2014
WATCH
EDITION

Work Area Traffic Control Handbook

CHARLOTTE.
TRANSPORTATION

Useful Phone Numbers

Charlotte Department of Transportation
(704) 336-2352 Emergency (24 hrs)
(704) 336-4119 General Information
(704) 336-3200 Street Maintenance Division
(704) 336-2315 Transportation Operations Division

Engineering and Property Management Department
(704) 336-2291 General Information

Land Use & Environmental Services Agency
(704) 336-2831 General Information

Charlotte-Mecklenburg Police Department
911 Emergency
(704) 336-3237 Dispatch
(704) 336-3229 Off-Duty Officer Program

Charlotte-Mecklenburg Utility Department (CMUD)
(704) 378-6632 Dispatch
(704) 336-2221 General Information

North Carolina Department of Transportation
(704) 596-6900 District Office
(980) 722-8278 Emergency

Time Warner Cable
(704) 685-3160 24-hour Repair Service
(704) 377-9600 General Information

Duke Energy Company
(800) 777-8989, option 1; option2

Piedmont Natural Gas Company
(704) 587-6908 (7am-4pm): (800) 752-7504 (after hours)
(704) 525-5585 General Information

AT&T North Carolina
(877) 737-2478l Emergency
(704) 393-6100 General Information

Underground Utility Locates (24-hours)
(704) 336-2564 CMUD
811 NC811 Call Center

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Publisher's Note

The primary distribution media for the WATCH will be in Adobe PDF, with limited quantities of printed books. Accordingly, CDOT will maintain a website dedicated to the WATCH so that users can download the entire manual, or any of the components that they may need. The current WATCH home website is: http://charmeck.org/city/charlotte/Transportation/ROWUse/Pages/WATCH.aspx .

CDOT is committed to keep the WATCH current with any changes in standards, guidelines, and policies and will publish PDF updates as necessary. Those revised documents will be posted to this website page. Use the **Notify Me** feature on the page to be automatically notified of updates by e-mail.

Section 1 - Purpose of Handbook

This Work Area Traffic Control Handbook (WATCH) is a user-friendly, pocket-sized book that covers some policy, standards, design elements, guidelines for the planning of roadway construction/maintenance related work, and diagrams depicting common application for setting up of temporary traffic control zones. Temporary Traffic Control (TTC) setups and devices are used to protect construction workers and direct/assist motorists, bicyclists, and pedestrians in safely navigating any facility open to public travel.

The WATCH is to be used in performing construction or maintenance work within the City owned street rights-of-way. This handbook can also be used by City forces or City contractors to perform work on North Carolina Department of Transportation (NCDOT) owned highway rights-of-way.

The WATCH is in total compliance with Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) and the NCDOT Supplement to the MUTCD.

This document can be viewed on computers and most smartphones using the link shown in the Publisher's Note above.

Section 2 - General Responsibility

All persons, or agencies doing work in public streets, highways, or public rights-of-way, are responsible for obtaining all necessary permits, coordinating the work with all affected government agencies and utilities, and informing occupants of adjacent properties of access impacts due to the work.

Responsibility for the installation and maintenance of TTC shall rest with the Contractor, Utility Company, or Public Agency doing the work. All TTC setups or TTC devices shall conform to the requirements of the WATCH, the current edition of the MUTCD, the current edition of NCDOT Supplement to the MUTCD, the NCDOT Roadway Standard Drawings, and the current edition of the NCDOT Standard Specifications for Roads and Structures.

The City Engineer, the Director of the Charlotte Department of Transportation, and/or their representatives, are authorized to stop any construction or maintenance activity in the public rights-of-way that has not been approved for construction or is not properly configured with TTC devices in accordance with the WATCH. Work will be allowed to resume when compliance is achieved.

Section 3 – Approval and Notification Requirements for Work in the Public Right-Of-Way

It is necessary for both public and private agencies to obtain approval from the Charlotte Department of Transportation (CDOT) before scheduling work that is impactful to the roadway structure or users. Once the approval is obtained, the contractor or agency planning to perform the work is required to provide CDOT with the appropriate notification prior to start of work. These requirements by CDOT are necessary to ensure proper construction sequencing, adequate phasing of the TTC plan, coordination of activities that take place in the right-of-way, and providing transit, emergency services, and the public sufficient time to adjust their travel plans.

The time required of review and approval by CDOT is dependent on the type of work, magnitude of impact to the roadway infrastructure, magnitude of impact on the traffic flow, number of utilities involved, and the complexity of the traffic control plans. For example, some maintenance and simple construction work may receive approval within hours while major construction work may take many days or weeks to work out or the details to receive CDOT's approval. The agency intending to do major work in the right of way is encouraged to make contact with CDOT as early as possible to start the review/ approval process. The approval process may take few reviews not only by CDOT but also by the impacted or involved utilities.

After receipt of CDOT's approval, the contractor, utility company, or public agency preparing to perform major/minor construction or routine maintenance in the public right-of-way MUST notify CDOT, using the appropriate advanced notification periods, prior to start of work if any of the following impacts on the roadway facility are to occur:

- Any cuts in the pavements, sidewalk or driveway.
- Closure of one or more travel lanes on a thoroughfare l.
- Closing more than one lane in one direction on a thoroughfare any time of the day
- Closing all lanes in one direction on a thoroughfare
- Closing more than one lane of a one-way street
- Closing sidewalks on both sides of the street
- Anytime work is performed in the Central Business District (area bounded by I-77 and I-277)

Mobile operations (see Section 17) are generally exempt from the requirement to notify CDOT provided that the work does not involve cutting the street or sidewalk and the contractor coordinates with other users.

The advanced notification period required prior to the beginning of work for lane closure through the peak hour periods is five (5) working days. The advanced notification period for a complete road closure or a complete one direction only closure is ten (10) working days. These notification periods do not include the plan approval time when plan approval is necessary.

For major construction projects and emergency road closures, contact CDOT's Implementation Section at 704-336-7086. For all other activities, projects and routine maintenance work, contact the Right-of-Way Management Section at 704-432-1562.

In emergency situations, weekends, holidays, or after normal business hours, the Police Department should be contacted (911) while the contractor is securing the site. The Police Department will be responsible for notifying the appropriate CDOT staff. **All required agreements and permits from various City agencies must be in place before commencing work.**

Section 4 – Certified Excavation License and Degradation Fee Payment Required

Any work that requires cutting of the street pavement, curbing, or sidewalk must be performed by, or under the supervision of, a person holding a valid Excavation Certification card issued by CDOT's Street Maintenance Division (SMD). Call SMD (704-336-5133) for information , cost, and scheduling of the next certification classes.

Payment of a Pavement Degradation Fee will be required when cutting the street pavement. This fee will be determined by SMD's Inspectors

and is added into the Resurfacing Program's funds. Utility companies can pay their accumulated degradation fees annually, but developers and other non-utility entities must pay the fee before a permit will be issued.

Section 5 – Notifications for complete Roadway Closure

When a road closure has been approved (see Section 3), or due to an emergency, the agency requesting the closure is required to notify the following agencies at least **1 week** prior to the expected closure:

(704) 336-3237 Police Department
(704) 336-2441 Fire Dispatch
(704) 943-6200 Medic Dispatch
(980) 343-5080 School Transportation
(704) 336-4042 Charlotte Transit
(704) 336-4119 CDOT Public Service (Press Releases)

Each of the above agencies shall also be contacted upon the reopening of the roadway.

Section 6 - Peak Flow Hours

The peak flows of traffic in Charlotte, **outside the Central Business District (CBD)**, generally occur between the hours of **7 am - 9 am and 4:30 pm - 6:30 pm**. During these hours, construction or maintenance work, which involves closure of a lane of traffic, will not be allowed on thoroughfare streets except for emergency situations or with approval from CDOT. As a general rule, all multi-lane roads or two-lane roads which are separated by a marked double yellow centerline should be considered to be thoroughfare streets.

The peak flows of traffic in the **CBD** generally occur between the hours of **7 am - 9 am and 4 pm - 6 pm**. During these hours, construction or maintenance work which involves closure of a lane of traffic or a sidewalk will not be allowed except for emergency situations or with prior approval from CDOT. The CBD is that area of the city which is bounded by I-77 and I-277.

Section 7- Fundamental Principles of Temporary Traffic Control Project Planning

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, 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.

When the normal function of the roadway is to be suspended due to

any type of construction or maintenance, TTC planning by the entity doing the work and the subsequent placement of TTC devices must provide for a reasonably safe and efficient movement of road users through or around TTC zones while reasonably protecting workers. All work shall be planned well in advance to keep traffic obstructions, public inconvenience, and lost working time by road users to a minimum.

Special plan preparation and coordination with transit, other roadway agencies, law enforcement, and other emergency units, utilities, schools, and railroad companies are required to reduce unexpected situations. During the design phase of a project, the agency responsible for the construction activity may be required to coordinate the development of a TTC plan with CDOT as well as obtain approval from CDOT prior to advertising for bids and/or scheduling the construction activity (see Section 3). The TTC plans and devices should follow the principles set forth in the WATCH and be in accordance with Part 6 of the MUTCD.

A TTC plan, in detail appropriate to the complexity of the work project, shall be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by a person trained and/or certified in proper TTC practices. Road user movement should be inhibited as little as practical, based on the following considerations:

- Early coordination with, and approval from CDOT when required must occur before the beginning of work (see Section 3)
- Frequent and abrupt changes, such as lane narrowing, etc. should be avoided.
- Bicyclists and pedestrians must be provided safe passage.
- Roadway work, as much as possible, should be scheduled during off-peak hours.

The following principles must be applied to guide road users approaching TTC zones:

- Adequate warning, delineation, and channelization in advance of, and through, the TTC zone. Providing information in usable formats to visually disabled pedestrians must be considered.
- TTC devices inconsistent with intended travel paths must be removed or covered. However, in intermediate-term stationary, short-term, and mobile operations, permanent devices that are inconsistent with intended travel paths can remain if additional devices that highlight the appropriate path are used.
- Individuals who are knowledgeable (for example, trained and/or certified) in the principles of proper TTC should be assigned responsibility for safety in TTC zones. The most important duty of

these individuals is to check that all TTC devices used for the project are reasonably consistent with the TTC plan and are effective in providing safe conditions for road users and workers.

- As the work progresses, temporary traffic controls must be modified appropriately.
- Construction equipment, materials, and debris should be stored in a manner to reduce the probability of being impacted by run-off-the-road vehicles (see Section 11-D).
- Each person whose actions affect TTC zone safety should receive TTC training appropriate to their job decisions. Only those TTC trained individuals should supervise the selection, placement, and maintenance of TTC devices used in TTC zones.
- All TTC devices shall be removed as soon as practical when they are no longer needed.

Section 8 - Pedestrian Considerations

When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, pedestrians must be provided with a safe and convenient temporary path that shall include accessibility and detectable features consistent with the features present in the existing pedestrian facility. Where pedestrian routes are closed, alternate pedestrian routes shall be provided. The needs and control of pedestrians (including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, 28CFR 35.130) through a TTC zone shall be an essential part of roadway construction, utility work, and maintenance operations.

The following items shall also be considered when planning for pedestrians in TTC zones:

- Pedestrians must not be led into conflicts with work site vehicles, equipment, and operations.
- Pedestrians must not be led into conflicts with vehicles moving through or around the work site.
- Pedestrian routes shall not be severed and/or moved for non-construction activities such as parking for vehicles and equipment.
- Pedestrian movements shall be separated from both work site activity and vehicular traffic. If a temporary traffic barrier is used to shield pedestrians, it shall be designed in accordance with Chapter 9 of the AASHTO “Roadside Design Guide”. The use of NCDOT approved water-filled barrier in lieu of concrete barrier provides for more practicality. Unless it is an emergency situation, any use of temporary barrier shall be approved by an engineer and permission obtained from the City.
- Pedestrians must be directed with signing at the intersection in

advance of a sidewalk closure to cross to the opposite side of the roadway when a reasonably safe alternate route that does not involve crossing the roadway can not be provided.

- There must not be any abrupt changes in grade or terrain.
- TTC devices such as, Jersey or water-filled barrier, and wooden or chain-link fencing with a continuous detectable edging should be used. Blocked path or alternate crossing information should be communicated to pedestrians with visual disabilities by providing devices such as audible information devices. It shall be assumed that visually disabled pedestrians use the existing facility, and accommodations shall be made accordingly.
- TTC devices used to delineate a TTC zone for pedestrian walkways shall be crashworthy.
- Movement by work vehicles and equipment across designated pedestrian paths should be minimized and, when necessary, must be controlled by flaggers.
- Staging or stopping work vehicles or equipment close to pedestrian paths must be done in a way that does not encourage movement of workers, equipment, and materials across the pedestrian path. Access across pedestrian walkways often creates unacceptable changes in grade, and rough or muddy terrain.
- A canopied walkway may be required to protect pedestrians from falling debris. Covered walkways shall be constructed in accordance with Chapter 11 and 24 of the North Carolina State Building Code.
- Access to temporary transit stops must be provided when practical; otherwise, the Charlotte Area Transit System must be contacted to relocate the bus stop.
- A smooth, continuous hard surface shall be provided throughout the entire length of the temporary pedestrian facility.
- The width of the existing pedestrian facility should be provided for the temporary facility, if practical. When it is not possible to maintain a minimum width of 60 inches throughout the entire length of the pedestrian pathway, a 60” x 60” passing space should be provided at least every 200 ft.
- Signs and other devices mounted lower than 7 ft. above the temporary pedestrian pathway shall not project more than 4 inches into the pedestrian path.
- Where pedestrian access is to be maintained across an excavation, a bridge designed to support a load of not less than 150 lbs/square foot shall be constructed. Suitable ramps shall be provided at each end and fences and handrails shall be provided along each side. (See section 2401.4 of the North Carolina State Building Code).

Section 9 - Worker Safety Considerations

Of equal importance to the safety of the public traveling through the work zone is the safety of workers. The constantly changing and unexpected conditions, which are often experienced in a work zone, tend to confuse drivers thus creating a high level of vulnerability for workers on or near the roadway.

Following the fundamental principles of this handbook and the other referenced materials will usually provide the degree of control and traffic operation that will bring about safe conditions for the worker. Of particular importance is maintaining work areas where traffic flow is inhibited as little as possible, providing standard and clear traffic devices that get the driver's attention and provide positive direction.

Below are key elements of traffic control that should be considered in any procedure for assuring worker safety:

- TRAINING - All workers should be trained in how to work next to vehicular traffic in a way that minimizes their vulnerability. In addition, personnel with specific traffic control responsibilities shall be trained in TTC techniques, device usage, and placement.
- WORKER CLOTHING - Workers exposed to traffic or construction equipment shall be attired in bright, highly visible safety vests, meeting the requirements of ISEA or equivalent revisions.
- BARRIERS – Temporary barriers shall be placed along the workspace depending on such factors as lateral clearance of workers from adjacent traffic, speed of traffic, duration of operations, time of day and volume of traffic.
- ACTIVITY AREA- Minimizing backing-up maneuvers of construction vehicles should be considered to minimize exposure to risk.
- LIGHTING - For nighttime work, lighting the area and approaches may allow the driver better comprehension of the requirements being imposed. Care must be taken to ensure that the lighting does not cause blinding.
- SPECIAL DEVICES - Judicious use of special warning and control devices may be helpful for certain difficult work area situations. These include changeable message signs, hazard identification beacons, flags, and warning lights. Misuse and overuse of special devices/ techniques can greatly lessen their effectiveness.
- PUBLIC INFORMATION - Improved driver performance may be realized through a well-prepared and complete public relations effort that covers the nature of the work, the time and duration of its execution, and its anticipated effects upon traffic and possible alternate routes and modes of travel. Such programs have been found to result in a significant drop in traffic, which reduces the

possible number of conflicts.

- ROAD CLOSURE - If acceptable alternate routes are available, the road may be closed temporarily during times of greatest worker hazard, which, in addition to offering maximum worker safety, may facilitate quicker project completion and thus further reduce worker vulnerability. Road closures will only be allowed with prior approval from CDOT or in emergency situations (see Sections 3, 5 and 6).

Section 10 - Transit Considerations

Provisions for effective continuity of transit service needs to be incorporated into the TTC planning process. Oftentimes, public transit buses cannot efficiently be detoured in the same manner as other vehicles (particularly for short-term maintenance projects). On transit routes, the TTC plan shall provide for features such as temporary bus stops, pullouts and waiting areas for transit patrons.

Transit operations are particularly affected by lane and road closures in the Central Business District (CBD). Additional work time restrictions may be included in the right-of-way use permit for work zones on the Tryon Street Transit Mall and in the vicinity of the Charlotte Transportation Center.

Section 11 - Miscellaneous Considerations

A. DROP-OFFS AND LOW SHOULDERS

At the end of each work day the contractor shall backfill up to the edge and elevation of the existing pavement, areas within 6 feet of an open travel lane that have a drop-off of more than 3 inches (see Figure 1). The contractor shall backfill, in a similar manner, any areas within 6-10 feet of an open travel lane that have a drop-off of more than 6 inches. Traffic shall be separated from any drop-offs of more than 1 foot either by a shoulder 10 or more feet wide or by an approved barrier. Slopes steeper than 2:1 are considered drop-offs. The backfill material shall be

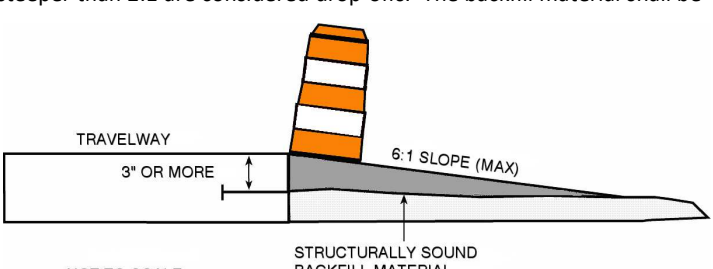


FIGURE 1
BACKFILL DETAIL

compacted and suit- able to support an errant vehicle. A "SOFT SHOULDER" (W8-4) or "LOW SHOULDER" (W8-9) sign shall be placed in advance of any such area.

B. UNEVEN AND ROUGH PAVEMENT

The contractor should maintain a smooth transition from existing pavement to the proposed paving operation. If a change in pavement elevation across an open travel lane exceeds 1 inch, a "BUMP" (W8-1) sign shall be placed at the point of the change in elevation. A change in pavement elevation across an open travel shall not be allowed to exceed 2 inches.

The difference in pavement elevation between two adjacent open travel lanes shall not be greater than 1 inch. Where such a difference in elevation exists, an "UNEVEN LANES" (W8-11) sign shall be placed in advance of the condition. A change in pavement elevation between two adjacent open travel lanes shall not be allowed to exceed 1.5 inches. A "ROUGH ROAD" (W8-8) sign shall be placed in advance of any milled areas of an open travel lane.

C. INGRESS AND EGRESS

Reasonable ingress and egress shall be maintained to all businesses and dwellings affected by the work activity. Access to driveways shall not be blocked unless reasonable alternative access is available or unless permission to block the driveway is granted by the affected property owner and/or tenant. Special attention shall be paid to maintaining easy access to fire hydrants.

D. STORAGE OF EQUIPMENT AND MATERIALS

During periods of construction inactivity, all construction equipment and materials may be stored in the right-of-way or temporary project easement, but must be placed safely 10 or more feet away from any open travel lane. It is recommended that all construction equipment and materials be stored on private property, which is posted against trespassing. It is the responsibility of the organization performing the work to obtain the permission to use a property for this purpose.

E. LANE WIDTHS

The minimum acceptable width of temporary travel lanes is 10 feet; however, a 12 feet wide lane is preferred and should be used wherever possible. A lane width of less than 10 feet will be accepted only where the existing permanent lanes are already less than 10 feet. In such cases, no additional narrowing of the lanes will be permitted.

F. WORKING BOTH SIDES OF ROADWAY

Work shall not be allowed on both sides of the road simultaneously within the same area except where the roadway is divided by a median. It will be acceptable to construct bore pits on each side of a roadway for boring utilities under the roadway.

G. OBSTRUCTION OF SERVICES

As far as is practicable, the TTC zone should not obstruct or interfere with services such as fire protection, mail pickup and delivery, transit stops, and garbage pickup,

Section 12 - Temporary Traffic Control Zone Components

The TTC zone includes the entire section of roadway between the first advance warning sign through the last traffic control device, where traffic returns to its normal path and conditions. Most TTC zones can be divided into four areas: the advance warning area, the transition area, the activity area, and the termination area. Figure 2 illustrates these four areas.

A. ADVANCE WARNING AREA

In the advance warning area, drivers are informed of what to expect. The advance warning may vary from a single sign or flashing lights on a vehicle to a series of signs in advance of the TTC zone transition area.

The number and spacing of advance warning devices is dependent on the type of activity in the work zone, the speed and volume of traffic and the visibility of the work zone to approaching traffic. Where construction is in or near a hill or horizontal curve, the advance warning area shall be extended so that there is adequate sight distance of the TTC zone.

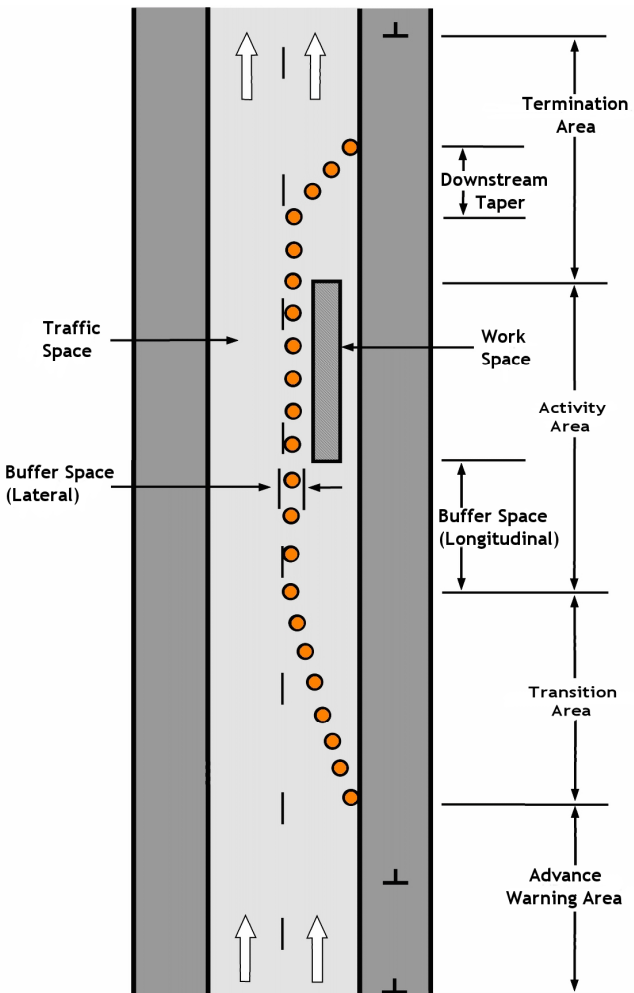
Advance warning is normally not needed when the activity is sufficiently removed from the driver's path such that it does not interfere with traffic flow.

B. TRANSITION AREA

When reduction of the driver's normal path is required, traffic must be channelized from the normal path to a new path. This redirection is intended to occur at the beginning of the transition area. In mobile operations, this transition area moves with the workspace. Transition areas usually involve strategic use of tapers, which are discussed in detail in Section 13. The length of the transition area is dependent on the speed of approaching traffic and the lateral distance which traffic is being diverted.

C. ACTIVITY AREA

The workspace is that portion of the roadway closed to traffic and set aside for workers, equipment, and materials. Long-term workspaces should be delineated by pavement markings and by channelizing devices or may be shielded by barriers to exclude vehicular, pedestrian, and bicycle traffic.



NOT TO SCALE

FIGURE 2
TEMPORARY TRAFFIC CONTROL ZONES

The buffer space separates the traffic area from the work activity and provides recovery space for an errant vehicle. Buffer spaces may also

be used to separate opposing traffic flows (Figure 3) or to separate pedestrian traffic areas from vehicular traffic areas. Neither work activity nor storage of equipment, vehicles, or materials shall occur in this space.

Except where space limitations prohibit it, a longitudinal buffer shall be placed in the initial portion of a closed lane in advance of the workspace, as shown in figure 2. Where construction is in or near a hill or horizontal curve, the standard buffer space should be extended so that there is adequate sight distance of the advance warning area and the transition area.

A lateral buffer space shall be used to separate the traffic space from the work space, as shown in figure 2, or a potentially hazardous area, such as an excavation or pavement drop-off. The width of the lateral buffer space should be determined by engineering judgment; however, a minimum lateral buffer space of 2 feet is required between the workspace and the nearest travel lane. Appropriate channelizing devices, such as cones or drums, may be placed inside the lateral buffer space.

D. TERMINATION AREA

The termination area is used to return traffic to the normal traffic path. The termination area extends from the downstream end of the work area to the "END ROAD WORK" signs, if used.

