Virginia Work Area Protection Manual

Standards and Guidelines for Temporary Traffic Control

VDOT

May 2005

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The Virginia Department of Transportation has published a complete revision of the *Virginia Work Area Protection Manual* effective May 1, 2005. This Manual replaces the previous issue of the *Virginia Work Area Protection Manual* dated January 2003.

This Manual is Virginia's version of Part 6 of the *Manual on Uniform Traffic Control Devices* (MUTCD) 2003 edition and either meets or exceeds the requirements for temporary traffic control established by the Federal Highway Administration. This Manual may also be accessed on the Virginia Department of Transportation web page at www.VirginiaDOT.org. Future revisions to this manual will be posted on the web site only and it will be the responsibility of the holder of this manual to periodically check the web site and replace revised pages.

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VIRGINIA WORK AREA PROTECTION MANUAL

STANDARDS AND GUIDELINES

FOR
TEMPORARY
TRAFFIC CONTROL

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219

MAY 2005

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VIRGINIA WORK AREA PROTECTION MANUAL

INTRODUCTION

Standard:

Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, or bikeway by authority of a public agency having jurisdiction.

Part VI of the Manual On Uniform Traffic Control Devices (MUTCD) is reproduced and modified here as a separate publication to meet the special demand for uniform standards for temporary traffic control during construction and maintenance operations on streets and highways in the Commonwealth of Virginia.

The Manual on Uniform Traffic Control Devices (MUTCD) is incorporated by reference in 23 Code of Federal Regulations (CFR), Part 655, Subpart F and shall be recognized as the national standard for traffic control devices on all public roads open to public travel in accordance with 23 U.S.C. 109(d) and 402(a). The policies and procedures of the Federal Highway Administration (FHWA) to obtain basic uniformity of traffic control devices shall be as described in 23 CFR 655, Subpart F.

Any traffic control device design or application provision contained in this Manual shall be considered to be in the public domain. Traffic control devices contained in this Manual shall not be protected by a patent or copyright, except for the Interstate Shield and any other items owned by the FHWA.

Standard:

The U.S. Secretary of Transportation, under authority granted by the Highway Safety Act of 1966, decreed that traffic control devices on all streets and highways open to public travel in accordance with 23 U.S.C. 109(d) and 402(a) in each State shall be in substantial conformance with the Standards issued or endorsed by the FHWA.

Guidance:

The need for standard controls is especially acute during roadway temporary traffic control operations. Abnormal conditions are the rule, and therefore, traffic is particularly dependent on design, placement, and uniformity of traffic control devices to direct and guide it safely and efficiently through what would otherwise be hazardous areas. The constantly shifting and changing nature of work zone activity on or adjacent to the roadway may require frequent readjustments of traffic control devices in order to handle new situations. Thus, the proper and adequate placement of standard highway signs, signals, pavement markings, channelizing devices, and traffic control devices on roadways in work zones is a continuous responsibility of officials having authority and jurisdiction over the particular roadway. This responsibility includes periodic daytime and nighttime inspection of existing devices and conditions throughout the duration of the temporary traffic control operation.

This Manual is issued to promote a uniform standard of traffic control associated with SPECIAL EVENTS, INCIDENT MANAGEMENT, and WORK AREA PROTECTION along the highways of Virginia. The standards, policies, and objectives contained in this Manual are intended to furnish information and guidance to personnel authorized to do work on the highway right- of-way, and are not intended to establish a legal requirement for installation. Good engineering judgment must be used to arrive at the best traffic controls for a particular worksite, depending on the nature of the activity, location and duration of work, type of roadway, traffic volume and speed, and potential hazard. Thus, while this Manual provides guidelines for design and application of traffic control devices, the Manual is not a substitute for engineering judgment.

It should be recognized that it is not feasible to cover every conceivable situation. The objective of this Manual is to illustrate many of the typical worksites and to describe many common conditions encountered. When circumstances occur which are not specifically covered in this Manual, or which require modification of the instructions contained herein, the judgment of the various levels of operating supervisors must be relied upon to meet the basic objectives. When warranted, the appropriate District Traffic Engineer should be consulted to select or tailor the proper traffic control devices.

Nothing contained herein is intended to abridge or disclaim the Manual on Uniform Traffic Control Devices, but rather to augment and to supplement for the safety of the traveling public.

Support:

23 CFR, Part 655.603 adopts the MUTCD as the national standard for any street, highway, or bicycle trail open to public travel in accordance with 23 U.S.C. 109(d) and 402(a). The "Uniform Vehicle Code (UVC)" is one of the documents referenced in the MUTCD. The UVC contains a model set of motor vehicle codes and traffic laws for use throughout the United States. The States are encouraged to adopt Section 15-117 of the UVC, which states that "No person shall install or maintain in any area of private property used by the public any sign, signal, marking, or other device intended to regulate, warn, or guide traffic unless it conforms with the State manual and specifications adopted under Section 15-104." Section 15-104 of the UVC adopts the MUTCD as the standard for conformance.

The Standard, Guidance, Option, and Support material described in this edition of the MUTCD provide the transportation professional with the information needed to make appropriate decisions regarding the use of traffic control devices on streets and highways. The material in this edition is organized to better differentiate between Standards that must be satisfied for the particular circumstances of a situation, Guidances that should be followed for the particular circumstances of a situation, and Options that may be applicable for the particular circumstances of a situation.

Throughout this Manual the headings Standard, Guidance, Option, and Support are used to classify the nature of the text that follows. Figures, tables, and illustrations supplement the text and might constitute a Standard, Guidance, Option, or Support. The user needs to refer to the appropriate text to classify the nature of the figure, table, or illustration.

Standard:

When used in this Manual, the text headings shall be defined as follows:

1. **Standard — a statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. All standards are labeled, and the text appears in bold type. The verb shall is typically used. Standards are sometimes modified by Options.**
2. **Guidance — a statement of highly recommended practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. These deviations shall be properly documented when not following guidance stipulations. All Guidance statements are labeled and the text appears in italicized type. The verb should is typically used. Guidance statements are sometimes modified by Options.**
3. **Option — a statement of practice that is a permissive condition and carries no requirement or recommendation. Options may contain allowable modifications to a Standard or Guidance. All Option statements are labeled, and the text is underlined. The verb may is typically used.**
4. **Support — an informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. Support statements are labeled, and the text appears in normal font. The verbs shall, should, and may are not used in Support statements.**

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CHAPTER 6A. GENERAL

Section 6A.01 General

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

When the normal function of the roadway is suspended, TTC planning provides for continuity of the movement of motor vehicle, bicycle, and pedestrian traffic (including accessible passage); transit operations; and access (and accessibility) to property and utilities.

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

Of equal importance to the public traveling through the TTC zone is the safety of workers performing the many varied tasks within the work space. TTC zones present constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for the workers and incident management responders on or near the roadway (see Section 6D.03). At the same time, the TTC zone provides for the efficient completion of whatever activity interrupted the normal use of the roadway.

Consideration for road user safety, worker and responder safety, and the efficiency of road user flow is an integral element of every TTC zone, from planning through completion. A concurrent objective of the TTC is the efficient construction and maintenance of the highway and the efficient resolution of traffic incidents.

No one set of TTC devices can satisfy all conditions for a given project or incident. At the same time, defining details that would be adequate to cover all applications is not practical. Instead, Part 6 displays typical applications that depict common applications of TTC devices. The TTC selected for each situation depends on type of highway, road user conditions, duration of operation, physical constraints, and the nearness of the work space or incident management activity to road users.

Improved road user performance might be realized through a well-prepared public relations effort that covers the nature of the work, the time and duration of its execution, the anticipated effects upon road users, and possible alternate routes and modes of travel. Such programs have been found to result in a significant reduction in the number of road users traveling through the TTC zone, which reduces the possible number of conflicts.

Standard:

TTC plans and devices shall be the responsibility of the authority of a public body or official having jurisdiction for guiding road users. There shall be adequate statutory authority for the implementation during traffic incidents. Such statutes shall provide sufficient flexibility in the application of TTC to meet the needs of changing conditions and enforcement of needed road user regulations, parking controls, speed zoning, and the management of traffic in the TTC zone.

Support:

Temporary facilities, including reasonably safe pedestrian routes around work sites, are also covered by the accessibility requirements of the Americans with Disabilities Act of 1990 (ADA) (Public Law 101-336, 104 Stat. 327, July 26, 1990. 42 USC 12101-12213 (as amended).

Guidance:

The TTC plan should start in the planning phase and continue through the design, construction, and restoration phases. The TTC plans and devices should follow the principles set forth in Part 6. The management of traffic incidents should follow the principles set forth in Chapter 6I.

Option:

TTC plans may deviate from the typical applications described in Chapter 6H to allow for conditions and requirements of a particular site or jurisdiction.

Support:

The criteria of Part 6 apply to both rural and urban areas. A rural highway is normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians. An urban street is typically characterized by relatively low speeds, wide ranges of road user volumes, narrower roadway lanes, frequent intersections and driveways, significant pedestrian activity, and more businesses and houses.

Section 6A.02 Definitions of Words and Phrases in This Manual

Standard:

The following select words and phrases have been incorporated from Section 1A.13 of the MUTCD along with some additions for convenience in using this Manual. Additional words and phrases and references exist in Section 1A.13 and shall be applicable when such definitions are not within this Manual. When used in this Manual, the following words and phrases shall have the following meanings:

1. **Centerline Markings - the yellow pavement marking line(s) that delineates the separation of traffic lanes that have opposite directions of travel on a roadway. These markings need not be at the geometrical center of the pavement.**
2. **Changeable Message Signs - signs that are capable of displaying more than one message, changeable manually, by remote control, or by automatic control. These signs are referred to as Dynamic Message Signs in the National Intelligent Transportation Systems (ITS) Architecture.**
3. **Channelizing Line Marking - a wide or double solid white line used to form islands where traffic in the same direction of travel is permitted on both sides of the island.**
4. **Clear Zone - the total roadside border area, starting at the edge of the traveled way, that is available for an errant driver to stop or regain control of a vehicle. This area might consist of a shoulder, a recoverable slope, and/or a nonrecoverable, traversable slope with a clear run-out area at its toe.**
5. **Crashworthy – a characteristic of a roadside appurtenance that has been successfully crash tested in accordance with a national standard such as the National Cooperative Highway Research Program Report 350, "Recommended Procedures for the safety Performance Evaluation of Highway Features."**
6. **Delineator – a retroreflective device mounted on the roadway surface or at the side of the roadway in a series to indicate the alignment of the roadway, especially at night or in adverse weather.**
7. **Detectable – Having a continuous edge within 6 inch of the surface so that pedestrians who have visual disabilities can sense its presence and receive usable guidance information.**
8. **Edge Line Markings - white or yellow pavement marking lines that delineate the right or left edge(s) of a traveled way.**
9. **Engineering Judgment - the evaluation of available pertinent information, and the application of appropriate principles, Standards, Guidance, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.**
10. **Engineering Study - the comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, Standards, Guidance, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. An engineering study shall be**

performed by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. An engineering study shall be documented.

11. **Expressway – a divided highway with partial control of access.**
12. **Flashing (Flashing Mode) - a mode of operation in which a traffic signal indication is turned on and off repetitively.**
13. **Freeway – a divided highway with full control of access.**
14. **Guide Sign - a sign that shows route designations, destinations, directions, distances, services, points of interest, or other geographical, recreational, or cultural information.**
15. **Highway – a general term for denoting a public way for purposes of travel by vehicular travel, including the entire area within the right-of-way.**
16. **Lane Line Markings - white pavement marking lines that delineate the separation of traffic lanes that have the same direction of travel on a roadway.**
17. **Limited Access – The regulated limitation of public access rights to and from properties abutting a highway facility. Limited access can be either of the following types:**
    - **(a) Full Limited Access – Provides access to selected public roads and prohibits crossings at grade and direct driveway connections.**
    - **(b) Partial Limited Access – Provides access to selected public roads, crossings at grade and some private driveway connections.**
18. **Longitudinal Markings – pavement markings that are generally placed parallel and adjacent to the flow of traffic such as lane lines, centerlines, edge lines, channelizing lines, and others.**
19. **Median - the area between two roadways of a divided highway measured from edge of traveled way to edge of traveled way. The median excludes turn lanes. The median width might be different between intersections, interchanges, and at opposite approaches of the same intersection.**
20. **Object Marker – a device used to mark obstructions within or adjacent to the roadway.**
21. **Pedestrian - a person afoot, in a wheelchair, on skates, or on a skateboard.**
22. **Raised Pavement Marker - a device with a height of at least 0.4 inch mounted on or in a road surface that is intended to be used as a positioning guide or to supplement pavement markings or to mark the position of a fire hydrant.**
23. **Regulatory Signs- -a sign that gives notice to road users of traffic laws or regulations.**
24. **Retroreflectivity - a property of a surface that allows a large portion of the light coming from a point source to be returned directly back to a point near its origin.**
25. **Right-of-Way [Assignment] - the permitting of vehicles and/or pedestrians to proceed in a lawful manner in preference to other vehicles or pedestrians by the display of sign or signal indications.**
26. **Road User - a vehicle operator (including cars, trucks, and motorcycles), bicyclist, or pedestrian within the highway, including workers in temporary traffic control zones.**
27. **Rumble Strip - a series of intermittent, narrow, transverse areas of rough-textured, slightly raised, or depressed road surface that is installed to alert road users to unusual traffic conditions.**
28. **Rural Highway - a type of roadway normally characterized by lower volumes, higher speeds, fewer turning conflicts, and less conflict with pedestrians.**
29. **Shared Roadway - a roadway that is officially designated and marked as a bicycle route, but which is open to motor vehicle travel and upon which no bicycle lane is designated.**
30. **Shared-Use Path - a bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths might also be used by pedestrians, skaters, wheelchair users, joggers, and other nonmotorized users.**

31. **Sidewalk - that portion of a street between the curb line, or the lateral line of a roadway, and the adjacent property line or on easements of private property, intended for use by pedestrians.**
32. **Sign - any traffic control device that is intended to communicate specific information to road users through a word or symbol legend. Signs do not include traffic control signals, pavement markings, delineators, or channelization devices.**
33. **Sign Assembly—a group of signs, located on the same support(s), that supplement one another in conveying information to road users.**
34. **Sign Illumination - either internal or external lighting that shows similar color by day or night. Street, highway, or strobe lighting shall not be considered as meeting this definition.**
35. **Sign Legend - all word messages, logos, and symbol designs that are intended to convey specific meanings.**
36. **Sign Panel - a separate panel or piece of material containing a word or symbol legend that is affixed to the face of a sign.**
37. **Speed - speed is defined based on the following classifications:**
    - **(a) Advisory Speed - a recommended speed for all vehicles operating on a section of highway and based on the highway design, operating characteristics, and conditions.**
    - **(b) Average Speed - the summation of the instantaneous or spot-measured speeds at a specific location of vehicles divided by the number of vehicles observed.**
    - **(c) Design Speed - a selected speed used to determine the various geometric design features of a roadway.**
    - **(d) 85th-Percentile Speed - The speed at or below which 85 percent of the motorized vehicles travel.**
    - **(e) Operating Speed - a speed at which a typical vehicle or the overall traffic operates. Operating speed may be defined with speed values such as the average, pace, or 85th-percentile speeds.**
    - **(g) Posted Speed - the speed limit determined by law and shown on Speed Limit signs.**
    - **(h) Statutory Speed - a speed limit established by legislative action that typically is applicable for highways with specified design, functional, jurisdictional and/or location characteristic and is not necessarily shown on Speed Limit signs.**
38. **Speed Limit - the maximum (or minimum) speed applicable to a section of highway as established by law.**
39. **Speed Zone - a section of highway with a speed limit that is established by law but which may be different from a legislatively specified statutory speed limit.**
40. **Stop Line - a solid white pavement marking line extending across approach lanes to indicate the point at which a stop is intended or required to be made.**
41. **Temporary Traffic Control Zone - an area of a highway where road user conditions are changed because of a work zone or incident by the use of temporary traffic control devices, flaggers, police, or other authorized personnel.**
42. **Traffic - pedestrians, bicyclists, ridden or herded animals, vehicles, streetcars, and other conveyances either singularly or together while using any highway for purposes of travel.**
43. **Traffic Control Device - a sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over, or adjacent to a street, highway, pedestrian facility, or bicycle path by authority of a public agency having jurisdiction.**
44. **Traffic Control Signal (Traffic Signal) - any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed.**
45. **Traveled Way - the portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.**
46. **Truck-Mounted Attenuator – Energy-absorbing device attached to the rear of trucks to reduce the severity of rear-end crashes.**

47. **Urban Street - a type of street normally characterized by relatively low speeds, wide ranges of traffic volumes, narrower lanes, frequent intersections and driveways, significant pedestrian traffic, and more businesses and houses.**
48. **Warning Sign - a sign that gives notice to road users of a situation that might not be readily apparent.**
49. **Warrant - a warrant describes threshold conditions to the engineer in evaluating the potential safety and operational benefits of traffic control devices and is based upon average or normal conditions. Warrants are not a substitute for engineering judgment. The fact that a warrant for a particular traffic control device is met is not conclusive justification for the installation of the device.**
50. **Work Zone - A work zone is an area of a highway or roadway with construction, maintenance, or utility work activities.**
51. **Wrong-Way Arrows - slender, elongated, white pavement marking arrows placed upstream from the ramp terminus to indicate the correct direction of traffic flow. Wrong-way arrows are intended primarily to warn wrong-way road users that they are going in the wrong direction.**

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CHAPTER 6B. FUNDAMENTAL PRINCIPLES

Section 6B.01 Fundamental Principles of Temporary Traffic Control

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

Construction, maintenance, utility, and incident zones can all benefit from TTC to compensate for the unexpected or unusual situations faced by road users. When planning for TTC in these zones, it can be assumed that it is appropriate for road users to exercise caution. Even though road users are assumed to be using caution, special care is still needed in applying TTC techniques.

Special plans preparation and coordination with transit, other highway agencies, law enforcement and other emergency units, utilities, schools, and railroad companies might be needed to reduce unexpected and unusual road user operation situations.

During TTC activities, commercial vehicles might need to follow a different route from passenger vehicles because of bridge, weight, clearance, or geometric restrictions. Also, vehicles carrying hazardous materials might need to follow a different route from other vehicles. The Hazardous Materials and National Network signs are included in Sections 2B.52 and 2B.53 of the MUTCD, respectively.

Experience has shown that following the fundamental principles of Part 6 will assist road users and help protect workers in the vicinity of TTC zones.

Guidance:

Road user and worker safety and accessibility in TTC zones should be an integral and high-priority element of every project from planning through design and construction. Similarly, maintenance and utility work should be planned and conducted with the safety and accessibility of all motorists, bicyclists, pedestrians (including those with disabilities), and workers being considered at all times. If the TTC zone includes a highway-rail grade crossing, early coordination with the railroad company should take place.

Support:

Formulating specific plans for TTC at traffic incidents is difficult because of the variety of situations that can arise.

Guidance:

General plans or guidelines should be developed to provide safety for motorists, bicyclists, pedestrians, workers, enforcement/emergency officials, and equipment, with the following factors being considered:

A. The basic safety principles governing the design of permanent roadways and roadsides should also govern the design of TTC zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and TTC devices as nearly as possible comparable to those for normal highway situations.

B. A TTC plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by an official knowledgeable (for example, trained and/or certified) in proper TTC practices and documented.

Road user movement should be inhibited as little as practical, based on the following considerations:

A. TTC at work and incident sites should be designed on the assumption that drivers will only reduce their speeds if they clearly perceive a need to do so (see Section 6C.01).

B. Frequent and abrupt changes in geometrics such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers, should be avoided.

C. Provisions should be made for the reasonably safe operation of work, particularly on high-speed, high-volume roadways.

D. Road users should be encouraged to use alternative routes that do not include TTC zones.

E. The need for smooth riding surfaces for motorcyclists should be provided, or advance warning notification given whenever roadway surfaces are disturbed (see Sections 6F.47a and 6G.12a).

F. Bicyclists and pedestrians, including those with disabilities, should be provided with access and reasonably safe passage through the TTC zone.

G. Roadway occupancy should be scheduled during off-peak hours and, if necessary, night work should be considered.

H. Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur before roadway or ramp closings.

Motorists (including cars, trucks, buses, and motorcycles), bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing TTC zones and incident sites. The following principles should be applied:

A. Adequate warning, delineation, and channelization should be provided to assist in guiding road users in advance of and through the TTC zone or incident site by using proper pavement marking, signing, or other devices that are effective under varying conditions. Providing information that is in usable formats by pedestrians with visual disabilities should also be considered.

B. TTC devices inconsistent with intended travel paths through TTC zones should be removed or covered. However, in intermediate-term stationary, short-term, and mobile operations, where visible permanent devices are inconsistent with intended travel paths, devices that highlight or emphasize the appropriate path should be used. Providing traffic control devices that are accessible to and usable by pedestrians with disabilities should be considered.

C. Flagging procedures, when used, should provide positive guidance to road users traversing the TTC zone.

To provide acceptable levels of operations, routine day and night inspections of TTC elements should be performed as follows:

Standard:

Temporary traffic control installations shall be reviewed daily to ensure the functionality of the temporary traffic control devices and compliance to this Manual. These reviews shall be documented on a weekly basis at a minimum using the Work Zone Safety Checklist form found in Appendix B of this manual, including as much detail information as warranted for the type of operation.

Guidance:

Review of temporary traffic control on high speed, high traffic volume projects should also be performed during night and non-work periods (weekends), as well on all projects after severe weather conditions.

Daily inspections should note the condition of the traffic control and traffic movement on the operation and recorded in the diary for construction and maintenance projects.

Standard:

A review of the temporary traffic control shall be performed for compliance immediately after a change in traffic patterns. Deficiencies in the temporary traffic control shall be corrected and documented as soon as possible.

The review and documentation of the temporary traffic control installation shall be by someone trained and knowledgeable about the fundamental principles of temporary traffic control and related work activities being performed. The individual responsible for temporary traffic control review shall have the authority to halt work until applicable or remedial safety measures are taken.

Changes to the traffic control plan shall be documented with what the changes were and the reason why they were changed.

Support:

Other methods of documentation include written notes, project diary entries, photographs, and video recordings.

Guidance:

When warranted, an engineering study should be made (in cooperation with law enforcement officials) of reported crashes occurring within the temporary traffic control zone. Crash records in temporary traffic control zones should be monitored to identify the need for changes in the temporary traffic control zone.

Standard:

All temporary traffic control devices shall be removed as soon as practical when they are no longer needed. When work is suspended for short periods, advance warning signs that are no longer appropriate shall be removed from the roadway, and other inappropriate devices removed from the work area so they are not visible to drivers.

Guidance:

Attention should be given to the maintenance of roadside safety during the life of the TTC zone by applying the following principles:

A. To accommodate run-off-the-road incidents, disabled vehicles, or emergency situations, unencumbered roadside recovery areas or clear zones should be provided where practical.
B. Channelization of road users should be accomplished by the use of pavement markings, signing, and crashworthy, detectable channelizing devices.
C. Work equipment, workers' private vehicles, materials, and debris should be stored in such a manner to reduce the probability of being impacted by run-off-the-road vehicles.

Each person whose actions affect TTC zone safety, from the upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make.

Standard:

Only those individuals who are trained in proper TTC practices and have a basic understanding of the principles (established by applicable standards and guidelines, including those of this Manual) shall supervise the selection, placement, and maintenance of TTC devices used for TTC zones and for incident management.

Guidance:

Good public relations should be maintained by applying the following principles:

A. The needs of all road users should be assessed such that appropriate advance notice is given and clearly defined alternative paths are provided.
B. The cooperation of the various news media should be sought in publicizing the existence of and reasons for TTC zones because news releases can assist in keeping the road users well informed.
C. The needs of abutting property owners, residents, and businesses should be assessed and appropriate accommodations made.
D. The needs of emergency service providers (law enforcement, fire, and medical) should be assessed and appropriate coordination and accommodations made.
E. The needs of railroads and transit should be assessed and appropriate coordination and accommodations made.
F. The needs of operators of commercial vehicles such as buses and large trucks should be assessed and appropriate accommodations made.

Standard:

Before any new detour or temporary route is opened to traffic, all necessary signs shall be in place.

All TTC devices shall be removed as soon as practical when they are no longer needed. When work is suspended for short periods of time, TTC devices that are no longer appropriate shall be removed or covered.

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CHAPTER 6C. TEMPORARY TRAFFIC CONTROL ELEMENTS

Section 6C.01 Temporary Traffic Control Plans

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

A TTC plan describes TTC measures to be used for facilitating road users through a work zone or an incident area. TTC plans play a vital role in providing continuity of reasonably safe and efficient road user flow when a work zone, incident, or other event temporarily disrupts normal road user flow. Important auxiliary provisions that cannot conveniently be specified on project plans can easily be incorporated into Special Provisions within the TTC plan.

TTC plans range in scope from being very detailed to simply referencing typical drawings contained in this Manual, standard approved highway agency drawings and manuals, or specific drawings contained in the contract documents. The degree of detail in the TTC plan depends entirely on the nature and complexity of the situation.

Guidance:

TTC plans should be prepared by persons knowledgeable (for example, trained and/or certified) about the fundamental principles of TTC and work activities to be performed. The design, selection and placement of TTC devices for a TTC plan should be based on engineering judgment.

Coordination should be made between adjacent or overlapping projects to check that duplicate signing is not used and to check compatibility of traffic control between adjacent or overlapping projects.

Traffic control planning should be completed for all highway construction, utility work, maintenance operations, and incident management including minor maintenance and utility projects prior to occupying the TTC zone. Planning for all road users should be included in the process.

Provisions for effective continuity of accessible circulation paths for pedestrians should be incorporated into the TTC process. Where existing pedestrian routes are blocked or detoured, information should be provided about alternative routes that are usable by pedestrians with disabilities, particularly those who have visual disabilities. Access to temporary bus stops, reasonably safe travel across intersections with accessible pedestrian signals (see Section 4E.06), and other routing issues should be considered where temporary pedestrian routes are channelized. Barriers and channelizing devices that are detectable by people with visual disabilities should be provided.

Option:

Provisions may be incorporated into the project bid documents that enable contractors to develop an alternate TTC plan.

Modifications of TTC plans may be necessary because of changed conditions or a determination of better methods of safely and efficiently handling road users.

Guidance:

This alternate or modified plan should have the approval of the responsible highway agency prior to implementation.

Provisions for effective continuity of transit service should be incorporated into the TTC planning process because often public transit buses cannot efficiently be detoured in the same manner as other vehicles (particularly for short-term maintenance projects). Where applicable, the TTC plan should provide for features such as accessible temporary bus stops, pull-outs, and satisfactory waiting areas for transit patrons, including

persons with disabilities, if applicable (see Section 10A.05 for additional light rail transit issues to consider for TTC).

Provisions for effective continuity of railroad service and acceptable access to abutting property owners and businesses should also be incorporated into the TTC planning process.

Reduced speed limits should be used only in the specific portion of the TTC zone where conditions or restrictive features are present. However, frequent changes in the speed limit should be avoided. A TTC plan should be designed so that vehicles can reasonably safely travel through the TTC zone with a speed limit reduction of no more than 10 mph.

Standard:

Speeds shall only be reduced within construction/maintenance work zones by the District Traffic Engineer upon completion of an engineering and traffic investigation warranting the reduction. Documentation of the change shall be performed and maintained.

Guidance:

TTC plans should be designed in accordance with the approach speeds prior to construction when possible.

A reduction of more than 10 mph in the speed limit should be used only when required by restrictive features in the TTC zone. Where restrictive features justify a speed reduction of more than 10 mph, additional driver notification should be provided. The speed limit should be stepped down in advance of the location requiring the lowest speed in ten-mile increments, and additional TTC warning devices should be used.

Reduced speed zoning (lowering the regulatory speed limit) should be avoided as much as practical because drivers will reduce their speeds only if they clearly perceive a need to do so.

Support:

Research has demonstrated that large reductions in the speed limit, such as a 30 mph reduction, increase speed variance and the potential for crashes. Smaller reductions in the speed limit of up to 10 mph cause smaller changes in speed variance and lessen the potential for increased crashes. A reduction in the regulatory speed limit of only up to 10 mph from the normal speed limit has been shown to be more effective.

Section 6C.02 Temporary Traffic Control Zones

Support:

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

A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC device.

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

Section 6C.03 Components of Temporary Traffic Control Zones

Support:

Most TTC zones are divided into five areas: the advance warning area, the transition area, the buffer area, the activity area, and the termination area. Figure 6C-1 illustrates these five areas. These five areas are described in Sections 6C.04 through 6C.07.

Section 6C.04 Advance Warning Area

Support:

The advance warning area is the section of highway where road users are informed about the upcoming work zone or incident area.

Option:

The advance warning area may vary from a single sign or high-intensity rotating, oscillating, or strobe lights on a vehicle to a series of signs in advance of the TTC zone activity area.

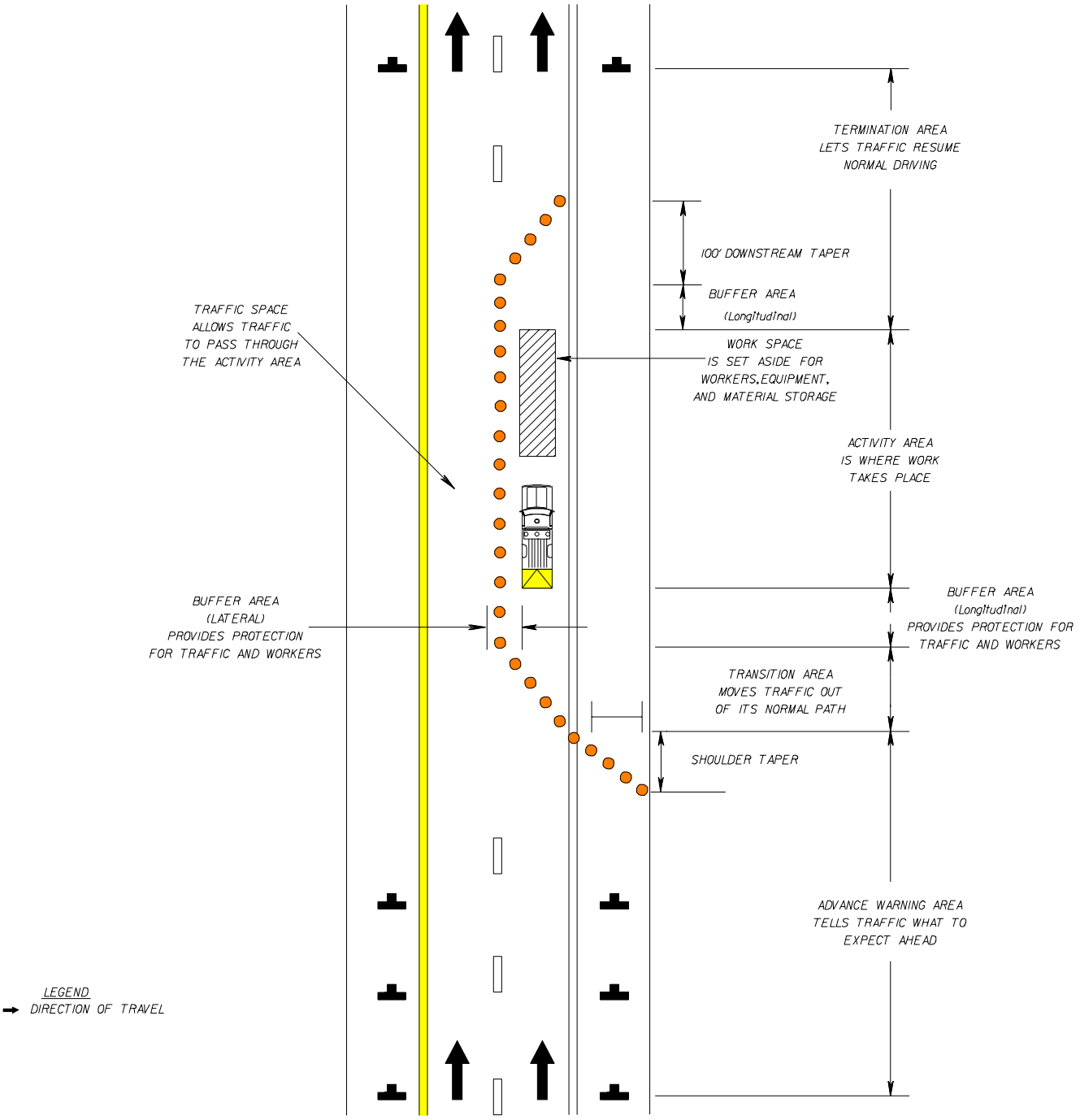


FIGURE 6C-1 COMPONENT PARTS OF A TEMPORARY TRAFFIC CONTROL ZONE

Guidance:

Sign spacing distance should be as shown in Table 6C-1, Spacing of Advance Warning Signs.

Option:

Low speed urban streets with speeds of 25 mph or less may reduce the spacing to 100' - 200' between signs.

Advance warning may be eliminated when the activity area is sufficiently removed from the road users' path so that it does not interfere with the normal flow (See Appendix A for clear zone requirements) and approved by the District Traffic Engineer.

Table 6C-1, Spacing of Advance Warning Signs	
Urban street with 25 mph or less posted speed *	**100' – 200'**
Urban street with 30 to 35 mph posted speed *	**225' – 275'**
Roadways with 45 mph or less posted speed	**350' – 500'**
Roadways with greater than 45 mph posted speed	**500' – 800'**
Limited access highways:	**1300' – 1500'**

* Note: For urban conditions, it is generally better to place all advance warning signs within a one block area versus spreading out over several blocks.

Section 6C.05 Transition Area

Support:

The transition area is that section of highway where road users are redirected out of their normal path. Transition areas usually involve strategic use of tapers, which because of their importance are discussed separately in detail.

Standard:

When redirection of the road users' normal path is required, they shall be channelized from the normal path to a new path.

Support:

In mobile operations, the transition area moves with the work space.

Section 6C.06 Buffer Area

Support:

The buffer area is a lateral and/or longitudinal clear space that separates road user flow from the work space or an unsafe area, and might provide some recovery space for an errant vehicle.

Standard:

Neither work activity nor storage of equipment, vehicles, or material shall occur within a buffer space.

Option:

Buffer spaces may be positioned either longitudinally or laterally with respect to the direction of road user flow. The activity area may contain one or more lateral or longitudinal buffer spaces.

Guidance:

A longitudinal buffer space should be placed in advance of a work space. The longitudinal buffer space may also be used to separate opposing road user flows that use portions of the same traffic lane, as shown in Figure 6C-2, Examples of Types of Tapers and Buffer Spaces.

If a longitudinal buffer space is used, the length should be as shown in Table 6C-2 and is based on the posted speed limit.

Support:

Typically, the buffer space is formed as a traffic island and defined by channelizing devices.

When a shadow vehicle, arrow panel, or changeable message sign is placed in a closed lane in advance of a work space, only the area upstream of the vehicle, arrow panel, or changeable message sign constitutes the buffer space.

Option:

The lateral buffer space may be used to separate the traffic space from the work space, as shown in Figure 6C-2, or such areas as excavations or pavement-edge drop-offs. A lateral buffer space also may be used between two travel lanes, especially those carrying opposing flows.

Guidance:

The width of a lateral buffer space should be determined by engineering judgment. Where traffic barrier service is being utilized, consideration should be given to the lateral maximum deflection for the type of barrier service being used so that the effective lateral buffer space is achieved.

Posted Speed Limit (mph)	Distance (feet)
≤ 20	115 - 125
25	155 - 165
30	200 - 210
35	250 - 260
40	305 - 325
45	360 - 380
50	425 - 445
55	500 - 530
60	570 - 600
65	645 - 675
70	730 - 760

Table 6C-2, Length of the Longitudinal Buffer Space

Option:

When work occurs on a high-volume, highly congested facility, a vehicle storage or staging space may be provided for incident response and emergency vehicles (for example, tow trucks and fire apparatus) so that these vehicles can respond quickly to road user incidents.

Guidance:

If used, an incident response and emergency-vehicle storage area should not extend into any portion of the buffer space.

Section 6C.07 Activity Area

Support:

The activity area is the section of the highway where the work activity takes place. It is comprised of the work space, and the traffic space.

The work space is that portion of the highway closed to road users and set aside for workers, equipment, and material, and a shadow vehicle if one is used upstream. Work spaces are usually delineated for road users by channelizing devices or, to exclude vehicles and pedestrians, by temporary barriers.

Option:

The work space may be stationary or may move as work progresses.

Guidance:

Since there might be several work spaces (some even separated by several miles) within the project limits, each work space should be adequately signed to inform road users and reduce confusion.

The maximum length of the work space should not exceed two miles unless approved by the District Traffic Engineer.

Support:

The traffic space is the portion of the highway in which road users are routed through the activity area.

Section 6C.08 Termination Area

Standard:

The termination area shall be used to return road users to their normal path. The termination area shall extend from the downstream end of the work area to the last TTC device such as END ROAD WORK signs, if posted.

Option:

An END ROAD WORK sign, a Speed Limit sign, or other signs may be used to inform road users that they can resume normal operations.

A longitudinal buffer space may be used between the work space and the beginning of the downstream taper.

Section 6C.09 Tapers

Option:

Tapers may be used in both the transition and termination areas. Whenever tapers are to be used in close proximity to an interchange ramp, crossroads, curves, or other influencing factors, the length of the tapers may be adjusted.

Support:

Tapers are created by using a series of channelizing devices and/or pavement markings to move traffic out of or into the normal path. Types of tapers are shown in Figure 6C-2.

Longer tapers are not necessarily better than shorter tapers (particularly in urban areas with characteristics such as short block lengths or driveways) because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes unnecessarily. The test concerning adequate lengths of tapers involves observation of driver performance after TTC plans are put into effect.

Guidance:

The criteria for determining the taper length (L) are shown in Table 6C-2 and should be the minimum used.

The appropriate taper length (L) should be determined using the criteria shown in Tables 6C-2.

The maximum distance in feet between devices in a taper should not exceed 20 feet at posted speeds up to 35 mph, and 40 feet for posted speeds greater than 35 mph.

Support:

A merging taper requires the longest distance because drivers are required to merge into common road space.

Guidance:

A merging taper should be long enough to enable merging drivers to have adequate advance warning and sufficient length to adjust their speeds and merge into a single lane before the end of the transition.

Taper Length Criteria for Temporary Traffic Control Zones	
Type of Taper	**Taper Length (L)**
Merging	L= Minimum
Shifting	L Desired, 1/2L Minimum
Shoulder	1/3 L Minimum
Two-Way Traffic	100 Feet Maximum
Downstream	100 Feet per Lane
L= Taper Length, W= Width of Offset, S= Posted Speed Limit	

Table 6C-3, Taper Length Criteria

TAPER LENGTH (L)					
POSTED SPEED LIMIT	WIDTH OF OFFSET (FT)				REMARKS
	9	10	11	12	
25 or below	94	105	115	125	$L= S^2W/60$
30	135	150	165	180	"
35	184	205	225	245	"
40	240	267	294	320	"
45	405	450	495	540	L=SW
50	450	500	550	600	"
55	495	550	605	660	"
60	540	600	660	720	"
65	585	650	715	780	"
70<	630	700	770	840	"
MINIMUM LANE CLOSURE TAPER LENGTH ON ALL LIMITED ACCESS ROADWAYS, REGARDLESS OF POSTED SPEED, SHALL BE 1000 FEET.					

Table 6C-4, Taper Length Chart

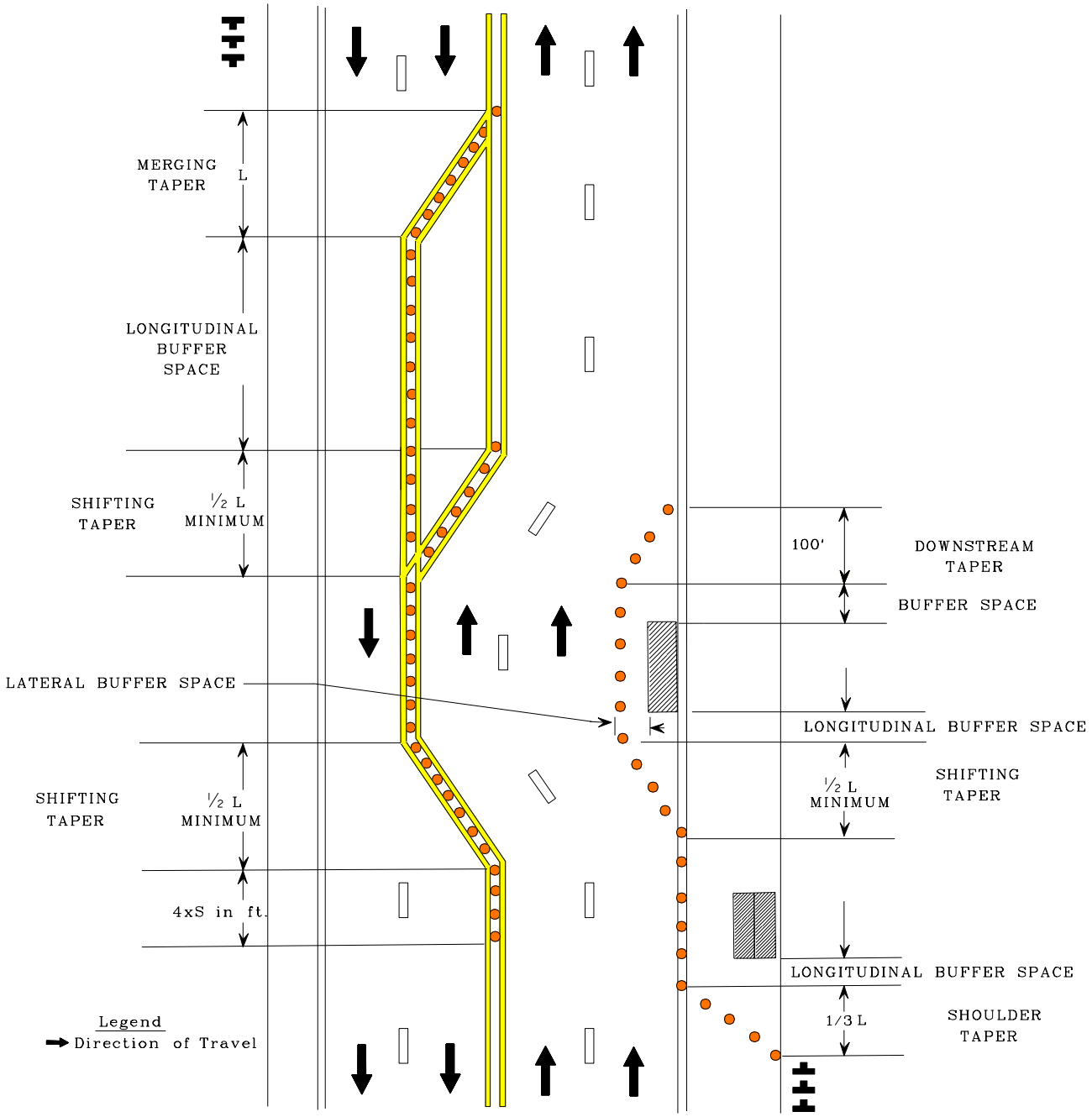


FIGURE 6C-2 EXAMPLES OF TYPES OF TAPERS AND BUFFER SPACES

Support:

A shifting taper is used when a lateral shift is needed. When more space is available, a longer than minimum taper distance can be beneficial. Changes in alignment can also be accomplished by using horizontal curves designed for normal highway speeds.

Guidance:

A shifting taper should have a desirable length of L but not less than 1/2 L (see Tables 6C-3 and 6C-4).

Support:

A shoulder taper may be beneficial on a high-speed roadway where shoulders are part of the activity area and are closed, or when improved shoulders might be mistaken as a driving lane. In these instances, the same type, but abbreviated, closure procedures used on a normal portion of the roadway can be used.

Guidance:

If used, shoulder tapers should have a length of approximately 1/3 L (see Tables 6C-3 and 6C-4). If a shoulder is used as a travel lane, either through practice or during a TTC activity, a normal merging (L) taper should be used.

Option:

A downstream taper may be useful in termination areas to provide a visual cue to the driver that access is available back into the original lane or path that was closed.

Guidance:

When used, a downstream taper should have a length of approximately 100 ft per lane with devices placed at a spacing of approximately 20 feet.

Support:

The one-lane, two-way taper is used in advance of an activity area that occupies part of a two-way roadway in such a way that a portion of the road is used alternately by traffic in each direction.

Guidance:

Traffic should be controlled by a flagger or a STOP or YIELD sign. A short taper having a maximum length of 100 feet with channelizing devices at approximately 20 feet spacings should be used to guide traffic into the one-way section.

Support:

An example of a one-lane, two-way traffic taper is shown in Figure 6C-3.

Section 6C.10 Detours and Diversions

Support:

A detour is a temporary rerouting of road users onto an existing highway in order to avoid a TTC zone.

Guidance:

Detours should be clearly signed over their entire length so that road users can easily use existing highways to return to the original highway.

Support:

A diversion is a temporary rerouting of road users onto a temporary highway or alignment placed around the work area.

Section 6C.11 One-Lane, Two-Way Traffic Control

Standard:

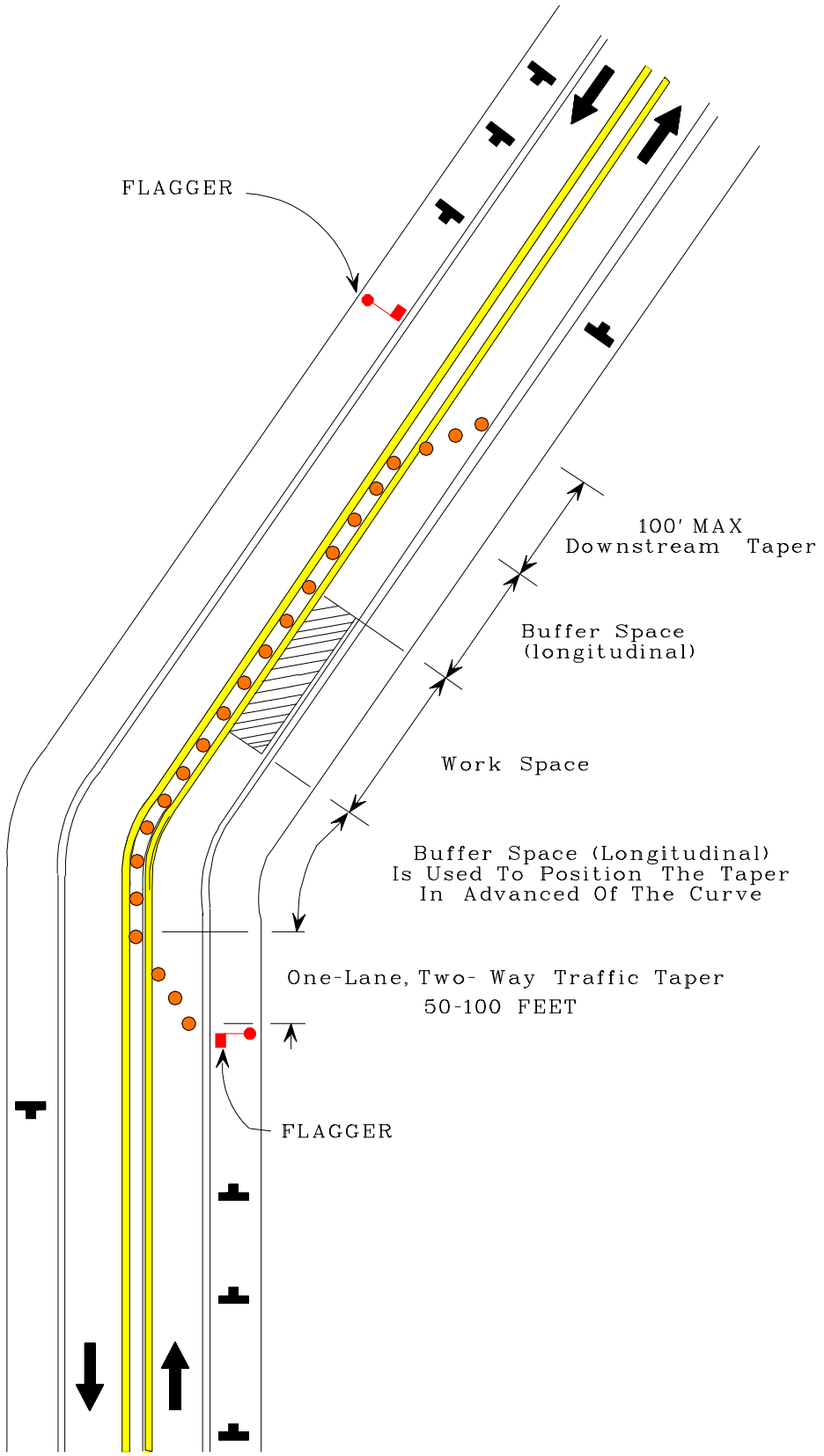
When traffic in both directions must use a single lane for a limited distance, movements from each end shall be coordinated.

Guidance:

Provisions should be made for alternate one-way movement through the constricted section via methods such as flagger control, a flag transfer, a pilot car, traffic control signals, or stop or yield control.

Control points at each end should be chosen to permit easy passing of opposing lanes of vehicles.

If traffic on the affected one-lane roadway is not visible from one end to the other, then flagging procedures,



EXAMPLE OF A
ONE-LANE, TWO-WAY TRAFFIC TAPPER
FIGURE 6C-3

a pilot car with a flagger used as described in Section 6C.14 and 6F.54, or a traffic control signal should be used to control opposing traffic flows.

Support:

At a spot constriction, such as an isolated pavement patch on highways with lower speeds and adequate sight distance, the movement of traffic through one-lane, two-way constrictions tends to be self-regulating.

Section 6C.12 Flagger Method of One-Lane, Two-Way Traffic Control

Option:

When a one-lane, two-way TTC zone is short enough to allow a flagger to see from one end of the zone to the other, traffic may be controlled by either a single flagger or by a flagger at each end of the section.

Guidance:

When a single flagger is used, the flagger should be stationed on the shoulder opposite the constriction or work space, or in a position where good visibility and traffic control can be maintained at all times. When good visibility and traffic control cannot be maintained by one flagger station, traffic should be controlled by a flagger at each end of the section. One of the flaggers should be designated as the coordinator. Flaggers should be able to communicate with each other orally, electronically, or with manual signals. These manual signals should not be mistaken for flagging signals.

Due to limited room for vehicles to pass activities and equipment occurring on narrow roadways, cones should not be used for channelization on roadways 20 foot or less in width.

Section 6C.13 Flag Transfer Method of One-Lane, Two-Way Traffic Control

Support:

The driver of the last vehicle proceeding into the one-lane section is given a red flag (or other token) and instructed to deliver it to the flagger at the other end. The opposite flagger, upon receipt of the flag, then knows that it is reasonably safe to allow traffic to move in the other direction. A variation of this method is to replace the use of a flag with an official pilot car that always follows the last road user vehicle proceeding through the section.

Guidance:

The flag transfer method should be employed only where the one-way traffic is confined to a relatively short length of a road, usually not more than 1 mile in length.

Section 6C.14 Pilot Car Method of One-Lane, Two-Way Traffic Control

Option:

A pilot car may be used to guide a queue of vehicles through the TTC zone or detour.

Guidance:

The operation of the pilot vehicle should be coordinated with flagging operations or other controls at each end of the one-lane section.

Option:

On low volume roadways, a "WAIT FOR PILOT VEHICLE" sign may be used with approval of the District Traffic Engineer.

Standard:

The PILOT CAR FOLLOW ME (G20-4) sign shall be mounted at a conspicuous location on the rear of the vehicle. The pilot car shall also have the name of the contractor or contracting authority prominently displayed.

Section 6C.15 Temporary Traffic Control Signal Method of One-Lane, Two-Way Traffic Control

Option:

Traffic control signals may be used to control vehicular traffic movements in one-lane, two-way TTC zones as approved by the District Traffic Engineer (see Figure TTC-42.0 and Chapter 4G of the MUTCD). For bridge reconstruction, see Standard TS-1, VIRGINIA ROAD AND BRIDGE STANDARDS.

Section 6C.16 Stop or Yield Control Method of One-Lane, Two-Way Traffic Control

Option:

STOP or YIELD signs may be used to control traffic on low-volume roads at a one-lane, two-way TTC zone when drivers are able to see the other end of the one-lane, two-way operation and have sufficient visibility of approaching vehicles.

Guidance:

The use of STOP or YIELD signs for traffic control on low-volume roads at a one-lane, two-way work zone should have written approval from the District Traffic Engineer. See warrants for No-Passing Zones at Curves in Chapter 3B of the MUTCD.

If the STOP or YIELD sign is installed for only one direction, then the STOP or YIELD sign should face road users who are driving on the side of the roadway that is closed for the work activity area.

CHAPTER 6D. PEDESTRIAN AND WORKER SAFETY

Section 6D.01 Pedestrian Considerations

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

A wide range of pedestrians might be affected by TTC zones, including the young, elderly, and people with disabilities such as hearing, visual, or mobility. These pedestrians need a clearly delineated and usable travel path. Considerations for pedestrians with disabilities are addressed in Section 6D.02.

The most desirable way to provide information to pedestrians with visual disabilities that is equivalent to visual signage for notification of sidewalk closures is a speech message provided by an audible information device. Devices that provide speech messages in response to passive pedestrian actuation are the most desirable. Other devices that continuously emit a message, or that emit a message in response to use of a pushbutton, are also acceptable. Signage information can also be transmitted to personal receivers, but currently such receivers are not likely to be carried or used by pedestrians with visual disabilities in TTC zones. Audible information devices might not be needed if detectable channelizing devices make an alternate route of travel evident to pedestrians with visual disabilities.

Guidance:

If a pushbutton is used to provide equivalent TTC information to pedestrians with visual disabilities, the pushbutton should be equipped with a locator tone to notify pedestrians with visual disabilities that a special accommodation is available, and to help them locate the pushbutton.

Standard:

The various TTC provisions for pedestrian and worker safety set forth in Part 6 shall be applied by knowledgeable (for example, trained and/or certified) persons after appropriate evaluation and engineering judgment.

Advance notification of sidewalk closures shall be provided to the maintaining agency. Where pedestrians with visual disabilities normally use the closed sidewalk, a barrier that is detectable by a person with a visual disability traveling with the aid of a long cane shall be placed across the full width of the closed sidewalk.

Support:

It must be recognized that pedestrians are reluctant to retrace their steps to a prior intersection for a crossing or to add distance or out-of-the-way travel to a destination.

Guidance:

Adequate provisions should be made for persons with disabilities as determined by an engineering study or by engineering judgment. Because printed signs and surface delineation are not usable by pedestrians with visual disabilities, blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing audible information devices, accessible pedestrian signals, and barriers and channelizing devices that are detectable to pedestrians traveling with the aid of a long cane or who have low vision.

The following three items should be considered when planning for pedestrians in TTC zones:

A. Pedestrians should not be led into conflicts with work site vehicles, equipment, and operations.
B. Pedestrians should not be led into conflicts with vehicles moving through or around the work site.

C. Pedestrians should be provided with a reasonably safe, convenient, and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or footpath(s). Where pedestrians who have visual disabilities encounter work sites that require them to cross the roadway to find an accessible route, instructions should be provided using an audible information device. Accessible pedestrian signals (see Section 4E.06) with accessible pedestrian detectors (see Section 4E.09) might be needed to enable pedestrians with visual disabilities to cross wide or heavily traveled roadways.

A pedestrian route should not be severed and/or moved for nonconstruction activities such as parking for vehicles and equipment.

Consideration should be made to separate pedestrian movements from both work site activity and vehicular traffic. Unless a reasonably safe route that does not involve crossing the roadway can be provided, pedestrians should be appropriately directed with advance signing that encourages them to cross to the opposite side of the roadway. In urban and suburban areas with high vehicular traffic volumes, these signs should be placed at intersections (rather than midblock locations) so that pedestrians are not confronted with midblock work sites that will induce them to attempt skirting the work site or making a midblock crossing.

Support:

Figures TTC-24.0 and TTC-25.0 show typical TTC device usage and techniques for pedestrian movement through work zones.

Guidance:

When pedestrian movement through or around a work site is necessary, a separate usable footpath should be provided. If the previous pedestrian facility was accessible to pedestrians with disabilities, the footpath provided during temporary traffic control should also be accessible. There should not be any abrupt changes in grade or terrain that could cause a tripping hazard or could be a barrier to wheelchair use. Barriers and channelizing devices should be detectable to pedestrians who have visual disabilities (see Section 6F.68).

Option:

Whenever it is feasible, closing off the work site from pedestrian intrusion may be preferable to channelizing pedestrian traffic along the site with TTC devices.

Support:

Maintaining a detectable, channelized pedestrian route is much more useful to pedestrians who have visual disabilities than closing a walkway and providing audible directions to an alternate route involving additional crossings and a return to the original route. Braille is not useful in conveying such information because it is difficult to find. Audible instructions might be provided, but the extra distance and additional street crossings might add complexity to a trip.

Guidance:

Fencing should not create sight distance restrictions for road users. Fences should not be constructed of materials that would be hazardous if impacted by vehicles.

Wooden railing, fencing, and similar systems placed immediately adjacent to motor vehicle traffic should not be used as substitutes for crashworthy temporary traffic barriers.

Standard:

TTC devices used to delineate a TTC zone pedestrian walkway shall be crashworthy and, when struck by vehicles, present a minimum threat to pedestrians, workers, and occupants of impacting vehicles.

Guidance:

Ballast for TTC devices should be kept to the minimum amount needed and should be mounted low to prevent penetration of the vehicle windshield.

Movement by work vehicles and equipment across designated pedestrian paths should be minimized and, when necessary, should be controlled by flaggers or TTC. Staging or stopping of work vehicles or equipment along the side of pedestrian paths should be avoided, since it encourages movement of workers, equipment, and materials across the pedestrian path.

Access to the work space by workers and equipment across pedestrian walkways should be minimized because the access often creates unacceptable changes in grade, and rough or muddy terrain, and pedestrians will tend to avoid these areas by attempting nonintersection crossings where no curb ramps are available.

Option:

A canopied walkway may be used to protect pedestrians from falling debris, and to provide a covered passage for pedestrians.

Guidance:

Covered walkways should be sturdily constructed and adequately lighted for nighttime use.

When pedestrian and vehicle paths are rerouted to a closer proximity to each other, consideration should be given to separating them by a temporary traffic barrier.

If a temporary traffic barrier is used to shield pedestrians, it should be designed to accommodate site conditions.

Support:

Depending on the possible vehicular speed and angle of impact, temporary traffic barriers might deflect upon impact by an errant vehicle. Guidance for locating and designing temporary traffic barriers can be found in Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11).

Standard:

Short intermittent segments of temporary traffic barrier shall not be used because they nullify the containment and redirective capabilities of the temporary traffic barrier, increase the potential for serious injury both to vehicle occupants and pedestrians, and encourage the presence of blunt, leading ends. All upstream leading ends that are present shall be appropriately flared or protected with properly installed and maintained crashworthy cushions. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly.

Normal vertical curbing shall not be used as a substitute for temporary traffic barriers when temporary traffic barriers are clearly needed.

Option

Temporary traffic barriers or longitudinal channelizing devices may be used to discourage pedestrians from unauthorized movements into the work space. They may also be used to inhibit conflicts with vehicular traffic by minimizing the possibility of midblock crossings.

Support:

A major concern for pedestrians is urban and suburban building construction encroaching onto the contiguous sidewalks, which forces pedestrians off the curb into direct conflict with moving vehicles.

Guidance:

If a significant potential exists for vehicle incursions into the pedestrian path, pedestrians should be rerouted or temporary traffic barriers should be installed.

Support:

TTC devices, jersey barriers, and wood or chainlink fencing with a continuous detectable edging can satisfactorily delineate a pedestrian path.

Guidance:

Tape, rope, or plastic chain strung between devices are not detectable, do not comply with the design standards in the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (see Section 1A.11), and should not be used as a control for pedestrian movements.

The extent of pedestrian needs should be determined through engineering judgment for each TTC zone situation. In general, pedestrian routes should be preserved in urban and commercial suburban areas. Alternative routing should be discouraged.

Standard:

The highway agency or municipality in charge of the TTC zone shall regularly inspect the activity area so that effective pedestrian TTC is maintained.

Section 6D.02 Accessibility Considerations

Support:

Additional information on the design and construction of accessible temporary facilities is found in publications listed in Section 1A.11 of the MUTCD (see Documents 10 and 29 through 31).

Guidance:

The extent of pedestrian needs should be determined through engineering judgment or by the individual responsible for each TTC zone situation. This individual should be aware that the absence of a continuous pathway, including curb ramps and other accessible features, might preclude the use of the facility by pedestrians with disabilities.

Standard:

When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility.

Guidance:

To accommodate the needs of pedestrians, including those with disabilities, the following considerations should be addressed when temporary pedestrian pathways in TTC zones are designed or modified:

A. *Provisions for continuity of accessible paths for pedestrians should be incorporated into the TTC process. Pedestrians should be provided with a reasonably safe, convenient, and accessible path that replicates as much as practical the desirable characteristics of the existing pedestrian facilities.*
B. *Access to temporary transit stops should be provided.*
C. *Blocked routes, alternate crossings, and sign and signal information should be communicated to pedestrians with visual disabilities by providing devices such as audible information devices, accessible pedestrian signals, or barriers and channelizing devices that are detectable to the pedestrians traveling with the aid of a long cane or who have low vision. Where pedestrian traffic is detoured to a TTC signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals should be considered for crossings along an alternate route.*
D. *When channelization is used to delineate a pedestrian pathway, a continuous detectable edging should be provided throughout the length of the facility such that pedestrians using a long cane can follow it. These detectable edgings should adhere to the provisions of Section 6F.68.*
E. *A smooth, continuous hard surface should be provided throughout the entire length of the temporary pedestrian facility. There should be no curbs or abrupt changes in grade or terrain that could cause tripping or be a barrier to wheelchair use. The geometry and alignment of the facility should meet the applicable requirements of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (see Section 1A.11).*
F. *The width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility. When it is not possible to maintain a minimum width of 60 inches throughout the entire length of the pedestrian pathway, a 60 inch x 60 inch passing space should be provided at least every 200 feet, to allow individuals in wheelchairs to pass.*
G. *Signs and other devices mounted lower than 7 feet above the temporary pedestrian pathway should not project more than 4 inches into accessible pedestrian facilities.*

Section 6D.03 Worker Safety Considerations

Support:

Equally as important as the safety of road users traveling through the TTC zone is the safety of workers. TTC zones present temporary and constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for workers on or near the roadway.

Maintaining TTC zones with road user flow inhibited as little as possible, and using TTC devices that get the road user's attention and provide positive direction are of particular importance. Likewise, equipment and vehicles moving within the activity area create a risk to workers on foot. When possible, the separation of moving equipment and construction vehicles from workers on foot provides the operator of these vehicles with a greater separation clearance and improved sight lines to minimize exposure to the hazards of moving vehicles and equipment.

Guidance:

The following are the key elements of worker safety and TTC management that should be considered to improve worker safety:

A. *Training—all workers should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, placement, and TTC review. Training should be conducted on a continual basis.*
B. *Worker Safety Apparel—all workers exposed to the risks of moving roadway traffic or construction equipment should wear high-visibility safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Safety Apparel" (see Section 1A.11), or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 1, 2, or 3 risk exposure. A competent person designated by the employer to be responsible for the worker safety plan within the activity area of the job site should make the selection of the appropriate class of garment (see standard below for clothing requirement when working in/near traffic).*
C. *Temporary Traffic Barriers—temporary traffic barriers should be placed along the work space depending on factors such as lateral clearance of workers from adjacent traffic, speed of traffic, duration and type of operations, time of day, and volume of traffic (see Appendix A, Guidelines for Use of Barrier/Channelization Devices).*
D. *Speed Reduction—reducing the speed of vehicular traffic, mainly through regulatory speed zoning, funneling, lane reduction, or the use of uniformed law enforcement officers or flaggers, should be considered where applicable.*
E. *Activity Area—planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the exposure to risk.*
F. *Use of shadow vehicles equipped with appropriate lights and warning signs should be used for mobile and constantly moving operations, such as pothole patching and striping operations, to protect the workers from impacts by errant vehicles. (See section 6F.83 for Truck Mounted Attenuator requirements)*
G. *Worker Safety Planning—a competent person designated by the employer should conduct a basic hazard assessment for the work site and job classifications required in the activity area. This safety professional should determine whether engineering, administrative, or personal protection measures should be implemented. This plan should be in accordance with the Occupational Safety and Health Act of 1970, as amended, "General Duty Clause" Section 5(a)(1) - Public Law 91-596, 84 Stat. 1590, December 29, 1970, as amended, and with the requirement to assess worker risk exposures for each job site and job classification, as per 29 CFR 1926.20 (b)(2) of "Occupational Safety and Health Administration Regulations, General Safety and Health Provisions " (see Section 1A.11of the MUTCD).*

Standard:

Beginning January 1, 2007, workers shall wear safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel" (see Section 1A.11 of the MUTCD) and labeled as meeting the ANSI 107-2004 standard performance for Class 2 risk exposure. The apparel background (outer) material shall be either fluorescent orange-red or fluorescent yellow-green as defined in 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 feet. The retroreflective clothing shall be designed to clearly identify the wearer as a person.

Guidance:

Until January 1, 2007, all workers should wear an orange, yellow, or yellow-green (or fluorescent versions of these colors) shirt, vest, or jacket for daytime work.

Standard:

Until January 1, 2007, nighttime work outside garments similar to daytime garments shall be worn and retro-reflective. The retro-reflective material shall be orange, yellow, white, silver, yellow green, or a fluorescent version of one of these colors and shall be visible at a minimum distance of 1000 feet. The retro-reflective clothing shall be designed to clearly identify the wearer as a person.

Option:

The following are additional elements of TTC management that may be considered to improve worker safety:

A. Road Closure—if alternate routes are available to handle road users, the road may be closed temporarily. This may also facilitate project completion and thus further reduce worker vulnerability.
B. Law Enforcement Use—in highly vulnerable work situations, particularly those of relatively short duration, law enforcement units may be stationed to heighten the awareness of passing vehicular traffic and to improve safety through the TTC zone.
C. Lighting—for nighttime work, the TTC zone and approaches may be lighted.
D. Special Devices—these include rumble strips, changeable message signs, hazard identification beacons, flags, and warning lights. Intrusion warning devices may be used to alert workers to the approach of errant vehicles.

Support:

Judicious use of the special devices described in Item E above might be helpful for certain difficult TTC situations, but misuse or overuse of special devices or techniques might lessen their effectiveness.

CHAPTER 6E. FLAGGER CONTROL

Section 6E.01 Qualifications for Flaggers

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

A flagger shall be a person who provides TTC.

A flagger shall be certified in flagging and shall have his/her certification card with them at all time while performing flagging activities.

Guidance:

Because flaggers are responsible for public safety and make the greatest number of contacts with the public of all highway workers, they should be trained in safe traffic control practices and public contact techniques. Flaggers should be able to satisfactorily demonstrate the following abilities:

A. *Ability to receive and communicate specific instructions clearly, firmly, and courteously;*
B. *Ability to move and maneuver quickly in order to avoid danger from errant vehicles;*
C. *Ability to control signaling devices (such as paddles and flags) in order to provide clear and positive guidance to drivers approaching a TTC zone in frequently changing situations;*
D. *Ability to understand and apply safe traffic control practices, sometimes in stressful or emergency situations; and*
E. *Ability to recognize dangerous traffic situations and warn workers in sufficient time to avoid injury.*

Standard:

Flaggers shall speak only English while performing their job duty as a flagger at the flagger station.

