this confuses drivers.

When flaggers do not have visual contact with each other, various methods can be used. Two-way radios are the best way to communicate. If radios are not available, a baton may be carried by the last car through the work zone, and given to the flagger on the other end. For long work zones a pilot car should be used to lead traffic through the zone.

Choose which suits your situation. The important thing is that the signal must be clear, simple and tamper-proof.
Figure 8 - Hand signaling procedures (MUTCD, Figure 6E-1)

NOTE: Flagging stations SHALL be illuminated at night except in emergency situations.
Appendix A - Videos

The following titles are available for loan from the NYS LTAP Center - Cornell Local Roads Program:

- A Traffic Plan to Live By: City Maintenance Operations © (TC210)
- A Traffic Plan to Live By: Flagging © (TC205)
- A Traffic Plan to Live By: Intersection work © (TC207)
- A Traffic Plan to Live By: Introduction to Low Speed Traffic Control © (TC202)
- A Traffic Plan to Live By: Low Speed Lane Closures © (TC203)
- A Traffic Plan to Live By: Parking Lane Shoulder Work © (TC209)
- A Traffic Plan to Live By: Street Closures © (TC208)
- A Traffic Plan to Live By: Traffic Control Procedures © (TC204)
- A Traffic Plan to Live By: Unattended Work Sites © (TC206)
- Flagger, The (TC116)
- Flagging Operations and Procedures © (TC167)
- Highway Safety: The Silent Factor (SA105)
- Life in the Closed Lane (TC118)
- New Directions in Sign Management (TC120)
- Nighttime Traffic Control in Work Zones (TC121)
- Roadway Design: Balancing Safety, Environment and Cost (RD240)
- Safe Roadside Signs (SA109)
- Striper’s Survival Guide, A (SA149)
- To Warn, Guide and Protect: An Introduction to Flagging (TC127)
- Traffic Control for Urban and Utility Workers (TC126)
- Traffic Control: What Works? (TC253)
- Work Zone Safety for Rural Local Agencies (TC112)
Appendix B - Publication Resources

American Traffic Safety Services Association (ATSSA)
15 Riverside Parkway, Suite 100, Fredericksburg, VA 22406
800-272-8772
ATTSA is a national organization representing companies and individuals in the traffic control industry.

National Manual on Uniform Traffic Control Devices (National MUTCD)
www.mutcd.fhwa.dot.gov (available from FHWA in HTML or PDF format only)
Printed copies of the National MUTCD can be purchased from the following:
The American Association of State Highway and Transportation Officials (AASHTO):
800-231-3475
The Institute of Transportation Engineers (ITE):
http://www.ite.org/cgi-bin/search.cgi?wh=S&kw=mutcd&sw=3&de=0&it=
202-289-0222
The American Traffic Safety Services Association (ATSSA):
http://www.atssa.com/store/bc_search.jsp?page=0&name=&cats=6
800-272-8772

NYS Supplement to the National MUTCD - 2003 Edition
https://www.nysdot.gov/portal/page/portal/divisions/operating/oom/transportation-systems/traffic-operations-section/mutcd (available from NYSDOT in PDF format only)
Printed copies of the NYS Supplement to the National MUTCD can be purchased from:
West Group Publishing, 610 Opperman Drive, Eagan, MN  55123
800-344-5008  Ask for Volume 17B of NYCRR

National Technical Information Services (NTIS)
5285 Port Royal Road, Springfield, VA 22161
703-487-4650

National Work Zone Safety Information Clearinghouse
Texas Transportation Institute, College Station, Texas
800-447-5556

Uniform Vehicle Code and Model Traffic Ordinance
Northwestern University Traffic Institute, 405 Church Street, Evanston, Illinois 60204
708-491-5283
This publication is designed as a comprehensive guide for developing standard state motor vehicle and traffic laws. It is based on actual experience under various state laws throughout the United States.
Appendix C - Internet/Website Resources

American Association of State Highway and Transportation Officials (AASHTO)
www.transportation.org OR www.aashto.org

American Traffic Safety Services Association (ATSSA)
www.atssa.com

Federal Highway Administration safety program
safety.fhwa.dot.gov

Institute of Transportation Engineers (ITE)
www.ite.org

National Manual on Uniform Traffic Control Devices (National MUTCD)
mutcd.fhwa.dot.gov

National Work Zone Safety Information Clearinghouse
wzsafety.tamu.edu

National Highway Traffic Safety Administration (NHTSA)
www.nhtsa.dot.gov

NYS Supplement to the National MUTCD - 2003 Edition
https://www.nysdot.gov/portal/page/portal/divisions/operating/oom/transportation-systems/traffic-operations-section/mutcd

Pedestrian Safety Roadshow (FHWA)
safety.fhwa.dot.gov/roadshow/walk

U.S. Department of Transportation
www.dot.gov/safety.html
Appendix D - NYSDOT Regional Offices