Section 13 – Tapers (refer to Figure 3)

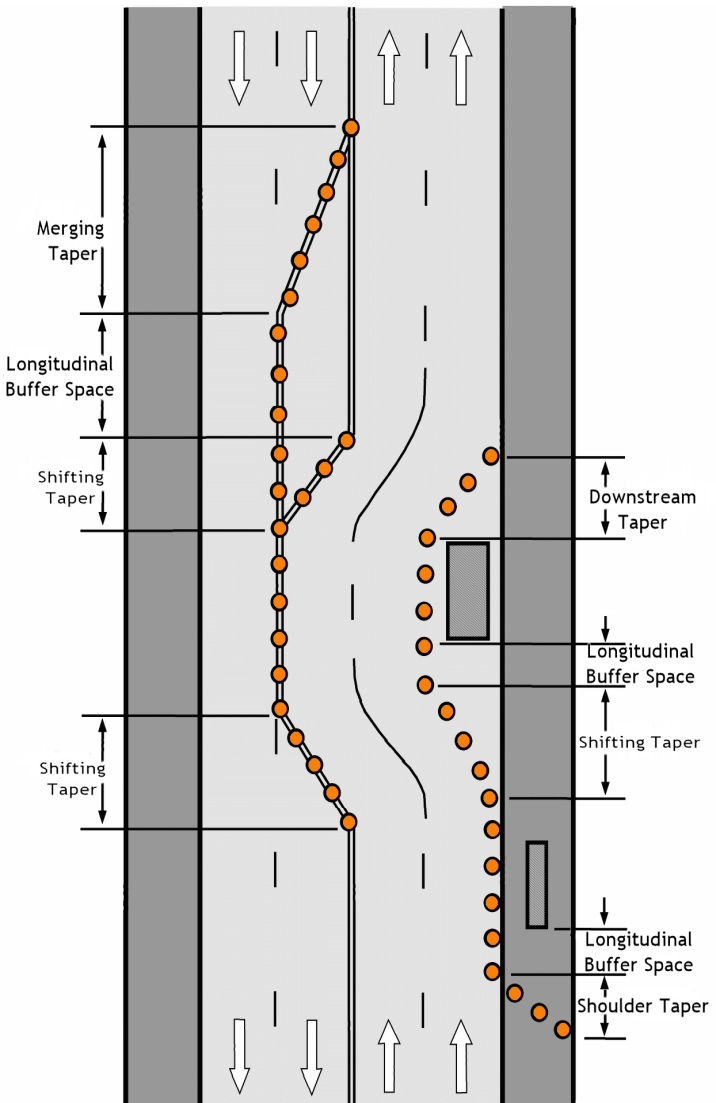
A common important element of a TTC zone is a roadway taper. Tapers may be used in both the transition and termination areas. Tapers are created using a series of channelizing devices and/or pavement markings placed to move traffic out of or into its normal path. The standard diagrams in this handbook show tapers of adequate length for most urban conditions. Whenever tapers are to be used near interchange ramps, crossroads, curves, or other influencing factors, it may be desirable to adjust the length of the tapers. Longer tapers are not necessarily better than shorter tapers (particularly in urban areas characterized by short block lengths, frequent driveways, etc.), because extended tapers tend to encourage sluggish operation and to encourage drivers to delay lane changes The real test of taper length involves observation of driver performance after traffic controls are in place.

There are five different types of tapers, each of which is described below.

A. MERGING TAPER

The taper should be long enough to enable merging drivers to adjust their speeds and merge into a single lane before the end of the transi-

tion. The appropriate series of lane reduction/merge signs shall be erected in the advance warning area before a merging taper. The "ONE LANE ROAD AHEAD" sign shall not be used in lieu of the proper lane reduction/merge signs.



NOT TO SCALE

FIGURE 3
TAPERS AND BUFFER SPACE

B. SHIFTING TAPER

A shifting taper is used when a lateral shift is needed to move traffic out of or into the normal path. Where more space is available, it may be beneficial to use longer-than-minimum distances. Guidance for changes in alignment may also be accomplished by using horizontal curves designed for normal roadway speeds. If a shifting taper is shorter than the minimum length for the roadway speed, then appropriate curve or turn warning signs with the appropriate advisory speed plates shall be erected in the advance warning area. A shifting taper be approximately half of the normal merging taper for the same speed.

C. SHOULDER TAPER

When work is occurring on the paved shoulder of a high-speed roadway, a shoulder taper may be beneficial. If used, shoulder tapers approaching the activity area should have a length of about one-third of a normal merging taper for the same speed. If a shoulder is used as a travel lane, either through practice or during a temporary traffic activity, a normal merging taper and proper advance warning signing should be used.

D. DOWNSTREAM TAPER

The downstream taper may be useful in termination areas to provide a visual clue to the driver that access is available to the original lane/path that was closed. When a downstream taper is used, it should have a minimum length of 100 feet per lane, with devices spaced about 20 feet apart.

E. ONE-LANE, TWO-WAY TAPER

The one-lane, two-way taper is used in advance of an activity area that requires the traffic space to be used alternately by traffic flowing in opposing directions. It shall serve the traffic direction that must shift sides. Typically, a flagger controls traffic. A short taper having a maximum length of 100 feet with channelizing devices at approximately 20-foot spacing should be used to guide traffic into the one-lane, two-way section. A "ONE LANE ROAD AHEAD" sign shall be placed in each direction in advance of a one-lane, two-way taper.

Section 14 - Detours and Diversions

A detour is a temporary rerouting of traffic onto another street or roadway to bypass the work zone. Detours should be clearly signed over their entire length so that roadway users can be directed easily to the original roadway.

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

Section 15 - One-Lane, Two-Way Traffic Control

Where traffic in both directions must, for limited distance, use a single lane in an alternating fashion, some means of coordinating movements at each end shall be used to avoid head-on conflicts and to minimize delays.

Alternate one-way traffic control may be accomplished by single flagger control, multiple flagger control, flag transfer, a pilot car, or by stop or yield control. "Flagger Ahead" signs shall be included in the advance warning area whenever flaggers are present. All flaggers shall be properly trained, attired, and equipped (see Section 16). "One Lane Road Ahead" signs shall be placed in the advance warning area of all one-lane, two-way traffic zones.

At "spot" obstructions (such as an isolated pavement patch or pipe crossing) on minor roadways with low speeds and very low volumes and with adequate sight distance, the movement may be self-regulating and no control is necessary.

A. SINGLE FLAGGER METHOD

Where a one-lane, two-way TTC zone is short enough to allow visibility from one end to the other, and traffic volumes and speeds are moderate to low, traffic may be controlled by a single flagger. The flagger should be stationed on the shoulder opposite the workspace, or in a position where good visibility and traffic control can be maintained at all times.

B. MULTIPLE FLAGGERS

When good visibility and traffic control cannot be maintained by a single flagger, traffic should be controlled by a flagger on each end of the work area. One of the flaggers should be designated as the coordinator. The flaggers should be able to communicate with each other orally or with signals. Signals should not be able to be mistaken with flagging signals to traffic. The use of radios is recommended even when there is visual contact between flaggers.

Multiple flaggers are likely to be needed on streets with higher traffic volumes and higher speeds and where the site conditions limit the visibility of a single flagger to approaching traffic. In TTC zones at intersections, it may be necessary to post flaggers on the intersecting streets to avoid conflicts with vehicles approaching the site from these streets.

C. FLAG TRANSFER METHOD

The flag transfer method can be very effective for long one-lane, two-way TTC zones; especially when flaggers are not able to see one anoth-

er. This method requires proper flagging operations at each end of the constricted area. Flaggers must also be stationed at each intersecting street or the intersecting streets must be closed.

D. PILOT CAR METHOD

A pilot car is used to guide a queue of vehicles through a complex or very long one-lane, two-way TTC zone. Its operation must be coordinated with flagging operations at each end of the one-lane section. Flaggers must also be stationed at each intersecting street or the intersecting streets must be closed.

Pilot cars shall have the PILOT CAR sign (G20-4) mounted at a conspicuous location on the rear of the vehicle.

The pilot car method will not generally be used under the urban conditions to which this handbook applies. This method is offered as an acceptable alternative and may be useful in helping to control speeds through TTC zone, even when two-way traffic is maintained.

E. STOP OR YIELD CONTROL

On low volume, low speed roadways where the TTC zone is very short and there is excellent visibility of the entire work zone to approaching traffic, a Yield (R1-2) or Stop (R1-1) sign may be used to control traffic. If the STOP or YIELD sign is installed for only one direction, then the STOP or YIELD sign should face users who are driving on the side of the roadway that is closed for the work activity area.

Section 16 - Flagging Procedures

Traffic shall not be stopped for more than 5 minutes at a time in any direction. After 5 minutes of stoppage, traffic shall be allowed to flow for a reasonable period of time to eliminate or reduce substantially the queue of vehicles before another stoppage takes place.

A. CERTIFICATION FOR FLAGGERS

Flagger Training is required for anyone who has to control traffic with a stop/slow paddle around a work crew. Certification and training for flagger is through the NCDOT or their approved private training agencies.

B. HIGH VISIBILITY SAFETY APPAREL

Flaggers, at all times, shall wear safety apparel meeting the requirements of ISEA “American National Standard for High-Visibility Apparel” and labeled as meeting the ANSI 107-2010 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 retro-reflective material shall be 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.

C. HAND SIGNALING EQUIPMENT

Except in emergency situations, flaggers shall use standard STOP/SLOW paddles to direct traffic through a work zone. The faces of the standard STOP/SLOW paddle are shown in Figure 4. The paddles shall be retro-reflectorized for nighttime use.

In emergency situations, red flags may be used in lieu of the standard STOP/SLOW paddle. Such flags will be a minimum of 24 inches square and shall be fastened to a staff about three feet long. The free edge should be weighted so the flag will hang vertically, even in heavy winds. When used at night, flags shall be retro-reflective red.

Flaggers should be equipped with whistles, horns, or other devices to warn workers of errant vehicles entering the work zone.

D. HAND SIGNALING PROCEDURES

Flaggers are provided to stop traffic intermittently as required by the work process or to maintain continuous traffic past a work site at reduced speeds to help protect the work crew. This is to be accomplished following the procedures shown in Figures 5 and 6. Traffic shall not be stopped for more than 5 minutes at a time in any direction.

E. FLAGGER STATIONS

The flaggers must, at all times, be clearly visible to approaching traffic for a distance in advance of the work zone sufficient to permit proper response by the motorist to the flagging instructions.

Flaggers should stand on the shoulder adjacent to the traffic being controlled. A single flagger stationed in the center of the work zone should stand on the shoulder opposite the workspace. A flagger should stand in an open travel lane only after traffic in that lane has been stopped.

It is critical that flaggers are clearly visible to approaching traffic. For this reason the flagger should stand alone. No other traffic control devices should be placed around the flagger station nor should other workers congregate around the flagger station.

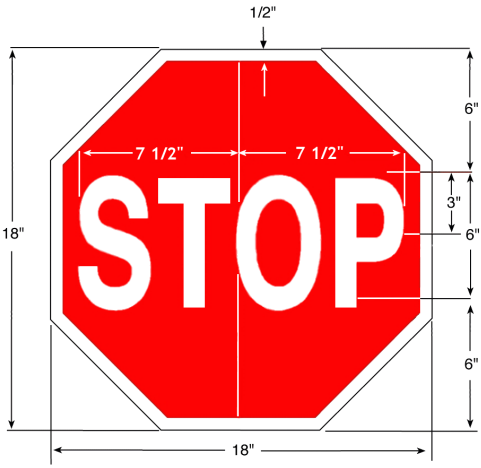
It is recognized that certain types of construction and/or maintenance activity, especially those in or near intersections, require extensive traffic control which can be effectively accomplished only by a uniformed police officer. Public and private agencies shall acquire the

services of a uniformed police officer when the situation so dictates for the safety of the public and the workers. Ample advance notice should be provided to the Police Department to schedule the services of uniformed police officer.

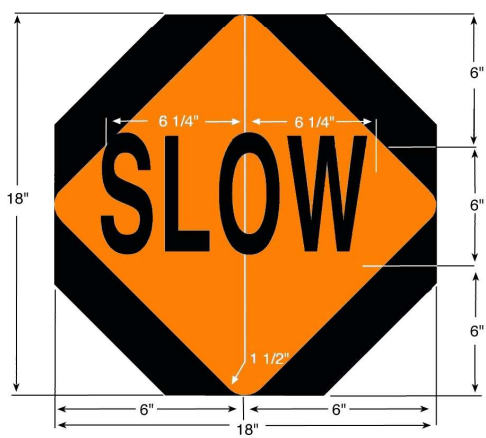
F. POLICE OFFICERS

Only uniformed police officers are authorized to direct traffic through signalized intersections. The traffic signal may be put into flashing operation or may remain in normal operation at the discretion of the officer.

Officers shall be properly attired and shall direct traffic with hand motions. Flashlights with red cones should be used at night. Officers may also use a whistle to signal when they are changing the direction of the right of way.



COLORS
LEGEND - WHITE (REFL)
BACKGROUND - RED (REFL)



COLORS
LEGEND - BLACK (NON-REFL)
BACKGROUND - ORANGE (REFL)
AREA OUTSIDE DIAMOND-BLACK

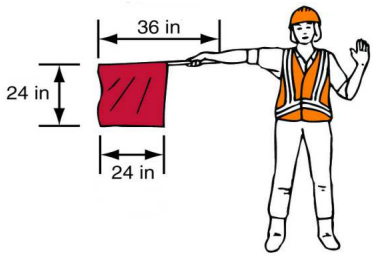
FIGURE 4
STANDARD STOP/SLOW PADDLE

TO STOP ROAD USERS:
The flagger shall face road users and extend the STOP sign paddle in a stationary position with the arm extended horizontally away from the body. The free arm should be raised with the palm toward the approaching traffic.

TO DIRECT STOPPED ROAD USERS TO PROCEED:
The flagger shall face road users with the SLOW paddle held in a stationary position with the arm extended horizontally away from the body. The flagger should motion with the free arm for the road users to proceed.

TO ALERT AND SLOW ROAD USERS:
The flagger shall face road users with the SLOW paddle held in a stationary position with teh arm extended horizontally away from the body. The flagger should slowly raise and lower the free arm vertically from the elbow, with the palm facing the pavement.

FIGURE 5
HAND SIGNALING PROCEDURES



TO STOP ROAD USERS:
The flagger shall face road users and extend the flag horizontally across the road user's lane in a stationary position, so that the full area of the flag is visible hanging below the staff. The free arm shall be raised with the palm toard the approaching traffic.

TO DIRECT STOPPED ROAD USERS TO PROCEED:
The flagger shall stand parallel to the road user movement with the flag and arm lowered from view of the road users,and shall motion with the free arm for the road users to proceed. Flags SHALL NOT be used to signal the road users to proceed.

TO ALERT AND SLOW ROAD USERS:
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.

FIGURE 6
FLAGGING PROCEDURES
(Emergencies Only)

Section 17 - Duration of Work

The duration of the work zone is a major factor in determining the number and types of devices used in TTC zones. The five categories of work duration are as follows:

- Long-term stationary - Work that occupies a location continuously, day and overnight, for more than 3 days.
- Intermediate-term stationary - Work that occupies a location continuously more than one day and overnight, up to 3 days; or night work.
- Short-term stationary - Active work zone that occupies a location from 1 hour to 1 day.
- Short-duration - Active work zone that occupies a location for up to 1 hour.
- Mobile - Work that moves intermittently or continuously.

At LONG- TERM STATIONARY work zones, there is ample time to install and realize benefits from the full range of traffic control procedures and devices that are available for use. Since these types of work zones extend overnight, all traffic control devices used shall be made with retro-reflective material. Drums shall be used to channelize vehicular traffic. Drums or approved barrier shall be used to separate the activity space from the traffic space. Portable channelizing devices (drums, cones, etc.) shall not be sufficient to separate opposing flows of traffic. Appropriate temporary pavement markings shall be installed and all conflicting pavement markings shall be removed. High-Level warning devices such as changeable message signs or flashing arrow panels should be used whenever possible.

During INTERMEDIATE- TERM STATIONARY work, it may not be feasible or practical to use procedures or devices that are desirable for long-term stationary work zones, such as altered pavement markings, barriers, or changeable message signs. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time. Since these projects extend overnight, all traffic control devices used shall be made with retro-reflective material. Cones may be used in lieu of drums but must be 28 inches high with white retro-reflective bands when workers are present. Drums or tubular markers affixed to the pavement shall be used if the site is left unattended and traffic is being diverted across conflicting pavement markings or if channelization devices are to be used in lieu of double yellow centerline to separate opposing traffic flows.

Most maintenance and utility operations are SHORT-TERM STATIONARY. The work crew is present to maintain and monitor the TTC zone.

A TTC zone in compliance with the figures of this handbook is required; however, for daylight only operations, the traffic control devices used do not need to be made of retro-reflective material. For nighttime operations, the traffic control devices shall either be made of retro-reflective materials or shall be externally illuminated.

Work zones that continue longer than one day, but are abandoned and cleared such that all travel lanes and shoulders are open during periods of inactivity, can be considered as short-term stationary work zones. In such cases, all TTC devices shall be removed or covered during periods of inactivity.

For SHORT-DURATION activities, it generally takes longer to set up and remove the TTC zone than to perform the work. Typically, such operations can be accomplished in 60 minutes or less. There are hazards involved for the crew in setting up and taking down a traffic control zone. Also, as the work time is short, the time during which motorists are affected is significantly increased when additional devices are installed and removed. Considering these factors, it is generally held that simplified control procedures are warranted for short-duration projects. Such shortcomings may be offset by the use of other, more dominant devices, such as high intensity rotating, flashing, oscillating, or strobe vehicles or larger, more visible signs.

The trade-off is economical because work duration is short. Mobility is essential; the crew is always on site. Safety is not compromised, as numerous small devices are merely replaced by fewer, more dominant and effective devices.

MOBILE operations include activities that stop intermittently and then move on (e.g., pothole patching) and those that move continuously (e.g., pavement striping). With operations that move slowly (less than 3 mph), it may be feasible to use stationary signing that is periodically retrieved and repositioned in the advance warning area. At higher speeds, trucks are typically used as components of the traffic control zones. Appropriately colored and marked vehicles with signs, high intensity rotating, flashing, oscillating, or strobes, truck mounted attenuators, and special lighting panels move as part of a train behind the work vehicles.

Mobile operations that move at speeds greater than 20 mph, such as snowplowing operations, shall have appropriate devices on the equipment, (i.e., rotating lights, signs, or special lighting), or shall use a protection vehicle with appropriate warning devices.

Safety should not be compromised by using fewer devices simply because the operation will frequently change its location. Portable devices should be used. Flaggers may be used, but caution must be exercised so they are not exposed to unnecessary hazards. The control devices should be moved periodically to keep them near the work area. If mobile operations are in effect in a travel lane of a high-speed (45 mph or greater), multi-lane roadway, flashing arrow panels mounted on the back of each vehicle should be used.

Section 18 - Temporary Traffic Control Zone Devices

The Contractor, Utility Company, or Public Agency performing the work shall furnish and install all necessary traffic control devices prior to the start of construction or maintenance operations. This same organization shall continuously patrol the work zone throughout the duration of construction to ensure that all traffic control devices are in place, are clean, visible, and are operating properly.

TTC devices, which are not required at any time, shall be removed, covered, or otherwise shielded from traffic. All TTC devices shall be removed or relocated as the work is finished or as work conditions change.

TTC devices include: signs, channelizing devices (barricades, traffic cones, drums, etc.), temporary pavement markings, warning lights, and arrow panels. The use of each of these devices is described below.

A. SIGNS

There are three categories of TTC signs: regulatory signs, warning signs and guide signs. Regulatory signs, such as "Keep Right" and "Road Closed" signs, are to be black on white. Warning signs for TTC zones and temporary guide signs such as detour route signs shall be black on orange.

All signs used at night shall be either retro-reflective in accordance with Section 633 of the Standard Specification for construction of Roads and Bridges on Federal Highway Projects (FP-74) or illuminated to show similar shape and color both day and night.

Standard orange flags and/or flashing warning lights (see Section 18-D) may be used in conjunction with signs to form high-level warning devices (see Figure 7).The flags and or flashers must not block the sign legend.

Advance warning signs should be placed in the shoulder on the right side of the traffic flow and shall face, and be visible to, the approaching

traffic. On one-way and median- divided streets, supplemental advance warning signs should also be placed in the shoulder on the left side of the road. Such supplemental signs are required when closing the left lane of a one-way or median divided Street. Advance warning signs should not be placed in the travel lane.

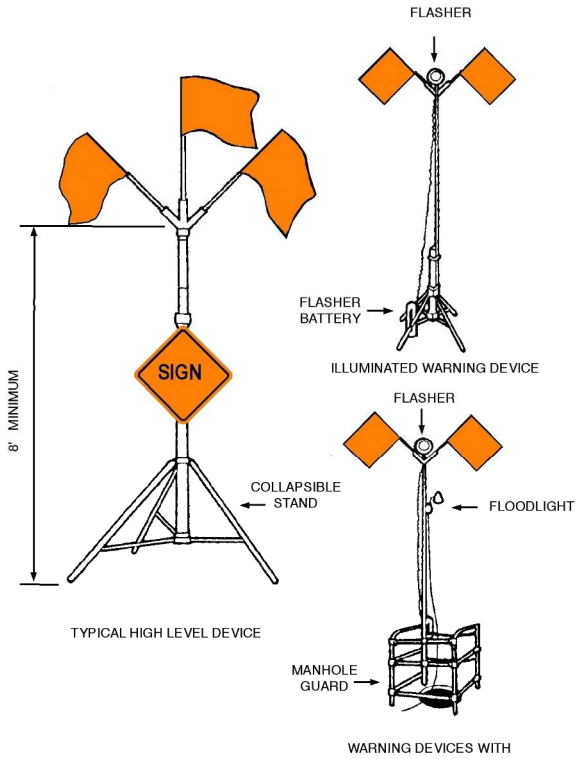


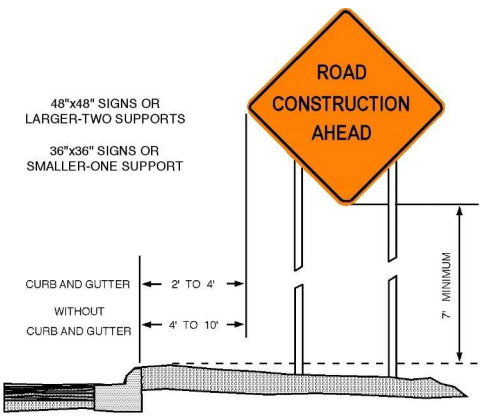
FIGURE 7

HIGH LEVEL WARNING DEVICES (RECOMMENDED IN CONGESTED AREAS)

Ground-mounted signs installed at the side of the road in rural areas shall be mounted at a height of at least 5 ft, 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 ft.

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).



FIXED MOUNTING

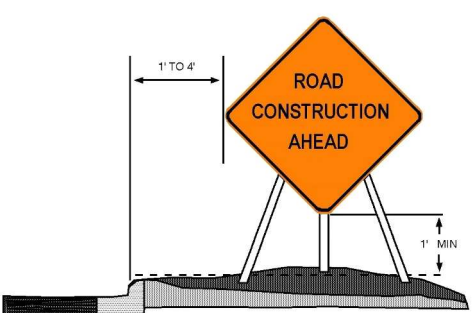


FIGURE 8
HEIGHT AND LATERAL LOCATION OF SIGNS
PORTABLE MOUNTING

Guidance: Neither portable nor permanent sign supports should obstruct pedestrian or bicycle traffic. Signs mounted lower than 7 ft. should not project more than 4 inches into pedestrian facilities.

Advance warning signs on long-term stationary projects shall be mounted on posts. On shorter-term projects, advance-warning signs may be

mounted on portable supports. Figure 8 shows the height and lateral clearance requirements for both of these types of mountings. Where appropriate, signs may be mounted on or above barricades. For mobile operations, a large sign may be mounted on a maintenance vehicle stationed in advance of the work area or moving along with it.

Signs, which are typically used in TTC zones, are shown in Diagrams 1 through 26. The sizes shown are standard for most urban conditions. Larger signs are recommended for highways. Smaller signs may be used on low volume local streets.

The Contractor, Utility Company, or Public Agency performing the work shall furnish, install, and maintain all temporary signs. **Only CDOT forces shall install, remove, or relocate any permanent signs within the Right-of-Way.** CDOT forces will usually correct any conflicts within 24 hours of being notified. Notification of conflicting signs may be made directly to the Transportation Operations Division or by calling the general information number for CDOT.

B. PORTABLE CHANGEABLE MESSAGE SIGNS

Portable Changeable Message signs shall be TTC devices with the flexibility to display a variety of messages. Each message shall consist of either one or two phases. A phase 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. They should not obstruct pedestrian or bicycle traffic and must not violate the noise ordinance at night time.

The primary purpose of Portable Changeable Message signs in TTC zones is to advise the road user of unexpected situations. Some typical applications include the following:

- Where significant queuing and delays are expected.
- Where advance notice of a present or future roadway closure.

Messages should be designed taking into account the following factors:

- Each phase should convey a single thought.
- If the message can be displayed in one phase, 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.
- The message should be as brief as possible.
- When abbreviations are used, they should be easily understood.

Portable Changeable Message signs 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 bottom of the message sign panel shall be a minimum of 7 ft. above the roadway. Portable Changeable Message signs should be used as a supplement to and not as a substitute for conventional signs and pavement markings.

Portable Changeable Message signs should be placed on the shoulder of the roadway or, if practical, further from the traveled lane. They should be delineated with retro-reflective TTC devices.

When Portable Changeable Message signs are not being used, they should be removed or shielded, if removal is not practical. If the previous two options are not feasible, they should be delineated with retro-reflective TTC devices.