Since a flagger can be held responsible for their actions, the flagger shall be a minimum of 18 years old.

Guidance:

To assure that a fully alert flagger is present at the flagger station, flaggers should be relieved for a minimum period of fifteen minutes every two hours.

Section 6E.02 High-Visibility Safety Apparel

Standard:

The flagger shall remain fully clothed, from neck to feet, when flagging. This includes the wearing of shirts with sleeves (at least short sleeves in length), long pants, OSHA approved hardhats and steel toe safety shoes. Prior to January 1, 2007, for daytime work, the flagger's vest, shirt, or jacket shall be either orange, yellow, yellow-green, or a fluorescent version of these colors. For nighttime work, similar outside garments shall be retroreflective. 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 ft. The retroreflective clothing shall be designed to clearly identify the wearer as a person.

Beginning January 1, 2007, for daytime activities, flaggers shall wear safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel" (see Section 1A.11 of the MUTCD) and labeled as meeting the ANSI107-2004 standard performance for Class 2 risk exposure. The apparel background (outer) material color shall be either fluorescent orange-red or fluorescent yellow-green as defined in 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 feet. The retroreflective safety apparel shall be designed to clearly identify the wearer as a person.

For nighttime activities beginning January 1, 2007, safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Apparel" (see Section 1A.11 of the MUTCD) and labeled as meeting the ANSI 107-2004 standard performance for Class 3 risk exposure shall be worn by flaggers.

Guidance:

When uniformed law enforcement officers are used, high-visibility safety apparel as described in this Section should be worn by the law enforcement officer.

Section 6E.03 Hand-Signaling Devices

Support:

Hand-signaling devices, such as STOP/SLOW paddles, lights, and red flags, are used to control road users through TTC zones.

Standard:

The STOP/SLOW paddle shall be the primary hand-signaling device because the STOP/SLOW paddle gives road users more positive guidance than red flags.

Guidance:

Use of flags should be limited to emergency (non-planned) situations and use by traffic spotters on low volume, low speed streets.

Standard:

The STOP/SLOW paddle shall have an octagonal shape on a rigid handle. STOP/SLOW paddles shall be at least 24 inch wide with letters at least 8 inch high and should be fabricated from light semirigid material. The background of the STOP face shall be red with white letters and border and made of encapsulated lens sheeting material. The background of the SLOW face shall be fluorescent orange prismatic lens sheeting material with black letters and border.

Option:

The STOP/SLOW paddle may be modified to improve conspicuity by incorporating either white or red flashing lights on the STOP face, and either white or yellow flashing lights on the SLOW face. The flashing lights may be arranged in any of the following patterns:

A. Two white or red lights, one centered vertically above and one centered vertically below the STOP legend; and/or two white or yellow lights, one centered vertically above and one centered vertically below the SLOW legend; or
B. Two white or red lights, one centered horizontally on each side of the STOP legend; and/or two white or yellow lights, one centered horizontally on each side of the SLOW legend; or
C. One white or red light centered below the STOP legend; and/or one white or yellow light centered below the SLOW legend; or
D. A series of eight or more small white or red lights no larger than 0.25 inch in diameter along the outer edge of the paddle, arranged in an octagonal pattern at the eight corners of the border of the STOP face; and/or a series of eight or more small white or yellow lights no larger than 0.25 inch in diameter along the outer edge of the paddle, arranged in a diamond pattern along the border of the SLOW face.
E. A series of white lights forming the shapes of the letters in the legend.

The size of STOP/SLOW paddles may be reduced to 18 inch wide with letters at least 6 inch high if flashing lights as described above are incorporated.

Standard:

If flashing lights are used on the STOP face of the paddle, their colors shall be all white or all red. If flashing lights are used on the SLOW face of the paddle, their colors shall be all white or all yellow.

If more than eight flashing lights are used, the lights shall be arranged such that they clearly convey the octagonal shape of the STOP face of the paddle and/or the diamond shape of the SLOW face of the paddle.

If flashing lights are used on the STOP/SLOW paddle, the flash rate shall be at least 50, but not more than 60, flashes per minute.

Flags, when used, shall be a minimum of 24 inch square, made of a good grade of red material, and securely fastened to a staff that is approximately 36 inch in length.

Guidance:

The free edge of a flag should be weighted so the flag will hang vertically, even in heavy winds.

Standard:

When used at nighttime, flags shall be retroreflectorized red.

Option:

For surveying and other operations occurring on the shoulder or near the centerline of two-lane roadways, a combination STOP/SLOW paddle and SLOW/SLOW paddle utilizing a double sided SLOW flip panel may be used to prevent unnecessary stopping of vehicles by the flagger.

Section 6E.04 Flagger Procedures

Support:

The use of paddles and flags by flaggers is illustrated in Figure 6E-1.

Standard:

The following methods of signaling with paddles shall be used:

A. To stop road users, the flagger shall face road users and aim the STOP paddle face toward road users in a stationary position with the arm extended horizontally away from the body. The free arm shall be held with the palm of the hand above shoulder level toward approaching traffic.

B. To direct stopped road users to proceed, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body. The flagger shall motion with the free hand for road users to proceed.

C. To alert or slow traffic, the flagger shall face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body.

Option:

To further alert or slow traffic, the flagger holding the SLOW paddle face toward road users may motion up and down with the free hand, palm down.

Standard:

The following methods of signaling with a flag shall be used:

A. To stop road users, the flagger shall face road users and extend the flag staff horizontally across the road users' lane in a stationary position so that the full area of the flag is visibly hanging below the staff. The free arm shall be held with the palm of the hand above the shoulder level toward approaching traffic.

B. To direct stopped road users to proceed, the flagger shall stand parallel to the road user movement and with flag and arm lowered from the view of the road users, and shall motion with the free hand for road users to proceed. Flags shall not be used to signal road users to proceed.

C. To alert or slow traffic, the flagger shall face road users and 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. The flagger shall keep the free hand down.

Section 6E.05 Flagger Stations

Standard:

Flagger stations shall be located such that approaching road users will have sufficient distance to stop at an intended stopping point.

Option:

The distances shown in Table 6E-1, which provides information regarding the stopping sight distance as a function of speed, may be used for the location of a flagger station. These distances may be increased for downgrades and other conditions that affect stopping distance.

Guidance:

Flagger stations should be located such that an errant vehicle has additional space to stop without entering the work space.

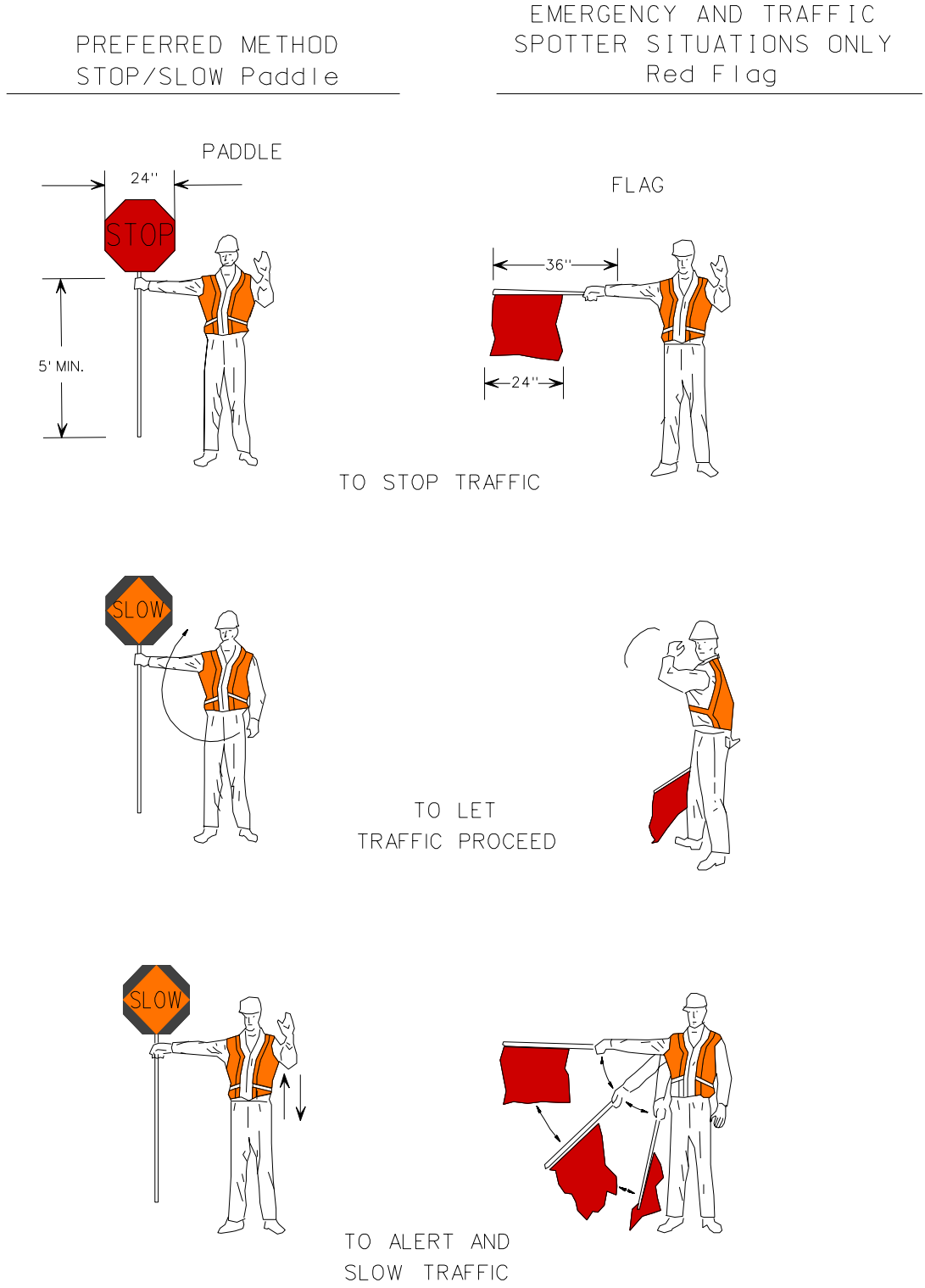


FIGURE 6E-1 USE OF HAND SIGNALING DEVICES BY FLAGGER

Standard:

Except in emergency situations, flagger stations shall be preceded by an advance warning sign or signs. Except in emergency situations, flagger stations shall be illuminated at night with a minimum of horizontal luminance of 5-foot candles (50 lux).

Guidance:

The flagger should stand either on the shoulder adjacent to the road user being controlled or in the closed lane prior to stopping road users. A flagger should only stand in the lane being used by moving road users after road users have stopped. The flagger should be clearly visible to the first approaching road user at all times. The flagger also should be visible to other road users. The flagger should be stationed sufficiently in advance of the workers to warn them (for example, with audible warning devices such as horns or whistles) of approaching danger by out-of-control vehicles.

The flagger should stand in a location that provides a readily escape route if approached by an errant vehicle. The flagger should always pay attention to approaching motorists, and anticipate the need to make an evasive maneuver if approached by an errant vehicle, or communicate a warning to the workers in the activity area to warn of a vehicle coming through the TTC zone.

Standard:

The flagger shall stand alone, never permitting a group of workers to congregate around the flagger station. Vehicles and equipment shall not be allowed around the flagger station, which can interfere with the visibility of the flagger to approaching motorist.

When the flagger is no longer at the flagger station performing flagging duties, the advance warning signs advising of flagging operations shall be removed.

Option:

If work and/or equipment is still in the area, the ROAD WORK AHEAD sign may remain.

At a spot constriction, the flagger may have to take a position on the shoulder opposite the closed section in order to operate effectively.

At spot lane closures where adequate sight distance is available for the reasonably safe handling of traffic, the use of one flagger may be sufficient.

Posted Speed (mph)	Distance (feet)
≤ 20	115 - 125
25	155 - 165
30	200 - 210
35	250 - 260
40	305 - 320
45	360 - 375
50	425 - 440
55	500 - 520
60	570 - 590

TABLE 6E-1, Distance of Flagger Station in Advance of the Work Space

Section 6E.06 Traffic Spotters

Support:

A traffic spotter's primary function is to alert and assist motorists through temporary traffic control zones on low volume (under 500 VPD), low speed subdivision streets.

Standard:

Qualifications, clothing requirements and hand signaling procedures for traffic spotters shall be the same as for flaggers. Hand signaling devices for traffic spotters shall be a red flag a minimum of 24 inches square fastened to a staff that is approximately 36 inches in length.

Guidance:

The location of the traffic spotter should be where he is visible and capable of directing traffic from both directions.

Standard:

The ROAD WORK AHEAD sign shall be the minimum sign requirement for traffic spotters.

Option:

Additional signing and other traffic control devices may be required depending on the type and visibility of the operation.

CHAPTER 6F. TEMPORARY TRAFFIC CONTROL ZONE DEVICES

Section 6F.01 Types of Devices

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Guidance:

The design and application of TTC devices used in TTC zones should consider the needs of all road users (motorists, bicyclists, and pedestrians), including those with disabilities. The special needs and control of motorcyclists should also be considered through a TTC zone.

Support:

FHWA policy requires that all roadside appurtenances such as traffic barriers, barrier terminals and crash cushions, bridge railings, sign and light pole supports, and work zone hardware used on the National Highway System meet the crashworthy performance criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features". The FHWA website at "http://safety.fhwa.dot.gov/programs/roadside_hardware.htm" identifies all such hardware and includes copies of FHWA acceptance letters for each of them. In the case of proprietary items, links are provided to manufacturers' websites as a source of detailed information on specific devices. The website also contains an "Ask the Experts" section where questions on roadside design issues can be addressed. A listing of VDOT approved devices for use on state maintained roadways is also available on VDOT's web site at VirginiaDOT.org, Business Center, Location and Design Division.

Crashworthiness and crash testing information on devices described in Part 6 are found in AASHTO's "Roadside Design Guide" (see Section 1A.11 of the MUTCD).

As stated in Definition 5 in Section 6A.02 of this manual, "crashworthy" is a characteristic of a roadside appurtenance that has been successfully crash tested in accordance with a national standard such as the National Cooperative Highway Research Program Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Standard:

Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide road users, placed on, over, or adjacent to a street, highway, pedestrian facility, or bikeway by authority of a public body or official having jurisdiction.

All traffic control devices used on street and highway construction, maintenance, utility, or incident management operations shall conform to the applicable provisions of this Manual.

Section 6F.02 General Characteristics of Signs

Support:

TTC zone signs convey both general and specific messages by means of words or symbols and have the same three categories as all road user signs: regulatory, warning, and guide.

Standard:

The colors for regulatory signs shall follow the Standards for regulatory signs in Table 2A-4 and Chapter 2B of the MUTCD. Warning signs in TTC zones shall have a black legend and border on an orange background, except for the Highway-Rail Grade Crossing Advance Warning (W10-1) sign which shall have a black legend and border on a yellow background, and except for signs that are permitted in Parts 2 or 7 to have fluorescent yellow-green backgrounds. Colors for guide signs shall follow the Standards in Table 2A-4 and Chapter 2D of the MUTCD, except for guide signs as noted in Section 6F.50.

Standard:

Reflective sheeting used on orange construction and maintenance activity signs shall be fluorescent prismatic lens type conforming to Section 247 of the Virginia Road and Bridge Specifications.

Support:

The fluorescent versions of orange provide higher conspicuity than standard orange, especially during twilight.

Option:

Warning and guide signs used for TCC incident management situations (see Chapter 6I) may have a black legend and border on a fluorescent pink background.

Existing warning signs that are still applicable may remain in place.

In order to maintain the systematic use of yellow or fluorescent yellow-green backgrounds for pedestrian, bicycle, and school warning signs in a jurisdiction, the yellow or fluorescent yellow-green background for pedestrian, bicycle, and school warning signs may be used in TTC zones.

Standard orange flags or flashing warning lights may be used in conjunction with signs.

Standard:

When standard orange flags or flashing warning lights are used in conjunction with signs, they shall not block the sign face.

Guidance:

Signs used for advance warning should be 48 inch by 48 inch, unless prevented by right-of-way restrictions or approved by the District Traffic Engineer.

Option:

The dimensions of signs shown in the typical traffic control figures in section 6H may be increased wherever necessary for greater legibility or emphasis, such as on freeways and expressways.

Standard:

Deviations from standard sizes as prescribed herein shall be in 6 inch increments.

Support:

Sign design details are contained in the "Standard Highway Signs" book (see Section 1A.11 of the MUTCD).

Standard:

All signs used during day and night shall be retroreflective with a material that has a smooth, sealed outer surface. Non retro-reflective signs, such as mesh signs, shall not be allowed due to fading, sunlight shining through, and improper use during hours of darkness.

Option:

Signs may be made of rigid or flexible material.

Guidance:

Advance warning signs used during night hours should be reviewed on a periodic basis during the shift to ensure moisture/condensation has not obscured the retro-reflectivity or visibility of the sign text.

Standard:

Post-mounted signs shall be made of rigid material. Sign substrates for signs mounted on plastic drums, Type III barricades, and portable sign stands shall be either a flexible retroreflective roll-up material, or a 0.4 inch thick corrugated polypropylene or polyethylene plastic material, or a 0.079 inch thick aluminum/plastic laminate material, and shall be the same material that was used when the device was tested and found compliance with NCHRP-350, Test Level 3 requirements.

Section 6F.03 Sign Placement

Guidance:

Signs should be located on the right side of the roadway unless otherwise specified in this Manual.

Standard:

On any roadway having a median wider than 8 foot, left and right sign assemblies shall be used unless otherwise specified in this Manual.

Option:

Signs may be mounted on or above type III barricades.

Support:

The Provisions of this section regarding mounting height apply unless specifically stated otherwise for a particular sign elsewhere in this Manual.

Guidelines for height and lateral clearance of temporary ground-mounted signs are shown in Figure 6F-1.

Standard:

Ground-mounted signs installed at the side of the road in rural areas shall be mounted at a height at least 7 foot, measured from the bottom of the sign to the near edge of the pavement. In business, commercial, and residential districts where parking and/or bicycle or pedestrian movement is likely to occur, or where there are other obstructions to view, the distance between the bottom of the sign and the top of the near edge of the traveled way shall be at least 7 feet.

Ground-mounted sign panels shall be securely fastened to posts or supports and erected plumb and maintained in plumb condition.

Signs mounted on barricades and barricade/sign combinations shall be crashworthy.

Where it has been determined that the accommodation of pedestrians with disabilities is necessary, signs shall be mounted and placed in accordance with Section 4.4 of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (see Section 1A.11 of the MUTCD).

Guidance:

Neither portable nor permanent sign supports should be located on sidewalks, bicycle facilities, or areas designated for pedestrian or bicycle traffic. Signs mounted lower than 7 feet should not project more than 4 inches into pedestrian facilities.

Option:

The height to the bottom of a secondary sign mounted below another sign may be 1 foot less than the appropriate height specified above.

Guidance:

Except as noted in the Option below, signs mounted on portable supports should not be used for a duration of more than 3 consecutive days (72 hours).

Option:

The R9-8 through R9-11a series, R11 series, W1-6 through W1-8 series, M4-10, E5-1, or other similar type signs (see Figures 6F-3a through 3f) may be used on portable supports for longer than 3 days.

Guidance:

The legs of portable sign supports should be as flush as possible to the ground or roadway surface for stability.

Signs mounted on Type III barricades should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails.

Standard:

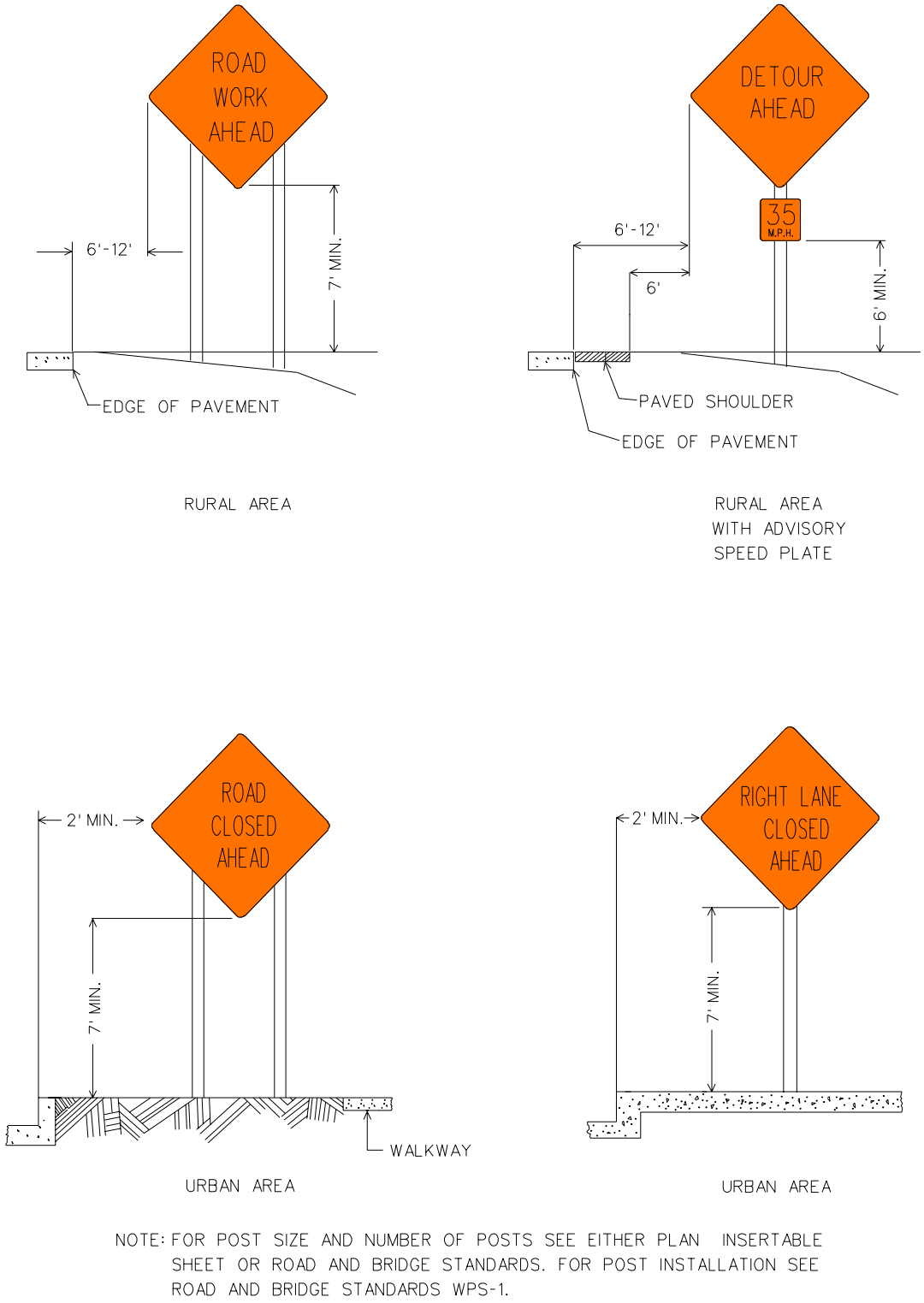
Sign supports shall be crashworthy. Large signs having an area exceeding 50 square feet that are installed on multiple breakaway posts shall be mounted a minimum of 7 feet above the ground.

Signs mounted on barricades, or other portable supports, shall be no less than 1 foot above the traveled way from the bottom of the sign.

Portable stands shall be self-erecting and meet the following conditions: accommodate signs of all standard shapes, including octagonal and triangular, have adjustable legs capable of adjusting to uneven surfaces, and while supporting a 16 square foot rigid sign panel, the stand shall withstand 50 MPH winds

without tipping over or rotating more than + 5 degrees about its vertical axis without the use of tie downs or ballast of any kind. The complete unit shall not exceed 40 pounds. The unit shall include decals, stenciling, or some other durable marking system that indicates the manufacturer and model number of the stand. The unit shall meet NCHRP 350 crashworthy standards.

Tripod type portable sign stands shall not be used on any roadway.



NOTE: FOR POST SIZE AND NUMBER OF POSTS SEE EITHER PLAN INSERTABLE SHEET OR ROAD AND BRIDGE STANDARDS. FOR POST INSTALLATION SEE ROAD AND BRIDGE STANDARDS WPS-1.

FIGURE 6F-1, HEIGHT AND LATERAL LOCATION OF SIGNS-TYPICAL POST MOUNT INSTALLATIONS

Option:

For mobile operations, a sign may be mounted on a work vehicle, a shadow vehicle, or a static portable sign stand in advance of the TTC zone, or moving along with it.

Guidance:

Unshielded sign posts placed in the clear zone should yield or breakaway upon impact to minimize obstructions to road users.

Support:

If alterations are made to specific traffic control device supports that have been successfully crash tested in accordance with NCHRP Report 350, the altered supports might not be considered to be crashworthy.

Standard:

When construction signs are covered to prevent the display of the message, the entire sign (not just the text) shall be covered with a breathable material approved by the Department or plywood per current VDOT specifications such that no portion of the message side of the sign shall be visible. Plywood shall be used on ground-mounted construction signs only, and not on overhead signs. Attachment methods used to attach the covering material to the signs shall be of a durable construction that will prevent the unintentional detachment of the material from the sign.

At no times shall a construction sign and/or post be rotated to prevent the display of the message. In addition, the posts where the signs are being covered shall have two ED-3, Type II delineators mounting vertically on the post below the signs at a height of 4 feet to the top of the topmost delineator. The bottom delineator shall be mounted 6 inches below the bottom of the top delineator.

Section 6F.04 Sign Maintenance

Standard:

Signs shall be properly maintained for cleanliness, visibility, and correct positioning.

Signs that have lost significant legibility shall be promptly replaced in accordance with the American Traffic Safety Service Association's (ATSSA) "Quality Standards For Work Zone Traffic Control Devices" publication.

Section 6F.05 Regulatory Sign Authority

Support:

Regulatory signs such as those shown in Figure 6F-2a, b, and c inform road users of traffic laws or regulations and indicate the applicability of legal requirements that would not otherwise be apparent.

Standard:

Regulatory signs impose legal obligations on all drivers, and they shall be authorized by the District Traffic Engineer or an official having jurisdiction and shall conform to Chapter 2B of the MUTCD.

Section 6F.06 Regulatory Sign Design

Standard:

TTC regulatory signs shall conform to the Standards for regulatory signs presented in Part 2 of the MUTCD and in the FHWA's "Standard Highway Signs" book (see Section 1A.11 of the MUTCD).

Support:

Regulatory signs are generally rectangular with a black legend and border on a white background. Exceptions include the STOP, YIELD, DO NOT ENTER, WRONG WAY, and ONE WAY signs.

Option:

The ONE WAY sign may be either a horizontal or vertical rectangular sign.

Section 6F.07 Regulatory Sign Applications

Standard:

If a TTC zone requires regulatory measures different from those existing, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary regulatory

signs. This change shall be made in conformance with applicable ordinances or statutes of the jurisdiction as well as comply with the sign design standards of the MUTCD.

Section 6F.08 ROAD (STREET) CLOSED Sign (R11-2)

Guidance:

The ROAD (STREET) CLOSED (R11-2) sign (see Figure 6F-2a) should be used when the roadway is closed to all road users except contractors' equipment or officially authorized vehicles. The R11-2 sign should be accompanied by appropriate warning and detour signing.

Option:

The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for ROAD (STREET) CLOSED where applicable.

Guidance:

The ROAD (STREET) CLOSED sign should be installed at or near the center of the roadway on or above a Type III barricade that closes the roadway (see Section 6F.63).

Standard:

The ROAD (STREET) CLOSED sign shall not be used where road user flow is maintained or where the actual closure is some distance beyond the sign.

Section 6F.09 Local Traffic Only Signs (R11-3a, R11-4)

Guidance:

The Local Traffic Only signs should be used where road user flow detours to avoid a closure some distance beyond the sign, but where local road users can use the roadway to the point of closure. These signs should be accompanied by appropriate warning and detour signing.

In rural applications, the Local Traffic Only sign (see Figure 6F-2c) should have the legend ROAD CLOSED XX MILES AHEAD, LOCAL TRAFFIC ONLY (R11-3a).

Option:

In urban areas, the legend ROAD (STREET) CLOSED TO THRU TRAFFIC (R11-4) or ROAD CLOSED, LOCAL TRAFFIC ONLY may be used.

The words BRIDGE OUT (or BRIDGE CLOSED) may be substituted for the words ROAD (STREET) CLOSED on the R11-3a or R11-4 sign where applicable.

Section 6F.10 Weight Limit Signs (R12-1, R12-2, R12-5)

Standard:

A Weight Limit sign which shows the gross weight or axle weight that is permitted on the roadway or bridge, shall be consistent with State or local regulations and shall not be installed without the approval of the authority having jurisdiction over the highway.

When weight restrictions are imposed because of the activity in a TTC zone, a marked detour shall be provided for vehicles weighing more than the posted limit.

Section 6F.11 STAY IN LANE Sign (R4-9)

Option:

A STAY IN LANE (R4-9) sign (see Figure 6F-2c) may be used where a multi-lane shift has been incorporated as part of the TTC on a highway to direct road users around road work that occupies part of the roadway on a multi-lane highway. It may also be used in pavement milling and paving operations to direct road users through areas with lane differentials of 2 inches or less in depth.

Section 6F.12 PEDESTRIAN CROSSWALK Sign (R9-8)

Option:

The PEDESTRIAN CROSSWALK (R9-8) sign may be used to indicate where a temporary crosswalk has been established.

R3-1
24" x 24"

R3-2
24" x 24"

R3-3
24" x 24"

R3-4
24" x 24"

R9-8
24" x 12"

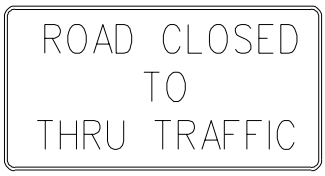
R9-11
24" x 12"

R9-11a
24" x 12"

R9-9
24" x 12"

R9-10
24" x 12"

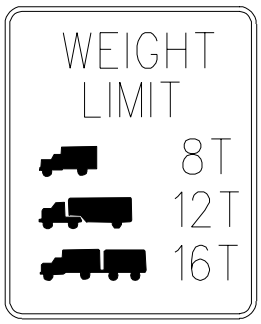
R11-2
48" x 30"



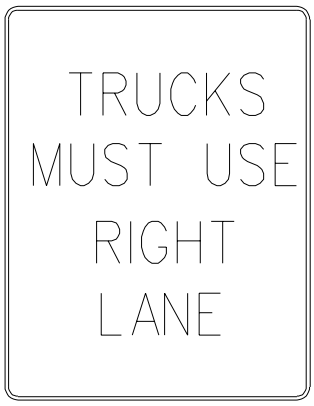
R11-4
60" x 30"

R12-1
24" x 30"

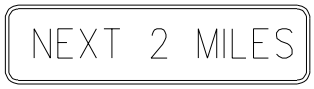
R12-2
24" x 30"



R12-5
30" x 36"



VR-26
48" x 60"



VR-27
48" x 12"

FIGURE 6F-2a, COMMONLY USED REGULATORY SIGNS

R1-1
30" x 30"

R1-2
36" x 36" x 36"

R5-1
30" x 30"

R5-1A
36" x 24"

R2-5a
24" x 30"

R2-5b
24" x 30"

R2-5c
24" x 30"

R2-1
24" x 30"

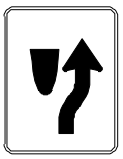
R8-3a
24" x 24"

VR-9L
48" x 48"

VR-9R
48" x 48"

R6-1
36" x 12"

R6-2
18" x 24"



R4-7
24" x 30"

R4-1
24" x 30"

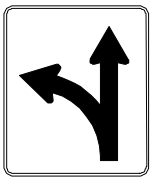
R4-2
24" x 30"

FIGURE 6F-2b, COMMONLY USED REGULATORY SIGNS

R1-2a
24" x 18"

R2-6
24" x 18"

R3-5
30" x 36"



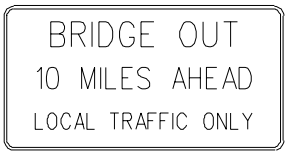
R3-6
30" x 36"

R3-7
30" x 30"

R3-8
30" x 30"

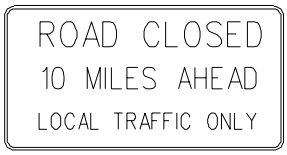
R3-18
30" x 30"

R4-9
48" X 60"



R11-3a
60" x 30"

OR



R11-3a
60" x 30"

FIGURE 6F-2c, COMMONLY USED REGULATORY SIGNS

Standard:

If a temporary crosswalk is established, it shall be accessible to pedestrians with disabilities in accordance with Section 6D.02.

Section 6F.13 SIDEWALK CLOSED Signs (R9-9, R9-10, R9-11, R9-11a)

Guidance:

SIDEWALK CLOSED signs (see Figure 6F-2a), should be used where pedestrian flow is restricted. Bicycle/Pedestrian Detour (M4-9a) signs or Pedestrian Detour (M4-9b) signs should be used where pedestrian flow is rerouted (see Section 6F.53).

The SIDEWALK CLOSED (R9-9) sign should be installed at the beginning of the closed sidewalk, at the intersections preceding the closed sidewalk, and elsewhere along the closed sidewalk as needed.

The SIDEWALK CLOSED, (ARROW) USE OTHER SIDE (R9-10) sign should be installed at the beginning of the restricted sidewalk when a parallel sidewalk exists on the other side of the roadway.

The SIDEWALK CLOSED AHEAD, (ARROW) CROSS HERE (R9-11) sign should be used to indicate to pedestrians that sidewalks beyond the sign are closed and to direct them to open crosswalks, sidewalks, or other travel paths.

The SIDEWALK CLOSED, (ARROW) CROSS HERE (R9-11a) sign should be installed just beyond the point to which pedestrians are being redirected.

Support:

These signs are typically mounted on a detectable barricade to encourage compliance and to communicate with pedestrians that the sidewalk is closed. Printed signs are not useful to many pedestrians with visual disabilities. A barrier or barricade detectable by a person with a visual disability is sufficient to indicate that a sidewalk is closed. If the barrier is continuous with detectable channelizing devices for an alternate route, accessible signage might not be necessary. An audible information device is needed when the detectable barricade or barrier for an alternate channelized route is not continuous.

Section 6F.14 Special Regulatory Signs

Option:

Special regulatory signs may be used based on engineering judgment consistent with regulatory requirements as per the MUTCD.

Guidance:

Special regulatory signs should conform to the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.

Standard:

The FINES HIGHER (R2-6) plaque (see Figure 6F-2c) shall be used to advise road users when increased fines are imposed for traffic violations within designated TTC zones.

The FINES HIGHER plaque shall be mounted below an applicable regulatory speed limit sign in a temporary traffic control zone.

The FINES HIGHER plaque shall be a rectangle with a black legend and border on a white background.

All supplemental plaques mounted below the FINES HIGHER plaque shall be rectangles with black legends and borders on white backgrounds.

The FINES HIGHER plaque shall include a WORK ZONE plaque mounted above the applicable regulatory sign. The WORK ZONE supplemental plaque shall be rectangular in shape with a black legend and border on an orange background.

Guidance:

If used, the FINES HIGHER plaque should be located just beyond any interchanges, major intersections, or other major traffic generators and as close to the actual work as possible. Experience has shown that

compliance to reduced speed limit signs is greater if placed as close to the work as possible, as opposed to placement prior to the advance warning signs (ROAD WORK AHEAD, etc.).

Agencies should limit the use of the FINES HIGHER plaque to locations where work is actually underway, or to locations where the roadway, shoulder, or other conditions require a speed reduction or extra caution on the part of the road user.

Support:

Section 2B.17 of the MUTCD contains additional information regarding the use of FINES HIGHER signs.

Section 6F.15 Warning Sign Function, Design, and Application

Support:

TTC zone warning signs notify road users of specific situations or conditions on or adjacent to a roadway that might not otherwise be apparent.

Standard:

TTC warning signs shall conform to the Standards for warning signs presented in Part 2 of the MUTCD and in the FHWA's "Standard Highway Signs" book (see Section 1A.11 of the MUTCD). Except as noted in the Option below, TTC warning signs shall be diamond-shaped with a black legend and border on an fluorescent orange prismatic lens sheeting background, except for the W10-1 sign which shall have a black legend and border on a yellow background, and except for signs that are permitted in Parts 2 or 7 of the MUTCD to have fluorescent yellow-green backgrounds.

The District Traffic Engineer shall approve and document the use of reduced regulatory speed limits in TTC zones. Sign material shall conform to the latest Virginia Road and Bridge specifications and all revisions to such.

Option:

Warning signs used for TCC incident management situations may have a black legend and border on a fluorescent pink background.

Mounting or space considerations may justify a change from the standard diamond shape.

In emergencies, available warning signs having yellow backgrounds may be used if signs with orange or fluorescent pink backgrounds are not at hand.

Guidance:

Where roadway or road user conditions require greater emphasis, larger than standard size warning signs should be used, with the symbol or legend enlarged approximately in proportion to the outside dimensions.

Where any part of the roadway is obstructed or closed by work activities or incidents, advance warning signs should be installed to alert road users well in advance of these obstructions or restrictions.

Where road users include pedestrians, the provision of supplemental audible information or detectable barriers or barricades should be considered for people with visual disabilities.

Support:

Detectable barriers or barricades communicate very clearly to pedestrians who have visual disabilities that they can no longer proceed in the direction that they are traveling.

Option:

Advance warning signs may be used singly or in combination.

Standard:

Because of their importance, the size of diamond shaped TTC advance warning signs shall be a minimum of 48 x 48 inch.

Option:

Where right-of-way constraints prohibit the use of 48 x 48 inch signs, a minimum size of 36 x 36 inch may be used for advance warning signs.

Advance warning signs larger than the minimum standard of 48 x 48 inch may be used for additional emphasis of the TTC zone (see Part 2 of the MUTCD).

Where distances are not shown on warning signs as part of the message, a supplemental plaque with the distance legend may be mounted immediately below the sign on the same support.

Section 6F.16 Position of Advance Warning Signs

Guidance:

Where highway conditions permit, warning signs should be placed in advance of the TTC zone at varying distances depending on roadway type, condition, geometrics, sight distance, and posted speed. Sign spacing distance should be as shown in Table 6C-1, Spacing of Advance Warning Signs.

Option:

For urban streets with posted speeds of 25 mph or less, the sign spacing may be reduced to 100'-200'.

Support:

For urban conditions, it is generally better to place all advance warning signs within a one block area versus spreading out over several blocks.

Various conditions, such as limited sight distance or obstructions that might require a driver to reduce speed or stop, might require additional advance warning signs.

Guidance:

The word AHEAD should be used in place of a specific distance on advance warning signs in most applications.

Option:

Utility work, maintenance, or minor construction can occur within the TTC zone limits of a major construction project, and additional warning signs may be needed.

Guidance:

Utility, maintenance, and minor construction signing and TTC should be coordinated with appropriate authorities so that road users are not confused or misled by the additional TTC devices.

Section 6F.17 ROAD (STREET) WORK Sign (W21-4)

Guidance:

The ROAD (STREET) WORK (W21-4) sign (see Figure 6F-3a), which serves as a general warning of obstructions or restrictions, should be located in advance of the work space or any detour, on the road where the work is taking place.

Where traffic can enter a TTC zone from a crossroad or a major (high-volume) driveway, an advance warning sign should be used on the crossroad or major driveway.

Standard:

The ROAD (STREET) WORK (W21-4) sign shall have the legend ROAD (STREET) WORK AHEAD.

Option:

Other warning signs may be used in place of ROAD WORK AHEAD when appropriate such as MOWING AHEAD, SPRAYING AHEAD, BRIDGE WORK AHEAD, etc. based on the type of operation.

Support:

A variation of this sign is shown in the MUTCD as a W20-1, ROAD WORK XX FEET.

Section 6F.18 DETOUR Sign (W20-2)

Guidance:

The DETOUR (W20-2) sign (see Figure 6F-3a) should be used in advance of a road user detour over a different roadway or route.

Standard:

The DETOUR sign shall have the legend DETOUR AHEAD, or XX FEET, XX MILES.

Section 6F.19 ROAD (STREET) CLOSED Sign (W20-3)

Guidance:

The ROAD (STREET) CLOSED (W20-3) sign (see Figure 6F-3a) should be used in advance of the point where a highway is closed to all road users, or to all but local road users.

Standard:

The ROAD (STREET) CLOSED sign shall have the legend ROAD (STREET) CLOSED AHEAD, or XX FEET or XX MILES.

Section 6F.20 ONE LANE ROAD Sign (W20-4)

Standard:

The ONE LANE ROAD (W20-4) sign (see Figure 6F-3a) shall be used only in advance of that point where motor vehicle traffic in both directions must use a common single lane (see Section 6C.10). It shall have the legend ONE LANE ROAD AHEAD.

Section 6F.21 Lane(s) Closed Signs (W20-5, W20-5a)

Standard:

The Lane(s) Closed sign (see Figure 6F-3a) shall be used in advance of that point where one or more through lanes of a multi-lane roadway are closed.

For a single lane closure, the Lane Closed (W20-5) sign shall have the legend RIGHT (LEFT) LANE CLOSED AHEAD, or XX FEET, XX MILES when appropriate. Where two adjacent lanes are closed, the W20-5a sign shall have the legend RIGHT (LEFT) TWO LANES CLOSED AHEAD, or XX FEET, XX MILES.

Section 6F.22 CENTER LANE CLOSED AHEAD Signs (W9-3, W9-3a)

Guidance:

The CENTER LANE CLOSED AHEAD (W9-3) sign should be used in advance of that point where work occupies the center lane(s) and approaching motor vehicle traffic is directed to the right or left of the work zone in the center lane.

Option:

The Center Lane Closed Ahead (W9-3a) symbol sign may be substituted for the ENTER LANE CLOSED AHEAD (W9-3) word message sign.

Section 6F.23 THRU TRAFFIC MERGE LEFT (RIGHT) Sign (W4-7)

Guidance:

The THRU TRAFFIC MERGE LEFT (RIGHT) (W4-7) sign should be used in advance of an intersection where one or more lane closures on the far side of a multi-lane intersection require through vehicular traffic on the approach to the intersection to use the left (right) lane to proceed through the intersection. In addition, it should be placed in advanced of the RIGHT (LEFT) LANE MUST TURN RIGHT (LEFT) sign (R3-7).

Section 6F.24 Graphic Lane Ends Sign (W4-2R or 2L)

Standard:

The Graphic Lane Ends (W4-2) symbol sign (see Figure 6F-3b) shall be used to warn drivers of the reduction in the number of lanes for moving motor vehicle traffic in the direction of travel on a multi-lane roadway.

The new version of this sign (New W4-2) displaying skip lines shall be the only version used after December 31, 2008. Prior to that date, either of the versions of the sign (with or without skip lines) may be used, however, the use shall be consistent throughout a lane closure operation, and the different types shall not be mixed during use.

Section 6F.25 ON RAMP Plaque (W13-4)

Guidance:

When work is being done on a ramp, but the ramp remains open, the ON RAMP (W13-4) plaque should be used to supplement the advance ROAD WORK AHEAD sign.

Option:

A RAMP WORK AHEAD sign may be used in place of the ON RAMP sign.

Section 6F.26 RAMP NARROWS Sign (W5-4)

Guidance:

The RAMP NARROWS (W5-4) sign should be used in advance of the point where work on a ramp reduces the normal width of the ramp along a part or all of the ramp.

Section 6F.27 SLOW TRAFFIC AHEAD Sign (W23-1)

Option:

The SLOW TRAFFIC AHEAD (W23-1) sign (see Figure 6F-4, sheet 4 of 4 in the MUTCD) may be used on a shadow vehicle, usually mounted on the rear of the most upstream shadow vehicle, along with other appropriate signs for mobile operations to warn of slow moving work vehicles. A ROAD WORK AHEAD (W21-4) sign may also be used with the SLOW TRAFFIC AHEAD sign.

Section 6F.28 EXIT OPEN, EXIT CLOSED, EXIT ONLY Signs (E5-2, E5-2a, E5-3)

Option:

An EXIT OPEN (E5-2), EXIT CLOSED (E5-2a), or EXIT ONLY (E5-3) sign (see Figure 6F-3e) may be used to supplement other warning signs where work is being conducted in the vicinity of an exit ramp and where the exit maneuver for motor vehicle traffic using the ramp is different from the normal condition.

Guidance:

When an exit ramp is closed, an EXIT CLOSED panel with a black legend and border on an orange background should be placed diagonally across the interchange/intersection guide signs.

Section 6F.29 Flagger Symbol Sign (W20-7a)

Guidance:

The Flagger (20-7a) symbol sign (see Figure 6F-3a) should be used in advance of any point where a flagger is stationed to control road users.

Option:

A distance legend may be displayed on a supplemental plaque below the Flagger sign. The sign may be used with appropriate legends or in conjunction with other warning signs, such as the BE PREPARED TO STOP (VW-27) sign (see Figure 6F-3d).

Standard:

The Flagger sign shall be removed, covered, or turned away from road users when the flagging operations are not occurring.

Section 6F.30 Two-Way Traffic Sign (W6-3)

Guidance:

When one roadway of a normally divided highway is closed, with two-way vehicular traffic maintained on the other roadway, the Two-Way Traffic (W6-3) sign (see Figure 6F-3a) should be used at the beginning of the two-way vehicular traffic section and at intervals of at least one sign every two miles to remind road users of opposing vehicular traffic.

Section 6F.31 New Traffic Pattern Ahead Sign (VW-)

Option:

The NEW TRAFFIC PATTERN AHEAD sign (see Figure 6F-3c) may be used to indicate a change from the normal traffic pattern. The sign may be used with other warning signs, placed in advance of the changed condition.

Guidance:

To retain it's effectiveness, the sign should be displayed for up to two weeks, then covered or removed.

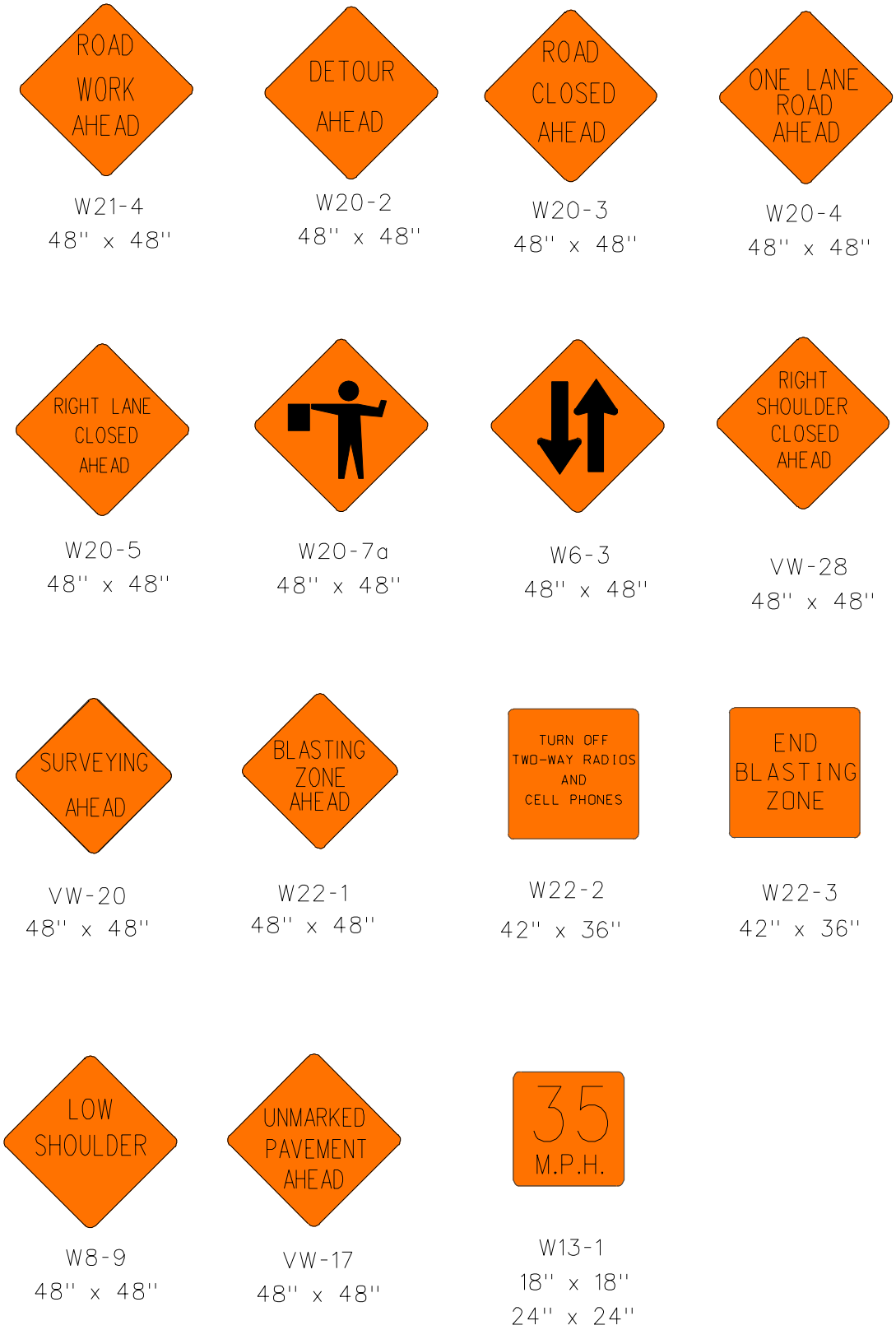


FIGURE 6F-3a, WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

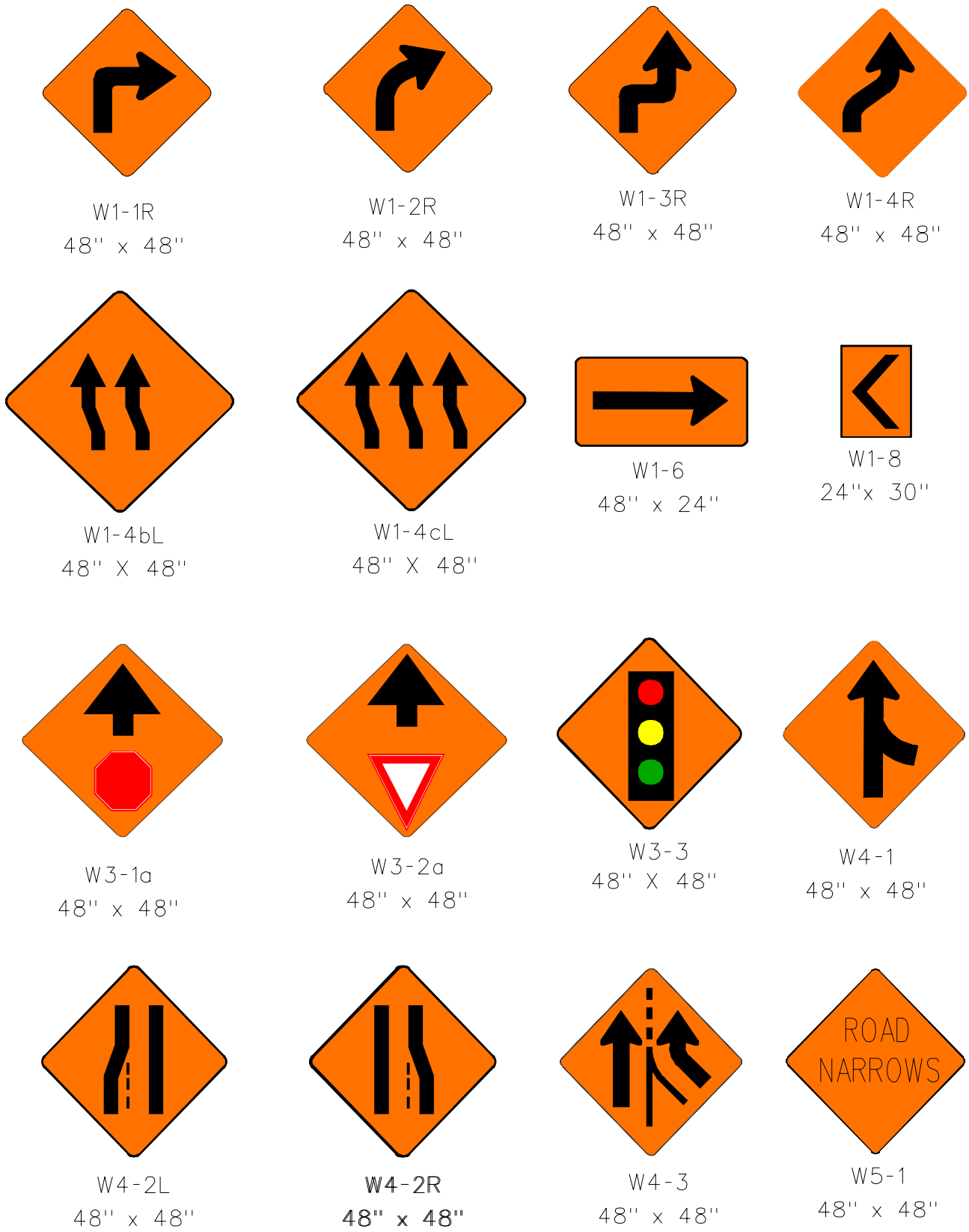


FIGURE 6F-3b, WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

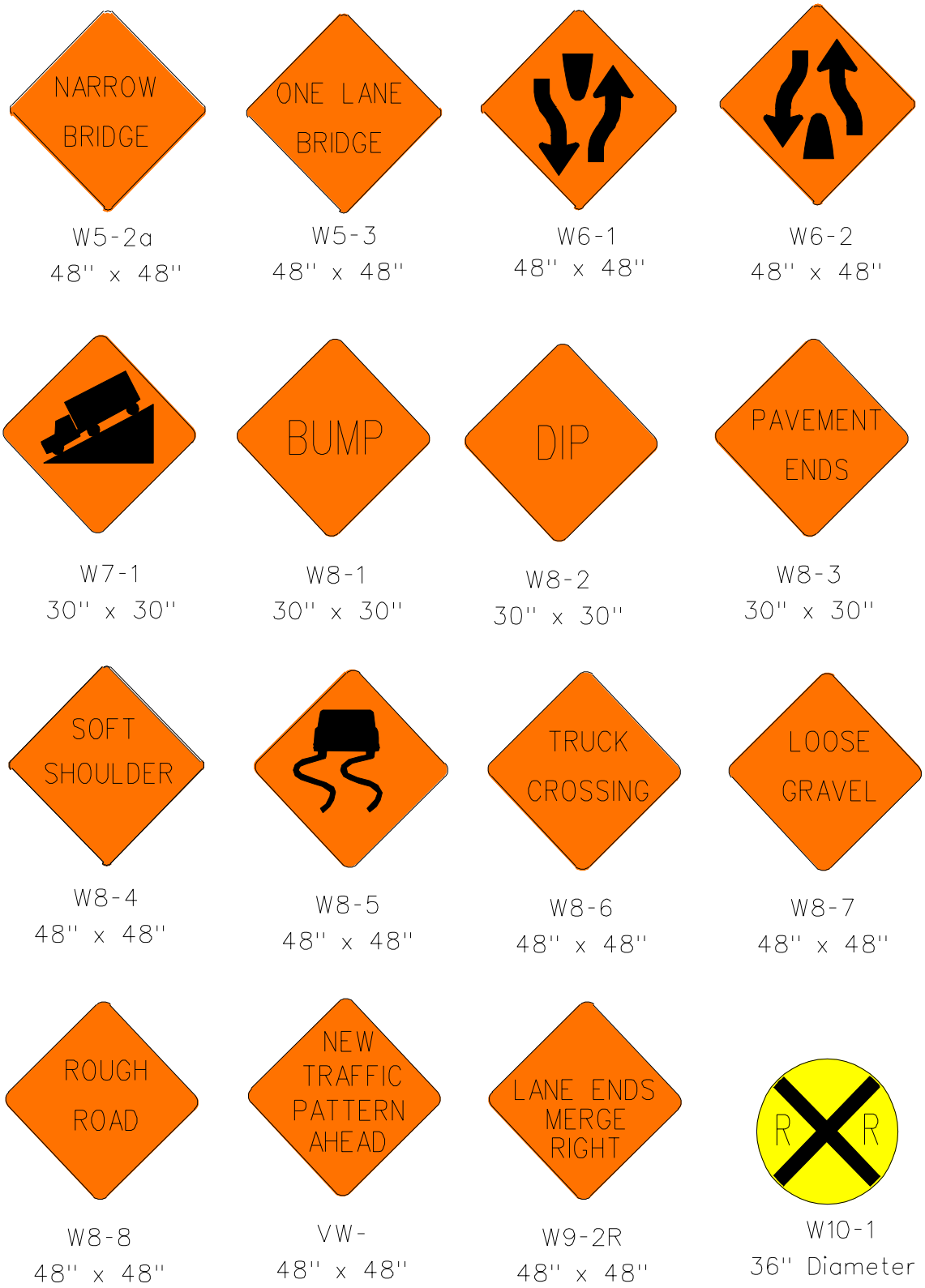


FIGURE 6F-3c, WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

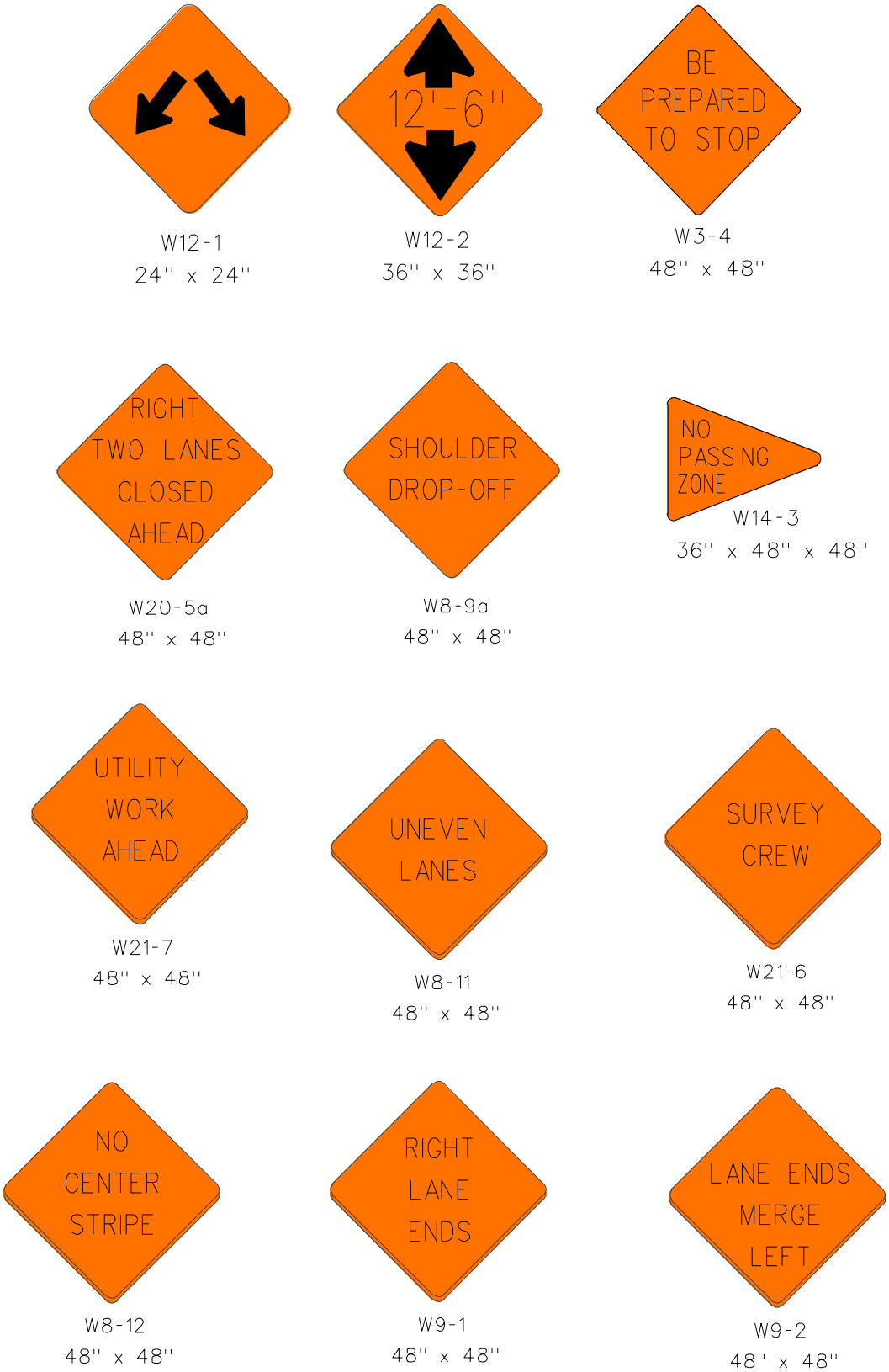
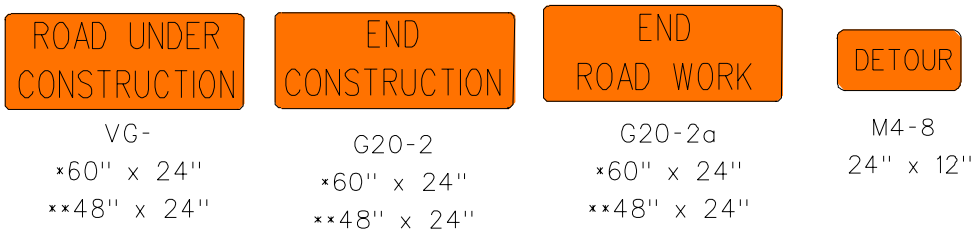


FIGURE 6F-3d, WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES



*Use On Primary And Limited Access Roadways
**Use On Secondary Roadways Only

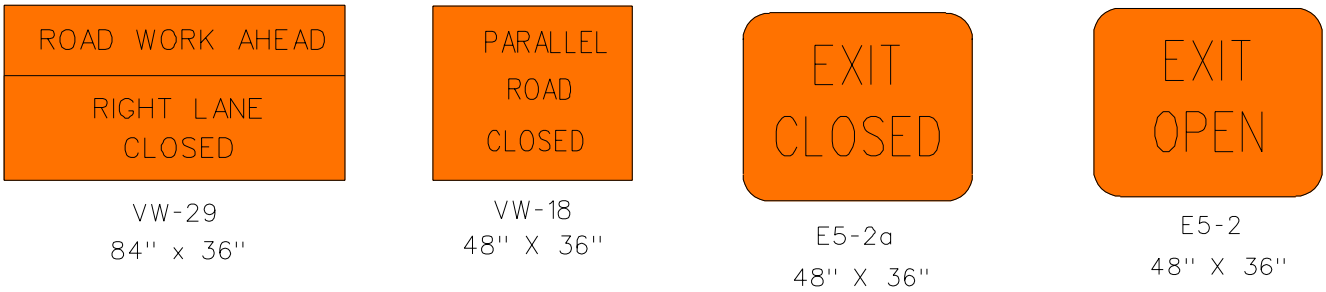
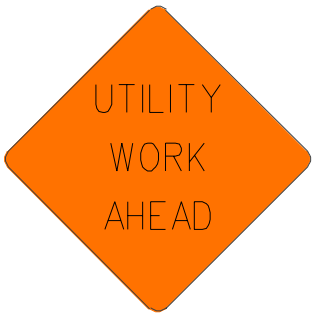


FIGURE 6F-3e, WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

48" x 48"

W21-6
48" x 48"



W21-7
48" x 48"

W8-11
48" x 48"

W8-12
48" x 48"

W9-1
48" x 48"

W9-2
48" x 48"

W3-5
48" x 48"

FIGURE 6F-3f, WARNING SIGNS USED IN TEMPORARY TRAFFIC CONTROL ZONES

Section 6F.32 GRAPHIC SPEED REDUCTION AHEAD Sign (W3-5)

The Graphic Speed Reduction Ahead (W3-5) symbol sign (see Figure 6F-3f) shall be used to warn motorists of the reduction in the posted speed limit ahead, and shall be followed by the posted speed limit sign as approved by the District Traffic Engineer.

The new graphic version of this sign (W3-5) displaying the reduced posted speed limit shall replace the REDUCED SPEED AHEAD (R2-5a) sign and shall be the only version used after December 31, 2008. Prior to that date, either (W3-5) or (R2-5a) may be used, however, the use shall be consistent throughout the TTC operation, and the different types shall not be mixed during use.

Section 6F.33 XX MPH SPEED ZONE AHEAD Sign (W3-5a)

Option:

The XX MPH SPEED ZONE AHEAD (W3-5a) sign (see Figure 6F-2b) may be used on portable sign supports in place of the GRAPHIC SPEED REDUCTION AHEAD (W3-5) symbol sign to warn motorists of the reduction in the posted speed limit ahead.

Standard:

The District Traffic Engineer prior to installation shall approve reduced posted speeds in TTC zones.

Section 6F.34 Motorized Traffic Signs (W8-6)

Option:

Motorized Traffic (W8-6) signs may be used to alert road users to locations where unexpected travel on the roadway or entries into or departures from the roadway by construction vehicles might occur. The TRUCK CROSSING (W8-6) word message sign may be used (see Figure 6F-3c) where there is an established construction vehicle crossing of the roadway.

Support:

These locations might be relatively confined or might occur randomly over a segment of roadway.

Section 6F.35 Shoulder Work Signs (W21-5, W21-5a, W21-5b)

Support:

Shoulder Work signs warn of maintenance, reconstruction, or utility operations on the highway shoulder where the roadway is unobstructed.

Standard:

The Shoulder Work sign shall have the legend SHOULDER WORK AHEAD (W21-5), RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5a), or RIGHT (LEFT) SHOULDER CLOSED XX FEET (W21-5b).

Option:

The Shoulder Work sign may be used in advance of the point on a nonlimited access highway where there is shoulder work. It may be used singly or in combination with a ROAD WORK NEXT X MILES or ROAD WORK AHEAD sign.

Guidance:

On freeways and expressways, the SHOULDER WORK AHEAD (w21-5) sign followed by the RIGHT (LEFT) SHOULDER CLOSED AHEAD (W21-5a) sign or the RIGHT (LEFT) SHOULDER CLOSED (W21-5b) XXX feet sign should be used in advance of the point where the shoulder work occurs.

Section 6F.36 SURVEING AHEAD Sign (VW-20)

Guidance:

The SURVEYING AHEAD (VW-20) sign (see Figure 6F-3a) should be used to warn of surveying crews working in or adjacent to the roadway. SURVEY CREW AHEAD may be used in place of the SURVEYING AHEAD sign.

Section 6F.37 UTILITY WORK AHEAD Sign (W21-7)

Option:

The UTILITY WORK AHEAD (W21-7) sign (see Figure 6F-3f) may be used as an alternate to the ROAD (STREET) WORK AHEAD (W20-1) sign for utility operations on or adjacent to a highway.

Standard:

The UTILITY WORK AHEAD sign shall carry the legend UTILITY WORK, XX FEET, XX MILES, or AHEAD.

Section 6F.38 Signs for Blasting Areas

Support:

Radio-Frequency (RF) energy can cause the premature firing of electric detonators (blasting caps) used in TTC zones.

Standard:

Road users shall be warned to turn off mobile radio transmitters and cellular telephones where blasting operations occur. A sequence of signs shall be prominently displayed to direct operators of mobile radio equipment, including cellular telephones, to turn off transmitters in a blasting area. These signs shall be covered or removed when there are no explosives in the area or the area is otherwise secured.

Guidance:

A minimum safe distance of 1000 feet should be used for warning sign placement (see Figure TTC-2.0).