Region 1

Region 2
Counties: Fulton, Hamilton, Herkimer, Madison, Montgomery, Oneida

Region 3
Counties: Cayuga, Cortland, Onondaga, Oswego, Seneca, Tompkins

Region 4
Counties: Genesee, Livingston, Monroe, Ontario, Orleans, Wayne, Wyoming

Region 5
Counties: Cattaraugus, Chautauqua, Erie, Niagara

Region 6
Counties: Allegany, Chemung, Schuyler, Steuben, Yates

Region 7
Counties: Clinton, Franklin, Jefferson, Lewis, St. Lawrence

Region 8
Counties: Columbia, Dutchess, Orange, Putnam, Rockland, Ulster, Westchester

Region 9
Counties: Broome, Chenango, Delaware, Otsego, Schoharie, Sullivan, Tioga

Region 10
Counties: Nassau, Suffolk

Region 11
Counties: Bronx, Kings, New York, Queens, Richmond
Appendix E - NYSDOT Regional Directors of Transportation

Main Office
Astrid Glynn, Commissioner
50 Wolf Road
6th Floor
Albany, NY 12232
(518) 457-4422

Region 1
Brian O. Rowback, P. E.
328 State Street
Schenectady, NY 12305
(518) 388-0388

Region 2
Michael A. Shamma
Utica State Office Building
207 Genesee Street
Utica, NY 13501
(315) 793-2447

Region 3
Carl F. Ford, P.E.
State Office Building
333 East Washington Street
Syracuse, NY 13202
(315) 428-4351

Region 4
Frank O’Buckley
1530 Jefferson Road
Rochester, NY 14623
(716) 272-3310

Region 5
Alan E. Taylor
100 Seneca Street
Buffalo, NY 14203
(716) 847-3238

Region 6
Peter E. White
107 Broadway
Hornell, NY 14843
(607) 324-8404

Region 7
R. Carey Babyak
Dulles State Office Building
Watertown, NY 13601
(315) 785-2333

Region 8
Joan Dupont, P.E.
Eleanor Roosevelt State Office Building
4 Burnett Boulevard
Poughkeepsie, NY 12603
(914) 431-5750

Region 9
Jack Williams
44 Hawley Street
Binghamton, NY 13901
(607) 721-8116

Region 10
Subimal Chakraborti
State Office Building
250 Veteran’s Memorial Highway
Hauppauge, NY 11788
(631) 952-6632

Region 11
Douglas Curret
Hunters Point Plaza
47-40 21st Street
Long Island City, NY 11101
(718) 482-4526
Appendix F - NYSDOT Regional Traffic Engineering & Safety Officers

Region 1
Mark Kennedy, P.E.
328 State Street
Schenectady, NY 12305
(518) 388-0380

Region 2
Nick Choubah
Utica State Office Building
207 Genesee Street
Utica, NY 13501
(315) 793-2459

Region 3
Diana L. Graser, P.E.
State Office Building
333 E. Washington Street
Syracuse, NY 13202
(315) 428-4380

Region 4
Larry Sherman
1530 Jefferson Road
Rochester, NY 14623
(716) 272-3460

Region 5
Thomas S. Messana
100 Seneca Street
Buffalo, NY 14203
(716) 847-3268

Region 6
Gary Funk
107 Broadway
Hornell, NY 14843
(607) 324-8512

Region 7
Martin Percy
Dulles State Office Building
317 Washington Street
Watertown, NY 13601
(315) 785-2321

Region 8
Richard Dillmann, P.E.
Eleanor Roosevelt State Office Building
4 Burnett Boulevard
Poughkeepsie, NY 12603
(845) 575-6040

Region 9
John Mancuso
44 Hawley Street
Binghamton, NY 13901
(607) 721-8080

Region 10
Frank Pearson
State Office Building
250 Veterans Memorial Highway
Hauppauge, NY 11788
(631) 952-6020

Region 11
(Contact the regional office)
Hunters Point Plaza
47-40 21st Street
Long Island City, NY 11101
(718) 482-4526
Appendix G - Overview of the National MUTCD

The following overview is an excerpt from the Federal Highway Administration’s website on the MUTCD, located at: mutcd.fhwa.dot.gov

OVERVIEW OF THE MUTCD

Americans relish the freedom of climbing in a vehicle and hitting the road. And as we drive, we rely on a complex series of visual cues to help us make the journey safely. The signs, signals, and pavement markings that guide us are called traffic control devices. These devices are the language that communicates to drivers along the Nation’s roadways. They tell us to slow down for the sharp curve on a two–lane rural byway. They make it possible for us to drive 65 mph on the highway separated from other lanes of traffic by only a narrow yellow line. They tell us when and where to stop, and where we should think twice before we park.

The Manual on Uniform Traffic Control Devices, or MUTCD defines the standards used by road managers nationwide to install and maintain traffic control devices on all streets and highways. The MUTCD is published by the Federal Highway Administration (FHWA) under 23 Code of Federal Regulations (CFR), Part 655, Subpart F.

The FHWA has worked closely with its public and private sector partners to rewrite the MUTCD. The MUTCD Millennium Edition was reformatted to improve the overall organization and discussion of the MUTCD content. This is important because the MUTCD audience encompasses more than the highway community. It includes the insurance industry, law enforcement agencies, academic institutions, private industry, and construction and engineering concerns.