C. CHANNELIZING DEVICES

The purpose of channelizing devices is to guide drivers and pedestrians through a TTC zone and to protect the workers inside the work area. Channelizing devices include drums, cones/tubular markers, and barricades. These devices have similar functions and can be interchanged for most applications. The best device to use will be dependent on the duration of the work, the type of work, the time of day and level of safety desired.

Channelizing devices are elements of a TTC system and should not be used without appropriate warning signs and/or other devices. To effectively guide traffic, channelizing devices must be placed in series to form tapers or to separate traffic from hazards. The spacing of the devices, to provide good guidance, is dependent on the speed of the approaching traffic. To provide good guidance, the type of channelizing device used should be consistent throughout a TTC zone. Types of devices in a series should not be mixed. A single channelizing device shall not be placed alone in a travel lane.

The standard design and typical application of each type of channelizing device is described below.

C1. DRUMS

Drums used for traffic warning or channelization shall be constructed of lightweight, flexible, and deformable materials and shall have a minimum height of 36 inches. The outside base diameter shall be at least 21 inches and no greater than 24 inches. The outside upper diameter shall be at least 18 inches but shall not exceed the outside base diameter. Drums should weigh between 12 and 15 pounds. The base shall be designed to accommodate a sandbag of 40 pounds to 60 pounds in

weight as ballast. **Ballast shall not be placed on top of the drum because it could become a hazard when struck.** Drums shall have closed tops to prevent water and debris from accumulating in the bottom of the drums.

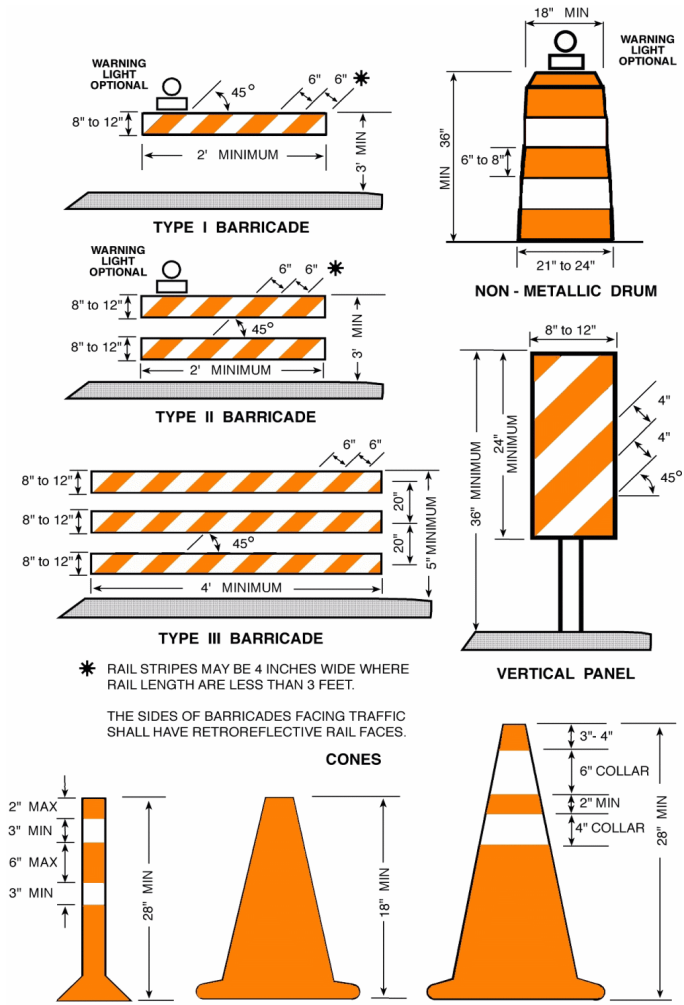


FIGURE 9
CHANNELIZING DEVICES

The markings on drums shall be alternating orange and white horizontal, circumferential, retro-reflective stripes 6 to 8 inches wide. There shall be at least two orange and two white stripes on each drum. Any

non-retro-reflective spaces between the horizontal orange and white stripes shall not exceed 2 inches wide (see Figure 9).

Drums are most commonly used to delineate the flow of traffic but may also be used to mark specific hazards.

Drums have the appearance of being formidable obstacles and, therefore, command the respect of drivers. They are portable enough to be shifted from place to place within a TTC zone to accommodate changing conditions but are generally used in situations where they will remain in place for a prolonged period. Drums are the recommended channelizing device for long-term and intermediate-term stationary projects.

C2. CONES AND TUBULAR MARKERS

All cones and tubular markers shall be predominantly orange and made of a material that can be struck without damaging vehicles on impact. Cones and tubular markers shall be at least 18 inches high when used on low speed, low volume roads. A minimum height of 28 inches is required on thoroughfares and other highways. Tubular markers shall be at least 2 inches wide. Cones and tubular markers used at night shall have retro-reflectorized bands as shown in Fig. 9.

Like drums, traffic cones are most commonly used to delineate the flow of traffic but may also be used to mark specific hazards. Cones are lightweight and very portable and are typically used on projects with very short durations where the site is not left unattended. Care must be taken when placing cones to ensure that they will not be blown over or displaced by wind or moving traffic. If a site is to be left unattended, cones should be double stacked to increase their weight and stability. Use of a space-saving "Channelizer Cone" is permissible as long as it is reflectorized and used with a weighted base.

Tubular markers have less visibility than other channelizing devices but may be useful where space limitations do not allow for the use of larger, more visible devices. A typical application of tubular markers is to separate opposing flows of traffic. If a site is to be left unattended the tubular markers should be affixed to the pavement with adhesive.

C3. BARRICADES

A barricade is a portable device having one to three horizontal rails with alternating orange and white retro-reflective stripes. The stripes slope downward at an angle of 45 degrees in the direction traffic is to pass the barricade (see Figure 9).

Barricade rails should be supported in a manner that allows them to be clearly seen by motorists and provide stable support. Because barricades

are often located adjacent to traffic and are subject to impact from errant vehicles they should be constructed of lightweight materials and should not have rigid bracing. Barricades may be ballasted with sandbags on the lower parts of the frame to prevent being blown over by wind or traffic. As with drums, solid objects such as rocks or chunks of concrete should not be used as ballast.

There are three types of barricades: Type I, Type II, and Type III. The type of barricade is determined by the number of horizontal rails with reflective striping (Type I barricades often include a second un-striped rail which is necessary for stability).

Type I and Type II barricades are intended for use in situations where traffic is maintained through the TTC zone. As with drums or cones, Type l or Type II barricades may be used to delineate the flow of traffic but may also be used to mark specific hazards. A single drum or barricade shall not be placed in an open travel lane.

Like drums, barricades have the appearance of being formidable obstacles and, therefore, command the respect of drivers. They should be portable enough to be shifted from place to place within a TTC zone to accommodate changing conditions but are generally used in situations where they will remain in place for a prolonged period. Type I barricades are adequate for all such applications in the city. Type II barricades are recommended for highways.

Type III barricades are used for the closure of all or a portion of the roadway. When used to close the entire roadway to all traffic, a sufficient number of Type III barricades shall be used to completely close the roadway.

When access by construction vehicles is required, the contractor, utility company, or agency doing the work is responsible for properly replacing the barricades at the end of the workday.

When access to local dwellings and businesses is to be maintained beyond the point of the closure, then an adequate opening shall be provided between the barricades to allow safe ingress and egress through the closure. A single Type III barricade may be used at the beginning of the activity area to help delineate the closed portion of a roadway.

D. TEMPORARY PAVEMENT MARKINGS

Properly maintained pavement markings can provide the best delineation around long-term stationary work zones. Pavement markings are not susceptible to being blown down or moved by wind or traffic and

are not easily changed by vandals. This "permanence" makes temporary pavement markings ideal for long-term stationary projects but also makes them inappropriate for shorter duration projects.

On long-term stationary projects, the contractor, utility company, or agency doing the work shall remove any existing pavement markings which conflict with the temporary traffic flow. New temporary markings, which direct traffic through the TTC zone, shall be installed and maintained for the duration of the project. Appropriate permanent markings shall be re-installed upon completion o the project.

Existing conflicting markings shall be obliterated so as to be unidentifiable as pavement markings under day or night, wet or dry conditions.

All temporary pavement markings shall meet the specifications for size, placement, and color of Part 3 (pavement markings) of the Manual on Uniform Traffic Control Devices and the current CDOT standards. Temporary pavement markings may either be painted or may be formed using temporary tape. Paint is recommended for any application, which is intended to remain longer than 2 weeks. All temporary markings shall be retro-reflective. The temporary markings should be checked each day and each night to ensure good visibility. Proper maintenance is critical for temporary markings to be effective.

E. WARNING LIGHTS

At night, when drivers' visibility is sharply reduced, it is often desirable and necessary to supplement retro-reflectorized signs and channelizing devices with warning lights. There are three types of warning lights:

- TYPE A low-intensity flashing warning lights are most commonly mounted on barricades, drums or advance warning signs and are intended to continually warn drivers that they are approaching or are adjacent to a hazardous area.
- TYPE B high-intensity flashing warning lights are normally mounted on advance warning signs or on independent supports. Since these lights are effective in daylight and in darkness, they are designed to operate 24 hours per day.
- TYPE C steady- burn lights are usually mounted on drums and barricades and are intended to be used to delineate the edge of the travel path, lane closures or similar situations.

TYPE A and TYPE B flashers shall not be used in a longitudinal display to delineate a travel path in an attempt to "guide" traffic, but only as a device to alert motorists. Where lights are needed to delineate the travel path through or around obstructions in a construction or maintenance area, the delineation shall be accomplished by use of TYPE C steady-burn lights.

As used herein, warning lights are portable, lens directed, enclosed lights. The color of the light emitted shall be yellow. They may be used in either a steady burn or flashing mode as noted above. Warning lights shall be in accordance with the requirements of **ITE Standard for Flashing and Steady Burn Barricade Warning lights** (See Table 1).

Table 1 - Warning Lights			
	Type A Low Intensity	Type B High Intensity	Type C Steady Burn
Lens Directional	1 or 2	1	1 or 2
Flash Rate	55 to 75	55 to 75	Constant
Flash Duration (a)	10%	8%	Constant
Minimum Effective	4.0 Candelas	35 Candelas	-
Minimum Beam	-	-	2 Candles
Hours of Opera-	Dusk to Dawn	24 hrs/day	Dusk to Dawn
(a) Length of time that instantaneous intensity is equal to, or greater			
(b) These values must be maintained within 9 degrees on each side of the vertical axis, and 5 degrees above and 5 degrees below the horizontal axis.			

F. <u>ARROW PANELS</u>

An arrow panel is a sign with a matrix of elements capable of either flashing or sequential displays. It is intended to provide additional warning and provide positive guidance to assist in merging and controlling traffic through a TTC zone. Arrow panels should be used in combination with, not in lieu of, appropriate barricades, signs, and other traffic control devices. Advance warning arrow panels shall meet the specifications of Table 2.

Table 2 - Arrow Panels			
Type	Size (minimum)	Number of Lamps (minimum)	Legibility Distance
A	24" x 48"	12	1/2 Mile
B	30" x 60"	13	3/4 Mile
C	48" x 96"	15	1 Mile
Type A Arrow Panels are appropriate for use on low speed urban streets.			
Type B Arrow Panels are appropriate for intermediate speed facilities and for maintenance or moving operations on high-speed roadways.			
Type C Arrow Panels are intended to be used on high-speed high-volume roadways.			

Operating Mode	Panel Display (Type C panel illustrated)
I. At least one of the three following modes shall be provided:	(Right arrow shown; left is similar)
Flashing Arrow	Move/Merge Right
Sequential Arrow	Move/Merge Right
Sequential Chevron	Move/Merge Right
II. The following mode shall be provided: Flashing Double Arrow	Move/Merge Right or Left
III. The following mode shall be provided: Flashing Caution	Caution or Caution

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

FIGURE 10
ARROW PANEL DISPLAYS

Arrow panels should have the capability of the following mode selections (see figure 10): (1) left or right flashing or sequential arrows; or (2) left or right sequential chevrons; and (3) flashing double arrow; and (4) caution.

The caution mode consists of four or more lamps arranged in a square pattern. Care must be taken to avoid driver confusion in the placement of arrow panels in the vicinity of ramps, median crossovers, and side road intersections.

Arrow panels are intended to assist with merging traffic. Arrow panels should not be used for work activities on the shoulder of the roadway except in the "CAUTION" mode because the panels can cause unnecessary lane changing. An arrow panel shall not be used on a two-lane, two-way roadway for temporary one-lane operation. An arrow panel **shall not** be used on a multi-lane roadway to laterally shift **all lanes** of traffic.

Section 19 - Excavations and Trenches

Trenches or excavations which cannot be properly backfilled and patched prior to the end of the work day may be bridged to permit an unobstructed flow of traffic. Trench walls and adjacent soils shall be sufficiently stabilized prior to the use of steel plates for bridging.

- Bridging must be secured against displacement by using adjustable cleats, angles, bolts, or other devices to prevent movement by traffic.
- The trench must be adequately shored to support the bridging and traffic.
- Steel plates used for bridging must extend 1 foot beyond the edges of the trench. Temporary paving materials (premix) should be used to feather the edges of the plate to minimize wheel impact.

All excavations in the public rights-of-way shall be in compliance with all current Occupational Safety and Health Act (OSHA) requirements. Any persons in an excavation not in compliance with OSHA regulations will be ordered out of the excavation until it is brought into compliance. OSHA-N.C. inspectors may be notified of any excavation not brought into compliance when ordered or if a contractor or utility company repeatedly violates OSHA regulations.

All agencies working within the public right-of-way shall comply with all of the provisions of the Underground Damage Prevention Act (Section 1, Chapter 87, Article 3 of the North Carolina General Statutes). The North Carolina 811 (NC811) is available to assist you with meeting the provisions of this act. Contacting NC811 (811) is sufficient notification

to most utilities in Charlotte; however, the agency making the excavation is also responsible for contacting those utilities in the area, which are not members of the NC811, including the Charlotte-Mecklenburg Utility Department. Except in cases of emergency, requests for underground utility locates must be made at least 48 hours, but no more than 2 weeks, before an excavation is begun. NC811 requires that the Contractor mark the proposed excavation area limits with soluble white paint. The agency making the excavation is responsible for any damage, which may result, from the failure to have all underground utilities properly located or for not following proper procedures in the vicinity of properly marked underground utilities.

All excavations or trenches made in the street or sidewalk shall be backfilled and patched in accordance with current CDOT and/or NCDOT specifications. A Street-Cut Permit shall be obtained from the CDOT Street Maintenance Division (see Section 3) prior to making an excavation or cutting a trench in the pavement or sidewalk.

Section 20– Crane Work in the Right-of-Way

All crane activity within the public rights-of-way shall comply with all current Occupational Safety and Health Act (OSHA) requirements.
No crane operator shall swing or lift a load over an open travel lane, open sidewalk, or any other part of the public right-of-way open for use by the public.

The crane operator should avoid swinging a load over the public rights-of-way. If the operator must swing/lift a load over or near an open right-of-way, the responsible party shall follow all relevant lane and/or sidewalk closure details and notification criteria to CDOT within this manual. The crane operator shall **not** swing or lift a load in a manner that endangers the public.

Section 21—Construction Signs

All TTC areas must be properly signed to provide advance warning to the roadway users. This section depicts the most commonly used signs used by CDOT and most of the designations begin with a “W” indicating that these are standardized signs from the FWHA Manual of Uniform Traffic Control Devices (MUTCD). CDOT has developed some custom signs that have a designation beginning with “C”.

CONSTRUCTION SIGNS

C2
36" x 36"
MAJOR CONSTRUCTION

W20-1
36" x 36"
MINOR CONSTRUCTION
OR MAINTENANCE

C2a
36" x 36"

C2b
36" x 36"

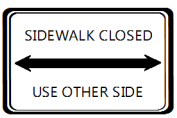
Note: Signs C2a, C2b,
and C2c may be used
in lieu of C2 as appropriate.

C2c
36" x 36"

W21-5
36" x 36"

CONSTRUCTION SIGNS

W21-1a
36" x 36"



R9-10
24" x 12"

W5-1
36" x 36"

W3-4
36" x 36"

W20-4
36" x 36"

W20-7a
36" x 36"

CONSTRUCTION SIGNS

W20-5L
36" x 36"

W20-5R
24" x 12"

W20-5C
36" x 36"

36" x 36"
C11

W4-2L
36" x 36"

W4-2R
36" x 36"

CONSTRUCTION SIGNS

W1-6
48" x 24"

W1-6
48" x 24"

W1-4L
36" x 36"

W1-4R
36" x 36"

W1-3L
36" x 36"

W1-3R
36" x 36"

CONSTRUCTION SIGNS

W20-3
36" x 36"

W20-2
36" x 36"

R11-2
48" x 30"

R11-4
60" x 30"

M4-10L
48" x 18"

M4-10R
48" x 18"

CONSTRUCTION SIGNS

M4-9L
30" x 24"

M4-9R
30" x 24"

30" x 24"
C22L

30" x 24"
C22R

M4-8a
24" x 18"

W12-1
36" x 36"

CONSTRUCTION SIGNS

W6-3
30" x 30"

R4-7
24" x 30"

W6-1
36" x 36"

W8-1
30" x 30"

W8-4
30" x 30"

W8-8
36" x 36"

CONSTRUCTION SIGNS

W8-9
30" x 30"
C31

W8-11
36" x 36"
C32

R1-1
30" x 30"
C33

R5-1
30" x 30"
C34

R3-2
24" x 24"
C35L

R3-1
24" x 24"
C35R

CONSTRUCTION SIGNS

R3-5L
30" x 36"

R3-5R
30" x 36"

R3-7L
30" x 30"

R3-7R
30" x 30"

W4-7L
36" x 36"

W4-7R
36" x 36"

CONSTRUCTION SIGNS

R9-9
24" x 12"

R9-8
24" x 12"

R9-11
24" x 12"

R9-11a
24" x 12"

W3-1
36" x 36"

W3-3
36" x 36"

CONSTRUCTION SIGNS

W9-1L
36" x 36"

W9-1R
36" x 36"

W1-8L
36" x 48"

W1-8R
36" x 48"

W8-12
36" x 36"

W5-2
36" x 36"

CONSTRUCTION SIGNS

W20-5aL
36" x 36"
C49L

W20-5aR
36" x 36"
C49R

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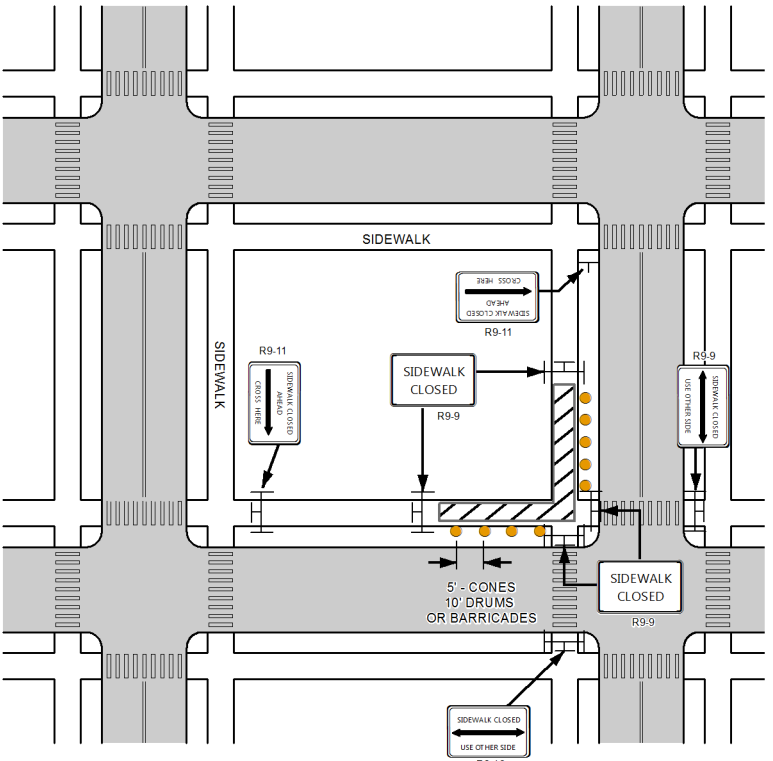
Section 22 – Typical Diagrams

This section contains diagrams which depict typical TTC zones. The diagrams include all the requirements for the type of closure shown. Some diagrams also include devices which are recommended or are optional. It should be noted that the diagrams are typical and that construction procedures may require that two or more typical diagrams be used in one area of construction. Channelizing devices associated with these typical diagrams shall be moved, supplemented, changed, or removed as required to ensure that the motorist does not receive false information.

If a project requires that typical diagrams be combined or altered numerous times throughout the duration of the project, it is recommended that a site-specific TTC plan be prepared for the project following the standards presented in the previous sections of this handbook, and in compliance with the MUTCD, for review and comments by CDOT before commencing work.

The standards presented in the previous sections of this handbook and the diagrams, which follow, are the minimum required. Additional signs, cones, barricades, and warning devices may be used, but at no time will less than what is specified herein be acceptable. Since public safety is involved, a high degree of conformity to the presented standards is necessary. Other traffic control devices or applications may be used, but only with the approval of the CDOT.

DIAGRAM 1
SIDEWALK CLOSURE



NOTES:

1. IN HEAVY PEDESTRIAN AREAS THE ADJACENT LANE MAY NEED TO BE CLOSED TO MAINTAIN PEDESTRIAN TRAFFIC.

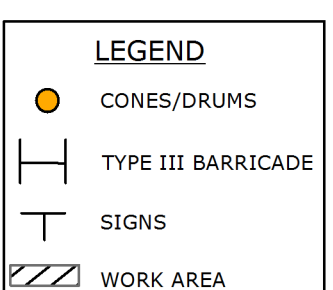
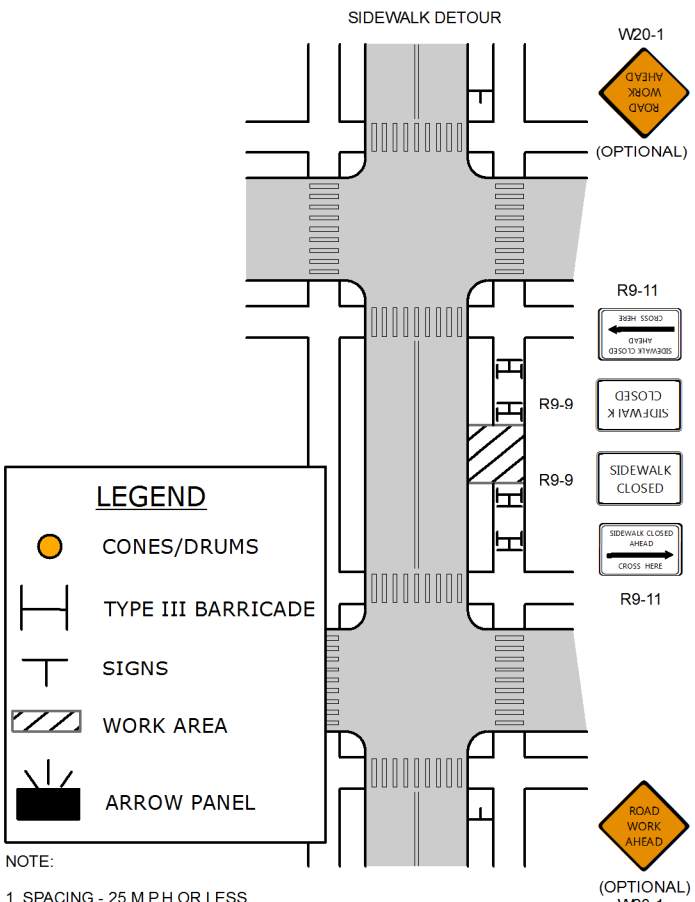


DIAGRAM 2
SIDEWALK DETOUR/DIVERSION



NOTE:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. IN HEAVY PEDESTRIAN AREAS THE ADJACENT LANE MAY NEED TO BE CLOSED TO MAINTAIN PEDESTRIAN TRAFFIC.

3. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

4. WHEN EXCAVATING WITHIN 4' OF THE EDGE OF PAVEMENT, THE ADJACENT LANE SHOULD BE CLOSED TO TRAFFIC USING OTHER APPLICABLE DIAGRAMS UNLESS BRACING OR SHORING IS USED.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

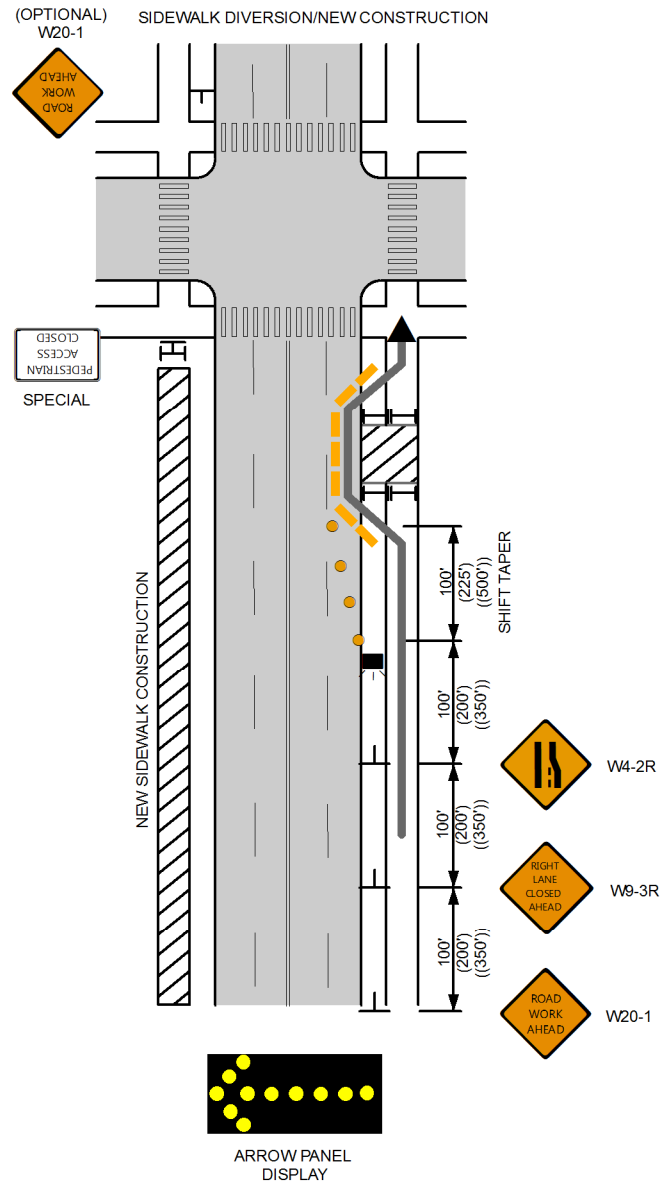
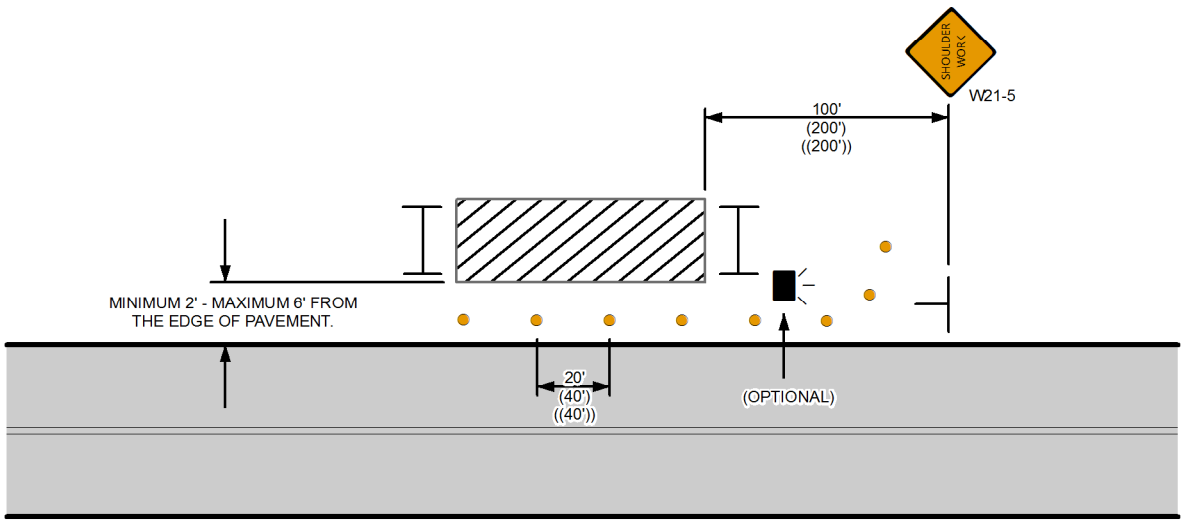
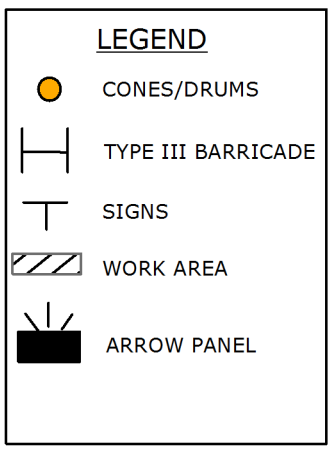


DIAGRAM 3
WORK AREA ON SHOULDER
(2' OR MORE FROM PAVEMENT)





NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

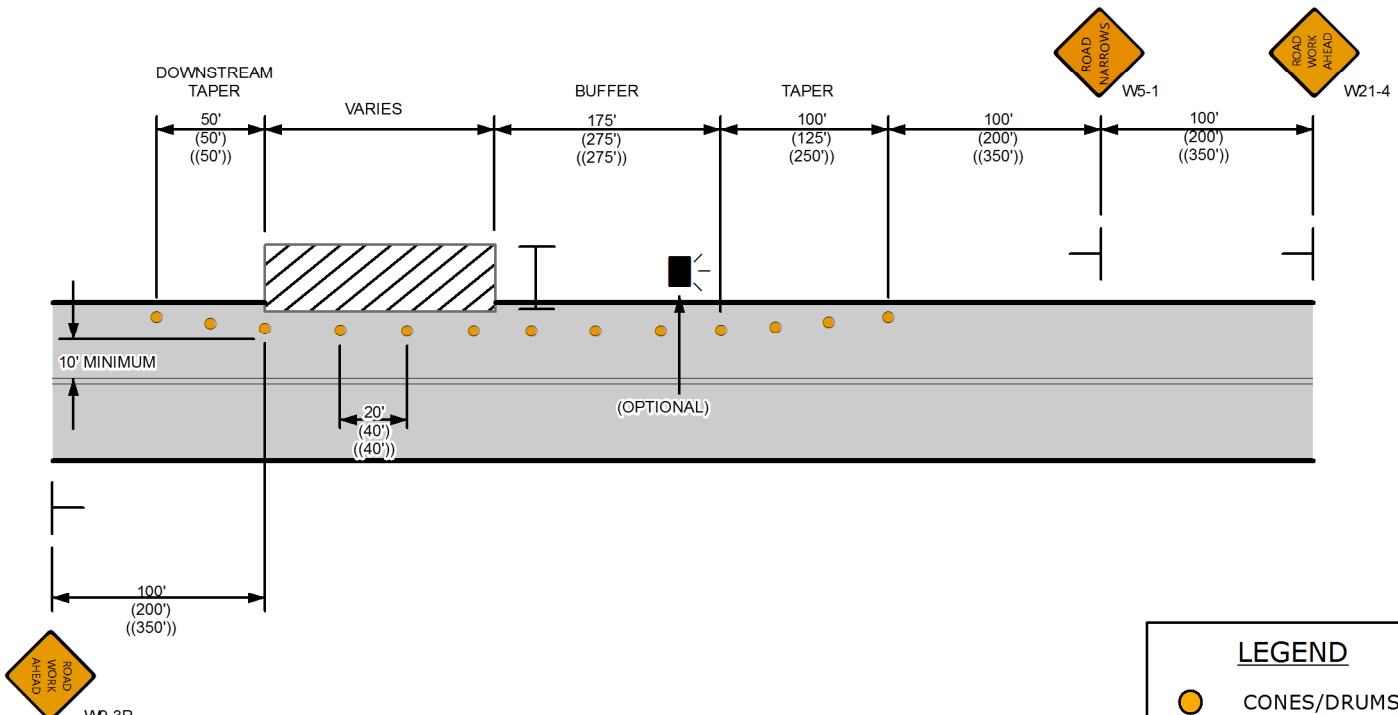
2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

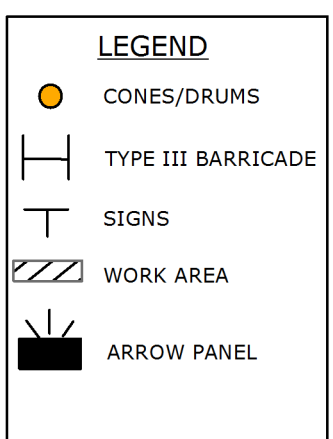
3. WHEN EXCAVATING WITHIN 4' OF THE EDGE OF PAVEMENT, THE ADJACENT LANE SHOULD BE CLOSED TO TRAFFIC USING OTHER APPLICABLE DIAGRAMS UNLESS BRACING OR SHORING IS USED.

4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

ARROW PANEL
DISPLAY
(IF USED)

DIAGRAM 4
WORK AREA ON SHOULDER
(MINOR ENCROACHMENT ON PAVEMENT)





NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

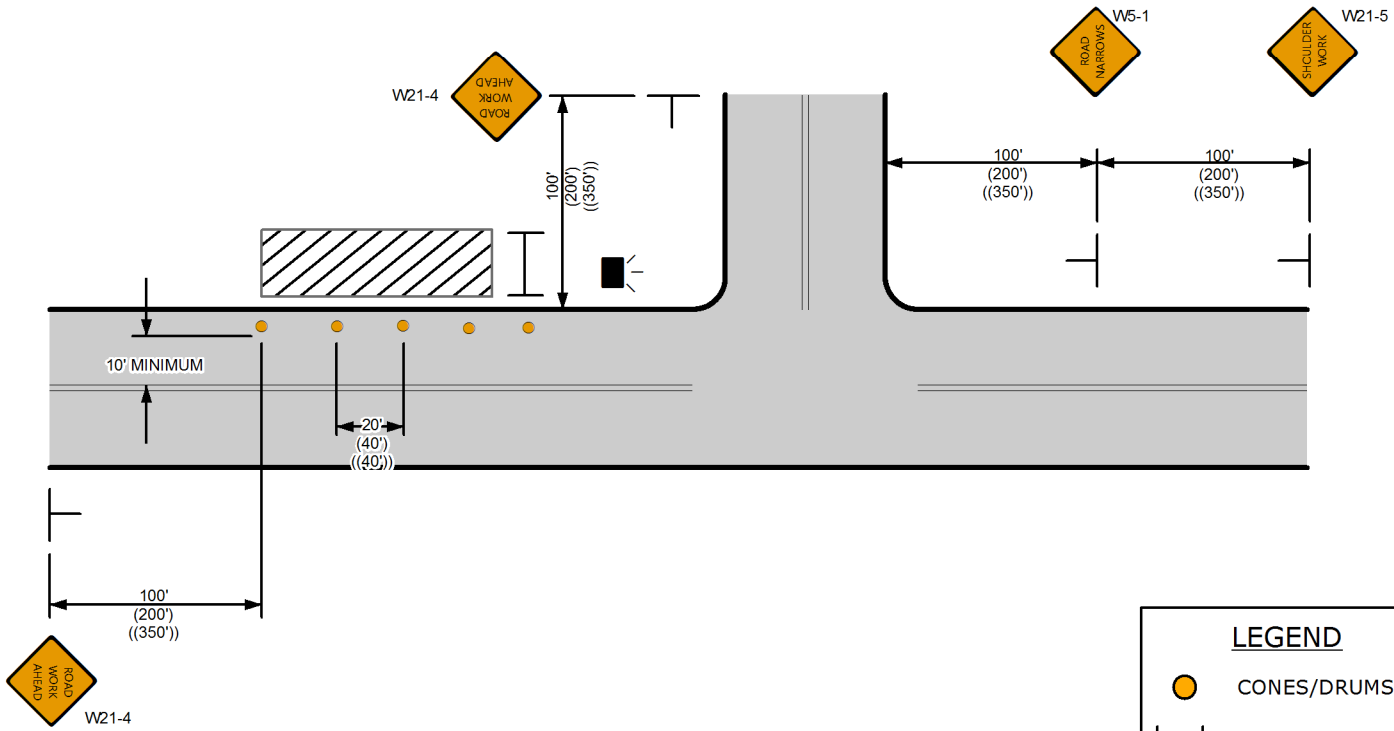
3. NO ADVANCED SIGNAGE REQUIRED IF 6' OR MORE OF CLEARANCE IS MAINTAINED FROM EDGE OF PAVEMENT.

4. WHEN EXCAVATING WITHIN 4' OF THE EDGE OF VEMENT, THE ADJACENT LANE SHOULD BE CLOSED TO TRAFFIC USING OTHER APPLICABLE DIAGRAMS UNLESS BRACING OR SHORING IS USED.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

ARROW PANEL
DISPLAY
(IF USED)

DIAGRAM 5
WORK AREA ON SHOULDER
(MINOR ENCROACHMENT ON PAVEMENT)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. NO ADVANCED SIGNAGE REQUIRED IF 6' OR MORE OF CLEARANCE IS MAINTAINED FROM EDGE OF PAVEMENT.

4. WHEN EXCAVATING WITHIN 4' OF THE EDGE OF VEMENT, THE ADJACENT LANE SHOULD BE CLOSED TO TRAFFIC USING OTHER APPLICABLE DIAGRAMS UNLESS BRACING OR SHORING IS USED.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

ARROW PANEL
DISPLAY
(IF USED)

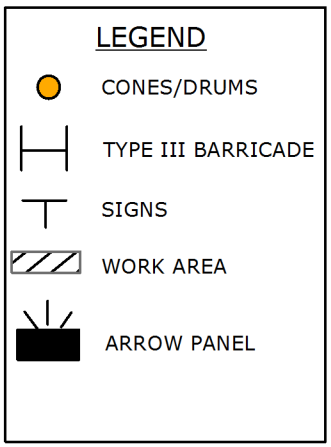
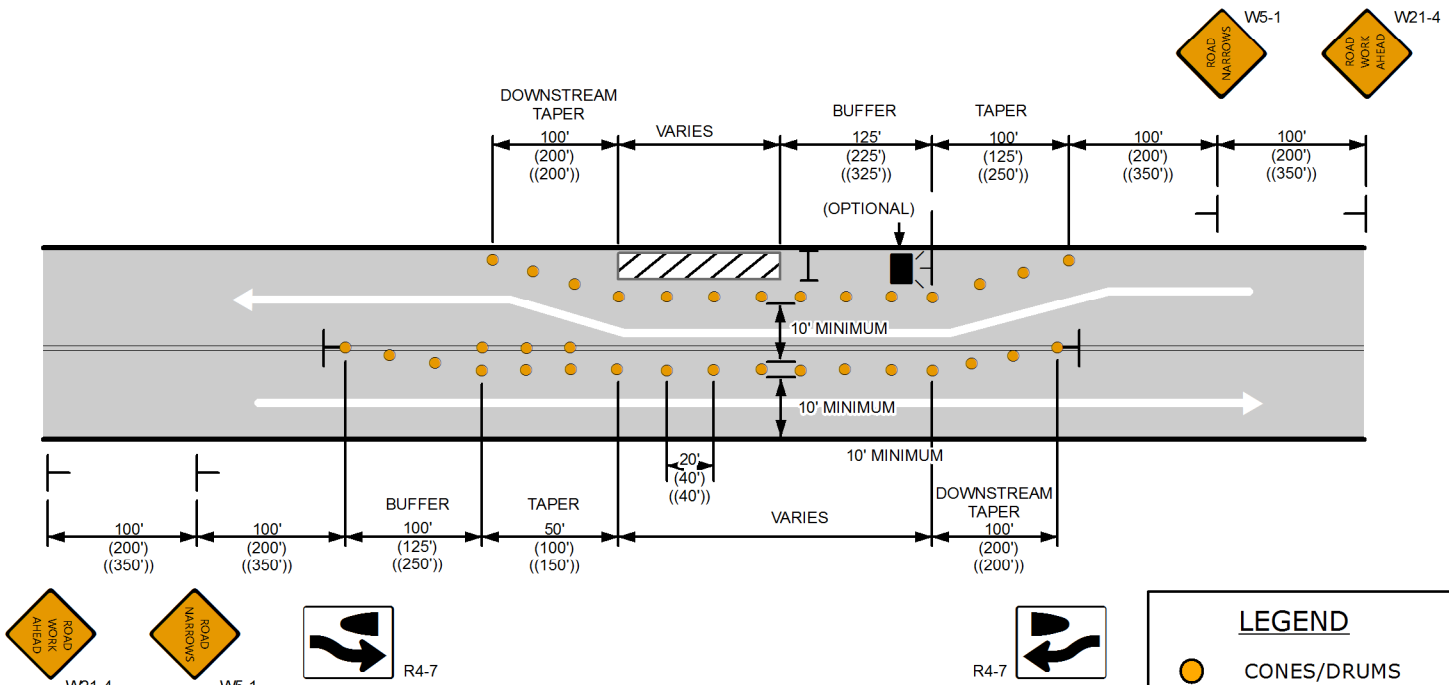
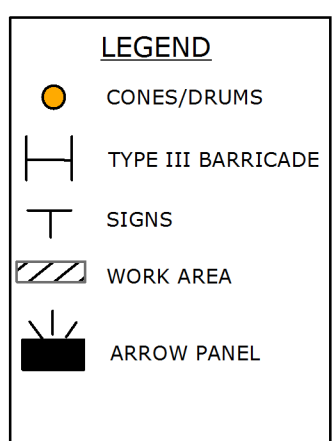


DIAGRAM 6
WORK AREA IN TRAVEL LANE
(MAINTAINING 2-WAY TRAFFIC)





NOTES:

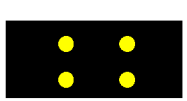
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN. DRUMS ON CENTERLINE ARE NOT REQUIRED IF PAVEMENT MARKINGS ARE REVISED.

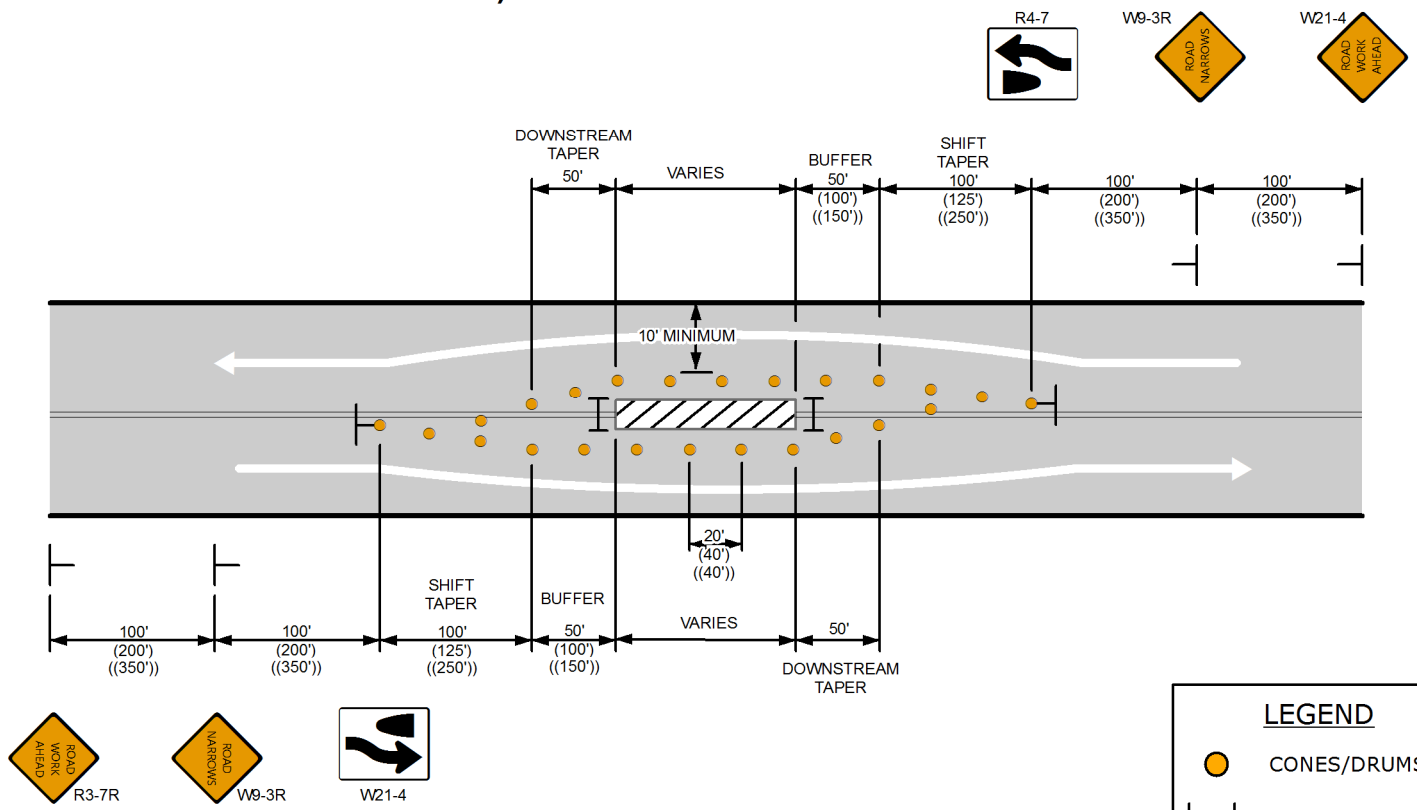
4. WHEN EXCAVATING WITHIN 4' OF THE EDGE OF VEMENT, THE ADJACENT LANE SHOULD BE CLOSED TO TRAFFIC USING OTHER APPLICABLE DIAGRAMS UNLESS BRACING OR SHORING IS USED.

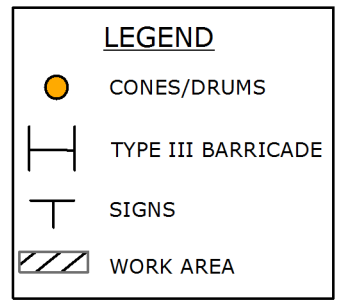
5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.



ARROW PANEL
DISPLAY
(IF USED)

DIAGRAM 7
WORK AREA IN CENTER STREET
(MAINTAINING 2-WAY TRAFFIC)





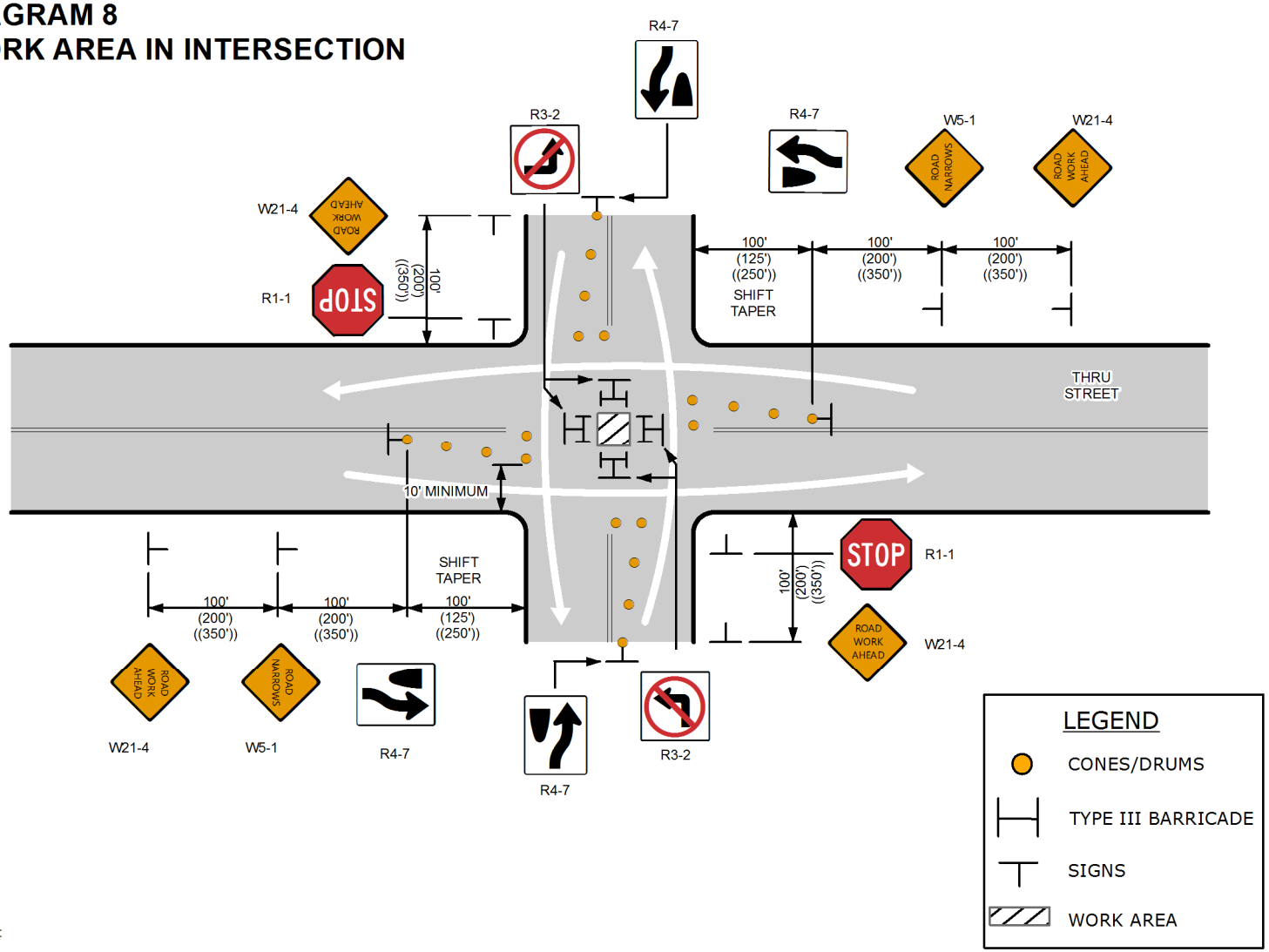
NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. PARKING ON BOTH SIDES OF THE STREET MUST BE PROHIBITED AS NECESSARY TO PROVIDE ADEQUATE TRAFFIC LANES. EMERGENCY NO PARKING SIGNS MAY BE OBTAINED FROM THE POLICE DEPARTMENT.