Section 6F.39 BLASTING ZONE AHEAD Sign (W22-1)

Standard:

The BLASTING ZONE AHEAD (W22-1) sign (see Figure 6F-3a) shall be used in advance of any TTC zone where explosives are being used. The TURN OFF 2-WAY RADIO AND CELL PHONE and END BLASTING ZONE signs shall be used in sequence with this sign.

Section 6F.40 TURN OFF 2-WAY RADIO AND CELL PHONE Sign (W22-2)

Standard:

The TURN OFF 2-WAY RADIO AND CELL PHONE (W22-2) sign (see Figure 6F-3a) shall follow the BLASTING ZONE AHEAD sign and shall be placed at least 1,000 feet before the beginning of the blasting zone.

Section 6F.41 END BLASTING ZONE Sign (W22-3)

Standard:

The END BLASTING ZONE (W22-3) sign (see Figure 6F-3a) shall be placed a minimum of 1,000 feet past the blasting zone.

Option:

The END BLASTING ZONE sign may be placed either with or preceding the END ROAD WORK sign.

Section 6F.42 Shoulder Signs (W8-4, W8-9, W8-9a)

Option:

The SOFT SHOULDER (W8-4) sign (see Figure 6F-3c) may be used to warn of a soft shoulder condition.

The LOW SHOULDER (W8-9) sign (see Figure 6F-3a) may be used to warn of a shoulder condition where there is an elevation difference of less than two (2) inches between the shoulder and the travel lane.

Standard:

The SHOULDER DROP OFF (W8-9a) sign (see Figure 6F-3d) shall be used when an unprotected shoulder drop-off, adjacent to the travel lane, exceeds two (2) inches in depth for a continuous length along the roadway, based on engineering judgment.

Section 6F.43 UNEVEN LANES Sign (W8-11)

Standard:

The UNEVEN LANES (W8-11) sign (see Figure 6F-3d) shall be used during operations that create a difference in elevation of two (2) inches or less between adjacent lanes that are open to travel.

Section 6F.44 NO CENTER STRIPE Sign (W8-12)

Guidance:

The NO CENTER STRIPE (W8-12) sign (see Figure 6F-3d) should be used when the work obliterates the centerline pavement markings. This sign should be placed at the beginning of the TTC zone and repeated at 2-mile intervals in long TTC zones.

Section 6F.45 Double Reverse Curve Signs (W24 Series)

Option:

The Double Reverse Curve (W24-1, W24-1a, or W24-1b) sign (see Figure 6F-4 of the MUTCD) may be used when the tangent distance between two reverse curves is less than 600 feet, thus making it difficult for a second Reverse Curve (W1-4 Series) sign to be placed between the curves.

Standard:

If a Double Reverse Curve sign is used, the number of lanes illustrated on the sign shall be the same as the number of through lanes available to road users, and the direction of the double reverse curve shall be appropriately illustrated.

Section 6F.46 Other Warning Signs

Option:

Advance warning signs may be used by themselves or with other advance warning signs.

Besides the warning signs specifically related to TTC zones, several other warning signs in Part 2 of the MUTCD may apply in TTC zones.

Standard:

Except as noted in Section 6F.02, other warning signs that are used in TTC zones shall have black legends and borders on a fluorescent orange background.

Section 6F.47 Special Warning Signs

Option:

Special warning signs may be used based on engineering judgment.

Guidance:

Special warning signs should conform to the general requirements of color, shape, and alphabet size and series. The sign message should be brief, legible, and clear.

Section 6F.47a STEEL PLATES AHEAD Sign (special)

Standard:

The STEEL PLATES AHEAD (special) sign (see Figure 6F-3f) shall be displayed whenever a steel plate is used to protect the surface of the roadway open to travel.

Guidance:

For rural locations, the sign should be placed 500' ± in advance of steel plates to provide adequate warning to approaching motorists. In urban locations, the sign should be placed a minimum of 100' in advance of steel plates.

Option:

Additional warning signs may be necessary for the conditions present. A ride through of the worksite should be performed to check for bumps and rough road conditions.

Support:

For additional information on steel plate warnings, see Section 6G.12a, Steel Plate Conspicuity and Warning.

Section 6F.48 Advisory Speed Plaque (W13-1)

Option:

In combination with a warning sign, an Advisory Speed (W13-1) plaque (see Figure 6F-3a) may be used to indicate a recommended safe speed through the TTC zone.

Standard:

The Advisory Speed plaque shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used with orange TTC zone signs, this plaque shall have a black legend and border on an orange background. The sign shall be at least 24 x 24 inches in size when used with a sign that is 36 x 36 inches or larger. Except in emergencies, an Advisory Speed plaque shall not be mounted until the District Traffic Engineer or official having jurisdiction determines the recommended speed.

Section 6F.49 Supplementary Distance Plaque (W7-3a)

Option:

In combination with a warning sign, a Supplementary Distance (W7-3a) plaque with the legend NEXT XX MILES may be used to indicate the length of highway over which a work activity is being conducted, or over which a condition exists in the TTC zone.

In long TTC zones, Supplementary Distance plaques with the legend NEXT XX MILES may be placed in combination with warning signs at regular intervals (maximum 2 miles) within the zone to indicate the remaining length of highway over which the TTC work activity or condition exists.

Standard:

The Supplementary Distance plaque with the legend NEXT XX MILES shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used with orange TTC zone signs, this plaque shall have a black legend and border on an orange background. The sign shall be at least 30 x 24 inches in size when used with a sign that is 36 x 36 inches or larger.

Guidance:

When used in TTC zones, the Supplementary Distance plaque with the legend NEXT XX MILES should be placed below the initial warning sign designating that, within the approaching zone, a temporary work activity or condition exists.

Section 6F.50 Guide Signs

Support:

Guide signs along highways provide road users with information to help them along their way through the TTC zone. The design of guide signs is presented in Part 2 of the MUTCD.

Guidance:

The following guide signs should be used in TTC zones as needed:

A. Standard route markings, where temporary route changes are necessary;
B. Directional signs and street name signs; and
C. Special guide signs relating to the condition or work being done.

Standard:

If additional temporary guide signs are used in TTC zones, they shall have a black legend and border on an orange background.

Option:

Guide signs used in TTC incident management situations may have a black legend and border on a fluorescent pink background.

When directional signs and street name signs are used in conjunction with detour routing, these signs may have a black legend and border on an orange background.

When permanent directional signs or permanent street name signs are used in conjunction with detour signing, they may have a white legend on a green background.

Section 6F.51 ROAD WORK NEXT XX MILES Sign (G20-1)

Guidance:

The ROAD WORK NEXT XX MILES (G20-1) sign should be installed in advance of TTC zones that are more than 2 miles in length.

Option:

The ROAD WORK NEXT XX MILES sign may be mounted on a Type III barricade. The sign may also be used for TTC zones of shorter length.

Standard:

The distance shown on the ROAD WORK NEXT XX MILES sign shall be stated to the nearest whole mile.

Section 6F.52 END ROAD WORK Sign (G20-2a)

Guidance:

When used, the END ROAD WORK (G20-2a) sign (see Figure 6F-3e) should be placed near the end of the termination area, as determined by engineering judgment.

Option:

The END ROAD WORK sign may be installed on the back of a warning sign facing the opposite direction of road users or on the back of a Type III barricade.

Section 6F.52a ROAD UNDER CONSTRUCTION (VG-), END CONSTRUCTION (G20-2) Sign

Standard:

When used, the ROAD UNDER CONSTRUCTION (VG-) sign (see Figure 6F-3e) shall be placed 2000' from the project limits, or 500' prior to any other warning sign. The END CONSTRUCTION (G20-2) sign shall be placed 100' past the end of the project.

Support:

The purpose of ROAD UNDER CONSTRUCTION and END CONSTRUCTION signs is to marked the beginning and ending termini of construction projects, and informs motorists when they are entering and exiting a potential construction area. See TTC-36.0 for additional information on the use of these signs.

Section 6F.53 Detour Signs (M4-8, M4-8a, M4-8b, M4-9, M4-9a, M4-9b, M4-9c, and M4-10)

Standard:

Each detour shall be adequately marked with standard temporary route signs and destination signs.

Option:

Detour signs in TTC incident management situations may have a black legend and border on a fluorescent pink background.

The Detour Arrow (M4-10) sign (see Figure 6F-3e) may be used where a detour route has been established.

The DETOUR (M4-8) sign (see Figure 6F-3e) may be mounted at the top of a route sign assembly to mark a temporary route that detours from a highway, bypasses a section closed by a TTC zone, and rejoins the highway beyond the TTC zone.

Guidance:

The Detour Arrow (M4-10) sign should normally be mounted just below the ROAD CLOSED (R11-2, R11-3a, or R11-4) sign. The Detour Arrow sign should include a horizontal arrow pointed to the right or left as required.

The DETOUR (M4-9) sign (see Figure 6F-3e) should be used for unnumbered highways, for emergency situations, for periods of short durations, or where, over relatively short distances, road users are guided along the detour and back to the desired highway without route signs.

A Street Name sign should be placed above, or the street name should be incorporated into, a DETOUR (M4-9) sign to indicate the name of the street being detoured.

Option:

The END DETOUR (M4-8a) or END (M4-8b) sign (see Figure 6F-3e) may be used to indicate that the detour has ended.

Guidance:

When the END DETOUR sign is used on a numbered highway, the sign should be mounted above a sign after the end of the detour.

The Pedestrian/Bicycle Detour (M4-9a) sign (see Figure 6F-3) should be used where a pedestrian/bicycle detour route has been established because of the closing of a pedestrian/bicycle facility to through traffic.

Standard:

If used, the Pedestrian/Bicycle Detour sign shall have an arrow pointing in the appropriate direction.

Option:

The arrow on a Pedestrian/Bicycle Detour sign may be on the sign face or on a supplemental plaque.

The Pedestrian Detour (M4-9b) sign or Bicycle Detour (M4-9c) sign (see Figure 6F-5 of the MUTCD) may be used where a pedestrian or bicycle detour route (not both) has been established because of the closing of the pedestrian or bicycle facility to through traffic.

Section 6F.54 PILOT CAR FOLLOW ME Sign (G20-4)

Standard:

The PILOT CAR FOLLOW ME (G20-4) sign (see Figure 6F-3e) shall be mounted in a conspicuous position on the rear of a vehicle used for guiding one-way vehicular traffic through or around a TTC zone. A flagger shall be stationed on the approach to the activity area to stop vehicular traffic until the pilot vehicle is available.

Section 6F.55 Portable Changeable Message Signs (PCMS's)

Standard:

Portable Changeable Message signs (PCMS) shall be TTC devices with the flexibility to display a variety of messages. Each message shall consist of either one or two screens. A screen shall consist of up to three lines of eight characters per line. Each character module shall use at least a five wide and seven high pixel matrix.

Support:

PCMS's are used most frequently on high-density urban freeways, but have applications on all types of highways where highway alignment, road user routing problems, or other pertinent conditions require advance warning and information.

PCMS's have a wide variety of applications in TTC zones including: roadway, lane, or ramp closures, crash or emergency incident management, width restriction information, speed control or reductions, advisories on work scheduling, road user management and diversion, warning of adverse conditions or special events, and other operational control.

The primary purpose of PCMS's in TTC zones is to advise the road user of unexpected situations. Some typical applications include the following:

A. Where the speed of vehicular traffic is expected to drop substantially;
B. Where significant queuing and delays are expected;
C. Where adverse environmental conditions are present;
D. Where there are changes in alignment or surface conditions;
E. Where advance notice of ramp, lane, or roadway closures is needed;
F. Where crash or incident management is needed; and/or
G. Where changes in the road user pattern occur.

Guidance:

The components of a PCMS should include: a message sign panel, control systems, a power source, and mounting and transporting equipment.

PCMS's should subscribe to the principles established in Section 2A.07 of the MUTCD and other sections of this Manual (see Appendix D – Changeable Message Sign Usage Procedure) and, to the extent practical, with the design (that is, color, letter size and shape, and borders) and applications prescribed in this Manual, except that the reverse colors for the letters and the background are considered acceptable.

The front face of the sign should be covered with a protective material. The color of the elements should be yellow or orange on a black background.

PCMS's should be visible from 0.5 mile under both day and night conditions. For a trailer or large truck mounted sign, the letter height should be a minimum of 18 inches. For Changeable Message signs mounted on service patrol trucks or work trucks, the letter height should be a minimum of 10 inches.

The message panel should have adjustable display rates (minimum of 2 seconds per screen), so that the entire message can be read at least twice at the posted speed, the off-peak 85th-percentile speed prior to work starting, or the anticipated operating speed.

Messages should be designed taking into account the following factors:

A. *Each screen should convey a single thought.*
B. *If the message can be displayed in one screen, the top line should present the problem, the center line should present the location or distance ahead, and the bottom line should present the recommended driver action.*
C. *The message should be as brief as possible.*
D. *When a message is longer than two screens, additional PCMS's should be used.*
E. *When abbreviations are used, they should be easily understood (see Appendix D of this manual and Section 1A.14 of the MUTCD).*

Option:

The message sign panel may vary in size.

Smaller letter sizes may be used on a PCMS mounted on a trailer or large truck provided that the message is legible from at least 650 feet, or mounted on a service patrol truck provided that the message is legible from at least 330 feet.

Two PCMS's may be used for the purpose of allowing the entire message to be read twice at the posted speed.

Guidance:

If two PCMS's are used to double indicate a message, they should be separated by a minimum of 1000 linear feet.

Standard:

PCMS's shall automatically adjust their brightness under varying light conditions, to maintain legibility.

The control system shall include a display screen upon which messages can be reviewed before being displayed on the message sign. The control system shall be capable of maintaining memory when power is unavailable.

PCMS's shall be equipped with a power source and a battery back-up to provide continuous operation when failure of the primary power source occurs.

The mounting of PCMS's on a trailer, a large truck, or a service patrol truck shall be such that the bottom of the message sign panel shall be a minimum of 7 feet above the roadway in urban areas and 5 feet above the roadway in rural areas when it is in the operating mode.

The text of the messages shall not scroll or travel horizontally or vertically across the face of the sign.

PCMS's shall be used as a supplement to and not as a substitute for conventional signs and pavement markings.

Guidance:

When PCMS's are used for route diversion, they should be placed far enough in advance of the diversion to allow road users ample opportunity to perform necessary lane changes, to adjust their speed, or to exit the affected highway.

The PCMS's should be sited and aligned to provide maximum legibility. Multiple Portable Changeable Message signs should be placed on the same side of the roadway, separated from each other at distances based on Table 6C-1, Spacing of Advance Warning Signs.

PCMS's should be placed on the shoulder of the roadway or, if practical, further from the traveled lane. When PCMS's are not being used, they should be removed from the roadway or, if not removed, they should be shielded by positive barriers or guardrail.

Standard:

PCMS trailers shall be delineated on a permanent basis by affixing retroreflective material, known as conspicuity material, in a continuous line on the face of the trailer as seen by oncoming road users.

A minimum of four (4) Group 2 channelizing devices shall be placed on the shoulder in advance of the PCMS in a taper for delineation.

Section 6F.56 Arrow Panels

Standard:

An arrow panel shall be a sign with a matrix of elements capable of flashing displays. This sign shall provide additional warning and directional information to assist in merging and controlling road users through or around a TTC zone.

An arrow panel in the arrow mode shall be used to advise approaching traffic of a lane closure along multi-lane roadways.

An arrow panel shall be used in combination with appropriate signs, channelizing devices, or other TTC devices.

Guidance:

An arrow panel should be placed on the shoulder of the roadway or, if practical, further from the traveled lane. When an arrow panel is not being used, it should be removed; if not removed, it should be shielded; or if the previous two options are not feasible, it should be delineated with a minimum of 4 retroreflective Group II channelizing devices.

Standard:

Arrow panels shall meet the minimum size, legibility distance, number of elements, and other specifications shown on Figure 6F-4.

Support:

Type A arrow panels are appropriate for use on low-speed (below 35 mph) urban streets. Type B arrow panels are appropriate for intermediate-speed (up to 44 mph) facilities and for maintenance or mobile operations on high-speed (45 mph and greater) roadways. Type C arrow panels are intended to be used on high-speed (45 MPH and greater), high-volume motor vehicle traffic control projects. Type D arrow panels are intended for use on low speed streets in municipalities on authorized vehicles.

Standard:

Type A, B, and C arrow panels shall have solid rectangular appearances. A Type D arrow panel shall conform to the shape of the arrow.

All arrow panels shall be finished in nonreflective black. The arrow panel shall be mounted on a vehicle, a trailer, or other suitable support.

Guidance:

The minimum mounting height of an arrow panel should be 7 feet from the roadway to the bottom of the panel, except on vehicle-mounted panels, which should be as high as practical.

A vehicle-mounted arrow panel should be provided with remote controls.

Standard:

Arrow panel elements shall be capable of at least a 50 percent dimming from full brilliance. The dimmed mode shall be used for nighttime operation of arrow panels.

Guidance:

Full brilliance should be used for daytime operation of arrow panels.

Standard:

The arrow panel shall have suitable elements capable of the various operating modes. The color presented by the elements shall be yellow.

Guidance:

If an arrow panel consisting of a bulb matrix is used, the elements should be recess-mounted or equipped with an upper hood of not less than 180 degrees.

Standard:

The minimum element on-time shall be 50 percent for the flashing mode. The flashing rate shall be not less than 25 nor more than 40 flashes per minute.

An arrow panel shall have the following three mode selections:

A. A Flashing Arrow mode; and
B. A flashing Double Arrow mode; and
C. A flashing Four Corner Caution mode.

An arrow panel in the arrow mode shall be used only for stationary or moving lane closures on multi-lane roadways.

For shoulder work, blocking the shoulder, for roadside work near the shoulder, or for temporarily closing one lane on a two-lane, two-way roadway, an arrow panel shall be used only in the four-corner caution mode.

Guidance:

For a stationary lane closure, the arrow panel should be located on the shoulder at the beginning of the merging taper. Where the shoulder is narrow, the arrow panel should be located in the closed lane as close to the beginning of the merging taper as possible, but completely within the channelizing devices.

Standard:

For consistency and to reduce confusion, only one arrow panel shall be used for each travel lane closed. When arrow panels are used to close multiple lanes, a separate arrow panel shall be used for each closed lane.

Guidance:

When arrow panels are used to close multiple lanes, if the first arrow panel is placed on the shoulder, the second arrow panel should be placed in the first closed lane at the beginning of the second merging taper (see Figure TTC 14.0). When the first arrow panel is placed in the first closed lane, the second arrow panel should be placed in the second closed lane at the downstream end of the second merging taper.

For mobile operations where a lane is closed, the arrow panel should be located to provide adequate separation from the work operation to allow for appropriate reaction by approaching drivers.

Standard:

A vehicle displaying an arrow panel shall be equipped with high-intensity rotating, oscillating, or strobe lights.

An arrow display shall not be used on a two-lane, two-way roadway for temporary one-lane operation.

An arrow display shall not be used on a multilane roadway to laterally shift traffic.

Option:

A portable changeable message sign may be used to simulate an arrow panel display on vehicle-mounted signs in moving/mobile operations.

Standard:

Arrow panels shall be maintained in a manner in which all of the appropriate numbers of lamps for selected mode are operating properly. Corrective action shall be taken when there is more than one lamp out in the stem (prior to returning to the next work shift). Immediate (within 30 minutes of notification) corrective action shall be taken when there are any lamps out in the arrow head(s).

Operating Mode	Panel Display (Type C Panel Illustrated)
The following modes shall be provided:	(Right arrow shown; left is similar)
I. Flashing Arrow	Move/Merge Right
II. Flashing Double Arrow	Move/Merge Right or Left
III. Flashing Caution	Caution

Panel Type	Minimum Size (Inches)	Minimum Legibility Distance (miles)	Minimum Number of Elements
A	48 x 24	1/2	12
B	60 x 30	3/4	13
C	96 x 48	1	15

Standard:

Arrow panels shall be maintained in a manner in which all of the appropriate number of lamps for the selected mode are operating properly. Immediate corrective action shall be taken when there is more than one lamp out in the stem. Immediate corrective shall be taken when there are any lamps out in the arrow head(s).

FIGURE 6F-4, ADVANCE WARNING ARROW DISPLAY SPECIFICATIONS

Section 6F.57 High-Level Warning Devices (Flag Trees)

Option:

A high-level warning device (flag tree) may supplement other TTC devices in TTC zones.

Support:

A high-level warning device is designed to be seen over the top of typical passenger cars (see Figure 6F-2 of the MUTCD).

Standard:

A high-level warning device shall consist of a minimum of two flags with or without a Type B high-intensity flashing warning light. The distance from the roadway to the bottom of the lens of the light and to the lowest point of the flag material shall be not less than 8 feet. The flag shall be 16 inch square or larger and shall be orange or fluorescent red-orange in color.

Option:

An appropriate warning sign may be mounted below the flags.

Support:

High-level warning devices are most commonly used in high-density road user situations to warn road users of short-term operations.

Section 6F.58 Channelizing Devices

Standard:

Designs of various channelizing devices shall be as shown in Figure 6F–5.

Support:

The function of channelizing devices is to warn road users of conditions created by work activities in or near the roadway and to guide road users. Channelizing devices include cones, tubular markers, vertical panels, drums, barricades, and temporary raised islands.

Channelizing devices provide for smooth and gradual vehicular traffic flow from one lane to another, onto a bypass or detour, or into a narrower traveled way. They are also used to separate vehicular traffic from the work space, pavement drop-offs, pedestrian or shared-use paths, or opposing directions of vehicular traffic.

Standard:

Devices used to channelize pedestrians shall be detectable to users of long canes and visible to persons having low vision.

Where barricades are used to channelize pedestrians, there shall be continuous detectable bottom and top rails with no gaps between individual barricades to be detectable to users of long canes. The bottom of the bottom rail shall be no higher than 6 inch above the ground surface. The top of the top rail shall be no lower than 36 inch above the ground surface.

Option:

A gap not exceeding 6 inches between the bottom rail and the ground surface may be used to facilitate drainage.

Standard:

If drums, cones, or tubular markers are used to channelize pedestrians, they shall be located such that there are no gaps between the bases of the devices, in order to create a continuous bottom, and the height of each individual drum, cone, or tubular marker shall be no less than 36 inch to be detectable to users of long canes.

Guidance:

Channelizing devices should be constructed and ballasted to perform in a predictable manner when inadvertently struck by a vehicle. Channelizing devices should be crashworthy. Fragments or other debris from the device or the ballast should not pose a significant hazard to road users or workers.

The spacing of channelizing devices should be as shown in Table 6F-1. The spacing of channelizing devices in tangent sections of the work zone is normally twice the distance for devices used in the taper and around curves of 6 degrees and greater.

When channelizing devices have the potential of leading vehicular traffic out of the intended vehicular traffic space as shown in Figure TTC-30.0, the channelizing devices should be extended a distance in feet of 2.0 times the posted speed limit in mph beyond the end of the transition area.

Option:

Warning lights may be added to channelizing devices in areas with frequent fog, snow, or severe roadway curvature, or where visual distractions are present.

Standard:

Warning lights shall flash when placed on channelizing devices used alone or in a cluster to warn of a spot condition. Warning lights placed on channelizing devices used in a series to channelize road users shall be steady-burn.

Warning lights or other devices placed on channelizing devices shall meet NCHRP 350 crashworthiness and have approval for use on that type of channelizing device. Barrier vertical panels shall not be installed on Group 1 or 2 channelizing devices.

The retroreflective material used on channelizing devices shall have a smooth, sealed outer surface that will display a similar color day or night. In addition to conforming to the requirements stated herein, channelizing devices, including retroreflective material, shall conform to the requirements of the

Virginia Department of Transportation's Road and Bridge Specifications.

Option:

The name and telephone number of the highway agency, contractor, or supplier may be shown on the nonretroreflective surface of all types of channelizing devices.

Standard:

The letters and numbers of the name and telephone number shall be nonretroreflective and not over 2 inches in height.

Guidance:

Particular attention should be given to maintaining the channelizing devices to keep them clean, visible, and properly positioned at all times.

Standard:

Devices that are damaged or have lost a significant amount of their retroreflectivity and effectiveness shall be replaced. Replacement and correction of ineffective channelizing devices shall be accomplished in accordance with the American Traffic Safety Service Association's (ATSSA) "Quality Standards For Work Zone Traffic Control Devices" publication.

Section 6F.59 Cones

Standard:

Cones (see Figure 6F-5) shall be predominantly orange and shall be made of a material that can be struck without causing damage to the impacting vehicle. The minimum height of cones for use on all roadways shall be 36 inch.

For nighttime use, cones shall be retroreflectorized or equipped with lighting devices for maximum visibility. Retroreflectorization of cones shall be provided by a minimum 13 inch white band placed a maximum of 3 inches from the top, or by a white band 6 inch wide located 3 to 4 inches from the top of the cone and an additional 4 inch wide white band approximately 2 inches below the 6 inch band.

Retroreflectorization of cones that are more than 36 inch in height shall be provided by horizontal, circumferential, alternating orange and white retroreflective stripes that are 4 to 6 inch wide. Each cone shall have a minimum of two orange and two white stripes with the top stripe being orange. Any nonretroreflective spaces between the orange and white stripes shall not exceed 3 inch in width.

Option:

When workers are present to maintain them, traffic cones may be used to channelize road users, divide opposing vehicular traffic lanes, divide lanes when two or more lanes are kept open in the same direction, and delineate short duration maintenance and utility work.

Guidance:

Steps should be taken to minimize the possibility of cones being blown over or displaced by wind or moving vehicular traffic.

Ballast should be kept to the minimum amount needed.

Option:

Cones may be doubled up to increase their weight.

Support:

Some cones are constructed with bases that can be filled with ballast. Others have specially weighted bases, or weight such as sandbag rings that can be dropped over the cones and onto the base to provide added stability.

Standard:

When workers are not present on the jobsite to maintain the cones, group 2 channelizing devices shall be used for channelization.

Guidance:

Cones should not be used for pedestrian channelization or as pedestrian barriers in TTC zones on or along sidewalks unless they are continuous between individual devices and detectable to users of long canes.

Section 6F.60 Tubular Markers

Standard:

Tubular markers (see Figure 6F-5) shall be predominantly orange and shall be not less than 36 inch high and 2 inch wide facing road users. They shall be made of a material that can be struck without causing damage to the impacting vehicle.

For nighttime use, tubular markers shall be retroreflectorized. Retroreflectorization of 36 inch or larger tubular markers shall be provided by two 3-inch wide white bands placed a maximum of 2 inches from the top with a maximum of 6 inches between the bands.

Guidance:

Tubular markers should not be used for pedestrian channelization or as pedestrian barriers in TTC zones on or along sidewalks unless they are continuous between individual devices and detectable to users of long canes.

Tubular markers have less visible area than other devices and should be used only where space restrictions do not allow for the use of other more visible devices.

Tubular markers should be stabilized by affixing them to the pavement, by using weighted bases, or weights such as sandbag rings that can be dropped over the tubular markers and onto the base to provide added stability. Ballast should be kept to the minimum amount needed.

Option:

Tubular markers may be used effectively to divide opposing lanes of road users, divide vehicular traffic lanes when two or more lanes of moving motor vehicle traffic are kept open in the same direction, and to delineate the edge of a pavement drop off where space limitations do not allow the use of larger devices.

Standard:

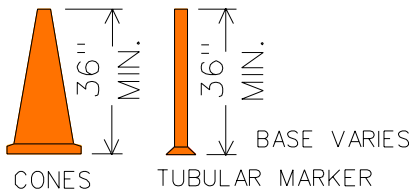
When a noncylindrical tubular marker is used, it shall be attached to the pavement in a manner such that the width facing road users meets the minimum requirements.

A tubular marker shall be attached to the pavement to display the minimum 2-inch width to the approaching road users.

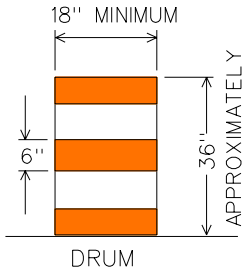
When workers are not present on the jobsite to maintain the tubular markers, the tubular markers shall be affixed to the pavement.

SPACING OF CHANNELIZING DEVICES		
Work Zone Location	**Posted Speed Limit**	**Spacing of Devices in Feet**
In Tapers and Curves	35 mph or less	**20**
Parallel to the Travelway	35 mph or less	**40**
Spot Construction Access *	35 mph or less	**80**
In Tapers and Curves	Greater than 35 mph	**40**
Parallel to the Travelway	Greater than 35 mph	**80**
Spot Construction Access *	Greater than 35 mph	**120**
***For easier access by construction vehicles into the work area, spacing of devices may be increased to this distance, but shall not exceed one access per 0.5 mile unless approved by the engineer and documented.**		

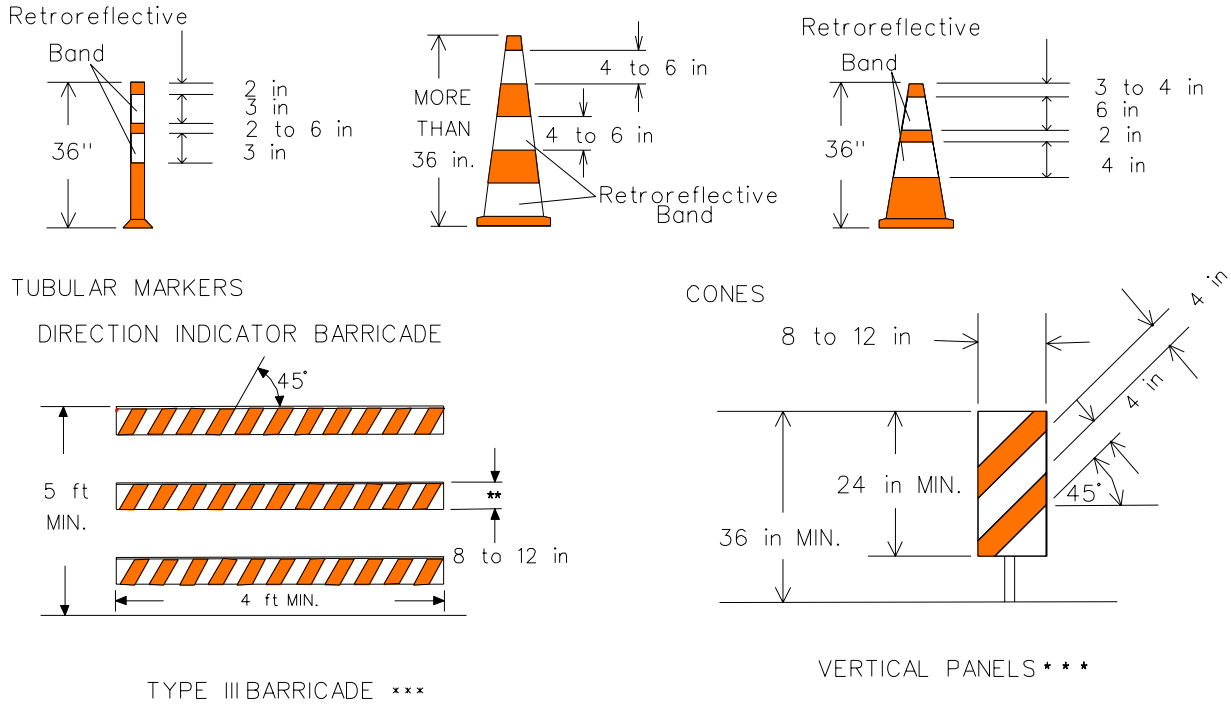
Table 6F-1, Spacing of Channelizing Devices



GROUP 1



GROUP 2



**Normal lumber dimensions are satisfactory for barricade rail width dimensions.

***Rail stripe widths shall be 6 inches, except that 4 inch wide stripes may be used if rail lengths are less than 36 inches.

****When the height of the vertical panel itself is 36 inches or greater panel stripe widths shall be 6 inches.

The sides of barricades facing traffic shall have retroreflective rail faces.

FIGURE 6F-5, CHANNELIZING DEVICES

Section 6F.61 Vertical Panels

Standard:

Vertical panels (see Figure 6F-5) shall be 8 to 12 inch in width and at least 24 inch in height. They shall have 6 inch orange and white diagonal stripes and shall be retroreflectorized.

Vertical panels shall be mounted with the top a minimum of 36 inches above the roadway.

Markings for vertical panels shall be alternating orange and white retroreflective stripes, sloping downward at an angle of 45 degrees in the direction vehicular traffic is to pass. Vertical panels used on freeways, expressways, and other high-speed roadways shall have a minimum of 270 sq. inch retroreflective area facing vehicular traffic.

Option:

Where space is limited, vertical panels may be used to channelize vehicular traffic and divide opposing lanes when approved by the District Traffic Engineer.

Section 6F.62 Drums

Standard:

Drums (see Figure 6F-5) used for road user warning or channelization shall be constructed of lightweight, deformable materials. They shall be a minimum of 36 inch in height and have at least an 18 inch minimum width regardless of orientation. Metal drums shall not be used. The markings on drums shall be horizontal, circumferential, alternating orange and white retroreflective stripes 6 inches wide. Each drum shall have a minimum of two orange and two white stripes with the top stripe being orange. Any nonretroreflectorized spaces between the horizontal orange and white stripes shall not exceed 3 inches wide. Drums shall have closed tops that will not allow collection of construction debris or other debris.

Support:

Drums are highly visible, have good target value, give the appearance of being formidable obstacles and, therefore, command the respect of road users. They are portable enough to be shifted from place to place within a TTC zone in order to accommodate changing conditions, but are generally used in situations where they will remain in place for a prolonged period of time.

Option:

Although drums are most commonly used to channelize or delineate road user flow, they may also be used alone or in groups to mark specific locations.

Guidance:

Drums should not be used for pedestrian channelization or as pedestrian barriers in TTC zones on or along sidewalks unless they are continuous between individual devices and detectable to users of long canes.

Drums should not be weighted with sand, water, or any material to the extent that would make them hazardous to road users or workers when struck. Drums used in regions susceptible to freezing should have drain holes in the bottom so that water will not accumulate and freeze causing a hazard if struck by a road user.

Standard:

Ballast shall not be placed on the top of a drum. Drums shall be adequately ballasted to prevent movement by passing vehicles. Weighted collars shall lay flat on the ground or roadway around the bottom of drums, and shall be the approved type and size for that particular device.

Guidance:

Drums that use weighted collars for ballast should use a minimum of 2 drum collars when placed within 12 feet of active travel lanes on limited access highways to ensure stability.

Standard:

Drums shall be used in all unmanned work zone locations, and in all merging and shifting tapers on limited access highways for nighttime operations.

Section 6F.63 Type III Barricades

Support:

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

Standard:

Stripes on barricade rails shall be alternating orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction road users are to pass. Barricade stripes shall be 6 inch wide and shall be made of sheeting meeting the requirements in the Department of Transportation's Road and Bridge Specifications.

The minimum length for a Type III Barricade shall be 48 inch. Each barricade rail shall be 8 to 12 inch wide. Barricades used on freeways, expressways, and other high-speed roadways shall have a minimum of 270 sq. inch of retroreflective area facing road users.

Guidance:

Where barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which road users must turn (see Figure 6F-5).

Where both right and left turns are provided, the barricade stripes should slope downward in both directions from the center of the barricade or barricades (inverted V-shape).

Where no turns are intended, the stripes should be positioned to slope downward toward the center of the barricade or barricades.

Barricade rails should be supported in a manner that will allow them to be seen by the road user, and in a manner that provides a stable support that is not easily blown over or displaced.

The width of the existing pedestrian facility should be provided for the temporary facility if practical. Traffic control devices and other construction materials and features should not intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility. When it is not possible to maintain a minimum width of 60 inch throughout the entire length of the pedestrian pathway, a 60 inch x 60 inch passing space should be provided at least every 200 feet to allow individuals in wheelchairs to pass.

Barricade rail supports should not project into pedestrian circulation routes more than 4 inch from the support between 27 inch and 80 inch from the surface as described in Section 4.4.1 of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)" (see Section 1A.11).

Standard:

Type III Barricades shall be crashworthy as they are located adjacent to vehicular traffic flow and are subject to impact by errant vehicles.

Guidance:

On high-speed expressways or in other situations where barricades may be susceptible to overturning in the wind, ballasting should be used.

Option:

Sandbags (one 50 pound bag) may be placed on each leg of the frame of Type III Barricades as flat to the ground as possible to provide the required ballast.

Standard:

Ballast shall not be placed on top of any striped rail. Barricades shall not be ballasted by nondeformable objects such as rocks or chunks of concrete. Ballast shall not extend into the accessible passage width of 60 inches.

Guidance:

Type III Barricades should be used to close or partially close a road.

Option:

Type III Barricades used at a road closure may be placed completely across a roadway or from curb to curb. Barricades may be used alone or in groups to close or partially close a road.

Standard:

Where provision is made for access of authorized equipment and vehicles, the responsibility for Type III Barricades shall be assigned to a person who will provide proper closure at the end of each work day.

Support:

When a highway is legally closed but access must still be allowed for local road users, barricades usually are not extended completely across the roadway.

Standard:

A sign (see Section 6F.09) shall be installed with the appropriate legend concerning permissible use by local road users. Adequate visibility of the barricades from both directions shall be provided.

Option:

Crashworthy signs may be installed on barricades (see Section 6F.03).

Section 6F.64 Direction Indicator Barricades

Standard:

Due to their proximity in appearance to a type II barricade, the use of Direction Indicator Barricades shall be approved by the District Traffic Engineer prior to its use as a channelizing device.

The Direction Indicator Barricade shall consist of a One-Direction Large Arrow (W1-6) sign mounted above a diagonal striped, horizontally aligned, retroreflective rail.

The One-Direction Large Arrow (W1-6) sign shall be black on an orange background. The stripes on the bottom rail shall be alternating orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction road users are to pass. The stripes shall be 4 inch wide. The One-Direction Large Arrow (W1-6) sign shall be 24 x 12 inch. The bottom rail shall have a length of 24 inch and a height of 8 inch.

The Direction Indicator Barricade, including any associated ballast or lights, shall be crashworthy.

Option:

The Direction Indicator Barricade, if approved, may be used in tapers, transitions, and other areas where specific directional guidance to drivers is necessary.

Guidance:

If used, Direction Indicator Barricades should be used in series to direct the driver through the transition and into the intended travel lane.

Section 6F.65 Temporary Traffic Barriers as Channelizing Devices

Support:

Temporary traffic barriers are not TTC devices in themselves; however, when placed in a position identical to a line of channelizing devices and marked and/or equipped with appropriate channelization features to provide guidance and warning both day and night, they serve as TTC devices.

Standard:

Temporary traffic barriers serving as TTC devices shall conform to requirements for such devices as set forth throughout this Manual and Part 6 of the MUTCD.

Temporary traffic barriers shall not be used solely to channelize road users, but also to protect the work space (see Section 6F.82). If used to channelize vehicular traffic, the temporary traffic barrier shall be supplemented with delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility.

Temporary traffic barriers by themselves shall not be used for a merging taper.

Guidance:

Group 2 channelizing devices and pavement markings should be used for a merging taper in advance of the traffic barrier (see Figure TTC-16.0). Temporary traffic barriers should not be used for a constricted/restricted TTC zone.

When used for channelization, temporary traffic barriers should be of a light color for increased visibility.

Section 6F.66 Longitudinal Channelizing Barricades

Support:

Longitudinal channelizing barricades are lightweight, deformable channelizing devices that can be used singly as Type III barricades, or connected so they are highly visible and have good target value.

Guidance:

When used as a barricade, longitudinal channelizing barricades should conform to the general size, color, stripe pattern, retroreflectivity, and placement characteristics established for the devices described in Chapter 6F.

Option:

Longitudinal channelizing barricades may be used instead of a line of cones, drums, or barricades as directed by the District Traffic Engineer.

Longitudinal channelizing barricades may be hollow and filled with water as ballast.

Guidance:

If used, longitudinal channelizing barricades should be interlocked to delineate or channelize flow including pedestrian traffic control. The interlocking barricade wall should not have gaps that allow pedestrians or vehicles to stray from the channelizing path.

Support:

Longitudinal channelizing barricades are often located adjacent to traffic and therefore are subject to impact by errant vehicles.

Guidance:

Because of their vulnerable position, longitudinal channelizing barricades should be constructed of lightweight materials and be crashworthy.

Standard:

Although longitudinal channelizing barricades might give the appearance of being formidable obstacles, they have not met the crashworthy requirements for temporary traffic barriers and, therefore, shall not be used to shield pedestrians, including workers, from vehicle impacts or obstacles.

Option:

Longitudinal channelizing barricades may be used to channelize pedestrians.

Section 6F.67 Other Channelizing Devices

Standard:

Channelizing devices other than those described in this Chapter shall require approval from the State Traffic Engineer of the Virginia Department of Transportation based on a review and/or engineering study prior to their use.

Guidance:

Other channelizing devices should conform to the general size, color, stripe pattern, retroreflection, and placement characteristics established for the devices described in this Chapter.

Section 6F.68 Detectable Edging for Pedestrians

Support:

Individual channelizing devices, tape or rope used to connect individual devices, other discontinuous barriers and devices, and pavement markings are not detectable by persons with visual disabilities and are

incapable of providing detectable path guidance on temporary or realigned sidewalks or other pedestrian facilities.

Guidance:

When it is determined that a facility should be accessible to and detectable by pedestrians with visual disabilities, a continuously detectable edging should be provided throughout the length of the facility such that it can be followed by pedestrians using long canes for guidance. This edging should protrude at least 6 inch above the surface of the sidewalk or pathway, with the bottom of the edging a maximum of 2.5 inch above the surface. This edging should be continuous throughout the length of the facility except for gaps at locations where pedestrians or vehicles will be turning or crossing. This edging should consist of a prefabricated or formed-in-place curbing or other continuous device that is placed along the edge of the sidewalk or walkway. This edging should be firmly attached to the ground or to other devices. Adjacent sections of this edging should be interconnected such that the edging is not displaced by pedestrian or vehicular traffic or work operations, and such that it does not constitute a hazard to pedestrians, workers, or other road users.

Support:

Examples of detectable edging for pedestrians include:

A. *Prefabricated lightweight sections of plastic, metal, or other suitable materials that are interconnected and fixed in place to form a continuous edge.*
B. *Prefabricated lightweight sections of plastic, metal, or other suitable materials that are interconnected, fixed in place, and placed at ground level to provide a continuous connection between channelizing devices located at intervals along the edge of the sidewalk or walkway.*
C. *Sections of lumber interconnected and fixed in place to form a continuous edge.*
D. *Formed-in-place asphalt or concrete curb.*
E. *Prefabricated concrete curb sections that are interconnected and fixed in place to form a continuous edge.*
F. *Continuous temporary traffic barrier or longitudinal channelizing barricades placed along the edge of the sidewalk or walkway that provides a pedestrian edging at ground level.*
G. *Chain link or other fencing equipped with a continuous bottom rail.*

Detectable pedestrian edging should be orange, white, or yellow and should match the color of the adjacent channelizing devices or traffic control devices, if any are present.

Section 6F.69 Temporary Raised Islands

Standard:

Temporary raised islands shall be used only in combination with pavement striping and other suitable channelizing devices.

Option:

A temporary raised island may be used to separate vehicular traffic flows in two-lane, two-way operations on roadways having a vehicular traffic volume range of 4,000 to 15,000 average daily traffic (ADT) and on freeways having a vehicular traffic volume range of 22,000 ADT to 60,000 ADT.

Temporary raised islands also may be used in other than two-lane, two-way operations where physical separation of vehicular traffic from the TTC zone is not required.

Guidance:

Temporary raised islands should have the basic dimensions of 4 inch high by at least 18 inch wide and have rounded or chamfered corners.

The temporary raised islands should not be designed in such a manner that they would cause a motorist to lose control of the vehicle if the vehicle inadvertently strikes the temporary raised island. If struck, pieces of the island should not be dislodged to the extent that they could penetrate the occupant compartment or involve other vehicles.

Standard:

Flexible post delineators shall be spaced every 80 feet, with a temporary pavement marker spaced in-between each delineator on top of the temporary raised median. Retro-reflective sheeting shall be placed

3 inches from the top of each flexible post delineator (see L&D special design drawing for Temporary Asphalt Median).

At pedestrian crossing locations, temporary raised islands shall have an opening or be shortened to provide at least a 60 inch wide pathway for the crossing pedestrian.

Section 6F.70 Opposing Traffic Lane Divider

Support:

Opposing traffic lane dividers are delineation devices used as center lane dividers to separate opposing vehicular traffic on a two-lane, two-way operation.

Standard:

Opposing traffic lane dividers shall not be placed across pedestrian crossings.

The Opposing Traffic Lane Divider (W6-4) sign (see Figure 6F-4 of the MUTCD) is an upright, retroreflective orange-colored sign placed on a flexible support and sized at least 12 inch wide by 24 inch high.

Section 6F.71 Pavement Markings

Standard:

The provisions of this Section shall not be considered applicable for short-term, mobile, or incident management TTC zones.

Pavement markings shall be maintained along paved streets and highways in all long- and intermediate-term stationary (see Section 6G.02) TTC zones. All pavement markings shall be in accordance with Chapters 3A and 3B of the MUTCD, except as indicated in Section 6F.72. Pavement markings shall match the markings in place at both ends of the TTC zone. Pavement markings shall be placed along the entire length of any surfaced detour or temporary roadway prior to the detour or roadway being opened to road users.

Warning signs, channelizing devices, and delineation shall be used to indicate required road user paths in TTC zones where it is not possible to provide a clear path by pavement markings. All pavement markings and devices used to delineate road user paths shall be carefully reviewed during daytime and nighttime periods.

For long-term stationary operations, pavement markings in the temporary traveled way that are no longer applicable shall be removed or obliterated as soon as practical. Pavement marking obliteration shall leave a minimum of pavement scars and shall remove old marking material. Painting over existing pavement markings with black paint or spraying with asphalt shall not be accepted as a substitute for removal or obliteration. Obliteration of pavement markings shall be in accordance to Typical Traffic Control Figure TTC-38.0.

Guidance:

Road users should be provided pavement markings within a TTC zone comparable to the pavement markings normally maintained along such roadways, particularly at either end of the TTC zone.

The intended vehicle path should be defined in day, night, and twilight periods under both wet and dry pavement conditions.

The work should be planned and staged to provide for the placement and removal of the pavement markings.

Markings should be provided in intermediate-term stationary work zones.

Option:

Removable, nonreflective, preformed tape may be used where markings need to be covered temporarily.

Section 6F.72 Temporary Pavement Markings

Support:

Temporary pavement markings are those that are allowed to remain in place until the earliest date when it is practical and possible to install pavement markings that meet the MUTCD Part 3 standards for pavement markings.

Guidance:

Temporary pavement markings should not be in place for more than 2 weeks unless justified by an engineering study.

Standard:

All temporary pavement markings, including pavement markings for no-passing zones, shall conform to the requirements of Chapters 3A and 3B of the MUTCD. All temporary broken-line pavement markings shall use the same cycle length as permanent markings and be at least 2 feet long.

Option:

Half-cycle lengths with a minimum of 2 foot stripes may be used on roadways with severe curvature (see MUTCD Section 3A.05) for centerlines in passing zones and for lane lines.

For temporary situations of 3 calendar days or less, for a two- or three-lane road, no-passing zones may be identified by using DO NOT PASS (R4-1), and PASS WITH CARE (R4-2), signs (see Sections 2B.29, 2B.30, and 2C.35 of the MUTCD) rather than pavement markings. Also, DO NOT PASS, and PASS WITH CARE (see figure 6F-2b) signs may be used instead of pavement markings on roads with low volumes for longer periods in accordance with the State's or highway agency's policy.

Guidance:

If used, the DO NOT PASS, and PASS WITH CARE signs should be placed in accordance with Sections 2B.29, 2B.30, and 2C.35 of the MUTCD.

The temporary use of edge lines, channelizing lines, lane reduction transitions, gore markings, and other longitudinal markings, and the various nonlongitudinal markings (such as stop lines, railroad crossings, crosswalks, words or symbols) should be in accordance with the State's or highway agency's policy.

Section 6F.73 Raised Pavement Markers

Standard:

Temporary pavement markers shall be installed with construction pavement markings (except non-retroreflective removable markings) in transition (lane drop) or lane shift areas of work zones which will encroach upon the traveled way for a period of more than three days and in other areas as required by the Engineer. Temporary pavement markers shall be installed on twenty-foot centers in lane shift and transition areas. When temporary pavement markers are used in other areas, they shall be installed on forty-foot centers unless otherwise required by the Engineer.

Temporary pavement markers shall match the color of the construction pavement markings.

Section 6F.74 Delineators

Standard:

When used, delineators shall combine with or supplement other TTC devices. They shall be mounted on crashworthy supports so that the reflecting unit is approximately 4 feet above the near roadway edge. The standard color for delineators used along both sides of two-way streets and highways and the right side of one-way roadways shall be white. Delineators used along the left side of one-way roadways shall be yellow.

Guidance:

Spacing along roadway curves should be as set forth in Section 3D.04 of the MUTCD and should be such that several delineators are always visible to the driver.

Option:

Delineators may be used in TTC zones to indicate the alignment of the roadway and to outline the required vehicle path through the TTC zone.

Section 6F.75 Lighting Devices

Guidance:

Lighting devices should be provided in TTC zones based on engineering judgment.

When used to supplement channelization, the maximum spacing for warning lights should be identical to the channelizing device spacing requirements.

Support:

Five types of lighting devices are commonly used in TTC zones. They are floodlights, flashing warning beacons, warning lights, steady-burn electric lamps, and vehicle warning lights.

Option:

Lighting devices may be used to supplement retroreflectorized signs, barriers, and channelizing devices.

During normal daytime maintenance operations, the functions of flashing warning beacons may be provided by high-intensity amber rotating, oscillating or strobe lights on a maintenance vehicle.

Standard:

Although vehicle hazard warning lights are permitted to be used to supplement high-intensity amber rotating, oscillating, or strobe lights, they shall not be used instead of high-intensity amber rotating, oscillating, or strobe lights.

Section 6F.76 Floodlights

Support:

Utility, maintenance, or construction activities on highways are frequently conducted during nighttime periods when vehicular traffic volumes are lower. Large construction projects are sometimes operated on a double-shift basis requiring night work (see Section 6G.20).

Guidance:

When nighttime work is being performed, floodlights should be used to illuminate the work area, equipment crossings, and other areas.

Standard:

Except in emergency situations, flagger stations shall be illuminated at night with a light source with minimum of 5 foot candles (50 lux)

Floodlighting shall not produce a disabling glare condition for approaching road users, flaggers, or workers.

The adequacy of the floodlight placement and elimination of potential glare shall be determined by driving through and observing the floodlighted area from each direction on all approaching roadways after the initial floodlight setup, at night, and periodically during each shift.

Support:

Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of 5-foot candles (50 lux) can be adequate for general activities. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 20-foot candles (216 lux).

Section 6F.77 Flashing Warning Beacons

Support:

Flashing warning beacons are often used to supplement a TTC device.

Standard:

Flashing warning beacons shall comply with the provisions of Chapter 4K of the MUTCD. A flashing warning beacon shall be a flashing yellow light with a minimum nominal diameter of 8 inch.

Guidance:

Flashing warning beacons should be operated 24 hours per day.

Support:

The temporary terminus of a freeway is an example of a location where flashing warning beacons alert drivers to the changing roadway conditions and the need to reduce speed in transitioning from the freeway to another roadway type.

Section 6F.78 Warning Lights

Support:

Type A, Type B, Type C, and Type D 360-degree warning lights are portable, powered, yellow, lens-directed, enclosed lights.

Standard:

Warning lights shall be in accordance with the current ITE "Purchase Specification for Flashing and Steady-Burn Warning Lights" (see Section 1A.11 of the MUTCD).

When warning lights are used, they shall be mounted on signs or channelizing devices in a manner that, if hit by an errant vehicle, they will not be likely to penetrate the windshield.

Guidance:

The maximum spacing for warning lights should be identical to the channelizing device spacing requirements.

Support:

The light weight and portability of warning lights are advantages that make these devices useful as supplements to the retroreflectorization on signs and channelizing devices. The flashing lights are effective in attracting road users' attention.

Option:

Warning lights may be used in either a steady-burn or flashing mode.

Standard:

Flashing warning lights shall not be used for delineation, as a series of flashers fails to identify the desired vehicle path.

Type A Low-Intensity Flashing warning lights, Type C Steady-Burn warning lights, and Type D 360-degree Steady-Burn warning lights shall be maintained so as to be capable of being visible on a clear night from a distance of 3,000 feet. Type B High-Intensity Flashing warning lights shall be maintained so as to be capable of being visible on a sunny day when viewed without the sun directly on or behind the device from a distance of 1,000 feet.

Warning lights shall have a minimum mounting height of 30 inch to the bottom of the lens.

Support:

Type A Low-Intensity Flashing warning lights are used to warn road users during nighttime hours that they are approaching or proceeding in a potentially hazardous area.

Option:

Type A warning lights may be mounted on channelizing devices.

Support:

Type B High-Intensity Flashing warning lights are used to warn road users during both daylight and nighttime hours that they are approaching a potentially hazardous area.

Option:

Type B warning lights are designed to operate 24 hours per day and may be mounted on post mounted advance warning signs or on independent supports.

Type C Steady-Burn warning lights and Type D 360-degree Steady-Burn warning lights may be used during nighttime hours to delineate the edge of the traveled way.

Guidance:

When used to delineate a curve, Type C and Type D 360-degree warning lights should only be used on devices on the outside of the curve, and not on the inside of the curve.

Section 6F.79 Steady-Burn Electric Lamps

Support:

Steady-Burn electric lamps are a series of low-wattage, yellow, electric lamps, generally hard-wired to a 110-volt external power source.

Option:

Steady-Burn electric lamps may be used in place of Type C Steady-Burn warning lights (see Section 6F.78).

Section 6F.80 Vehicle Warning Lights

Guidance:

Warning lights on vehicles should be mounted as to be viewed 360 degrees on vehicles without arrow panels, and 180 degrees on vehicles with arrow panels.

Standard:

Vehicle warning lights shall be a high intensity amber rotating, oscillating or strobe light or combinations of and meet the following conditions:

1. **Rotating amber lights shall consist of a minimum of two halogen sealed beams enclosed within an amber colored dome. Sealed beams shall be at least 60,000 Candlepower and shall have a flash rate of 80 to 100 flashes per minute. Rotating lights shall be approximately 8½ inches or greater in diameter and height (6 inches in height for multi-light bars). Rotating lights shall be mounted as to be viewed 360 degrees; double lights may be used to achieve 360 degree viewing.**
2. **Oscillating amber lights shall consist of a minimum 35 watt halogen bulb with an oscillating parabolic reflector which produces an up and down and side to side motion within an amber colored sealed lens. Oscillating amber lights shall be mounted as to be viewed 360 degrees; or may be used in combinations with amber rotating and/or strobe lights.**
3. **High intensity amber strobe lights shall consist of a double flash unit enclosed within an amber colored lens. Flash rate shall be 80±10 flashes per minute. Strobe lights shall be approximately 6 inches in diameter and 7½ inches in height or greater. Strobe lights shall be mounted as to be viewed 360 degrees; double lights may be used to achieve 360 degree viewing.**

Warning lights shall be used on all vehicles performing moving and mobile operations.

Option:

If the work operation vehicle in a moving/mobile operation is a motorized piece of equipment, such as a motor grader, grad-all, etc., warning lights may be optional.

Guidance:

During night operations, work vehicles entering and exiting the work area should be equipped with and have operating at least one high intensity amber rotating light or amber strobe light visible from 360 degrees.

Section 6F.81 Temporary Traffic Control Signals

Standard:

Temporary traffic control signals (see Section 4D.20 of the MUTCD) used to control road user movements through TTC zones and in other TTC situations shall meet the applicable provisions of Part 4 of the MUTCD.

Support:

Temporary traffic control signals are typically used in TTC zones such as temporary haul road crossings; temporary one-way operations along a one-lane, two-way highway; temporary one-way operations on bridges, reversible lanes, and intersections.

Standard:

One-lane, two-way vehicular traffic flow (see Chapter 4G of the MUTCD) requires an all-red interval of sufficient duration for road users to clear the portion of the TTC zone controlled by the traffic control signals. Safeguards shall be incorporated to avoid the possibility of conflicting signal indications at each end of the TTC zone. All equipment shall be in compliance with Section 238 of the VDOT Road and Bridge Specifications and in excellent working condition.

Guidance:

Where pedestrian traffic is detoured to a temporary traffic control signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals (see Section 4E.06 of the MUTCD) are needed for crossing along an alternate route.

When temporary traffic control signals are used, conflict monitors typical of traditional traffic control signal operations should be used.

Option:

Temporary traffic control signals may be portable or temporarily mounted on fixed supports.

Standard:

The District Traffic Engineer shall determine which traffic control signal will be used - portable or temporarily mounted on fixed supports.

The supports for temporary traffic control signals shall not encroach into the minimum required width of a "pedestrian access route" of 48 inch or an "alternate circulation path" of 36 inch.

Guidance:

Temporary traffic control signals should only be used in situations where temporary traffic control signals are preferable to other means of traffic control, such as changing the work staging or work zone size to eliminate one-way vehicular traffic movements, using flaggers to control one-way or crossing movements, using STOP or YIELD signs, and using warning devices alone.

Support:

Factors related to the design and application of temporary traffic control signals include the following:

A. Safety and road user needs;
B. Work staging and operations;
C. The feasibility of using other TTC strategies (for example, flaggers, providing space for two lanes, or detouring road users, including bicyclists and pedestrians);
D. Sight distance restrictions;
E. Human factors considerations (for example, lack of driver familiarity with temporary traffic control signals);
F. Road-user volumes including roadway and intersection capacity;
G. Affected side streets and driveways;
H. Vehicle speeds;
I. The placement of other TTC devices;
J. Parking;
K. Turning restrictions;
L. Pedestrians;
M. The nature of adjacent land uses (such as residential or commercial);
N. Legal authority;
O. Signal phasing and timing requirements;
P. Full-time or part-time operation;
Q. Actuated, fixed-time, or manual operation;
R. Power failures or other emergencies;
S. Inspection and maintenance needs;
T. Need for detailed placement, timing, and operation records; and
U. Operation by contractors or by others.

Although temporary traffic control signals can be mounted on trailers or lightweight portable supports, fixed supports offer superior resistance to displacement or damage by severe weather, vehicle impact, and vandalism.

Guidance:

Other TTC devices should be used to supplement temporary traffic control signals, including warning and regulatory signs, pavement markings, and channelizing devices.

The design and placement of temporary traffic control signals should include interconnection to other traffic control signals along the subject roadway.

Temporary traffic control signals not in use should be covered or removed.

Standard:

Temporary traffic control signals exposed to traffic shall have a minimum of four (4) Group 2 channelizing devices placed in a taper on the shoulder in advance of the signal for delineation.

Section 6F.82 Temporary Traffic Barriers

Support:

Temporary traffic barriers are devices designed to help prevent penetration by vehicles while minimizing injuries to vehicle occupants, and are designed to protect workers, bicyclists, and pedestrians.

The four primary functions of temporary traffic barriers are:

A. To keep vehicular traffic from entering work areas, such as excavations or material storage sites;
B. To separate workers, bicyclists, and pedestrians from motor vehicle traffic;
C. To separate opposing directions of vehicular traffic; and
D. To separate vehicular traffic, bicyclists, and pedestrians from the work area such as false work for bridges and other exposed objects.

Option:

Temporary traffic barriers, including shifting portable or movable barrier installations to accommodate varying directional vehicular traffic demands, may be used to separate two-way vehicular traffic.

Guidance:

Because the protective requirements of a TTC situation have priority in determining the need for temporary traffic barriers, their use should be based on an engineering study. When serving the additional function of channelizing vehicular traffic (see Section 6F.65), temporary traffic barriers should be a light color for increased visibility.

Standard:

Temporary traffic barriers shall be supplemented with standard delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility if they are used to channelize vehicular traffic. The delineation color shall match the applicable pavement marking color.

In order to mitigate the effect of striking the end of a temporary traffic barrier, the end shall be installed in accordance with AASHTO's "Roadside Design Guide" (see Section 1A.11) by flaring until the end is outside the acceptable clear zone or by providing crashworthy end treatments.

Barrier vertical panels 8 inches in width and 12 inches in height shall be installed on top of the barrier. Panels shall be installed on 48 foot centers in the transition or taper sections and on 96 foot centers in the tangent sections. A Type A flashing light shall be installed on the barrier at the breakpoint where the transition or taper ends and the barrier becomes parallel to the roadway. Barrier vertical panels shall have a fluorescent orange retroreflective surface in the direction of oncoming traffic.

The effect of striking the ends of barriers shall be mitigated by use of impact attenuators or by flaring the ends of barriers away from the traveled way. Following in the order of preference are the methods to be used in mitigating the effect of striking the ends of barriers:

1. **Where guardrail exists, the guardrail shall be attached to the barrier with the appropriate fixed object attachment.**
2. **Where cut slope exists, bury the barrier into the cut slope and provide for drainage as needed.**
3. **Extend end of barrier until it is beyond the established Clear Zone (see Appendix A for clear zone values).**
4. **When barrier end is inside the desired Clear Zone, attenuator service Type I or Type II (Sand Barrels) shall be used. Refer to Location and Design Division's Special Design Drawings. Contact Location and Design Division's Special Design Section for type and quantity needed for each location.**

Support:

More specific information on the use of temporary traffic barriers is contained in Chapters 8 and 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11 of the MUTCD).

Support:

A movable barrier is a linear system of connected barrier segments that can rapidly be shifted laterally by using a specially designed transfer vehicle. The transfer is accomplished in a manner that does not interfere with vehicular traffic in adjacent lanes. Applications of movable barriers include the following:

A. Closing an additional lane during work periods while maintaining the advantage of having the travel way separated from the work space by a barrier;
B. Closing an additional lane during off-peak periods to provide extra space for work activities without adversely impacting vehicular traffic flow; and
C. Creating a temporary reversible lane, thus providing unbalanced capacity favoring the major direction of vehicular traffic flow.

Section 6F.83 Crash Cushions

Support:

Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles, either by smoothly decelerating the vehicle to a stop when hit head-on, or by redirecting the errant vehicle. The two types of crash cushions that are used in TTC zones are stationary crash cushions and truck-mounted attenuators. Crash cushions in TTC zones help protect the drivers from the exposed ends of barriers, fixed objects, shadow vehicles, and other obstacles. Specific information on the use of crash cushions can be found in AASHTO's "Roadside Design Guide" (see Section 1A.11 of the MUTCD).

Standard:

Crash cushions shall be crashworthy conforming to the requirements of National Cooperative Highway Research Program Report (NCHRP) 350, except as otherwise indicated herein. They shall also be designed for each application to stop or redirect errant vehicles under prescribed conditions. Crash cushions shall be periodically inspected to verify that they have not been hit or damaged. Damaged crash cushions shall be promptly repaired or replaced to maintain their crashworthiness.

The rear panel of the TMA cushion shall have alternate 6-inch wide orange and black chevron (inverted v) stripes. Stripes shall be sloped at a 45 degrees angle downward in both directions from the upper center of the rear panel. Stripes shall be fabricated from fluorescent orange retroreflective sheeting conforming to VDOT specifications.

Support:

Stationary crash cushions are used in the same manner as permanent highway installations to protect drivers from the exposed ends of barriers, fixed objects, and other obstacles.

Standard:

Stationary crash cushions shall be designed for the specific application intended.

Truck-mounted attenuators (TMA's) shall be energy-absorbing devices attached to the rear of shadow trucks. If used, the shadow vehicle with the attenuator shall be located in advance of the work area, workers, or equipment to reduce the severity of rear-end crashes from errant vehicles.

Support:

Trucks are often used as shadow vehicles to protect workers or work equipment from errant vehicles. These shadow vehicles are normally equipped with flashing arrows, changeable message signs, and/or high-intensity rotating, oscillating, or strobe lights located properly in advance of the workers and/or equipment that they are protecting. However, these shadow vehicles might themselves cause injuries to occupants of the errant vehicles if they are not equipped with truck-mounted attenuators.

Standard:

Shadow trucks with TMA's shall be used:

A. When closing a lane on a four or more lane roadway with a posted speed of 45 mph or greater;
B. On ramps and loops of interstate and limited access highways;
C. When a mobile operation occupies all or part of the travel lane on a multi-lane roadway with a posted speed of 45 mph or greater;
D. Other locations where the District Traffic Engineer feels such protection is warranted.

TMA units used on all Limited Access highways, as well as on all four or more lane primary roadways with posted speeds of 55 mph or greater, shall be NCHRP 350, Test Level 3 units. On July 1, 2005, all TMA units shall conform to the requirements of NCHRP 350, Test Level 3 regardless of where the units will be used.

Option:

NCHRP 230 and NCHRP 350, Test Level 2 units may be used on all roadways except Limited Access Highways and four or more lane Primary roadways with posted speeds of 55 mph or greater until July 1, 2005.

Standard:

The shadow truck with a TMA shall be positioned a sufficient distance (50-100 feet) in advance of the workers or equipment being protected to allow for appropriate vehicle roll-ahead, but not so far that errant vehicles will travel around the vehicle and strike the protected workers and/or equipment.

When all work crews, equipment, or hazards have been sufficiently removed from the lane closure, the shadow truck shall be removed.

Guidance:

Shadow trucks should be used when installing and removing lane roadway. In mobile operations, the shadow truck with a truck-mounted attenuator should be 1000 feet ± in advance of the work vehicle.

Option:

Shadow trucks with TMA's may be eliminated when their use would destroy or damage uncured asphalt.

For additional operations or hazards located further downstream from the taper, a shadow vehicle without a truck-mounted attenuator may be used for protection, placed a sufficient distance (50-100 feet) in advance of the hazard.

Support:

Asphalt pavement resurfacing operations are typically those instances where shadow trucks with TMA's would destroy or damage uncured asphalt. Other operations being accomplished under the same project would still require the use of TMA's if their use would not destroy or damage the uncured asphalt. Examples of those operations include shoulder work where the adjacent lane is required to be closed, pavement marking applications closures from the (except pavement marking tape being inlaid into the new asphalt surface), and other similar type operations.

Standard:

During operation as a shadow vehicle with a TMA, the truck shall not be used as a work operations vehicle. All material and/or equipment on the shadow vehicle TMA shall be properly secured to prevent spillage if struck by an errant vehicle.

Guidance:

The attenuator should be in the full down-and-lack position when in use as a protection vehicle. For stationary operations, the truck-mounted attenuator should be placed in accordance with the manufacturer's recommendations.

Standard:

The TMA shall be visually inspected daily prior to use and shall be in accordance with and used by the manufacturer's specifications.

Support:

Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11) contains additional information regarding the use of shadow vehicles.

Section 6F.84 Vehicle-Arresting Systems

Support:

Vehicle-arresting systems are designed to prevent penetration into activity areas while providing for smooth, reasonably safe deceleration for the errant vehicles. They can consist of portable netting, cables, and energy-absorbing anchors.

Guidance:

When used, a vehicle-arresting system should be used in accordance with the manufacturer's specifications, and should be located so that vehicles are not likely to penetrate the location that the system is designed to protect.

Section 6F.85 Rumble Strips

Support:

Transverse rumble strips consist of intermittent narrow, transverse areas of rough-textured or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to unusual vehicular traffic conditions. Through noise and vibration they attract the driver's attention to such features as unexpected changes in alignment and to conditions requiring a stop.

Longitudinal rumble strips consist of a series of rough-textured or slightly raised or depressed road surfaces located along the shoulder to alert road users that they are leaving the travel lanes.

Standard:

If it is desirable to use a color other than the color of the pavement for a longitudinal rumble strip, the color of the rumble strip shall be the same color as the longitudinal line the rumble strip supplements.