FREQUENTLY ASKED QUESTIONS

1. What is the Federal Highway Administration’s (FHWA) role in selecting and installing traffic control devices (signs, signals, pavement markings, etc.)?

   The FHWA is responsible for developing standards for the design, application and proper placement of traffic control devices. These standards are approved by the FHWA in accordance with Title 23, United States Code, Section 109(d) and Title 23, Code of Federal Regulations, Part 655.601 through 655.603. The FHWA is also responsible for publishing the Manual on Uniform Traffic Control Devices, which contains the national standards and guidance for traffic control devices used on all roads open to the public. The responsibility for the selection, installation, operation, and maintenance of traffic control devices is that of the individual State and local highway agencies.

2. How can I get a traffic signal, STOP sign, or other traffic control device installed somewhere?

   The State and local highway agencies are responsible for selecting, installing, and maintaining traffic control devices in compliance with the Manual on Uniform Traffic Control Devices. The responsibility for the placement, operation, and maintenance
of traffic control devices is that of the individual State and local highway agencies. Therefore, you should contact either the State department of transportation where you live or the local transportation agency. If you are uncertain about who has jurisdiction over the road in question, contact the State department of transportation.

3. Who is responsible for the repair of broken or damaged traffic signals, signs, pavement markings, and other traffic control devices?

Maintenance of traffic control devices – including traffic signals, signs, and pavement markings – rests with the governmental body or official having jurisdiction over the road where the device is located. Most often the local transportation agency has responsibility. If you are uncertain about who has jurisdiction over the device in question, contact your State department of transportation or highway agency.

4. Where are the national standards for signs, signals, and other traffic control devices contained?

The standards for traffic control devices can be found in the Manual on Uniform Traffic Control Devices and the Standard Highway Signs Book.

5. What if a new traffic control device or application of a traffic control device has been developed and the producer thinks it may be useful. Is it possible to experiment with and implement traffic control devices not currently discussed in the Manual on Uniform Traffic Control Devices?

Yes. The Manual is a constantly evolving document, and all the standards contained in it are subject to change. Continuing advances in technology will produce changes in the highway, the vehicle, and in driver proficiency. Accordingly, portions of the system of control devices in this Manual will require updating.

Requests for experimentation must originate with the State/local highway agency or toll operator responsible for the operation of the road or street on which the experiment is to take place. The responsible organization in turn must forward the request to the Federal Highway Administration for approval before the experimentation can take place.

6. What is the History of the Manual on Uniform Traffic Control Devices?

The need for uniform standards was recognized long ago. The American Association of State and Highway Officials (AASHO), now known as American Association of State Highway Transportation Officials (AASHTO), published a manual for rural highways in 1927 and the National Conference on Street and Highway Safety (NCSHS) published a manual for urban streets in 1930. In the early years, the necessity for unification of the standards applicable to the different classes of road and street systems was obvious. To meet this need, a joint committee of AASHO and NCSHS developed, and published in 1935, the original edition of this Manual on Uniform Traffic Control Devices (MUTCD). That committee, now called the National Committee on Uniform Traffic Control Devices (NCUTCD) - though changed from time to time in name, organization, and personnel - has been in continuous existence and has contributed to periodic revisions of the MUTCD.
The FHWA has administered the MUTCD since the 1971 edition. The FHWA and its predecessor organizations have participated in the development and publishing of the seven previous editions. Several of these editions were revised one or more times.

The Secretary of Transportation, under authority granted by legislation in 1966, decreed that traffic control devices on all roads in each State shall be in substantial conformance with the standards issued or endorsed by the FHWA. Prior to 1966, compliance with the MUTCD was required for traffic control devices on all Federal-aid roads.
Appendix H - Flagger Do's and Dont's

Check out our online Work Zone Safety and Flagging Tutorial at:
www.clrp.cornell.edu/flaggingtutorial/flagtips.htm

- **DO** get proper training
- **DO** use Stop/Slow paddles whenever possible
- **DO** set up proper advanced warning signage for approaching traffic at 500 feet on higher speed roads; 200 feet in lower speed areas
- **DO** use Table 1 to locate the flagger sign
- **DO** face traffic
- **DO** hold up your left hand to stop traffic
- **DO** hold the flag or paddle away from your body
- **DO** be visible
- **DO** make eye contact with drivers
- **DO** go to the center of the road after traffic stops, if you need to
- **DO** step to the road shoulder to release traffic; drop the flag or turn the paddle to “slow”
- **DO** make sure you have a good escape route, should something go wrong

- **DON’T** become distracted
- **DON’T** stand in the travel lane
- **DON’T** use the flag to signal
- **DON’T** wave the flag, as it confuses drivers
- **DON’T** assume traffic will stop
- **DON’T** start traffic until you communicate with the other end of the work zone
- **DON’T** use walkmans, radios, etc.
- **DON’T** turn your back to traffic unless it is absolutely necessary after approaching vehicles have stopped