DIAGRAM 8
WORK AREA IN INTERSECTION



NOTES:

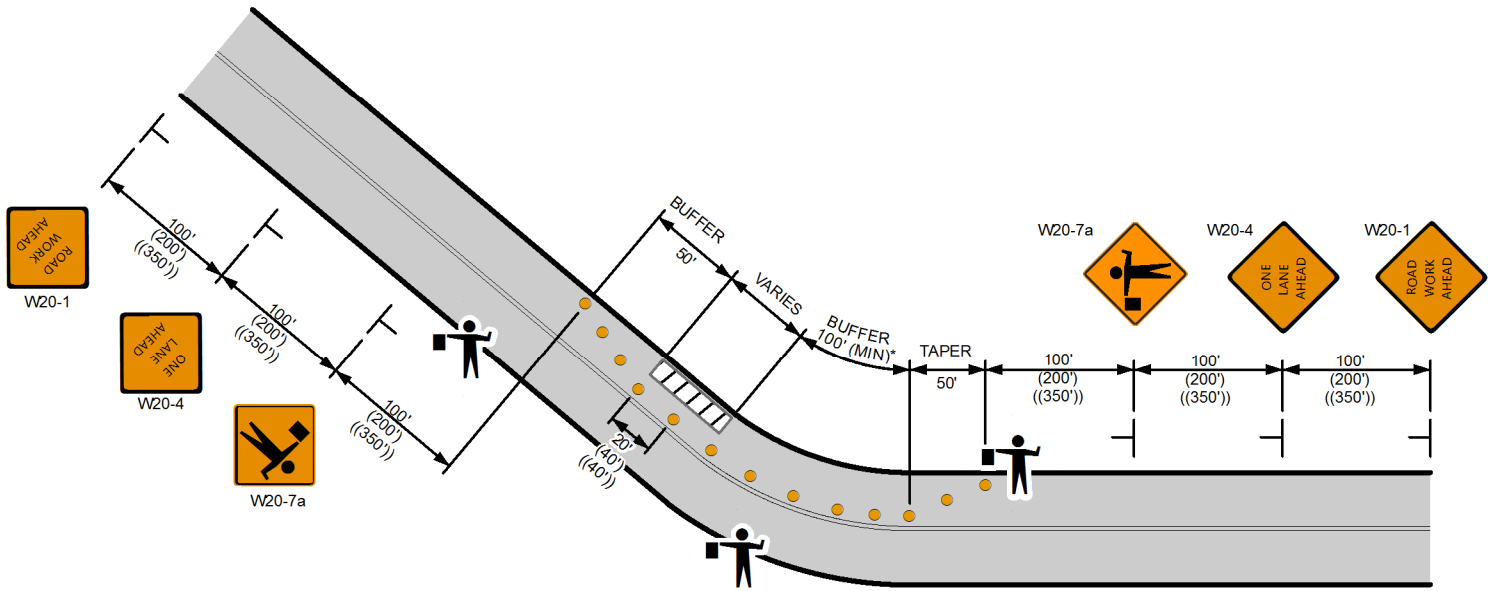
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

3. POLICE OFFICERS ARE REQUIRED TO DIRECT TRAFFIC AT SIGNALIZED INTERSECTION.

4. ADDITIONAL SIGNAGE, AND/OR TRAFFIC CONTROLS SUCH AS TURN PROHIBITIONS AND ADDITIONAL FLAGGERS MAY BE REQUIRED.

DIAGRAM 9
2 WAY, ONE LANE TRAFFIC
(FLAGGER CONTROL)



LEGEND

- CONES/DRUMS
- TYPE III BARRICADE
- SIGNS
- WORK AREA
- FLAGGER

NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

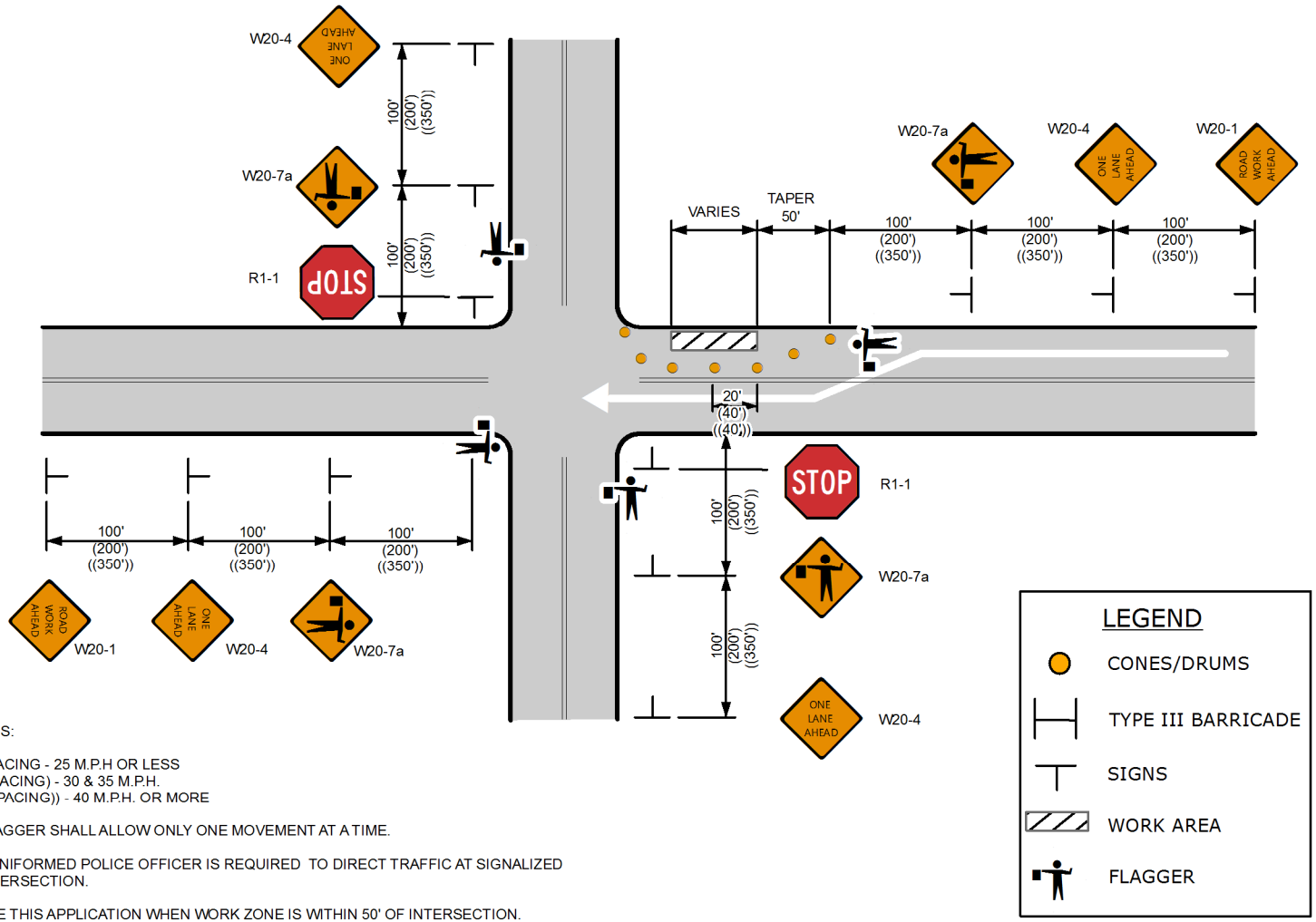
2. *BUFFER SHALL EXTEND BACK TO THE BEGINNING OF THE CURVE OR HILL TO PROVIDE ADEQUATE SIGHT DISTANCE FOR THE APPROACHING TRAFFIC.

3. ON LOW VOLUME, RESIDENTIAL STREETS WHERE THERE IS ADEQUATE VISIBILITY, A SINGLE FLAGGER POSITIONED AS SHOWN MAY BE ACCEPTABLE.

4. IF WORK IS WITHIN 50' OF AN INTERSECTION SEE DIAGRAM 10 OR 11.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

DIAGRAM 10
WORK AREA BEFORE AN INTERSECTION
(FLAGGER CONTROL)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. FLAGGER SHALL ALLOW ONLY ONE MOVEMENT AT A TIME.

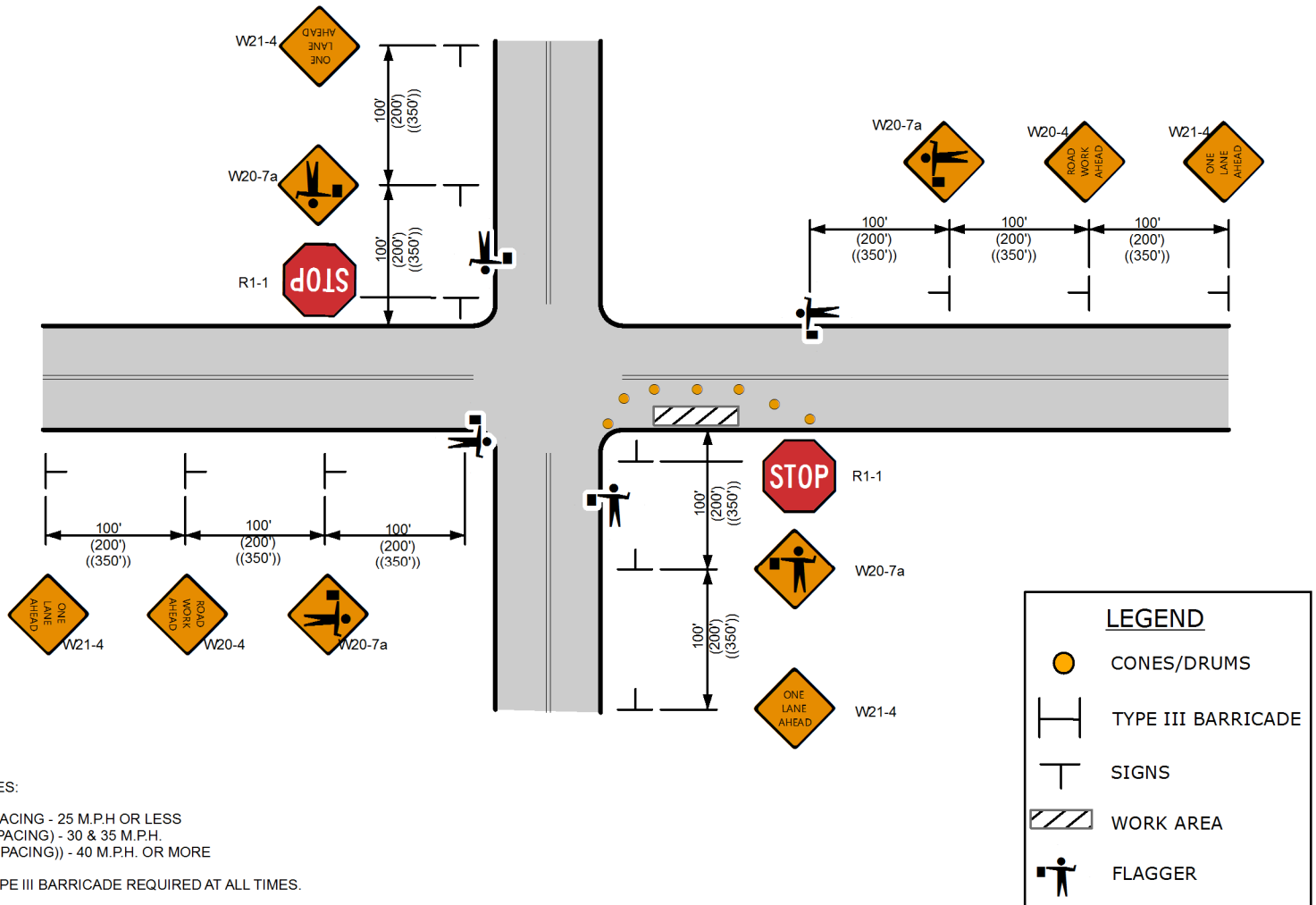
3. A UNIFORMED POLICE OFFICER IS REQUIRED TO DIRECT TRAFFIC AT SIGNALIZED INTERSECTION.

4. USE THIS APPLICATION WHEN WORK ZONE IS WITHIN 50' OF INTERSECTION.

5. ADDITIONAL SIGNAGE AND/OR TRAFFIC CONTROLS SUCH AS TURN PROHIBITIONS AND ADDITIONAL FLAGGER MAY BE REQUIRED.

6. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

DIAGRAM 11
WORK AREA BEYOND AN INTERSECTION
(FLAGGER CONTROL)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

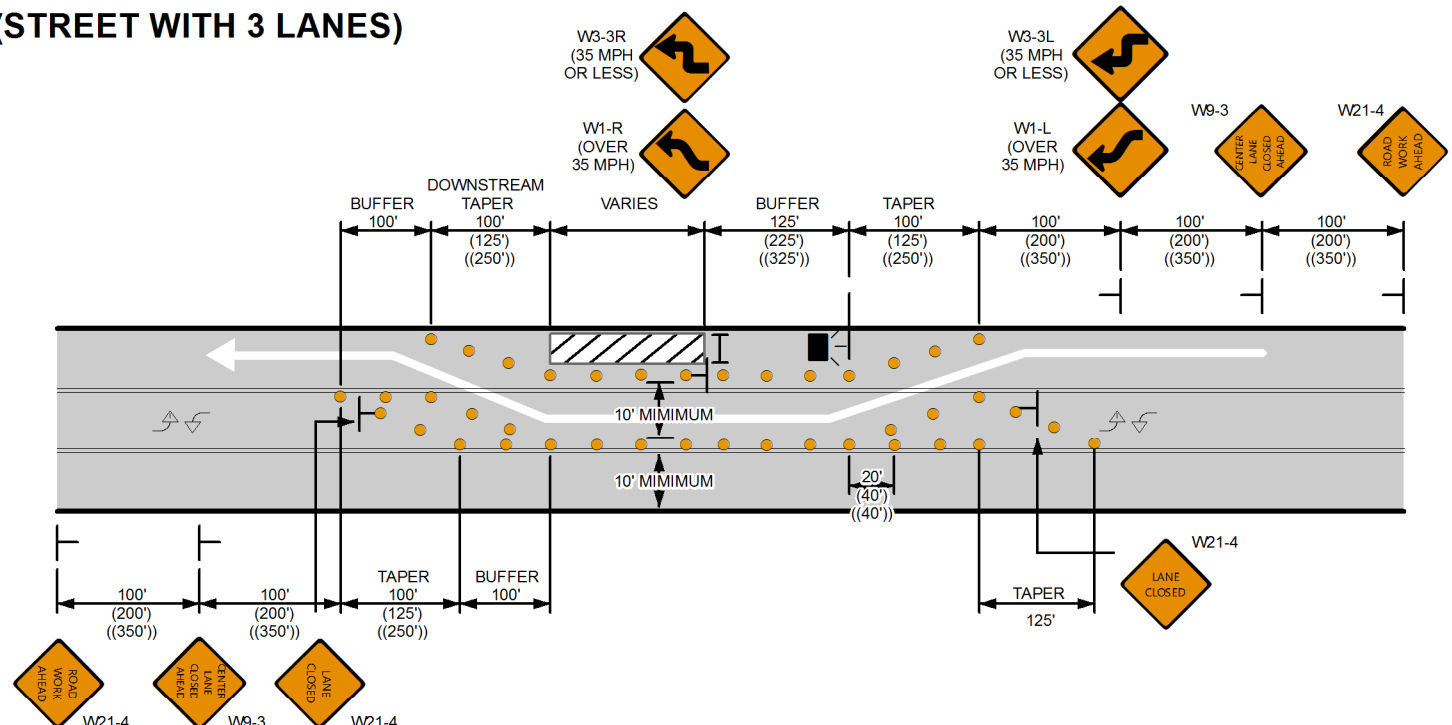
2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

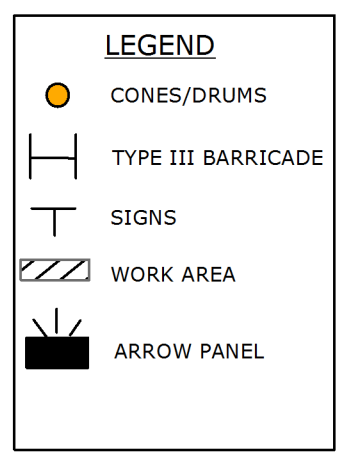
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

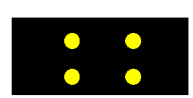
4. USE THIS DIAGRAM IF THE WORK AREA IS WITHIN 350' (625') OF THE INTERSECTION.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

DIAGRAM 12
WORK AREA IN THE THRU LANE
(STREET WITH 3 LANES)







ARROW PANEL
DISPLAY
(IF USED)

NOTES:

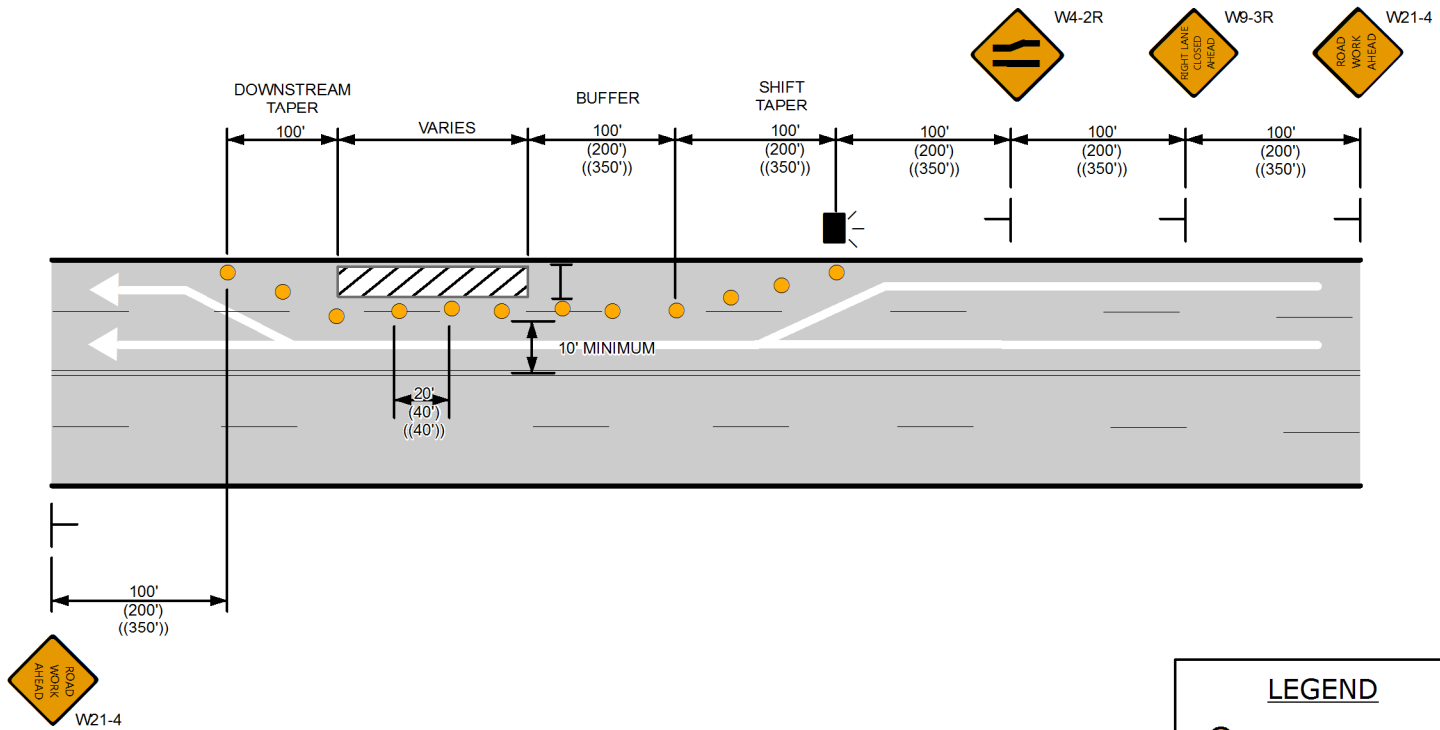
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY ID WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES. REFER TO DIAGRAM 31.

DIAGRAM 13
WORK AREA IN TRAVEL LANE
(MULTI-LANE ROADWAY)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. USE THIS DIAGRAM IF THE WORK AREA IS WITHIN 350' (625') OF THE INTERSECTION.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

6. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.

ARROW PANEL DISPLAY

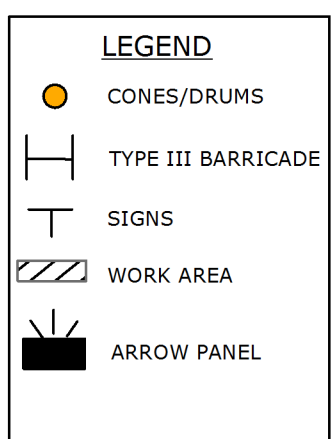
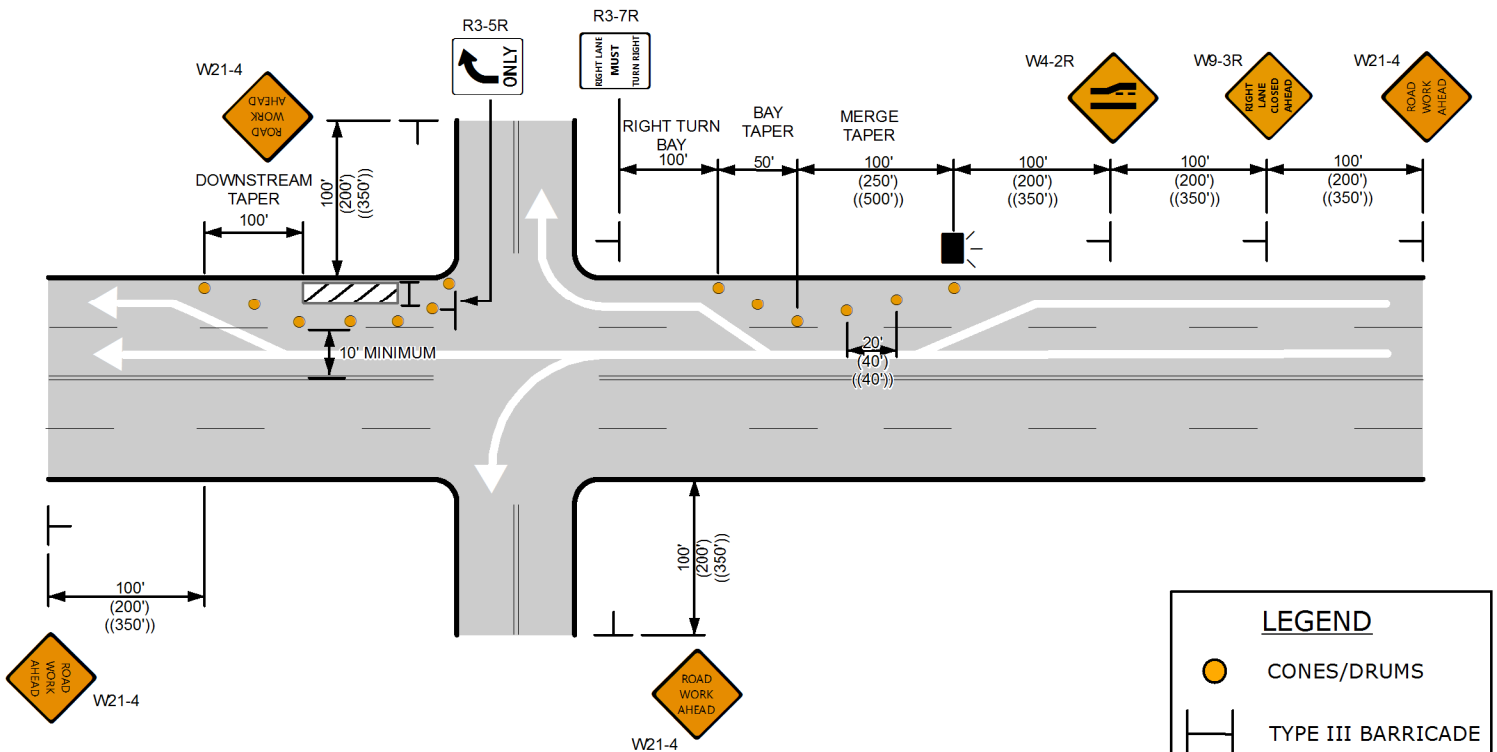


DIAGRAM 14A
RIGHT LANE CLOSURE ON FAR SIDE OF INTERSECTION (LOW VOLUME OF RIGHT-TURN TRAFFIC)



NOTES:

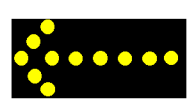
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

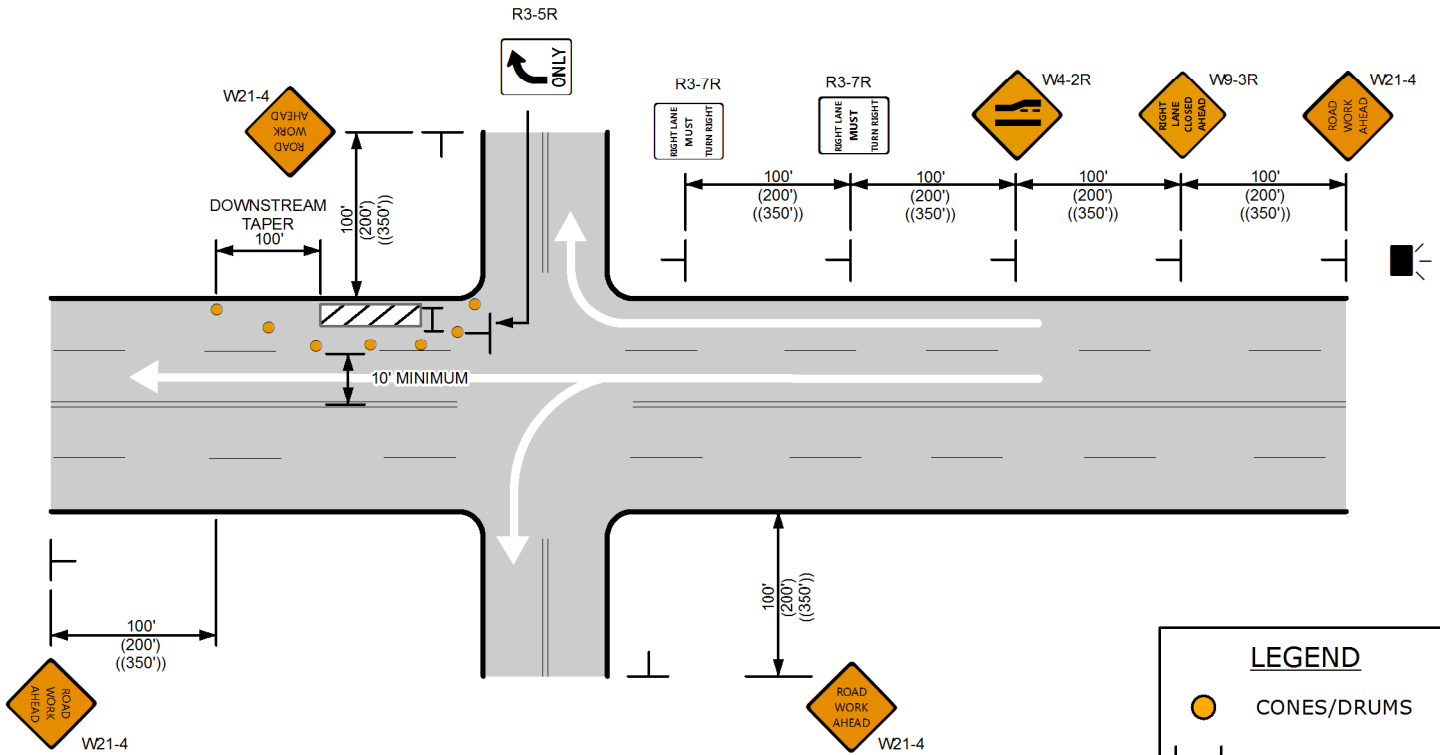
4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

5. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.