If the color of a transverse rumble strip used within a travel lane is not the color of the pavement, the color of the rumble strip shall be white.

Option:

Intervals between transverse rumble strips may be reduced as the distance to the approached conditions is diminished in order to convey an impression that a closure speed is too fast and/or that an action is imminent. A sign warning drivers of the onset of rumble strips may be placed in advance of any transverse rumble strip installation.

Guidance:

Transverse rumble strips should be placed transverse to vehicular traffic movement. They should not adversely affect overall pavement skid resistance under wet or dry conditions.

In urban areas, even though a closer spacing might be warranted, transverse rumble strips should be designed in a manner that does not promote unnecessary braking or erratic steering maneuvers by road users.

Transverse rumble strips should not be placed on sharp horizontal or vertical curves.

Rumble strips should not be placed through pedestrian crossings or on bicycle routes.

Transverse rumble strips should not be placed on roadways used by bicyclists unless a minimum clear path 4 feet is provided at each edge of the roadway or on each paved shoulder as described in AASHTO's "Guide to the Development of Bicycle Facilities" (see Section 1A.11 of the MUTCD).

Longitudinal rumble strips should not be placed on the shoulder of a roadway that is used by bicyclists unless a minimum clear path of 4 feet is also provided on the shoulder.

Sections 6F.86 Screens

Support:

Screens are used to block the road users' view of activities that can be distracting. Screens might improve safety and motor vehicle traffic flow where volumes approach the roadway capacity because they discourage gawking and reduce headlight glare from oncoming motor vehicle traffic.

Guidance:

Screens should not be mounted where they could adversely restrict road user visibility and sight distance and adversely affect the reasonably safe operation of vehicles.

The use of screens mounted on the top of temporary traffic barriers should be considered in crossover applications whenever multi-lane traffic is reduced to two-way motor vehicle traffic to reduce headlight glare from oncoming traffic and improve mobility through the crossover.

Design of screens should be in accordance with Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11 of the MUTCD).

Section 6F.87 Future and Experimental Devices

Support:

Virginia, as well as other States, FHWA, AASHTO, the Transportation Research Board, and other organizations conduct research and experimentation on new traffic control and safety devices. Users of this Manual are encouraged to stay abreast of these current efforts and to use such devices with care so as to avoid presenting road users with unusual or confusing situations that might be abnormal or unexpected.

Standard:

New traffic control devices shall conform to the provisions for design, use, and application set forth in this Manual. New traffic control devices that do not conform with the provisions in this Manual shall be subject to experimentation, documentation, and adoption following the provisions of Section 1A.10 of the MUTCD.

Approval shall be obtained from the State Traffic Engineer of the Virginia Department of Transportation for new traffic control devices prior to their use and/or implementation.

CHAPTER 6G. TYPE OF TEMPORARY TRAFFIC CONTROL ZONE ACTIVITIES

Section 6G.01 Typical Applications

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

Each TTC zone is different. Many variables, such as location of work, highway type, geometrics, vertical and horizontal alignment, intersections, interchanges, road user volumes, road vehicle mix (buses, trucks, and cars), and road user speeds affect the needs of each zone. The goal of TTC in work zones is safety with minimum disruption to road users. The key factor in promoting TTC zone safety is proper judgment.

Typical figures of TTC zones are organized according to duration, location, type of work, and highway type. Table 6H-1 is an index of these Typical Traffic Control figures. These typical figures include the use of various TTC methods, but do not include a layout for every conceivable work situation.

Guidance:

Typical traffic control figures should be altered, when necessary, to fit the conditions of a particular TTC zone. The alteration should be documented.

Option:

Other devices may be added to supplement the devices shown in the typical applications, while others may be deleted. The sign spacings and taper lengths may be increased to provide additional time or space for driver response.

Support:

Decisions regarding the selection of the most appropriate typical traffic control figure to use as a guide for a specific TTC zone require an understanding of each situation. Although there are many ways of categorizing TTC zone applications, the four factors mentioned earlier (work duration, work location, work type, and highway type) are used to characterize the typical applications illustrated in Chapter 6H.

Section 6G.02 Work Duration

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Work duration is a major factor in determining the number and types of devices used in TTC zones. The duration of a TTC zone is defined relative to the length of time a work operation occupies a spot location.

Standard:

The five categories of work duration and their time at a location shall be:

A. Long-term stationary is work that occupies a location more than 3 days.
B. Intermediate-term stationary is work that occupies a location more than one daylight period up to 3 days, or nighttime work lasting more than 1 hour.
C. Short-term stationary is daytime work that occupies a location for more than 1 hour within a single daylight period.
D. Short duration is work that occupies a location up to 1 hour.
E. Mobile is work that moves intermittently (1-15 minutes) or continuously.

Support:

At long-term stationary TTC zones, there is ample time to install and realize benefits from the full range of TTC procedures and devices that are available for use. Generally, increased number of channelizing devices, temporary roadways, and temporary traffic barriers are used.

Standard:

Since long-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in long-term stationary TTC zones. In addition, Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned cones.

Guidance:

Inappropriate pavement markings in long-term stationary (longer than three days) TTC zones should be removed and replaced with temporary pavement markings.

Support:

In intermediate-term stationary TTC zones, it might not be feasible or practical to use procedures or devices that would be desirable for long-term stationary temporary traffic control zones, such as altered pavement markings, temporary traffic barriers, and temporary roadways. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time. In other instances, there might be insufficient pay-back time to economically justify more elaborate TTC measures.

Standard:

Since intermediate-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in intermediate-term stationary TTC zones. In addition, Group 2 channelizing devices shall be used in place of cones when the work crew is not present to align displaced or overturned cones.

Support:

Most maintenance and utility operations are short-term stationary work.

As compared to stationary operations, mobile and short-duration operations are activities that might involve different treatments. Devices having greater mobility might be necessary such as signs mounted on trucks. Devices that are larger, more imposing, or more visible can be used effectively and economically. The mobility of the TTC zone is important.

Maintaining reasonably safe work and road user conditions is a paramount goal in carrying out mobile operations.

Guidance:

Safety in short-duration or mobile operations should not be compromised by using fewer devices simply because the operation will frequently change its location.

Option:

Appropriately colored or marked vehicles with rotating/strobe lights, and augmented with signs or arrow panels, may be used in place of static signs and channelizing devices for short duration or mobile operations.

Support:

During short-duration work, it often takes longer to set up and remove the TTC zone than to perform the work. Workers face hazards in setting up and taking down the TTC zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed.

Option:

Considering these factors, simplified control procedures may be warranted for short-duration work. A reduction in the number of devices may be offset by the use of other more dominant devices such as high-intensity amber rotating, oscillating, or strobe lights on work vehicles.

Support:

Mobile operations often involve frequent short stops of 15 minutes or less for activities such as litter cleanup, pothole patching, or utility operations, and are similar to short-duration operations.

Guidance:

Warning signs, high-intensity amber rotating, oscillating, or strobe lights on a vehicle, and/or channelizing devices should be used and moved periodically to keep them near the mobile work area.

Option:

Flaggers may be used for mobile operations that often involve frequent short stops.

Support:

Mobile operations also include work activities where workers and equipment move along the road without stopping, usually at slow speeds. The advance warning area moves with the work area.

Guidance:

When mobile operations are being performed, a shadow vehicle equipped with an arrow panel and a sign should follow the work vehicle, especially when vehicular traffic speeds or volumes are high. Where feasible, warning signs should be placed along the roadway and moved periodically as work progresses.

Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours.

Standard:

If there are mobile operations on a high-speed travel lane of a multilane divided highway, arrow panels shall be used. Additionally, if posted speeds are 45 mph or greater, a Truck Mounted Attenuator (TMA) shall be used on the shadow vehicle(s).

Option:

For mobile operations that move at speeds less than 3 mph, mobile signs or stationary signing that is periodically retrieved and repositioned in the advance warning area may be used.

At higher speeds, vehicles may be used as components of the TTC zones for mobile operations. Appropriately colored and marked vehicles with signs, flags, high-intensity amber rotating, oscillating, or strobe lights, truck-mounted attenuators, and arrow panels or portable changeable message signs may follow a train of moving work vehicles.

For some continuously moving operations, such as street sweeping and snow removal, a single work vehicle with appropriate warning devices on the vehicle may be used to provide warning to approaching road users.

Standard:

Mobile operations that move at speeds greater than 20 mph, such as pavement marking operations, shall have appropriate devices on the equipment (that is, high-intensity amber rotating, oscillating, or strobe lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.

Section 6G.03 Location of Work

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

The choice of TTC needed for a TTC zone depends upon where the work is located. As a general rule, the closer the work is to road users (including bicyclists and pedestrians), the greater the number of TTC devices that are needed. Procedures are described later in this Chapter for establishing TTC zones in the following locations:

A. Outside the shoulder;
B. On the shoulder with no encroachment;
C. On the shoulder with minor encroachment;
D. Within the median; and
E. Within the traveled way.

Standard:

When the work space is within the traveled way, advance warning signs shall provide a general warning message (ROAD WORK AHEAD), advise that work is taking place (RIGHT or LEFT LANE CLOSED AHEAD) and direct and supply information about highway conditions (KEEP RIGHT, or LEFT and LANE ENDS MERGE RIGHT or LEFT). In addition, TTC devices shall provide a clear travel path through the TTC zone.

Section 6G.04 Modifications To Fulfill Special Needs

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

The typical traffic control figures in Chapter 6H illustrate commonly encountered situations in which TTC devices are employed. Roadway characteristics to consider in selecting the appropriate temporary traffic control figure also include travel speeds and traffic volumes. The definition of a high speed roadway is prevailing speeds of 45 mph and greater, and low speed roadway of speeds of less than 45 mph. High volume roadways have an average daily traffic (ADT) of 500 or more vehicles per day, while low volume roadways have less than 500 vehicles per day.

Option:

Other devices may be added to supplement the devices indicated in the typical applications, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

Guidance:

When conditions are more complex, typical traffic control figures should be modified by giving particular attention to the provisions set forth in Chapter 6B of the MUTCD and by incorporating appropriate devices and practices from the following list:

A. Additional devices:
1. Signs
2. Arrow panels
3. More channelizing devices at closer spacing (see Section 6F.68 for information regarding detectable edging for pedestrians)
4. Temporary raised pavement markers
5. High-level warning devices
6. Portable changeable message signs
7. Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals).
8. Temporary traffic barriers
9. Crash cushions
10. Screens
11. Rumble strips
12. More delineation

B. Upgrading of devices:
1. A full complement of standard pavement markings
2. Brighter and/or wider pavement markings
3. Larger and/or brighter signs
4. Channelizing devices with greater conspicuity
5. Temporary traffic barriers in place of channelizing devices

C. Improved geometrics at detours or crossovers, giving particular attention to the provisions set forth in Chapter 6B

D. Increased distances:
1. Longer advance warning area
2. Longer tapers

E. Lighting:
1. Temporary roadway lighting
2. Flashing lights for isolated hazards
3. Illuminated signs
4. Floodlights

Where pedestrian or bicycle usage is high, typical traffic control figures should also be modified by giving particular attention to the provisions set forth in Chapter 6D, Section 6F.68, and other Sections of Part 6 related to accessibility and detectability provisions in TTC zones.

Section 6G.05 Work Affecting Pedestrian and Bicycle Facilities

Support:

It is not uncommon, particularly in urban areas, that road work and the associated TTC will affect existing pedestrian or bicycle facilities. It is essential that the needs of all road users, including pedestrians with disabilities, are considered in TTC zones.

In addition to specific provisions identified in Sections 6G.06, 6G.07, 6G.08, 6G.10, 6G.11, 6G.12, and 6G.13, there are a number of provisions that might be applicable for all of the types of activities identified in this Chapter.

Guidance:

Where pedestrian or bicycle usage is high, the typical applications should be modified by giving particular attention to the provisions set forth in Chapters 6D and 6G, Section 6F.68, and in other Sections of Part 6 related to accessibility and detectability provisions in TTC zones.

Pedestrians should be separated from the worksite by appropriate devices that maintain the accessibility and detectability for pedestrians with disabilities.

Bicyclists and pedestrians should not be exposed to unprotected excavations, open utility access, overhanging equipment, or other such conditions.

Except for short duration and mobile operations, when a highway shoulder is occupied, a SHOULDER WORK AHEAD sign should be placed in advance of the activity area. When work is performed on a paved shoulder 8 feet or more in width, channelizing devices should be placed on a taper having a length that conforms to the requirements of a shoulder taper. Signs should be placed such that they do not narrow any existing pedestrian passages to less than 48 inch.

Pedestrian detours should be avoided since pedestrians rarely observe them and the cost of providing accessibility and detectability might outweigh the cost of maintaining a continuous route. Whenever possible, work should be done in a manner that does not create a need to detour pedestrians from existing routes or crossings.

Standard:

Where pedestrian routes are closed, alternate pedestrian routes shall be provided.

When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.

Section 6G.06 Work Outside of Shoulder

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

When work is being performed off the roadway (beyond the shoulders, but within the right-of-way), little TTC might be needed. TTC generally is not needed where work is confined to an area 30 feet or more from the edge of the traveled way and out of the clear zone (see Appendix A for clear zone values). However, TTC is appropriate where distracting situations exist, such as vehicles parked on the shoulder, vehicles accessing the work site via the highway, and equipment traveling on or crossing the roadway to perform the work operations (for example, mowing). For work beyond the shoulder, see Figure TTC-1.0 and TTC-2.0.

Guidance:

Where the above situations exist, a single warning sign, such as ROAD WORK AHEAD, should be used. If the equipment travels on the roadway, the equipment should be equipped with appropriate flags, high-intensity amber rotating, oscillating, or strobe lights, and/or a SLOW MOVING VEHICLE sign or symbol.

If work vehicles are on the shoulder, a SHOULDER WORK AHEAD sign should be used. For mowing operations, the sign MOWING AHEAD and WATCH FOR SLOW MOVING VEHICLES should be used.

Option:

Where the activity is spread out over a distance of more than 2 miles, the SHOULDER WORK AHEAD sign may be repeated every one (1) mile.

A supplementary plaque with the message NEXT X MILES may be used.

Guidance:

A general warning sign like ROAD WORK AHEAD should be used if workers and equipment must occasionally move onto the shoulder.

Section 6G.07 Work on the Shoulder with No Encroachment

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

The provisions of this Section apply to short-term (daytime work that occupies a location for more than 1 hour, but less than 12 hours) through long-term stationary (more than 3 days) operations.

Standard:

When paved shoulders having a width of 8 foot or more are closed, at least one advance warning sign shall be used. In addition, channelizing devices shall be used to close the shoulder in advance to delineate the beginning of the work space and direct motor vehicle traffic to remain within the traveled way.

Guidance:

When paved shoulders having a width of 8 feet or more are closed on freeways and expressways, road users should be warned about potential disabled vehicles that cannot get off the traveled way. An initial general warning sign (such as ROAD WORK AHEAD) should be used, followed by a RIGHT or LEFT SHOULDER CLOSED sign. Where the end of the shoulder closure extends beyond the distance which can be perceived by road users, a supplementary plaque bearing the message NEXT X FEET or MILES should be placed below the SHOULDER CLOSED sign. On multi-lane, divided highways, signs advising of shoulder work or the condition of the shoulder should be placed only on the side of the affected shoulder.

When an improved shoulder is closed on a high-speed roadway, it should be treated as a closure of a portion of the road system because road users expect to be able to use it in emergencies. Road users should be given ample advance warning that shoulders are closed for use as refuge areas throughout a specified length of the approaching TTC zone. The sign(s) should read SHOULDER CLOSED AHEAD with distances indicated. The work space on the shoulder should be closed off by a taper or channelizing devices with a length of 0.33 L using the formulas in Table 6C-2.

Standard:

When the shoulder is not occupied but work has adversely affected its condition, the LOW SHOULDER, SOFT SHOULDER, or SHOULDER DROP OFF sign shall be used, as appropriate.

Where the condition extends over a distance in excess of 1 mile, the sign shall be repeated at one (1) mile intervals.

Option:

In addition, a supplementary plaque bearing the message NEXT X MILES may be used. Temporary traffic barriers may be needed to inhibit encroachment of errant vehicles into the work space and to protect workers.

Standard:

When used for shoulder work, arrow panels shall operate only in the four-corner caution mode.

Support:

A typical traffic control figure for stationary work operations on shoulders is shown in Figure TTC-4.0. Short duration or mobile work on shoulders is shown in Figure TTC-3.0. Work on freeway shoulders is shown in Figure TTC-6.0.

Section 6G.08 Work on the Shoulder with Minor Encroachment

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Guidance:

When work takes up part of a lane, vehicular traffic volumes, vehicle mix (buses, trucks, cars, motorcycles, and bicycles), speed, and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment permits a remaining lane width of 11 feet, the lane should be closed.

Truck off-tracking should be considered when determining whether the minimum lane width of 11 feet is adequate.

Option:

A lane width of 10 feet may be used for short-term stationary work on low-volume (less than 500 vehicles per day), low-speed (under 45 mph) roadways when vehicular traffic does not include longer and wider heavy commercial vehicles.

A lane width of 10 feet may be used for work activities located on entrance and exit ramps of limited access highways.

Guidance:

Truck off-tracking should be considered when determining whether the minimum lane width of 10 feet is adequate for entrance and exit ramps (see figure TTC-27.0).

Support:

Figure TTC-5.0 illustrates a method for handling vehicular traffic where the stationary or short duration work space encroaches slightly into the traveled way.

Standard:

Due to occasional travel by over width vehicles, work zones which reduce the one way travel path of roadways or ramps to widths less than 14'-0'' wide measured from edgeline to edgeline shall be signed with a ROAD NARROWS (W5-1) or RAMP NARROWS (W5-5) sign and a supplemental plaque mounted below stating the actual width of the roadway or ramp in feet and inches.

Guidance:

The ROAD NARROWS or RAMP NARROWS sign assembly should be placed approximately 1000 feet in advance of the restricted location, as well as in advance of the last alternate route prior to the lane width restriction.

Section 6G.09 Work Within the Median

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Guidance:

If work in the median of a divided highway is within 15 feet from the edge of the traveled way for either direction of travel, or within the clear zone as determined by Appendix A, temporary traffic control should be used through the use of advance warning signs and channelizing devices.

Option:

When working in the median, temporary traffic control, especially advance warning signage, may be required in both directions of travel.

Section 6G.10 Work Within the Traveled Way of Two-Lane Highways

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Detour signs are used to direct road users onto another roadway. At diversions, road users are directed onto a temporary roadway or alignment placed within or adjacent to the right-of-way. Examples of typical applications for detouring or diverting road users on two-lane highways can be found in Figures 6H-7, 6H-8, and 6H-9 of the MUTCD. Figure 6H-7 illustrates the controls around an area where a section of roadway has been closed and a diversion has been constructed. Channelizing devices and pavement markings are used to indicate the transition to the temporary roadway.

Standard:

Detours and diversions shall be reviewed and approved by the District Traffic Engineer prior to implementation.

Guidance:

When a detour is long, Detour Marker (M4-8) or Detour (M4-9) signs should be installed to remind and reassure road users periodically that they are still successfully following the detour.

When an entire roadway is closed, a detour should be provided and road users should be warned in advance of the closure. If local road users are allowed to use the roadway up to the closure, the ROAD CLOSED TO THRU TRAFFIC, and LOCAL TRAFFIC ONLY signs should be used. The portion of the road open to local road users should have adequate signing, marking, and delineation.

Detours should be signed so that road users will be able to traverse the entire detour route and back to the original roadway.

Support:

Techniques for controlling vehicular traffic under one-lane, two-way conditions are described in Section 6C.10.

Option:

Flaggers may be used as shown in Figure TTC-18.0.

STOP/YIELD sign control may be used on roads with low traffic volumes (under 500 vehicles per day) as approved by the District Traffic Engineer.

Section 6G.11 Work Within the Traveled Way of Urban Streets

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

In urban TTC zones, decisions are needed on how to control vehicular traffic, such as how many lanes are required, whether any turns need to be prohibited at intersections, and how to maintain access to business, industrial, and residential areas.

Pedestrian traffic needs separate attention. Chapter 6D contains information regarding pedestrian movements near TTC zones.

Standard:

If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.

If the TTC zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided (see Part 9 of the MUTCD).

Where transit stops are affected or relocated because of work activity, access to temporary transit stops shall be provided.

Guidance:

If a designated bicycle route is closed because of the work being done, a signed alternate route should be provided. Bicyclists should not be directed onto the path used by pedestrians.

Work sites within the intersection should be protected against inadvertent pedestrian incursion by providing detectable channelizing devices.

Support:

Utility work takes place both within and outside the roadway to construct and maintain services such as power, gas, light, water, or telecommunications. Operations often involve intersections, since that is where many of the network junctions occur. The work force is usually small, only a few vehicles are involved, and the number and types of TTC devices placed in the TTC zone is usually minimal.

Standard:

All TTC devices shall be retroreflective or illuminated if utility work is performed during nighttime hours.

Guidance:

As discussed under short-duration projects, however, the reduced number of devices in utility work zones should be offset by the use of high-visibility devices, such as high-intensity amber rotating, oscillating, or strobe lights on work vehicles or high-level warning devices.

Support:

Figures TTC-17.0, TTC-18.0, and TTC 20.0 through TTC 23.0 are examples of typical applications for utility operations. Other typical applications might apply as well.

Section 6G.12 Work Within the Traveled Way of Multi-lane, Nonaccess Controlled Highways

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Work on multi-lane (two or more lanes of moving motor vehicle traffic in one direction) highways is divided into right-lane closures, left-lane closures, interior-lane closures, multiple-lane closures, and closures on five-lane roadways.

Standard:

When a lane is closed on a multi-lane road for other than a mobile operation, a transition area containing a merging taper and an arrow panel shall be used.

Guidance:

When justified by an engineering study, temporary traffic barriers should be used to prevent incursions of errant vehicles into hazardous areas or work space.

Standard:

When temporary traffic barriers are placed immediately adjacent to the traveled way, they shall be equipped with appropriate channelizing devices, delineation, and/or other TTC devices. For lane closures, the merging taper shall use channelizing devices and the temporary traffic barrier shall be placed beyond the transition area.

Support:

It must be recognized that although temporary traffic barriers are shown in several of the typical applications of Chapter 6H, they are not considered to be TTC devices in themselves.

Figure TTC-16.0 illustrates a lane closure in which temporary traffic barriers are used.

Option:

When the right lane is closed, TTC similar to that shown in Figure TTC-16.0 may be used for undivided or divided four-lane roads.

Guidance:

If morning and evening peak hour vehicular traffic volumes in the two directions are uneven and the greater volume is on the side where the work is being done in the right lane, consideration should be given to closing the inside lane for opposing vehicular traffic and making the lane available to the side with heavier vehicular traffic.

If the larger vehicular traffic volume changes to the opposite direction at a different time of the day, the TTC should be changed to allow two lanes for opposing vehicular traffic by moving the devices from the opposing lane back to the centerline. When it is necessary to create a temporary centerline that is not consistent with the pavement markings, channelizing devices should be used and closely spaced.

Option:

When closing a left lane on a multi-lane undivided road, as vehicular traffic flow permits, the two interior lanes may be closed to provide drivers and workers additional lateral clearance and to provide access to the work space.

Standard:

When only the left lane is closed on undivided roads, channelizing devices shall be placed along the centerline as well as along the adjacent lane.

Guidance:

When an interior lane is closed, an adjacent lane should also be considered for closure to provide additional space for vehicles and materials and to facilitate the movement of equipment within the work space.

When multiple lanes in one direction are closed, a capacity analysis should be made to determine the number of lanes needed to accommodate motor vehicle traffic needs. Vehicular traffic should be moved over one lane at a time. As shown in Figure TTC-14.0, the tapers should be separated by a distance of 2L, with L being determined by the formulas in Table 6C-2.

Standard:

When a directional roadway is closed, inapplicable WRONG WAY signs and markings, and other existing traffic control devices at intersections within the temporary two-lane, two-way operations section shall be covered, removed, or obliterated.

Option:

When half the road is closed on an undivided highway, both directions of vehicular traffic may be accommodated as shown in Figure TTC-30.0. When both interior lanes are closed, temporary traffic controls may be used as indicated in Figure TTC-14.0. When a roadway must be closed on a divided highway, a median crossover may be used (see Section 6G.16).

Support:

TTC for lane closures on five-lane roads is similar to other multi-lane undivided roads. Figure TTC-30.0 can be adapted for use on five-lane roads. Figure TTC-14.0 can be used on a five-lane road for short duration and mobile operations.

Standard:

When work is being performed over a roadway open to traffic (on bridges, overhead signs, traffic signals, etc.) the traveled lanes(s) or shoulder that the work operation is over shall be closed, unless it is physically improbable materials, equipment or personnel could fall into the open lane or shoulder.

Option:

A mobile closure may be an acceptable method of TTC depending on traffic volumes and location of the overhead work.

Section 6G.12a Steel Plate Conspicuity and Warning

Support:

Steel plates are occasionally used in areas where an excavation is made in the roadway for repairs or utility work, providing temporary protection to motorists and pedestrians and continued movement of traffic. This situation provides a challenge to motorcyclists when they traverse a steel plate unexpectedly in the roadway.

Standard:

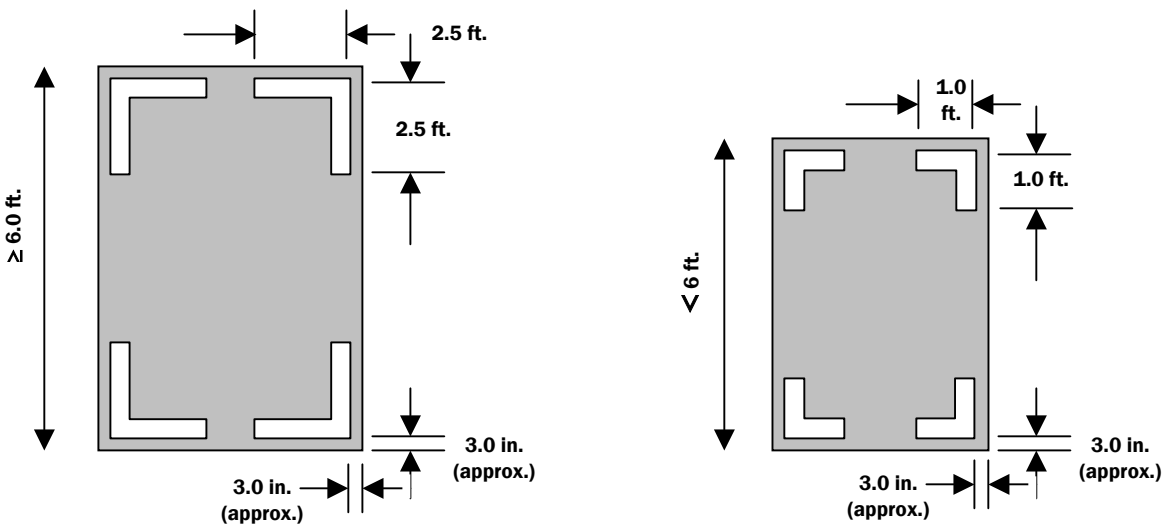
Steel plates installed in connection with temporary repairs on roadways open to traffic shall be marked with durable, highly reflective white pavement marking tape, no less than 4 inches in width, conforming to Type B, Class VI of the department's specifications and shall be recommended for turning movements by the manufacturer.

Placement of the reflective white pavement marking shall be as shown in Figure 6G-1. The markings shall be maintained throughout the use of the plate in a condition that provides sufficient retroreflectivity to distinguish the corners of the steel plate. Replacement of the markings shall be based on a visual assessment performed periodically at night by a moving inspection vehicle. Any leg of the marking that has lost fifty percent or more of its conspicuity shall be replaced.

A STEEL PLATES AHEAD sign shall be placed in advance of the temporary steel plate to warn approaching motorists of the changed roadway condition (see section 6F.47a).

Option:

Additional warning signs may be needed due to the complexity of the work location and other field conditions.



LEFT: Steel plates with any side greater than or equal to 6 feet in length

RIGHT: Steel plates with all sides less than 6 feet in length

FIGURE 6G-1, STEEL PLATE CONSPICUITY MARKINGS

Section 6G.13 Work Within the Traveled Way at an Intersection

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

The typical applications for intersections are classified according to the location of the work space with respect to the intersection area (as defined by the extension of the curb or edge lines). The three classifications are near side, far side, and in-the-intersection. Work spaces often extend into more than one portion of the intersection. For example, work in one quadrant often creates a near-side work space on one street and a far-side work space on the cross street. In such instances, an appropriate TTC plan is obtained by combining features shown in two or more of the intersection and pedestrian typical applications.

TTC zones in the vicinity of intersections might block movements and interfere with normal road user flows. Such conflicts frequently occur at more complex signalized intersections having such features as traffic signal heads over particular lanes, lanes allocated to specific movements, multiple signal phases, signal detectors for actuated control, and accessible pedestrian signals and detectors.

Guidance:

The effect of the work upon signal operation should be considered, such as signal phasing for ensuring adequate capacity, maintaining or adjusting signal detectors, and ensuring the appropriate visibility of signal heads.

Standard:

When work will occur near an intersection where operational, capacity, or pedestrian accessibility problems are anticipated, VDOT or the agency having jurisdiction shall be contacted.

Guidance:

For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical applications depict urban intersections on arterial streets. Where the posted speed limit, the off-peak 85th-percentile speed prior to the work starting, or the anticipated speed exceeds 40 mph, additional warning signs should be used in the advance warning area.

Pedestrian crossings near TTC sites should be separated from the worksite by appropriate barriers that maintain the accessibility and detectability for pedestrians with disabilities.

Support:

Near-side work spaces, as depicted in Figure TTC-20.0, are simply handled as a midblock lane closure. A problem that might occur with near-side lane closure is a reduction in capacity, which during certain hours of operation could result in congestion and backups.

Option:

When near-side work spaces are used, an exclusive turn lane may be used for through vehicular traffic.

Where space is restricted in advance of near-side work spaces, as with short block spacings, two warning signs may be used in the advance warning area, and a third action-type warning or a regulatory sign (such as Keep Left) may be placed within the transition area.

Support:

Far-side work spaces, as depicted in Figure TTC-21.0, involve additional treatment because road users typically enter the activity area by straight-through and left- or right-turning movements.

Guidance:

When a lane through an intersection must be closed on the far side, it should also be closed on the near-side approach to preclude merging movements within the intersection. In addition, if multiple turn lanes feed into the far side closure, one lane of the dual turn lane should be closed.

Option:

If there are a significant number of vehicles turning from a near-side lane that is closed on the far side, the near-side lane may be converted to an exclusive turn lane.

Support:

Figure TTC-22.0 provides guidance on applicable procedures for work performed within the intersection.

Option:

If the work is within the intersection, any of the following strategies may be used:

A. A small work space so that road users can move around it, as shown in Figure TTC-22.0;
B. Use of uniformed law enforcement officers to direct road users;
C. Work in stages so the work space is kept to a minimum;
D. Road closures or upstream diversions to reduce road user volumes; and
E. Use of certified Flaggers on each approach to the intersection.

Guidance:

Depending on road user conditions, a certified flagger(s) and/or a uniformed law enforcement officer(s) should be used to control road users.

Standard:

Certified flaggers shall not direct vehicles through a red signal at an intersection since they are not authorized to do so (see Section 46.2-834 of Highway Laws of Virginia).

Section 6G.14 Work Within the Traveled Way of Freeways and Expressways

Support:

Problems of TTC might occur under the special conditions encountered where vehicular traffic must be moved through or around TTC zones on high-speed, high-volume roadways. Although the general principles outlined in the previous Sections of this Manual are applicable to all types of highways, high-speed, access-controlled highways need special attention in order to reasonably safely and efficiently accommodate vehicular traffic while also protecting work forces. The road user volumes, road vehicle mix (buses, trucks, cars, and motorcycles), and speed of vehicles on these facilities require that careful TTC procedures be implemented, for example, to induce critical merging maneuvers well in advance of work spaces and in a manner that creates minimum turbulence and delay in the vehicular traffic stream. These situations often require more conspicuous devices than specified for normal rural highway or urban street use. However, the same important basic considerations of uniformity and standardization of general principles apply for all roadways.

Work under high-speed, high-volume vehicular traffic on a controlled access highway is complicated by the roadway design and operational features. The presence of a median that establishes separate roadways for directional vehicular traffic flow might prohibit the closing of one of the roadways or the diverting of vehicular traffic to the other roadway. Lack of access to and from adjacent roadways prohibits rerouting of vehicular traffic away from the work space in many cases. Other conditions exist where work must be limited to night hours, thereby necessitating increased use of warning lights, illumination of work spaces, and advance warning systems.

TTC for a typical lane closure on a divided highway is shown in Figure TTC-12.0 and TTC-13.0. Temporary traffic controls for short duration and mobile operations on freeways are shown in Figure TTC-8.0. A typical application for shifting vehicular traffic lanes around a work space is shown in Figure TTC-15.0. TTC for multiple and interior lane closures on a freeway is shown in Figures TTC-14.0.

Guidance:

The method for closing an interior lane when the open lanes have the capacity to carry vehicular traffic should be as shown in Figure TTC14-0. When the capacity of the other lanes is needed, the method shown in Figure TTC-15.0 should be used.

Standard:

When work is being performed over a roadway open to traffic (on bridges, overhead signs, traffic signals, etc.) the traveled lanes(s) or shoulder that the work operation is over shall be closed, unless it is physically improbable materials, equipment or personnel could fall into the open lane or shoulder.

Option:

A mobile closure may be an acceptable method of TTC depending on traffic volumes and location of the overhead work.

Section 6G.15 Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway

Support:

Two-lane, two-way operation on one roadway of a normally divided highway is a typical procedure that requires special consideration in the planning, design, and work phases, because unique operational problems (for example, increasing the risk of head-on crashes) can arise with the two-lane, two-way operation.

Standard:

When two-lane, two-way traffic control must be maintained on one roadway of a normally divided highway, opposing vehicular traffic shall be separated with either temporary traffic barriers (concrete

safety-shape or approved alternate) or with channelizing devices throughout the length of the two-way operation. The use of markings and complementary signing, by themselves, shall not be used.

Support:

Figure 6H-39 of the MUTCD shows the procedure for two-lane, two-way operation. Treatments for entrance and exit ramps within the two-way roadway segment of this type of work are shown in Figures 6H-40 and 6H-41 of the MUTCD.

Guidance:

Modifications to any of these layouts must first be reviewed and approved by the District Traffic Engineer prior to their use and documented.

Section 6G.16 Crossovers

Guidance:

The following are considered good guiding principles for the design of crossovers:

A. *Tapers for lane drops should be separated from the crossovers.*
B. *Crossovers should be designed for speeds no lower than 10 mph below the posted speed, the off-peak 85th-percentile speed prior to the work starting, or the anticipated operating speed of the roadway, unless unusual site conditions require that a lower design speed be used.*
C. *A good array of channelizing devices, delineators, and full-length, properly placed pavement markings should be used to provide drivers with a clearly defined travel path.*
D. *The use of screens mounted on the top of temporary traffic barriers should be considered in crossover applications whenever multi-lane traffic is reduced to two-way motor vehicle traffic to reduce headlight glare from oncoming traffic and improve mobility through the crossover.*
E. *The design of the crossover should accommodate all vehicular traffic, including motorcycles, trucks and buses.*

Support:

Temporary traffic barriers and the excessive use of TTC devices cannot compensate for poor geometric and roadway cross-section design of crossovers.

Section 6G.17 Interchanges

Guidance:

Access to interchange ramps on limited-access highways should be maintained even if the work space is in the lane adjacent to the ramps. Access to exit ramps should be clearly marked and delineated with channelizing devices. For long-term projects, conflicting pavement markings should be removed and new ones placed. Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur before ramp closings.

Option:

If access is not possible, ramps may be closed by using signs and Type III barricades. As the work space changes, the access area may be changed, as shown in Figure TTC-26.0. A TTC zone in the exit ramp may be handled as shown in Figure TTC-27.0.

When a work space interferes with an entrance ramp, a lane may need to be closed on the freeway. A TTC zone in the entrance ramp may require shifting ramp vehicular traffic (see Figure TTC-28.0).

Section 6G.18 Movable Barriers

Support:

Figure 6H-45 of the MUTCD shows a temporary reversible lane using movable barriers.

Option:

If the work activity in Figure TTC-16.0 permits, a movable barrier may be used and relocated to the shoulder during nonwork periods or peak-period vehicular traffic conditions.

Standard:

Modifications to Figure TA-45 of the 2003 MUTCD shall be reviewed and approved by the district Traffic Engineer prior to its use and documented.

Section 6G.19 Work in the Vicinity of Highway-Rail Grade Crossings

Standard:

When highway-rail grade crossings exist either within or in the vicinity of a TTC zone, lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the railroad tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or certified flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.

Support:

Figure TTC-39.0 shows work in the vicinity of a highway-rail grade crossing.

Guidance:

Early coordination with the railroad company should occur before work starts.

Section 6G.20 Temporary Traffic Control During Nighttime Hours

Support:

Chapter 6D and Sections 6F.68 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Conducting highway construction and maintenance activities during night hours could provide an advantage when traditional daytime traffic control strategies cannot achieve an acceptable balance between worker and public safety, traffic and community impact, and constructability. The two basic advantages of working at night are reduced traffic congestion and less involvement with business activities. However, the two basic conditions that must normally be met for night work to offer any advantage are reduced traffic volumes and easy set up and removal of the traffic control patterns on a nightly basis.

Shifting work activities to night hours, when traffic volumes are lower and normal business is less active, might offer an advantage in some cases, as long as the necessary work can be completed and the work site restored to essentially normal operating conditions to carry the higher traffic volume during non-construction hours.

Although working at night might offer advantages, it also includes safety issues. Reduced visibility inherent in night work impacts the performance of both drivers and workers. Because traffic volumes are lower and congestion is minimized, speeds are often higher at night necessitating greater visibility at a time when visibility is reduced. Finally, the incidence of impaired (alcohol or drugs), fatigued, or drowsy drivers might be higher at night.

Working at night also involves other factors, including construction productivity and quality, social impacts, economics, and environmental issues. A decision to perform construction or maintenance activities at night normally involves some consideration of the advantages to be gained compared to the safety and other issues that might be impacted.

Guidance:

Considering the safety issues inherent to night work, consideration should be given to enhancing traffic controls (see Section 6G.04) to provide added visibility and driver guidance, and increased protection for workers.

In addition to the enhancements listed in Section 6G.04, consideration should be given to providing additional lights and retroreflective markings to workers, work vehicles, and equipment.

Option:

Where reduced traffic volumes at night make it feasible, the entire roadway may be closed by detouring traffic to alternate facilities, thus removing the traffic risk from the activity area.

Guidance:

Because typical street and highway lighting is rarely adequate to provide sufficient levels of illumination for work tasks, temporary lighting should be provided where workers are active to supply sufficient illumination to reasonably safely perform the work tasks.

Temporary lighting for night work should be designed such that glare does not interfere with driver visibility, or create visibility problems for truck drivers, equipment operators, flaggers, or other workers.

Consideration should also be given to stationing uniformed law enforcement officers and lighted patrol cars at night work locations where there is a concern that high speeds or impaired drivers might result in undue risks for workers or other drivers.

Standard:

Except in emergencies, temporary lighting providing a minimum of 5 foot candles (50 lux) shall be provided at all flagger stations.

Floodlighting shall not produce a disabling glare condition for approaching road users, flaggers, or workers.

The adequacy of the floodlight placement and elimination of potential glare shall be determined by driving through and observing the floodlighted area from each direction on all approaching roadways after the initial floodlight setup, at night, and periodically during each shift.

Support:

Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of 50 lux (5 foot candles) can be adequate for general activities. An average horizontal luminance of 108 lux (10 foot candles) can be adequate for activities around equipment. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 216 lux (20 foot candles).

Guidance:

Advance warning signs used during night hours should be reviewed on a periodic basis during the shift to ensure moisture/condensation has not obscured the retro-reflectivity or visibility of the sign text.

Standard:

Group II channelizing devices (drums) shall be used in all unmanned work zone locations, and in all merging and shifting tapers on limited access highways for nighttime operations.

Section 6G.21 Work During Inclement Weather

Support:

Inclement weather (rain, snow, fog, etc.) creates the following conditions for road users:

- Lack of visibility to the road and temporary traffic control devices;
- Greater distance required for slowing and stopping a motor vehicle;
- An increase in the difficulty of controlling a motor vehicle, and;
- An increase in the distraction and anxiety for road users while traveling on the roadway.

Guidance:

Therefore, planned work activities should be avoided, if possible, during inclement weather conditions.

Option:

Emergency operations (snow removal, debris cleanup, etc.), however, may be performed where inaction would be worst for motorists than allowing the condition to remain unattended.

Support:

See Chapter 6I, Control Of Traffic Through Traffic Incident Management Areas, for TTC.

CHAPTER 6H. TYPICAL APPLICATIONS

Section 6H.01 Typical Applications

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

Chapter 6G contains discussions of typical TTC activities. Chapter 6H presents typical applications for a variety of situations commonly encountered. While not every situation is addressed, the information illustrated can generally be adapted to a broad range of conditions. In many instances, an appropriate TTC plan is achieved by combining features from various typical applications. For example, work at an intersection might present a near-side work zone for one street and a far-side work zone for the other street. These treatments are found in two different typical applications, while a third typical application shows how to handle pedestrian crosswalk closures. For convenience in using the typical application diagrams, Tables 6C-2 and 6E-1 are reproduced in this Chapter as Tables 6H-2 and 6H-3, respectively.

Procedures for establishing TTC zones vary with such conditions as road configuration, location of the work, work activity, duration of work, road user volumes, road vehicle mix (buses, trucks, cars, motorcycles, and bicycles), and road user speeds. Examples are presented in this Chapter showing how to apply principles and standards. Applying these guidelines to actual situations and adjusting to field conditions requires judgment. In general, the procedures illustrated represent minimum solutions for the situations depicted.

Option:

Other devices may be added to supplement the devices and device spacing may be adjusted to provide additional reaction time or delineation. Fewer devices may be used based on field conditions.

Support:

Figures and tables found throughout Part 6 provide information for the development of TTC plans. Table 6H-2 is used for the determination of taper lengths, Table 6H-3 for buffer lengths, and Table 6H-4 for flagger placement.

Table 6H-1 is an index of the 41 Typical Traffic Control (TTC) figures. Typical traffic control figures are shown on the right page with notes on the facing page to the left. The legend for the symbols used in the TTC figures is provided in Figure 6H-1. In many of the typical applications, sign spacings and other dimensions are indicated in the notes to the left of the figure.

Most of the typical applications show TTC devices for only one direction.

Table 6H-1. Index to Typical Traffic Control Figures and Notes

Type of Operation	Figure Number	Page Numbers
Work Outside the Shoulder		
Work Beyond the Shoulder Operation	TTC-1.0	6H-6, 6H-7
Blasting Zone Operation	TTC-2.0	6H-8, 6H-9
Work On the Shoulder		
Mobile or Short Duration on Shoulder Operation	TTC-3.0	6H-10, 6H-11
Stationary Operation on Shoulder	TTC-4.0	6H-12, 6H-13
Shoulder Closure with Barrier and Lane Shift Operation	TTC-5.0	6H-14, 6H-15
Shoulder Closure with Barrier Operation	TTC-6.0	6H-16, 6H-17
Mowing Operation with Encroachment	TTC-7.0	6H-18, 6H-19
Work Within the Travelway		
Moving/Mobile Operation on Limited Access Highway	TTC-8.0	6H-20, 6H-21
Moving/Mobile Operation on Multi-Lane Roadway	TTC-9.0	6H-22, 6H-23
Moving/Mobile Operation on Two-Lane Roadway	TTC-10.0	6H-24, 6H-25
Short Duration Operation on Multi-Lane Roadway	TTC-11.0	6H-26, 6H-27
Outside Lane Closure Operation on Four-Lane Roadway	TTC-12.0	6H-28, 6H-29
Inside Lane Closure Operation on Four-Lane Roadway	TTC-13.0	6H-30, 6H-31
Multi-Lane Closure Operation	TTC-14.0	6H-32, 6H-33
Lane Closure Operation with Lane Weave	TTC-15.0	6H-34, 6H-35
Lane Closure Operation with Traffic Barrier	TTC-16.0	6H-36, 6H-37
Center Turn Lane Closure Operation	TTC-17.0	6H-38, 6H-39
Flagging Operation on Two-Lane Roadway	TTC-18.0	6H-40, 6H-41
Non-Stationary Flagging Operation on Two-Lane Roadway	TTC-19.0	6H-42, 6H-43
Work Within the Travelway at an Intersection and Sidewalks		
Lane Closure Operation – Near Side of Intersection	TTC-20.0	6H-44, 6H-45
Lane Closure Operation – Far Side of Intersection	YYC-21.0	6H-46, 6H-47

Table 6H-1. Index to Typical Traffic Control Figures and Notes

Type of Operation	Figure Number	Page Numbers
Closure Operation in Intersection	TTC-22.0	6H-48, 6H-49
Turn Lane Closure Operation	TTC-23.0	6H-50, 6H-51
Sidewalk Closure and Bypass Sidewalk Operation	TTC-24.0	6H-52, 6H-53
Crosswalk Closure and Pedestrian Detour Operation	TTC-25.0	6H-54, 6H-55
Work Within the Travelway of Multi-Lane Highways		
Work Operation in the Vicinity of Exit Ramps	TTC-26.0	6H-56, 6H-57
Partial Ramp Closure Operation	TTC-27.0	6H-58, 5H-59
Work Operation in the Vicinity of Entrance Ramps	TTC-28.0	6H-60, 6H-61
Multi-Lane Shift Operation	TTC-29.0	6H-62, 6H-63
Half Road Closure Operation on Multi-Lane Roadway	TTC-30.0	6H-64, 6H-65
Total Freeway Closure Operation	TTC-31.0	6H-66, 6H-67
Specialty Operations Within or Near the Travelway		
Surveying Operations	TTC-32.0	6H-68, 6H-69
Temporary Disruption Operation on Multi-Lane Roadway	TTC-33.0	6H-70, 6H-71
Haul Road Crossing Operation	TTC-34.0	6H-72, 6H-73
Signing for Speed Limit and Fine Signs in Work Zones	TTC-35.0	6H-74, 6H-75
Signing for Project Limits	TTC-36.0	6H-76, 6H-77
Motorist Survey Operation on Two-Lane Roadway	TTC-37.0	6H-78, 6H-79
Eradication of Pavement Markings in Work Zones	TTC-38.0	6H-80, 6H-81
Work in the Vicinity of Highway-Rail Crossing	TTC-39.0	6H-82, 6H-83
Signing for Partial Roadway Resurfacing Operations	TTC-40.0	6H-84, 6H-85
Signing for Full Roadway Resurfacing Operations	TTC-41.0	6H-86, 6H-87

Table 6H-2, TAPER LENGTH (L)					
POSTED SPEED LIMIT	WIDTH OF OFFSET (FT)				REMARKS
	9	10	11	12	
25 or below	94	105	115	125	$L= S^2W/60$
30	135	150	165	180	"
35	184	205	225	245	"
40	240	267	294	320	"
45	405	450	495	540	L=SW
50	450	500	550	600	"
55	495	550	605	660	"
60	540	600	660	720	"
65	585	650	715	780	"
70<	630	700	770	840	"
MINIMUM LANE CLOSURE TAPER LENGTH ON ALL LIMITED ACCESS ROADWAYS, REGARDLESS OF POSTED SPEED, SHALL BE 1000 FEET.					

Posted Speed Limit	Distance (Feet)
≤ 20	115 - 125
25	155 - 165
30	200 - 210
35	250 - 260
40	305 - 325
45	360 - 380
50	425 - 445
55	500 - 530
60	570 - 600
65	645 - 675
70	730 - 760

Table 6H-3, Buffer Space Table

Posted Speed	Distance (Feet)
≤ 20	115 - 125
25	155 - 165
30	200 - 210
35	250 - 260
40	305 - 320
45	360 - 375
50	425 - 440
55	500 - 520
60	570 - 590

Table 6H-4, Flagger Distance from Work Area

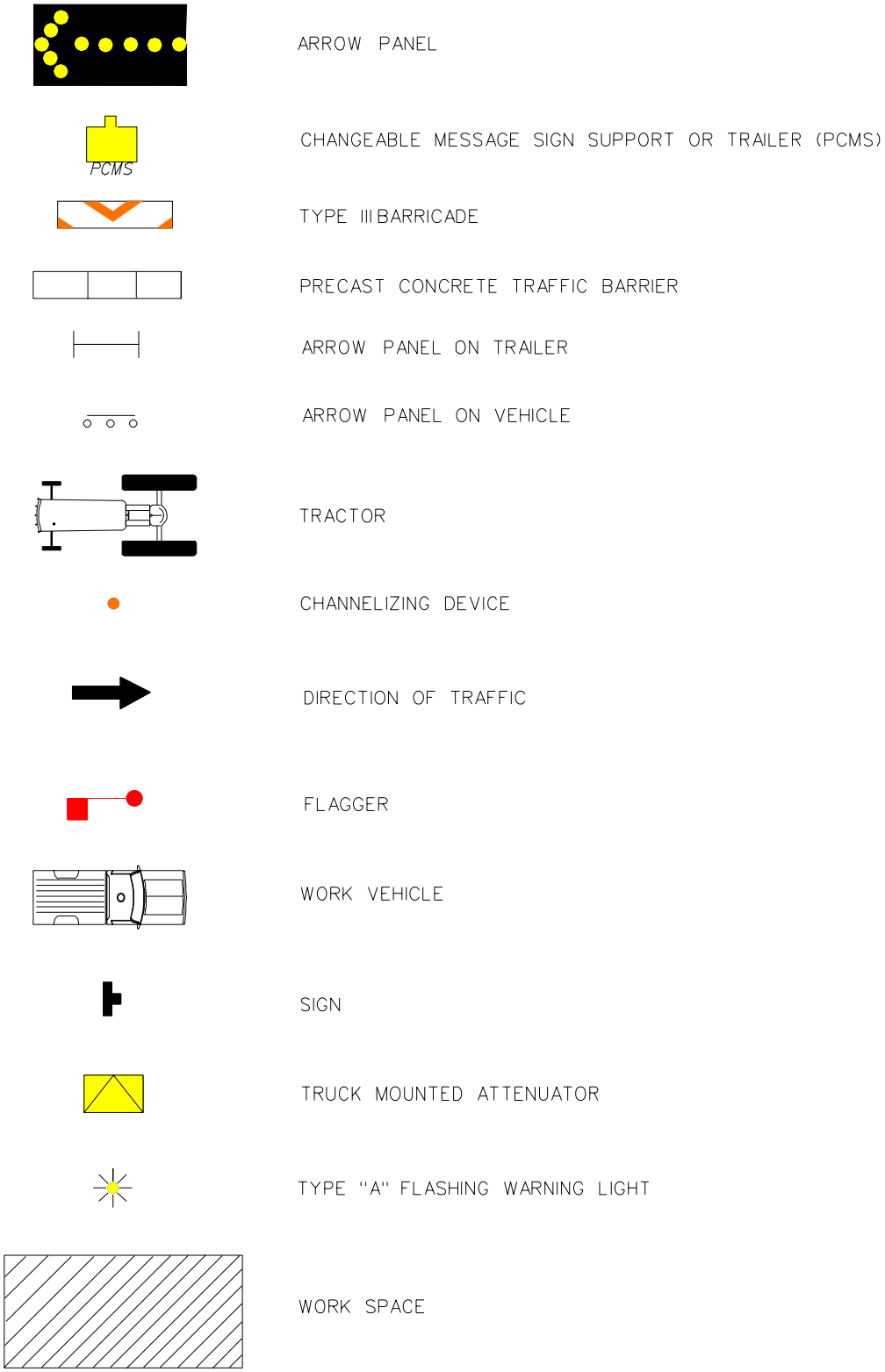


Figure 6H-1, Symbols Used In Typical Application Figures

Typical Traffic Control
Work Beyond the Shoulder Operation
(Figure TTC-1.0)

NOTES

Guidance:

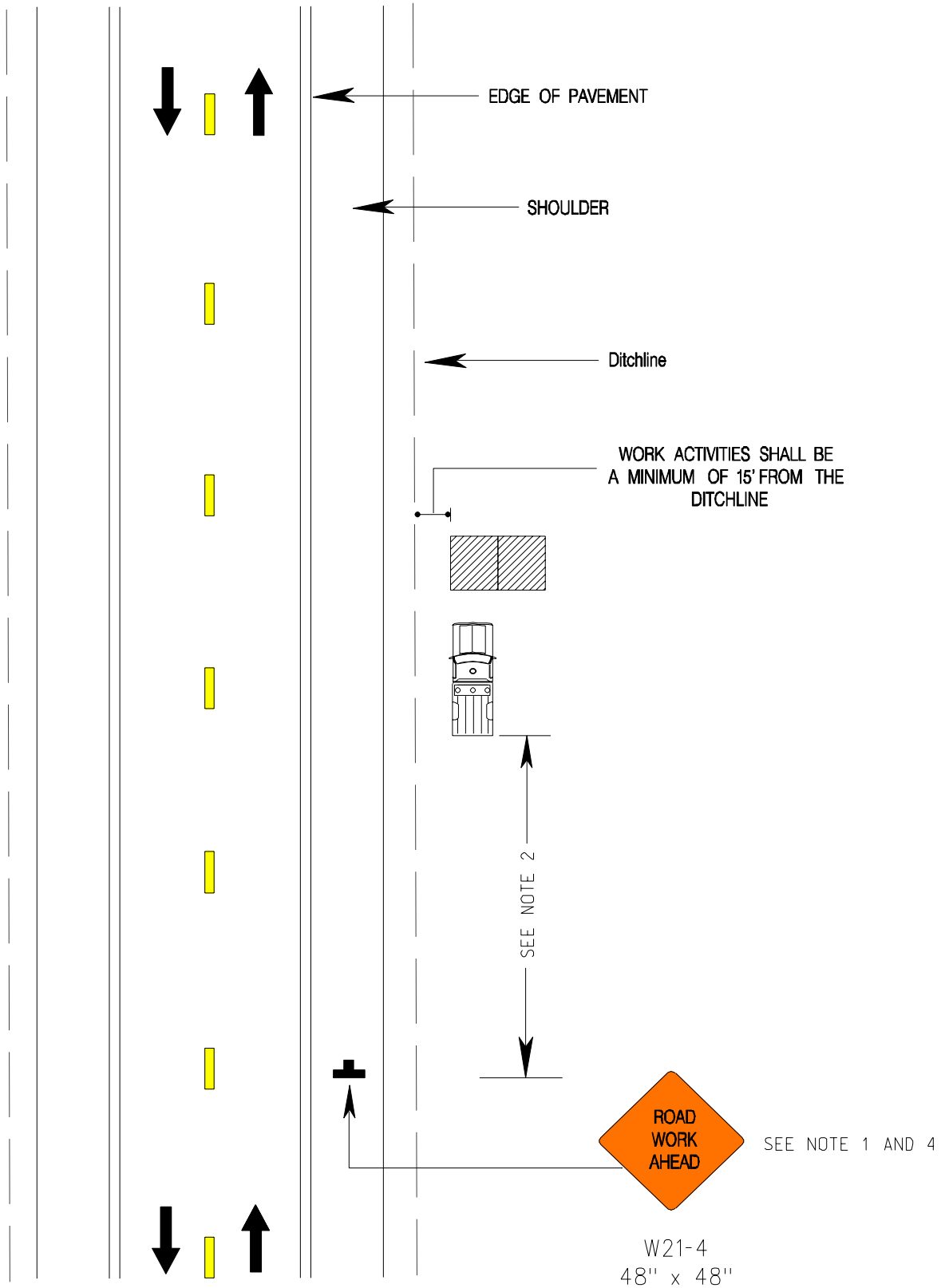
1. *An advance warning sign should be used if the work will be performed immediately adjacent to the shoulder, if equipment will cross or move along the roadway, or if the activity may distract motorists.*
2. *The minimum distance between sign and work vehicle should be 1300'-1500' on limited access highways, and on all other roadways 500'-800' where posted speed limit is* greater *than 45 mph, and 350'-500' where posted speed limit is 45 mph or less.*

Option:

3. The ROAD WORK AHEAD sign may be replaced with other appropriate signs such as the SHOULDER WORK AHEAD sign or UTILITY WORK AHEAD sign. The SHOULDER WORK AHEAD sign may be used for work adjacent to the shoulder.
4. If the vehicle and/or work activity are both outside the right-of-way, behind the ditchline, behind the guardrail, more then 2' behind the curb, or 15' or more from the edge of any nonlimited access roadway, then only an activated rotating amber light or high intensity amber strobe light is needed.
5. For short-term, short-duration or mobile operation, all signs and channelizing devices may be eliminated if a vehicle with activated high-intensity amber rotating, oscillating, or strobe lights is used.
6. Vehicle hazard warning signals may be used to supplement high-intensity amber rotating, oscillating, or strobe lights.

Standard:

7. **If the workspace is in the median of a divided highway, an advance warning sign shall also be placed on the left side of the directional roadway.**



Work Beyond the Shoulder
(Figure TTC-1.0)

Typical Traffic Control
Blasting Zone Operation
(Figure TTC-2.0)

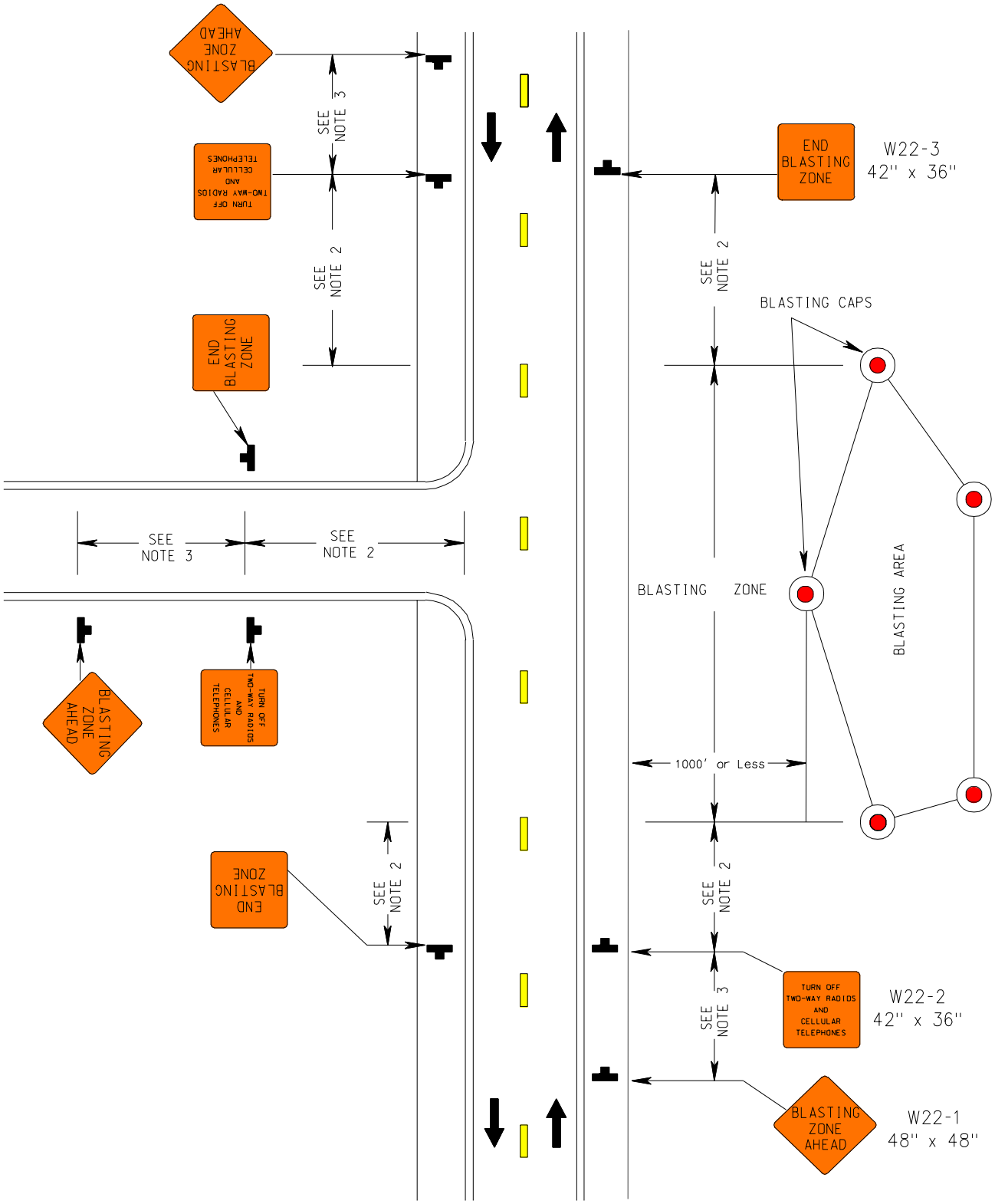
NOTES

Standard:

1. **Whenever blasting caps are used within 1,000 feet of a roadway, the signing shown shall be used.**
2. **Sign spacing distance shall be a minimum of 1000 feet from the blasting area.**
3. **Spacing between signs shall be 1300'-1500' for limited access highways. For all other roadways, the sign spacing shall be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or greater.**
4. **The signs shall be covered or removed when there are no explosives in the area or the area is otherwise secure.**
5. **Whenever a side road intersects the roadway between the BLASTING ZONE AHEAD sign and the END BLASTING ZONE sign, or a side road is within 1,000 feet of any blasting cap, similar signing, as on the mainline, shall be installed on the side road.**
6. **Prior to blasting, the blaster in charge shall determine whether road users in the blasting zone will be endangered by the blasting operation. If there is danger, road users shall not be permitted to pass through the blasting zone during blasting operations.**

Guidance:

7. *On a divided highway, the signs should be mounted on both sides of the directional roadways.*



Blasting Zone Operation
(Figure TTC-2.0)

Typical Traffic Control
Mobile or Short-Duration Shoulder Operation
(Figure TTC-3.0)

NOTES

Option:

1. The first advance warning vehicle may be replaced with a 48" x 48" ROAD WORK AHEAD, UTILITY WORK AHEAD, or SHOULDER WORK AHEAD sign.
2. This layout may be used for shoulder operations on two or more lane roadways.
3. Warning signs may be omitted when the work vehicle displays high-intensity amber rotating, oscillating, or strobe lights if the distance between work locations is 1 mile or more, and if the work vehicle travels at vehicular traffic speeds between locations.

Guidance:

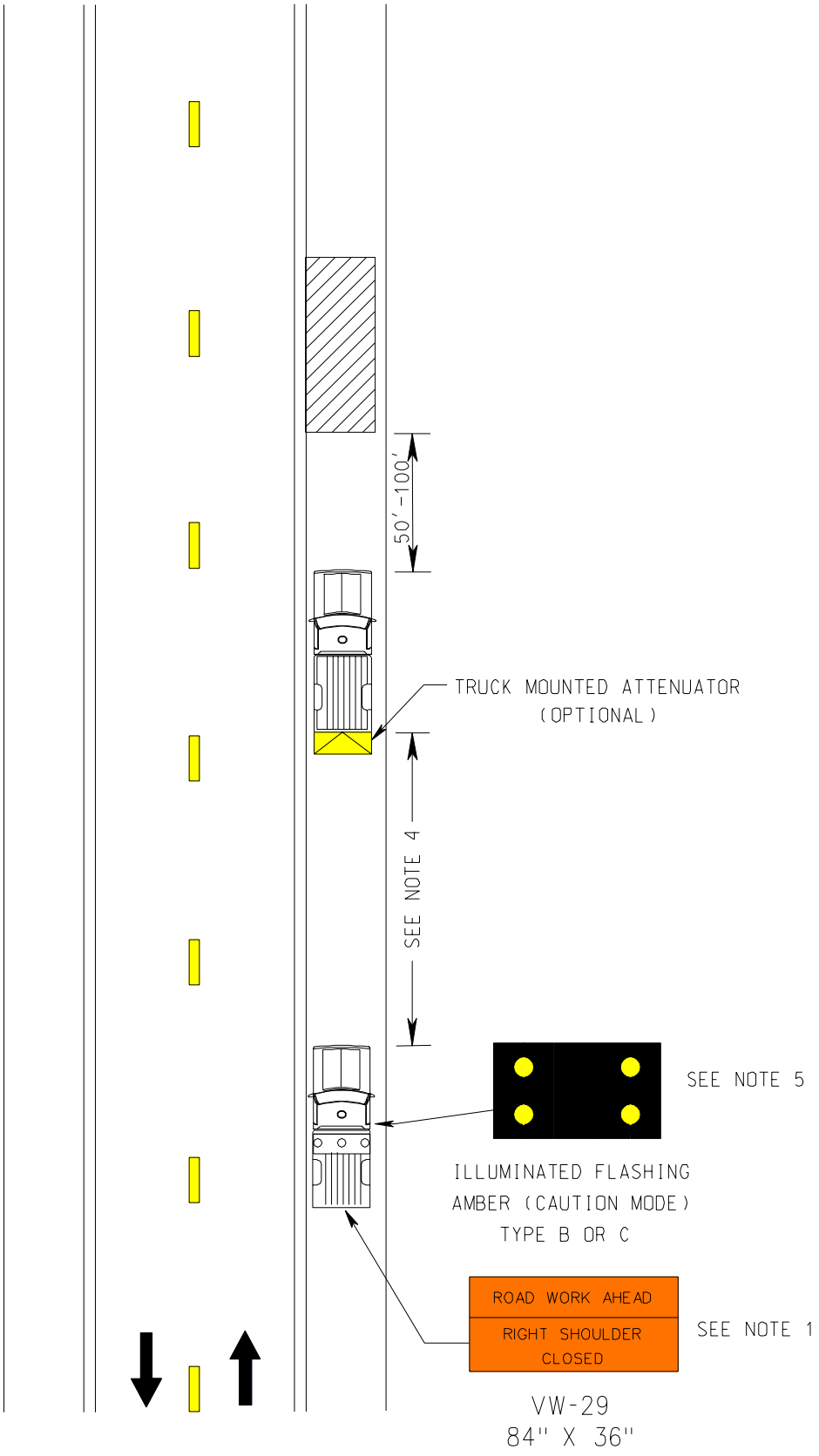
4. *In those situations where multiple work locations within a limited distance make it practical to place stationary signs, the distance between the advance warning sign and the work should not exceed 5 miles. Where the distance between the advance warning signs and the work is 2 miles to 5 miles, a Supplemental Distance plaque should be used with the ROAD WORK AHEAD sign.*

Standard:

5. **Each vehicle involved in the operation shall have either an arrow board operating in the caution mode, or at least one high-intensity amber rotating, oscillating, or strobe light.**
6. **Vehicle-mounted signs shall be mounted in a manner such that they are not obscured by equipment or supplies. Sign legends on vehicle-mounted signs shall be covered or turned from view when work is not in progress.**

Option:

7. Vehicle hazard warning signals may be used to supplement high-intensity amber rotating, oscillating, or strobe lights.