ARROW PANEL DISPLAY

DIAGRAM 14B
RIGHT LANE CLOSURE ON FAR SIDE OF INTERSECTION (HIGH VOLUME OF RIGHT-TURN TRAFFIC)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

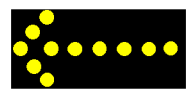
2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. USE THIS DIAGRAM IF THE WORK AREA IS WITHIN 350' (625') OF THE INTERSECTION.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

6. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.



ARROW PANEL DISPLAY

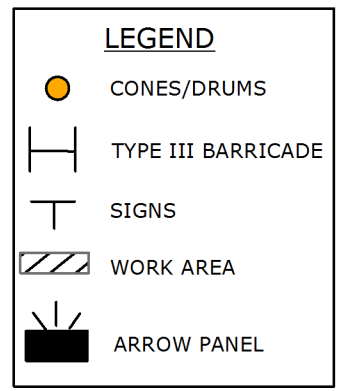
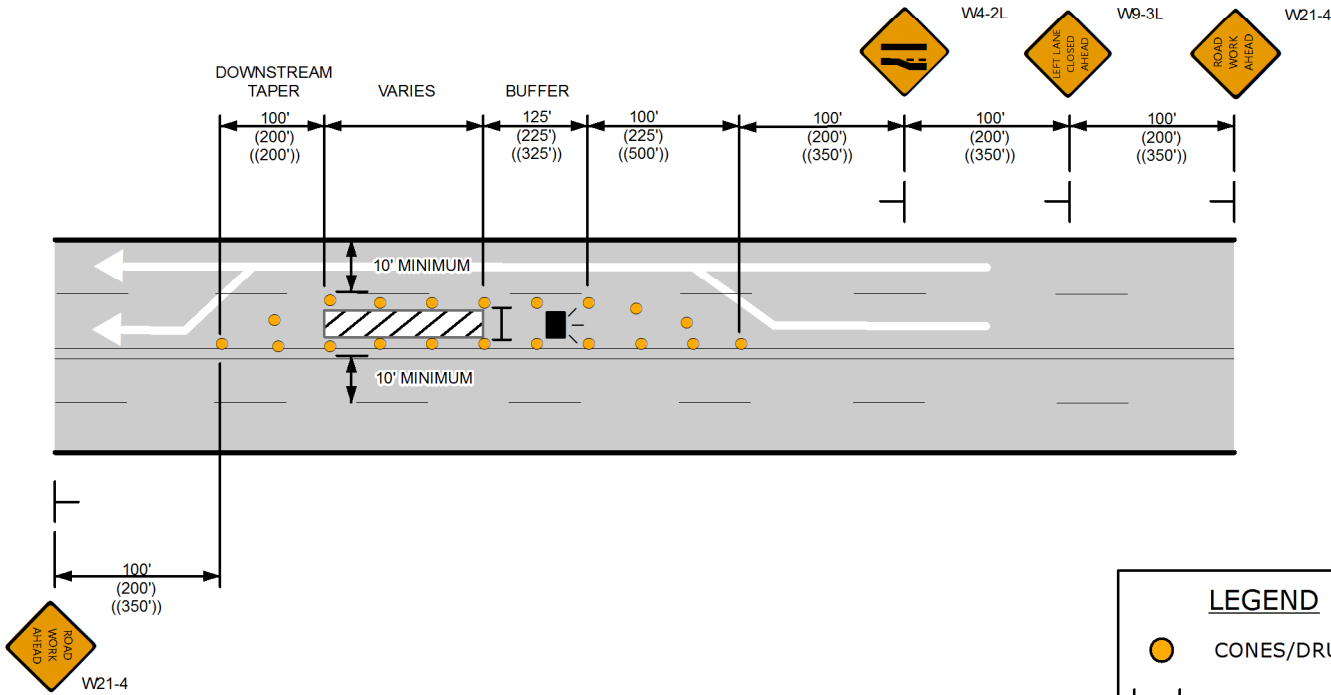
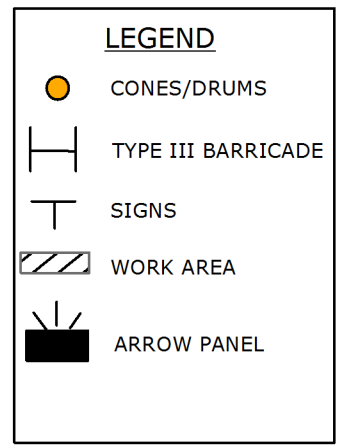


DIAGRAM 15
WORK AREA IN LEFT LANE
(MULTI-LANE ROADWAY)





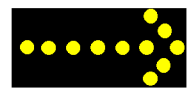
NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

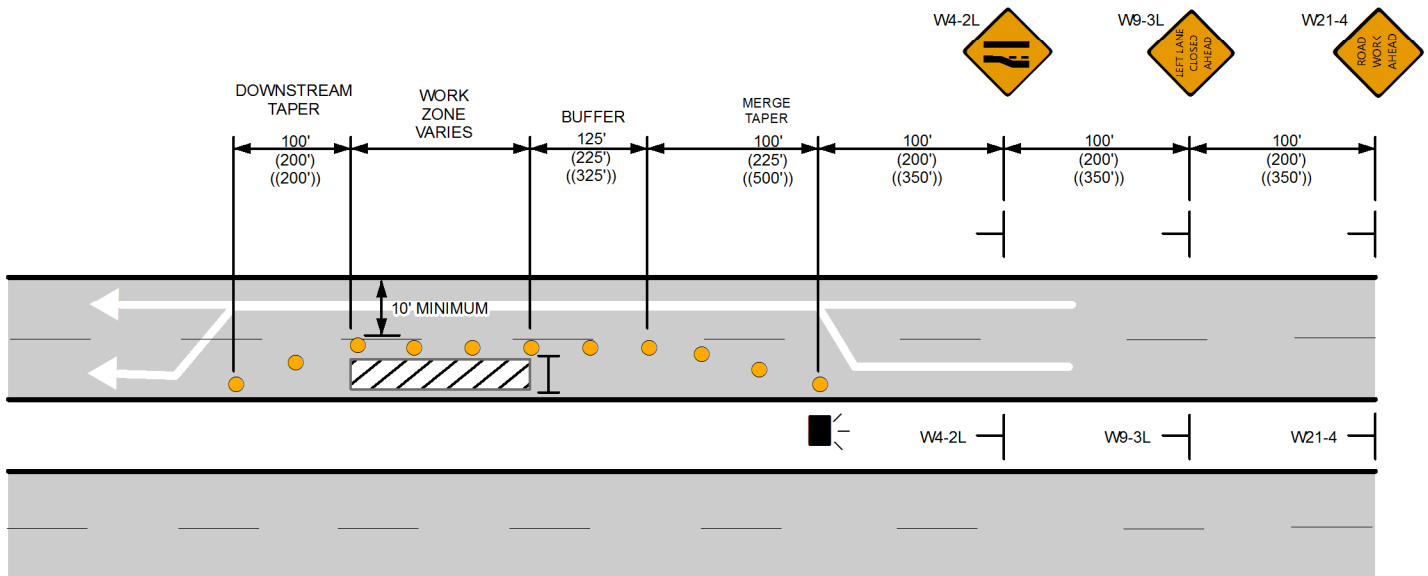
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

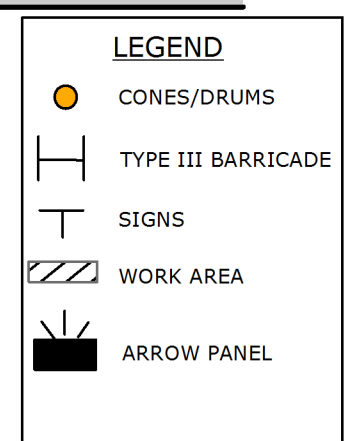
4. SEE DIAGRAM 16 FOR LEFT TURN LANE CLOSURE ON A MEDIAN DIVIDED ROADWAY.



ARROW PANEL DISPLAY

DIAGRAM 16
WORK AREA IN LEFT LANE
(STREET WITH MEDIAN)





NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

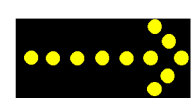
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. USE ALSO ON ONE-WAY STREETS OF 2 OR MORE LANES.

5. IF MEDIAN IS NOT SUFFICIENT WITH FOR PLACEMENT OF ADVANCE CONSTRUCTION WARNING SIGNS THEN USE "WORK AREA IN LEFT LANE (MULTI-LANE ROADWAY) DIAGRAM 15.

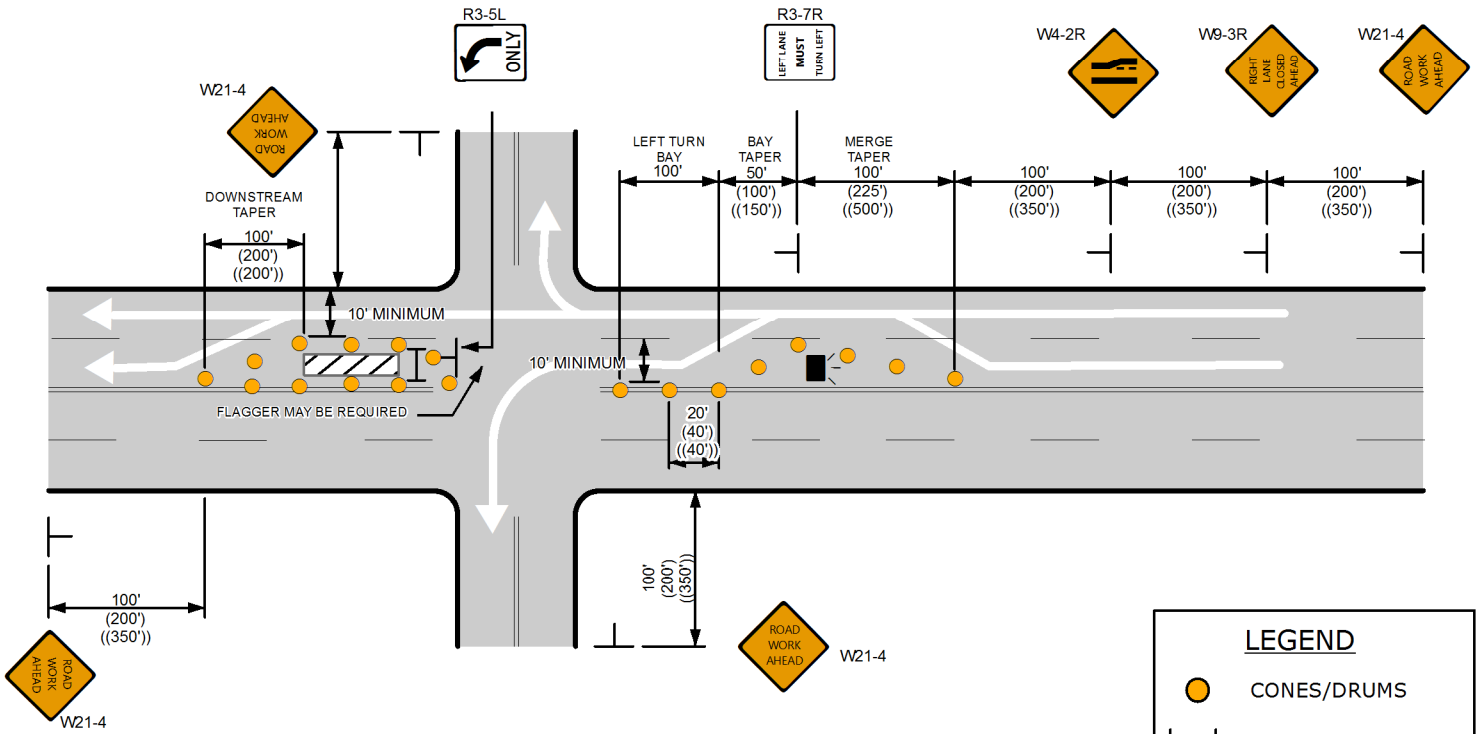
6. USE OF AN ARROW PANEL AS SHOWN IS RECOMMENDED.

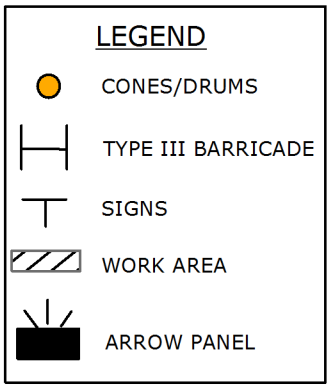
7. SIGN W1-6 MAY BE SUBSTITUTED FOR THE ARROW PANEL DURING DAYLIGHT OPERATIONS.



ARROW PANEL DISPLAY

DIAGRAM 17
WORK AREA IN LEFT LANE
(BEYOND INTERSECTION)





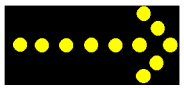
NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

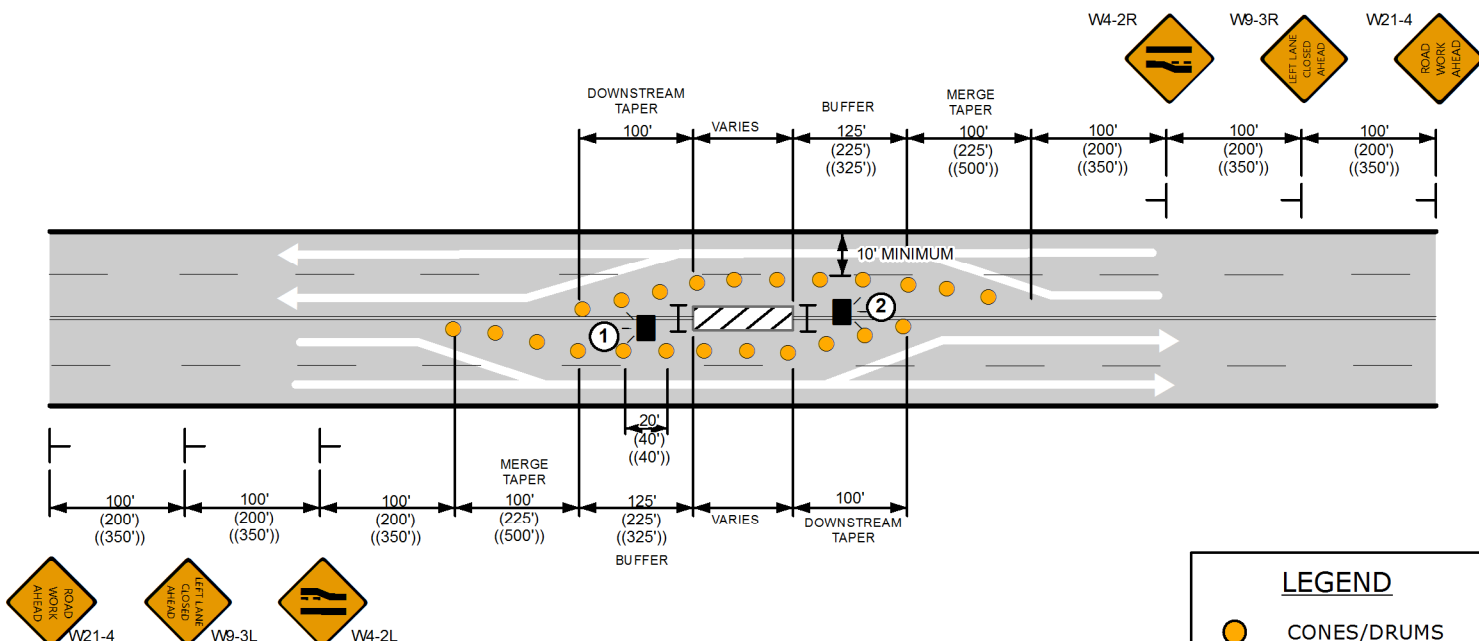
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

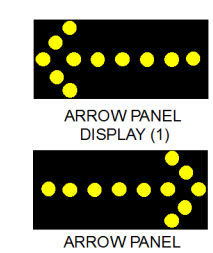
4. USE THIS DIAGRAM IF THE WORK AREA IS WITHIN 350' (625') OF THE INTERSECTION.

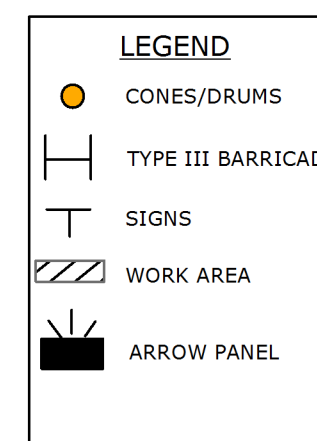


ARROW PANEL DISPLAY

DIAGRAM 18
WORK AREA IN CENTER OF STREET
(MULTI-LANE ROADWAY)







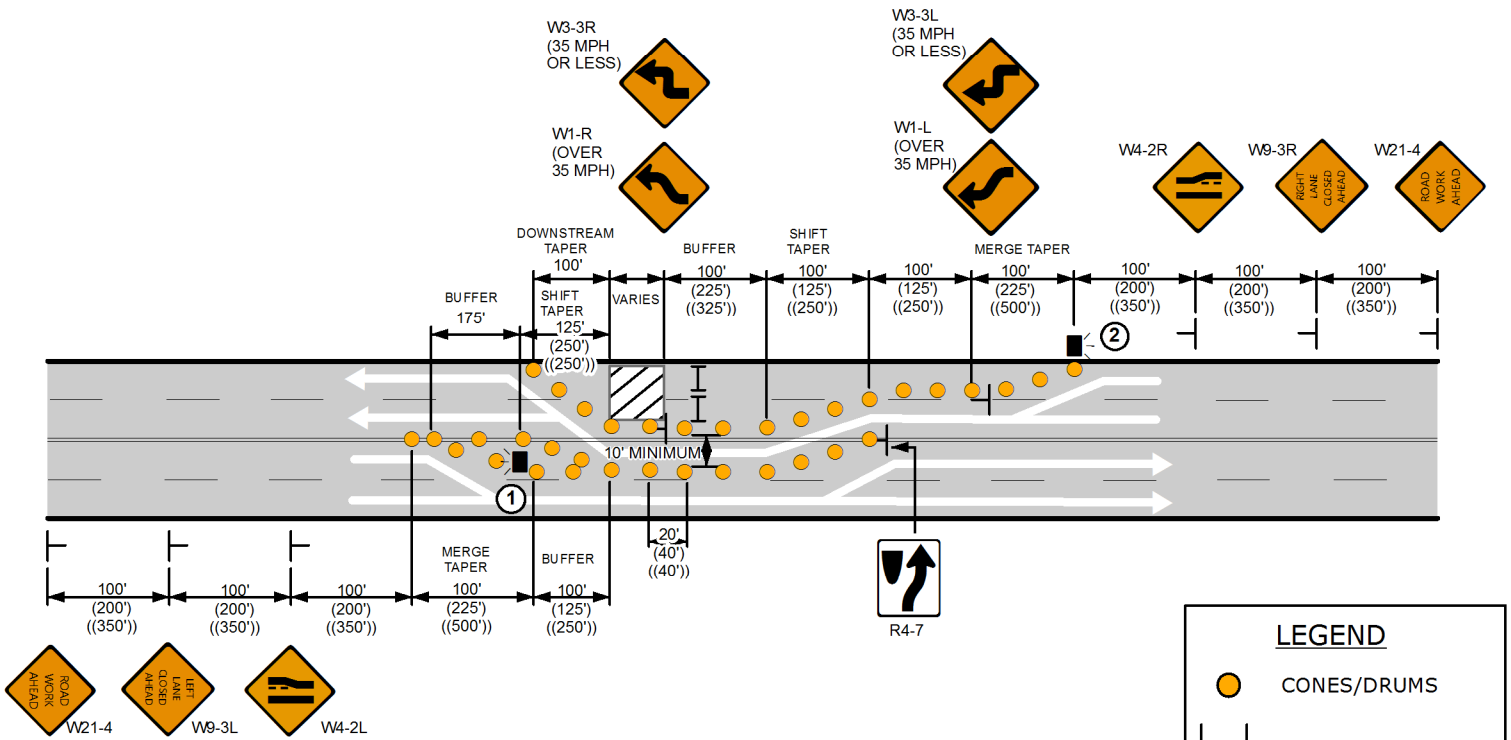
NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

DIAGRAM 19
WORK AREA IN HALF OF STREET
(4LANES, 2 WAY TRAFFIC)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

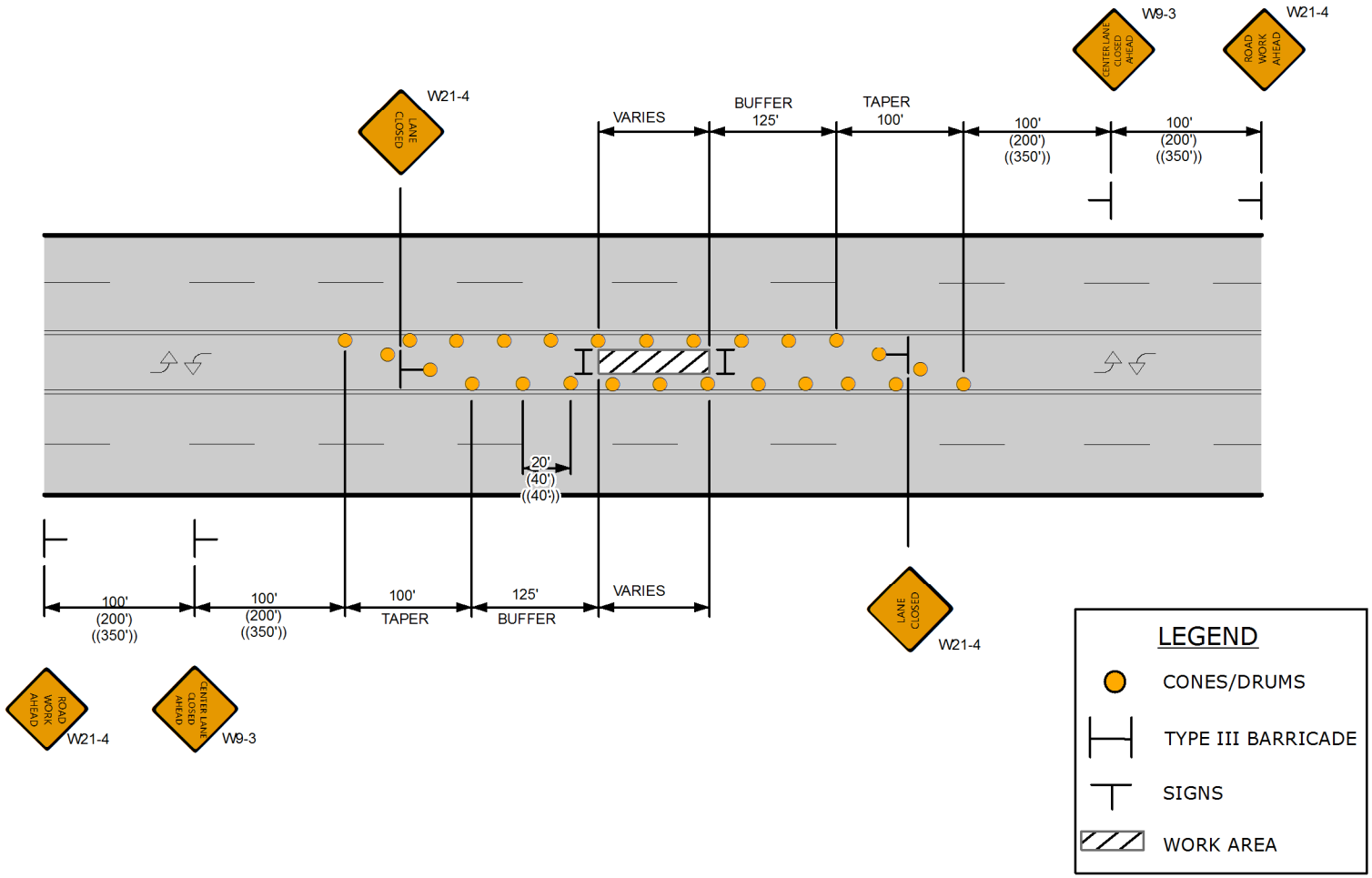
2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

5. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.

DIAGRAM 20
WORK AREA IN TWO-WAY LEFT TURN LANE
(ALL THRU LANES OPEN)

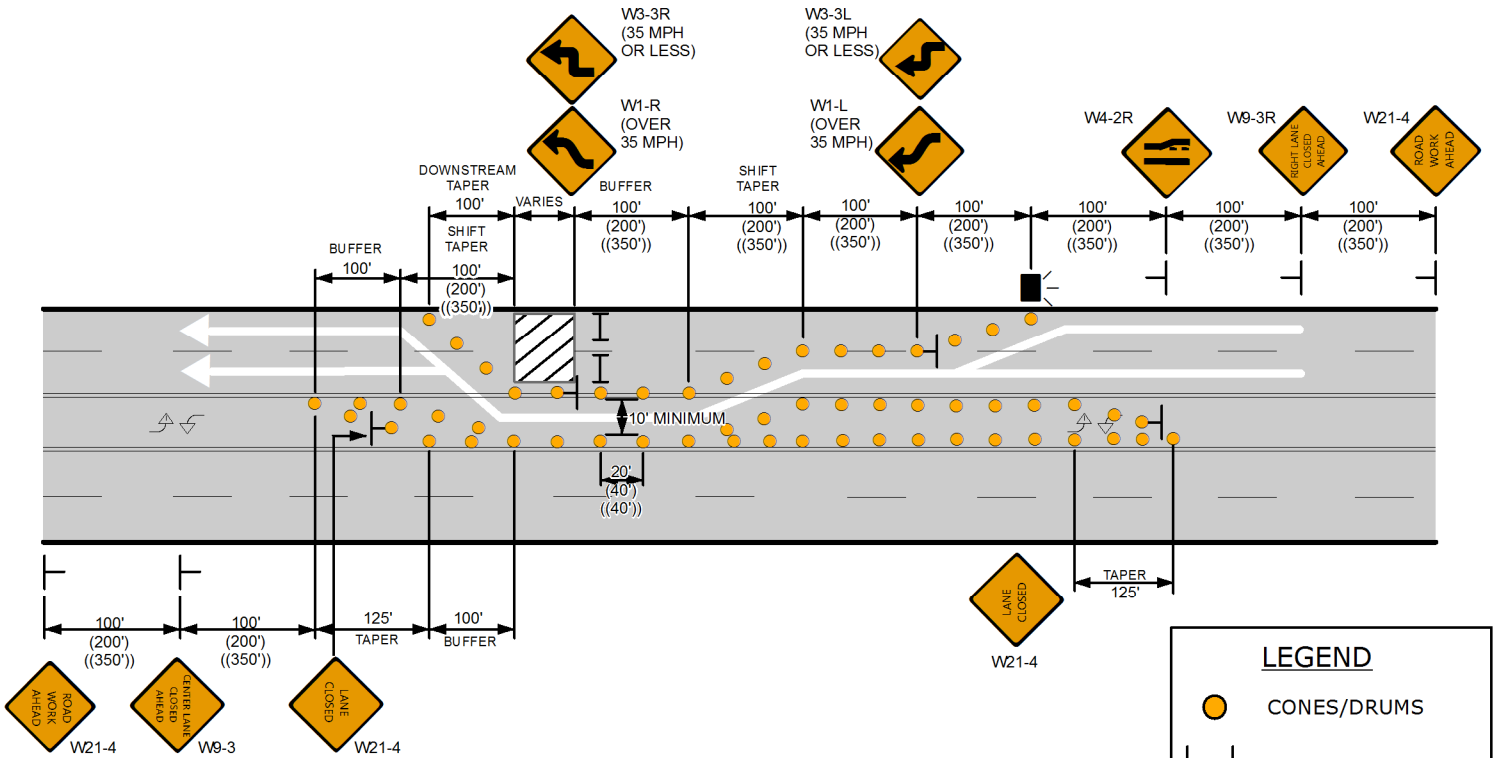


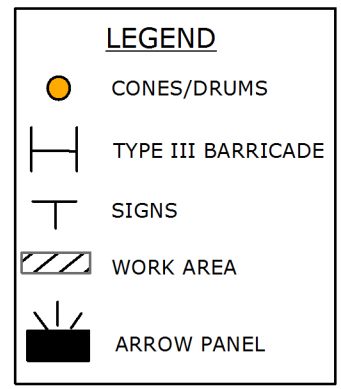
NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

DIAGRAM 21
WORK AREA IN BOTH THRU LANES
(STREET WITH 5 LANES)





NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

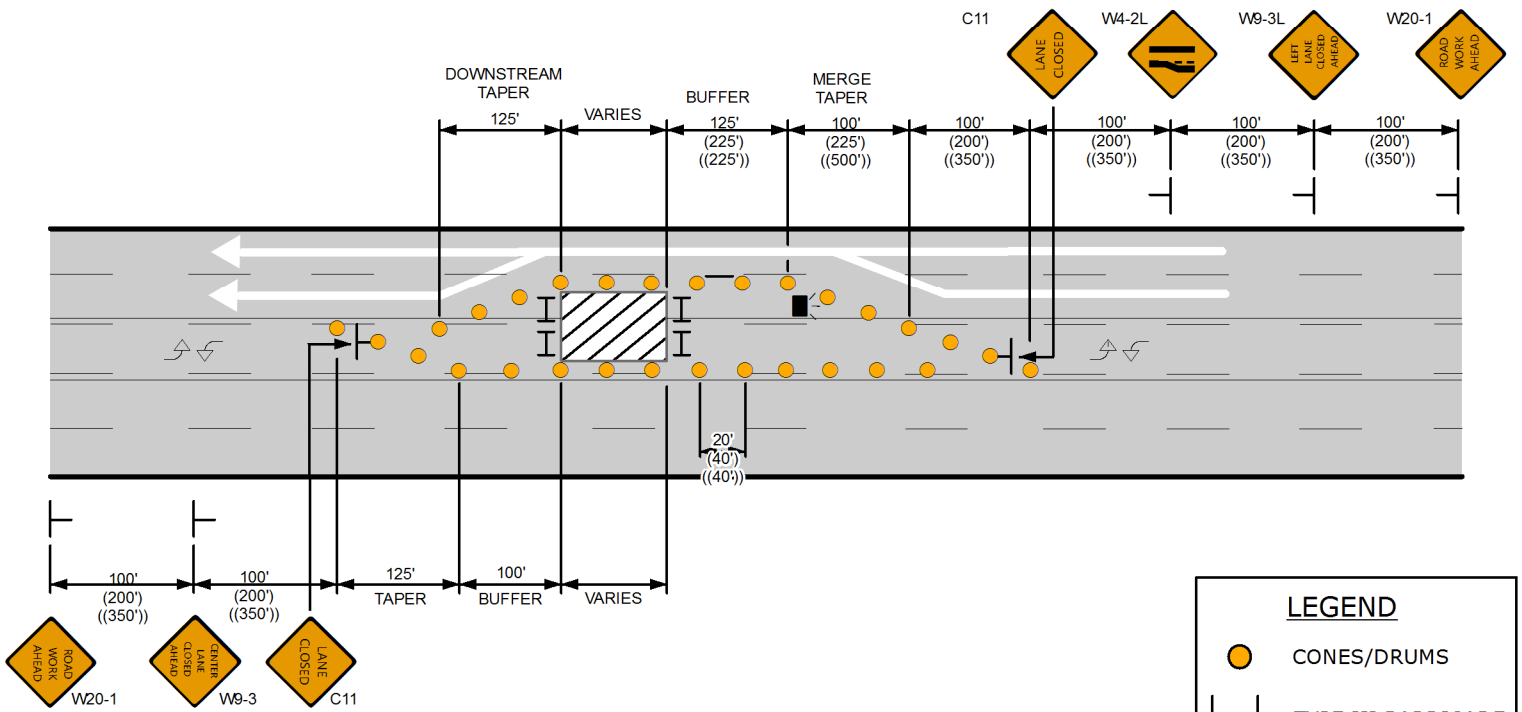
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. FOR WORK AREA IN THE LEFT TURN LANE, ALSO CLOSE CENTER TWO-WAY LEFT TURN LANE AS SHOW

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

ARROW PANEL
DISPLAY

DIAGRAM 22
WORK AREA IN LEFT THRU LANE AND CENTER 2 WAY LEFT TURN LANE (STREET WITH FIVE LANES)



LEGEND

- CONES/DRUMS
- TYPE III BARRICADE
- SIGNS
- WORK AREA
- ARROW PANEL

ARROW PANEL DISPLAY

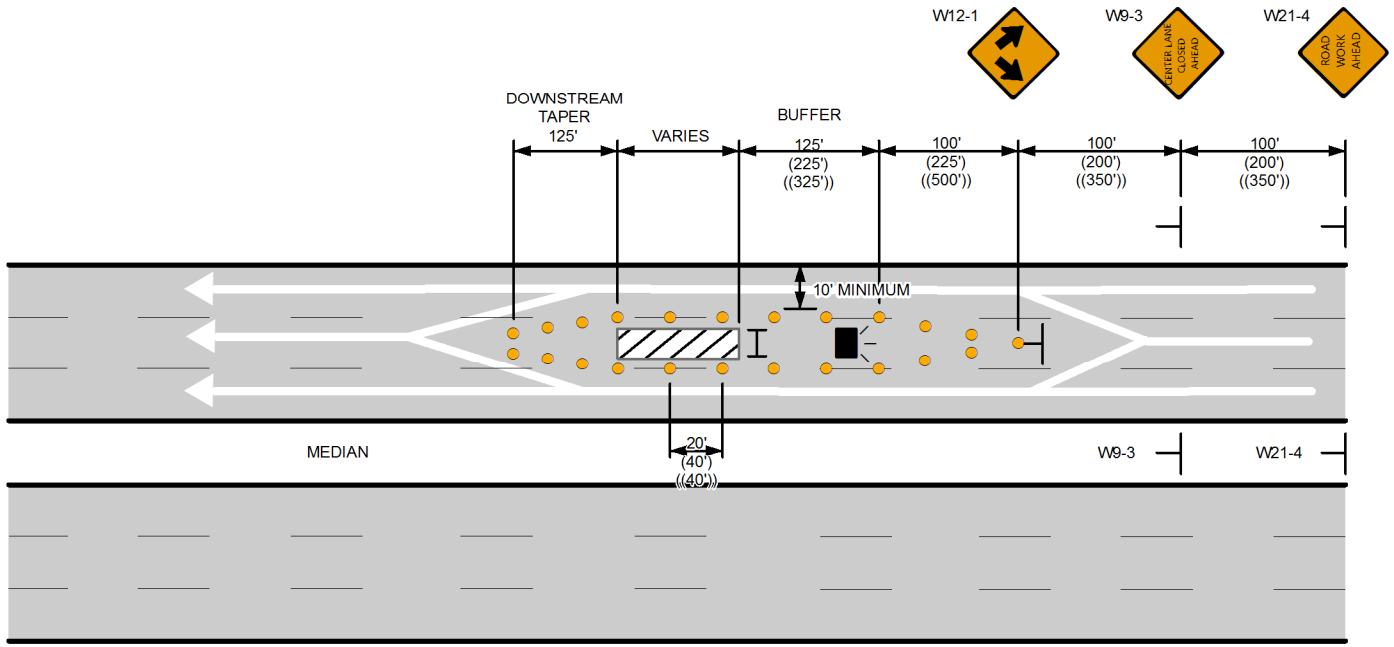
NOTES:

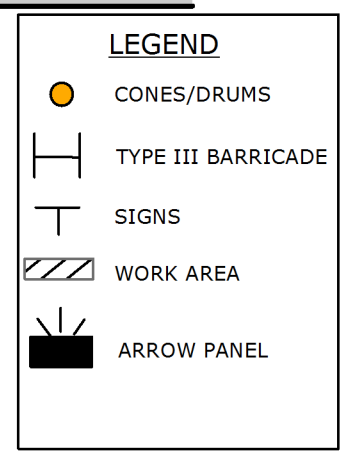
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

DIAGRAM 23
WORK AREA IN CENTER LANE
(3 OR MORE LANES IN ONE DIRECTION)





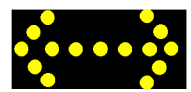
NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

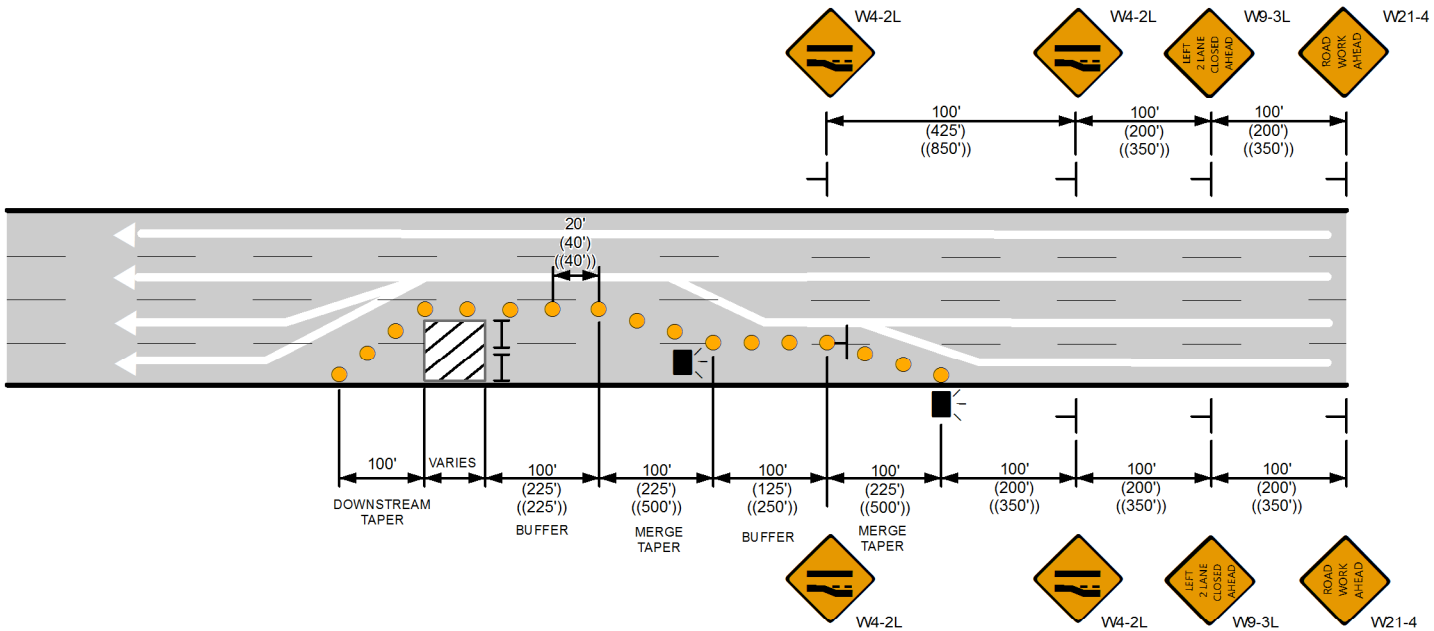
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

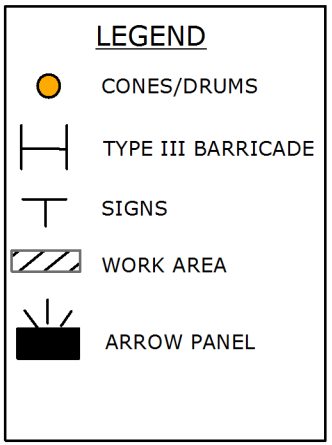
4. USE ALSO ON ONE-WAY STREETS OF THREE OR MORE LANES.



ARROW PANEL DISPLAY

DIAGRAM 24
WORK AREA IN LEFT TWO LANES
(3 OR MORE LANES IN ONE DIRECTION)





NOTES:

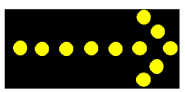
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

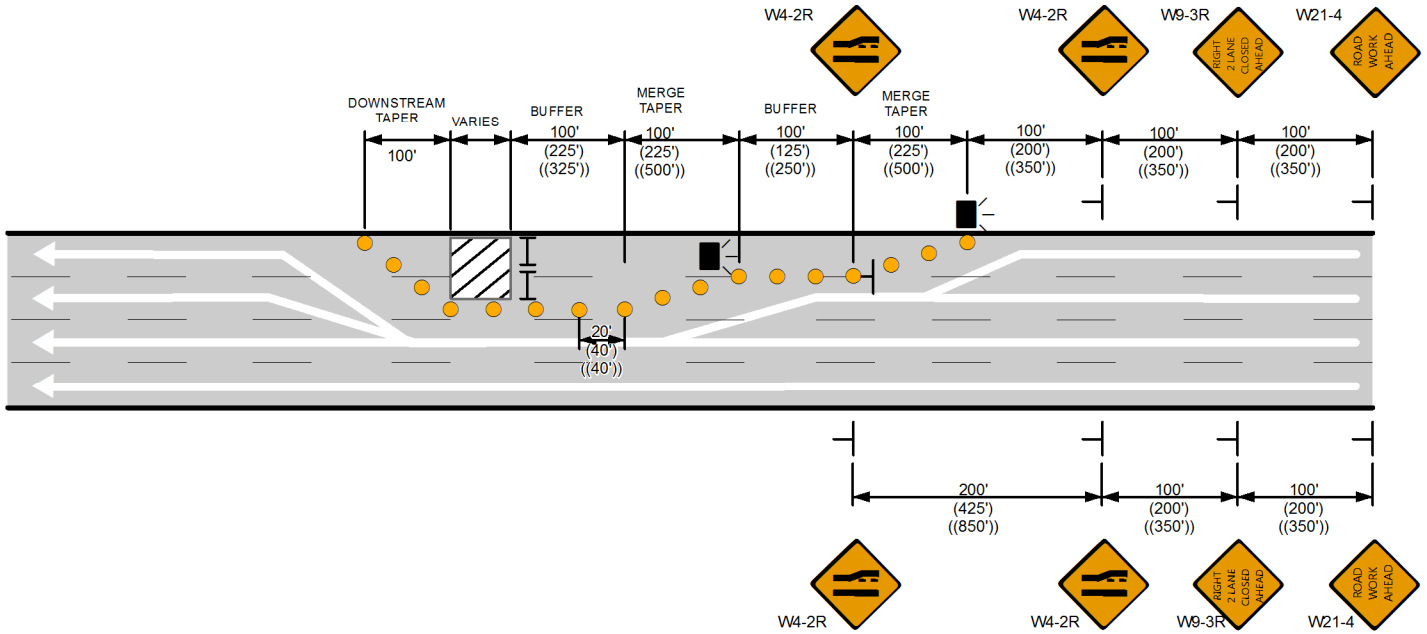
4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

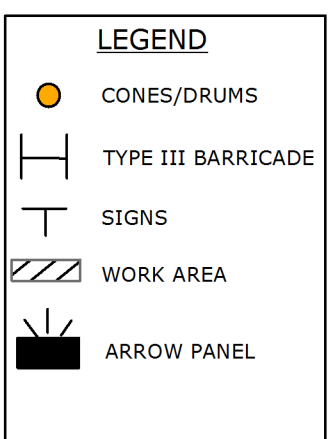
5. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.



ARROW PANEL DISPLAY

DIAGRAM 25
WORK AREA IN RIGHT TWO LANES
(3 OR MORE LANES IN ONE DIRECTION)





NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

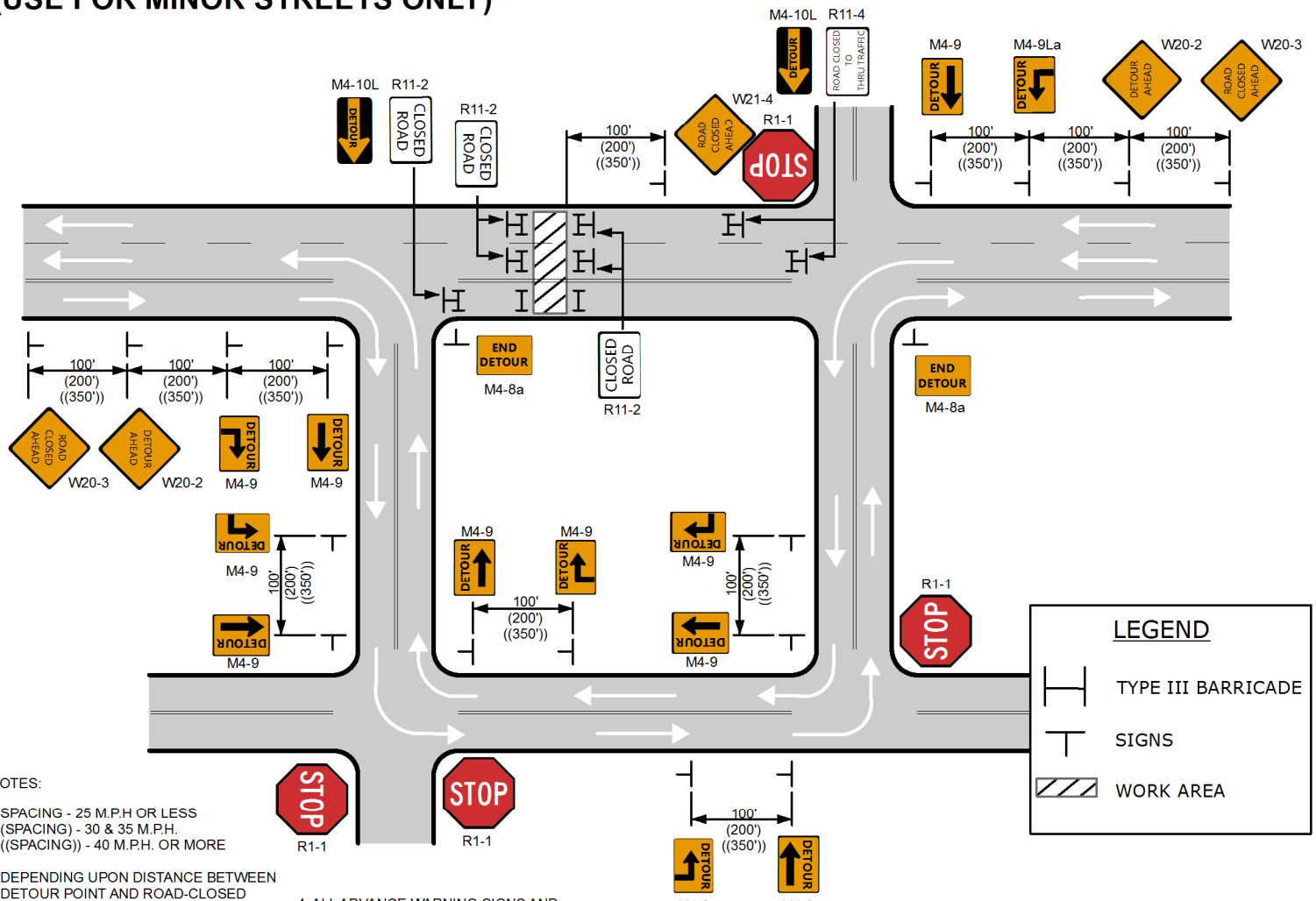
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

5. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.