Mobile or Short-Duration Shoulder Operation
(Figure TTC 3.0)

Typical Traffic Control
Stationary Operation on Shoulder
(Figure TTC-4.0)

NOTES

Guidance:

1. *A ROAD WORK AHEAD sign or SHOULDER WORK AHEAD sign should be placed on the left side of the roadway for a divided or one-way street only if the left shoulder is affected.*
2. *Sign spacing should be 1300'-1500' for limited access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350-500' where the posted speed limit is 45 mph or greater.*

Standard:

3. **Channelizing device spacing shall be at the following:**

	Posted Speed (mph)	
Location	**0-35**	**36+**
Transition Spacing	**20'**	**40'**
Travelway Spacing	**40'**	**80'**

4. **The buffer space length shall be as shown in Table 6H-4 for the posted speed limit.**
5. **Cone Taper Length (L):**

Speed Limit MPH	Taper Length Lane Width in Feet 10	11	12	
25	105	115	125	
30	150	165	180	
35	205	225	245	
40	270	295	320	
45	450	495	640	(Shoulder Taper = 1/3L Minimum)
50	500	550	600	
55	550	605	660	
60	600	660	770	
65	650	715	780	

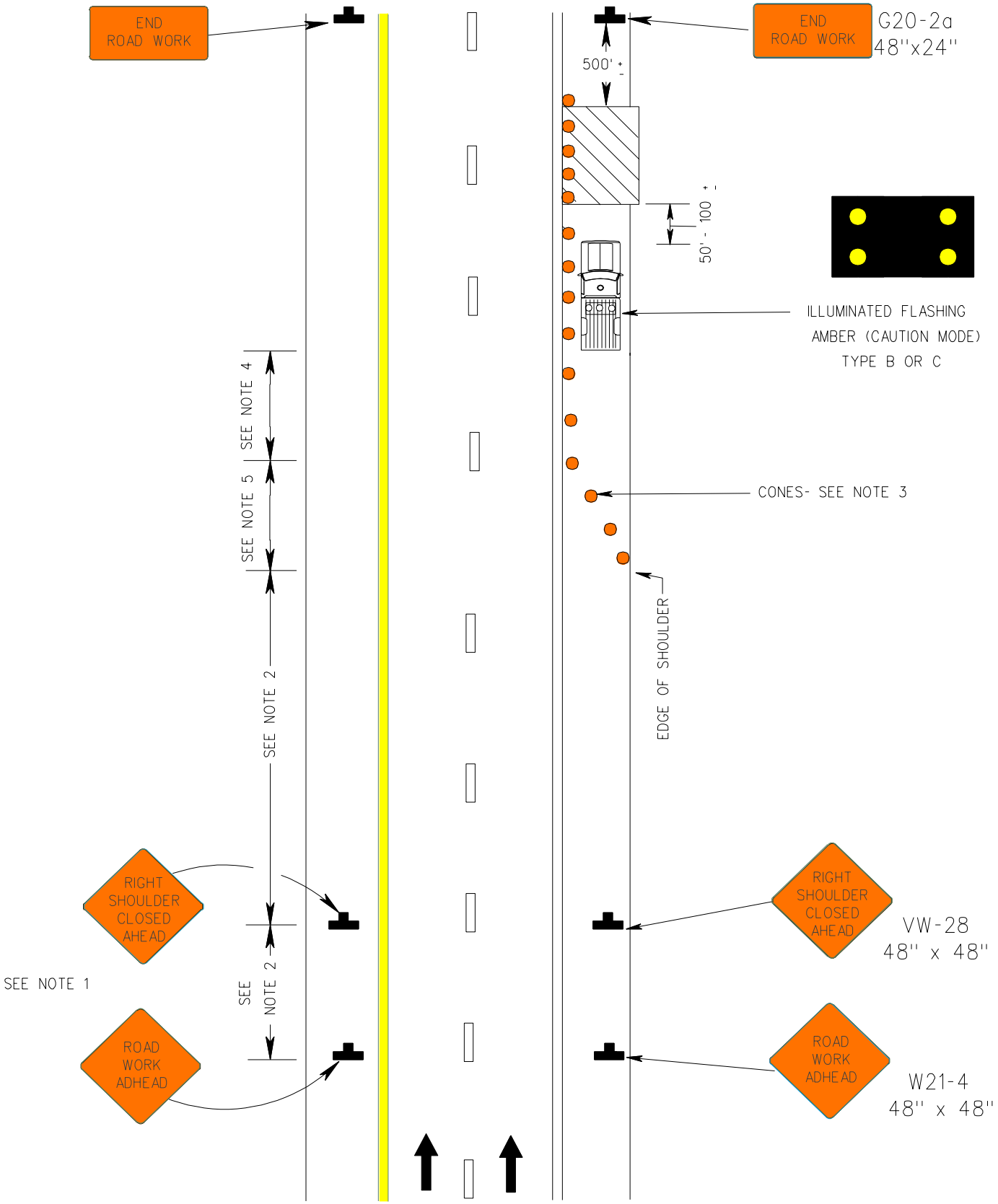
6. **A shadow vehicle with either an arrow board operating in the caution mode, or at least one high-intensity amber rotating, oscillating, or strobe light shall be parked 50'-100' in advance of the first work crew.**

Option:

7. For short-duration operations of 60 minutes or less, all signs and channelizing devices may be eliminated if a vehicle with activated high-intensity amber rotating, oscillating, or strobe lights is used.
8. Vehicle hazard warning signals may be used to supplement high-intensity rotating, flashing, oscillating, or strobe lights.

Standard:

9. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Stationary Operation on Shoulder
(Figure TTC-4.0)

Typical Traffic Control
Shoulder Closure with Barrier and Lane Shift Operation
(Figure TTC 5.0)

NOTES

Guidance:

1. *The Lane shift should be used when the work space extends into either the right or left lane of a divided highway and it is not practical, for capacity reasons, to reduce the number of available lanes.*
2. *When a lane shift is accomplished by using: (1) geometry that meets the design speed at which the permanent highway was designed, (2) full normal cross-section (full lane width and full shoulders),and (3) complete pavement markings, then only the "ROAD WORK AHEAD" and "RIGHT SHOULDER CLOSED AHEAD" advance warning signs are required.*
3. *Double Lane Shift signs may be used in place of the Reverse Curve signs.*
4. *Sign spacing distance should be 1300'-1500' for limited access highways. For all other roadways, the sign spacing should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

5. **On divided highways having a median wider than 8', left and right sign assemblies shall be required.**
6. **Length of pavement marking transition (L) = posted speed (S) x width of transition (W). (Example: 55' x 2' = 110')**
7. **Group 2 channelizing device spacing shall be at the following:**

	Posted Speed (mph)	
Location	**0-35**	**36+**
Transition Spacing	**20'**	**40'**
Travelway Spacing	**40'**	**80'**

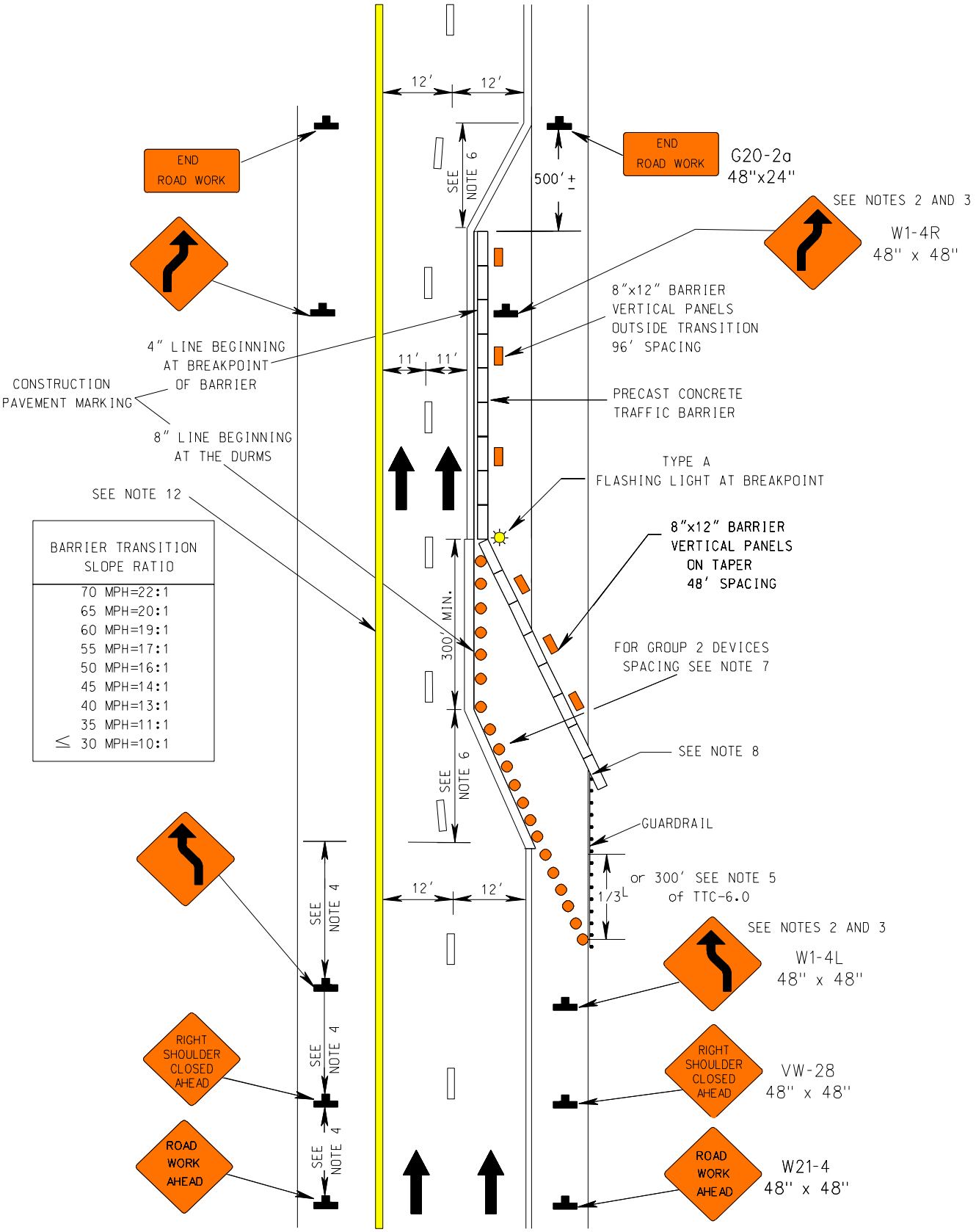
8. **For end treatment of the barrier in order of preference see Note 7 of TTC-6.0.**
9. **Barrier vertical panel 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be Type A flashing. Barrier delineators shall be installed along the traffic side of the concrete barrier in accordance with Section 702 of VDOT's Road and Bridge Specifications.**
10. **Unless approved by the District Traffic Engineer, the minimum width of the travel lanes shall be 11 feet.**
11. **For long-term stationary work, existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Option:

12. Temporary pavement may be needed to maintain traffic with 11' minimum width lanes.

Guidance:

13. *If drivers cannot see a pull-off area beyond the closed shoulder, information regarding the length of the shoulder closure should be provided in feet or miles, as appropriate.*
14. *Eradication of existing pavement markings should be as shown in Typical Traffic Control figure TTC-38.0.*



Shoulder Closure with Barrier and Lane Shift Operation
(Figure TTC 5.0)

Typical Traffic Control
Shoulder Closure with Barrier Operation
(Figure TTC 6.0)

NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for limited access highways, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *If drivers cannot see a pull-off area beyond the closed shoulder, information regarding the length of the shoulder closure should be provided in feet or miles as appropriate.*

Standard:

3. **On divided highways having a median wider than 8', left and right sign assemblies shall be required.**
4. **Group 2 channelizing device spacing shall be at the following:**

	Posted Speed (mph)	
Location	**0-35**	**36+**
Transition Spacing	**20'**	**40'**
Travelway Spacing	**40'**	**80'**

5. **The minimum length for a shoulder taper should be 300' on limited access highways, and 1/3 L for all other roadways. (See note 5, TTC-4.0 for values of L).**
6. **Barrier transition slope ratio shall be as follows:**

   70 mph=22:1 60 mph=19:1 50 mph=16:1 40 mph=13:1 30 ≥ mph=10:1
   65 mph=20:1 55 mph=17:1 45 mph=14:1 35 mph=11:1

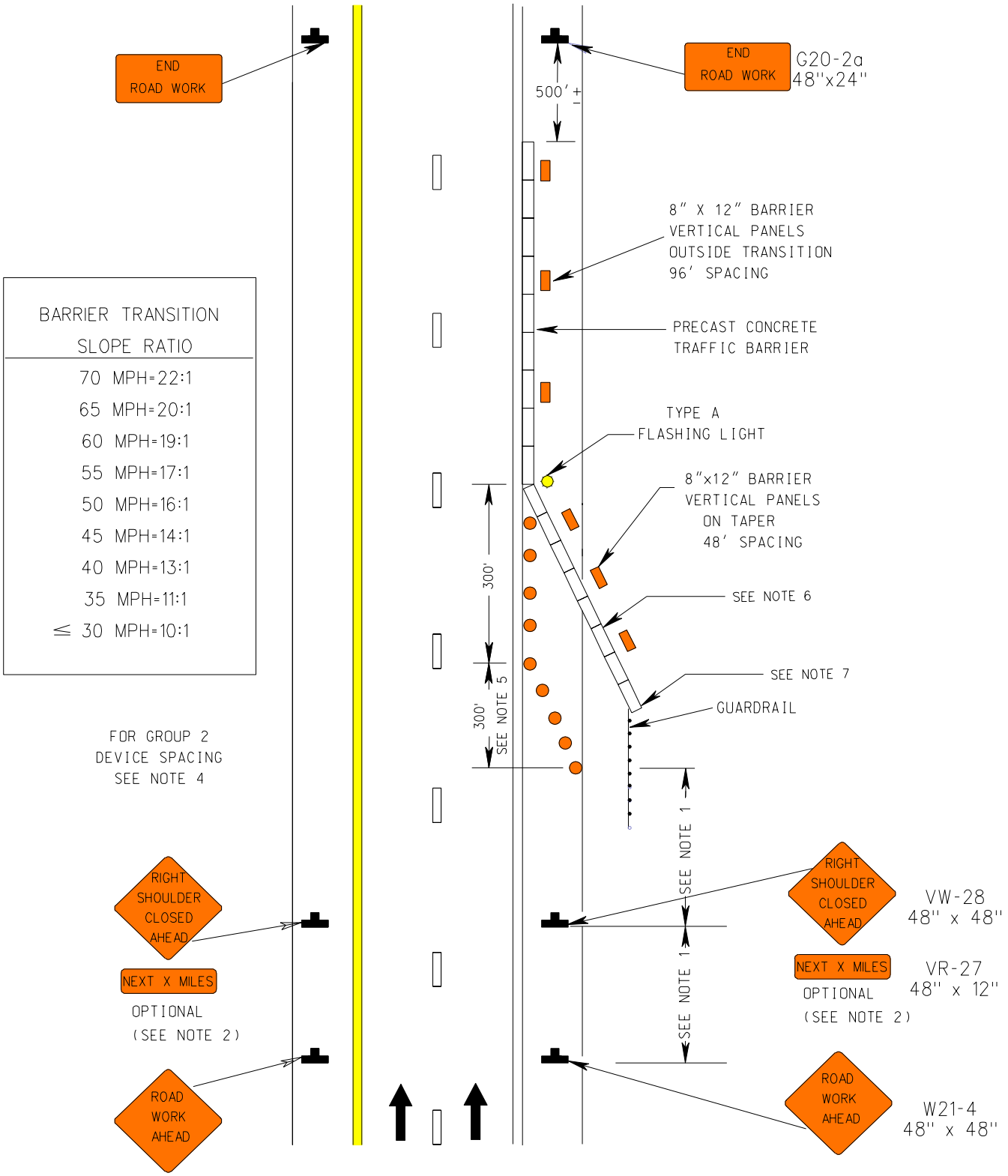
   When the barrier transition slope is on a horizontal alignment, the total offset shall be prorated around the curve in lieu of a straight-line slope.
7. **End treatment of barrier in order of preference:**

   a. Where guardrail exists, attach to barrier with appropriate fixed object attachment.

   b. Where cut slope exists, bury barrier into cut slope and provide for drainage as needed.

   c. Extend end of barrier until it is beyond the established clear zone (see Appendix A, Page A-4 for clear zone values).

   d. When barrier end is inside the established clear zone, attenuator service Type I or Type II shall be used. Refer to L&D special design drawings.
8. **Barrier vertical panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be a Type A flashing light. Barrier delineators shall be installed along the traffic side of the concrete barrier in accordance with Section 702 of VDOT's Road and Bridge Specifications.**



Shoulder Closure with Barrier Operation
(Figure TTC 6.0)

Typical Traffic Control
Mowing Operation with Encroachment
(Figure TTC 7.0)

NOTES

Standard:

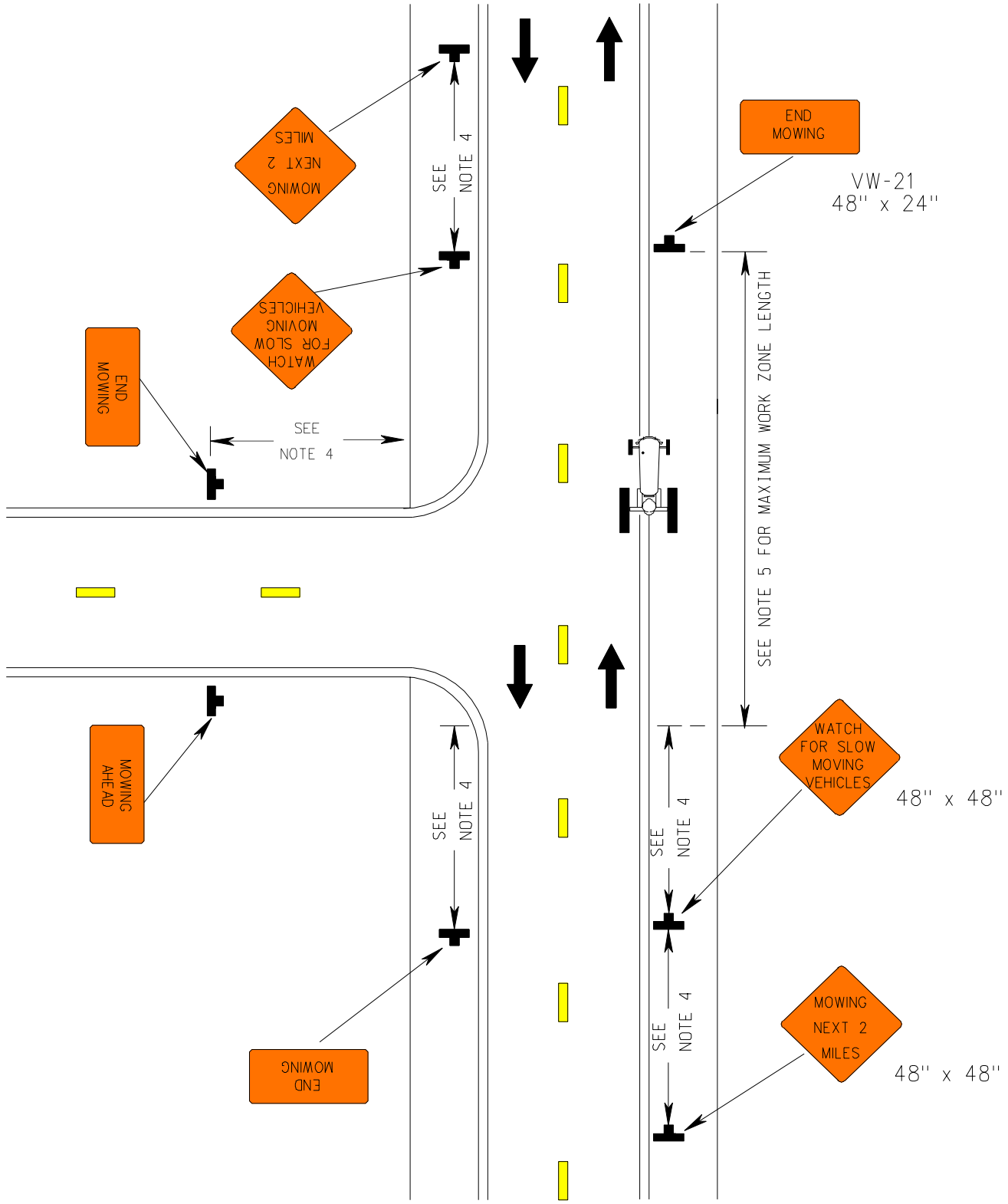
1. **Each vehicle involved in the operation shall be equipped with at least one rotating amber light or high intensity amber strobe or oscillating light visible from 360°.**
2. **On divided highways having a median wider than 8', left and right sign assemblies shall be required.**
3. **Connecting roads entering into the work area shall be signed as shown.**

Guidance:

4. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
5. *No more than 2 complete setups (2 miles each) should be exposed to motorist at any one time.*
6. *To prevent multiple lane changing by motorists and constriction of traffic flow, mowing operations should be limited to one side of the roadway at a time, or separated by a minimum of 1000 feet between right and left side operations.*

Option:

7. If the operation is completely off the travelway, the 'WATCH FOR SLOW MOVING VEHICLES" sign may be omitted.



Mowing Operation with Encroachment
(Figure TTC 7.0)

Typical Traffic Control
Moving/Mobile Operations On Limited Access Highways
(Figure TTC 8.0)

NOTES

Standard:

1. **Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the advance warning vehicles shall be Type C (96 x 48 inch), and on the work operations vehicle a Type B (60 x 30 inch) or Type C.**
   Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement.

Option:

2. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow may be deleted.
3. The static warning sign and arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters. The arrow display using a CMS may be a Type B. Arrow direction and lane designation may change as needed.

Standard:

4. **The first advance warning vehicle shall travel along the paved shoulder with either a flashing arrow, or a portable changeable message sign with 18" height characters advising of the operation ahead ("LINE PAINTING AHEAD"), and lane closure information ("RIGHT LANE CLOSED", "MERGE LEFT"). The second advance warning vehicle, with a truck mounted attenuator (TMA), shall either straddle the edgeline, partially on the shoulder and partially in the lane, or travel fully in the travel lane. The third advance warning vehicle, with a TMA, shall be in the travel lane.**
5. **If the first advance warning vehicle cannot run completely on the shoulder out of the travel lane and would be partially in the travel lane, it shall be equipped with either a truck mounted attenuator or follow option in Note 6.**

Option:

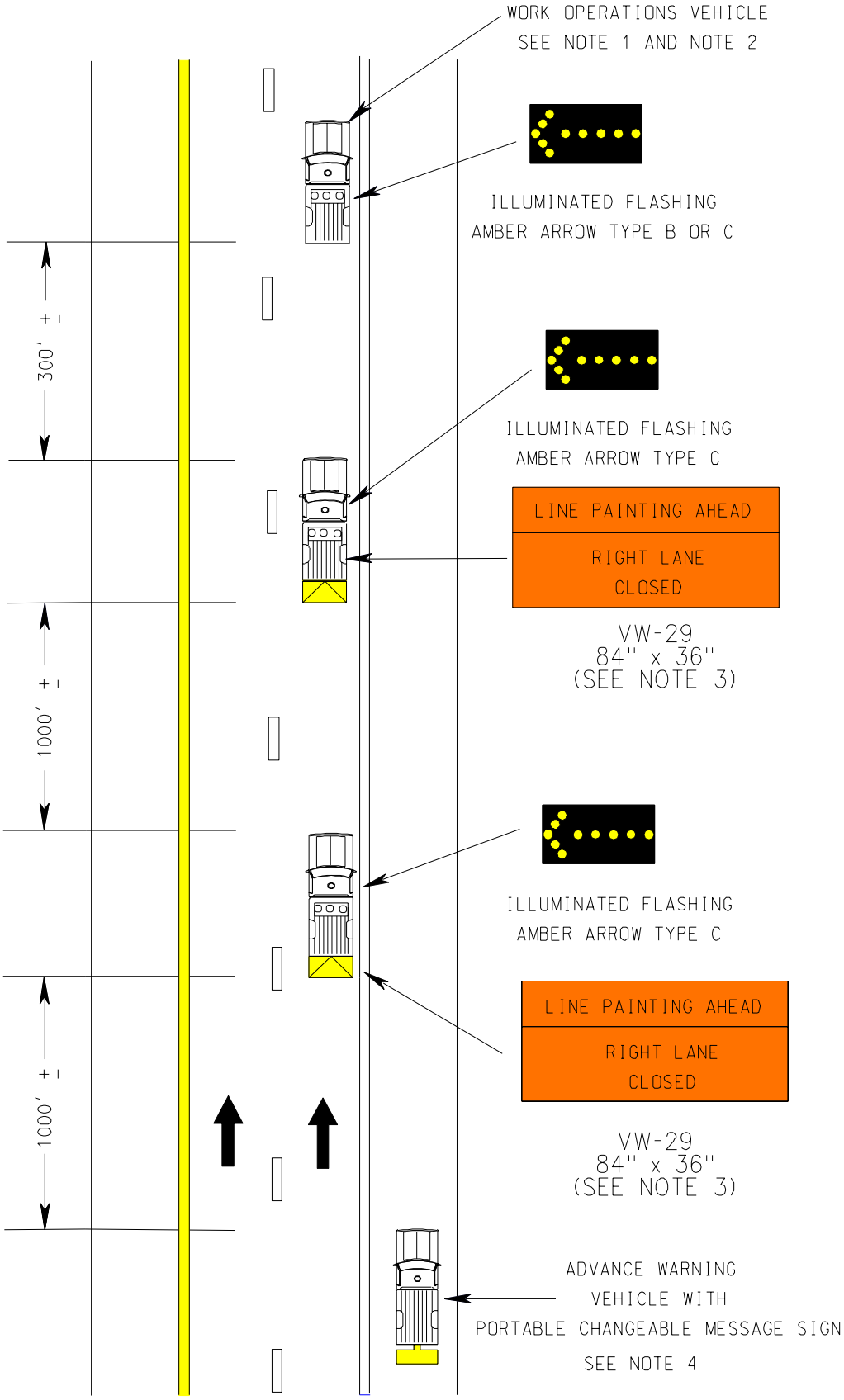
6. When the first advance warning vehicle cannot run completely on the shoulder, it may be replaced with a PCMS with the messages in Note 4 displayed, or with a static warning sign with the appropriate message (LINE PAINTING NEXT 2 MILES). For inside lane closure operations, the first advance warning vehicle may be positioned on the right shoulder without arrow designation.

Standard:

7. **When the work operations vehicle is stationary, the advance warning vehicle following the operations vehicle shall be in a position 50'-100' in advance of the operations vehicle to provide protection. When the work operations vehicle is moving, the advance warning vehicle following the operations vehicle shall follow at a distance of 300'+.**
8. **Each vehicle involved in the moving operation shall have radio communication between vehicles.**

Guidance:

9. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of operation. Whenever adequate stopping sight distance exists to the rear, the protection vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The protection vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
10. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*



Moving/Mobile Operations On Limited Access Highways
(Figure TTC 8.0)

Typical Traffic Control
Moving/Mobile Operations On Multi-Lane Roadway
(Figure TTC 9.0)

NOTES

Standard:

1. **Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the advance warning vehicles and work operations vehicle shall be a Type B (60 x 30 inch) or Type C (96" x 48 inch). Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement**.

Option:

2. If the work operations vehicle is a motorized piece of equipment, such as a motor grader, grade-all, etc., the illuminated flashing arrow will not be required.
3. The static warning sign and arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters.
4. Arrow direction and designation may change as needed.

Guidance:

5. *Spacing between vehicles may vary, depending on the speed, sight distance, and type of moving operation. Whenever adequate stopping sight distance exists to the rear, the protection vehicle should maintain the minimum distance and proceed at the same speed as the work operation vehicle. The protection vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
6. *Actual conditions could dictate more traffic control device needs in the operation. On high speed, high volume roads, an advance warning vehicle on the shoulder with an arrow board and sign should be used. Also, in certain situations, appropriate stationary signing ("SPRAYING NEXT 2 MILES") may be used to further enhance safety.*

Standard:

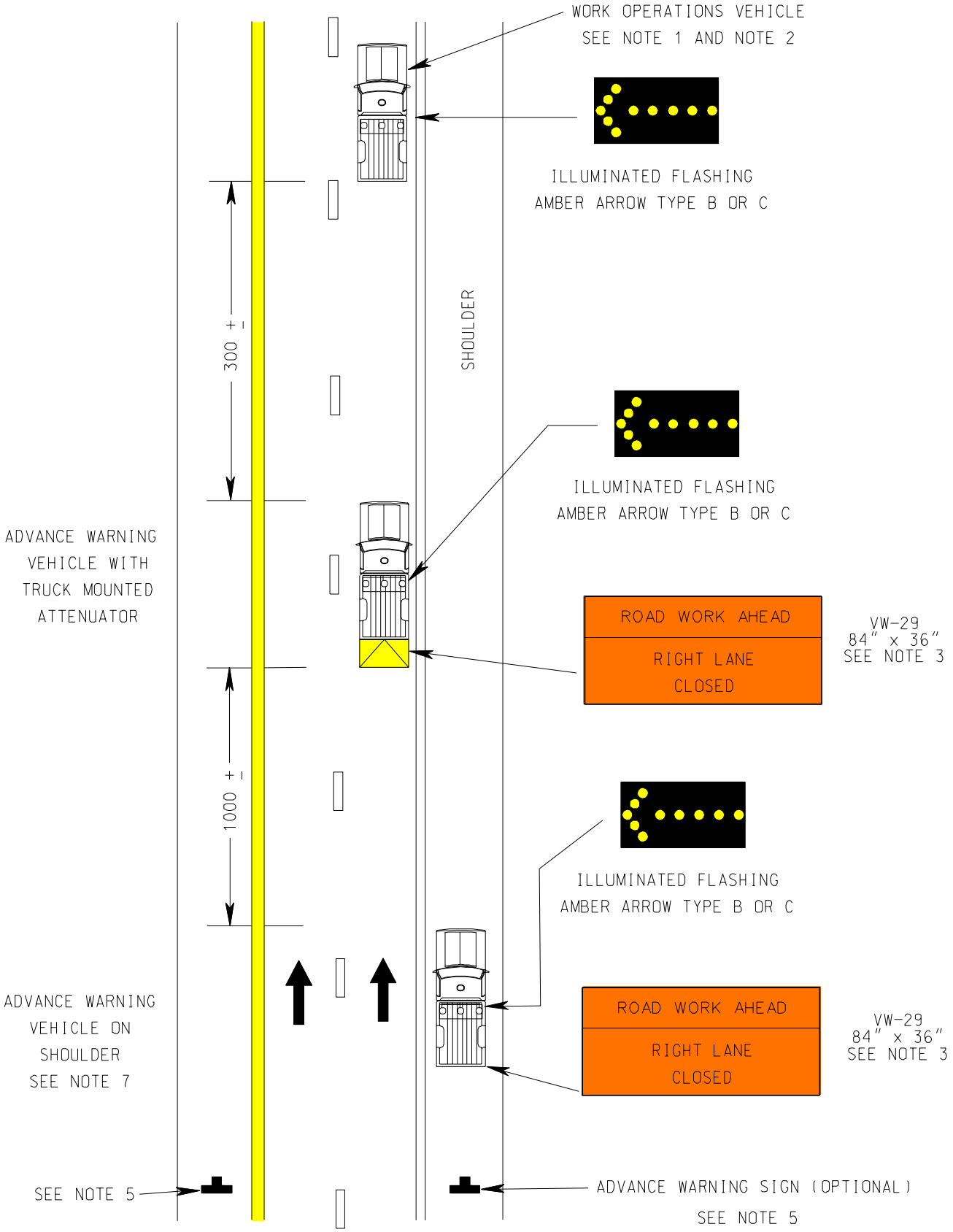
7. **When the work operations vehicle is stationary, the advance warning vehicle following the operations vehicle shall be in a position 50'-100' in advance of the operations vehicle to provide protection. When the work operations vehicle is moving, the advance warning vehicle following the operations vehicle shall follow at a distance of 300'+.**
8. **If the first advance warning vehicle cannot run completely on the shoulder and is partially in the travel lane, it shall be equipped with a truck mounted attenuator (TMA).**

Option:

9. For inside lane closure operations, the first advance warning vehicle may be positioned on the right shoulder without arrow designation.
10. **When the operation is completely off the travelway, only one advance warning vehicle will be required. A truck mounted attenuator will not be required. The second line of the sign message shall be changed to "Right Shoulder" and the arrows shall be changed to the four corner caution mode.**

Guidance:

11. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*



Moving/Mobile Operations On Multi-Lane Roadway
(Figure TTC 9.0)

Typical Traffic Control
Mobile/Moving Operation On Two-Lane Roadway
(Figure TTC 10.0)

NOTES

Standard:

1. **Each vehicle involved in the moving/mobile operation shall be equipped with at least one high-intensity amber rotating, oscillating, or strobe light. Illuminated flashing arrows on the advance warning vehicles and work operations vehicle shall be a type B (60 x 30 inch) or Type C (96 x 48 inch). Vehicle hazard warning signals shall not be used instead of rotating lights or strobe lights, but as a supplement**.
2. **Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inches above the pavement and mounted in a manner such that equipment or supplies do not obscure them. Sign legends shall be covered or turned from view when work is not in progress.**

Guidance:

3. *Where practical and when needed, the work and shadow vehicles should pull over periodically to allow motor vehicle traffic to pass.*
4. *Whenever adequate stopping sight distance exists to the rear, the shadow vehicle should maintain the minimum distance from the work vehicle and proceed at the same speed. The shadow vehicle should slow down in advance of vertical or horizontal curves that restrict sight distance.*
5. *A truck-mounted attenuator should be used on the shadow vehicle.*

Standard:

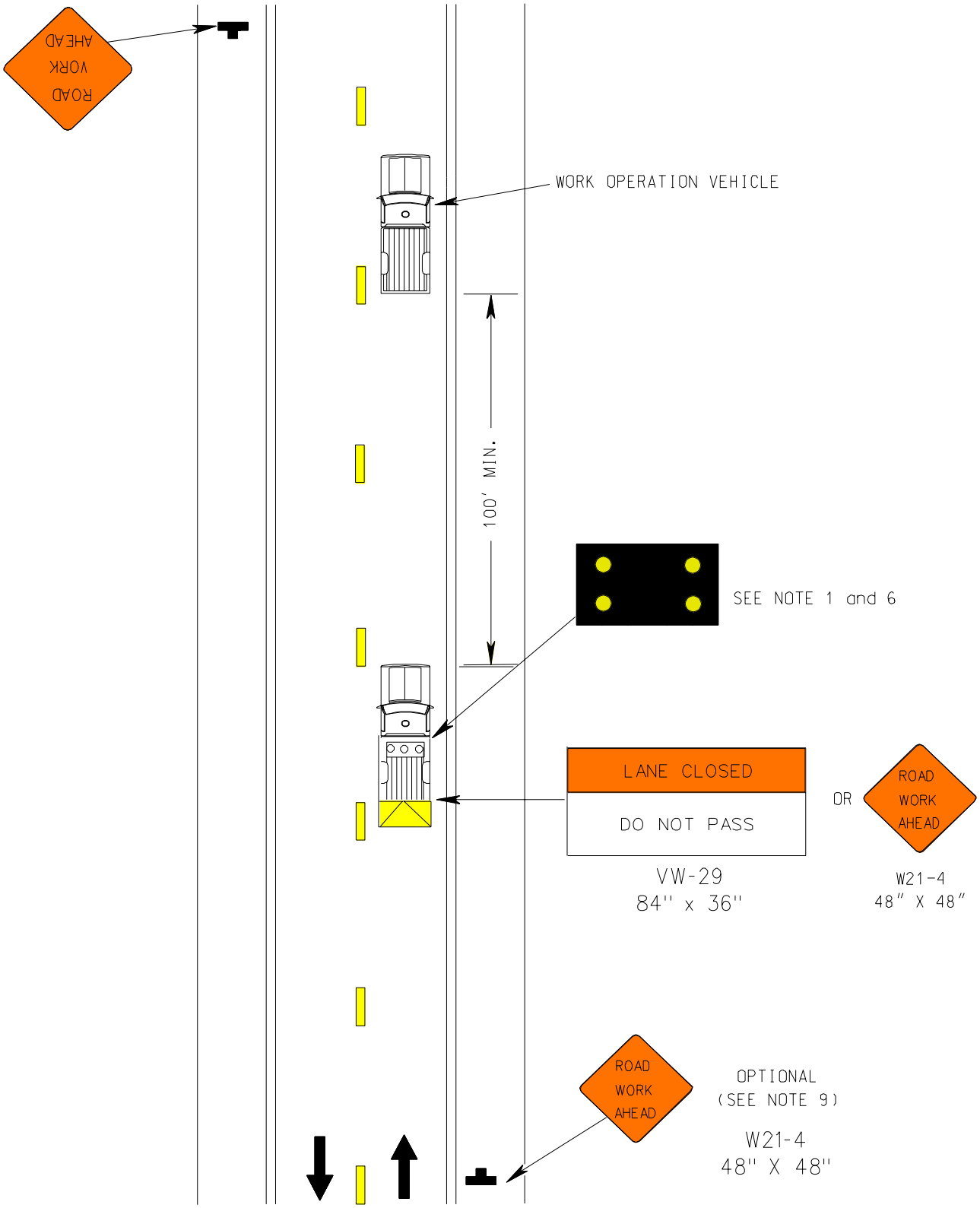
6. **If using an arrow board on the shadow vehicle, it shall operate in the four corner caution mode.**

Option:

7. The distance between the work and shadow vehicles may vary according to speed, terrain, paint drying time, and other factors.
8. If the work and shadow vehicles cannot pull over to allow motor vehicle traffic to pass frequently, a "DO NOT PASS" sign may be placed on the rear of the vehicle blocking the lane.
9. Stationary signing may be used on high volume, high speed roadways. Signs may be fabricated to permit change of the message in the field to identify the type of moving operation ("SPRAYING NEXT XX MILES"). The maximum distance between the sign and protection vehicle is 5 miles for limited access highways, and 2 miles for all other roads.
10. The static warning sign and caution mode arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters.

Guidance:

11. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the Type B arrow display.*



Mobile/Moving Operation On Two-Lane Roadway
(Figure TTC 10.0)

TYPICAL TRAFFIC CONTROL
Short Duration Operation On Multi-Lane Roadway
(Figure TTC-11.0)

NOTES

Standard:

1. **This typical traffic control layout shall not be used for Limited Access Highway or Two-lane roadways.**
2. **Each vehicle involved in the operation shall have either an arrow board operating in the caution mode, or at least one high-intensity amber rotating, oscillating, or strobe light. Although vehicle hazard warning signals can be used to supplement the rotating, oscillating or strobe lights, they shall not be used instead of rotating, oscillating, or strobe lights.**
3. **Vehicle-mounted signs shall be mounted with the bottom of the sign at a minimum height of 48 inches above the pavement.**

Guidance:

4. *The minimum distance between the sign/shadow vehicle and the truck mounted attenuator (TMA) vehicle should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Option:

5. The first advance warning shadow vehicle on the shoulder side where the operation is occurring may be replaced with a "ROAD WORK AHEAD" sign on low speed (less than 45 mph), low volume (less than 500 vehicles per day) roadways.
6. The static warning sign and arrow panel may be replaced with a vehicle mounted CMS with a minimum of 10" height characters.

Standard:

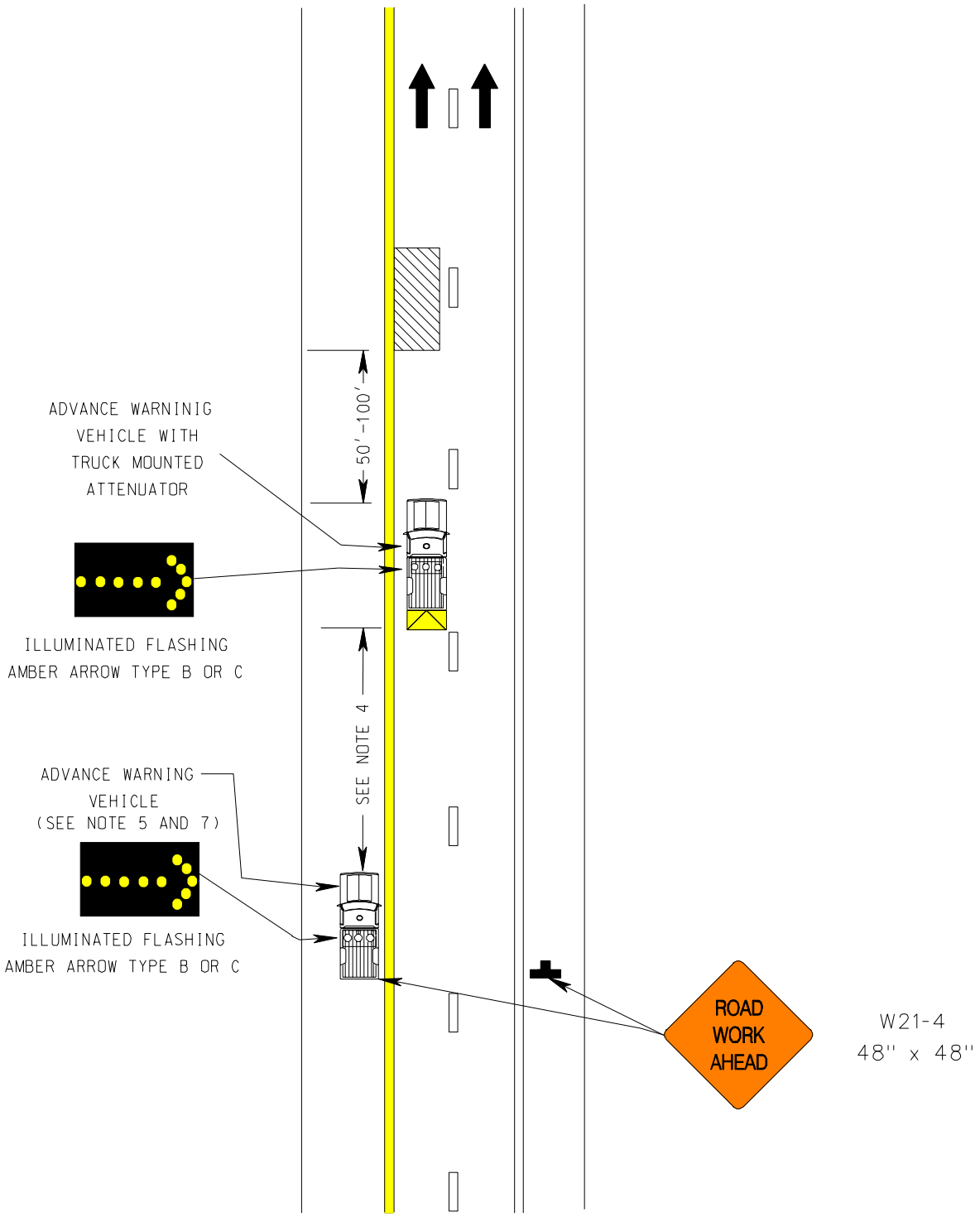
7. **A truck mounted attenuator (TMA) shall be used on the second shadow vehicle in the travelway regardless of the posted speed limit. If the first shadow vehicle occupies any part of the travel lane, it shall be equipped with a TMA, or replaced with the "ROAD WORK AHEAD" sign.**

Guidance:

8. *When using a CMS to replace the static sign and arrow panel, each word message phase should be followed by the type B arrow display.*

Support:

9. A short duration operation is defined as an operation that requires 16 minutes to 60 minutes to perform in the immediate area. (The immediate area is defined as a 1000' ± linear distance.)



Short Duration Operation On Multi-Lane Roadway
(Figure TTC-11.0)

TYPICAL TRAFFIC CONTROL
Outside Lane Closure Operation On Four-Lane Roadway
(Figure TTC-12.0)

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*
4. *All vehicles, equipment, workers and their activities should be restricted to one side of the pavement.*

Standard:

5. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

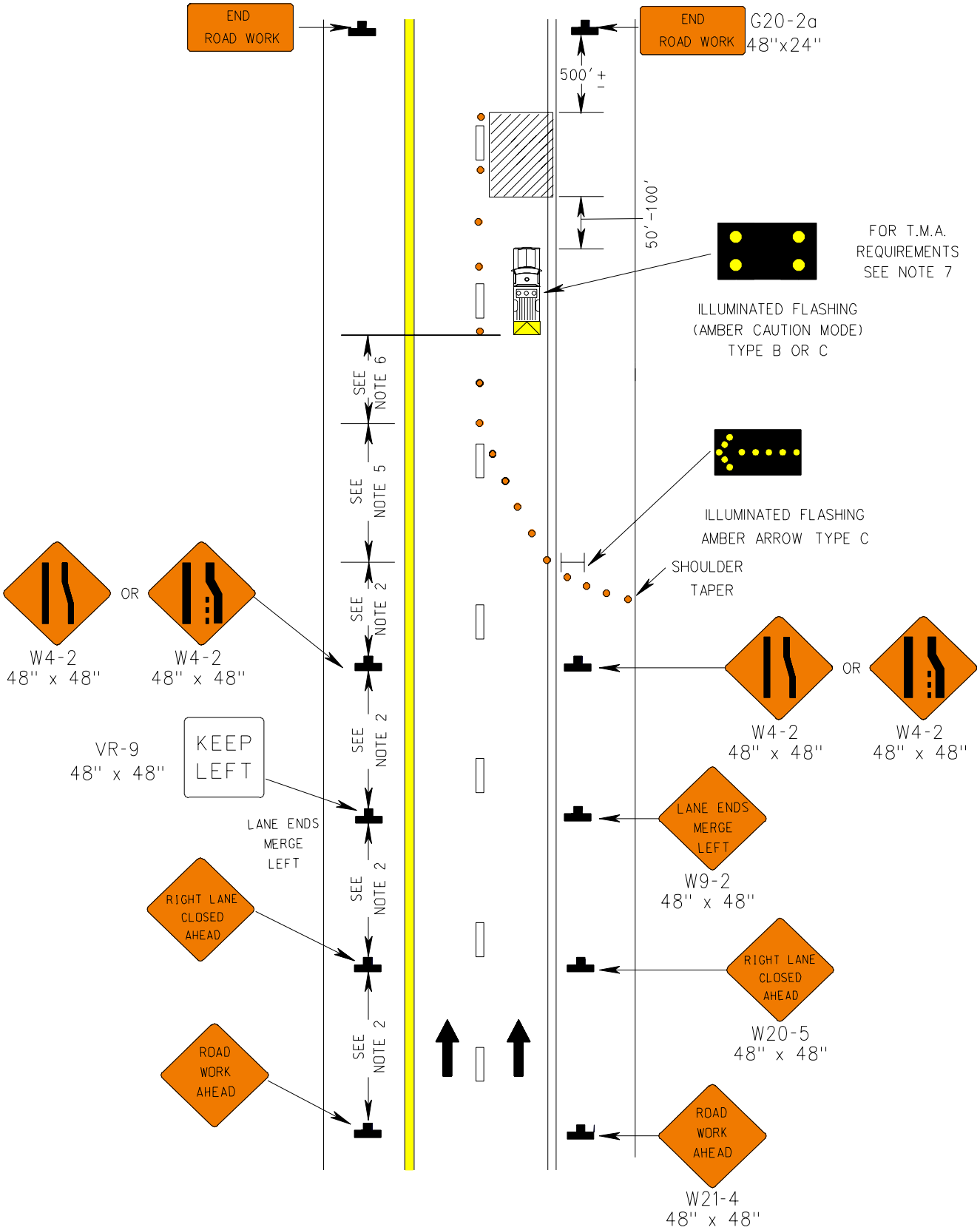
	Speed (mph)	
Location	0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-4 for the posted speed limit.**
7. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
8. **Vehicle hazard warning signals shall not be used instead of the vehicle's high intensity rotating, oscillating, or amber strobe light.**
9. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Outside Lane Closure Operation On Four-Lane Roadway
(Figure TTC-12.0)

TYPICAL TRAFFIC CONTROL
Inside Lane Closure Operation On Four-Lane Roadway
(Figure TTC-13.0)

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*
4. *All vehicles, equipment, workers and their activities should be restricted to one side of the pavement.*

Standard:

5. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

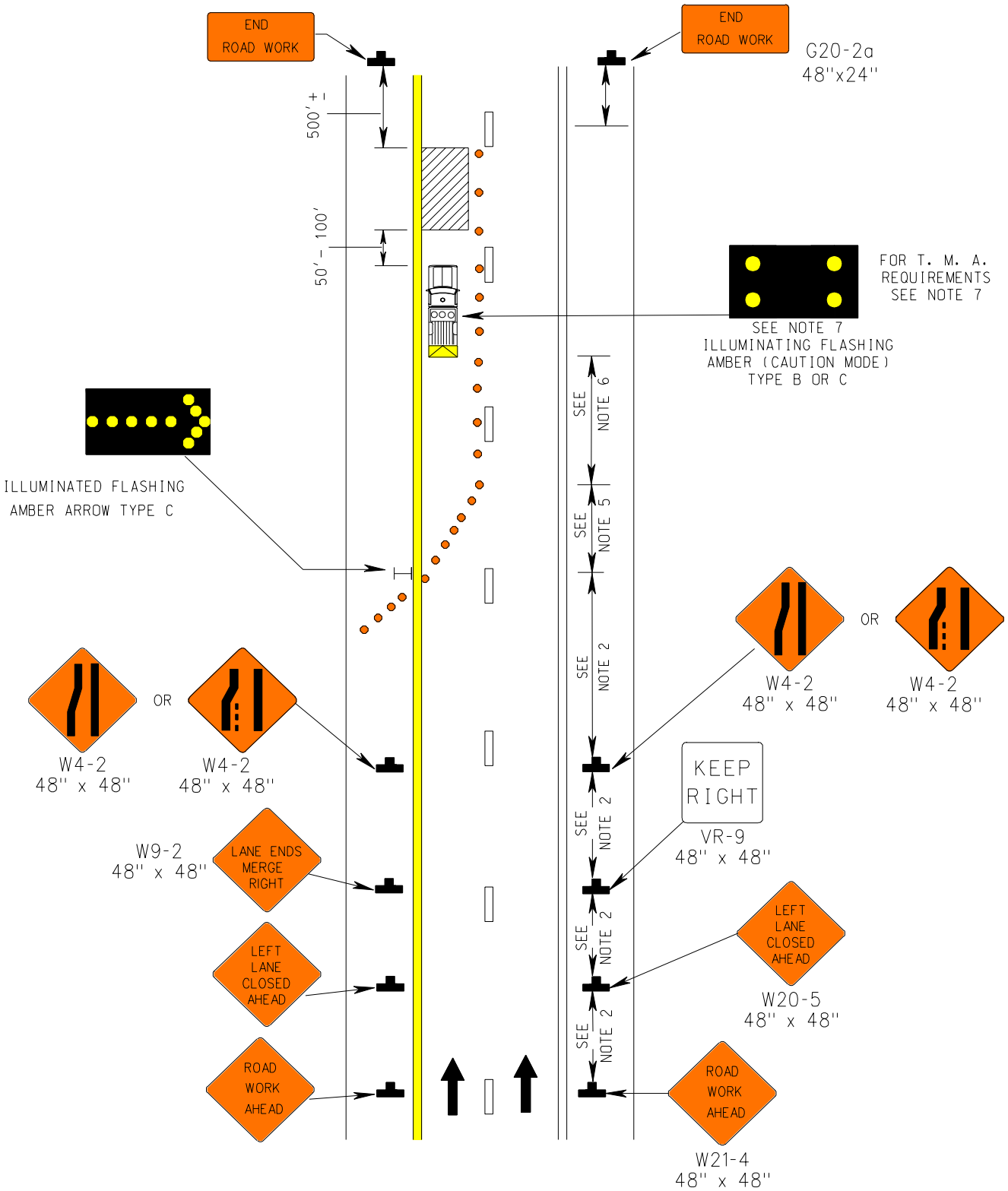
	Speed (mph)	
Location	0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

(Shoulder Taper = 1/3 L Minimum)

NOTE: For all limited access highways, the taper length shall be a minimum of 1000'.

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-4 for the posted speed limit.**
7. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
8. **Vehicle hazard warning signals shall not be used instead of the vehicle's high intensity rotating, oscillating, or amber strobe light.**
9. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Inside Lane Closure Operation On Four-Lane Roadway
(Figure TTC-13.0)

TYPICAL TRAFFIC CONTROL
Multi-Lane Closure Operation
(Figure TTC-14.0)

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*
4. *All vehicles, equipment, workers and their activities should be restricted to one side of the pavement.*

Standard:

5. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

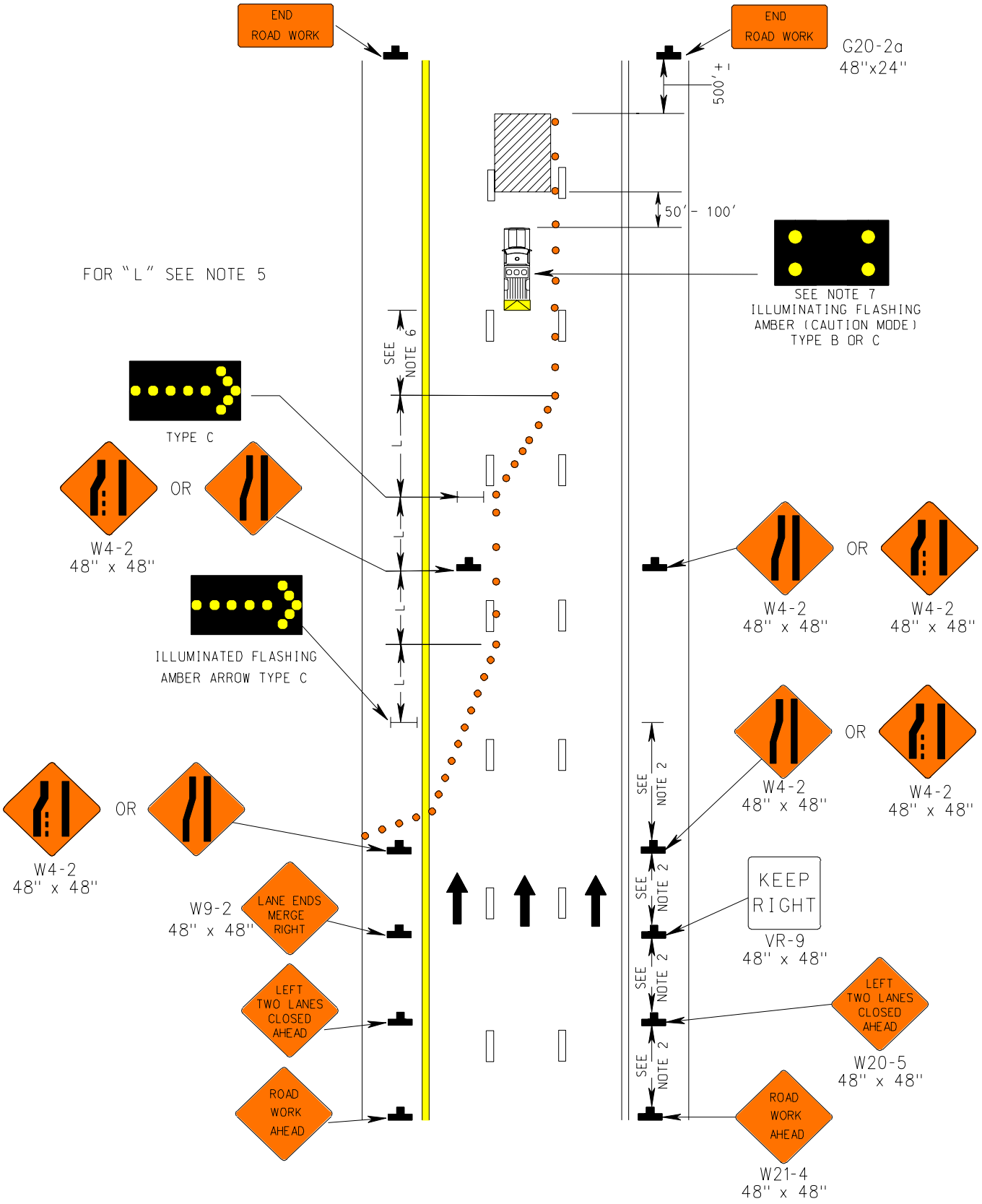
	Speed (mph)	
Location	0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

6. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-4 for the posted speed limit.**
7. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
8. **Vehicle hazard warning signals shall not be used instead of the vehicle's high intensity rotating, oscillating, or amber strobe light.**
9. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Multi-Lane Closure Operation
(Figure TTC-14.0)

TYPICAL TRAFFIC CONTROL
Lane Closure Operation With Lane Weave
(Figure TTC-15.0)

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

4. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

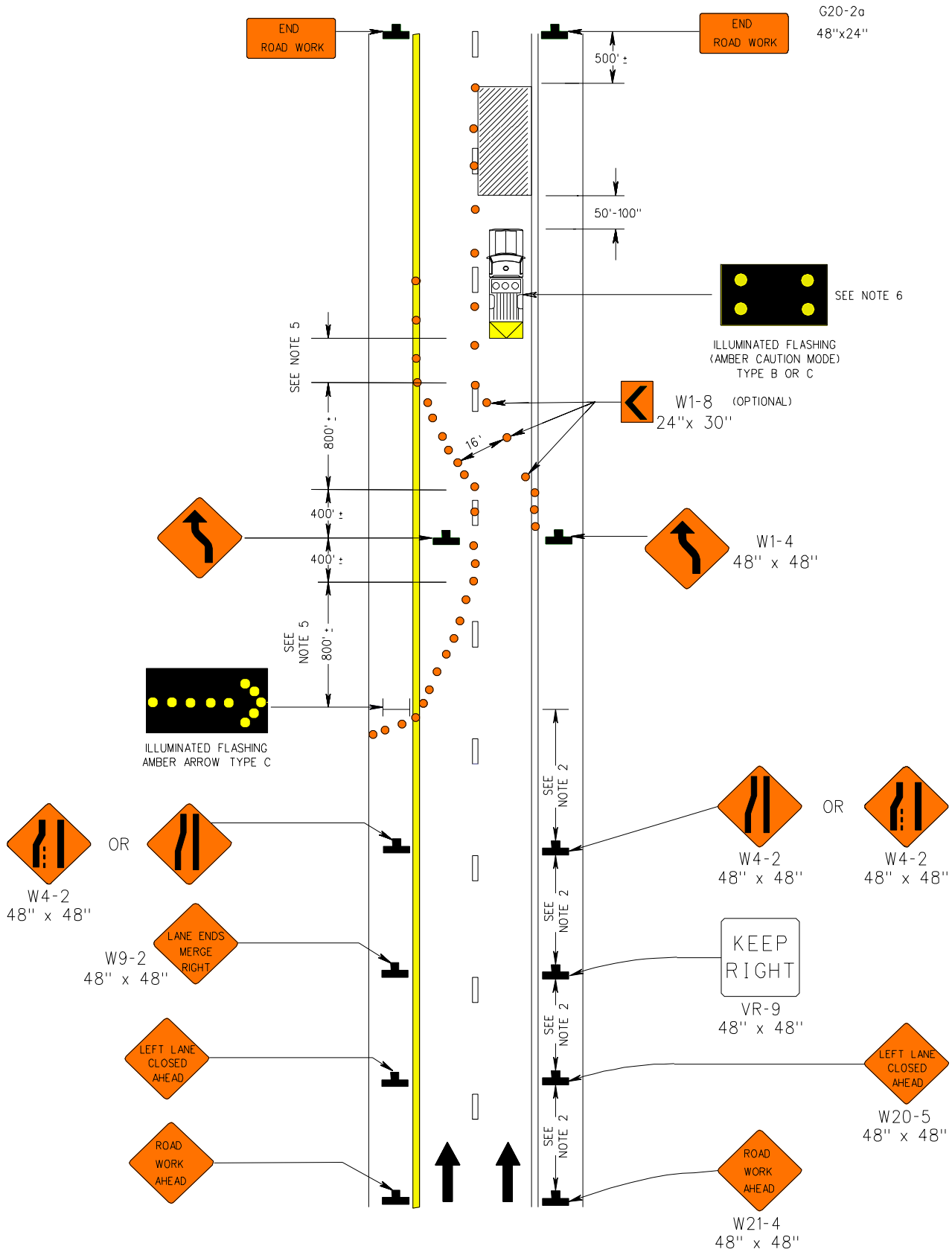
Location	Speed (mph) 0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

On roadways with paved shoulders having a width of 8 feet or more, channelizing devices shall be used to close the shoulder in advance of the merging taper to direct vehicular traffic to remain within the traveled way.

5. **The buffer space length shall be as shown in Table 6H-3.0 on page 6H-4 for the posted speed limit.**
6. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
7. **Vehicle hazard warning signals shall not be used instead of the vehicle's high intensity rotating, oscillating, or amber strobe light.**
8. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Lane Closure Operation With Lane Weave
(Figure TTC-15.0)

TYPICAL TRAFFIC CONTROL
Lane Closure Operation With Concrete Traffic Barrier
(Figure TTC-16.0)

NOTES

Standard:

1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

2. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

4. **Group 2 Channelizing device spacing shall be at the following:**

Location	*Speed (mph)* 0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

5. **Length of pavement marking transition (L) = Posted Speed (S) x Width of Transition (W). (Example: 55 x 12'= 660')**
6. **End treatment of barrier in order of preference shall be:**
   a. **Where guardrail exists, attach to barrier with appropriate fixed object attachment.**
   b. **Where cut slope exists, bury barrier into cut slope and provide for drainage as needed.**
   c. **Extend end of barrier until it is beyond the established clear zone (see Appendix A, page A-4 for clear zone values).**
   d. **When barrier end is inside the established clear zone, attenuator service Type I or Type II shall be used. Refer to L&D special design drawings.**
7. **Barrier transition slope ratio shall be as follows:**

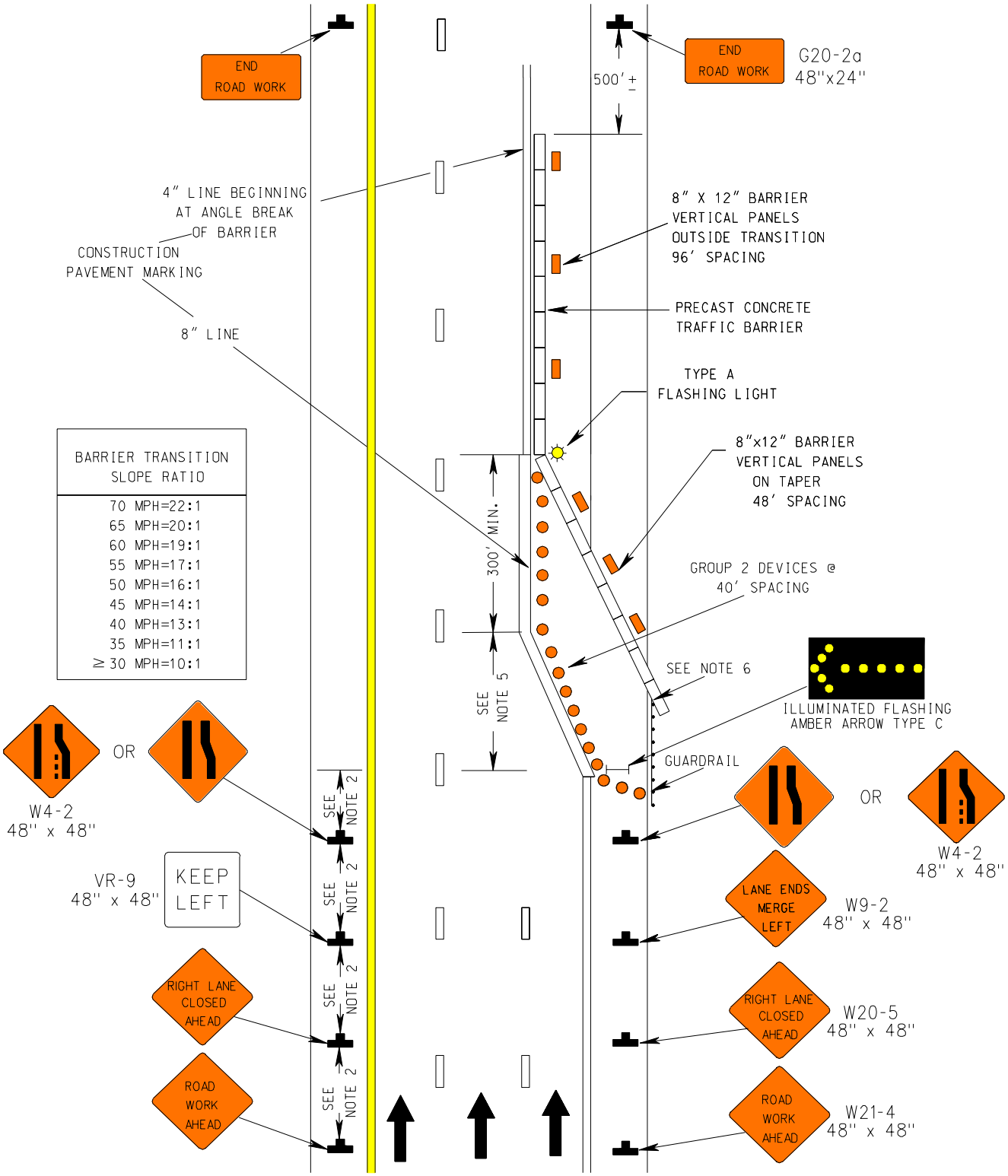
70 mph=22:1	60 mph=19:1	50 mph=16:1	40 mph=13:1	30 ≥ mph=10:1
65 mph=20:1	55 mph=17:1	45 mph=14:1	35 mph=11:1	

When the barrier transition slope is on a horizontal alignment, the total offset shall be prorated around the curve in lieu of a straight-line slope.