ARROW PANEL DISPLAY

DIAGRAM 26
DETOUR PLAN FOR CLOSED ROAD
(USE FOR MINOR STREETS ONLY)



NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

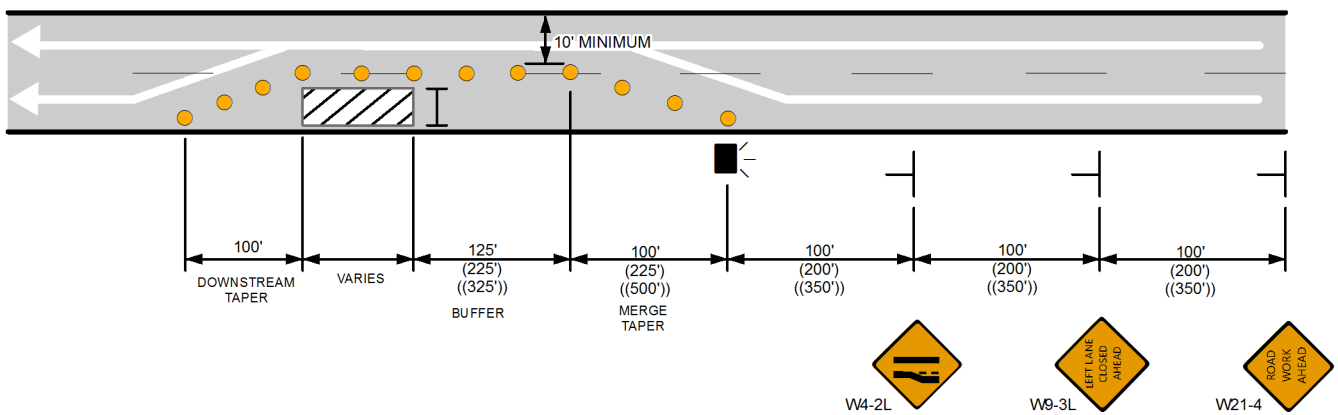
2. DEPENDING UPON DISTANCE BETWEEN DETOUR POINT AND ROAD-CLOSED POINT ADEQUATE ADDITIONAL WARNING IS REQUIRED ON APPROACH TO ROAD-CLOSE BARRICADES (1 TO 3 SIGNS).

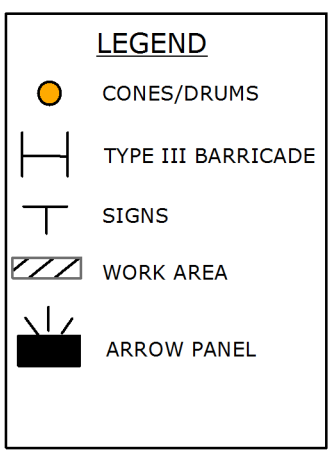
3. DEPENDING ON CONDITIONS, SOME SIGNS MAY BE REQUIRED ON CROSS STREET APPROACHES.

4. ALL ADVANCE WARNING SIGNS AND DETOUR SIGNS MAYBE SUPPLEMENTED WITH FLASHER AND/OR FLAGS.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

DIAGRAM 27
WORK AREA IN LEFT LANE
(MULTI-LANE, ONE WAY STREET)





NOTES:

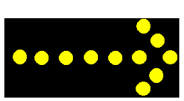
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED ONLY IF WORK ZONE IS LEFT UNATTENDED OVERNIGHT.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

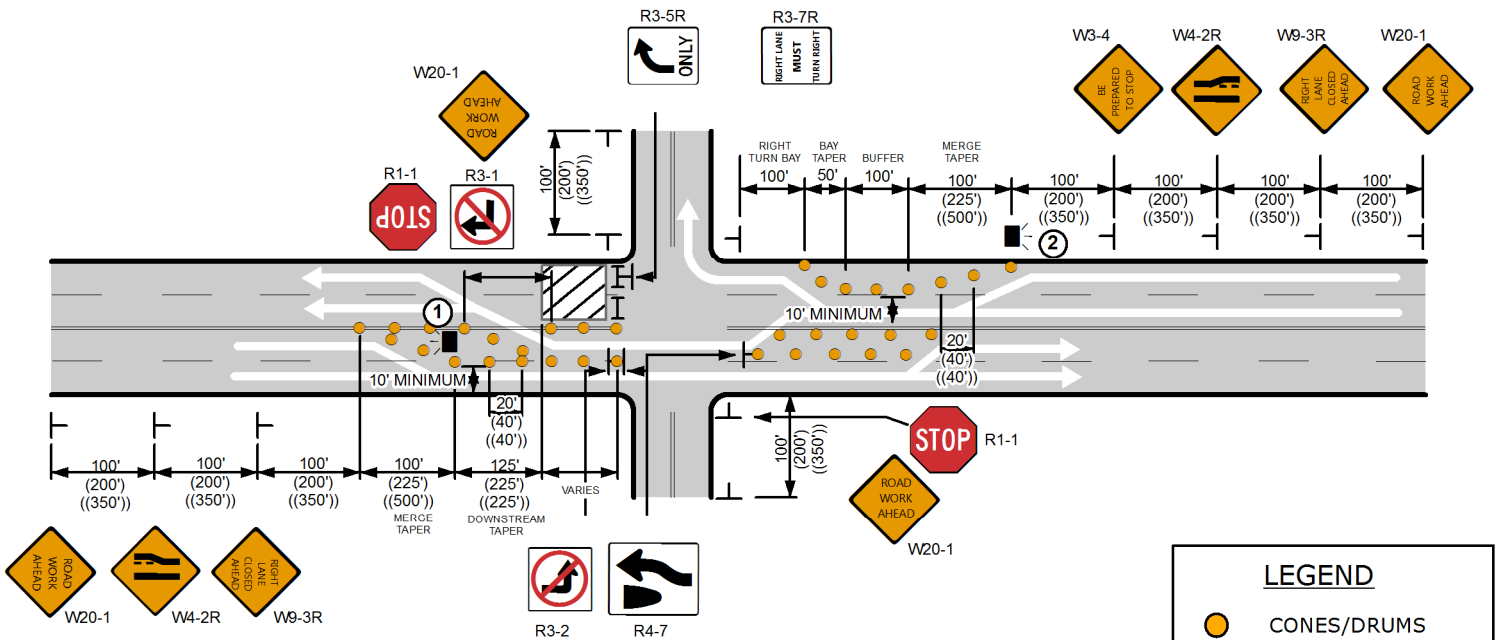
4. USE THIS DIAGRAM IF THE WORK AREA IS WITHIN 350' (625') OF THE INTERSECTION.

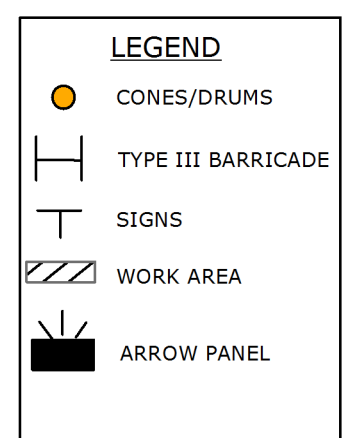
5. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.



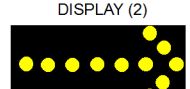
ARROW PANEL DISPLAY

DIAGRAM 28
RIGHT LANE CLOSURE ON FAR SIDE OF INTERSECTION





ARROW PANEL DISPLAY (2)



ARROW PANEL DISPLAY (1)

NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

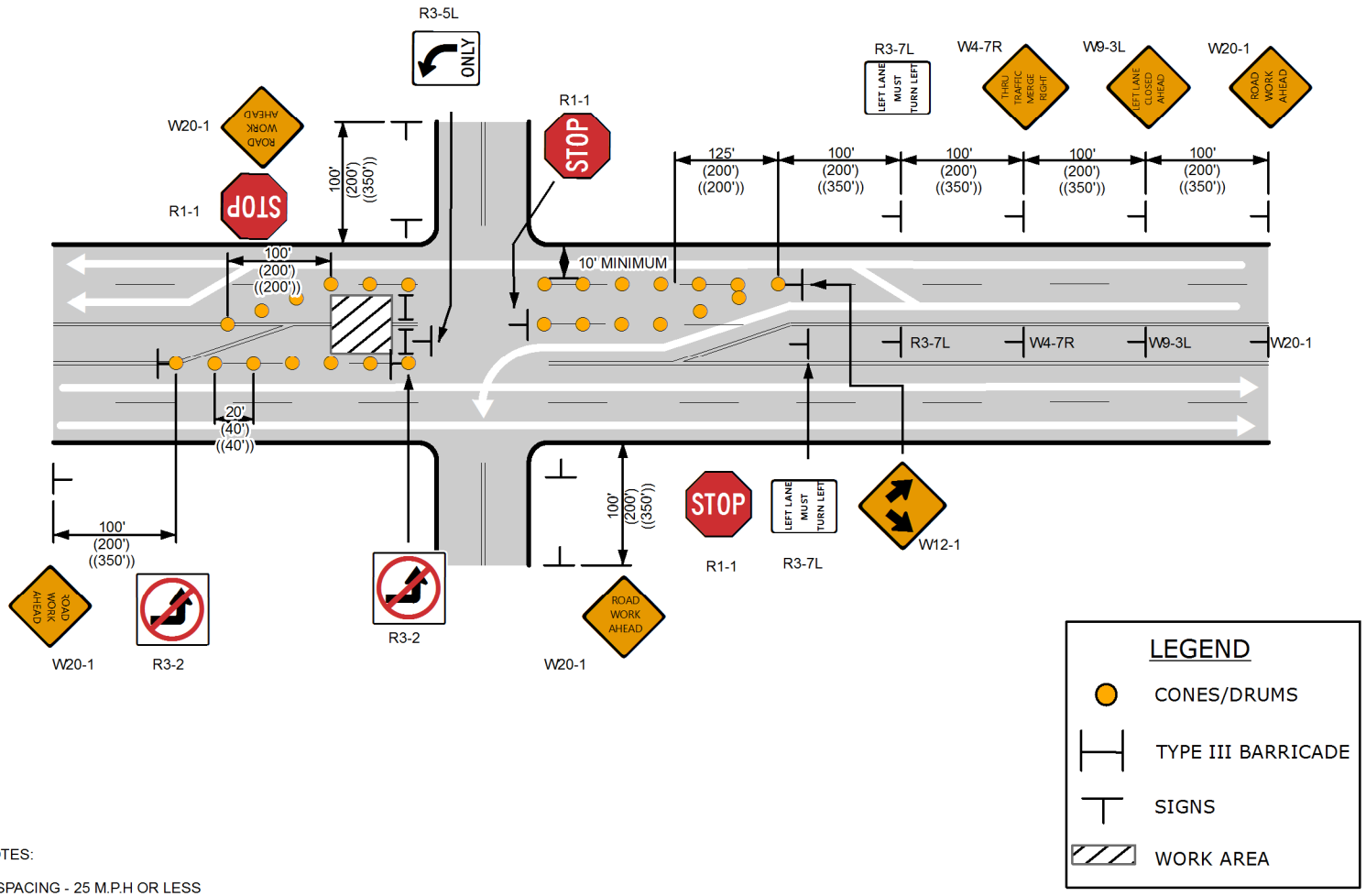
3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. USE THIS DIAGRAM IF THE WORK AREA IS WITHIN 350' (625') OF THE INTERSECTION.

5. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

6. ARROW PANEL SHALL NOT BLOCK SIDEWALK OR PEDESTRIAN MOVEMENT.

DIAGRAM 29
WORK AREA AT INTERSECTION
(MULTI LANE CLOSURES)



NOTES:

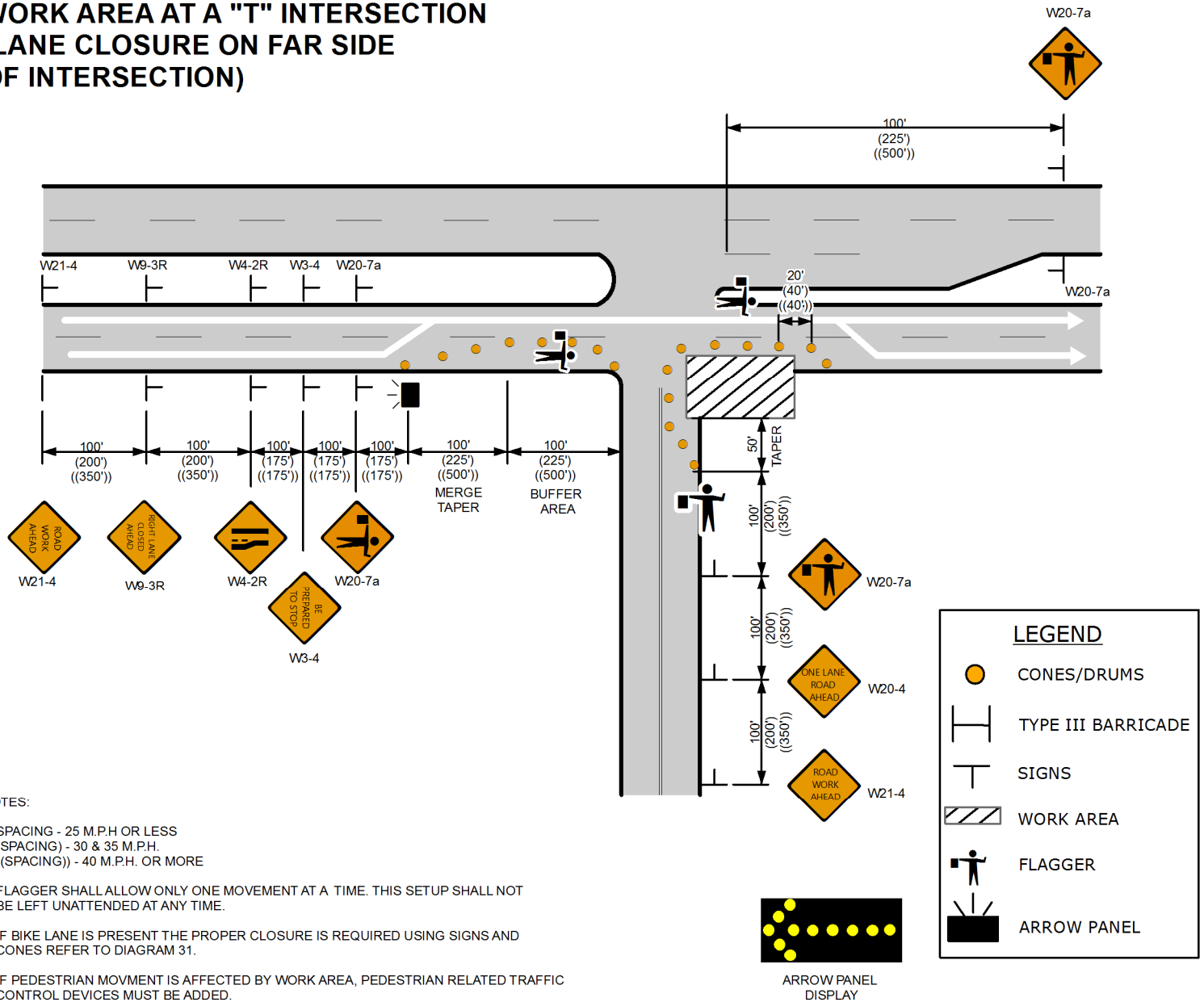
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. TYPE III BARRICADE REQUIRED AT ALL TIMES.

3. IF CLOSURE IS LONG-TERM (SEE SECTION 17), PAVEMENT MARKING SHALL BE REVISED TO MATCH THE TRAFFIC PATTERN.

4. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

DIAGRAM 30
WORK AREA AT A "T" INTERSECTION (LANE CLOSURE ON FAR SIDE OF INTERSECTION)



NOTES:

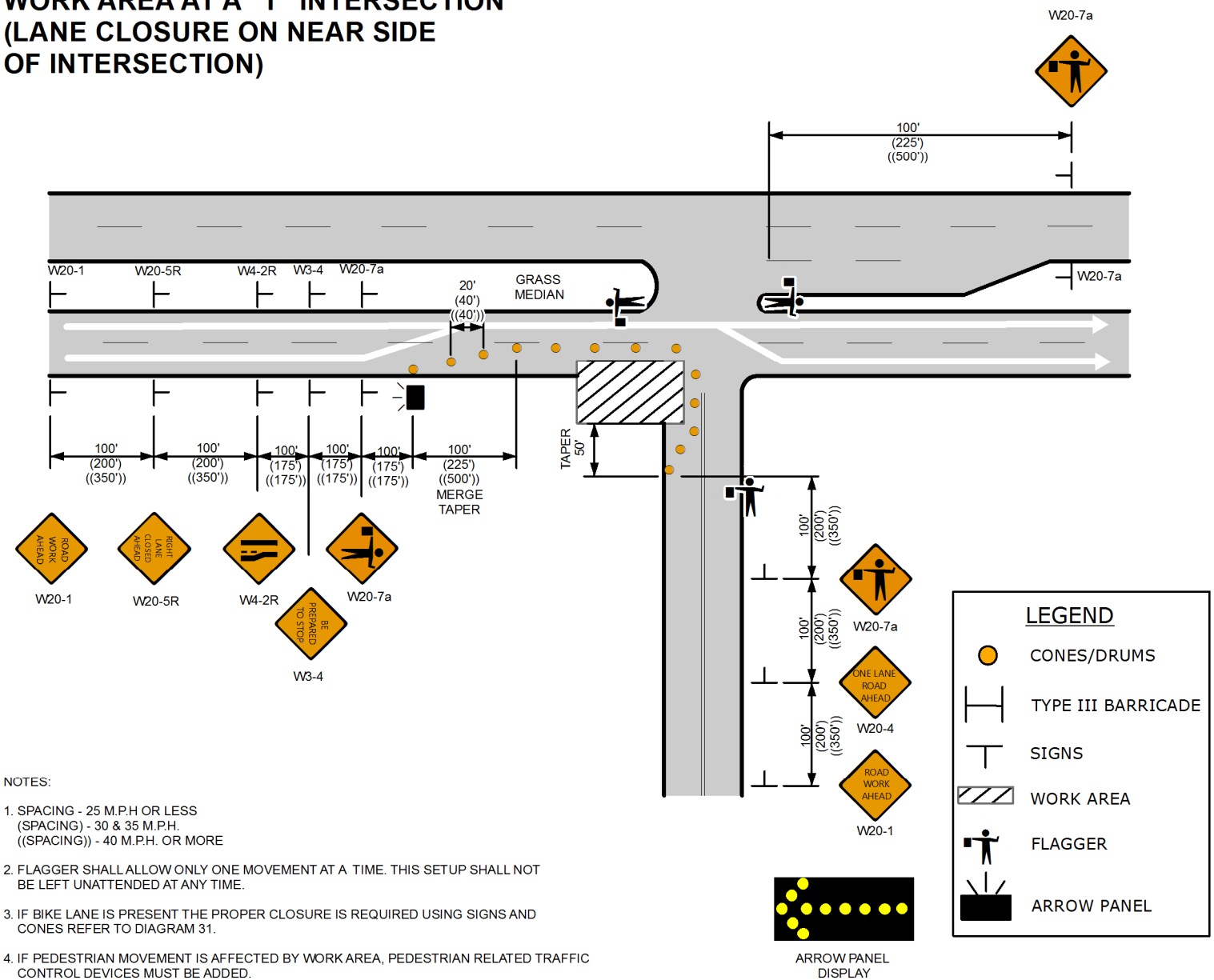
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. FLAGGER SHALL ALLOW ONLY ONE MOVEMENT AT A TIME. THIS SETUP SHALL NOT BE LEFT UNATTENDED AT ANY TIME.

3. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

4. IF PEDESTRIAN MOVMENT IS AFFECTED BY WORK AREA, PEDESTRIAN RELATED TRAFFIC CONTROL DEVICES MUST BE ADDED.

DIAGRAM 30A
WORK AREA AT A "T" INTERSECTION (LANE CLOSURE ON NEAR SIDE OF INTERSECTION)



NOTES:

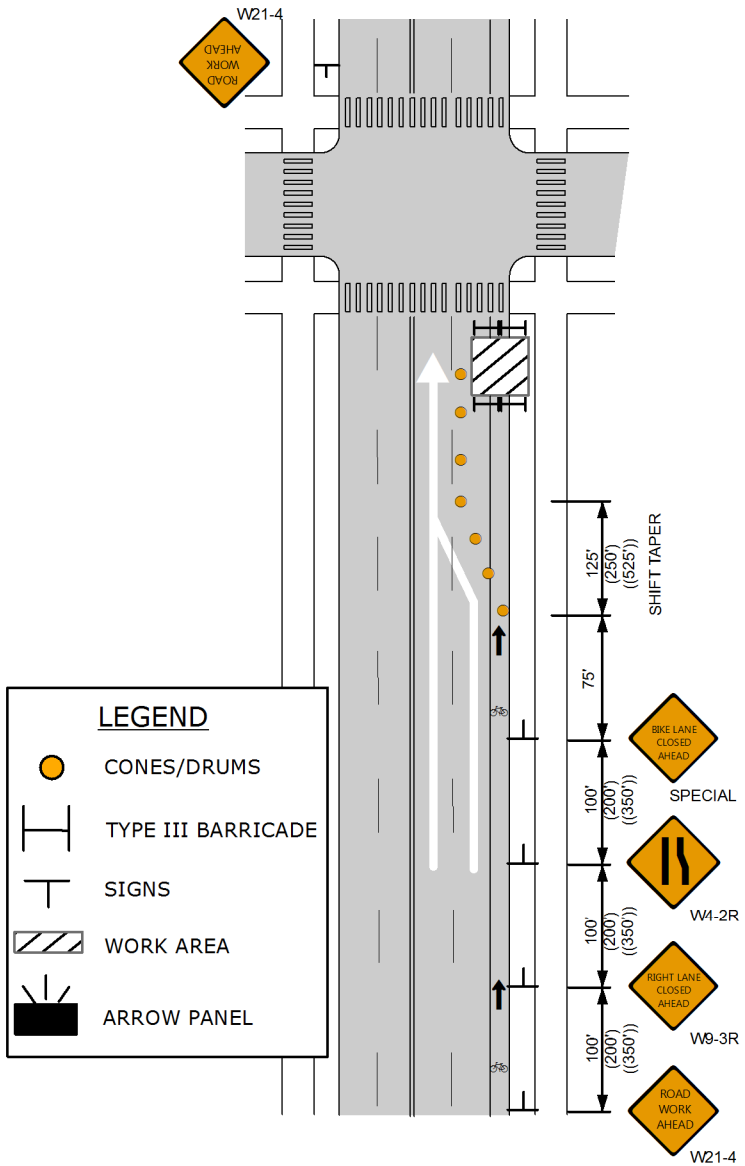
1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

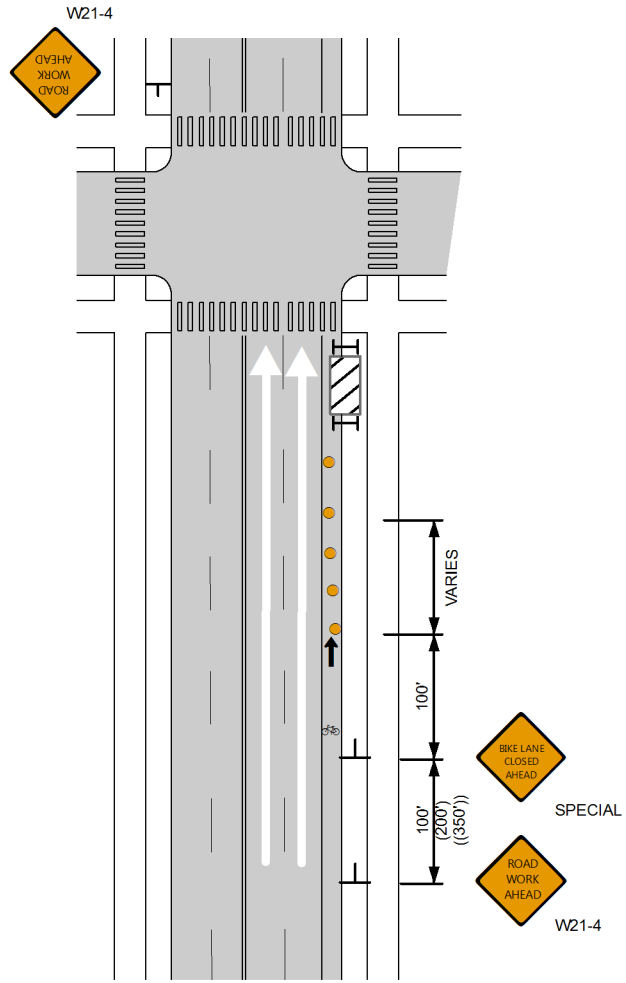
2. FLAGGER SHALL ALLOW ONLY ONE MOVEMENT AT A TIME. THIS SETUP SHALL NOT BE LEFT UNATTENDED AT ANY TIME.

3. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

4. IF PEDESTRIAN MOVEMENT IS AFFECTED BY WORK AREA, PEDESTRIAN RELATED TRAFFIC CONTROL DEVICES MUST BE ADDED.

DIAGRAM 31
BIKE LANE CLOSURE





NOTES:

1. SPACING - 25 M.P.H OR LESS
   (SPACING) - 30 & 35 M.P.H.
   ((SPACING)) - 40 M.P.H. OR MORE

2. IF BIKE LANE IS PRESENT THE PROPER CLOSURE IS REQUIRED USING SIGNS AND CONES REFER TO DIAGRAM 31.

3. IF PEDESTRIAN MOVMENT IS AFFECTED BY WORK AREA, PEDESTRIAN RELATED TRAFFIC CONTROL DEVICES MUST BE ADDED.

The **W**ork **A**rea **T**raffic **C**ontrol **H**andbook is authorized by the
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