8. **Barrier vertical panels 8 inches in width and 12 inches in height shall be placed on top of the concrete barrier and spaced 96' on centers along the parallel or tangent sections and 48' on centers along the transition or taper sections. Reflectorized surface shall be fluorescent orange prismatic lens sheeting. The light at the breakpoint where the taper ends and the barrier becomes parallel to the roadway shall be a Type A flashing light. Barrier delineators shall be installed along the traffic side of the concrete barrier in accordance with Section 702 of VDOT's Road and Bridge Specifications.**

Guidance:

9. *Eradication of existing pavement markings should be as shown in Typical Traffic Control figure TTC-38.0.*



Lane Closure Operation With Concrete Traffic Barrier
(Figure TTC-16.0)

TYPICAL TRAFFIC CONTROL
Center Turn Lane Closure Operation
(Figure TTC-17.0)

NOTES

Guidance:

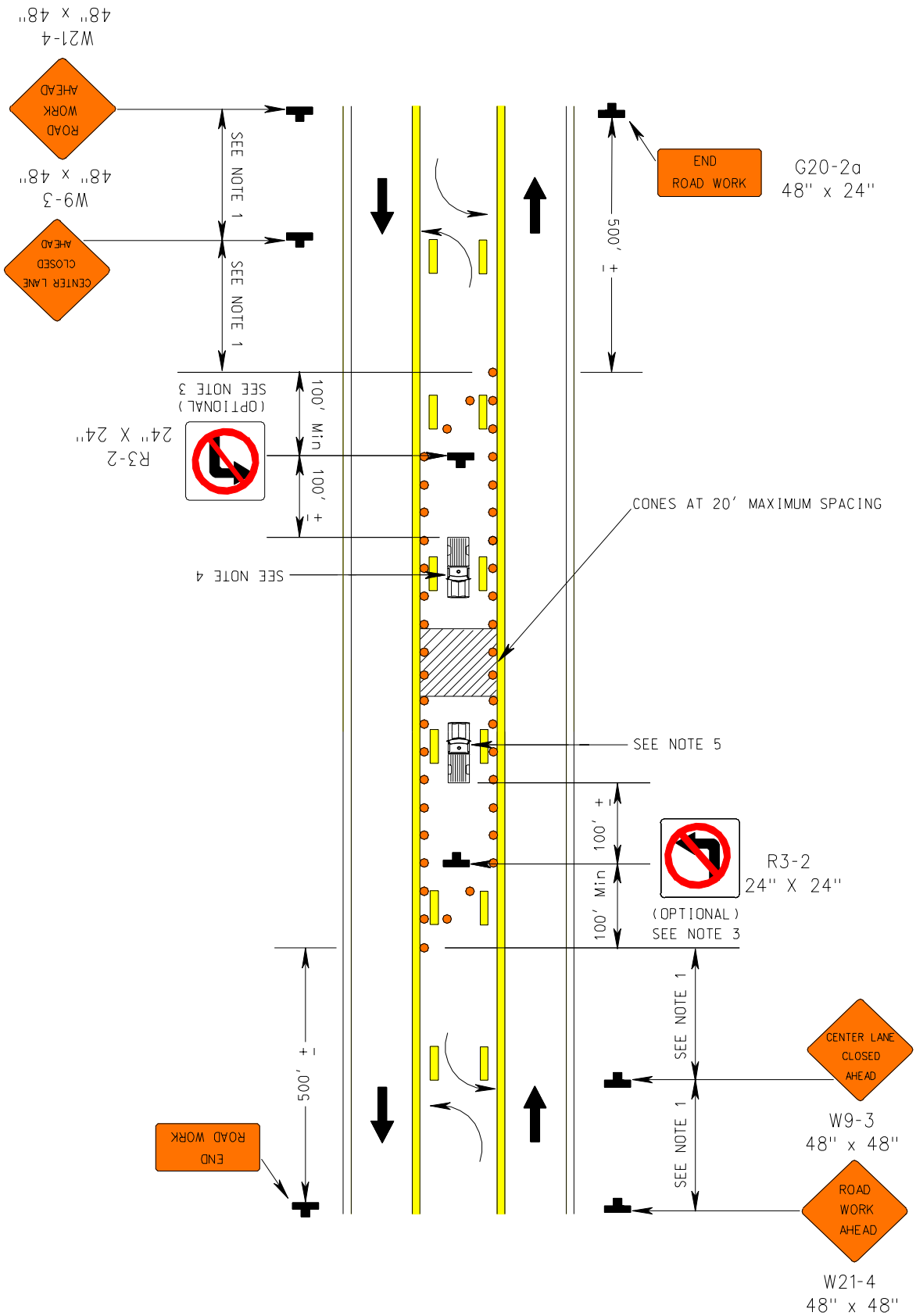
1. *The distance between signs and beginning of cone transition should be a minimum of 500' and a maximum of 800'.*

Option:

2. Where Right-of-Way or geometric conditions prevent use of 48" x 48" signs, 36" x 36" signs may be used.
3. For locations with a high volume of left turning movements, R3-2 graphic "NO LEFT TURN" signs may be used within the closed lane.

Standard:

4. **To prevent vehicles from entering into the work zone, channelizing device spacing shall be a maximum of 20' on centers.**
5. **A shadow vehicle with either a type B or C arrow panel operation in the caution mode, or at least one rotating amber light or high intensity amber strobe light shall be parked 50'-100' in advance of the work crew in both directions of travel. If multiple lanes are present (four or more lanes, excluding the center turn lane) and the posted speed limit is 45 mph or greater, the vehicles shall be equipped with a truck mounted attenuator (TMA).**
6. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Center Turn Lane Closure Operation
(Figure TTC-17.0)

TYPICAL TRAFFIC CONTROL
Flagging Operation On Two-Lane Road
(Figure TTC-18.0)

NOTES

Guidance:

1. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*

Option:

3. Where Right-of-Way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

4. **Flagging stations shall be located far enough in advance of the work zone to permit approaching traffic to reduce speed and/or stop before passing the work zone and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-4.0 on page 6H-4).**
5. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. (See Section 6E.01, Qualifications for Flaggers)**
6. **Cone spacing shall be at the following:**

Location	*Speed (mph)*	
	0-35	*36+*
Transition Spacing	**20'**	**40'**
Travelway Spacing	**40'**	**80'**

7. **A shadow vehicle with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew.**

Option:

8. A supplemental flagger may be required in this area to give advance warning of the operation ahead by slowing approaching traffic prior to reaching the flagger station or queued traffic.

Guidance:

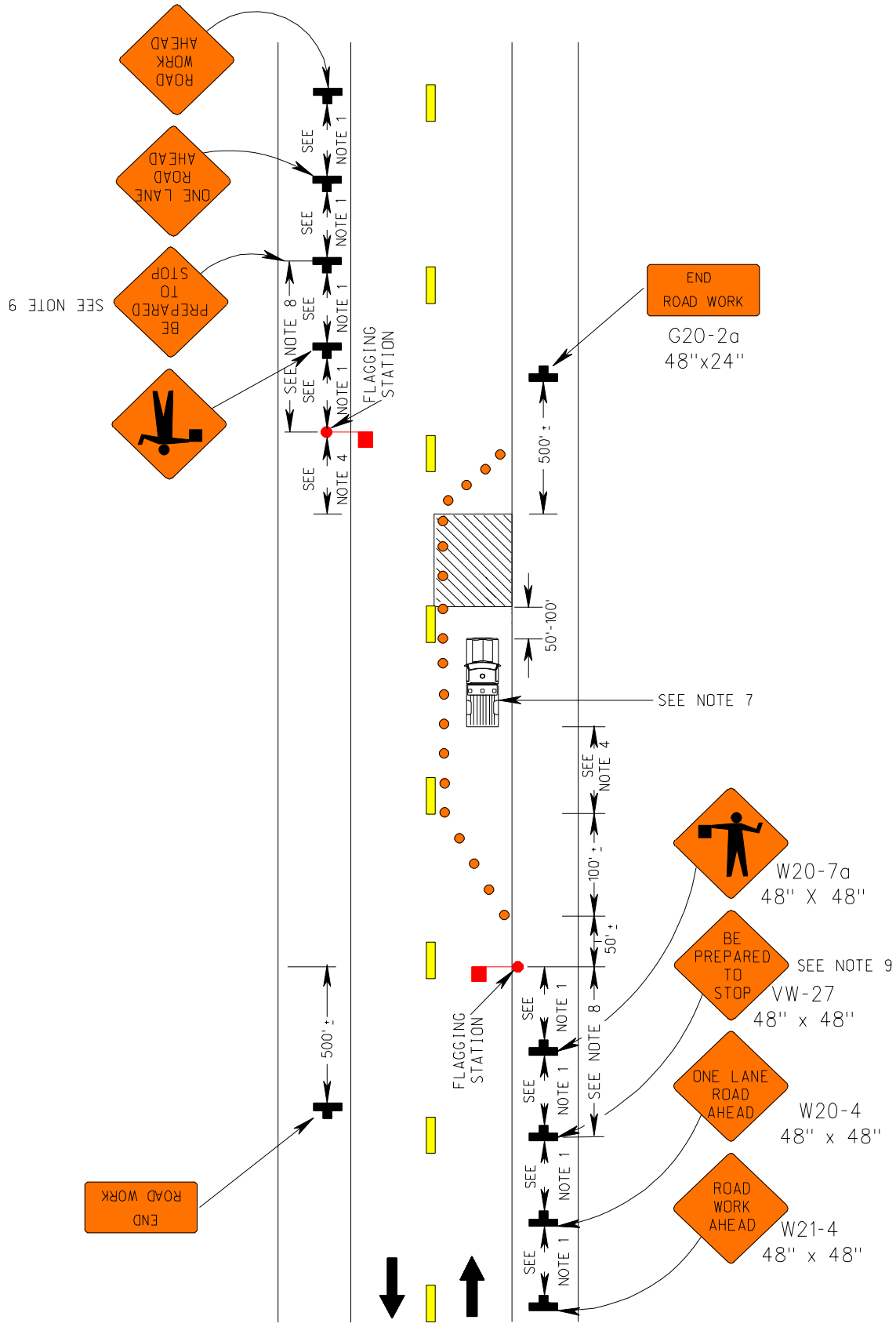
9. *If the queue of traffic reaches the "BE PREPARED TO STOP" sign, then the signs should be readjusted at greater distances.*
10. *When a highway-rail crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the highway-rail grade crossing, the temporary traffic control zone should be extended so that the transition area precedes the highway-rail crossing (See figure TTC-39.0 for additional information on highway-rail crossings).*

Standard:

11. **At night, flagger stations shall be illuminated, except in emergencies.**

Option:

12. Cones may be eliminated when using a pilot vehicle operation or when the total roadway width is 20 feet or less.
13. For low-volume situations with short work zones on straight roadways where the flagger is visible to road users approaching from both directions, a single flagger, positioned to be visible to road users approaching from both directions, may be used (see Chapter 6E).



Flagging Operation On Two-Lane Road
(Figure TTC-18.0)

TYPICAL TRAFFIC CONTROL
Non-Stationary Flagging Operation On Two-Lane Road
(Figure TTC-19.0)

NOTES

Guidance:

1. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*

Option:

3. Where Right-of-Way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.

Standard:

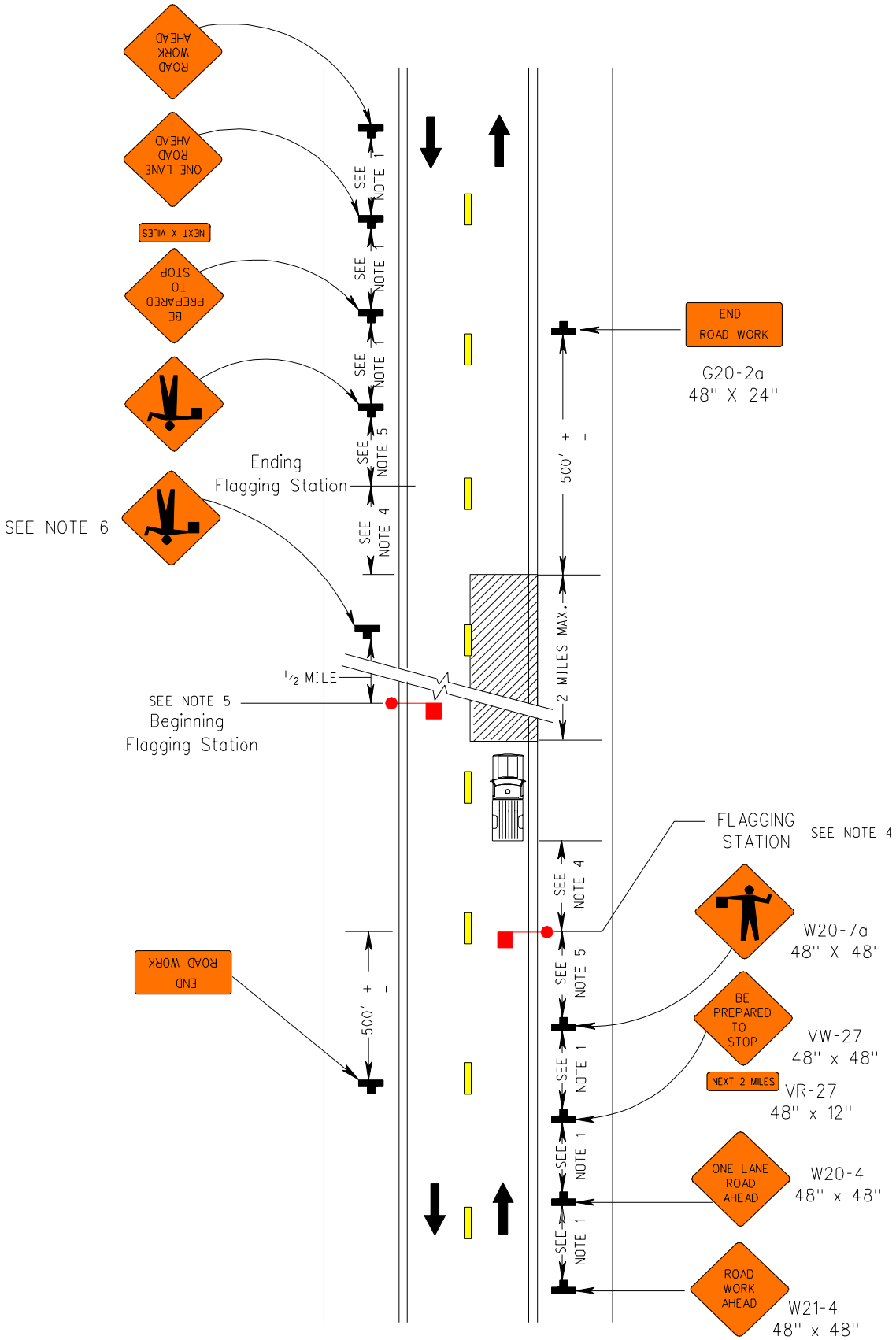
4. **Flagging stations shall be located far enough in advance of the work zone to permit approaching traffic to reduce speed and/or stop before passing the work zone and allow sufficient distance for departing traffic in the left lane to return to the right lane before reaching opposing traffic (see Table 6H-4.0 on page 6H-4).**
5. **The GRAPHIC FLAGGER AHEAD sign (W20-7A) shall stay within ½ mile of each flagger.**

Guidance:

6. *Additional GRAPHIC FLAGGER AHEAD signs should be placed at ½ mile intervals and either erected by the approaching flagger, or taken down as the operation proceeds past this point.*
7. *When a highway-rail crossing exists within or upstream of the transition area and it is anticipated that queues resulting from the lane closure might extend through the highway-rail grade crossing, the temporary traffic control zone should be extended so that the transition area precedes the highway-rail crossing (See figure TTC-39.0 for additional information on highway-rail crossings).*

Standard:

8. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties. (See section 6E.01, Qualifications for Flaggers)**
9. **A shadow vehicle with at least one rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew.**
10. **The maximum length of the work area shall be two miles.**



Non-Stationary Flagging Operation On Two-Lane Road
(Figure TTC-19.0)

TYPICAL TRAFFIC CONTROL
Lane Closure Operation – Near Side Of Intersection
(Figure TTC-20.0)
NOTES

Guidance:

1. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
3. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

Location	Speed (mph) 0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

(Shoulder Taper = 1/3 L Minimum)

On three or more lane roadways, the merging taper shall direct vehicular traffic into either the right or left lane, but not both.

Guidance:

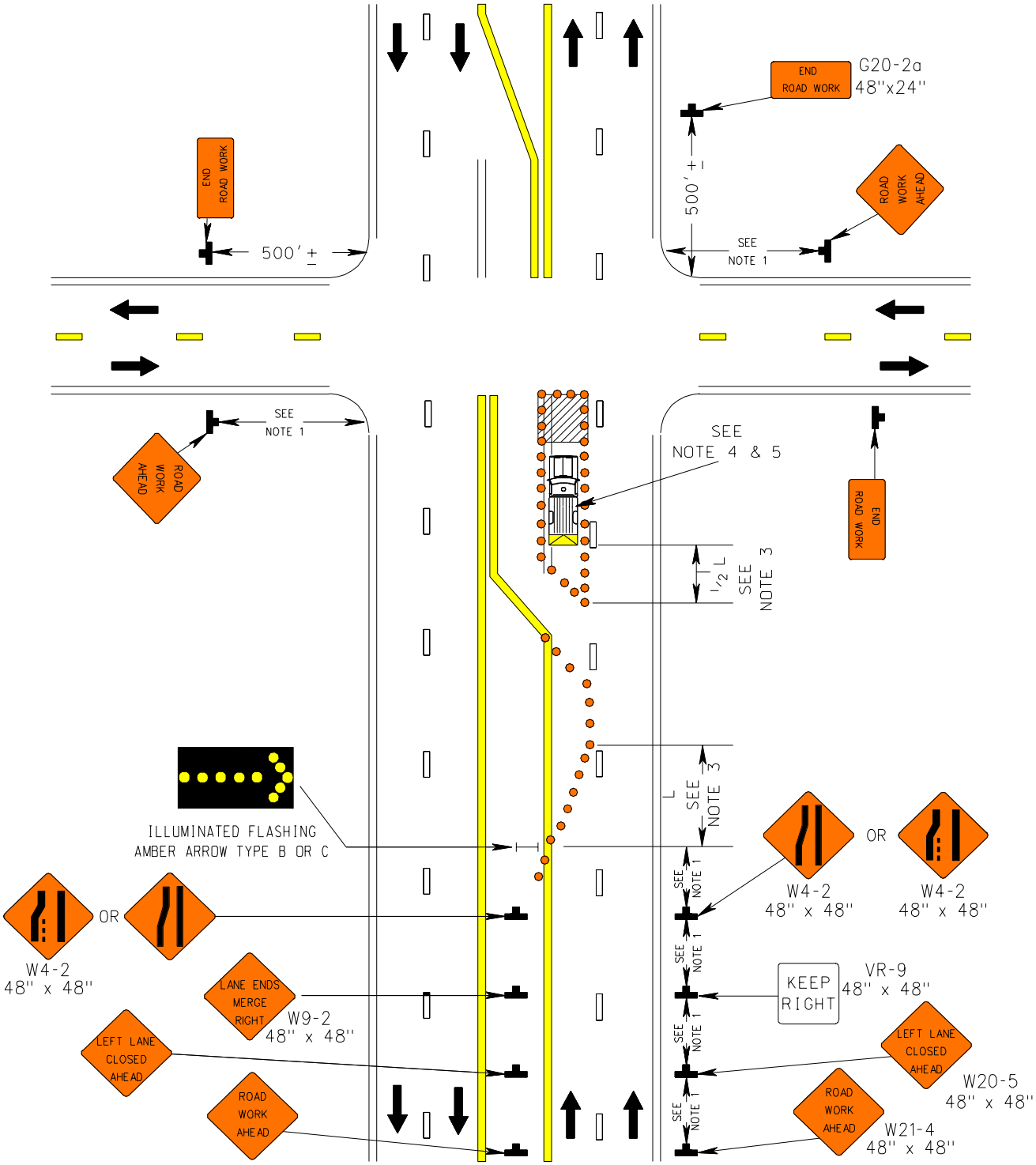
4. *If room permits, a shadow vehicle with at least one rotating, oscillating, or amber strobe light should be parked 50'-100' in advance of the first work crew.*

Standard:

5. **If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck mounted attenuator.**
6. **For emergency situations (any non-planned operation) of 30 minutes or less duration, two rotating amber lights or two high intensity amber strobe lights mounted on the vehicle and visible for 360 ° shall be required in addition to the channelizing devices shown around the vehicle. Also, vehicle hazard warning signals or amber oscillating lights shall be used.**
7. **Although vehicle hazard warning signals or amber oscillating lights are to be used to supplement the amber rotating lights or strobe lights, they shall not be used instead of the amber rotating lights or strobe lights.**

Guidance:

8. *If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-25.0.*



Lane Closure Operation – Near Side Of Intersection
(Figure TTC-20.0)

TYPICAL TRAFFIC CONTROL
Lane Closure Operation – Far Side Of Intersection
(Figure TTC-21.0)

NOTES

Guidance:

1. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
3. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

Location	Speed (mph) 0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

(Shoulder Taper = 1/3 L Minimum)

Guidance:

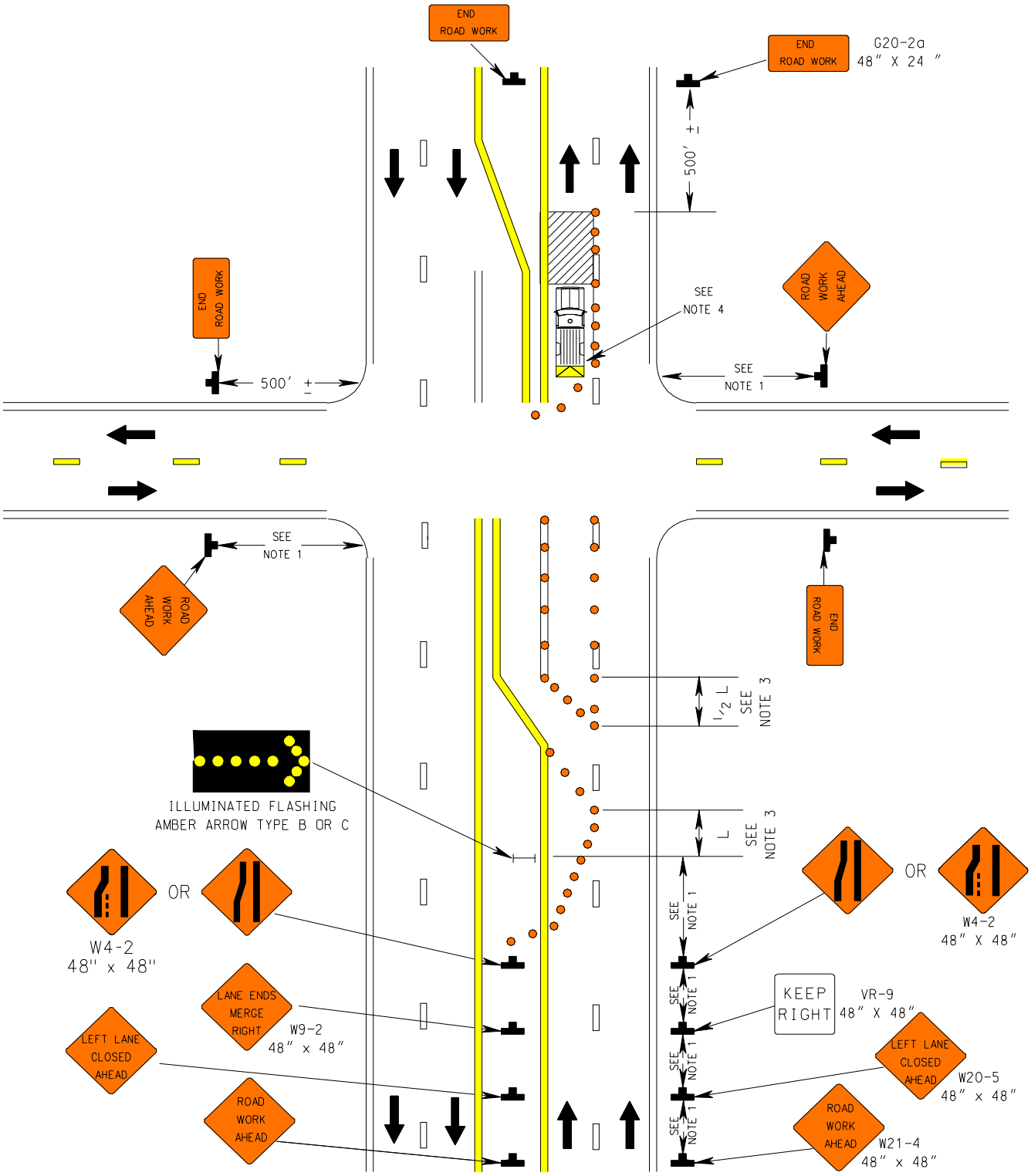
4. *If room permits, a shadow vehicle with at least one rotating, oscillating, or high intensity amber strobe light should be parked 50'-100' in advance of the first work crew.*

Standard:

5. **If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck mounted attenuator.**
6. **For emergency situations (any non-planned operation) of 30 minutes or less duration, two rotating amber lights or high intensity amber strobe lights mounted on the vehicle and visible for 360 ° shall be required in addition to the channelizing devices shown around the vehicle. Also, vehicle hazard warning signals or amber oscillating lights shall be used.**
7. **Although vehicle hazard warning signals and amber oscillating lights are to be used to supplement the rotating lights or strobe lights, they shall not be used instead of the amber rotating lights or strobe lights.**

Guidance:

8. *If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-25.0.*



Lane Closure Operation – Far Side Of Intersection
(Figure TTC-21.0)

TYPICAL TRAFFIC CONTROL
Closure Operation In Intersection
(Figure TTC-22.0)

NOTES

Guidance:

1. *The control of traffic through the intersection in order of preference should be:*
   a) *Obtain the services of law enforcement personnel.*
   b) *Divert the effective routes to other roads and streets as approved and directed by the District Traffic Engineer.*
   c) *Place a state certified flagger on each leg of the intersection with the appropriate signing as shown.*
2. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

3. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
4. **Cone spacing shall be on 20' centers or less.**

Guidance:

5. *If room permits, a shadow vehicle with at least one rotating amber light or high intensity amber strobe light should be parked 50'-100' in advance of the first work crew.*

Standard:

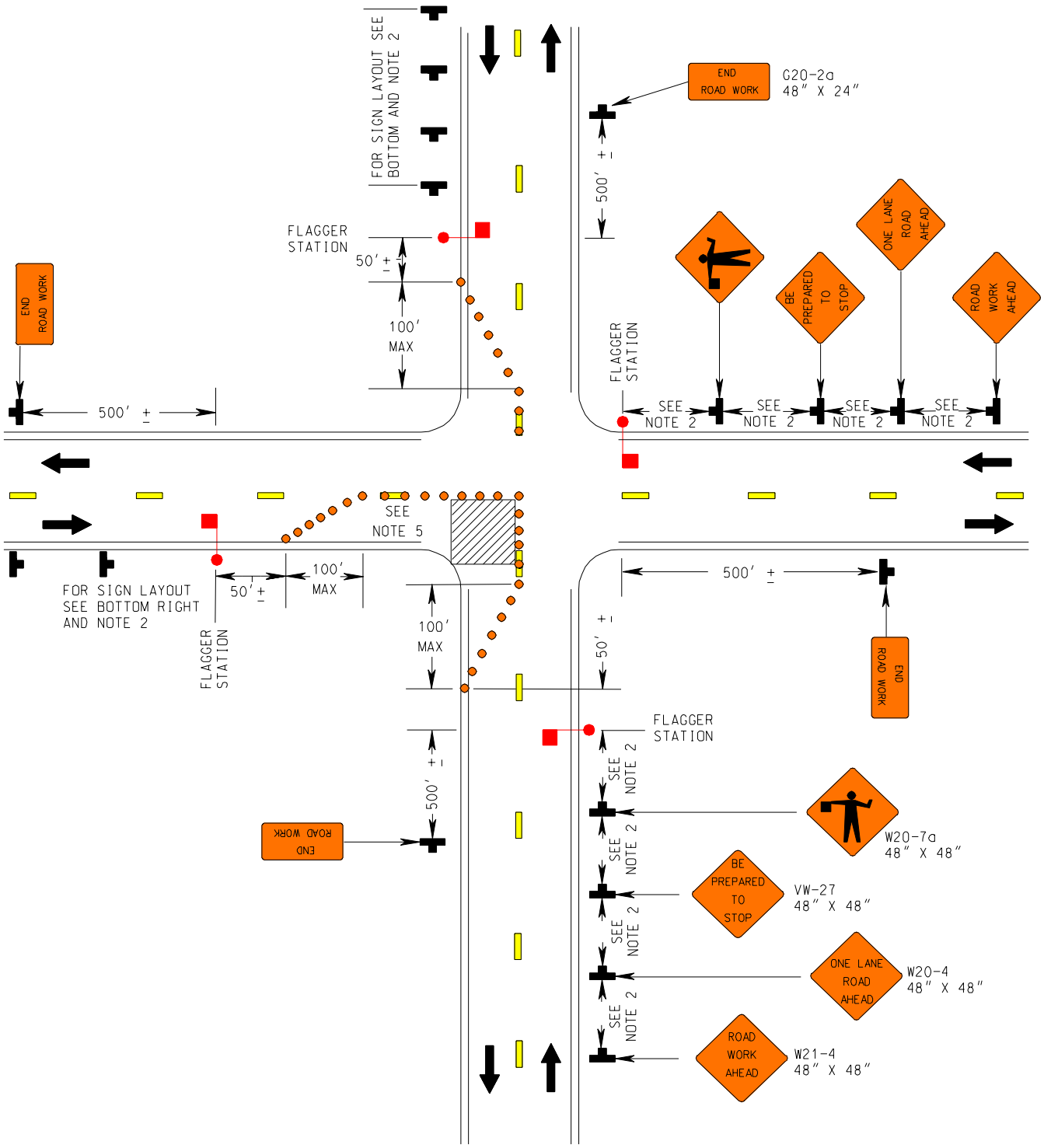
6. **If the posted speed limit is 45 mph or greater, the shadow vehicle shall have a truck mounted attenuator.**
7. **For emergency situations (any non-planned operation) of 30 minutes or less duration, two rotating amber lights or high intensity amber strobe lights mounted on the vehicle and visible for 360 ° shall be required in addition to the channelizing devices shown around the vehicle. Also, vehicle hazard warning signals or amber oscillating lights shall be used.**
8. **Although vehicle hazard warning signals or amber oscillating lights can be used to supplement the amber rotating lights or strobe lights, they shall not be used instead of the amber rotating lights or strobe lights.**

Guidance:

9. *If the work space extends across a crosswalk, the crosswalk should be closed using the information and devices shown in Figure TTC-25.0.*

Support:

10. Turns can be prohibited as required by vehicular traffic conditions. Unless the streets are wide, it might be physically impossible to make certain turns, especially for large vehicles.



Closure Operation In Intersection
(Figure TTC-22.0)

TYPICAL TRAFFIC CONTROL
Turn Lane Closure Operation
(Figure TTC-23.0)

NOTES

Guidance:

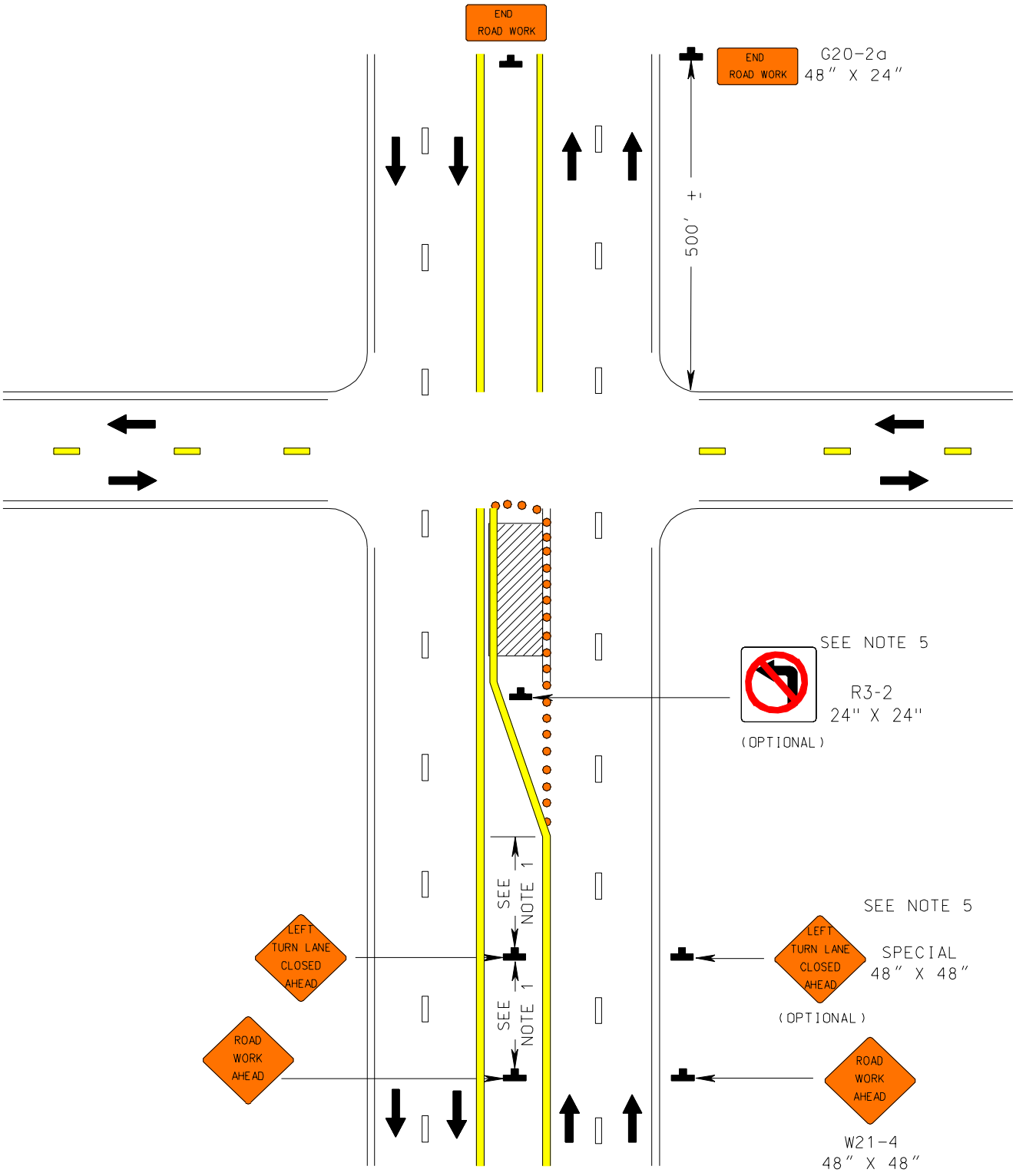
1. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
3. **To prevent accidental intrusion into the work area, cone spacing shall not exceed 20' on centers.**

Option**:**

4. This layout may be used for either right or left turn lane closures.
5. For a high volume of turning movements, additional traffic control devices, such as signs (graphic "NO LEFT TURN", "LEFT LANE MUST TURN LEFT" or "LEFT TURN CLOSED AHEAD"), cones and vehicles may be used



Turn Lane Closure Operation
(Figure TTC-23.0)

TYPICAL TRAFFIC CONTROL
Sidewalk Closure And Bypass Sidewalk Operation
(Figure TTC-24.0)

NOTES

Standard:

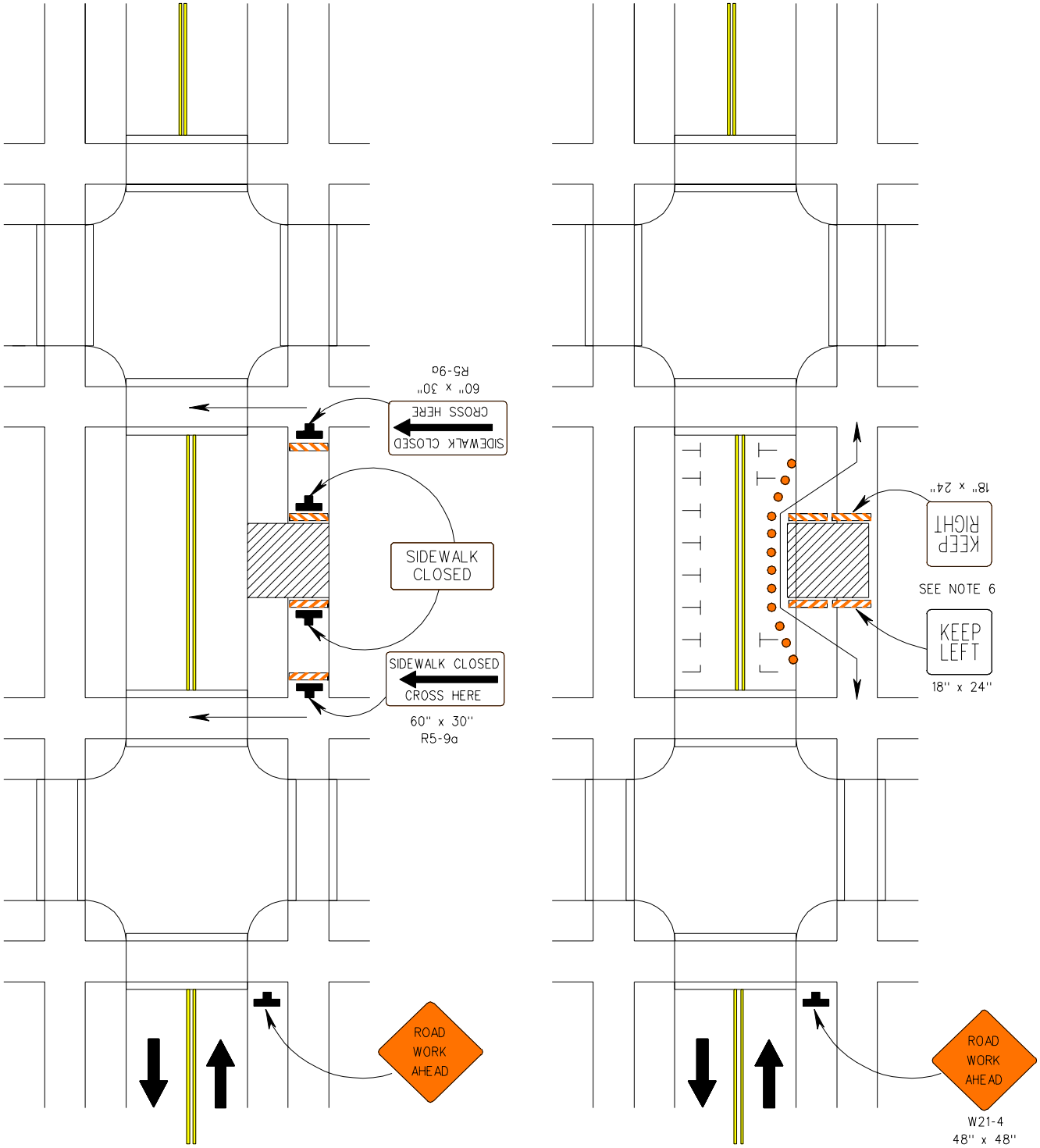
1. **When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.**

Guidance:

2. *Where high speeds are anticipated, a temporary traffic barrier and, if necessary, a crash cushion should be used to separate the temporary sidewalks from vehicular traffic.*
3. *Audible information devices should be considered where midblock closings and changed crosswalk areas cause inadequate communication to be provided to pedestrians who have visual disabilities.*

Option:

4. Only traffic control devices controlling pedestrian flows are shown. Other devices, such as lane closure signing or "ROAD NARROWS" signs, may be used to control motor vehicle traffic.
5. For nighttime closures, Type A flashing warning lights may be used on barricades supporting signs and closing walkways.
6. Signs, such as "KEEP RIGHT" and "KEEP LEFT" may be placed along a temporary sidewalk to guide or direct pedestrians.
7. Street lighting may be considered.



Sidewalk Closure And Bypass Sidewalk Operation
(Figure TTC-24.0)

TYPICAL TRAFFIC CONTROL
Crosswalk Closure And Pedestrian Detour Operation
(Figure TTC-25.0)

NOTES

Standard:

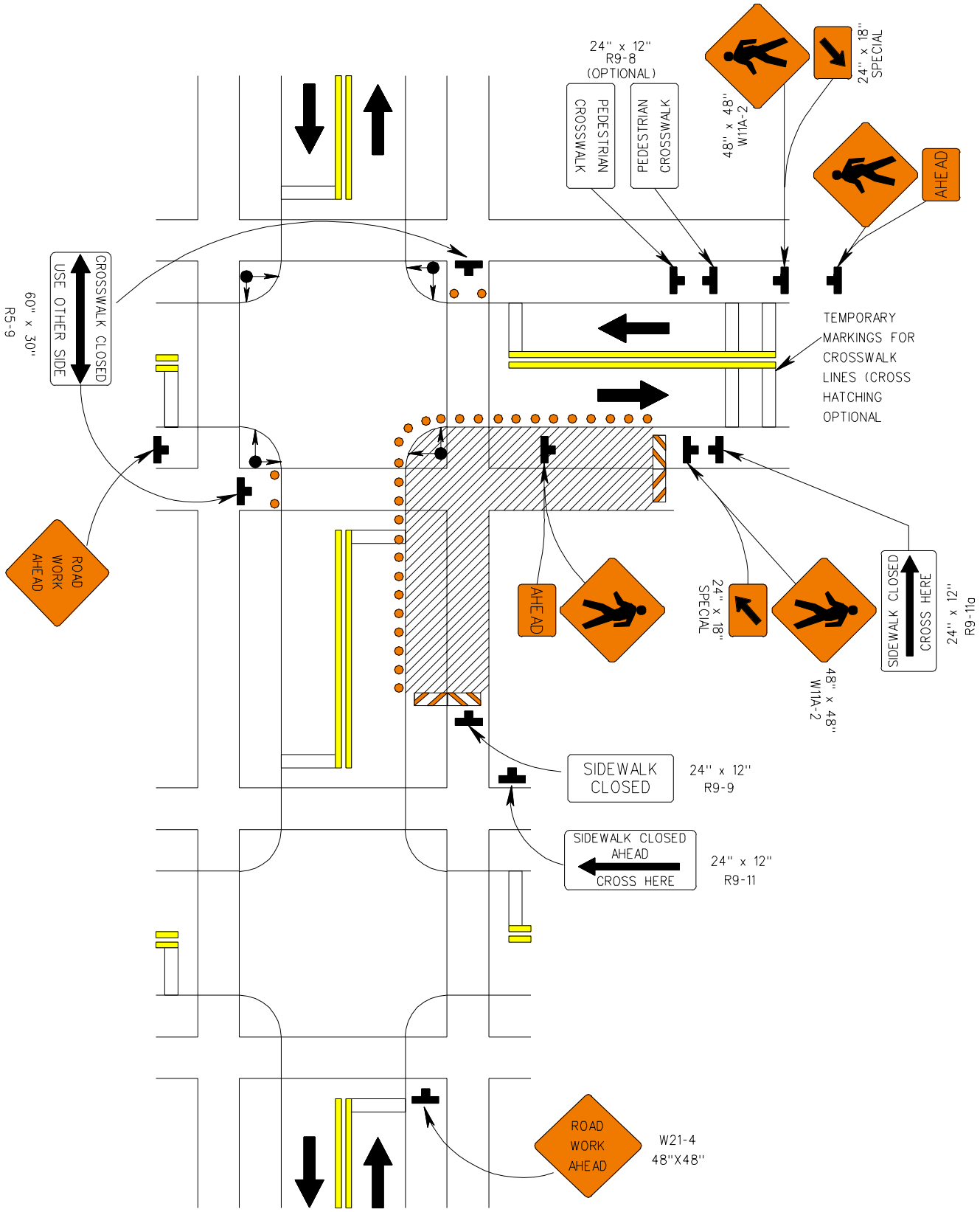
1. **When crosswalks or other pedestrian facilities are closed or relocated, temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility.**
2. **Curb parking shall be prohibited for at least 50 feet in advanced of the midblock crosswalk.**

Guidance:

3. *Audible information devices should be considered where midblock closings and changed crosswalk areas cause inadequate communication to be provided to pedestrians who have visual disabilities.*
4. *Pedestrian traffic signal displays controlling closed crosswalks should be covered or deactivated.*
5. *Temporary markings should be considered for operations exceeding three days in duration.*

Option:

6. Only the temporary traffic control devices related to pedestrians are shown. Other devices, such as lane closure signing or "ROAD NARROWS" signs, may be used to control vehicular traffic.
7. For nighttime closures, Type A flashing warning lights may be used on barricades supporting signs and closing walkways.
8. In order to maintain the systematic use of the fluorescent yellow-green background for pedestrian, bicycle, and school warning signs in a jurisdiction, the fluorescent yellow-green background for pedestrian, bicycle, and school warning signs may be used in the TTC zone.



Crosswalk Closure And Pedestrian Detour Operation
(Figure TTC-25.0)

TYPICAL TRAFFIC CONTROL
Work Operation In The Vicinity Of Exit Ramps
(Figure TTC-26.0)

NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*

Standard:

3. **On roadways having a median wider than 8', left and right sign assemblies shall be used.**
4. **A temporary "EXIT" sign shall be located in the temporary gore. For better visibility, it shall be mounted a minimum of 7 feet from the pavement surface to the bottom of the sign.**
5. **Taper Length and Channelizing Device Spacing shall be:**

Taper Length

Speed Limit M.P.H	Taper Length Lane Width In Feet 10	11	12
25	105	115	125
30	150	165	180
35	205	225	245
40	270	295	320
45	450	495	540
50	500	550	600
55	550	605	660
60	600	660	770
65	650	715	780

Channelizing Device Spacing

	Speed (mph)	
Location	0-35	36+
Transition Spacing	20'	40'
Travelway Spacing	40'	80'

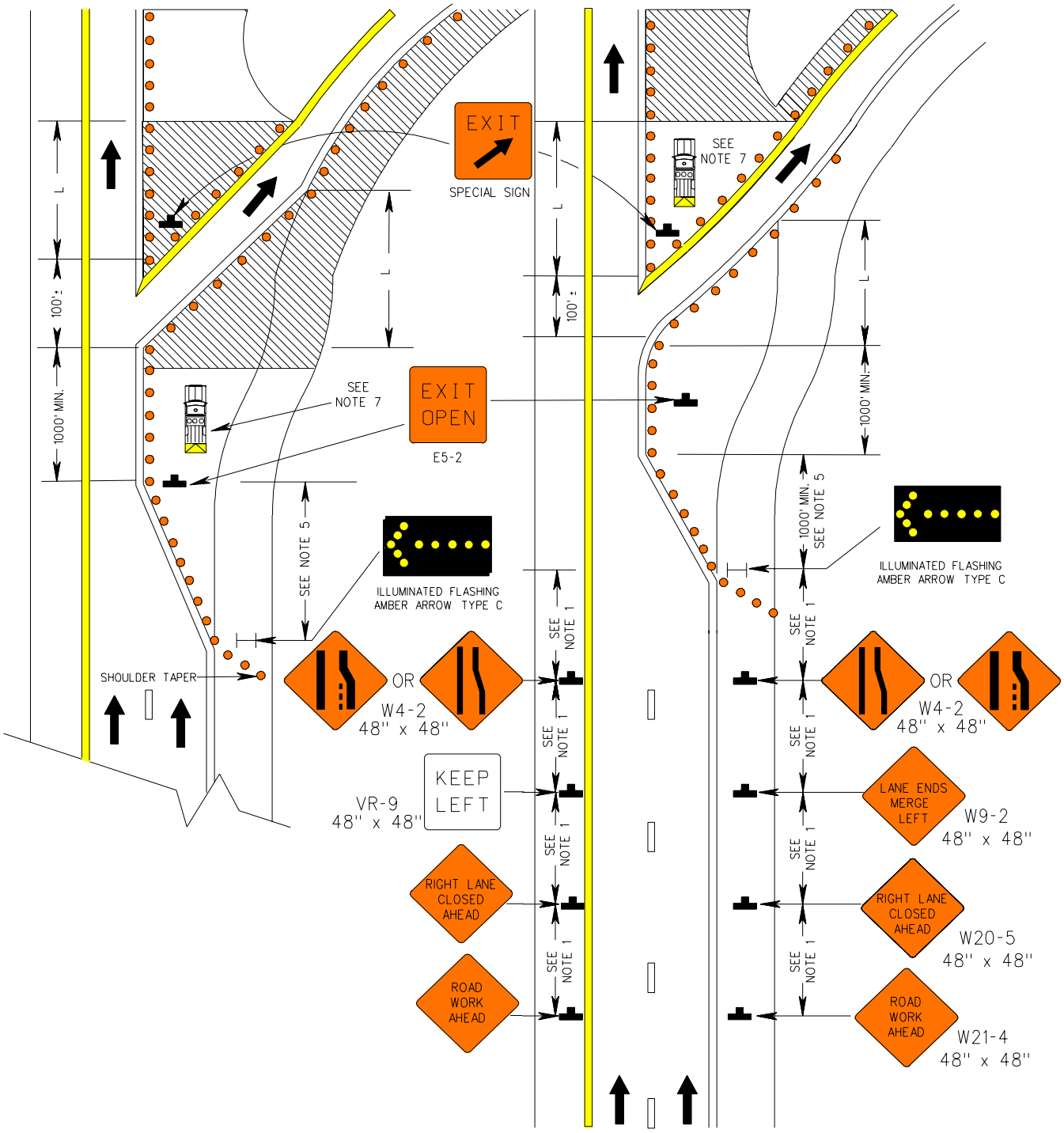
(Shoulder Taper = 1/3 L Minimum)

For all limited access highways, the taper length shall be a minimum of 1000'.

6. **A 1000' buffer located from the end of the taper to the beginning of the off ramp shall be used.**
7. **A shadow vehicle with either a Type B or C arrow panel operating in the caution mode, or equipped with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**

Guidance:

8. *The guide sign should indicate that the ramp is open, and where the temporary ramp is located. However, if the ramp is closed, guide signs should indicate that the ramp is closed.*
9. *When the exit ramp is closed, a black on orange EXIT CLOSED panel should be placed diagonally across the interchange/intersection guide sign.*
10. *An END ROAD WORK sign should be placed 500' past the temporary traffic control devices on the off ramp.*



Work Operation In The Vicinity Of Exit Ramps
(Figure TTC-26.0)

TYPICAL TRAFFIC CONTROL
Partial Ramp Closure Operation
(Figure TTC-27.0)
NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

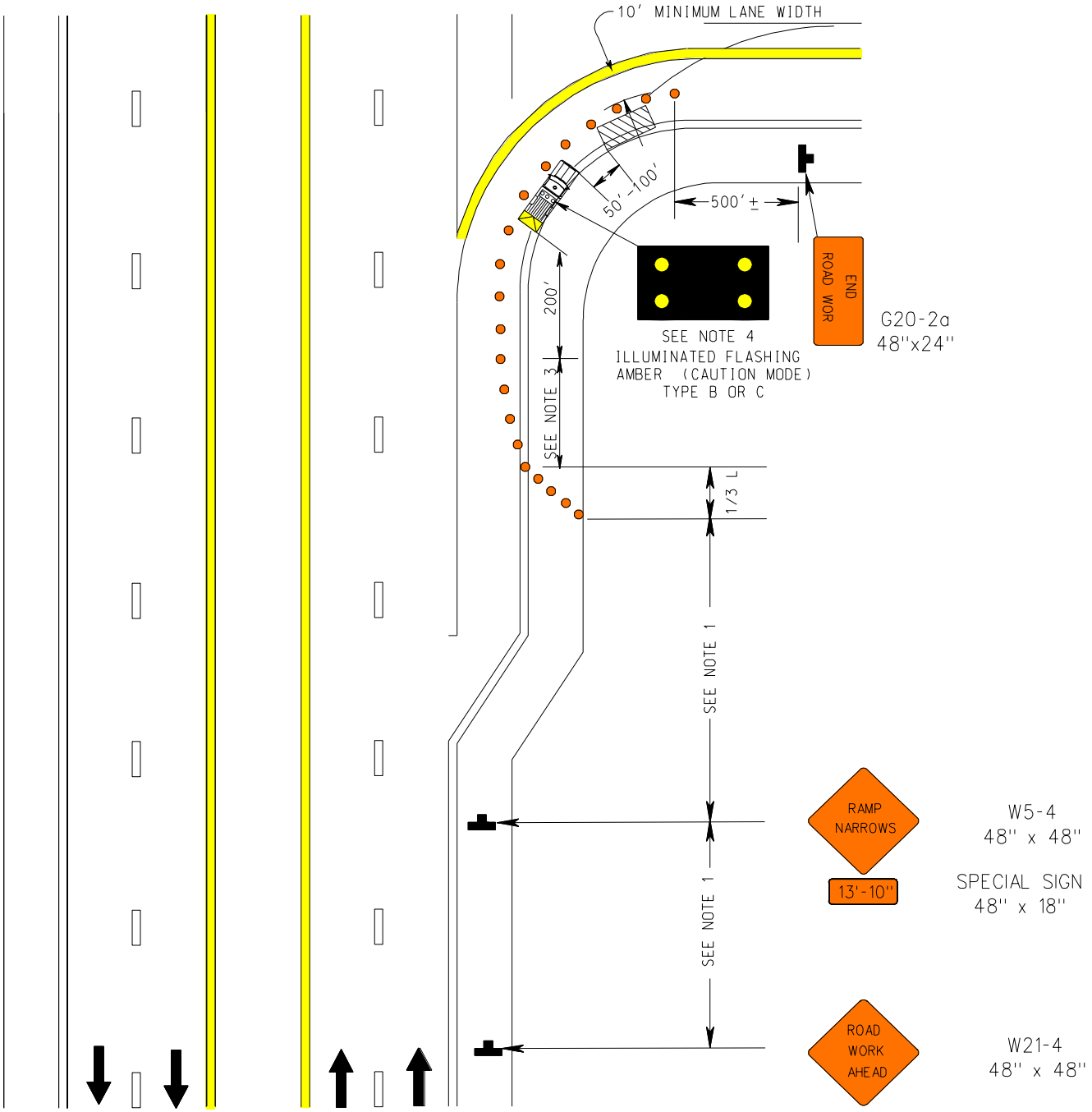
2. **To prevent accidental intrusion into the work area, cone spacing shall not exceed 20' on centers.**
3. **Cone Taper Length (L) = Posted Speed Limit (S) x Width of actual ramp closure (W). (Example: 55 x 6' = 330')**
4. **A shadow vehicle with either a Type B or C arrow panel operating in the caution mode, or equipped with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
5. **If an advisory speed limit sign is used, the District Traffic Engineer shall determine the advisory speed limit.**

Guidance:

6. *A minimum 200' buffer space should be provided, when possible.*

Standard:

7. **Truck off-tracking shall be considered when determining whether the 10 foot minimum lane width is adequate.**
8. **For long term stationary work (occupying a location for longer than three consecutive days) when the distance between the edgeline and the channelizing devices is less than 12 foot, a RAMP NARROWS sign shall be used, along with a 48" by 18" panel displaying the width from edgeline to the channelizing devices in feet and inches rounded down to the nearest inch.**
9. **Due to blanket permits for over width loads, whenever a travel direction is reduced to less than 14 feet in width from edgeline to the face of channelizing devices, a 96" by 48" black on white sign displaying the message RESTRICTED ROUTE, XX FT.- YY INCHES shall be installed 1000 feet ± prior to the last exit from the approached side of the restricted work zone route.**



Partial Ramp Closure Operation
(FIGURE TTC-27.0)

TYPICAL TRAFFIC CONTROL
Work Operation In The Vicinity Of Entrance Ramps
(Figure TTC-28.0)

NOTES

Guidance:

1. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the flagger station and transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8.*
3. *An acceleration lane of sufficient length should be provided whenever possible as shown on the left diagram.*

Standard:

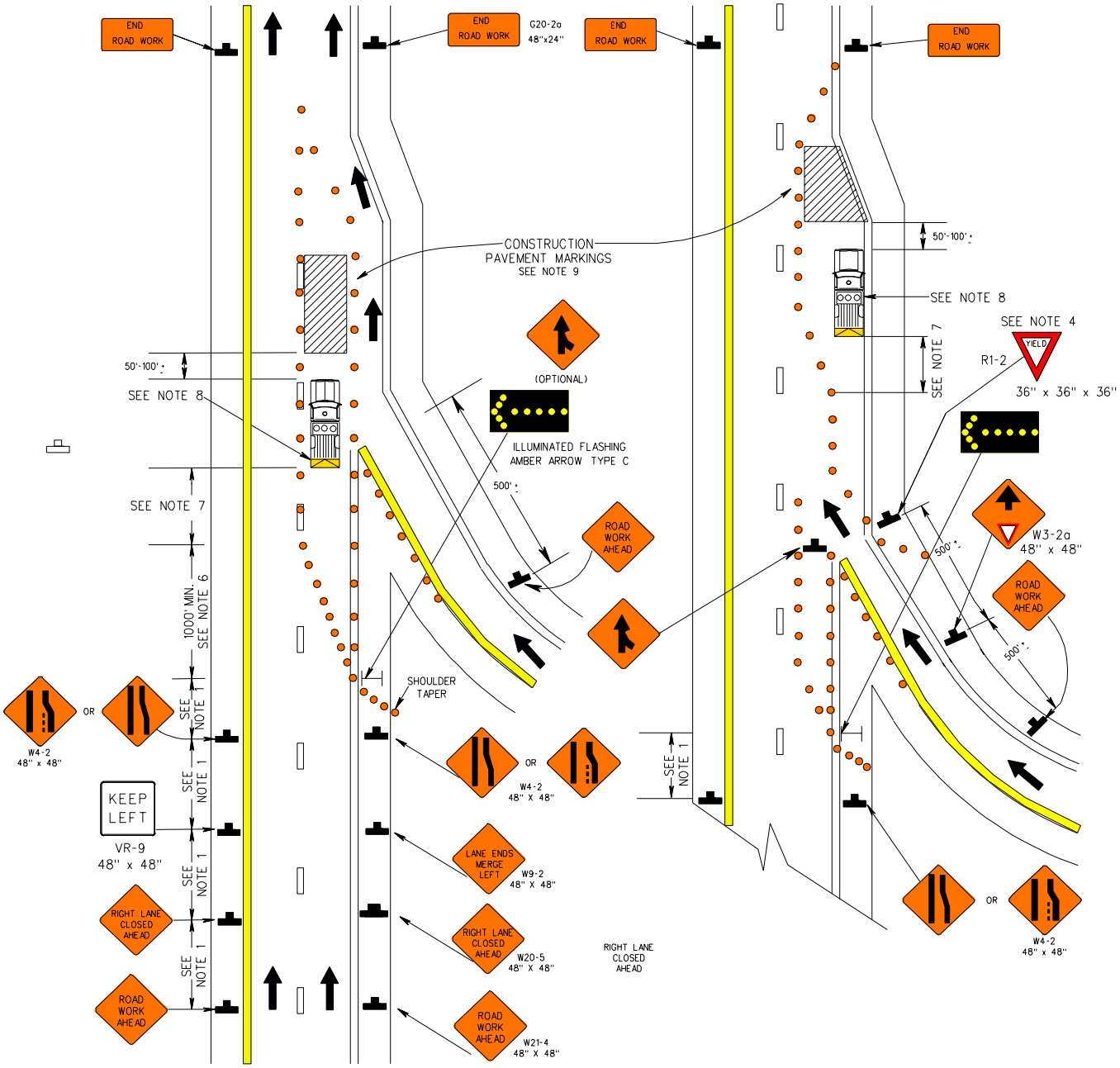
4. **For the information shown on the diagram on the right side of the typical application, where inadequate acceleration distance exists, for the temporary entrance, the YIELD sign shall be replaced with STOP signs (one on each side of the approach).**
5. **On highways having a median wider than 8', left and right sign assemblies shall be used.**
6. **For taper lengths and channelizing device spacing, Note 5 of TTC 26.0 shall be used. The minimum length of a lane closure taper on a limited access highway shall be 1000'.**
7. **The buffer space length shall be as shown in Table 6H-3 on page 6H-4.0 for the posted speed limit.**
8. **A shadow vehicle with either a Type B or C arrow panel operating in the caution mode, or equipped with at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
9. **Existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Guidance:

10. *When used, the YIELD or STOP sign should be located so that ramp vehicular traffic has adequate sight distance of oncoming mainline vehicular traffic to select a reasonably safe gap in the mainline vehicular traffic flow. Also, a longer acceleration lane should be provided beyond the sign to reduce the gap size needed. If insufficient gaps are available, consideration should be given to closing the ramp.*
11. *Where STOP signs are used, a temporary stop line should be placed across the ramp at the desired stop location.*
12. *The mainline merging taper with the arrow panel at its starting point should be located sufficiently in advance so that the arrow panel is not confusing to drivers on the entrance ramp, and so that the mainline merging vehicular traffic from the lane closure has the opportunity to stabilize before encountering the vehicular traffic merging from the ramp.*
13. *If the ramp curves sharply to the right, warning signs with Advisory Speed Limits located in advance of the entrance terminal should be placed in pairs (one on each side of the ramp).*

Option:

10. When operations are 3 days or less in duration, lanes may be delineated by channelizing devices in lieu of temporary markings.
11. A Type B High-Intensity warning flasher with a red lens may be placed above the STOP signs.



Work Operation In The Vicinity Of Entrance Ramps
(Figure TTC-28.0)

TYPICAL TRAFFIC CONTROL
Multi-Lane Shift Operation
(Figure TTC-29.0)

NOTES

Guidance:

1. *The lane shift should be used when the work area extends into either the right or left lane of a divided highway and it is not practical, for capacity reasons, to reduce the number of available lanes.*
2. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *If the "STAY IN LANE" sign is used, then solid 4 inch wide minimum white lines should be used.*

Standard:

4. Shoulder and shifting taper lengths shall be as shown in Table 6H-2.0 on page 6H-4.

Option:

5. For all limited access highways, the desired shifting transition length is 1000', but lesser values, not to exceed ½ L, may be used.

Standard:

6. The minimum width of the shoulder lane shall be 10'.

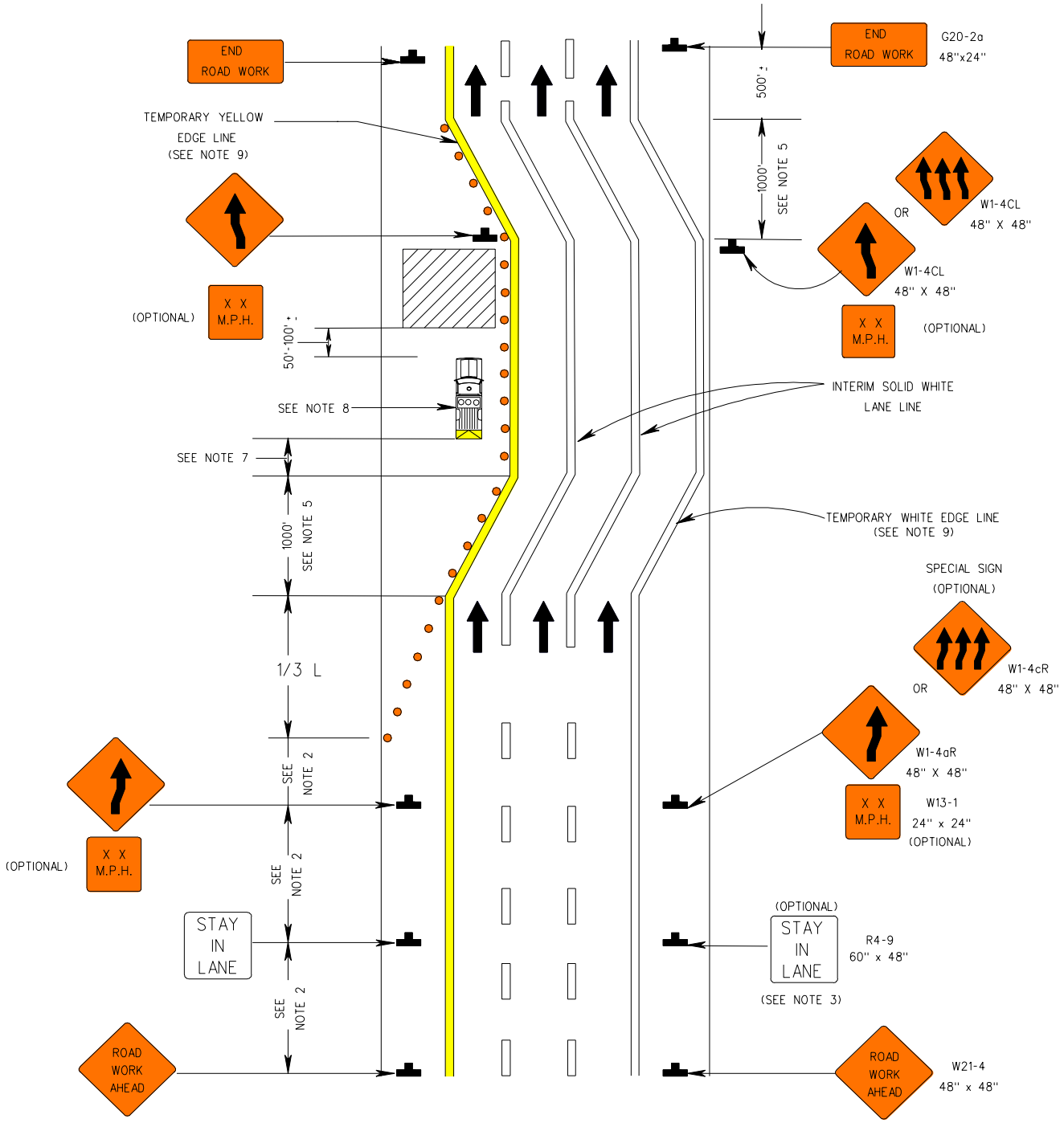
7. The buffer space length shall be as shown in Table 6H-3.0 on page 6H-4 for the posted speed limit.

8. A shadow vehicle with either a type B or C arrow panel operating in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.

9. For long-term (over 3 days duration) stationary work, existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.

Option:

10. For short-term (less than 3 days duration) stationary work, lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.



Multi-Lane Shift Operation
(Figure TTC-29.0)

TYPICAL TRAFFIC CONTROL
Half Road Closure Operation On Multi-Lane Roadway
(Figure TTC-30.0)

NOTES

Guidance:

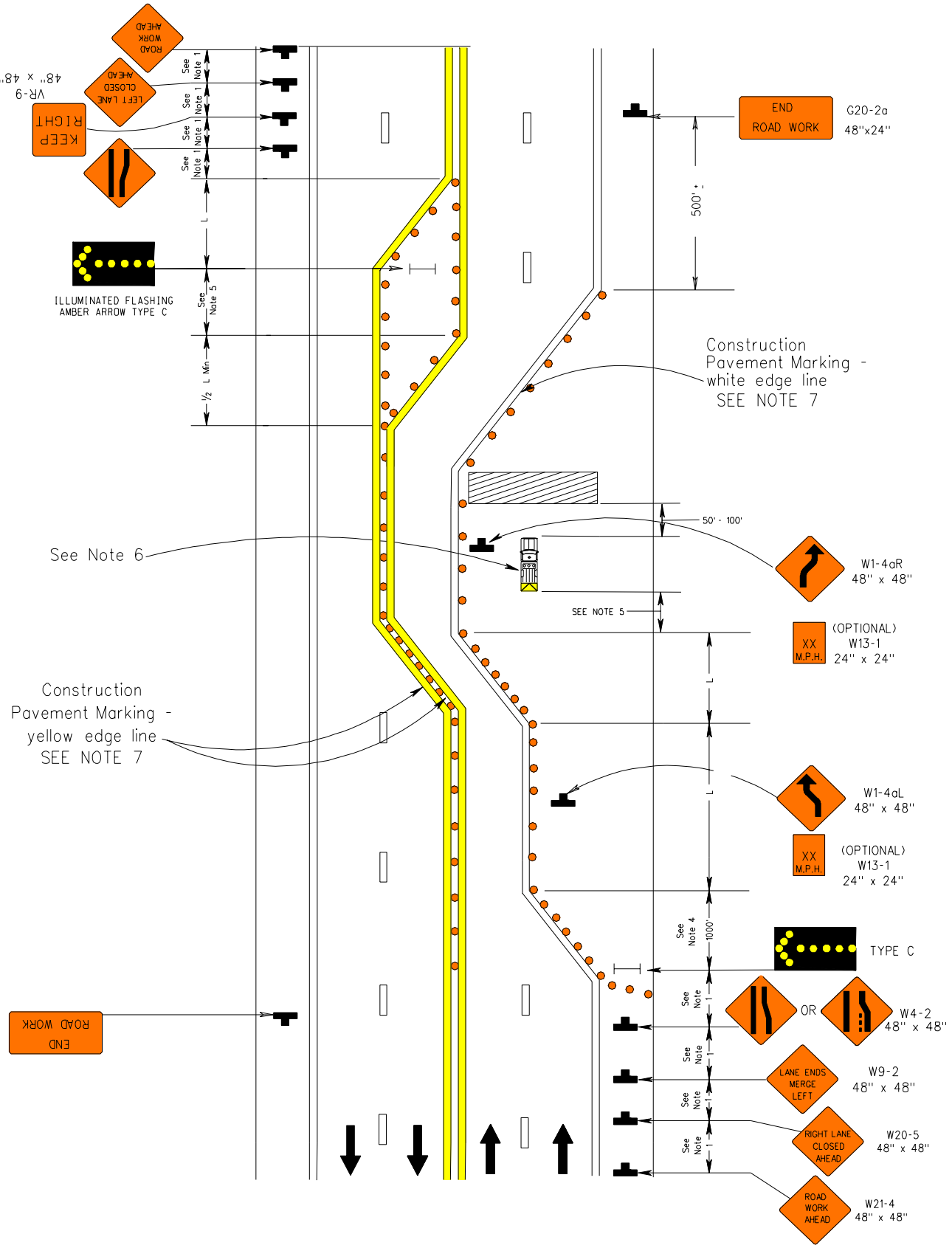
1. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
2. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

3. **On highways having a median wider than 8', left and right sign assemblies shall be used.**
4. **Taper lengths and channelizing device spacing shall be as shown in Table 6H-2.0 on page 6H-4. The minimum length of a lane closure taper on a limited access highway shall be 1000'.**
5. **The buffer space length shall be as shown in Table 6H-3 on page 6H-4 for the posted speed limit.**
6. **A shadow vehicle with either a type B or C arrow panel operating in the caution mode, or at least one high intensity rotating, oscillating, or amber strobe light shall be parked 50'-100' in advance of the first work crew. When the posted speed limit is 45 mph or greater, a truck mounted attenuator shall be used.**
7. **For long-term (less than 3 days duration) stationary work, existing conflicting pavement markings shall be removed and temporary markings shall be installed before traffic patterns are changed.**

Option:

8. For short-term stationary work (under 3 days duration), lanes may be delineated by channelizing devices or removable pavement markings instead of temporary pavement markings.



Half Road Closure Operation On Multi-Lane Roadway
(Figure TTC-30.0)

TYPICAL TRAFFIC CONTROL
Total Freeway Closure Operation
(Figure TTC-31.0)

NOTES

Guidance:

1. *A Portable Changeable Message Sign (PCMS) should be placed a minimum of one mile in advance of the exit preceding the incident or in advance of queued traffic advising of the road closure ahead. An additional PCMS should be placed one mile in advance of the stationary signing advising "ACCIDENT AHEAD", ALL LANES EXIT RIGHT". Traffic should be monitored and the advanced warning adjusted to stay in advance of traffic queues to allow adequate response to the approaching conditions.*
2. *Sign spacing distance should be 1300'-1500' for limited access highways.*

Standard:

3. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**

Guidance:

4. *GRAPHIC LANE REDUCTION signs, W4-2, should be placed within the closed lanes only as shown to allow access to the shoulder for emergency vehicles.*

Standard:

5. **Cone spacing shall be a maximum of 40' in transitions, and 80' along the travelway. Transitions shall be a minimum of 1000' in length.**

Guidance:

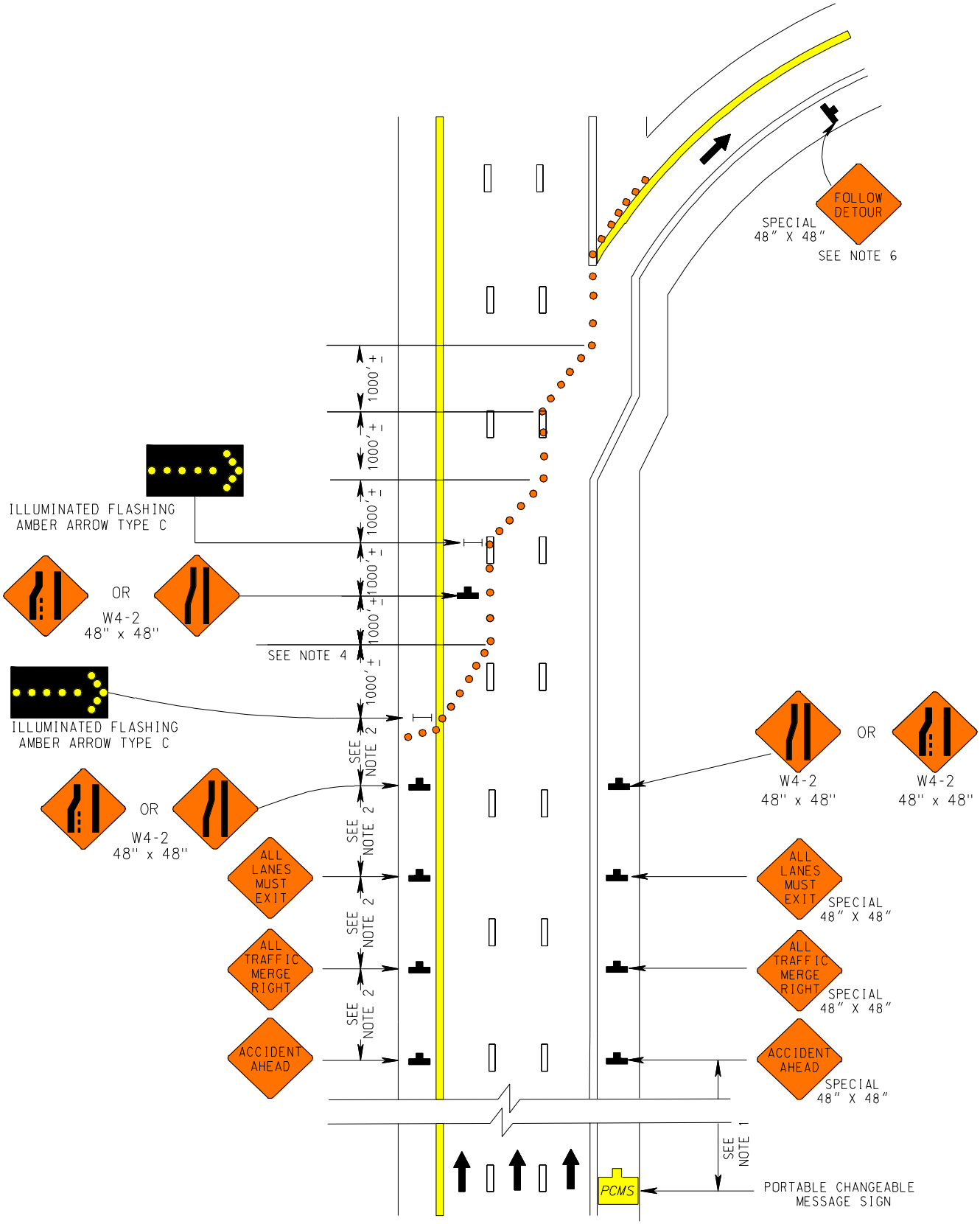
6. *If detour signing has been installed along the detour route, a "FOLLOW DETOUR" sign should be placed halfway up the ramp or loop. Additionally, a third message should be added to the one mile Portable Changeable Message Sign advising "FOLLOW DETOUR".*

Option:

7. Other sign layouts for "Total Freeway Closure" may be substituted as directed by the District Traffic Engineer.

Support:

8. See Chapter 6I for additional information on incident management traffic control.



Total Freeway Closure Operation
(Figure TTC-31.0)

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TYPICAL TRAFFIC CONTROL
Surveying Operation
(Figure TTC-32.0)

NOTES

OFF TRAVELWAY -

Guidance:

1. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

2. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**
3. **Each vehicle involved in the surveying operation shall be equipped with at least one rotating amber light or high intensity amber light.**
4. **Although vehicle hazard warning signals can be used to supplement the rotating light or strobe light, they shall not be used instead of rotating lights or strobe lights.**
5. **Maximum length of the work zone shall be two miles.**

Option:

6. Where Right-of-way and/or geometric conditions do not allow the use of 48" x 48" signs, 36" x 36" signs may be used.
7. ROAD WORK AHEAD or SURVEYING AHEAD signs may be used in place of the SURVEY CREW AHEAD sign

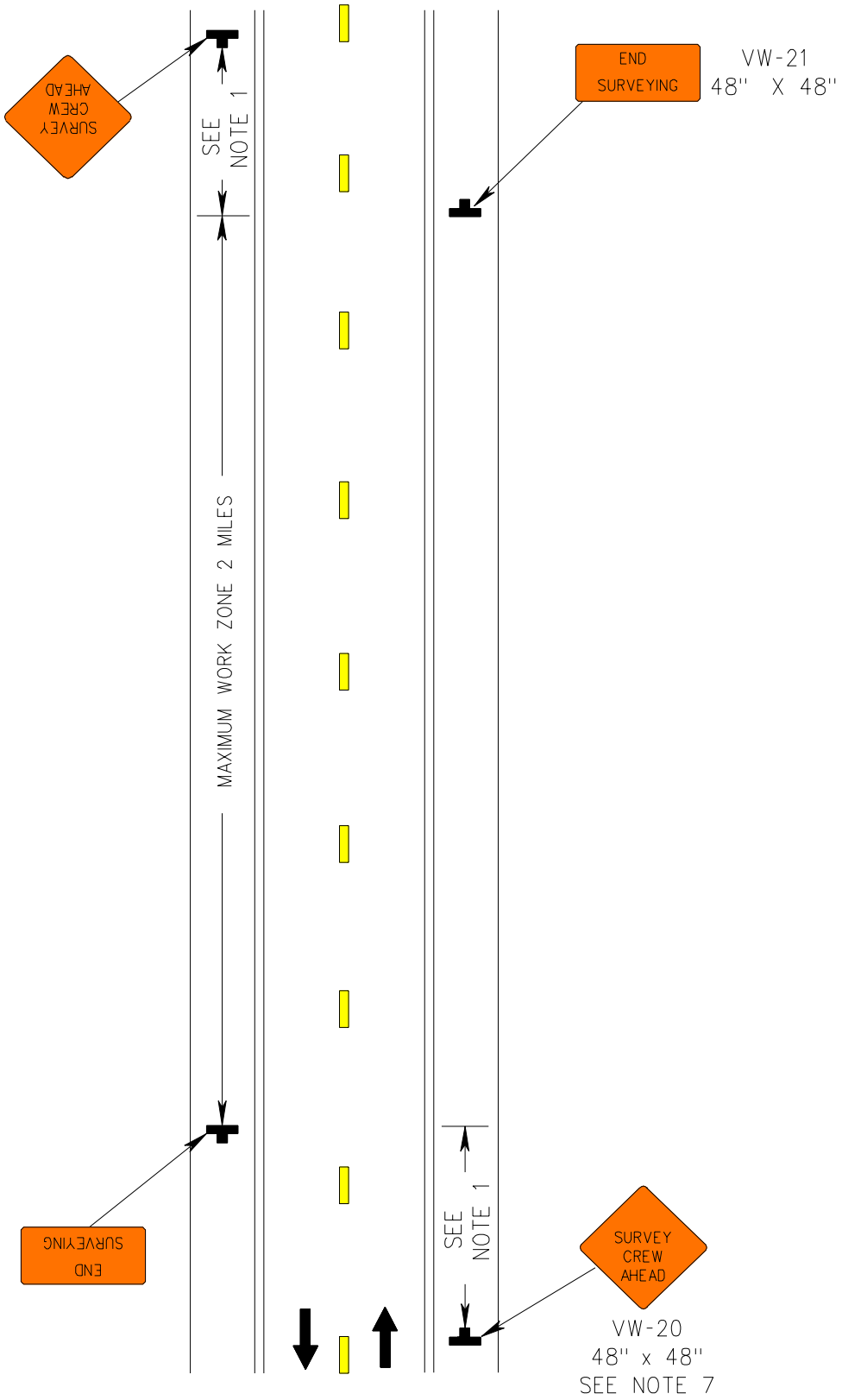
Standard:

8. **All workers near the roadway shall wear high visibility clothing (see Section 6D.03 for worker safety apparel).**

OFF TRAVELWAY -

Guidance:

9. *For surveying operations on the travelway, Typical Traffic Control Figure TTC-19.0, Flagging Operation on Two Lane Roadway, or Typical Traffic Control Figure TTC-12.0 or 13.0, Right or Left Lane Closure Operation on Four-Lane Roadway, should be used.*



Surveying Operation
(Figure TTC-32.0)

TYPICAL TRAFFIC CONTROL
Disruption Operation On Multi-Lane Roadway
(Figure TTC-33.0)

NOTES

Support:

1. Conditions represented are a planned closure not exceeding 20 minutes during the daytime.

Guidance:

2. *On limited access highways, the sign spacing distance and flagger distance should be 1300'- 1500'. For all other roadways, the distance between the advance warning signs and between the flagger should be 500'-800' where the posted speed limit is 45 mph or less.*
3. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*

Standard:

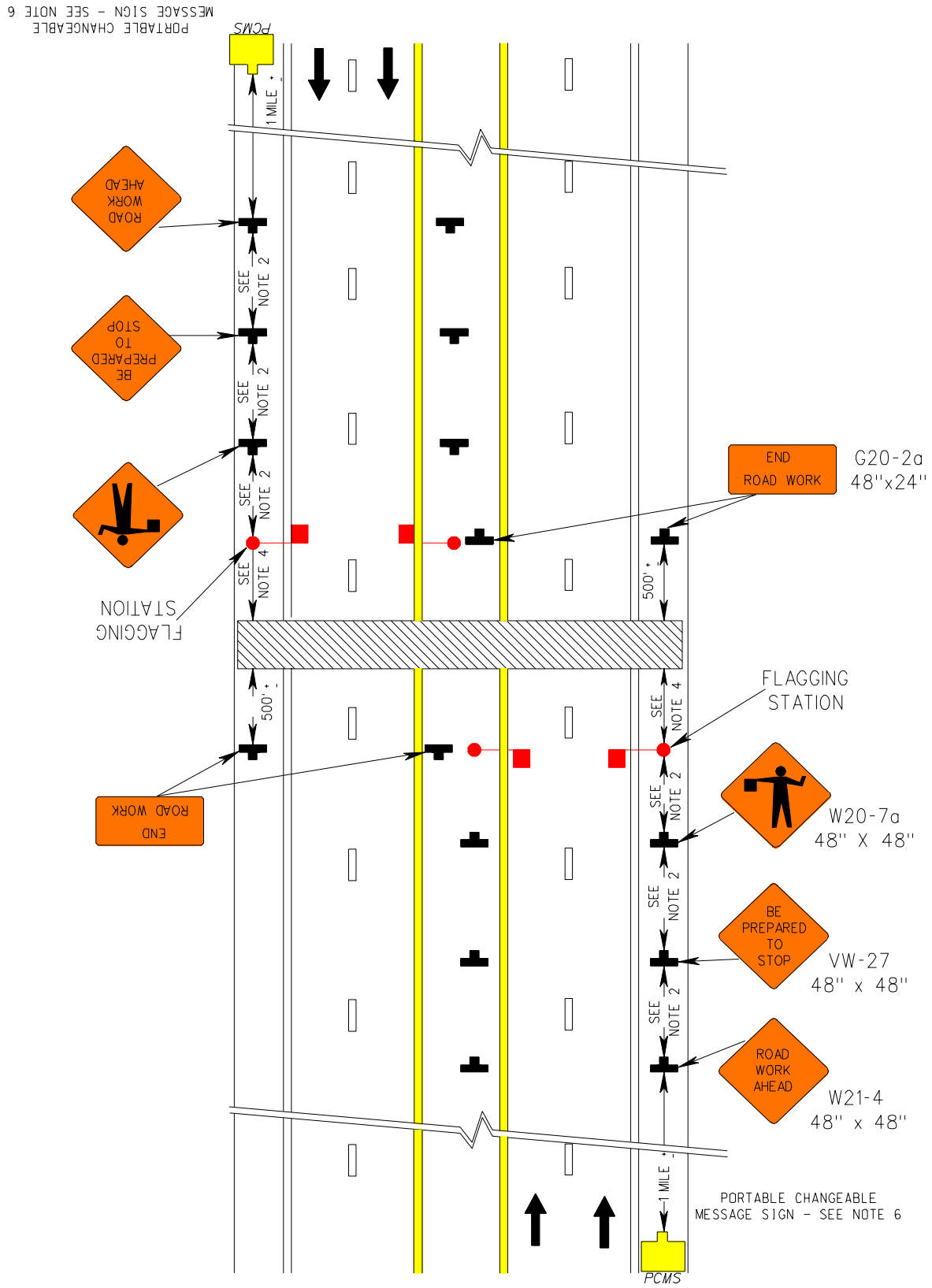
4. **Flagging stations shall be located far enough in advance of the operation to permit approaching traffic to reduce speed and/or stop before passing into the operation.**
5. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties and shall follow the procedures noted in Sections 6E.04 and 6E.05.**

Guidance:

6. *A Portable Changeable Message Sign (PCMS) should be used on limited access highways and placed a minimum of one mile in advance of the warning signs warning of the operation ahead (UTILITY WORK AHEAD) and advising of the action required (BE PREPARED TO STOP).*
7. *Disruptions to traffic should be coordinated with all entities involved in advance and performed during off-peak hours to minimize the impact on the motoring public. On limited access highways, state police should assist with the stoppage of traffic.*

Option:

8. A uniformed law enforcement officer may be used for this application in place of the flagger.
9. The ROAD WORK AHEAD sign may be replaced with other appropriate signs such as UTILITY WORK AHEAD.



Disruption Operation On Multi-Lane Roadway
(Figure TTC-33.0)

TYPICAL TRAFFIC CONTROL
Haul Road Crossing Operation
(Figure TTC-34.0)

NOTES

Guidance:

1. *Floodlights should be used to illuminate haul road crossings where existing light is inadequate.*
2. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
3. *Where no passing lines are not already in place, they should be added.*

Standard:

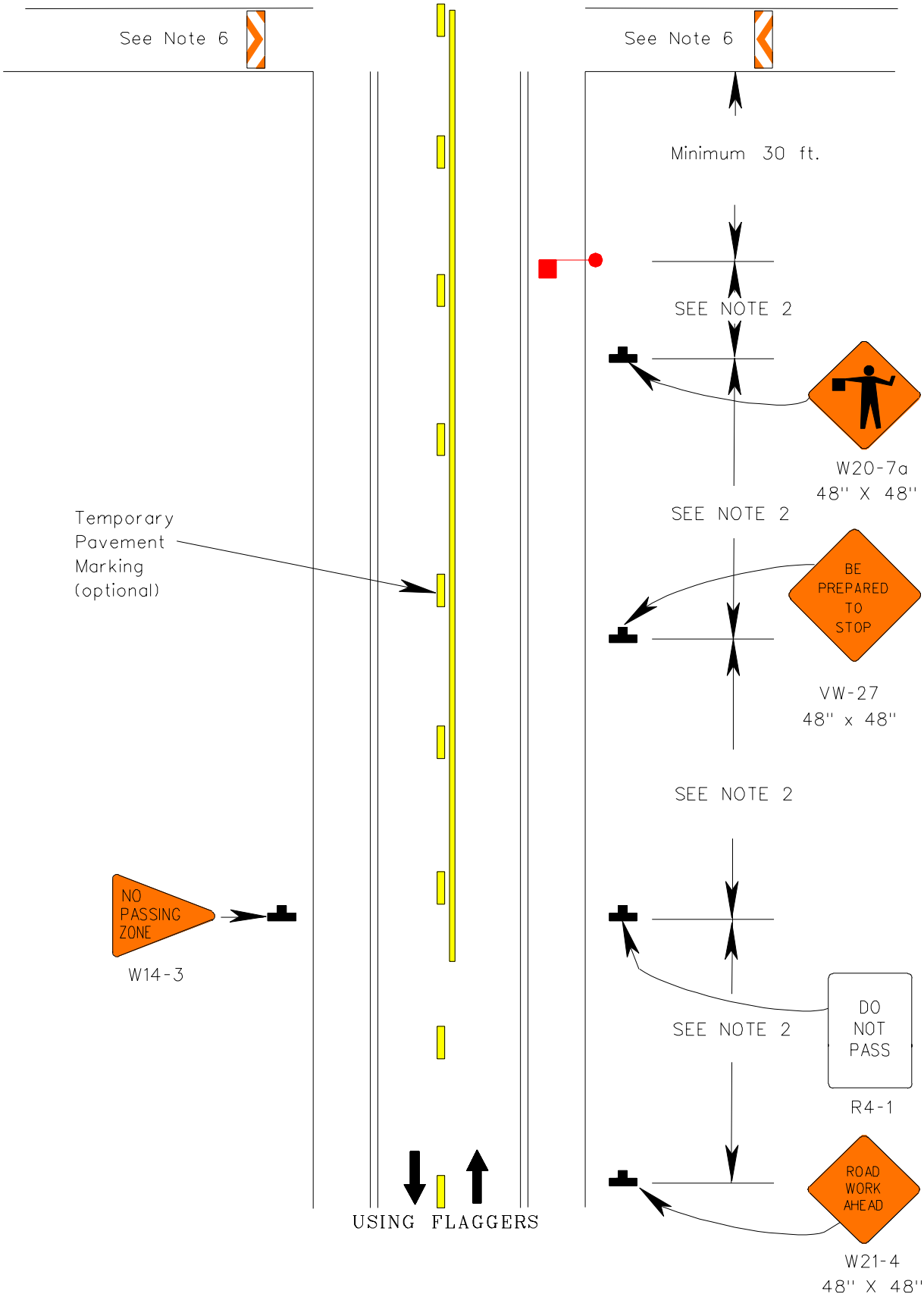
4. **The traffic control signing shall be the same in both directions.**
5. **A NO PASSING ZONE sign (W14-3) shall be used directly across from the DO NOT PASS sign (R4-1).**
6. **When a road used exclusively as a haul road is not in use, Type III barricades shall be in place and the Flagger symbol and BE PREPARED TO STOP signs covered or removed.**
7. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**

Flagging Method

8. **When a road used exclusively as a haul road is not in use, the haul road shall be closed with Type III barricades and the Flagger symbol signs covered.**
9. **The flagger shall follow the procedures noted in Sections 6E.04 and 6E.05.**
10. **At night, flagger stations shall be illuminated, except in emergencies.**

Signalized Method

11. **When a road used exclusively as a haul road is not in use, Type III barricades shall be in place. The signals shall either flash yellow on the main road or be covered, and the Signal Ahead and STOP HERE ON RED signs shall be covered or hidden from view.**
12. **The temporary traffic control signals shall control both the highway and the haul road and shall meet the physical display and operational requirements of conventional traffic control signals as described in Part 4 of the MUTCD. Authorized officials shall establish traffic control signal timing.**
13. **Stop lines shall be used on existing highway with temporary traffic control signals.**
14. **Existing conflicting pavement markings and raised pavement marker reflectors between the stop lines shall be removed. After the temporary traffic control signal is removed, the stop lines and other temporary pavement markings shall be removed and the permanent pavement markings restored.**
15. **Safeguards shall be incorporated to avoid the possibility of conflicting signal indications at each end of the TTC zone.**



Haul Road Crossing Operation
(Figure TTC-34.0)

TYPICAL TRAFFIC CONTROL
Signing For Speed Limit And Fine Signs In Work Zones
(Figure TTC-35.0)

NOTES

Standard:

1. **The District Traffic Engineer must approve reducing the speed limit in a work zone after performing a Traffic Engineering study prior to the use of this layout.**

Option:

2. This layout depicts signing requirements for speed limits and increased fines in work zones. Additional signing and traffic control devices may be required based on the operation being performed.

Guidance:

3. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

4. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**
5. **The use of the "NOTICE - UP TO $500 FINE FOR EXCEEDING SPEED LIMIT IN WORK ZONE" sign shall be approved by the District Traffic Engineer prior to installation. The size shown shall be used on Major Primary and Interstate highway systems. Existing NOTICE - $500 MAXIMUM FINE FOR EXCEEDING SPEED LIMIT IN WORK ZONE sign may be used in order to utilize existing stock, however, mixing of the signs shall not occur on an approach.**

Option:

6. For Secondary and Minor Primary road systems, a 66" x 42" sign may be used.

Standard:

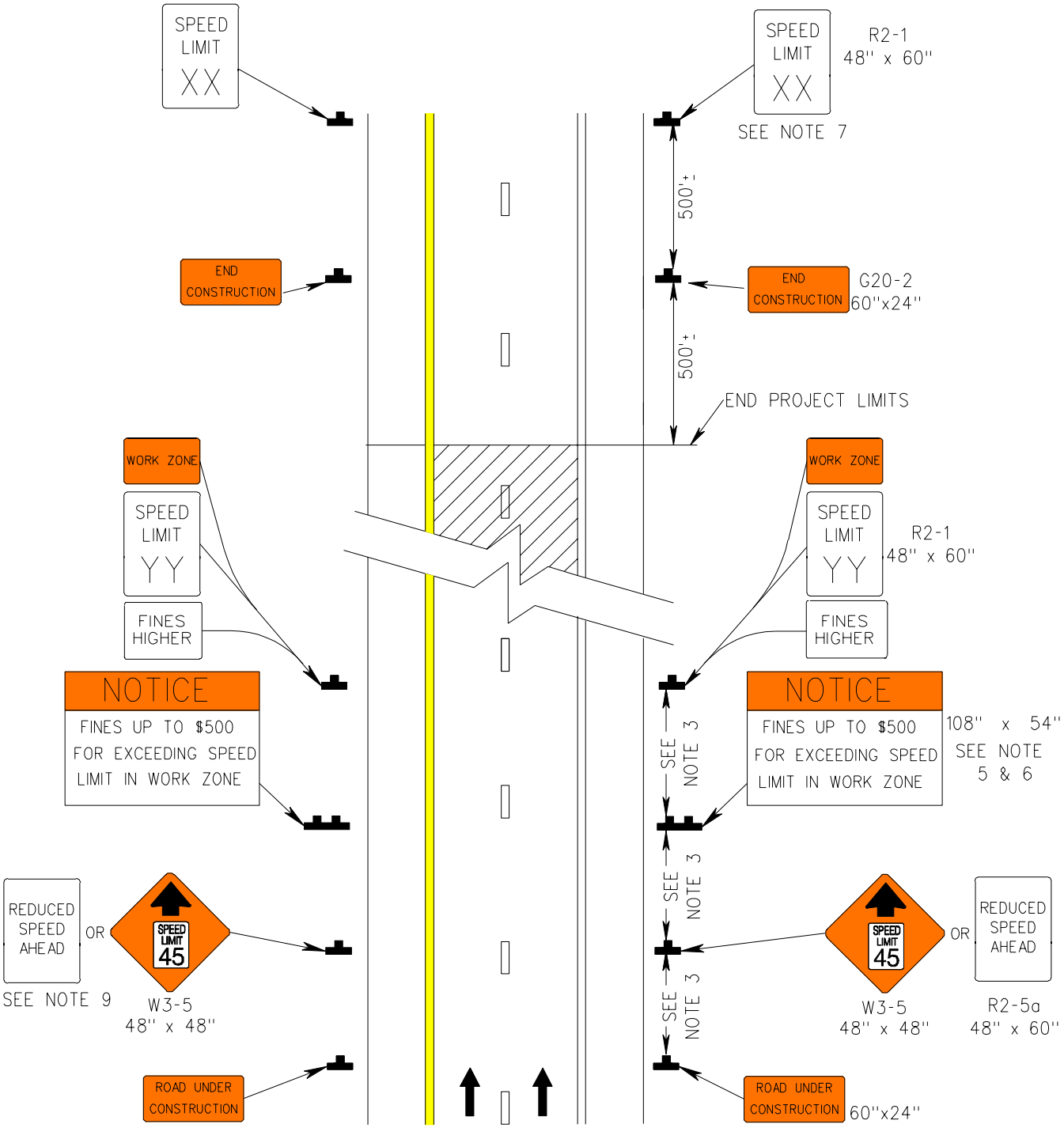
7. **If the entire project is signed for a reduced speed, and an original speed limit sign is not within 1000 linear feet of the "END CONSTRUCTION" sign, signs depicting the original speed limit shall be erected 500'± past the "END CONSTRUCTION" sign. On secondaries with unposted speed limits, an "END XX SPEED LIMIT" (VR-5) sign shall be used in place of erecting an R2-1 sign. If only part of the project is signed for a reduced speed, then the original speed limit shall be posted 500'± past the end point of reduced speed.**

Option:

8. Experience has shown that compliance to the reduced speed signing is greater if these signs are placed as close to the work as possible, as opposed to placement prior to the advance warning signs ("ROAD WORK AHEAD", etc.).
9. The W3-5 graphic signs or REDUCED SPEED AHEAD (R2-5a) signs are only required if the speed limit is being reduced in the work zone. Either type of sign may be used until January 1, 2009, in which time only the W3-5 graphic sign will be allowed.

Standard:

10. **Mixing of W3-5 and R2-5a signs shall not occur on an approach.**



Signing For Speed Limit And Fine Signs In Work Zones
(Figure TTC-35.0)

TYPICAL TRAFFIC CONTROL
Signing For Project Limits
(Figure TTC-36.0)
NOTES

Support:

1. This layout depicts signing requirements for designating the beginning and ending termini of construction projects. The purpose of the signs is to inform motorists when they are entering and exiting a potential construction area. This layout also applies to multi-lane highways including limited access highways.

Standard:

2. The "ROAD UNDER CONSTRUCTION" sign shall be placed 2000' ± from the project limit, or 500' ± prior to any other construction warning sign.

Option:

3. On projects where there is a one time set up of construction signs and the length of the actual work zone is unchanged during the project, the "ROAD UNDER CONSTRUCTION" sign may be eliminated as directed by the District Traffic Engineer.

Standard:

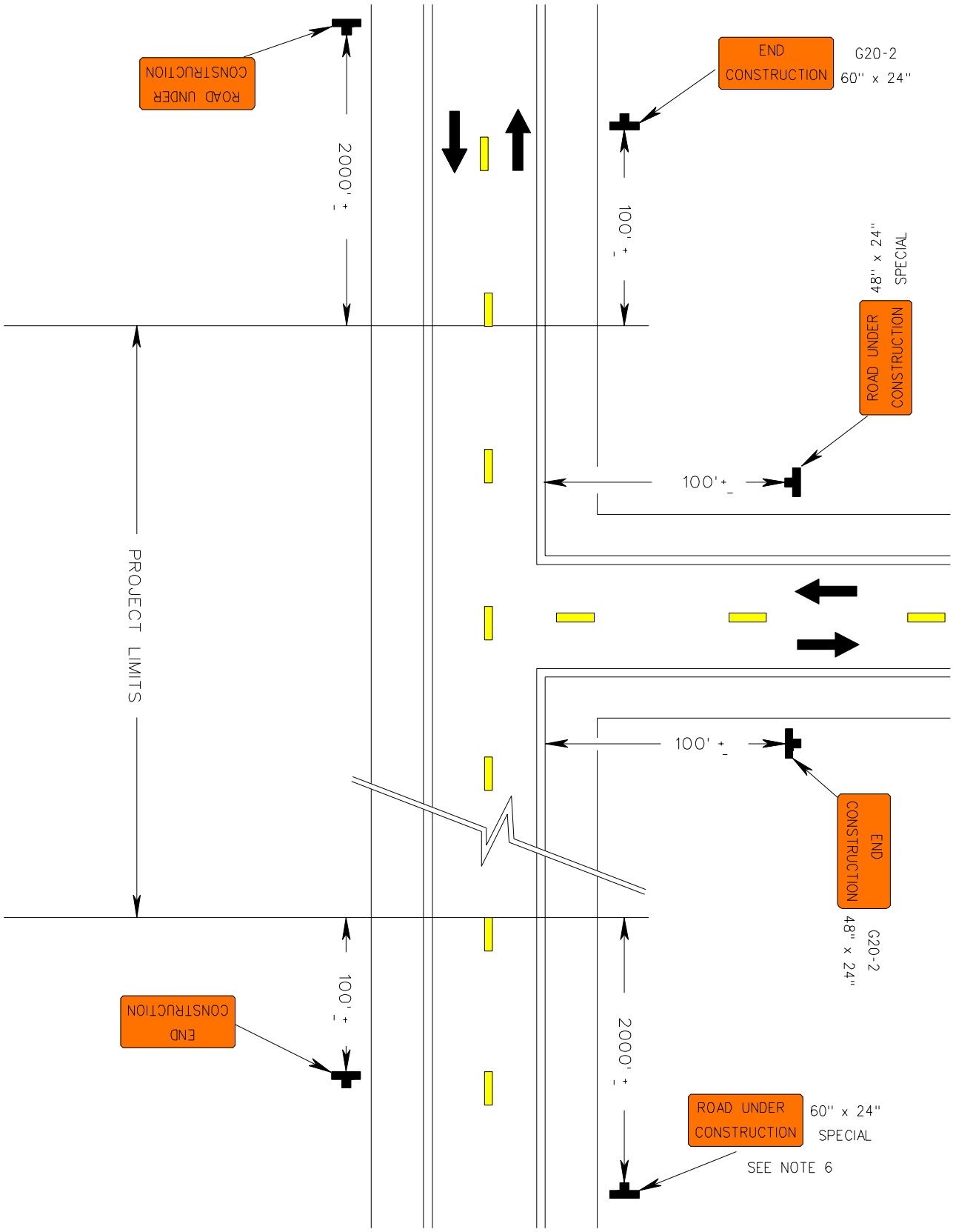
4. On roadways having a median wider than 8', left and right sign assemblies shall be required.

Guidance:

5. All connections within the project limits should be identified with project termini signs.

Option:

6. The signing shown (60" x 24") is for Primary and Limited Access highway systems. For Secondary road systems, 48" x 24" may be used.



Signing For Project Limits
(Figure TTC-36.0)

TYPICAL TRAFFIC CONTROL
Motorist Survey Operation On Two-Lane Roadway
(Figure TTC-37.0)

NOTES

Guidance:

1. *Care should be exercised when establishing the limits of the work zone to insure maximum possible sight distance in advance of the transition, based on the posted speed limit and at least equal to or greater than the values in Appendix A, Page A-8. For limited access highways a minimum of 1000' is desired.*
2. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Standard:

3. **Where Right-of-way or geometric conditions prevent the use of 48" x 48" signs, 36" x 36" signs may be used.**
4. **Flagging stations shall be located far enough in advance of the survey area to permit approaching traffic to reduce speed and/or stop before passing through the survey area.**

Option:

5. A supplemental flagger may be required in this area to give advance warning of the operation ahead by slowing approaching traffic prior to reaching the flagger station or queued traffic.

Guidance:

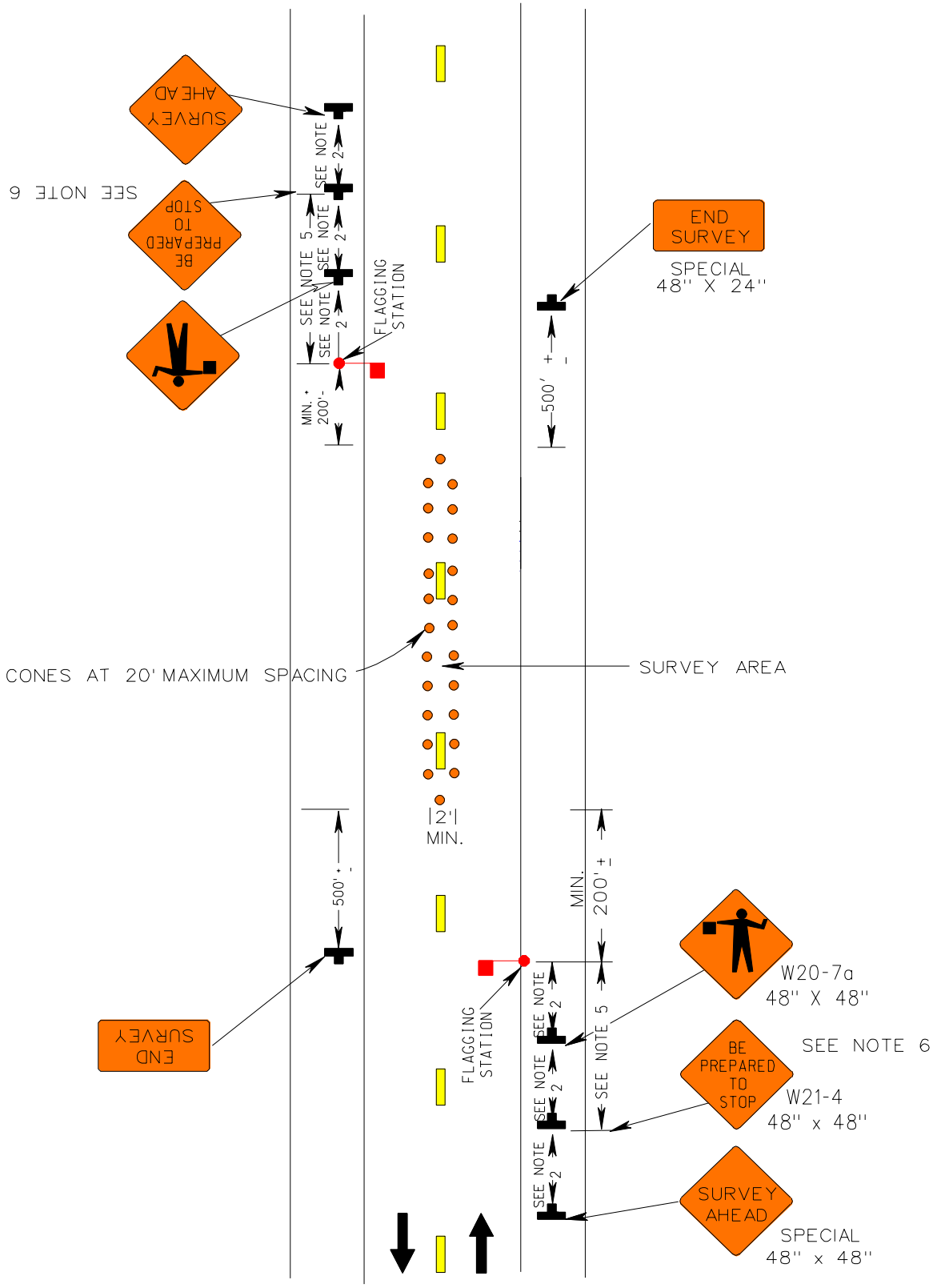
6. *If the queue of traffic reaches the "BE PREPARED TO STOP" sign, the flaggers controlling the traffic in both directions should turn their paddles to "SLOW" to allow the traffic to clear. Also, the advance warning signs should be readjusted at greater distances.*

Standard:

7. **All flaggers shall be state certified and have their certification card in their possession when performing flagging duties.**
8. **Cones spaced a maximum of 20' on center shall be used to delineate the survey area.**
9. **The minimum width of the open travel lane shall be 10 feet.**
10. **All workers in or near the roadway shall wear high-visibility clothing (see section 6D-03).**
11. **For surveying on the centerline of a high-volume road, one lane shall be closed using the information illustrated in Figure TTC-18.0.**

Option:

12. Additional traffic control devices may be needed as determined by the District Traffic Engineer.



Motorist Survey Operation On Two-Lane Roadway
(Figure TTC-37.0)

TYPICAL TRAFFIC CONTROL
Eradication Of Pavement Markings In Work Zones
(Figure TTC-38.0)

NOTES

Support:

1. This figure depicts requirements for pavement marking removal for long-term (over 3 days continuous duration) work zones. These are minimum removal requirements for existing pavement markings.

Standard:

2. **All skip lines shall be removed a minimum of 200' in advance of the beginning of a lane closure transition in the lane being closed to the point where the new edge line covers the skips.**
3. **The existing edge line shall be removed a minimum of 200' past the beginning point where the new edge line is transitioned over.**
4. **In lane shift situations, all skip lines not behind concrete traffic barriers and within 6' of the new edge line shall be removed.**

Option:

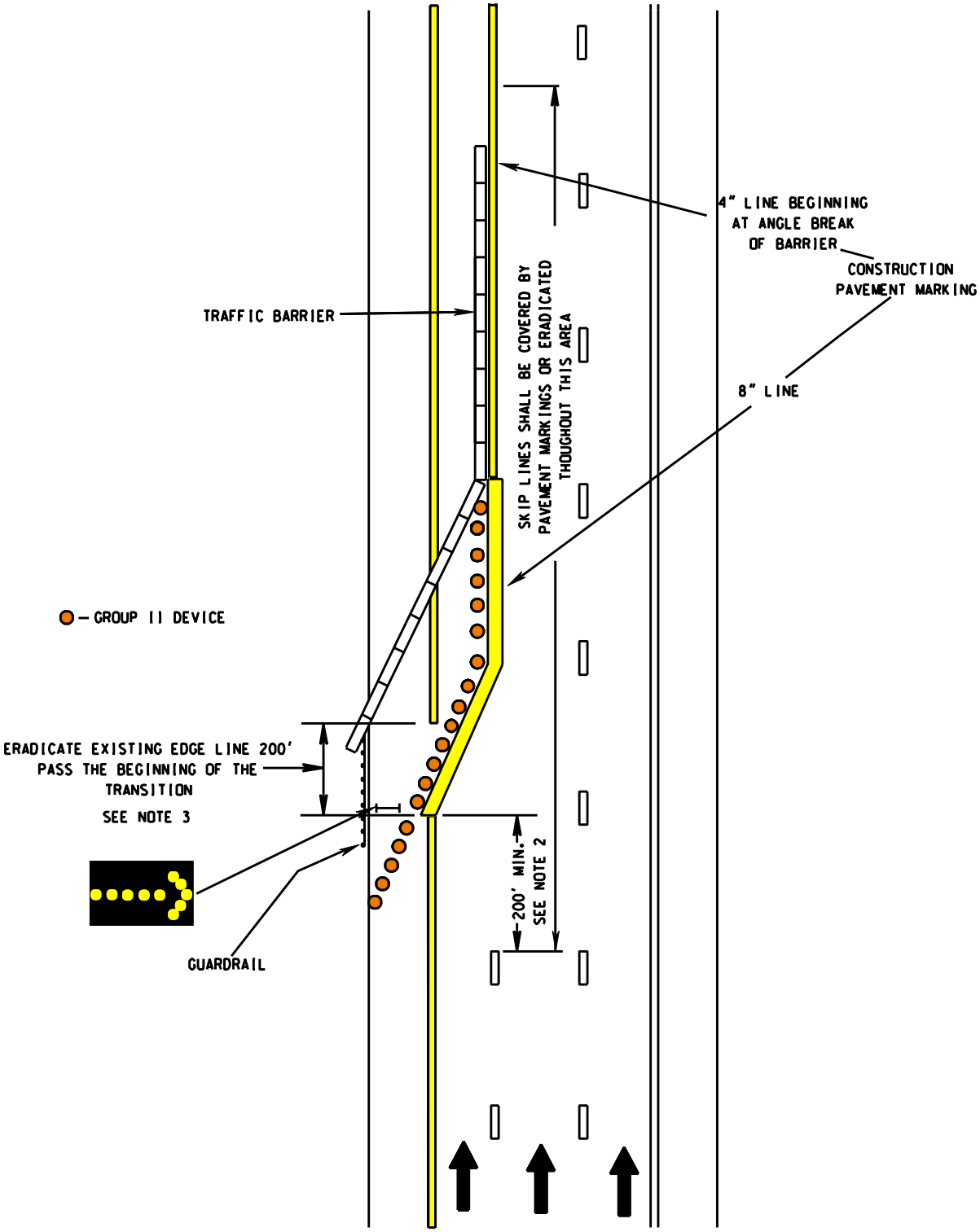
5. In lane shift situations, if Group 2 channelizing devices are placed between the barrier service or work area and the travel lanes, removal of skip lines in excess of 6'away from the new edge line is not required and may remain.

Standard:

6. **All existing pavement markers in conflict with the new construction pavement markings shall have the reflective element remove.**
7. **Work zones shall be reviewed the first night period after changes have been made to the pavement markings to ensure all conflicting markings and markers have been adequately removed, and the new markings and markers properly delineate the intended travel path.**

Option:

8. Additional markings may require removal based on the roadway geometrics and night review of the site.



Eradication Of Pavement Markings In Work Zones
(Figure TTC-38.0)

TYPICAL TRAFFIC CONTROL
Work In The Vicinity Of Highway-Rail Crossing
(Figure TTC-39.0)

NOTES

Guidance:

1. *When highway-rail grade crossings exist either within or in the vicinity of roadway work activities, extra care should be taken to minimize the probability of conditions being created, either by lane restrictions, flagging or other operations, where vehicles might be stopped within the highway-rail grade crossing, considered as being 15 feet on either side of the closest and farthest rail.*

Standard:

2. **If the queuing of vehicles across active rail tracks cannot be avoided, a law enforcement officer or flagger shall be provided at the highway-rail grade crossing to prevent vehicles from stopping within the highway-rail grade crossing (as described in Note 1), even if automatic warning devices are in place.**

Guidance:

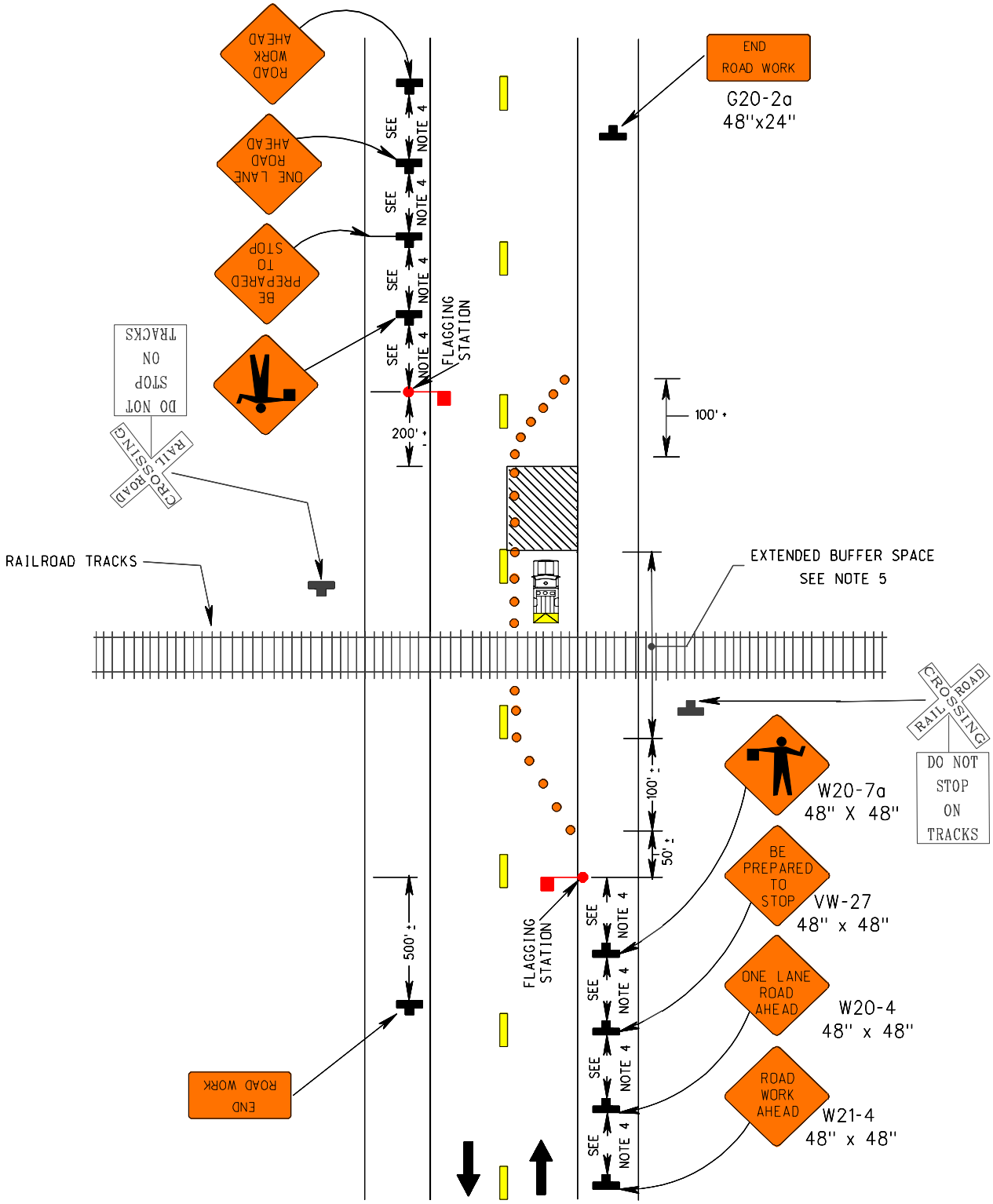
3. *Early coordination with the railroad company should occur before work starts.*
4. *Sign spacing distance should be 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*
5. *In the example depicted in TTC-39.0, the buffer space should be extended upstream of the highway-rail grade crossing (as shown) so that a queue created by the flagging operation will not extend across the highway-rail grade crossing.*
6. *The DO NOT STOP ON TRACKS sign should be used on all approaches to a highway-rail grade crossing within the limits of the temporary traffic control zone.*

Standard:

7. **Flaggers shall be state certified and have their certification card in their possession when performing flagging duties (see Section 6E.01, Qualifications for Flaggers)**
8. **Lighting shall be provided as needed to adequately illuminate the flagger stations at night.**
9. **Cones shall not be required on roadways 20 feet or less in width. For roadways greater than 20 feet in width, cones shall be used at the following spacing:**

Location	*Speed (mph)*	
	0-35	*36+*
Transition Spacing	**20'**	**40'**
Travelway Spacing	**40'**	**80'**

10. **A shadow vehicle with at least one high intensity rotating, oscillating or amber strobe light shall be parked 50'-100' in advance of the first work crew. If the work is performed on a multi-lane highway with posted speeds of 45 mph or greater, it shall be a truck mounted attenuator.**
11. **Vehicle hazard warning signals shall not be used instead of the vehicle's high intensity rotating, oscillating, or amber strobe light.**
12. **When a side road intersects the highway within the temporary traffic control zone, additional traffic control devices shall be placed as needed.**



Work In The Vicinity Of Highway-Rail Crossing
(Figure TTC-39.0)

TYPICAL TRAFFIC CONTROL
Signing for Partial Roadway Resurfacing Operations
(Figure TTC-40.0)

NOTES

Standard:

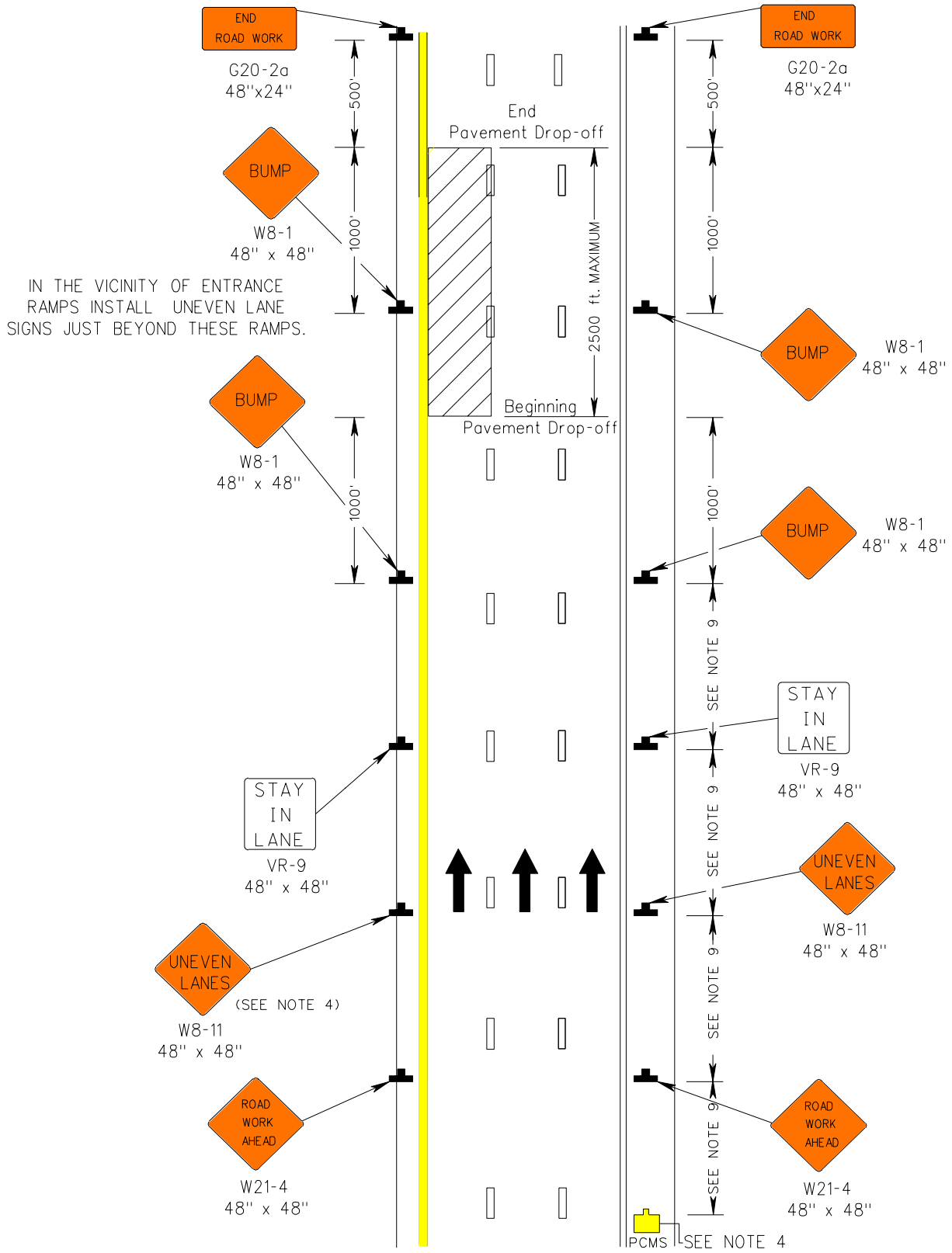
1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**
2. **The maximum pavement edge drop-off between traffic lanes shall be 2.0 inches or less.**
3. **The maximum length of the pavement resurfacing shall be 2500 feet.**
4. **A portable changeable message sign with ROUGH ROAD AHEAD and other appropriate messages shall be used.**
5. **A BUMP sign shall be placed approximately 1000 feet in advance of the end of the pavement drop-off.**
6. **The District Traffic Engineer shall determine speed reductions.**
7. **In the vicinity of entrance ramps UNEVEN LANE signs shall be installed.**
8. **In the vicinity of exit ramps BUMP signs shall be installed where conditions warrant.**

Guidance:

9. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Option:

10. Only traffic control signing for partial pavement resurfacing is shown. Other devices may be needed and used for the control of traffic through the work area.



Signing for Partial Roadway Resurfacing Operations
(Figure TTC-40.0)

TYPICAL TRAFFIC CONTROL
Signing for Full Roadway Resurfacing Operations
(Figure TTC-41.0)

NOTES

Standard:

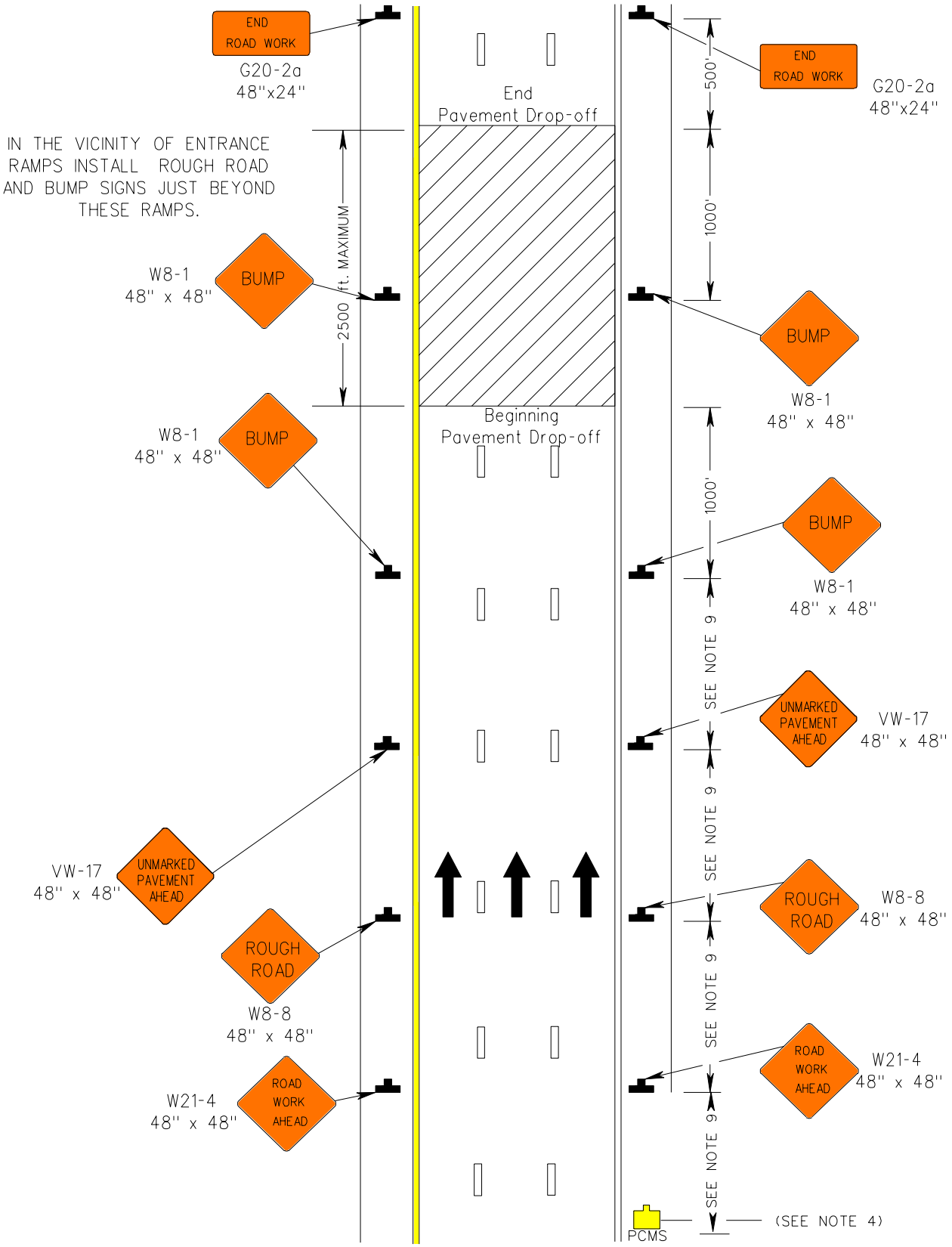
1. **On roadways having a median wider than 8', left and right sign assemblies shall be required.**
2. **The maximum pavement edge drop-off shall be 2.0 inches or less.**
3. **The maximum length of the pavement resurfacing shall be 2500 feet.**
4. **A portable changeable message sign with ROUGH ROAD AHEAD and other appropriate messages shall be used.**
5. **A BUMP sign shall be placed approximately 1000 feet in advance of the end of the pavement drop-off.**
6. **The District Traffic Engineer shall determine speed reductions.**
7. **In the vicinity of entrance ramps ROUGH ROAD and BUMP signs shall be installed.**
8. **In the vicinity of exit ramps BUMP signs shall be installed.**

Guidance:

9. *Sign spacing distance should be 1300'-1500' for limited access highway, and on all other roadways 500'-800' where the posted speed limit is greater than 45 mph, and 350'-500' where the posted speed limit is 45 mph or less.*

Option:

10. Only traffic control signing for pavement resurfacing is shown. Other devices may be needed and used for the control of traffic through the work area.



Signing for Full Roadway Resurfacing Operations
(Figure TTC-41.0)

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CHAPTER 6I. CONTROL OF TRAFFIC THROUGH TRAFFIC INCIDENT MANAGEMENT AREAS

Section 6I.01 General

Support:

Whenever the acronym "TTC" is used in this Chapter, it refers to "temporary traffic control".

Standard:

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

Support:

A traffic incident is an emergency road user occurrence, a natural disaster, or other unplanned event that affects or impedes the normal flow of traffic.

A traffic incident management area is an area of a highway where temporary traffic controls are imposed by authorized officials in response to a road user incident, natural disaster, hazardous material spill, or other unplanned incident. It is a type of TTC zone and extends from the first warning device (such as a sign, light, or cone) to the last TTC device or to a point where vehicles return to the original lane alignment and are clear of the incident.

Traffic incidents can be divided into three general classes of duration, each of which has unique traffic control characteristics and needs. These classes are:

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

The primary functions of TTC at a traffic incident management area are to move road users reasonably safely and expeditiously past or around the traffic incident, to reduce the likelihood of secondary traffic crashes, and to preclude unnecessary use of the surrounding local road system. Examples include a stalled vehicle blocking a lane, a traffic crash blocking the traveled way, a hazardous material spill along a highway, and natural disasters such as floods and severe storm damage.

Guidance:

In order to reduce response time for traffic incidents, highway agencies, appropriate public safety agencies (law enforcement, fire and rescue, emergency communications, emergency medical, and other emergency management), and private sector responders (towing and recovery and hazardous materials contractors) should mutually plan for occurrences of traffic incidents along the major and heavily traveled highway and street system.

On-scene responders should be trained in safe practices for accomplishing their tasks in and near traffic. Responders should always be aware of their visibility to oncoming traffic and take measures to move the traffic incident as far off the traveled roadway as possible or to provide for appropriate warning.

Responders arriving at a traffic incident should, within 15 minutes of arrival on-scene, estimate the magnitude of the traffic incident, the expected time duration of the traffic incident, and the expected vehicle queue length, and then should set up the appropriate temporary traffic controls for these estimates.

Standard:

Traffic incidents shall be reported to the appropriate Smart Traffic Center or statewide Transportation Emergency Operations Center as soon as practical once the on scene evaluation has been performed.

Option:

Warning and guide signs used for TTC traffic incident management situations may have a black legend and border on a fluorescent pink background (see Figure 6I-1).

Support:

While some traffic incidents might be anticipated and planned for, emergencies and disasters might pose more severe and unpredictable problems. The ability to quickly install proper temporary traffic controls might greatly reduce the effects of an incident, such as secondary crashes or excessive traffic delays. An essential part of fire, rescue, spill clean-up, highway agency, and enforcement activities is the proper control of road users through the traffic incident management area in order to protect responders, victims, and other personnel at the site while providing reasonably safe traffic flow. These operations might need corroborating legislative authority for the implementation and enforcement of appropriate road user regulations, parking controls, and speed zoning. It is desirable for these statutes to provide sufficient flexibility in the authority for, and implementation of, TTC to respond to the needs of changing conditions found in traffic incident management areas.

Option:

For traffic incidents, particularly those of an emergency nature, TTC devices on hand may be used for the initial response as long as they do not themselves create unnecessary additional hazards.

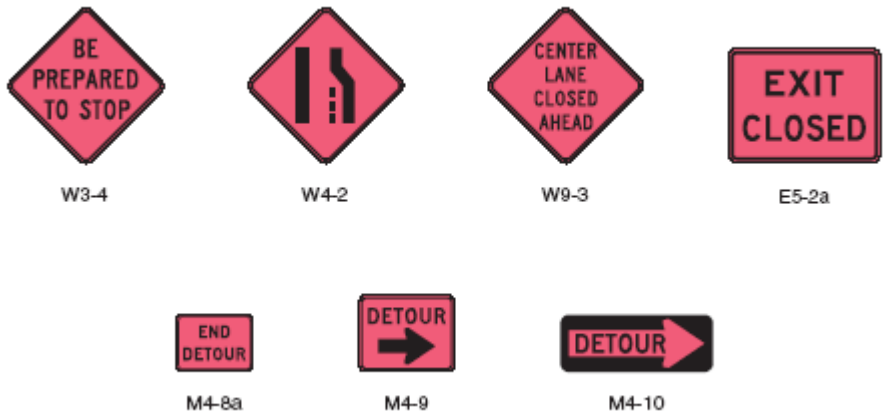

FIGURE 6I-1, EXAMPLES OF TRAFFIC INCIDENT MANAGEMENT AREA SIGNS

Section 6I.02 Major Traffic Incidents

Support:

Major traffic incidents are typically traffic incidents involving hazardous materials, fatal traffic crashes involving numerous vehicles, and other natural or man-made disasters. These traffic incidents typically involve closing all or part of a roadway facility for a period exceeding 2 hours.

Guidance:

If the traffic incident is anticipated to last more than 24 hours, applicable procedures and devices set forth in this manual should be used.

Support:

A road closure can be caused by a traffic incident such as a road user crash that blocks the traveled way. Road users are usually diverted through lane shifts or detoured around the traffic incident and back to the original roadway. A combination of traffic engineering and enforcement preparations is needed to determine the detour route, and to install, maintain or operate, and then to remove the necessary traffic control devices when the detour is terminated. Large trucks are a significant concern in such a detour, especially when detouring them from a controlled-access roadway onto local or arterial streets.

During traffic incidents, large trucks might need to follow a route separate from that of automobiles because of bridge, weight, clearance, or geometric restrictions. Also, vehicles carrying hazardous material might need to follow a different route from other vehicles.

Some traffic incidents such as hazardous material spills might require closure of an entire highway. Through road users must have adequate guidance around the traffic incident. Maintaining good public relations is desirable. The cooperation of the news media in publicizing the existence of, and reasons for, traffic incident management areas and their TTC can be of great assistance in keeping road users and the general public well informed.

The establishment, maintenance, and prompt removal of lane diversions can be effectively managed by inter-agency planning that includes representatives of highway and public safety agencies.

Guidance:

All traffic control devices needed to set up the TTC at a traffic incident should be available so that they can be readily deployed for all major traffic incidents. The TTC should include the proper traffic diversions, tapered lane closures, and upstream warning devices to alert approaching traffic of the end of a queue.

Attention should be paid to the end of the traffic queue such that warning is given to road users approaching the end of the queue.

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

Option:

If flaggers are used to provide traffic control for an incident management situation, the flaggers may use appropriate traffic control devices that are readily available or that can be brought to the traffic incident scene on short notice.

Guidance:

When flares are used to initiate TTC at traffic incidents, more permanent traffic control devices should replace them as soon as practical. Both the flare and its supporting device should then be removed from the roadway.

Option:

Chemical lightsticks may be used in placed of roadway flares and follow the same removal requirements as stated for flares and their supporting devices.

Support:

Approved colors for chemical lightsticks are yellow or lime green.

Guidance:

On-scene responders should be trained in safe practices for accomplishing their tasks in and near traffic. Responders should always be aware of their visibility to oncoming traffic and take measures to move the traffic incident as far off the traveled roadway as possible or to provide for appropriate warning.

Section 6I.03 Intermediate Traffic Incidents

Support:

Intermediate traffic incidents typically affect travel lanes for a time period of 30 minutes to 2 hours, and usually require traffic control on the scene to divert road users past the blockage. Full roadway closures might be needed for short periods during traffic incident clearance to allow traffic incident responders to accomplish their tasks.

The establishment, maintenance, and prompt removal of lane diversions can be effectively managed by inter-agency planning that includes representatives of highway and public safety agencies.

Guidance:

All traffic control devices needed to set up the TTC at a traffic incident should be available so that they can be readily deployed for intermediate traffic incidents. The TTC should include the proper traffic diversions, tapered lane closures, and upstream warning devices to alert approaching traffic of the end of a queue (See TTC-31.0, Total Freeway Closure Operation).

Attention should be paid to the end of the traffic queue such that warning is given to road users approaching the end of the queue.

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

Option:

If flaggers are used to provide traffic control for an incident management situation, the flaggers may use appropriate traffic control devices that are readily available or that can be brought to the traffic incident scene on short notice.

Guidance:

When flares are used to initiate TTC at traffic incidents, more permanent traffic devices should replace them as soon as practical. Both the flare and its supporting device should then be removed from the roadway.

Option:

Chemical lightsticks may be used in placed of roadway flares and follow the same removal requirements as stated for flares and their supporting devices.

Support:

Approved colors for chemical lightsticks are yellow or lime green.

Guidance:

On-scene responders should be trained in safe practices for accomplishing their tasks in and near traffic. Responders should always be aware of their visibility to oncoming traffic and take measures to move the traffic incident as far off the traveled roadway as possible or to provide for appropriate warning.

Section 6I.04 Minor Traffic Incidents

Support:

Minor traffic incidents are typically disabled vehicles and minor crashes that result in lane closures of less than 30 minutes. On-scene responders are typically law enforcement and towing companies, and occasionally highway agency safety service patrol vehicles.

Diversion of traffic into other lanes is often not needed or is needed only briefly. It is not generally possible or practical to set up a lane closure with traffic control devices for a minor traffic incident. Traffic control is the responsibility of on-scene responders.

Guidance:

When a minor traffic incident blocks a travel lane, it should be removed from that lane to the shoulder as quickly as possible.

Section 6I.05 Use of Emergency-Vehicle Lighting

Support:

The use of emergency-vehicle lighting (such as high-intensity rotating, oscillating, or strobe lights) is essential, especially in the initial stages of a traffic incident, for the safety of emergency responders and persons involved in the traffic incident, as well as road users approaching the traffic incident. Emergency-vehicle lighting, however, provides warning only and provides no effective traffic control. It is often confusing to road users, especially at night. Road users approaching the traffic incident from the opposite direction on a divided facility are often distracted by emergency-vehicle lighting and slow their vehicles to look at the traffic incident posing a hazard to themselves and others traveling in their direction.

The use of emergency-vehicle lighting can be reduced if good traffic control has been established at a traffic incident scene. This is especially true for major traffic incidents that might involve a number of emergency vehicles. If good traffic control is established through placement of advanced warning signs and traffic control devices to divert or detour traffic, then public safety agencies can perform their tasks on scene with minimal emergency-vehicle lighting.

Guidance:

Public safety agencies should examine their policies on the use of emergency-vehicle lighting, especially after a traffic incident scene is secured, with the intent of reducing the use of this lighting as much as possible while not endangering those at the scene. Special consideration should be given to reducing or extinguishing forward facing emergency-vehicle lighting, especially on divided roadways, to reduce distractions to on-coming road users.

Vehicle headlights not needed for illumination, or to provide notice to other road users of the incident response vehicle being in an unexpected location, should be turned off at night.

Standard:

Incident management response vehicles shall not face oncoming traffic within a closed lane with their headlights on.

Section 6I.06 Emergency Responder Safety

Guidance:

For responders establishing TTC at a traffic incident, the wearing of high visibility clothing should increase the safety of the operation. Therefore, all responders exposed to the risks of moving roadway traffic or other emergency equipment should at a minimum, wear high-visibility safety apparel meeting the requirements of ISEA "American National Standard for High-Visibility Safety Apparel" (see Section 1A.11), or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 risk exposure.

All incident responders should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, placement, and TTC review. Training should be conducted on a continual basis.

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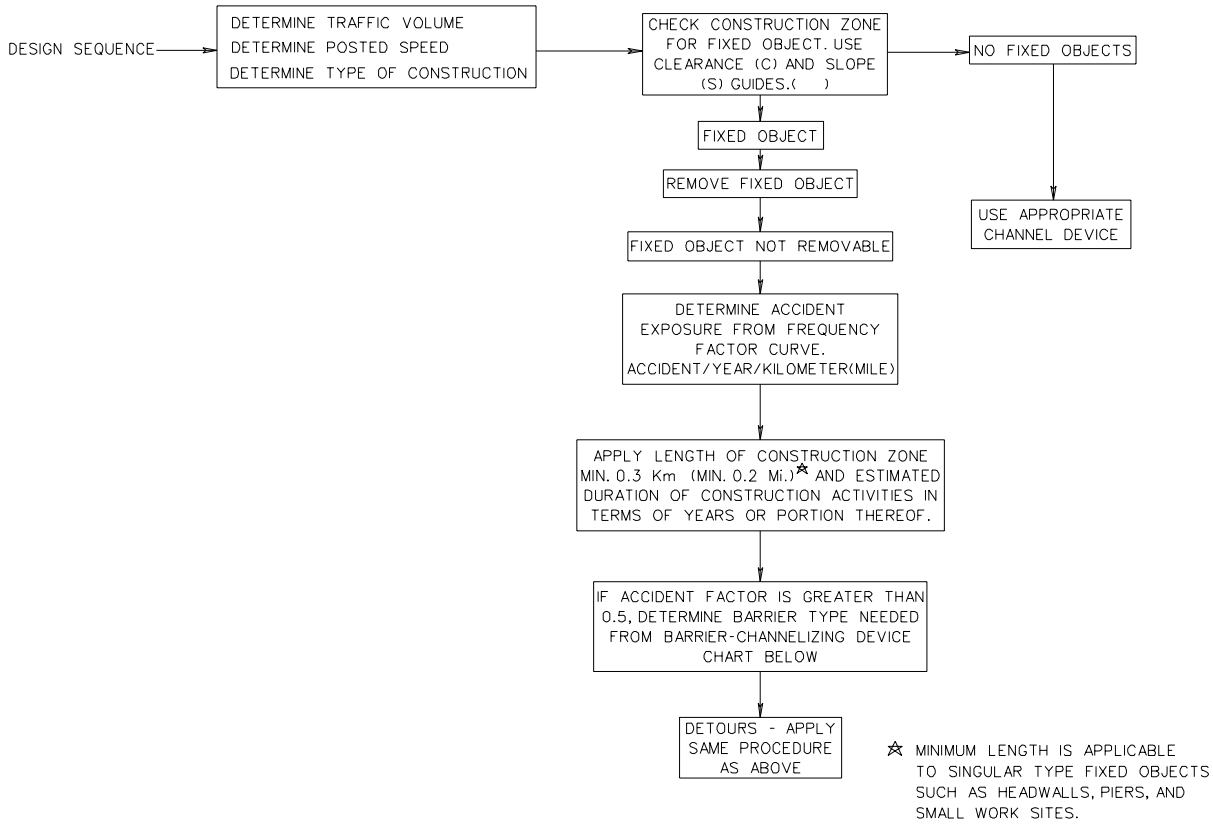
APPENDIX A

GUIDELINES FOR USE OF BARRIER/CHANNELIZATION DEVICES

The following Safety Guidelines for Construction Zones have been developed to provide a methodical framework from which to assess every project as to the needs for appropriate techniques and devices to be employed during the construction phase. This covers a broad range of traffic conditions, vehicle speed and duration of construction, to insure that motorist and worker safety are addressed in a uniform manner throughout the State. Of particular note is the step in the design sequence that asks the question, "Can the fixed object be removed?" The use of barriers to shield fixed objects should only be employed if it is not economically feasible to provide an alternate method of construction. The "Guidelines" are to be used as a supplement to the Millennium edition of the Manual on Uniform Traffic Control Devices (MUTCD) and the Virginia Work Area Protection Manual.

DETERMINATION OF BARRIER / CHANNELIZATION DEVICES IN CONSTRUCTION ZONES



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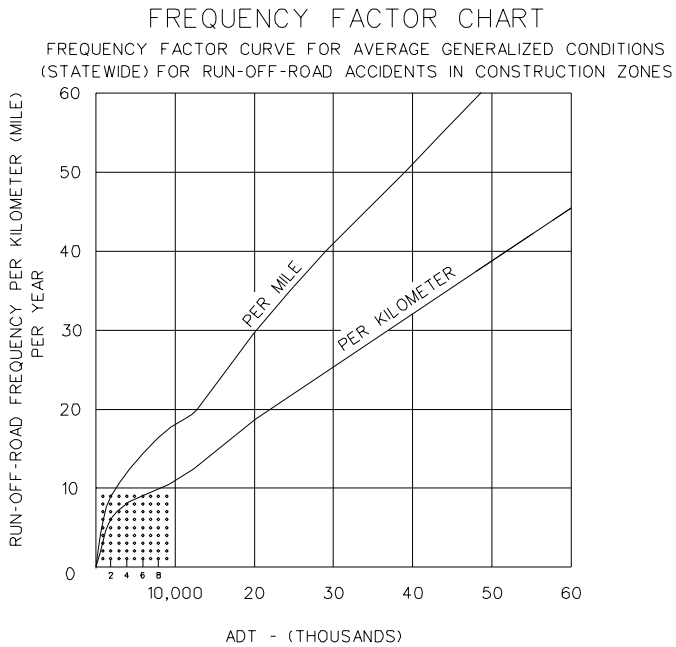
* A FIXED OBJECT IS ANY CONDITION RESULTING FROM THE CONSTRUCTION ACTIVITIES OR ANY OBJECT CONSIDERED DAMAGING TO A MOVING VEHICLE AS WOULD BE THE FOLLOWING:

HEADWALL	BARRIER ENDS	OPEN EXCAVATION
PARAPET	DROP INLET	SIGN POLES & BASES
MANHOLE	PIPE	BRIDGE PIER
GUARDRAIL END	SLOPE	BOX CULVERT
STORED MAT'L.	EQUIPMENT	



DATA PRESENTED IS FOR 2 WAY ADT.
WHEN APPLYING THIS CHART TO 4 OR MORE
LANES UNDIVIDED AND TO DIVIDED ROADWAYS,
REDUCE ADT BY ONE HALF BEFORE ENTERING CHART.

- Having determined a fixed object, excavation or hazardous slope exists within the clear zone and cannot be removed, proceed with the following.

- Determine accident exposure from Frequency Factor Curve [Accidents/Kilometer (Mile)/Year].

- Apply Length of Construction Zone and Estimated Duration of Construction Activities in terms of years or portion thereof.

  For singular type fixed objects such as headwalls, piers, and small work sites use minimum of 0.3 km (0.2 mi.) for Length of Construction Zone.

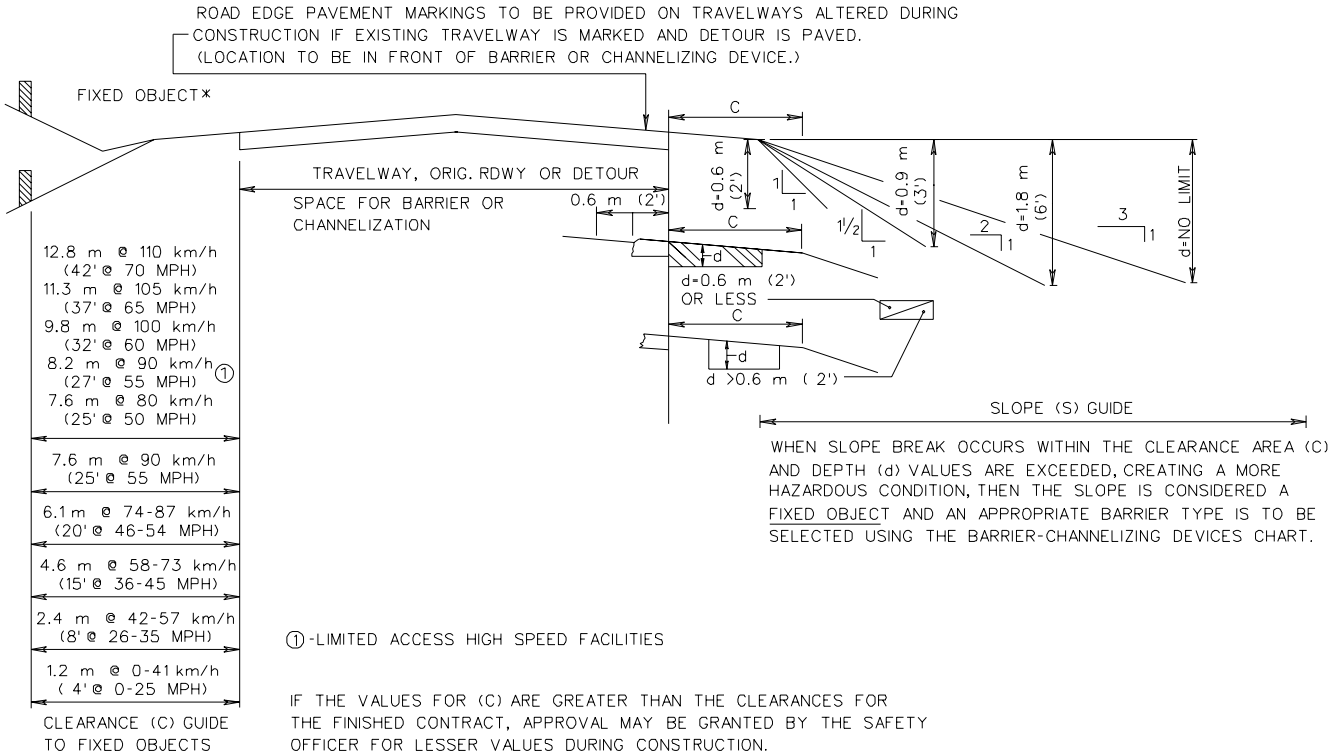
- Example: (2 lane - 2 way)
  ADT = 20,000
  Length of Construction Zone = 2.5 km (1.6 mi.)
  Construction Time = 0.5 yr.

  (1) From Frequency Factor Chart, ADT of 20,000 would indicate 19 (30) Run-off-Road Accidents/Kilometer(Mile)/Year.

  (2) Accident Factor is 19 (30) x 2.5 km (1.6 mi.) x 0.5 yr = 23.75 (22.5)

- If Accident Factor is greater than 0.5, go to Barrier Channelization Device Chart to determine type needed.

FIXED OBJECT CLEARANCE & SLOPE GUIDES



Example

ADT = 15,000 (2 - lane, 2 - way)

1½: 1 Slope d = 1.5 m (5')

Construction Time = 0.5 yr.

90 km/h (55 MPH)

Fixed Object @ 5.5 m (18')

Length of Construction Zone = 2.5 km (1.6 mi.)

0.3 m (1') excavation at 3 m (10')

Accident Frequency Factor = 15 (17)

(1) From Clear Zone Guide, clear zone (c) for 90 km/h (55MPH) = 6.9 m (20')

(2) Fixed object @ 5.5 m (18') is within 6.9 m (20') (c); go to Barrier Channelization Device Chart
For 15,000 ADT and 90 km/h (55MPH), Type A Barrier required.

(3) Since 1.5 m (5') for 1½: 1 slope exceeds 0.9 m (3') in Slope (s) Guide, Type A Barrier required.

(4) Since 0.3 m (1') excavation occurs within 6.9 m (20') (c), use lesser value from upper left segment of Barrier-Channelization Device Chart, Type B Barrier required.

SELECTING BARRIERS, BARRICADES AND CHANNELIZING DEVICES

BARRIER-CHANNELIZING DEVICE CHART

EXISTING TRAFFIC ADT	POSTED SPEED LIMIT - MPH 0-25	26-35	36-45	46-54	55+
0-750	1, 2 / 1, 2	1, 2 / 1, 2	1, 2 / 1, 2	1, 2 / 1, 2	1, 2 / B
751-5500	1, 2 / 1, 2	1, 2 / 1, 2	1, 2 / B	B / B	B / A
5500-15000	1, 2 / 1, 2	1, 2 / B	B / B	B / A	A / A
ABOVE 15000	1, 2 / 1, 2	1, 2 / B	A / A	A / A	A / A

A MORE POSITIVE TYPE OF BARRIER CAN BE SUBSTITUTED FOR VALUES SHOWN.

BARRIER BEGINNINGS ARE TO BE PLACED AS FAR AS POSSIBLE FROM TRAVELWAY.

WHEN AN EXCAVATION OCCURS WITHIN THE CLEARANCE (C) AREA WITH A DEPTH (d) BETWEEN 150 mm (6") AND 0.6 m (2') USE THE LESSER VALUE FROM THE UPPER LEFT SEGMENT OF THE BARRIER - CHANNELIZATION DEVICE CHART. ALL OTHER CONDITIONS REQUIRING A BARRIER OR CHANNELIZATION DEVICE SHOULD USE THE TYPE DEPICTED IN THE LOWER RIGHT SEGMENT.

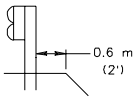
DRUMS SHALL BE USED TO DELINEATE ALL UNMANNED WORK AREAS

TYPES OF BARRIERS (Fixed Object Class)

FOR DETAILS - SEE PLANS

ALPHABETICAL LISTING OF BARRIERS IS IN ORDEROF POSITIVE REDIRECTION CAPACITY. INSTALLATION IS TO BE IN ACCORDANCE WITH THE ROAD AND BRIDGE STANDARDS.

A
POSITIVE



B
LESS POSITIVE

BRIDGES

TEMPORARY CONCRETE PARAPET

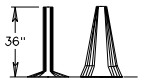
BR. ENGR. APPROVAL

TEMPORARY CONCRETE TRAFFIC BARRIER

BOLTED DOWN CHANNEL SECTION SUBJ. TO BR. ENGR. APPROVAL

BARRICADES & CHANNELIZING DEVICES

(FOR DETAILS AND METHOD OF PLACEMENT SEE MUTCD AND PLANS)



CONES

GROUP 1

DRUM

GROUP 2

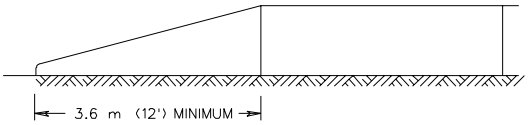
SPACING GUIDE

SPEED	0-57 (0-35)	58+ (36+)
SPACING	12(40)	24(80)

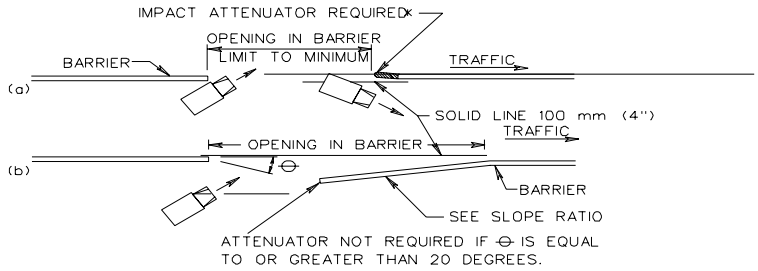
CHANNELIZATION DEVICE SPACING ALONG TRAVELWAY -METERS (FEET)- SPACING ON CURVES 280 m (6°) OR GREATER, ON TRANSITIONS OR LOCATIONS DETERMINED BY DISTRICT TRAFFIC ENGINEER TO BE ½ OF TRAVELWAY SPACING.

PC BARRIER END TREATMENT

To be USED ONLY when "Clear Zone" distance requirements are met

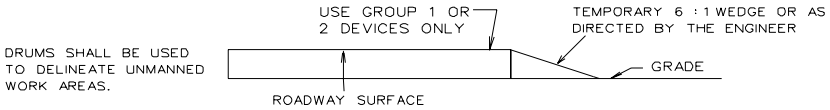


CONSTRUCTION ACCESS TECHNIQUES

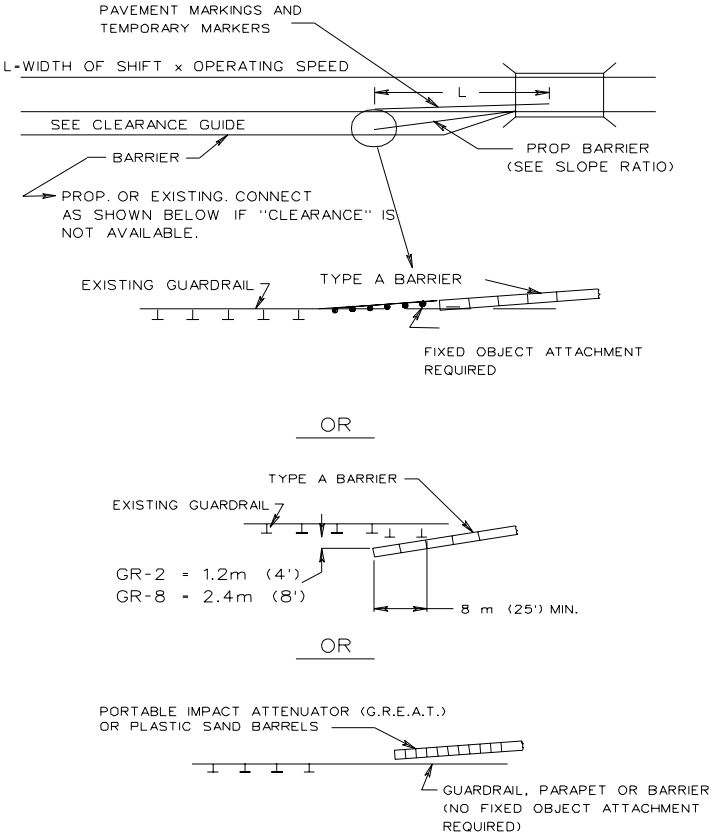


* IMPACT ATTENUATORS USED WITH BARRIER OPENINGS FOR EQUIPMENT ACCESS WILL NOT BE SUMMARIZED. (SEE SPECIFICATION 512.)

PAVEMENT PLACEMENT GUIDE



INTRODUCED BARRIER (FIXED OBJECT)



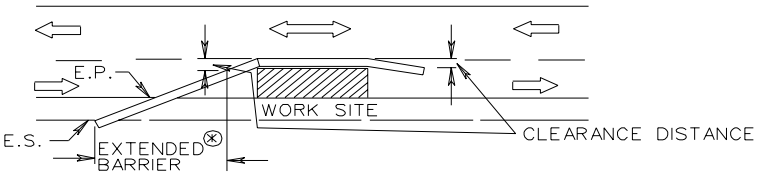
BARRIER TRANSITION SLOPE RATIO

110 km/h (70 MPH)	=	22:1
105 km/h (65 MPH)	=	20:1
100 km/h (60 MPH)	=	19:1
90 km/h (55 MPH)	=	17:1
80 km/h (50 MPH)	=	16:1
70 km/h (45 MPH)	=	14:1
60 km/h (40 MPH)	=	13:1
52 km/h (35 MPH)	=	11:1
45 km/h (30 MPH)	=	10:1
Below 30 MPH	=	10:1

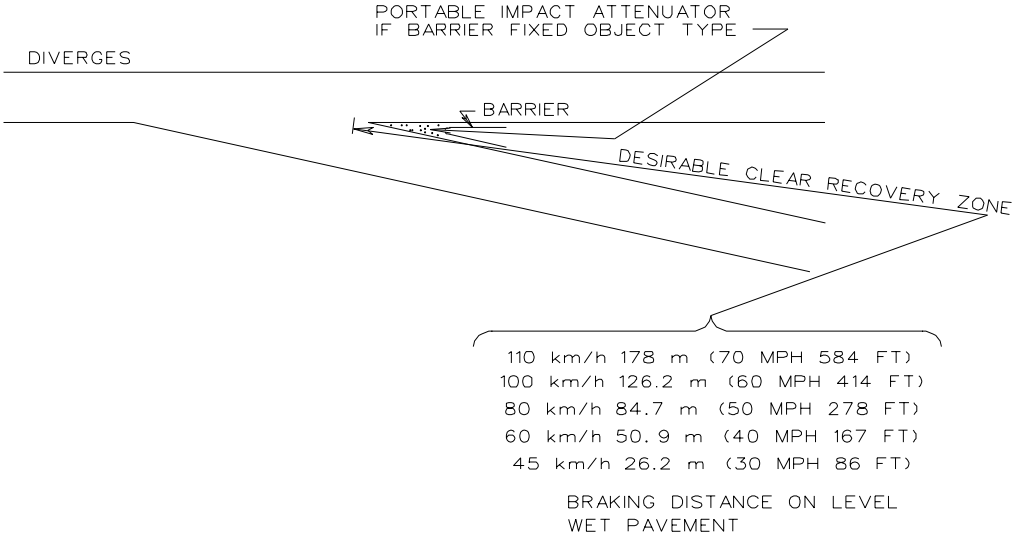
WHEN THE BARRIER TRANSITION SLOPE IS ON HORIZONTAL ALIGNMENT THE TOTAL OFFSET SHALL BE PRORATED AROUND THE CURVE IN LIEU OF A STRAIGHT LINE SLOPE.

INTRODUCED BARRIER (FIXED OBJECT)

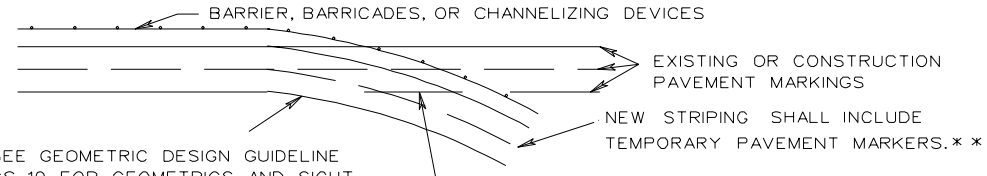
SEE TYPICAL TRAFFIC CONTROL FIGURE TTC-16.0 FOR DETAIL INFORMATION ON BARRIER INSTALLATION AND REQUIRED TRAFFIC CONTROL



⊗ WHENEVER A TRAVEL LANE IS DIVERTED WITH THE USE OF CONCRETE BARRIERS AND THE CLEARANCE DISTANCE DOES NOT PLACE THE BARRIER OR ITS END TO THE OUTSIDE OF THE SHOULDER OF THE ONCOMING LANE, THEN THE BARRIER IS TO BE EXTENDED TO THE SHOULDER, OR AN IMPACT ATTENUATOR SHALL BE UTILIZED.



DETOURS



SEE GEOMETRIC DESIGN GUIDELINE GS-10 FOR GEOMETRICS AND SIGHT DISTANCE VALUES WHEN TRAFFIC IS DIVERTED FROM NORMAL PATH OF LANE OR LANES. USE CLEARANCE GUIDE FOR FIXED OBJECTS.

REMOVE OR COVER EXISTING STRIPING WITH PAVEMENT COURSE.

** TEMPORARY PAVEMENT MARKERS TO BE SPACED ON 6 m (20') CENTERS IN TRANSITIONS. WHEN TEMPORARY MARKERS ARE REQUIRED IN OTHER AREAS, THEY SHALL BE INSTALLED ON 12 m (40') CENTERS, OR LOCATIONS DETERMINED BY THE DISTRICT TRAFFIC ENGINEER.

STOPPING SIGHT DISTANCE (SSD) – Feet

Height of Eye – 3.5 ft.
Height of Object – 2.0 ft.

Use "Desirable" values as minimum on the Interstate system, and the Arterial system where feasible.

Posted Speed (mph)	20	25	30	35	40	45	50	55	60	65	70
Minimum SSD	125	150	200	225	275	325	400	450	525	550	625
Desirable SSD	125	150	200	250	325	400	475	550	650	725	850

APPENDIX B

WORK ZONE SAFETY CHECKLIST FORM DOCUMENTATION

The following Work Zone Safety Checklist form has been developed to provide a consistent and helpful way to review and document temporary traffic control in construction, maintenance, utility and permit work zone operations. When used correctly, work zone deficiencies should be noted and detailed information provided to allow rapid and thorough correction of the problem. Therefore, additional sheets may be attached to this form if needed.

Work zones should be carefully monitored under varying conditions of road user volumes, light, construction activities, and weather to check that applicable temporary traffic control devices are effective, clearly visible, clean, and in compliance with the traffic control plan and this manual. Individuals who are knowledgeable (for example, trained and/or certified) in the principles of proper temporary traffic control should be assigned responsibility for safety in temporary traffic control zones. Part of their duties should consist of reviewing daily the traffic control devices and their functionality to ensure that reasonable safe conditions exist for motorists (including motorcyclists), bicyclists, pedestrians, and workers.

As stated in Section 6B.01, "Temporary traffic control installations shall be reviewed daily to ensure the functionality of the temporary traffic control devices and compliance to this Manual. These reviews shall be documented on a weekly basis at a minimum using the Work Zone Safety Checklist form found in Appendix B of this manual including as much detail information as warranted for the type of operation." This required frequency is a minimum, and depending on the type and location of the project, more frequent checks may be necessary, particularly at night. Additional methods of documentation may also be used with this form, including written notes and sketches, project diary entries, photographs, and video recordings.

Changes to the traffic control plan, no matter how small, must also be documented and may be performed using this form. Information should include what the changes were, why they were made, and who was notified and/or authorized the change.

An explanation form to explain the fields found on the work zone safety checklist form follows on pages B-5 through B-11.

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Form #TE-97001
TRAFFIC ENGINEERING
CONSTRUCTION / MAINTENANCE / UTILITY / PERMIT

WORK ZONE SAFETY CHECKLIST

URGENT CORRECT IMMEDIATELY [ ]
5 – WORKING DAYS TO CORRECT [ ]

WHEN URGENT IS MARKED DENOTE ITEM

RESIDENCY: _____ CONTRACTOR / AREA HEADQUARTERS: _____

CITY / COUNTY: _____ PROJ. NO. / PERMIT NO. / LOCATION: _____

TYPE OF OPERATION: _____ DAY / DATE: _____ TIME: _____

PERSON IN CHARGE: _____ POSTED SPEED: _____ MPH

WEATHER CONDITION: _____ DAY OR NIGHT WORK ☐ IN ☐ NOT IN PROGRESS

A. DRIVE THRU:

ARE MANEUVERS DIFFICULT OR UNEXPECTED? ☐ YES ☐ NO

ADEQUATE WARNING OF HAZARDS? ☐ YES ☐ NO

IS SIGNING CLEAR / UNCLUTTERED AND PROPERLY SPACED? ☐ YES ☐ NO

ARE TRAFFIC CONTROL DEVICES SUFFICIENTLY VISIBLE? ☐ YES ☐ NO

COMMENTS:

B. SIGNS

☐ ADEQUATE ☐ INADEQUATE

NEED TO BE (REMOVED / REPOSITIONED / COVERED) ☐

NEED (CLEANING / REPLACEMENT) ☐

CONFLICTING (PERMANENT / TEMPORARY SIGNING) ☐

NON-APPROVED SIGN SUPPORT ☐

BLOCKED BY VEGETATION ☐

COMMENTS:

C. PORTABLE CHANGEABLE MESSAGE SIGN:

☐ ADEQUATE ☐ INADEQUATE

APPLICATION DOES NOT MEET GUIDELINES ☐

INAPPROPRIATE (MESSAGE) ☐

TO MUCH INFORMATION ON P.C.M.S. ☐

NOT DELINEATED, NO CONES / BARRELS ☐

COMMENTS:

D. ARROW PANEL:

☐ ADEQUATE ☐ INADEQUATE

MALFUNCTION (BULB OUT, ETC.) ☐

INCORRECT PLACEMENT ☐

MISALIGNED BULBS ☐

NOT DIMMED AT NIGHT ☐

COMMENTS:

E. DRUMS = D / CONES = C ***D*** ***C***

☐ ADEQUATE ☐ INADEQUATE

INAPPROPRIATE TAPER LENGTH

SPACING INADEQUATE (TO LONG / TOO SHORT

(REPAIR / CLEAN / REPLACEMENT)

REFLECTIVE BANDS (DAMAGED / MISSING) ON (CONES / TUBULAR MARKERS)

ADDITIONAL DEVICES NEEDED

MISALIGNED

COMMENTS:

F. TRAFFIC BARRIER:

☐ ADEQUATE ☐ INADEQUATE

IMPROPER BARRIER WALL FLARE ☐

IMPROPER TERMINAL TREATMENT ☐

BARRIER NEEDS TO BE (REALIGNED / REMOVED) ☐

WARNING LIGHT (SERVICE / CLEAN) ☐

DELINEATORS (CLEAN / ADDITIONAL ☐

8' X 12" VERTICAL BARRIER PANELS (CLEAN ADDITIONAL) ☐

ATTENUATOR (REPAIR / REPLACE) ☐

COMMENTS:

G. FLAGGING OPERATION:

☐ ADEQUATE ☐ INADEQUATE

NEED ADDITIONAL ADVANCE SIGNING

ARE FLAGPERSONS

CERTIFIED?	☐ YES	☐ NO
POSITIONED CORRECTLY?	☐ YES	☐ NO
HIGHLY VISIBLE?	☐ YES	☐ NO
PROPERLY CLOTHED?	☐ YES	☐ NO
FLAGGING CORRECTLY?	☐ YES	☐ NO

COMMENTS:

H. PAVEMENT MARKING

☐ PERMANENT ☐ CONSTRUCTION

☐ ADEQUATE ☐ INADEQUATE

REMOVE

REPAIR

NEED ADDITIONAL

UNNECESSARY (MARKINGS /
NOT ERADICATED COMPLETED)

COMMENTS:

I. PAVEMENT MARKERS:

☐ PERMANENT ☐ CONSTRUCTION

☐ ADEQUATE ☐ INADEQUATE

REPLACE MISSING	☐
REMOVE	☐
NEED ADDITIONAL	☐

COMMENTS:

J. TRUCK MOUNTED ATTENUATOR:

PROPERLY POSITIONED?	☐ YES	☐ NO
PROPERLY MAINTAINED / DELINEATED?	☐ YES	☐ NO

COMMENTS:

K. MISCELLANEOUS: ☐ YES ☐ NO

ADEQUATE BUFFER SPACE?	☐ YES	☐ NO
IS THE WORK AREA PROTECTED?	☐ YES	☐ NO
MATERIALS PROPERLY STORED?	☐ YES	☐ NO
ARE LANE CLOSURES IN ACCORD WITH ALLOWED HOURS"	☐ YES	☐ NO

ACCIDENTS:

EVIDENCE OF AN ACCIDENT	☐ YES	☐ NO
DAMAGED TRAFFIC CONTROL DEVICES	☐	
SKID MARKS ☐	DEBRIS	☐

COMMENTS / RECOMMENDATION:

REVIEWED BY: _____ (SIGN & DATE)

REVIEWED WITH: _____ (SIGN & DATE)

COPY: CONTRACTOR, INSPECTOR, RESIDENT ENGINEER, OR OTHER _____

WORK ZONE SAFETY CHECKLIST FORM # TE-97001 & 97002
EXPLANATION SHEET

The box at the upper right-hand corner of the page is used to show the seriousness of the condition at the work site. If this will require immediate attention, (when life-threatening conditions are present) check the **"URGENT**: ***Correct immediately box"***. If conditions are not life threatening, then check the ***"5 - Working days to correct"*** box.

"WHEN *URGENT* IS MARKED DENOTE ITEM" - When the urgent box is checked, write the word ***URGENT*** in the appropriate section's comments line to indicate a life threatening condition is present.

"*CONSTRUCTION / MAINTENANCE / UTILITY / PERMIT*" - Circle the type of operation being reviewed.

"*RESIDENCY:*" - Residency managing the work zone.

"*CITY / COUNTY:*" - Location of the work zone.

"*PERSON IN CHARGE:*" - Project inspector or supervisor overseeing the project.

"*WEATHER CONDITION:*" - Type of weather when the inspection is being performed.

"*CONTRACTOR / AREA HEADQUARTERS:*" - Name of the contractor or, when checking a maintenance operation, name of the Area Headquarters performing the operation.

"*PROJ. NO. / PERMIT NO. / LOCATION:*" - Circle the applicable title and list the corresponding project or permit number or route number for maintenance operations.

"*DAY / DATE:*" - The day and date of the review.

"*TIME:*" - The time when the review is performed.

"*POSTED SPEED:*" - The posted speed limit on the project.

"*DAY OR NIGHT:*" - Circle day for daylight or night for darkness during the time the review was conducted.

"*WORK (IN/NOT IN) PROGRESS:*" - Circle "IN" if operations are being performed during the review or "NOT IN" if operations are not in progress.

A. *DRIVE THRU:* Drive through the work zone at the prevailing or 85 percentile speed and take notice of the traffic's movements and reactions to the traffic control devices.

"*ARE MANEUVERS DIFFICULT OR UNEXPECTED?*" - Based on the drive thru and observation of the traffic, answer yes or no.

"***ADEQUATE WARNING OF HAZARDS?*"** - Are the placement of the advance warning signs in regards to hazards adequate for proper reaction?

"*IS SIGNING CLEAR / UNCLUTTERED AND PROPERLY SPACED?*" - Are the advance warning signs visible and easy to read and understand?

"*ARE TRAFFIC CONTROL DEVICES SUFFICIENTLY VISIBLE?*" - Are all the traffic control devices (signs, cones, plastic drums, arrow panels, etc.) visible?

"*COMMENTS:*" - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

B. SIGNS: See Section 6F-02 of the Virginia Work Area Protection Manual (VWAPM)

"***ADEQUATE*** or ***INADEQUATE:*****"** - Used to describe the condition of the warning signs. When "ADEQUATE" is checked continue to the next section. If "INADEQUATE" is checked one of the conditions below will be checked or other types of problems listed on the comment line.

"*NEED TO BE (REMOVED / REPOSITIONED / COVERED):*" - Circle one of the statements that describes the condition: "REMOVED" when the sign is not necessary or inappropriate for the traffic control; "REPOSITIONED" when a sign is found in an incorrect location; or "COVERED" when the sign conveys a conflicting message.

"*NEED (CLEANING / REPLACEMENT):*" - ***Circle*** one of the statements that describes the condition: "CLEANING" if a sign is dirty and/or "REPLACEMENT" when the sign is no longer legible.

"*NEED ADDITIONAL SIGNS:*" - Mark when additional signs are needed to comply with the *Virginia Work Area Protection Manual.*

"*NON-APPROVED SIGN SUPPORTS:*" - Mark when not in compliance with the VWAPM (spring loaded sign stands required unless prevented by roadway geometrics and approved by the District Traffic Engineer.

"*COMMENTS:*" - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

C. PORTABLE CHANGEABLE MESSAGE SIGN: See Section 6F-52 of the VWAPM

"***ADEQUATE*** or ***INADEQUATE:*****"** - Used to describe the condition of the PCMS. When "ADEQUATE" is checked, continue to the next section. If "INADEQUATE" is checked, one of the conditions below will be checked or other types of problems listed on the comment line.

"*APPLICATION DOES NOT MEET GUIDELINES:*" - Mark if the message on the PCMS is giving conflicting information or guidance.

"*INAPPROPRIATE MESSAGE:*" - Mark if the message is unclear or does not pertain to the work zone.

"*NOT DELINEATED, NO CONES / BARRELS:*" - Circle one of the statements that describes the condition: "CONES" should be used to delineate the PCMS during daylight hours and "BARRELS" must be used for night delineation.

"*COMMENTS:*" - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.

D. ARROW PANEL: See Section 6F-53 of the VWAPM

Note: Desired placement is on the shoulder at the beginning of the transition. The four- corner display shall be used for the caution mode.

"*ADEQUATE* or *INADEQUATE:*" - Used to describe the condition of the arrow panel. When "ADEQUATE" is checked, continue to the next section. If "INADEQUATE" is checked, one of the conditions below will be checked or other types of problems listed on the comments line.

"*MALFUNCTION (BULB OUT, ETC.):*" - Circle one of the statements that describes the condition: "MALFUNCTION" if the entire panel is out or "BULB" if one or more bulbs are out.

"*MISALIGNED BULBS:*" - Mark if bulbs appear dimmer than others due to being out of alignment.

"*NOT DIMMED AT NIGHT:*" - Mark if the panel is too bright at night.

"COMMENTS:" - **This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

E. DRUMS & CONES: See Section 6F-55 of the VWAPM

DRUMS = D: Circle the letter ***D*** when drums are checked.
CONES = C: Circle the letter ***C*** when cones are checked.

(Both ***D*** and ***C*** can be used at the same time. The boxes that are under the heading letters can be checked based on the deficiency found with these devices.)

"*ADEQUATE* or *INADEQUATE:*" - Used to describe the condition of the drums or cones. When "ADEQUATE" is checked continue to the next section. If "INADEQUATE" is checked, one of the conditions below will be checked or other types of problems listed on the comments line.

"*INAPPROPRIATE TAPER LENGTH:*" - Mark if the taper does not meet the length requirements found in the WAPM and check the box under the letter heading for that device.

"*SPACING INADEQUATE (TOO LONG / TOO SHORT):*" - Mark if the space between the devices is not in accordance with the WAPM and check the box under the letter heading for that device.

"*(REPAIR / CLEAN / REPLACE):*" - Circle the statements that describes the condition of the devices and check the box under the letter heading for that device.

"*REFLECTIVE SLEEVES OR BANDS MISSING ON (CONES / TUBULAR MARKERS):*" Circle the statement that describes the condition and check the box under the letter heading for that device. (Reflective sheeting is required on cones and tubular markers at night)

"*ADDITIONAL DEVICES NEEDED:*" - Mark if spacing is not within WAPM requirements or if hazards are not adequately protected and check the box under the letter heading for that device.

"*MISALIGNED:*" - Mark when the drums or cones are out of alignment in either the transition or tangent area and check the box under the letter heading for that device.

"COMMENTS:" - **This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

F. TRAFFIC BARRIER: See Section 6F-76 and Appendix A of the VWAPM

"*ADEQUATE* or *INADEQUATE:*" - Used to describe the condition of the traffic barrier. When "ADEQUATE" is checked continue to the next section. If "INADEQUATE" is checked, one of the conditions below will be checked or other types of problems listed on the comment line.

"*IMPROPER BARRIER WALL FLARE:*" - Mark if the concrete barrier flare does not meet the requirements of the barrier transition slope ratio table in Appendix A of the *Virginia Work Area Protection Manual*.

"*BARRIER NEEDS TO BE (REALIGNED / REMOVED):*" - Circle statements that describes the condition: "REALIGNED" when gaps greater than one inch are found between barrier joints or needs straightening or "REMOVED" when the barrier is no longer needed to protect the work area.

"*WARNING LIGHT (SERVICE / CLEAN):*" - Circle the statements that describes the condition: "SERVICE" when the type "A" warning light is not working; "CLEAN" when the light is dirty with reduced visibility.

DELINEATORS (CLEAN / ADDITIONAL): Circle the statements that describe the condition: "CLEAN" when the delineators on the side of the barrier are dirty; "ADDITIONAL" when they are missing from the barrier.

"*8" X 12" VERTICAL BARRIER PANELS (CLEAN / ADDITIONAL):*" - Circle the statements that describes the condition: "CLEAN" when the retroreflectivity of the vertical panels is reduced due to dirt; "ADDITIONAL" when vertical panels are missing from the concrete barrier wall.

"*ATTENUATOR (REPAIR / REPLACE):*" - Circle the statement that describes the condition: "REPAIR" when damage has occurred to the attenuator; "REPLACE" when the device cannot be repaired.

***"COMMENTS:"* - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

G. FLAGGING OPERATION: See Section 6E of the VWAPM

"*ADEQUATE* or *INADEQUATE:*" - Used to describe the condition of the flagging operation. When "ADEQUATE" is checked continue to the next section. If "INADEQUATE" is checked, one of the conditions below will be checked or other types of problems listed on the comment line.

"*NEED ADDITIONAL ADVANCE SIGNING:*" - Mark if signs are missing in the flagger sign series as required in the VWAPM.

ARE FLAGPERSONS:

"*CERTIFIED?*" - Check to see if flag persons have their certification card on their possession and mark the appropriate box.

"*POSITIONED CORRECTLY?*" - Check position of flag persons for compliance to WAPM requirements and mark the appropriate box.

"*HIGHLY VISIBLE?*" - Check the approaching visibility of the flagger and mark the appropriate box.

"*PROPERLY CLOTHED?*" - Flagpersons shall be dressed in accordance with the VWAPM. Mark the appropriate box.

"*FLAGGING CORRECTLY?*" - Observe the flag person for proper flagging procedures and mark the appropriate box.

***"COMMENTS:"* - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

H. PAVEMENT MARKING: See Section 6F-65 of the VWAPM

"*PERMANENT* or *CONSTRUCTION:*" - Mark the type of pavement marking being reviewed.

"***ADEQUATE* or *INADEQUATE:*"** - Used to describe the condition of the pavement marking: When "ADEQUATE" is checked, continue to the next section. If "INADEQUATE" is checked one of the conditions below will be checked or other types of problems listed on the comments line.

"*REMOVE:*" - Mark when inappropriate or conflicting pavement marking is found on the roadway.

"*REPAIR:*" - Mark when existing pavement marking needs to be remarked in spot locations.

"*NEED ADDITIONAL:*" - Mark when additional pavement marking is needed on the roadway.

"*UNNECESSARY (MARKINGS / NOT ERADICATED COMPLETELY):*" - Circle the statement that describes the condition: "MARKINGS" when the markings on the roadway are misguiding or confusing to motorists; "NOT ERADICATED COMPLETELY" when the existing markings are still visible and misleading to motorists.

***"COMMENTS:"* - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

I. PAVEMENT MARKERS: See Section 6F-67 of the VWAPM

"*PERMANENT* or *CONSTRUCTION:*" - Mark the type of pavement markers being reviewed.

"*ADEQUATE* or *INADEQUATE:*" - Used to describe the condition of the pavement markers. When "ADEQUATE" is checked, continue to the next section. If "INADEQUATE" is checked, one of the conditions below will be checked or other types of problems listed on the comments line.

"*REPLACE MISSING:*" - Mark when pavement markers are missing from the roadway as defined by the VWAPM.

"*REMOVE:*" - Mark when either existing or temporary markers are misleading to traffic.

"*NEED ADDITIONAL:*" - Mark when the markers are missing from the roadway and are needed for more positive guidance with the pavement markings.

***"COMMENTS:"* - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

J. TRUCK MOUNTED ATTENUATOR: See Section 6F-77 of the VWAPM

"*PROPERLY POSITIONED?*" - Mark the appropriate box according to the requirements of the VWAPM.

"*PROPERLY MAINTAINED / DELINEATED?*" - Circle the statements that describes the condition: "PROPERLY MAINTAINED" describing the condition of the attenuator, not in need of repair; "DELINEATED" describing required marking and activated warning lights on vehicle.

***"COMMENTS:"* - This space shall be used to address any of the items in this section that are deficient and need correcting. As much detail information, such as location of the problem and action needed for correction, shall be documented here.**

K. MISCELLANEOUS:

"*ADEQUATE BUFFER SPACE?*" - Is this area installed according to VWAPM requirements: See Buffer length Table on page 6H-5

"*IS THE WORK AREA PROTECTED?*" - Is the work area protected by cones, barrels or positive barrier?

"*MATERIALS PROPERLY STORED?*" - Are materials stored in the work zone protected or out of the clear zone (See Appendix A for clear zone values)?

"*EQUIPMENT PROPERLY STORED?*" - Is equipment in or stored at the work zone behind a positive barrier or outside the clear zone (See Appendix A for clear zone values)?

"*ARE LANE CLOSURES IN ACCORD WITH ALLOWED HOURS?*" - Are time restrictions being followed?

ACCIDENTS: Are there indications of accidents in the work zone?

"*EVIDENCE OF AN ACCIDENT?*" - Are there skid marks, vehicle debris, or damaged traffic control devices present?

"*DAMAGED TRAFFIC CONTROL DEVICES?*" - Are damaged traffic control devices present? Are they in need of repair?

"*SKID MARKS?*" - Are skid marks present which may indicate a problem with the work zone layout?

"*DEBRIS?*" - Are debris present in the work zone?

"*COMMENTS / RECOMMENDATION:*" - This area may be used to give additional information on a section listed above or to give a location of the problem. Positive comments should be given under this heading as well. "RECOMMENDATION" is for remarks concerning

suggestions to problems addressed in other sections above. Additional sheets may be attached to this report if necessary.

"*REVIEWED BY:*" - Signed and dated by the person conducting the review.

"*REVIEWED WITH:*" - Signed and dated by the person supervising the work zone.

"*COPY: CONTRACTOR, INSPECTOR, RESIDENT ENGINEER, OR OTHER:*" - Suggested distribution of this project review: one copy to person overseeing the work for the state, one copy retained by the reviewer, one copy to the contractor, and one copy forwarded to the resident engineer. However, the district should determine the final distribution.

NOTE: When a work zone temporary traffic control review has been performed and deficiencies have been found and documented, a follow-up review should be performed within a reasonable amount of time to ensure the items have been corrected. The follow-up review should also be documented and placed with the project files.

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APPENDIX C

GUIDELINES FOR USE OF VIRGINIA STATE POLICE IN CONSTRUCTION/MAINTENANCE WORK ZONES

The following Guidelines for use of Virginia State Police in construction and maintenance work zones have been developed by the Virginia State Police and VDOT to ensure the maximum effectiveness of law enforcement in work zone operations. These guidelines are not intended to be all-inclusive, as each work zone presents its own unique situations and ever-changing conditions. Situations will occur which dictate deviations from these guidelines as stated and/or are not covered by the guidelines. In those situations, the project inspector and the trooper should confer on the best way to address the traffic safety problems presented.

Guidelines for Use of Virginia State Police In Construction/Maintenance Work Zones

To ensure the maximum effectiveness of the use of the Virginia State Police in work zones, the following guidelines have been developed for standard lane closure operations:

1. Prior to placing a request for state police on a particular project or work zone operation, the project inspector (or VDOT maintenance personnel) and contractor's superintendent should meet and discuss when and where the trooper will give the best benefit in reducing excessive speeds through the work zone. The following suggestions are offered:

   A. If traffic is expected to be free flowing through the work zone with little to no back-ups, the trooper should be located in the lane closure 500 - 1000 feet in advance of the first work crew. If a Truck Mounted Attenuator (TMA) is used within the lane closure, the trooper's vehicle should not block the TMA cushion.

   B. If traffic is backing-up within the transition area or within the advance warning area, the trooper should position his vehicle on the shoulder in advance of the back-up to slowed/stopped traffic, which should increase driver attention and prevent potential crashes. This may require repositioning of the vehicle from time to time to stay in advance of the back up.

   C. Mobile lane closure operations on multilane roadways are one of the most dangerous operations performed. If possible, the use of a trooper, placed on the shoulder 500 to 800 feet in advance of the vehicles performing the lane closure operations, is recommended to increase motorists' awareness and slow approaching traffic. The trooper's vehicle should not block an open lane unless protected by a TMA.

2. After determining when and where the state police are to be used, the project inspector (or VDOT maintenance personnel) should contact the state police and arrange for a meeting on the project <u>to discuss that day's operations and placement of the trooper</u>. VDOT contact information, including name and cell phone or pager number, shall be given to the trooper so that communication may be maintained throughout the shift for that operation. During the course of the day/night, the project inspector, VDOT maintenance supervisor, or his designate shall relay any changes to the placement of the trooper.

3. VDOT personnel should request that the trooper's vehicle be a marked vehicle and equipped with a radar unit.

4. Once on the project at the designated location, the state police vehicle should operate with its lights flashing. If equipped with radar, the trooper should operate the radar unit, periodically stopping vehicles exceeding the safe speed established for that work zone. To retain credibility with motorists, the trooper may travel out of the work zone to stop speeding motorists. Otherwise, motorists will believe that the trooper is there for "show" only and not for "enforcement". Due to the activities occurring in the work zone at any given time, the trooper should stop motorists outside of the closed lane or work zone area, then return when possible.

5. Upon completion of the state trooper's shift, the trooper and the project inspector, maintenance supervisor or his designate should meet to review that shifts operation and to agree upon the time worked and sign the appropriate log. If the trooper must leave the site due to an emergency or other related situation, the VDOT contact person shall be notified.

6. These guidelines are not intended to be all-inclusive. Situations will occur which dictate deviations from the guidelines as stated and/or are not covered by the guidelines. In those situations, the project inspector and the trooper should confer on the best way to address the traffic safety problems presented.

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APPENDIX D

CHANGEABLE MESSAGE SIGN (CMS) USAGE PROCEDURE

The following document has been developed to give users of changeable message signs (CMS) clear instructions on acceptable as well as unacceptable uses of these valuable communication tools, as well as create uniformity in CMS usage across the state. This document also applies to Portable Changeable Message Signs (PCMS) often used in work zone applications. This document has been developed and adopted by VDOT, and will be updated and revised as needed by the VDOT State Mobility Management Engineer.

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CHANGEABLE MESSAGE SIGN (CMS) USAGE PROCEDURE

1.0 Introduction

Changeable Message Signs (CMS) are an important resource for the Virginia Department of Transportation (VDOT). These signs are a direct information link between VDOT and motorists. Ultimately, the success of CMS depends upon the motorists' belief in information being displayed. Improper sign usage or incorrect information will erode motorist confidence and reduce overall sign effectiveness. Therefore, VDOT has developed this procedure for the use of CMS on VDOT maintained roadways within the Commonwealth of Virginia.

Changeable Message Signs (CMS), Dynamic Message Signs (DMS), and Variable Message Signs (VMS) offer very subtle differences. In practice, these terms have become interchangeable. For the purpose of this document, the term CMS is used, and defined as a programmable traffic control device that can usually display any combination of characters to present messages to motorists.

Numerous CMS technologies are currently utilized throughout Virginia. This policy is intended to be technology independent. No matter the sign technology, this procedure shall be in effect and applicable to both permanently mounted CMS as well as portable or trailer-mounted CMS located or operated on VDOT maintained roadways.

This document is intended to create uniformity in CMS usage across Virginia, yet provide flexibility for local needs. For some areas of the state, this procedure may provide ample direction on the use of CMS. Other areas may feel a need to better develop CMS guidelines (i.e. acceptable wording, CMS response times, display characteristics, etc.) VDOT District offices are encouraged to develop local or regional CMS guidelines to address such needs. All locally developed guidelines, however, must adhere to this statewide procedure.

CMS messages must quickly relay concise and meaningful information to motorists. Basic CMS message content should include the "what" (situation the motorist will encounter), "where" it is located, and an "action" the motorist should take. Situations will arise when a CMS could be used for two or more situations at the same time. The CMS operator should display the higher priority message based on proximity of the sign to the event, volume of traffic potentially affected, and reliability of the information.

This document has been developed to give CMS users clear instructions on acceptable and unacceptable uses. Numerous sources were used to develop this policy including:

- The *Manual on Uniform Traffic Control Devices* (MUTCD)
- The *Virginia Work Area Protection Manual*
- Several FHWA reports and directives
- VDOT user comments
- Studies conducted by noted researcher; Dr. Conrad L. Dudek, Texas A&M University.

The office of the VDOT State Mobility Management Engineer shall make any updates, exceptions, or revisions to this procedure.

2.0 Responsibility for Operation of CMS

VDOT personnel shall oversee the operation of CMS on roadways under its jurisdiction. Within VDOT Districts where a 24-hour/7-day Smart Traffic Center (STC) is present, the STC shall have full operational control of all permanently mounted CMS within that District; except special facilities, such as tunnels, weigh stations, where the special facility operations center may control CMS specifically related to that facility. In Districts without a full-time STC, the VDOT District Administrator shall assign responsibility. Regardless of who is assigned this operational responsibility, 24-hour/7-day control shall be maintained, and authorized users must be trained to ensure that proper messages are displayed. VDOT will work with law enforcement personnel to post messages for given traffic and/or highway situations.

Any use of CMS within VDOT right of way shall adhere to this procedure. VDOT shall be notified prior to any such use.

3.0 Inoperable Signs

VDOT staff will make every effort to keep CMS operational at all times. If any permanent CMS becomes inoperable, a portable CMS may be used until the permanent sign becomes operational.

If a permanent CMS is expected to remain inoperable for longer than fifteen (15) days, a static sign may be installed notifying motorists of the inoperable condition. This provision also relates to new CMS that are physically installed but not yet under VDOT control.

4.0 Acceptable CMS Usage

Credibility is the foundation upon which any successful CMS program is built. Motorists must be able to easily recognize, read, and comprehend CMS messages. Messages must be timely, reliable, accurate, and relevant to motorists at that time and location.

VDOT has established acceptable CMS uses to provide for statewide consistency in order to improve motorist expectations on the accuracy of the information about traffic conditions or travel efficiency throughout the Commonwealth. The remainder of this section details acceptable uses of CMS in Virginia.

4.1. Blank Signs

A blank sign shall be viewed as a valid message, “telling” motorists that there is no unusual travel information to relay. Conditioning motorists to this use of signs provides the greatest potential for driver compliance. Unless a CMS is displaying a message in accordance with this Section, the sign shall remain blank.

4.2 Traffic Incident Situations

One of the most important uses of CMS is alerting motorists to lane closures due to traffic incidents. Within this policy, a traffic incident will be defined as any unexpected situation that reduces roadway capacity.

Any traffic incident is acceptable for a message. However, no message should be displayed if the sign is such a distance away from the affected area that full capacity is restored before motorists reading the sign would be impacted. Conversely, if the incident

is confined to an adjoining route and motorists reading the sign would be affected, a message should be displayed.

Depending on the location, severity, and duration of the incident, messages may be displayed several hundred miles in advance of the scene. Should a situation arise whereby multiple incidents are downstream from a sign, CMS shall alert motorists to the closest incident unless conditions warrant otherwise.

4.3 Construction and Maintenance Activities

CMS have a wide variety of uses for temporary work zone applications. Example situations include, but are not limited to, the following:

- Lane and/or shoulder closures
- Lane width restriction
- Roadway or ramp closures
- Areas of significant queuing or delays
- Changes in roadway alignment or surface conditions
- Changes in traffic patterns
- Detours/alternate routes
- Advance notice of new traffic control devices

The current edition of the *Virginia Work Area Protection Manual* shall be referenced for proper use of the CMS in work zone applications. CMS shall not be a substitute for devices required by the *Virginia Work Area Protection Manual*.

4.4 Display of Future Roadwork

Traffic-related information that provides advance notice of future roadwork requiring lane closures may be displayed, but shall be replaced by current information whenever applicable. Advance notification should not be given more than six (6) days prior to the roadwork. Days of the week (e.g., *TUES-FRI*) shall be displayed. Calendar dates (e.g., *SEPT 25-SEPT 28*) are discouraged, but may be used in the message. Advance notice messages have lower priority to messages that impact the safety and operation of the roadway.

4.5 Adverse Weather, Environmental, and Roadway Conditions

CMS may be used to display adverse weather, environmental, or roadway conditions. Information must be confirmed either from personnel on-scene, roadway weather data, or the National Weather Service. In general, weather information should be <u>location specific</u> and not readily apparent to motorists. Proper messaging may include fog, flooding, major snowstorms, icy roadway, high cross winds, and severe weather warnings. CMS may also be used to advise of specific recommendations due to the weather or roadway conditions (e.g., tire chains or snow tires).

4.6 Other Sources of Traveler Information

Motorists only have a brief period of time to read and understand CMS messages. If extensive travel information must be conveyed, CMS should refer motorists to Highway

Advisory Radio (HAR), 511 Virginia and/or local media. No CMS messages shall be allowed to solely promote a traveler information service.

4.7 Special Events

CMS may be used to help alleviate major traffic problems generated by special events (e.g., sporting events, festivals, auto races, graduations, etc.) Because VDOT prohibits the display of advertising messages on any CMS, messages related to special events shall only use generic terms describing the event and be approved by VDOT.

CMS usage of this type must be coordinated with the event organizers. Furthermore, CMS operators must remain available for contact with on-scene personnel to ensure message accuracy. This is especially important when CMS are used in conjunction with alternate route/parking strategies.

CMS may be used to inform drivers of other transportation opportunities for visitors to the special event (i.e. shuttle parking).

CMS messages may also advise through-drivers of adverse traffic conditions created as a result of special event traffic or conditions, or to reroute.

4.8 Display of Future Special Events That Adversely Affect Travel

CMS may be used to relay traffic-related information in advance of future special events that will adversely affect travel (e.g., concerts, auto races, festivals, etc.) or that require closing streets or highways (e.g., parades, bike races, marathons, etc.) Advance notification should not be given more than six (6) days prior to the event. Days of the week (e.g., *TUES-FRI*) shall be displayed. Calendar dates (e.g., *SEPT 25-SEPT 28*) are discouraged, but may be used in the message. Advance notice messages have lower priority to messages that impact the safety and operations of the roadway.

4.9 Display of Travel Times

An evolving use of CMS is to display the travel time from the CMS to a given point downstream. Regular users of that section of roadway will then be able to judge the level of delay. Travel time information may be displayed if times can be measured or calculated directly using data from freeway sensor equipment, cell phones, toll tags, or other technology. To ensure accuracy, travel time information should be displayed automatically as manual entry may be impractical and error-prone.

4.10 Displaying Messages for Other States or Transportation Agencies

CMS may be used to display traffic-related messages for other transportation agencies. It is acceptable to display messages about traffic conditions in neighboring states if the information is credible. The priority for displaying messages shall remain in the control of VDOT. All efforts must be made to keep the information current and accurate.

4.11 Emergency Messages

CMS may be used in times of emergency to convey critical information. Messages related to homeland security and AMBER Alerts are two such emergency situations. Regardless of the emergency, sound CMS policies and practices must be followed. CMS

advisories shall provide sufficient yet concise information while ensuring safe and efficient traffic flow. Messages must be transportation related or convey specific emergency conditions that require motorist action. All emergency messages must be coordinated through VDOT's Transportation Emergency Operations Center (TEOC), who will help determine the geographic area over which the message should be displayed, and the period of time to display the message.

Priority for displaying messages shall remain in VDOT's control. Specific wording shall also remain in VDOT's control, although close coordination with emergency personnel is strongly encouraged. If extensive emergency information must be conveyed, CMS should refer motorists to 511 Virginia, HAR or local media.

The "AMBER Alert" plan is a valuable tool used to help law enforcement agencies protect our children. The Virginia "AMBER Alert" plan has been developed to include VDOT assistance in order to provide valuable information to motorists. Activation of Virginia's "AMBER Alert" Plan must be initiated through the Virginia State Police (VSP). VSP will contact VDOT's TEOC, who will coordinate CMS usage for the event. Only CMS messages that follow this chain of authority will be allowed.

4.12 Ozone Advisory Messages

Ozone forecasts are issued on hot summer days for most of Virginia. From May through September, these forecasts are available Monday through Friday afternoon for the <u>following</u> day. On "Code Red" days and the prior afternoon, VDOT will support this effort in declared areas, by displaying messages that will advise motorists of the air quality condition, and promote strategies to reduce vehicle emissions. Ozone advisory messages have lower priority to messages that impact the safety and operation of the roadway.

4.13 Safety Campaigns

CMS messages related to traffic/driver safety campaigns may only be displayed as supplements to specific national or statewide traffic/driver safety media campaigns on the same topic. Message wording must clearly relate to the applicable campaign. The campaign should be less than two (2) weeks. The total duration of any such safety message should not exceed two hours per day at any CMS location, and should not be displayed during peak travel periods. Safety campaign messages have lower priority to messages that impact the safety and operations of the roadway.

Prior to being displayed on a CMS, a traffic/driver safety campaign must be approved by the VDOT State Mobility Management Engineer. The VDOT Mobility Management Division will determine appropriate message wording that will be consistent on all CMS. The VDOT District Traffic Engineer or District Smart Traffic Center Manager shall determine message duration and applicable signs.

4.14 Test Messages

It is sometimes necessary to display messages on a CMS to assure correct operations or "burn-in" a new sign. Acceptable test messages must state "*TEST*" within at least one frame of the posted message.

4.15 VDOT Public Hearings

It is permissible to use portable CMS in advance of a public hearing related to a VDOT project. The portable CMS should be placed in the general vicinity of the project but not more than 2 miles from the project site.

5.0 Unacceptable CMS Usage

Any CMS usage not identified under Section 4.0 of this policy is prohibited. Any questionable messages or unusual circumstances should be directed to the appropriate VDOT District Traffic Engineer or District Smart Traffic Center Manager. Further policy interpretation will be directed to the VDOT State Mobility Management Engineer. Although not all-inclusive, several specific improper uses of CMS in Virginia are listed below.

5.1 Advertising

Messages advertising any product, service, event or political party are prohibited. Special event messages shall be designed such that advertising is not embedded in the message.

5.2 Public Service Announcements

Messages designed to relay a public service announcement (catch phrases, greetings, jingles, general safety statements, non-VDOT public meetings, etc.) shall not be permitted on CMS. Safety campaign messages, as described in Section 4.13 and VDOT public hearings as described in Section 4.15, may be acceptable.

5.3 Routine Congestion Messages

During daily peak traffic periods, messages shall be used to advise motorists of unusual conditions (e.g., accidents, lane blockages, 10 minute delay, etc.) Generic descriptors (e.g., *CONGESTION AHEAD*) shall not be used to advise motorists of normal daily peak period traffic congestion. Specific information regarding the level of congestion is acceptable (e.g. *SLOW TRAFFIC, NEXT 2 MILES*).

5.4 Contact Information

No phone numbers (other than those permitted under Section 4.6), web sites, or mailing addresses shall be displayed on CMS. This is a distraction to motorists.

Any reference to 911 and #77 is prohibited unless specifically requested by the law enforcement or dispatching agency that would answer the resulting calls.

5.5 Date/Time

Messages giving only the date and/or time are not allowed on CMS. If no message is to be displayed, the sign shall remain blank.

5.6 Static signing

A CMS shall not be used to replace a static sign.

Appendix D Table 1, Acceptable Abbreviations

Word Message	Standard Abbreviation	Word Message	Standard Abbreviation
Afternoon / Evening	PM	Liquid Propane Gas	LP-GAS
Alternate	ALT	Maintenance	MAINT
Avenue	AVE	Meter(s)	M
Bicycle	BIKE	Metric Ton	t
Boulevard	BLVD	Mile(s)	MI
Cannot	CANT	Miles Per Hour	MPH or M.P.H.
CB Radio	CB	Minute(s)	MIN
Center	CNTR	Monday	MON
Civil Defense	CD	Morning/Late Night	AM
Compressed Natural Gas	CNG		Normal NORM
		North	N
Crossing (other than highway-rail)	XING	Northbound	NB
		Parking	PKING
Diesel Fuel	D		Parkway PKWY
Do Not	DON'T	Pedestrian	PED
Drive	DR	Pounds	LBS
East	E	Right	RHT
Eastbound	EB	Road	RD
Electric Vehicle	EV	Saturday	SAT
Emergency	EMER	Service	SERV
Entrance, Enter	Entrance, Enter	Shoulder	SHLDR
Expressway	EXPWY	Slippery	SLIP
FM Radio	FM	South	S
Freeway	FRWY, FWY	Speed	SPD
Friday	FRI	Street	ST
Hazardous Cargo	HC	Sunday	SUN
Hazardous Material	HAZMAT	Telephone	PHONE
High Occupancy Vehicle	HOV	Temporary	TEMP
		Thursday	THURS
Highway	HWY	Tires With Lugs	LUGS
Highway-Rail Grade	RXR	Tons of Weight	T
Crossing (other than highway rail)	XING	Traffic	TRAF
		Travelers	TRAVLRS
Hospital	H	Tuesday	UES
Hour(s)	HR	Two-Way Intersection	-2WAY
Information	INFO	Two-Wheeled Vehicles	CYCLES
It Is	ITS	US Numbered Route	US
Junction / Intersection	JCT	Vehicles	VEH
Kilogram	kg	Warning	WARN
Kilometer(s)	KM	Wednesday	WED
Kilometers Per Hour	km/h	West	W
Lane	LN	Westbound	WB
Left	LFT	Will Not	WONT

Appendix D Table 2, Abbreviations That Are Acceptable Only with a Prompt Word

Word	Abbreviation	Prompt Word
Access	ACCS	Road
Ahead	AHD	Fog*
Blocked	BLKD	Lane*
Bridge	BRDG	[Name]*
Chemical	CHEM	Spill
Condition	COND	Traffic*
Congested	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic*
Eastbound	E-BND	Traffic
Exit	EX, EXT	Next*
Express	EXP	Lane
Frontage	FRNTG	Road
Hazardous	HAZ	Driving
Interstate	I	[Number]
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Northbound	N- BND	Traffic
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Quality	QLTY	Air*
Roadwork	RDWK	Ahead [Distance]
Route	RT	Best*
Southbound	S- BND	Traffic
Township	TWNSHP	Limits
Turnpike	TRNPK	[Name]*
Upper	UPR	Level
Vehicle	VEH	Stalled*
Westbound	W- BND	Traffic

* These prompt words should precede the abbreviation

Appendix D Table 3, Unacceptable Abbreviations

Abbreviation	Intended Word	Common Misinterpretations
ACC	Accident	Access Road
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	LANE (Merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong