Traffic Control Plan Development Course

March 2019

DEPARTMENT OF TRANSPORTATION

Office of Traffic Engineering

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1. INTRODUCTION

1.1 Background

This is a two-day Traffic Control Plan Development Course designed to enable the participants to obtain an understanding of the fundamental concepts and MnDOT standard practices related to the design of traffic control plans within the State of Minnesota.

1.2 Goals of Course

The main emphasis is to provide an overview of Temporary Traffic Control (TTC) plan development. At the end of this course, you will be able to:

- ✓ List the common publications and guidelines used in temporary traffic control (TTC)
- ✓ Understand the Transportation Management Plan (TMP) and coordination of the plan
- ✓ Address traffic control during the scoping level
- ✓ Identify devices and materials used in TTC
- ✓ Illustrate a typical layout required for a TTC situation
- ✓ Identify TTC impacts and strategies to mitigate
- ✓ Create a basic TTC plan set
- ✓ Locate and navigate through the various specifications and provisions
- ✓ Develop TTC special provisions

1.3 Disclaimer

This manual is disseminated under the sponsorship of the Minnesota Department of Transportation (MnDOT), Office of Traffic Engineering. MnDOT and Albeck Gerken, Inc. assume no liability for its contents or use thereof.

MnDOT does not endorse products or manufacturers. Trademarks of manufacturer's names appear herein only because they are considered essential to the object of this manual.

1.4 Acknowledgements

The development of this Traffic Control Plan Manual has been a result of the efforts of the MnDOT Office of Traffic Engineering (OTE) and Albeck Gerken, Inc. The contributions by Ken Johnson, Jeffrey Morey, Scott Meier, Adam Wellner, Ted Ulven and Ethan Peterson are gratefully acknowledged.

1.5 Contact Information

MnDOT's technical experts are listed below with contact information.

Exhibit 1-1 TTC Technical Expert Contacts

Name	Email	Phone
Ken Johnson	ken.johnson@state.mn.us	651-234-7386
Jeffrey Morey	jeffrey.morey@state.mn.us	651-234-7058

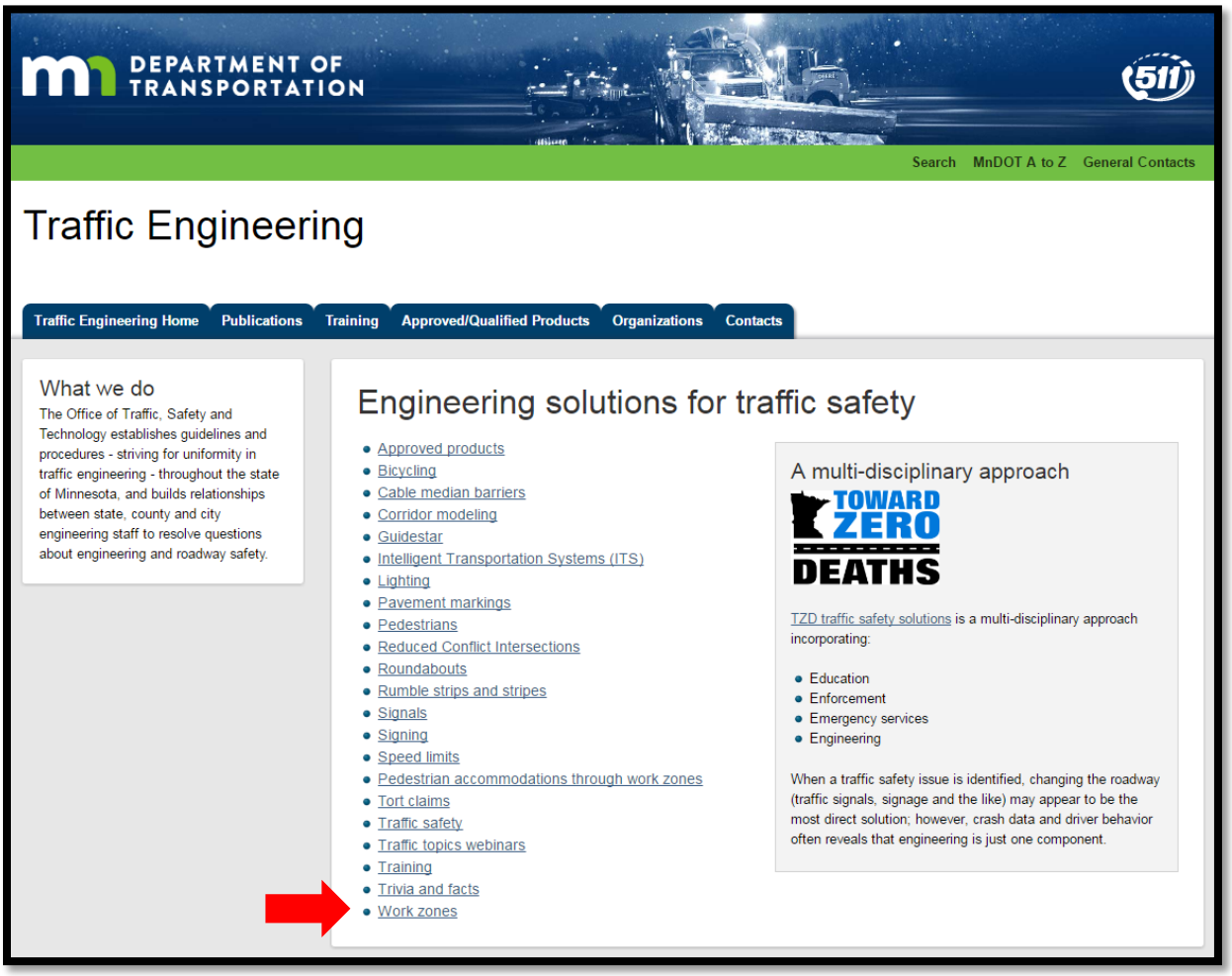
1.6 MnDOT OTE Website

The MnDOT Office of Traffic Engineering website (see **Exhibit 1-2**) includes a wide variety of traffic engineering information, including Work Zones. The website can be visited by going to:

www.dot.state.mn.us/trafficeng/index.html.

Click on the links to proceed to the appropriate Traffic Engineering Site. The Work Zones page is the bottom link shown with the arrow in the exhibit.

Exhibit 1-2 MnDOT OTE Website



Details on the work zones website are listed in Section **2.6.1**.

1.7 Written Communications Policy

To request this document in an alternative format, please contact the Affirmative Action Office at 651-366-4723 or 1-800-657-3774 (Greater Minnesota); 711 or 1-800-627-3529 (Minnesota Relay). You may also send an e-mail to ADArequest.dot@state.mn.us. (Please request at least one week in advance).

1.8 Glossary of Terms

The following words and terms, when used in this manual, have the following meanings, unless the context clearly indicates otherwise.

Term	Definition
Active work zone	The portion of a work zone where construction, maintenance or utility workers are on the roadway or on the shoulder of the highway, and workers are adjacent to an active travel lane. Workers are not considered adjacent to an open travel lane if they are protected by a traffic barrier and no ingress or egress to the work zone exists through an opening in the traffic barrier.
Activity Area	That part of a TTC zone activity area where the work actually takes place. It consists of the work space, traffic space and one or more buffer spaces.
ADT - Average daily traffic	The total volume of traffic during a number of whole days, more than 1 day and less than 1 year, divided by the number of days in that period.
Advance Warning Area	That part of a TTC zone used to inform the motorist what to expect ahead. This area may contain anywhere from a single sign or a rotating/strobe light on a vehicle to a series of signs and the use of a portable changeable message sign (PCMS). The location of the beginning of the TTC zone is dependent on it's visibility to motorists. Good visibility is achieved where the sight distance is sufficient to meet decision sight distance.
Advance Warning Following Distance (F)	The distance in a mobile operation between the Shadow Vehicle and the Work Vehicle. It is used to provide advance warning to traffic that some type of work is being done within the traffic lane. Traffic will have to change lanes, slow down, and wait for a safe time to pass, or adjust their position within the lane to allow for a narrower traffic lane. The Shadow Vehicle shall be equipped with appropriate advance warning signing. Typical Advance Warning Following Distances (F) are included in the TTC Distance Charts. This distance is a range with a minimum of the recommended distance between Advance Warning Signs (A), and a maximum of the Decision Sight Distance (D). These distances are dependent upon the roadway and traffic conditions.
Advance Warning Sign Spacing (A)	The distance between signs or between a sign and some other location or device within the TTC zone. This distance is determined by the posted speed limit. Signs should be placed to allow adequate time for a motorist to read the signs and react accordingly. Typical Advance Warning Sign Spacings (A) are included in the TTC Distance Charts.
Advisory Speed	The recommended speed for all to safely negotiate a potentially hazardous condition, such as a curve within a crossover or a reduction in lane capacity which would lead to a delay causing a natural reduced speed condition. (see Section **2.6.8**).

Term	Definition
Approach Sight Distance	The distance which a motorist can visually identify a work space. The work space may be the flagger station, a lane closure, a slow moving or stopped vehicle, or any other situation which requires adjustments by the motorist.
Alternate Pedestrian Access Route (APR)	An alternate pedestrian route is used when an existing pedestrian access route is blocked by construction, alteration, maintenance, or other temporary conditions.
Approach Sight Distance	The distance by which a motorist can visually identify a work space. This work space may be a flagger station, a lane closure, a slow moving or stopped vehicle, or any other situation requiring adjustments by the motorist.
Attended Work Space	A work space is considered to be attended when the TTC devices are reviewed for knock-downs or other needed adjustments on an hourly basis.
Average Daily Traffic (ADT)	The average 24-hour volume of traffic during a stated time period divided by the number of days in that period.
Buffer Space	The space which provides a margin of safety for both the driver and the workers. It is important that the buffer space be free of equipment, workers, material and vehicles and can be used in conjunction with “Roll Ahead Distance”.
Clear Zone (Work Zone)	The unobstructed (clear of obstructions, hazards, or fixed objects), relatively flat (1V:4H slope or flatter) area impacted by construction that extends outward from the edge of the traveled way. The clear zone concept applied to work zones differs from clear zone concepts applied to permanent roadways.
Crashworthy	Is a characteristic of roadside devices that have been successfully crash tested in accordance with a national standard such as the National Cooperative Highway Research Program Report 350, “Recommended Procedures for the Safety Performance Evaluation of Highway Features” or "Manual for Assessing Safety Hardware (MASH)".
Deadheading	The process of transporting vehicles and equipment between work sites while traveling at less than the minimum speed limit or substantially slower than prevailing traffic, totally or partially in the travel lanes. Deadheading shall be treated as a mobile operation.
Decision Sight Distance (D)	The total distance traveled during the length of time required for a driver to: ✓ Detect an unexpected or otherwise difficult-to-perceive information source or hazard in a roadway environment that may be visually cluttered, ✓ Recognize the hazard or its potential threat, ✓ Select an appropriate speed and path, and ✓ Initiate and complete the required maneuver safely and efficiently.

Term	Definition
	In the Field Manual, the Decision Sight Distance (D) is used to determine the minimum distance required for the driver to see a flagger (as the flagger is in a vulnerable location) or work areas in layouts with minimal signing. It is also used to determine if an operation qualifies as Mobile (see definition of Duration). The required Decision Sight Distances (D) are included in the TTC Distance Charts.
Deflection	Also known as lateral deflection. The distance the barrier travels laterally during impact, under the guidance of crash testing standards. Note that lateral deflection can be expected whether the barriers are anchored or unanchored.
Delineator	A retroreflective device mounted on the road surface or at the side of the roadway in a series to indicate the alignment of the roadway, especially at night or in adverse weather. These are not typically used in work zones, other than on temporary barriers. Surface mounted delineators are typically used in work zones.
Designated Bicycle Route	A system of bikeways designated by the jurisdiction having authority with appropriate directional and informational route signs, with or without specific bicycle route numbers.
Divided Road	A highway or two roadways where opposing traffic is separated by a median (ditch, barrier, curbing, etc.), and the median is generally wide enough to place TTC devices. Temporary traffic control for divided multi-lane roads may be also used for one-way roadways.
Downstream	A term that refers to a location that is encountered by traffic subsequent to an upstream location as it flows in an "upstream to downstream" direction. For example, "the downstream end of a lane line separating the turn lane from a through lane on the approach to an intersection" is the end of the lane line that is closest to the intersection.
Downstream Taper	The taper at the end of the activity area which guides traffic back into its original lane. When used, this taper is a minimum length of approximately 100 feet with a 20-foot spacing between channelizing devices.
Drivable	Capable of being driven on safely without a significant reduction in speed.
Duration	The length of time any work operation occupies a specific location or causes a traffic obstruction without changing the location. This time is measured from the first disruption to traffic until the total clearing of the area. The following durations are defined in overlapping intervals since TTC layouts for longer durations may always be used for shorter durations, especially when roadway attributes such as traffic volume and speed, and the work space location may warrant higher levels of traffic control.

Term	Definition
	✓ **Mobile** - when an operation is continuously moving or stopped in one location for periods of 15 minutes or less. The traffic control devices are typically vehicle-mounted. The work area should change by at least the decision sight distance for it to be considered a change in location. ✓ **Short Duration** - when an operation stays in one location during daylight conditions from 15 minutes to one hour. Since it often takes longer to set up and remove traffic control that it would to perform the work - and workers may be more exposed in the set up and take down procedures, simplified control procedures (as compared to Short Term) may be warranted. ✓ **Short Term** - when an operation stays in one location during daylight conditions from 15 minutes to twelve hours, such that advance signing and channelizing devices are required. ✓ **Intermediate Term/Night** - when an operation stays in one location during daylight conditions from 15 minutes to no more than 3 days, or stays in one location during hours of darkness. Advance signing and larger channelizing devices (Type B) are required. ✓ **Long Term** - when an operation stays in one location for more than 3 days. A project specific Traffic Control Plan is typically required. For State Projects within the metro district a Transportation Management Plan Scoping Worksheet may be required. This can be found at http://www.dot.state.mn.us/metro/trafficeng/control_striping.html.
Engineering Judgment	The evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in the MN MUTCD and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required. See Section **0**.
Engineering Study	The comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in the MN MUTCD and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. An engineering study shall be performed by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. An engineering study shall be documented. See Section **0**.

Term	Definition
Exposure Control Measures	Traffic management strategies to avoid work zone crashes involving workers and motorized traffic by eliminating or reducing traffic through the work zone or diverting traffic away from the work space.
Expressway	A high speed, multilane, divided highway which is generally an arterial road with a posted speed greater than 55 mph. Most intersections are at-grade, although grade separated interchanges may exist.
Fixed Object	Hazards that are firm, unyielding, and greater than 4 inches in height along the roadside such as bridge piers, abutments, footings, walls, posts, trees, construction equipment, supplies, stockpiles, and large boulders.
Flare Rate	The flare rate is the rate at which the Temporary barrier approaches the traveled way.
Following Distance (F)	See Advance Warning Following Distance (F).
Freeway	A divided highway with full control of access.
High Speed Road	A roadway where the posted speed limit is 45 miles per hour or greater.
Interim Pavement Markings	Pavement Markings that are a thinner marking applied in order to maintain traffic until the next lift or permanent markings can be placed. See additional information in Section **3.4**.
Lane Closure	A closure of one or more lanes of the roadway to traffic. Generally, a minimum lane width of 10 feet is required for a traffic operation. Work operations that restrict adjacent lane width should consider various lane closure alternatives depending upon volume and speeds on the roadway.
Intelligent Work Zone (IWZ)	A system of devices that provides motorists, and/or workers, “real-time” information for improved mobility and safety through a work zone.
Late Merge	See “Zipper Merge”
Lane Width	For temporary traffic control purposes, a minimum lane width of 10 feet shall be provided. The lane width should be no less than 11 feet on multi-lane roads.
Lateral Buffer Space	The space that separates the traffic space from the work space. It is typically the extra space provided between traffic and workers, excavations, pavement edge drop-offs, or an opposing lane of traffic. Traffic lanes may be closed to provide for lateral buffer space. See the longitudinal drop-off guidelines (pages 6k-xxi thru 6k-xxiii) of this MN MUTCD for more information.

Term	Definition
Lateral offset to Obstruction	In urban environments, a lateral offset to vertical obstructions (e.g. signs, fire hydrants, etc.), including breakaway devices, is needed to accommodate motorists operating on the roadway. Urban environments with lower operating speeds tend to have sidewalks beginning at the face of the curb, enclosed drainage, numerous fixed objects (e.g., signs, utility poles, luminaire supports, fire hydrants, sidewalk furniture), and frequent traffic stops.
Longitudinal Buffer Space (B)	T The distance between the transition area and the work space. If a driver does not see the advance warning or fails to negotiate the transition area, a buffer space provides room to stop before the work space. Typical Longitudinal Buffer Spaces (B) are included in the TTC Distance Charts.
Longitudinal Drop-off	Any slope steeper than 1V:3H.
Low Speed Road	A roadway where the posted speed limit is 40 miles per hour or less.
Low Volume Road	A roadway with volume less than 400 ADT.
Merging Taper (L)	This taper is used on a multi-lane road to close a lane and combine its traffic from that of the adjacent lane. Its length is dependent on the posted speed of the roadway. Higher speeds require a longer distance for traffic to merge lanes. Typical Merging Tapers (L) are included in the TTC Distance Charts.
MN MUTCD	The current edition of the Minnesota Manual on Uniform Traffic Control Devices, Part 6 addresses temporary traffic control.
Mobile Buffer Space	The distance in a mobile operation between the shadow vehicle and the work vehicle. This distance is dependent on whether the shadow vehicle is being used as an advance warning device or as a blocking/protection device for the work vehicle. Usually used in conjunction with “Roll Ahead Distance”.
Modes of Transportation	Motor vehicles (including buses and trucks), transit, bicycles or pedestrians.
Motorist	An operator of a motorized vehicle intended to be used on a roadway.
Multi-Lane Road	A roadway where two or more lanes of traffic travel in the same direction. A multi-lane roadway may be classified as either undivided or divided.
Normal Speed Limit	The statutory or posted speed limit that existed before temporary traffic control was established, for example, prior to the beginning of a work zone. It is used to determine the spacings of TTC devices and the lengths of various tapers on the TTC Layouts.
Occupied Work Space	A work space is considered to be occupied when workers are present within the work space. Temporary Traffic Control (TTC) devices should continuously be reviewed by workers and adjustments made as needed.

Term	Definition
Off Shoulder	A work space located primarily off of the shoulder, or which causes a little or no restrictions on the use of the shoulder. This work space should have little or no interference with traffic such that traffic speeds generally are not reduced.
Pilot Car	A specially marked vehicle that leads motorists through a work zone.
Portable Changeable Message Sign (PCMS)	PCMS are variable message signs that can be moved to a location as required. In moving operations, portable signs may be mounted on a truck. See Section **2.6.9**.
Portable Concrete Barrier (PCB)	Specifically Type "F" concrete barrier per the latest version of MnDOT Standard Plate No. 8337.
Posted Speed Limit	The speed limit is speed shown on regulatory Speed Limit signs.
Positive Protection	Positive Protection is the use of devices that contain and/or redirect vehicles, reducing the risk of vehicle intrusion into the workspace.
Posted Speed Limit	The posted speed indicates the posted speed limit in force prior to construction or the recommended speed due to engineered work zone geometry.
Protection Vehicle	The vehicle that is placed -upstream of the work space and equipment to block errant motorists from entering the work space.
Public Information Plan (PIP)	A plan that informs the public of the impacts on traffic and the general area during or prior to construction.
Road Authority	The roadway agency or private owner having jurisdiction over a road open to public travel.
Road, Roadway	That portion of a highway improved, designed, or ordinarily used for vehicular travel and parking lanes, but exclusive of the sidewalk, berm, or shoulder even though such sidewalk, berm, or shoulder is used by persons riding bicycles or other human-powered vehicles.
Roll Ahead Distance (R)	The recommended minimum distance from the front of the Protection Vehicle to the beginning of the work space. A Protection Vehicle may be used in a mobile operation to provide extra safety for the workers. Typical Roll Ahead Distances (R) are included in the TTC Distance Charts.
Rural Highway	A highway where traffic is normally characterized by lower volume, higher speed, fewer turning conflicts, and fewer conflicts with pedestrians.
Shadow Vehicle	The vehicle placed in advance of the work space in a mobile operation to provide advance warning to motorists. Because mobile operations generally have all advance warning signing mounted on vehicles, the spacing between vehicles should be the Following Distance (F) as included in the TTC Distance Charts.

Term	Definition
Shifting Taper	The taper used to move traffic from the traffic lane onto a by-pass or shoulder. This traffic maneuver generally requires half the distance than a merging taper. See the TTC Distance Charts for the length of a shifting taper called L/2.
Shoulder Closure	A closure of the roadway shoulder for work operations. The shoulder then becomes unusable by traffic for vehicle maneuvers or break-downs. TTC layouts for work operations using or on a shoulder are dependent on the type of shoulder usage and duration.
Shoulder Taper	The taper used to close the shoulder off to traffic so that shoulder work can be done or equipment can be placed on the shoulder. Since this taper is used to guide errant traffic back to its normal lane path, it does not require a full merge distance. The taper length is reduced to one-third of a merging taper length.
Significant Projects	Is defined as one that, alone or in combination with other concurrent projects nearby, is anticipated to cause sustained work zone impacts that are greater than what is considered tolerable based on State policy and/or engineering judgment. See the MN work zone safety and mobility policy as described in Section **2.6.14**.
Spotter	A person on the work crew whose sole duty is to warn the work crew of impending danger. The Spotter is not a Flagger. The Flagger's role is to direct traffic.
Temporary Pavement Markings	Pavement markings placed for staging of traffic on long term projects.
Temporary Pedestrian Access Route (TPAR)	A TPAR is a temporary pedestrian route that is fully accessible and meets the standards and guidelines.
Temporary Traffic Control (TTC) Plan	A TTC plan describes TTC measures to be used for facilitating road users through a work zone or an incident area. TTC plans play a vital role in providing continuity of effective road user flow when a work zone, incident, or other event temporarily disrupts normal road user flow. Important auxiliary provisions that cannot conveniently be specified on project plans can easily be incorporated into Special Provisions within the TTC plan.
Temporary Traffic Control (TTC) Zone	An area of a highway where road user conditions are changed because of a work zone or incident by the use of temporary traffic control devices, flaggers, uniformed law enforcement officers, or other authorized personnel. See figures 6k-6 and 6k-7 of the MN MUTCD, component parts of a temporary traffic control zone.
Termination Area	That part of a TTC zone located beyond the work space which guides traffic back into its normal traffic path. A longitudinal buffer space may be used between the end of the work space and the beginning of the downstream taper.

Term	Definition
TMA (Truck/Trailer Mounted Impact Attenuator)	Energy-absorbing devices attached to the rear of vehicles in work zones that primarily reduce the severity of impacts from errant vehicles.
TPAR Device	TPAR devices are pedestrian elements (such as temporary curb ramps, pedestrian channelizers, sidewalk barricades, etc) that meet the parameters defined in PROWAG.
Traffic Control Device	A sign, signal, marking, or other device used to regulate, warn, or guide traffic, placed on, over or adjacent to a street, highway, pedestrian facility, or shared-use path by authority of a public agency having jurisdiction.
Traffic Space	That part of the roadway open to traffic that is next to the activity area. Traffic routing is provided with channelizing devices of various sizes and shapes. For a description of the various types of channelizing devices and their general uses, see the temporary traffic control devices section (page 6k-xiii) of the MN MUTCD.
Transition Area	That part of the TTC zone that moves the traffic from its normal path or lane into the traffic space. This movement of traffic is done through the use of channelizing devices and directional signing placed in various types of tapers.
Transportation Management Area	An area designated by the Secretary of Transportation, having an urbanized area population of over 200,000, or upon special request from the Governor and the MPO designated for the area (see the Work Zone Safety and Mobility Policy in Section **2.6.14**). There is only one in Minnesota (the Minneapolis/St. Paul area).
Transportation Management Plan (TMP)	Lays out a set of coordinated strategies and describes how these strategies will be used to manage the impacts of a project during construction. It may include the TCP, TOP and PIP (see the Work Zone Safety and Mobility Policy in Section **2.6.14**).
Transportation Operations Plan (TOP)	A plan that includes Demand Management Strategies, Corridor\Network Management Strategies, Work Zone Safety Management Strategies and Traffic\Incident Management and Enforcement Strategies. Traffic modeling may be required.
Traveled Way	The portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.
Turn Lane Closure	The closure of a right or left turn lane for work operations. Signing in the TTC zone shall provide adequate warning to the motorists and may provide an alternative turning maneuver. Layouts from the various roadway types should be reviewed for the best alternate depending upon roadway intersection design, traffic control (stop, yield, signals, etc.), speed limit and volume.
Two Way Taper	The taper used on two-lane, two-way road to change the road into a single lane of two-way traffic. It is primarily used for flagging operations.

Term	Definition
Two-Lane, Two-Way Road	A roadway consisting of two single opposing lanes of undivided traffic.
Two-Way Left Turn Lane (TWLTL)	That part of the roadway that has a continuous two-way left turn lane located between the opposing lanes of traffic. This design variation may be found on either two-lane, two-way roads or multi-lane undivided roads.
Undivided Road	A roadway where opposing traffic lanes have no physical separation except pavement markings (where required).
Upstream	A term that refers to a location that is encountered by traffic prior to a downstream location as it flows in an "upstream to downstream" direction. For example, "the upstream end of a lane line separating the turn lane from a through lane on the approach to an intersection" is the end of the lane line that is farthest from the intersection.
Urban Street	A type of street normally characterized by relatively low speed, wide ranges in traffic volume, narrower roadway lanes, frequent intersections, significant pedestrian traffic, and more roadside obstacles.
Volume	The number of vehicles passing a given point on the roadway during a given timeframe. Commonly used volume rates in temporary traffic control are Average Daily Traffic (ADT) and vehicles per hour (vph).
Work Space	That part of the TTC zone closed to traffic and set aside for workers, equipment and materials. The space requirements for a specific TTC Zone will determine the type of TTC layout that is appropriate for the project. The layout will specify the appropriate sign locations, flagger stations and tapers depending on the type of work space.
Work Zone	A segment of highway or street where a road authority or its agent is constructing, reconstructing, or maintaining the physical structure of the roadway, its shoulders, or features adjacent to the roadway, including underground and overhead utilities and highway appurtenances, when workers are present. See full definition in Section **2.3**.
Work Zone Speed Limits	A temporary regulatory speed limit in a temporary traffic control zone. This speed limit requires proper documentation to approve and install. See *work zone speed limit guidelines* at the following website for details: www.dot.state.mn.us/speed/pdf/WZSpeedLimitGuideline.pdf
Zipper Merge (Late Merge)	When a lane is closed in a construction zone, a zipper merge occurs when motorists use both lanes of traffic until reaching the defined merge area, and then alternate in "zipper" fashion into the open lane. ✓ In an Active Zipper Merge, sensors and intelligence tell drivers when to use the Zipper Merge. ✓ In a Passive Zipper Merge, signs or PCMS notifying drivers to use Zipper Merge when backups occur.

2. TEMPORARY TRAFFIC CONTROL OVERVIEW

2.1 General

A Temporary Traffic Control (TTC) Zone (aka Work Zone) is an area of a roadway where road user conditions are changed because of a work space or incident by the use of TTC devices, flaggers, uniformed law enforcement officers or other authorized personnel. The type of operation planned, space requirements, time duration, and roadway characteristics for a specific TTC Zone will determine the appropriate procedures and preparation needed for the work zone.

Safety in the work zone is the primary consideration to be addressed in a TTC plan. A work zone may be as small as a single worker stopping alongside the roadway, to a mobile maintenance operation, to a flagger-controlled lane closure, to a reduction of lanes on a multi-lane roadway and up to detoured traffic for a full roadway closure. The TTC plan must provide a safe work place and a safe route for the motorist and users of other transportation modes, such as pedestrians and bicyclists.

While Safety is of primary importance, mobility is also a consideration. Lack of mobility through a temporary traffic control zone can lead to frustration of drivers resulting in aggressive or otherwise unsafe driving behavior.

The topics in the manual address TTC over a longer period that requires a TTC plan.

Various laws, policies, standards, guidelines, and information are required to provide for this safety and mobility. The documents found through this chapter are a collection of Work Zone Design Tools which provide guidance to the project planner, temporary traffic control designer, contractors and field personnel.

The Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD) defines the term "temporary traffic control" as:

> "Temporary Traffic Control Zone—an area of a highway where road user conditions are changed because of a work zone or incident by the use of temporary traffic control devices, flaggers, uniformed law enforcement officers, or other authorized personnel."

Some refer to this term as "work zone traffic control," which is the most common type of temporary traffic control.

2.2 MN MUTCD Chapter 6B - Fundamental Principles

The following is a handout from the MN MUTCD Chapter 6B on TTC Fundamental Principles. The MN MUTCD can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

HANDOUT

PART 6. TEMPORARY TRAFFIC CONTROL
Chapter 6B. Fundamental Principles

6B.1 Fundamental Principles of Temporary Traffic Control

SUPPORT:

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

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

During TTC activities, commercial vehicles might need to follow a different route from passenger vehicles because of bridge, weight, clearance, or geometric restrictions. Also, vehicles carrying hazardous materials might need to follow a different route from other vehicles. . The Hazardous Materials and National Network signs are included in Sections 2B.62 and 2B.63, respectively.

Experience has shown that following the fundamental principles of Part 6 will assist road users and help protect workers in the vicinity of TTC zones. While these principles provide guidance for good TTC for the practitioner, they do not establish standards and warrants.

GUIDANCE:

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

SUPPORT:

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

GUIDANCE:

The following are the seven fundamental principles of TTC:

1. General plans or guidelines should be developed to provide safety for motorists, bicyclists, pedestrians, workers, enforcement/emergency officials, and equipment, with the following factors being considered:
   A. The basic safety principles governing the design of permanent roadways and roadsides should also govern the design of TTC zones. The goal should be to route road users through such zones using roadway geometrics, roadside features, and TTC devices as nearly as possible comparable to those for normal highway situations.
   B. A TTC plan, in detail appropriate to the complexity of the work project or incident, should be prepared and understood by all responsible parties before the site is occupied. Any changes in the TTC plan should be approved by an official knowledgeable (for example, trained and/or certified) in proper TTC practices.
2. Road user movement should be inhibited as little as practical, based on the following considerations:
   A. TTC at work and incident sites should be designed on the assumption that drivers will only reduce their speeds if they clearly perceive a need to do so (see Section 6C.1).
   B. Frequent and abrupt changes in geometrics such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers, should be avoided.
   C. Work should be scheduled n a manner that minimizes the need or lane closures or alternate routes, while still getting the work completed quickly and the lanes or roadway open to traffic as soon as possible.
   D. Attempts should be made to reduce the volume of traffic using the roadway or freeway to match the restricted capacity conditions. Road users should be encouraged to use alternative routes. For high-volume roadways and freeways, the closure of selected entrance ramps or other access points and the use of signed diversion routes should be evaluated.
   E. Bicyclists and pedestrians should be provided with access and reasonably safe passage through the TTC zone.

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F. If work operations permit, lane closures on high-volume streets and highways should be scheduled during off-peak hours. Night work should be considered if the work can be accomplished with a series of short-term operations.

G. Early coordination with of officials having jurisdiction over the affected cross streets and providing emergency services should occur if significant impacts to roadway operations are anticipated.

3. Motorists, bicyclists, and pedestrians should be guided in a clear and positive manner while approaching and traversing TTC zones and incident sites. The following principles should be applied:

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

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

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

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

A. 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 should be to check that all TTC devices of the project are consistent with the TTC plan and are effective for motorists, bicyclists, pedestrians, and workers.

B. As the work progresses, temporary traffic controls and/or working conditions should be modified, if appropriate, in order to provide mobility and positive guidance to the road user and to promote worker safety. The individual responsible for TTC should have the authority to halt work until applicable or remedial safety measures are taken.

C. TTC zones should be carefully monitored under varying conditions of road user volumes, light, and weather to check that applicable TTC devices are effective, clearly visible, clean, and in compliance with the TTC plan.

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

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

A. To accommodate run-off-the-road incidents, disabled vehicles, or emergency situations, unencumbered roadside recovery areas or clear zones should be provided where practical.

B. Channelization of road users should be accomplished by the use of pavement markings, signing, and crashworthy channelizing devices.

C. Work equipment, workers' private vehicles, materials, and debris should be stored in such a manner to reduce the probability of being impacted by run-off-the-road vehicles.

6. Each person whose actions affect TTC zone safety, from the upper-level management through the field workers, should receive training appropriate to the job decisions each individual is required to make. Only those individuals who are trained in proper TTC practices and have a basic understanding of the principles (established by applicable standards and guidelines, including those of this Manual) should supervise the selection, placement, and maintenance of TTC devices used for TTC zones and for incident management.

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

A. The needs of all road users should be assessed such that appropriate advance notice is given and clearly defined alternative paths are provided.

B. The cooperation of the various news media should be sought in publicizing the existence of and reasons for TTC zones because news releases can assist in keeping the road users well informed.

C. The needs of abutting property owners, residents, and businesses should be assessed and appropriate accommodations made.

D. The needs of emergency service providers (police, fire, and medical) should be assessed and appropriate coordination and accommodations made.

HANDOUT

HANDOUT

E. The needs of railroads and transit should be assessed and appropriate coordination and accommodations made.
F. The needs of operators of commercial vehicles such as buses and large trucks should be assessed and appropriate accommodations made.

STANDARD:

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

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

HANDOUT

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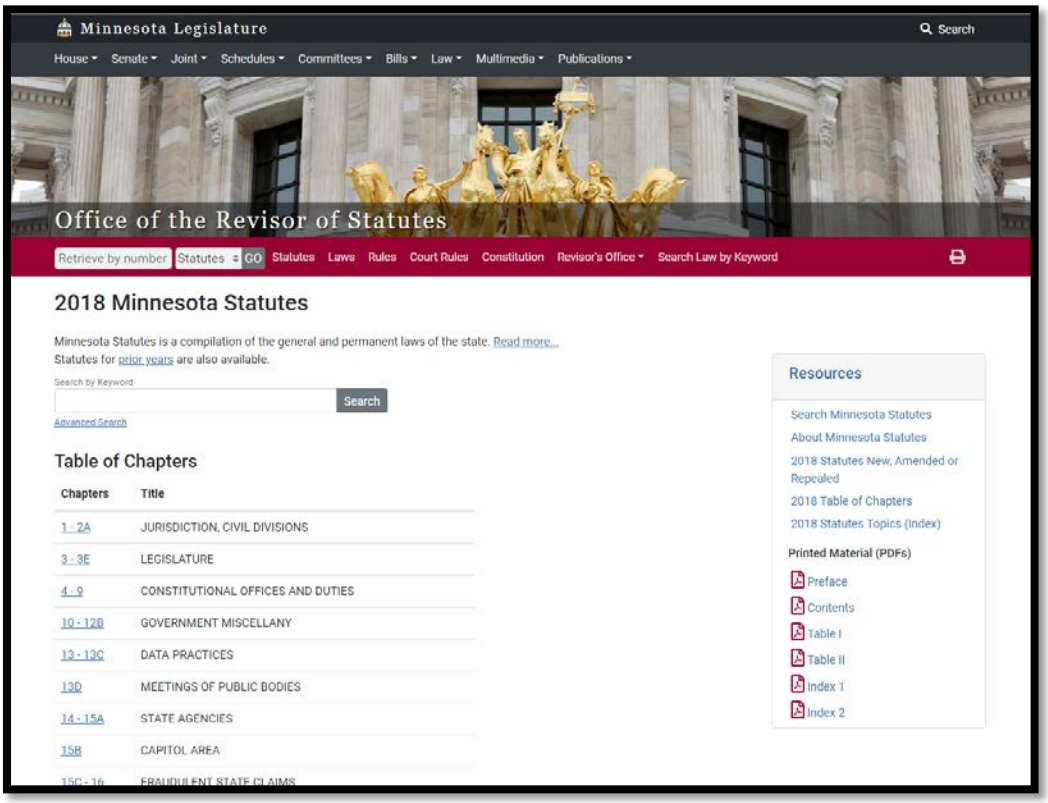
2.3 Legal Authority for Transportation

Legal authority for transportation is found in the Minnesota Statutes, Chapters 160 to 174A. The Statutes can be found at https://www.revisor.mn.gov/statutes/.

Exhibit 2-1 Minnesota Statutes Website



Chapter 169.011, **Definitions** includes the following:

Subd. 95.**Work zone**. "Work zone" means a segment of street or highway for which:

(1) a road authority or its agent is constructing, reconstructing, or maintaining the physical structure of the roadway, which may include, but is not limited to, shoulders, features adjacent to the roadway, and utilities and highway appurtenances, whether underground or overhead; and

(2) any of the following applies:

(i) official traffic-control devices that indicate the segment of street or highway under construction, reconstruction, or maintenance, are erected;

(ii) one or more lanes of traffic are closed;

(iii) a flagger under section 169.06, subdivision 4a, is present;

(iv) a construction zone speed limit under section 169.14, subdivision 4, is established; or

(v) a workers present speed limit under section 169.14, subdivision 5d, is in effect

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2.4 Federal Regulations

Title 23 of the United States Code (U.S.C) outlines the role of highways in the United States Code (www.ecfr.gov/). Part 630 Subpart J covers Work Zone Safety and Mobility and Subpart K outlines Temporary Traffic Control Devices.

2.5 Engineering Standards

2.5.1 MN MUTCD Text Headings

When used in the sections of the MN MUTCD (see Section **2.6.3**), the text headings shall be defined as follows:

STANDARD: A statement of required, mandatory, or specifically prohibitive practice regarding a traffic control device. The verb "shall" is typically used. Standards are sometimes modified by Options.

GUIDANCE: A statement of recommended, but not mandatory, practice in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate. The verb "should" is typically used. Guidance statements are sometimes modified by Options.

OPTION: A statement of practice that is a permissive condition and carries no requirement or recommendation. Options may contain allowable modifications to a Standard or Guidance. The verb "may" is typically used.

SUPPORT: An informational statement that does not convey any degree of mandate, recommendation, authorization, prohibition, or enforceable condition. The verbs "shall", "should", and "may" are **not** used in Support statements.

Exhibit 2-2 is an example of the text headings used for Section 6H-4 from the MN MUTCD.

Exhibit 2-2 Text Heading Example from MN MUTCD

STANDARD: TTC plans and devices shall be the responsibility of the authority of a public body or official having jurisdiction for guiding road users. There shall be adequate statutory authority for the implementation and enforcement of needed road user regulations, parking controls, speed zoning, and management of traffic incidents. Such statutes shall provide sufficient flexibility in the application of TTC to meet the needs of changing conditions in the TTC zone. **SUPPORT:** Temporary facilities, including pedestrian routes around work sites, are also covered by the accessibility requirements of the Americans with Disabilities Act of 1990 (ADA) (Public Law 101-336, 104 Stat. 327, July 26, 1990. 42 USC 12101-12213 (as amended)).	**GUIDANCE:** The TTC plan should start in the planning phase and continue through the design, construction, and restoration phases. The TTC plans and devices should follow the principles set forth in Part 6. The management of traffic incidents should follow the principles set forth in Chapter 6G. **OPTION:** TTC plans may deviate from the typical applications described in Chapter 6H to allow for conditions and requirements of a particular site or jurisdiction.

2.5.2 Definition of Should, Shall and May

Shall: Indicates a statement of required, mandatory, or a specifically prohibitive practice regarding a traffic control device.

Should: Indicates a statement of recommended practice, but not mandatory, in typical situations, with deviations allowed if engineering judgment or engineering study indicates the deviation to be appropriate.

May: Indicates a statement of practice that is a permissive condition and carries no requirement or recommendation.

2.5.3 Engineering Judgment and Documentation

In many instances, engineering judgment is required when standards cannot be fully met. For instance, in the definition of Guidance above, it states, "deviations allowed if **engineering judgment** or engineering study indicates the deviation". The definition of engineering judgment from the MN MUTCD section 1A.13 states:

> **Engineering Judgment** - the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.

While "documentation of engineering judgment is not required", it is highly recommended. For liability purposes, it is important to document engineering judgment. Often, tort claims occur many months or years later. Documentation of decisions, including minutes of meetings, notes in a diary, notes on a plan, etc. become very important during depositions and trials.

> Proper documentation of decision-making during design and proper review and implementation during construction results in not only a better design and safer work zone, but clearly reduces risk and liability.

2.6 Associated Manuals and Guideline

There are a variety of manuals and guidelines related to TTC. In this section, some of the more common manuals are presented.

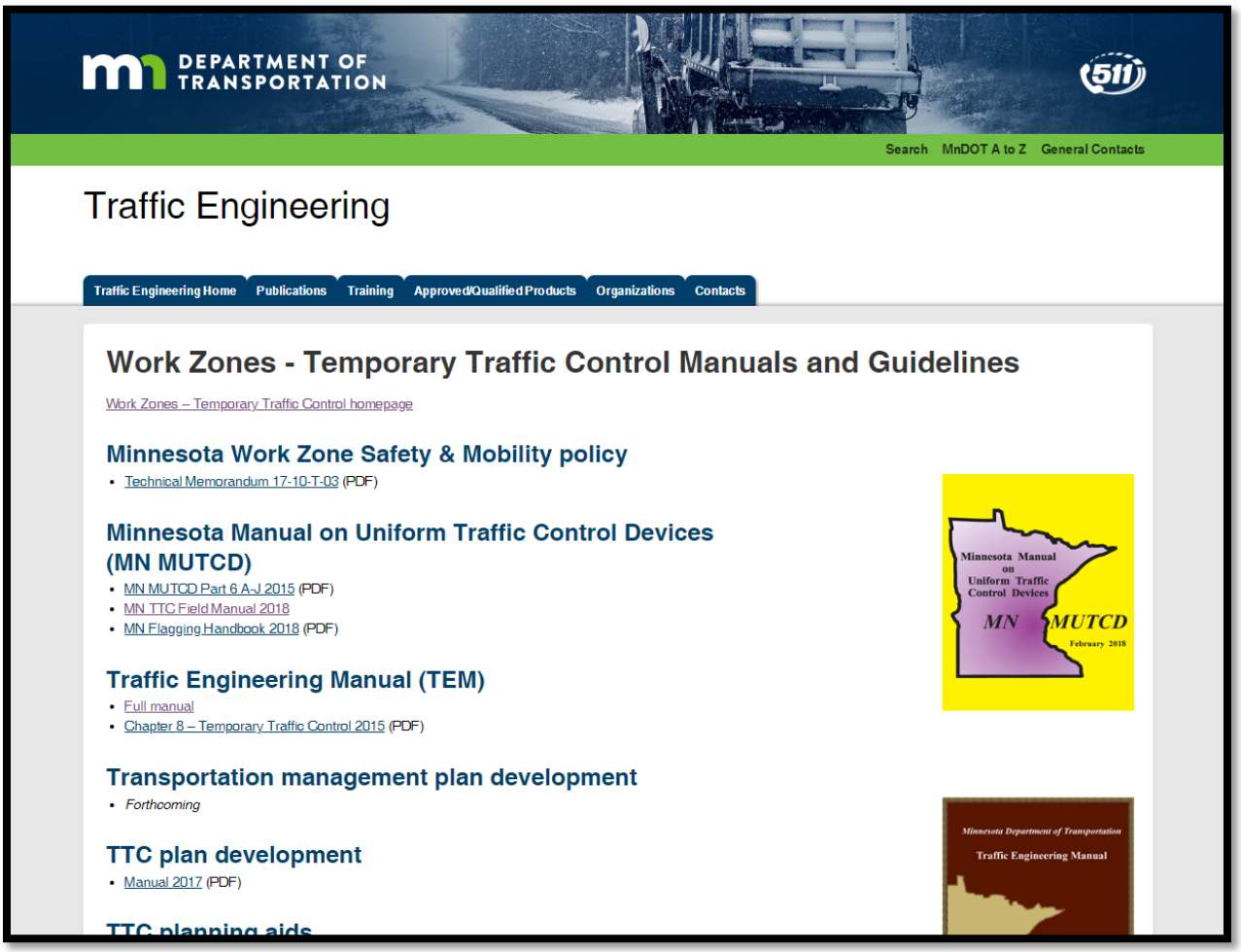
2.6.1 Work Zone Manuals and Guidelines Website

The Work Zone manuals and guidelines website (see **Exhibit 2-3**) includes a large variety of publications related to work zones. The website can be visited by going to:

www.dot.state.mn.us/trafficeng/workzone/wzmanual.html

Please be sure to visit the website to view the most up-to-date resources.

Exhibit 2-3 Work Zone Manuals and Guidelines Website



The following sections describe some of the more common manuals and resources found within the above website. However, each item listed on the website could be relevant to your need.

2.6.2 Federal Manual on Uniform Traffic Control Devices

The Federal Highway Administration (FHWA) publishes the MUTCD, which contains all national design, application, and placement, standards, guidance, options, and support provisions for traffic control devices. At the time of publication of this manual, the 2009 Edition with Revision Numbers 1 and 2 incorporated, dated May 2012 is the current version. The national MUTCD website is located at:

http://mutcd.fhwa.dot.gov/index.htm.

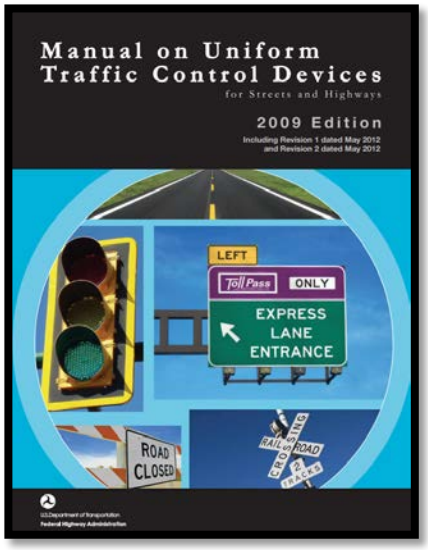
The purpose of the MUTCD is to provide uniformity of these devices, which include signs, signals, and pavement markings, to promote highway safety and efficiency on the Nation's streets and highways.

Title 23 of the Code of Federal Regulations requires all States to do one of three things within two years after a new national MUTCD edition is issued or any national MUTCD amendments are made:

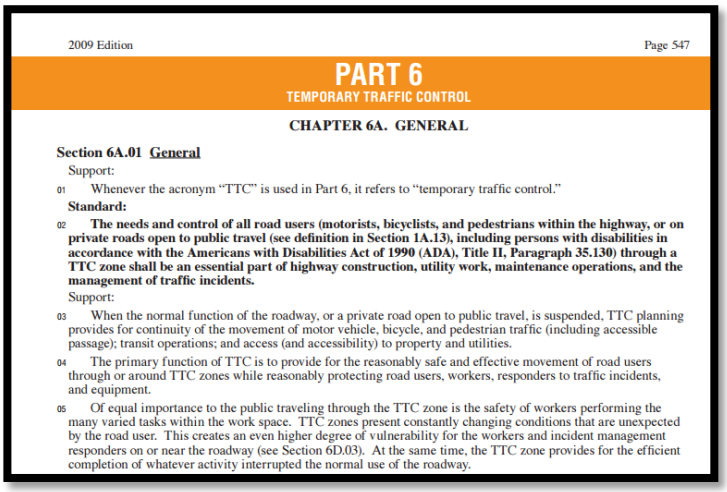
1. adopt the new or revised national MUTCD as the standard for traffic control devices in the State;
2. adopt the national MUTCD with a State Supplement that is in substantial conformance with the new or revised national MUTCD; or
3. adopt a State MUTCD that is in substantial conformance with the new or revised national MUTCD.

Minnesota develops and adopts a State MUTCD (3 above) that is in substantial conformance with the national MUTCD.

Exhibit 2-4 Federal MUTCD



Chapter 6 of the Federal MUTCD related to TTC



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PART 6
TEMPORARY TRAFFIC CONTROL

CHAPTER 6A. GENERAL

Section 6A.01 General

Support:

01 Whenever the acronym "TTC" is used in Part 6, it refers to "temporary traffic control."

Standard:

02 **The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel (see definition in Section 1A.13), including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.**

Support:

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

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

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

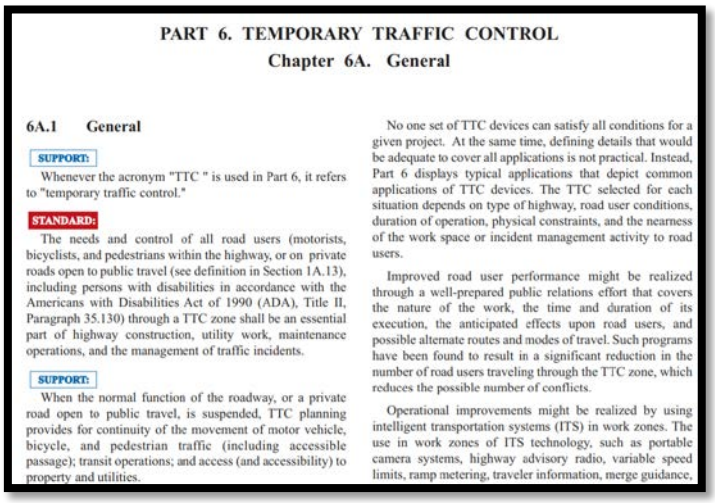
The Federal MUTCD is not just a "policy". It is not a MnDOT document. It applies to all public roads in the United States. The MUTCD is part of Federal Law and the MN MUTCD is part of State Law. The Federal government issues the MUTCD and gives states a certain amount of time to adopt it or lose federal funding. Some states adopt it "as is", many states publish a supplement. Minnesota re-writes the document. Those that re-write can be more conservative, but not less. The MN MUTCD is the document to follow in Minnesota.

2.6.3 Minnesota Manual on Uniform Traffic Control Devices

As noted above, Minnesota develops and adopts a state MUTCD that is in substantial conformance with the Federal MUTCD. The Minnesota MUTCD (MN MUTCD) was recently updated in July 2012. Chapter 6 of the MN MUTCD is dedicated to temporary traffic control (TTC).

Exhibit 2-5 Minnesota MUTCD

Chapter 6 of the MN MUTCD related to TTC



PART 6. TEMPORARY TRAFFIC CONTROL
Chapter 6A. General

6A.1 General

SUPPORT:
Whenever the acronym "TTC " is used in Part 6, it refers to "temporary traffic control."

STANDARD:
The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel (see definition in Section 1A.13), including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.

SUPPORT:
When the normal function of the roadway, or a private road open to public travel, is suspended, TTC planning provides for continuity of the movement of motor vehicle, bicycle, and pedestrian traffic (including accessible passage); transit operations; and access (and accessibility) to property and utilities.

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

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

Operational improvements might be realized by using intelligent transportation systems (ITS) in work zones. The use in work zones of ITS technology, such as portable camera systems, highway advisory radio, variable speed limits, ramp metering, traveler information, merge guidance,

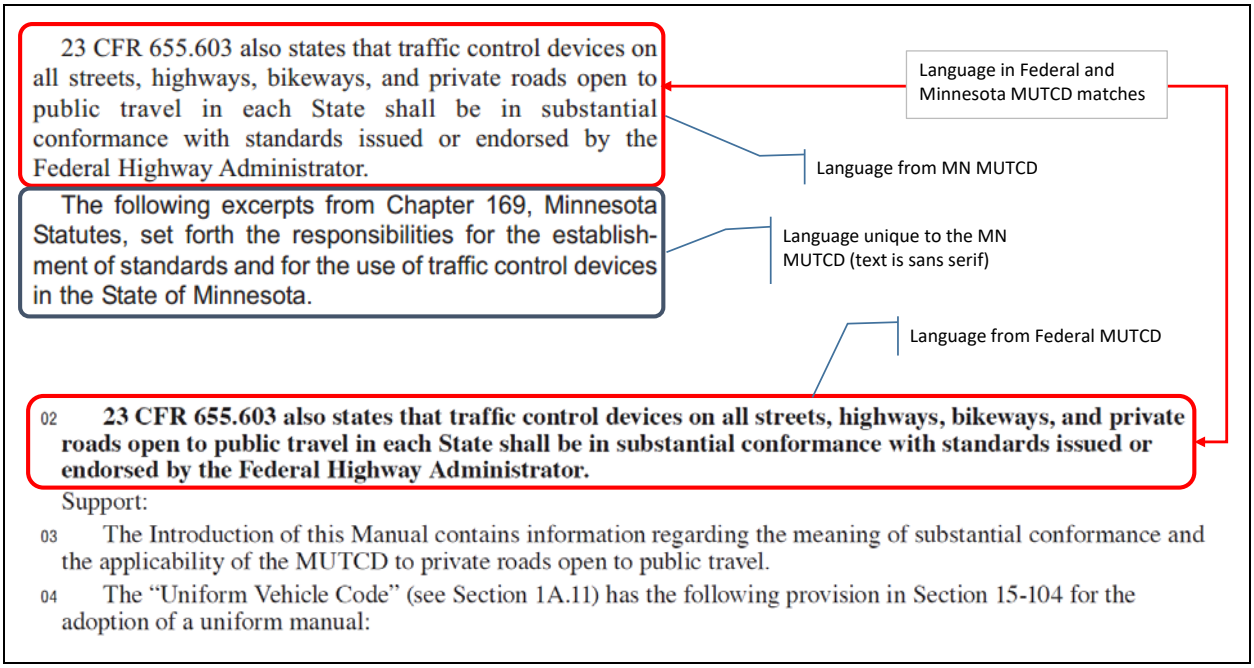
The MN MUTCD contains Standards, Guidance, and Options for the signing of all types of highways, and private roads open to public travel. Detailed TTC requirements are in the following section of Part 6 of the MN MUTCD:

- ✓ Chapter 6A. General
- ✓ Chapter 6B. Fundamental Principals
- ✓ Chapter 6C. Temporary Traffic Control Elements
- ✓ Chapter 6D. Pedestrian and Worker Safety
- ✓ Chapter 6E. Flagger Control
- ✓ Chapter 6F. Temporary Traffic Control Zone Devices
- ✓ Chapter 6G. Type of Temporary Traffic Control Zone Activities
- ✓ Chapter 6H. Speed Limits in Temporary Traffic Control Zones
- ✓ Chapter 6I. Control of Traffic Through Traffic Incident Management Areas
- ✓ Chapter 6J. Long Term Temporary Traffic Control Zone Layouts
- ✓ Chapter 6K. Minnesota Temporary Traffic Control Field Manual (See Section **2.6.4**)

Chapter 6K is also known as the Field Manual and is available as a separate document.

Information in the MN MUTCD that was added or changed from the Federal MUTCD is shown in a sans serif font. See **Exhibit 2-6**.

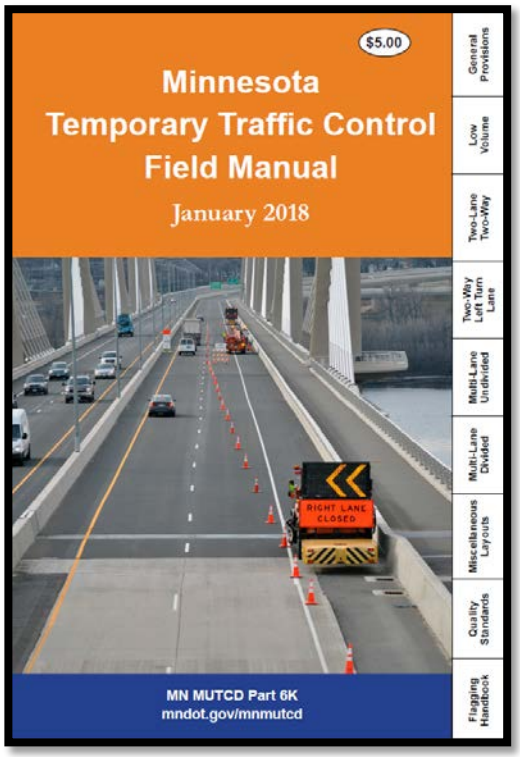
Exhibit 2-6 Example of Language Unique to MN MUTCD



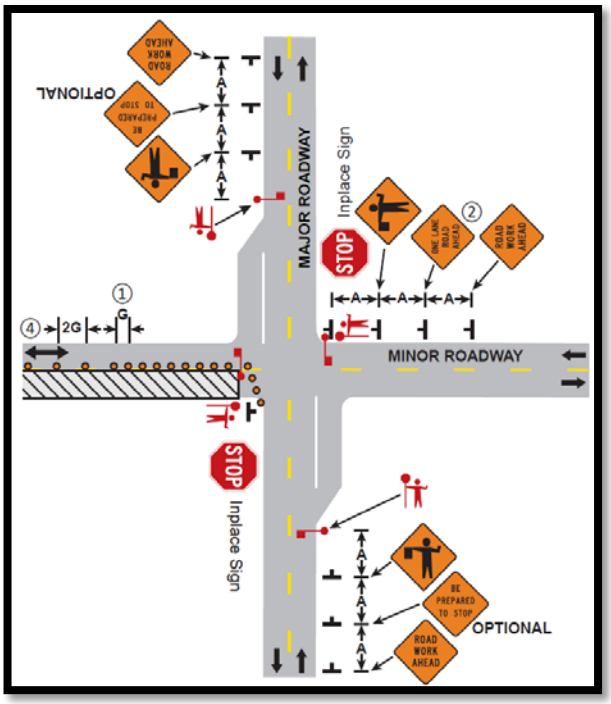
2.6.4 Minnesota Temporary Traffic Control Field Manual (MN MUTCD Chapter 6K)

This Field Manual is a section of Part 6 of the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD). It has been reprinted as a separate document for use in field operations. This Field Manual contains the general Temporary Traffic Control (TTC) standards and the user should refer to the MN MUTCD - Part 6 for more details, and follow any TTC plans, specifications, and special provisions written for a specific project. When specific TTC plans for a specific operation are not available, any public or private agency whose work affects vehicular and pedestrian traffic should use this Field Manual to provide proper temporary traffic control (TTC).

Exhibit 2-7 Temporary Traffic Control Zone Layouts Field Manual



Sample Layout from Manual



The sections in the manual include:

- ✓ Introduction
- ✓ Definition of Shall, Should, and May
- ✓ Glossary
- ✓ Temporary Traffic Control General Guidelines
- ✓ Temporary Traffic Control Devices
- ✓ Longitudinal Drop-Off Guidelines
- ✓ Symbols Used in Typical Layouts
- ✓ Components of Temporary Traffic Control Zone
- ✓ Temporary Traffic Control Distance Charts
- ✓ Quality Standards
- ✓ Minnesota Flagging Handbook
- ✓ MnDOT Telephone Numbers
- ✓ Layouts

2.6.5 Traffic Engineering Manual

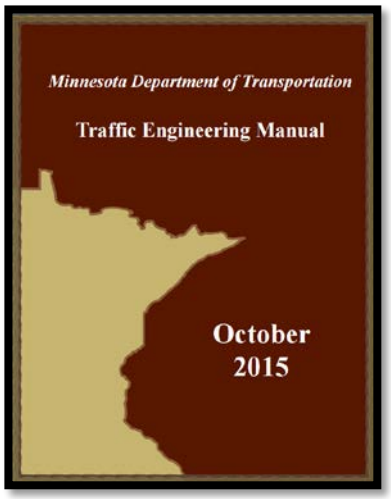
The Traffic Engineering Manual (TEM) is issued and updated by the MnDOT Office Traffic Engineering (TEM). The purpose of the TEM is to establish uniform guidelines and procedures, primarily for use by personnel at MnDOT. Counties, cities, and local units of government will also find this manual useful when striving for uniformity in traffic engineering throughout the state of Minnesota. It is the intent of this Manual to set forth accepted practices, procedures, and guidelines, chiefly for the sake of uniformity of application, but there is no legal requirement for their use.

The TEM contains 13 chapters. Chapter 8 is related to Work Zone Traffic Controls (see **Exhibit 2-8**). The most current version of the TEM can be found at:

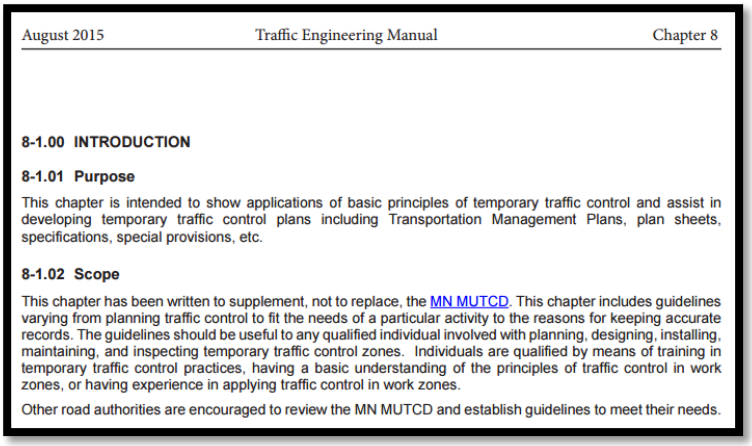
http://www.dot.state.mn.us/trafficeng/publ/tem/index.html

At the time of this publication print, MnDOT OTE was working on an update to the TEM. Be sure to check the above reference website for future updates to the manual. A new section on business signing is one of the future updates. The approved language on this topic is included as a handout in Section **3.2.7**.

Exhibit 2-8 MnDOT Traffic Engineering Manual (TEM)



Chapter 8 of the TEM related to Work Zone TC



August 2015 Traffic Engineering Manual Chapter 8

8-1.00 INTRODUCTION

8-1.01 Purpose

This chapter is intended to show applications of basic principles of temporary traffic control and assist in developing temporary traffic control plans including Transportation Management Plans, plan sheets, specifications, special provisions, etc.

8-1.02 Scope

This chapter has been written to supplement, not to replace, the MN MUTCD. This chapter includes guidelines varying from planning traffic control to fit the needs of a particular activity to the reasons for keeping accurate records. The guidelines should be useful to any qualified individual involved with planning, designing, installing, maintaining, and inspecting temporary traffic control zones. Individuals are qualified by means of training in temporary traffic control practices, having a basic understanding of the principles of traffic control in work zones, or having experience in applying traffic control in work zones.

Other road authorities are encouraged to review the MN MUTCD and establish guidelines to meet their needs.

Chapter 8 of the TEM is broken into the following subsections:

- ✓ 8-1.00 Introduction
- ✓ 8-2.00 Glossary
- ✓ 8-3.00 Responsibility
- ✓ 8-4.00 Planning for Temporary Traffic Control
- ✓ 8-5.00 Temporary Traffic Control Devices
- ✓ 8-6.00 Temporary Traffic Control Plans
- ✓ 8-7.00 Establishing and Maintaining Detours
- ✓ 8-8.00 Installation and Inspection of TTC Devices
- ✓ 8-9.00 References

2.6.6 Standard Specifications for Construction

The "Spec Book" (**Exhibit 2-9**) contains standard specifications to be used and referred to in the design of plans and in the preparing of Special Provisions. Plan designers need to be aware of the specifications contained in the Spec Book that may apply to their individual project.

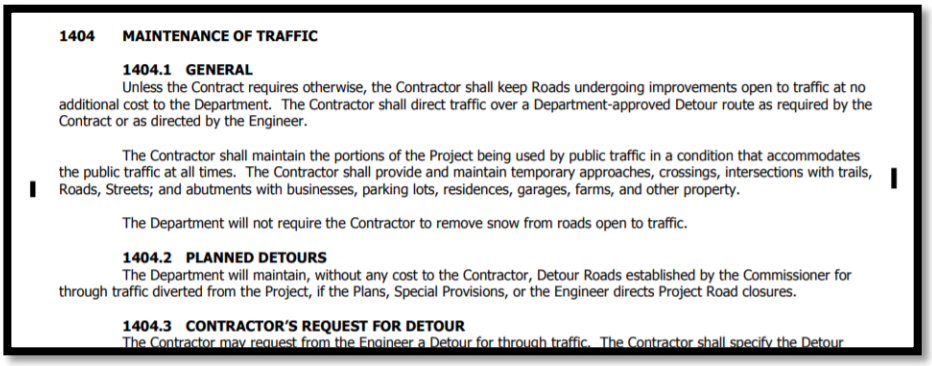
Exhibit 2-9 Standard Specifications for Construction Book (Spec Book)

MINNESOTA

DEPARTMENT OF TRANSPORTATION
ST. PAUL, MINNESOTA

STANDARD
SPECIFICATIONS
FOR
CONSTRUCTION

2018 EDITION


1404 MAINTENANCE OF TRAFFIC

1404.1 GENERAL
Unless the Contract requires otherwise, the Contractor shall keep Roads undergoing improvements open to traffic at no additional cost to the Department. The Contractor shall direct traffic over a Department-approved Detour route as required by the Contract or as directed by the Engineer.

The Contractor shall maintain the portions of the Project being used by public traffic in a condition that accommodates the public traffic at all times. The Contractor shall provide and maintain temporary approaches, crossings, intersections with trails, Roads, Streets; and abutments with businesses, parking lots, residences, garages, farms, and other property.

The Department will not require the Contractor to remove snow from roads open to traffic.

1404.2 PLANNED DETOURS
The Department will maintain, without any cost to the Contractor, Detour Roads established by the Commissioner for through traffic diverted from the Project, if the Plans, Special Provisions, or the Engineer directs Project Road closures.

1404.3 CONTRACTOR'S REQUEST FOR DETOUR
The Contractor may request from the Engineer a Detour for through traffic. The Contractor shall specify the Detour

The Spec Book is made of three divisions:

- ✓ Division I - General Requirements and Covenants
- ✓ Division II - Construction Details
- ✓ Division III - Materials

A few of the specifications of interest include the following (not all are listed, be sure to investigate all applicable sections:

- ✓ 1404 - Maintenance of Traffic
- ✓ 1504 – Coordination of Plans and Specifications
- ✓ 1710 – Traffic Control Devices
- ✓ 1807 – Failure to Complete the Work on Time
- ✓ 2102 – Pavement Marking Removal
- ✓ 2554 – Traffic Barriers
- ✓ 2564 – Traffic Signs And Devices
- ✓ 2580 – Interim Pavement Marking
- ✓ 2581 – Removable Preformed Pavement Marking Tape
- ✓ 2582 – Pavement Markings

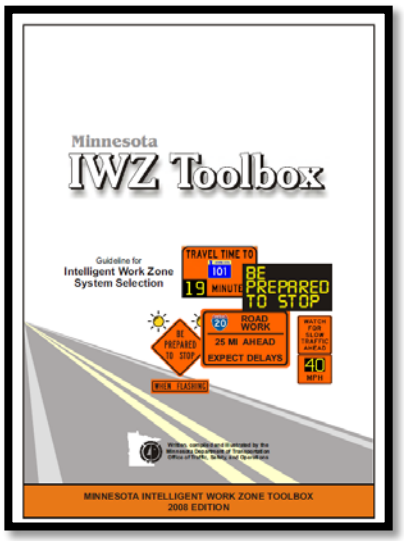
Refer to Chapter **6** for additional details.

2.6.7 Minnesota Intelligent Work Zone Toolbox

The IWZ Toolbox (**Exhibit 2-10**) has been prepared as a guideline for selecting an appropriate Intelligent Work Zone (IWZ) System for existing work zone traffic issues and to mitigate anticipated issues on scheduled projects. The IWZ System descriptions contained in this toolbox are intended as brainstorming

material and should lead to practical solutions to a project's unique problems. The examples are purposely left void of many dimensions, except where distances are highly recommended, and engineering judgment is required to customize the system to a project.

Exhibit 2-10 Minnesota IWZ Toolbox



At the time of this publication print, MnDOT OTE was updating the IWZ Toolbox. Some of the sheets found in the toolbox are listed as "Under Development".

In general, an intelligent work zone will have three elements:

1. The ability to sense traffic via detection
2. Process this information with algorithms
3. Report this information to the motorist/public

The IWZ systems included in the document are:

- ✓ Travel Time Information - Trip Time or Estimated Delay
- ✓ Speed Advisory Information
- ✓ Congestion Advisory
- ✓ Stopped Traffic Advisory
- ✓ Dynamic Merge - Late or Early
- ✓ Traffic Responsive Temporary Signals
- ✓ Temporary Ramp Metering
- ✓ Excessive Speed Warning - incl. Dynamic Speed Display Signs
- ✓ Over Dimension Warning
- ✓ Work Space / Haul Road Intrusion Warning
- ✓ Construction Vehicle Warnings - Merging, Crossing & Exiting
- ✓ Hazardous Condition Warnings - Road Surface or Visibility
- ✓ Changeable Work Zone Signage - incl. WZ Speed Limits
- ✓ Traffic Surveillance Camera

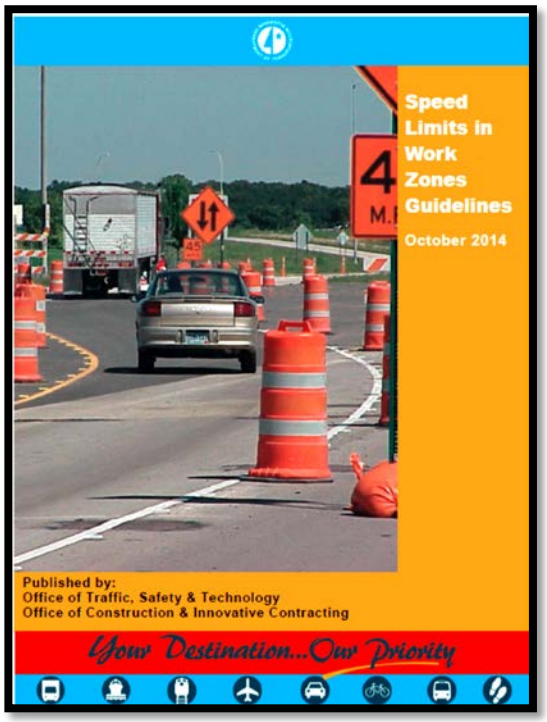
A Synthesis of Intelligent Work Zone Practices can be found at, http://enterprise.prog.org/. Keep in mind that the guidance on this site are not an all-inclusive list of IWZ features that are available to the designer.

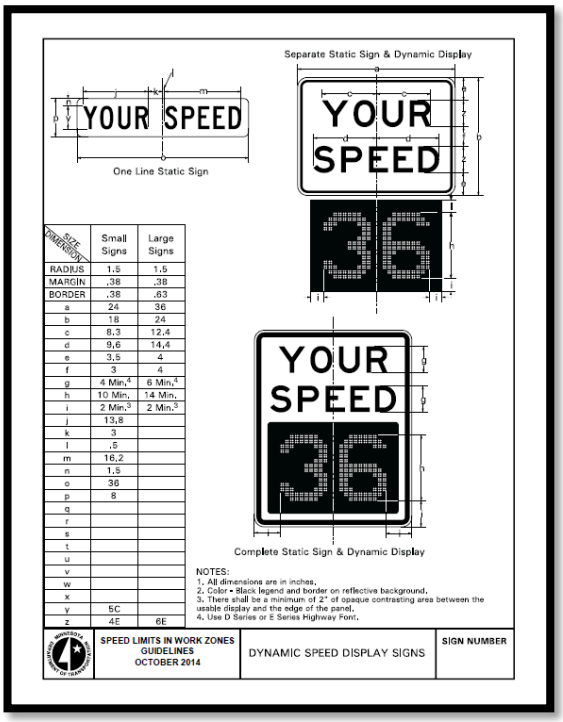
2.6.8 Work Zone Speed Limit Guidelines

The purpose of the Work Zone Speed Limits Guidelines (**Exhibit 2-11**) is to provide a uniform guideline for the proper application of speed limits in street and highway work zones. The booklet outlines the

guidelines, proper layouts and procedures for implementing work zone speed limits primarily for use by MnDOT personnel. Although it is usually desirable to provide all traffic controls as shown in the layouts, situations arise where this becomes impractical. Engineering judgment may dictate modifications to the typical layouts. When modifications are made, factors such as traffic volume, speed, sight distance, type of work, etc. must be considered.

Exhibit 2-11 Work Zone Speed Limit Guidelines





SIZE DIMENSION	Small Signs	Large Signs
RADIUS	1.5	1.5
MARGIN	.38	.38
BORDER	.38	.63
a	24	36
b	18	24
c	8.3	12.4
d	9.6	14.4
e	3.5	4
f	3	4
g	4 Min.[4]	6 Min.[4]
h	10 Min.	14 Min.
i	2 Min.[3]	2 Min.[3]
j	13.8	
k	3	
l	.5	
m	16.2	
n	1.5	
o	36	
p	8	
q		
r		
s		
t		
u		
v		
w		
x		
y	5C	
z	4E	6E

The topics include in the booklet include:

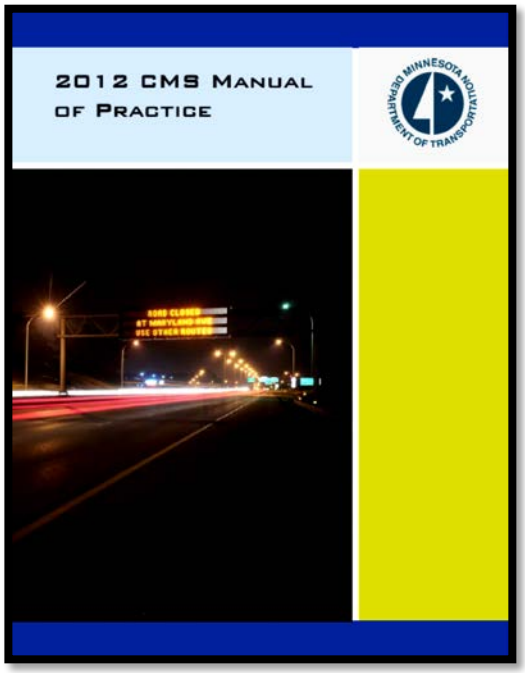
- ✓ Introduction
- ✓ The Law
- ✓ Documentation
- ✓ Advisory Speed Limits
- ✓ Workers Present Speed Limits
- ✓ 24/7 Construction Speed Limits
- ✓ Higher Fines for Inplace Speed Limits in Work Zones
- ✓ Speed Limits On Detours
- ✓ Dynamic Speed Display Signs
- ✓ Extraordinary Law Enforcement

At the time of this publication print, MnDOT OTE was updating the Work Zone Speed Limit Guidelines.

2.6.9 2012 CMS Manual of Practice

The 2012 CMS Manual of Practice document (**Exhibit 2-12**) is in conformance with the Mn MUTCD and the guidelines set forth by FHWA. It is intended to be used as a guide for MnDOT internal stakeholders and external stakeholders, including other agencies and private contractors.

Exhibit 2-12 2012 CMS Manual of Practice



The items include in the manual are:

- ✓ Introduction
- ✓ Message Guidelines
- ✓ Permanent Changeable Message Signs
- ✓ Portable Changeable Message Signs (PCMS)

The 2012 CMS Manual includes information on the types of allowable and prohibited message and abbreviations that can be displayed on a CMS. Allowable and prohibited messages can also be found in the MN MUTCD

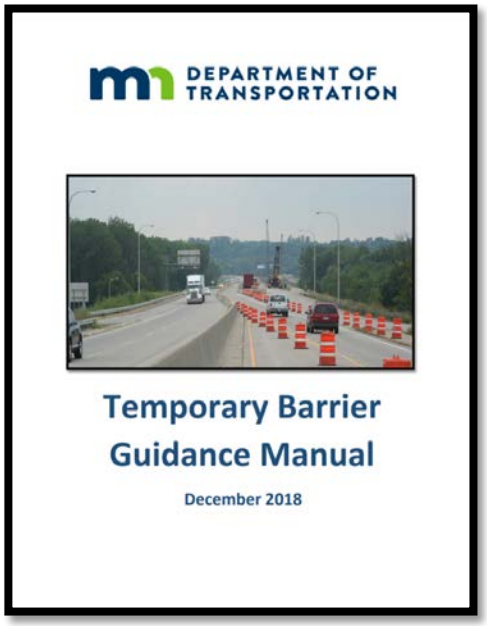
Web-based training on CMS is available from the following site:

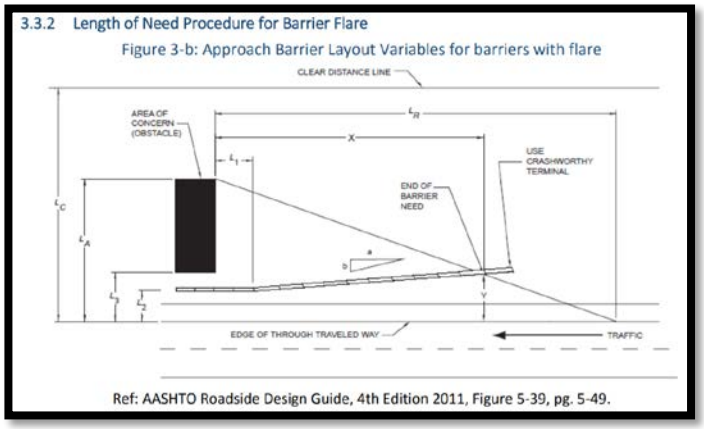
http://www.dot.state.mn.us/trafficeng/education/changeable-message-signs/index.html.

2.6.10 Temporary Barrier Guidance Manual

Temporary barrier is effective in providing positive separation between traffic and work areas; it is primarily used for protecting vehicles from severe hazards (e.g. drop-offs, embankments, fixed objects), protecting workers from errant vehicles, and to separate opposing directions of traffic in certain temporary traffic control applications.

Exhibit 2-13 Temporary Barrier Guidance Manual





The items include in the manual are:

- ✓ Introduction
- ✓ Work Zone Clear Zone and Roadside Safety
- ✓ Temporary Barrier for Hazard Protection - Placement and Deflection Distance Guidance
- ✓ Portable Concrete Barrier (PCB) design details and requirements
- ✓ Appendix

Refer to Section **3.6** for information on Temporary Barrier Guidance.

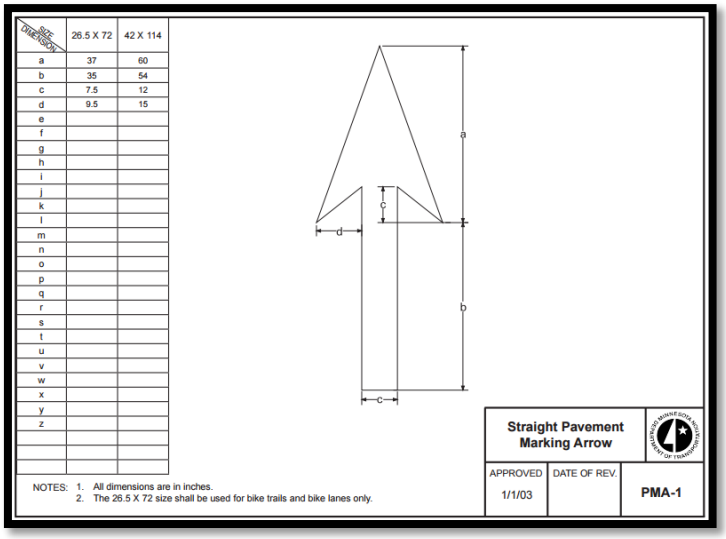
2.6.11 Standard Signs and Markings Manual

The Standard Signs and Markings Manual contains a wide variety of standard signs that are used in the state (see **Exhibit 2-14**). It includes the common R, W, M, G, S, D, I, E and X series. Each Series is broken into groups. For instance, the R series is broken into 16 groups from Group 1 on Right of Way to Group 16 Miscellaneous. The manual also includes pavement markings.

The Standard Signs Manual includes detailed information on the layout of the sign.

Exhibit 2-14 MnDOT Standard Signs and Markings Manual

Sample Page from Standard Signs and Markings Manual (R1-1)



SIGN DIMENSION	26.5 X 72	42 X 114
a	37	60
b	35	54
c	7.5	12
d	9.5	15
e		
f		
g		
h		
i		
j		
k		
l		
m		
n		
o		
p		
q		
r		
s		
t		
u		
v		
w		
x		
y		
z		

2.6.12 Standard Signs Summary

As the name implies, the Standard Signs Summary is a summary of the standard signs used in the state (See **Exhibit 2-15**). It includes the sign number (nomenclature), a drawing of the sign, and the color of the sign and the sizes of the sign. Unlike the Standard Signs Manual, it does not contain the detailed layout details of the sign.

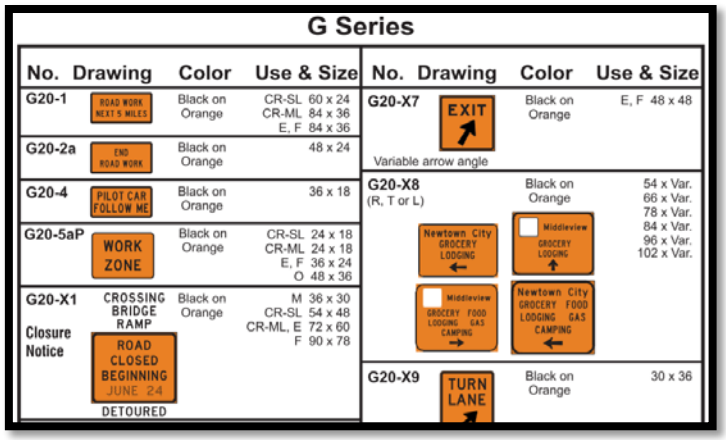
For the pavement markings, the following abbreviations are used in the manual:

- ✓ PMA = Pavement Markings Arrows
- ✓ PMC = Pavement Marking Characters
- ✓ PMS = Pavement Marking Symbol
- ✓ PMW = Pavement Marking Word

If any special signs are used, the designer needs to call out the structure that is to be used.

Exhibit 2-15 MnDOT Standard Signs Summary

Sample G Series from Standard Signs Summary



G Series

No.	Drawing	Color	Use & Size
G20-1	ROAD WORK NEXT 5 MILES	Black on Orange	CR-SL 60 x 24 CR-ML 84 x 36 E, F 84 x 36
G20-2a	END ROAD WORK	Black on Orange	48 x 24
G20-4	PILOT CAR FOLLOW ME	Black on Orange	36 x 18
G20-5aP	WORK ZONE	Black on Orange	CR-SL 24 x 18 CR-ML 24 x 18 E, F 36 x 24 O 48 x 36
G20-X1 Closure Notice	CROSSING BRIDGE RAMP ROAD CLOSED BEGINNING JUNE 24 DETOURED	Black on Orange	M 36 x 30 CR-SL 54 x 48 CR-ML, E 72 x 60 F 90 x 78
G20-X7	EXIT Variable arrow angle	Black on Orange	E, F 48 x 48
G20-X8 (R, T or L)	Newtown City GROCERY LODGING Middleview GROCERY LODGING Middleview GROCERY FOOD LODGING GAS CAMPING Newtown City GROCERY FOOD LODGING GAS CAMPING	Black on Orange	54 x Var. 66 x Var. 78 x Var. 84 x Var. 96 x Var. 102 x Var.
G20-X9	TURN LANE	Black on Orange	30 x 36

2.6.13 Additional Manuals and Guidelines

The above sections (**2.6.1** to **2.6.12**) are a sampling of some of the more common (not necessarily most important) manuals and guidelines found on the Work Zone Manuals and Guidelines website. Be sure to fully investigate the website for details as it is continually being updated.

2.6.14 Minnesota Work Zone Safety and Mobility Policy Tech Memo

The following is a handout Technical Memorandum 17-10-T-03. The memo can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/workzone/wzmanual.html.

It is important that the holder of this manual checks the above link for updates.

The policy is addressed in three (3) levels as follows:

1. Project Level Procedures
2. District or Local Agency Level Process and Procedures
3. State Level Processes and Procedures

Of interest for this manual are the Project Level Procedures. These procedures are divided into:

- ✓ Work Zone Mobility Impact Assessment
- ✓ Transportation Management Plan (TMP)
- ✓ Plans, Specifications and Estimates (PS&Es)
- ✓ Project Temporary Traffic Control (TTC) Field Observations

It is important to provide the proper attention to these items in the early stages of the development process. Refer to the handout for full details.

HANDOUT

DEPARTMENT OF TRANSPORTATION

Minnesota Department of Transportation
Engineering Services Division
Technical Memorandum No. 17-10-T-03
August 21, 2017

Technical Memorandum

To: **Electronic Distribution Recipients**

From: **Nancy T. Daubenberger, P.E.**
Divison Director, Engineering Services

Subject: Technical Memorandum; Minnesota Work Zone Safety and Mobility

Expiration and Purpose

This Technical Memorandum extends the expiration date of Technical Memorandum 12-03-T-02 to August 21, 2018 unless superseded prior to that date.

The purpose of the attached is to implement the requirements and guidelines contained in the Code of Federal Regulations, Title 23 Part 630, Subpart J, "Work Zone Safety and Mobility" for appropriate highway projects in Minnesota.

Guidelines

Refer to Attachment TM 12-03-T-02

Questions

Any questions regarding the technical provisions of this Technical Memorandum can be addressed to either of the following:

Ken Johnson, State Work Zone, Pavement Marking & Traffic Devices Engineer **at (651) 234-7386**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

To add, remove or change your name on the Technical Memoranda mailing list, please visit the web page http://techmemos.dot.state.mn.us/subscribe.aspx

Attachments:

TM 12-03-T-02

-END-

HANDOUT

MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
Technical Memorandum No. 12-03-T-02
February 6, 2012

To: Electronic Distribution Recipients

From: Jon M. Chiglo, P.E.
Division Director, Engineering Services

Subject: Minnesota Work Zone Safety and Mobility Policy

Expiration
This Technical Memorandum supersedes TM 07-16-T-05 and shall remain in force until February 6, 2017 unless superseded prior to that date or incorporated in the Traffic Engineering Manual.

Implementation
This policy shall be implemented immediately for all projects and operations in the planning and design phase. The provisions of these policies and procedures apply to Federal and non-Federal aid MnDOT projects and State-Aid projects with Federal aid in the State of Minnesota.

For projects that are in the later stages of development at/or about the compliance date, and if it is determined that the delivery of those projects would be significantly impacted as a result of this rule's provisions, MnDOT may request variances for those projects from the FHWA, on a project-by-project basis. They should also be implemented on maintenance and utility operations to the extent practical.

The provisions contained in this Technical Memorandum do not apply to **current** Construction Projects and Maintenance Operations.

Introduction
Use of the Work Zone Impact Assessment Decision Tree for projects on lower-volume streets and highways typically only requires the development of a temporary traffic control plan. Agencies are encouraged to apply the good practices, especially the decision tree included in the Minnesota Work Zone Safety and Mobility Policy, on all projects.

Purpose
The purpose of the attached "Minnesota Work Zone Safety and Mobility Policy" is to implement the requirements and guidelines contained in the Code of Federal Regulations, Title 23 Part 630, Subpart J, "Work Zone Safety and Mobility" for appropriate highway projects in Minnesota.

Guidelines
See attachment "Minnesota Work Zone Safety and Mobility Policy".

Questions
For information on the technical contents of this memorandum, please contact **Ken Johnson** at **(651) 234-7386.**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

To add, remove, or change your name on the Technical Memoranda mailing list, please visit the web page http://techmemos.dot.state.mn.us/subscribe.aspx

Attachments:
Minnesota Work Zone Safety and Mobility Policy
Work Zone Impact Considerations Worksheet
Work Zone Management Strategies

HANDOUT

Minnesota Work Zone Safety and Mobility Policy

February 6, 2012

INTRODUCTION

Work zones directly impact the safety and mobility of road users and highway workers. These safety and mobility impacts are exacerbated by an aging highway infrastructure and growing congestion in many locations. Everyone involved in project development and delivery including field operations must be committed to providing safety and mobility for all operations. Addressing these safety and mobility issues requires considerations that start early in project development and continue through project completion.

Purpose

The purpose of the policy contained in this document is to implement the requirements and guidelines contained in the Code of Federal Regulations, Title 23 Part 630, Subpart J, "Work Zone Safety and Mobility" for appropriate highway projects in Minnesota.

This document establishes requirements and provides guidance for systematically addressing the safety and mobility impacts of work zones, and developing strategies to help manage these impacts. The requirements and guidance are addressed at the following three (3) levels with associated procedures for each level and policies that should be developed ensure their uniformity and compliance statewide:

1. Project Level Procedures including:
    a. Work Zone Mobility Impact Assessment
    b. Transportation Management Plan (TMP)
    c. Plans, Specifications and Estimates (PS&Es)
    d. Project Temporary Traffic Control (TTC) Field Observations
2. District or Local Agency Level Process and Procedures
    a. Establishment of a Work Zone Safety Coordinator
    b. Operational Performance Information
    c. Work Zone Crash Data Review
3. State Level Processes and Procedures
    a. Statewide Work Zone Data
    b. Statewide Field Reviews
    c. Training
    d. Process Feed-Back Discussions
    e. Statewide Group Activities

Scope

The provisions of these policies and procedures apply to federal and non-federal aid MnDOT and State-Aid Projects with federal-aid in the State of Minnesota. They should also be implemented on maintenance and utility operations to the extent practical and feasible.

HANDOUT
HANDOUT
HANDOUT

HANDOUT

PROJECT LEVEL PROCESSES AND PROCEDURES

This section provides guidance and establishes procedures to manage the work zone impacts of individual projects.

For all construction and maintenance projects attention must be given to traffic mobility and safety from the early stages of development of the project, through the completion of the actual construction, including the preliminary layout studies, detailed design, and the drafting of the special provisions. It is considered essential that personnel of various technical expertise be involved in order to provide their specialty input so an appropriate transportation management plan can be developed.

During project planning and preliminary plan development, the Project Manager should review the scope of the project with traffic engineering, construction, design and maintenance personnel to establish traffic mobility and determine traffic control concepts for the proposed project. Project staging should be determined by the traffic carrying capacities of the roadway under construction, bypasses or detours. Consideration should be given for other construction/maintenance work in the proposed roadway corridor or general vicinity. Work zone mobility impact assessments should be done for all projects as detailed in the next section.

Work Zone Mobility Impact Assessment

The Work Zone Mobility Impact Assessment Decision Tree shown in Figure 1 should be used for all projects to identify the potential impact the project will have on mobility through the work zone and provide guidelines for developing the strategies to mitigate the impact. When the impacts are identified, the documentation and management of the mitigation strategies are combined into an appropriate level of Transportation Management Plan for the project.

To facilitate the use of this decision tree each district or local road authority should develop and implement a general traffic delay restriction policy for their jurisdiction. This policy should include restrictions by time-of-day, day-of-week, seasonal or special events, and may specify allowed durations or exceptions. A simple example of a district/road authority traffic delay restriction policy would be: “There shall be no lane closures on holiday weekends between 12 noon the day preceding the weekend until 5 am the day after the weekend”.

The district or local road authority may have an established “Lane Closure Manual” which specifies times that a lane may be closed. These restrictions are typically based upon hourly traffic volume predictions. In areas where roads are not covered by such a manual, the following guidelines should be used to identify a potential mobility impact due to a lane closure:

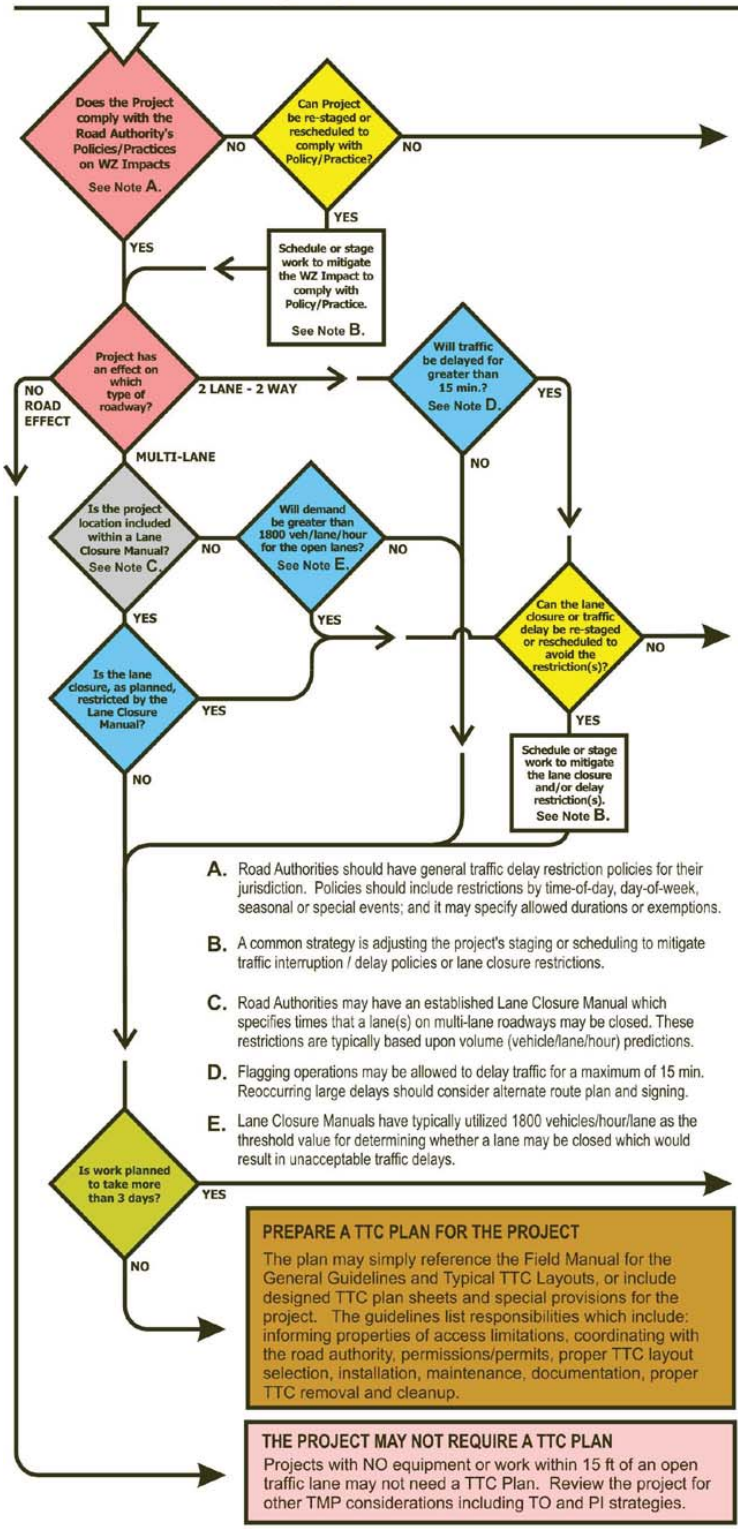
- On 2-lane 2-way roadways, traffic should not be stopped (such as a flagging operation) for greater than 15 minutes.
- On multi-lane roadways, traffic volumes should not exceed 1800 vehicles per hour per open lane.

The Work Zone Mobility Impact Assessment Decision Tree (Figure 1) also considers any project which will impact mobility for more than three (3) days as requiring at least a Basic TMP as explained below.

HANDOUT

Work Zone Mobility Impact Assessment - Decision Tree

Figure 1.



A. Road Authorities should have general traffic delay restriction policies for their jurisdiction. Policies should include restrictions by time-of-day, day-of-week, seasonal or special events; and it may specify allowed durations or exemptions.

B. A common strategy is adjusting the project's staging or scheduling to mitigate traffic interruption / delay policies or lane closure restrictions.

C. Road Authorities may have an established Lane Closure Manual which specifies times that a lane(s) on multi-lane roadways may be closed. These restrictions are typically based upon volume (vehicle/lane/hour) predictions.

D. Flagging operations may be allowed to delay traffic for a maximum of 15 min. Reoccurring large delays should consider alternate route plan and signing.

E. Lane Closure Manuals have typically utilized 1800 vehicles/hour/lane as the threshold value for determining whether a lane may be closed which would result in unacceptable traffic delays.

PREPARE A TTC PLAN FOR THE PROJECT

The plan may simply reference the Field Manual for the General Guidelines and Typical TTC Layouts, or include designed TTC plan sheets and special provisions for the project. The guidelines list responsibilities which include: informing properties of access limitations, coordinating with the road authority, permissions/permits, proper TTC layout selection, installation, maintenance, documentation, proper TTC removal and cleanup.

THE PROJECT MAY NOT REQUIRE A TTC PLAN

Projects with NO equipment or work within 15 ft of an open traffic lane may not need a TTC Plan. Review the project for other TMP considerations including TO and PI strategies.

PREPARE A TRANSPORTATION MANAGEMENT PLAN

A **Transportation Management Plan (TMP)** should be prepared through the assistance of the road authority's Traffic Engineer. The scope of the TMP will range from minor to major depending upon the project's complexity. Also see "Basic TMP" below.

Tasks include listing all potential work zone impacted services, businesses, or specific traffic types, and the estimated volumes and durations. Refer to the worksheet of "***Work Zone Impact Considerations***" for examples of potentially work zone impacted services, businesses, and traffic types.

Mitigation strategies for each identified Work Zone Impact should be identified and incorporated into the TMP. Many work zone impact management strategies can be used to minimize traffic delays, improve mobility, maintain or improve motorist and worker safety, complete road work in a timely manner, and maintain access for businesses and residents. Refer to the listing of "***Work Zone Impact Management Strategies***" for examples of typical measures utilized to reduce work zone impacts.

Refer to FHWA publication titled "*Developing and Implementing Transportation Management Plans for Work Zones*" for complete descriptions of various work zone management strategies, grouped according to the following categories:

Temporary traffic control (TTC):
- Control strategies.
- Traffic control devices.
- Project coordination, contracting and innovative construction strategies.

Public information (PI):
- Public awareness strategies.
- Motorist information strategies.

Transportation operations (TO):
- Demand management strategies.
- Corridor/network management (traffic operations) strategies.
- Work zone safety management strategies.
- Traffic/incident management and enforcement strategies.

PREPARE A BASIC TRANSPORTATION MANAGEMENT PLAN

A **Basic Transportation Management Plan (TMP)** shall contain documentation of all anticipated Work Zone Impacts and associated mitigation strategies. The Basic TMP may vary in complexity as appropriate for the project, but as a minimum, it shall have provisions for a TTC Plan and include details on the required minimum mitigation strategies to avoid any restrictions and to provide public information.

For example, the ***Basic TMP***, which is typically minimal in scope, should consist of the following:
- **TO**: a detour plan and/or access plan (if needed), with an appropriate work schedule for min. delay,
- **PI**: a process for contacting potentially affected services, businesses, and/or residents, and
- **TTC**: a selection of an appropriate combination of TTC plan layouts from the Long-term TTC Templates or plan sheets developed specifically for the project. Some projects may utilize modified layouts from the MN MUTCD Field Manual.

Figure 1.

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Transportation Management Plan (TMP)

A Transportation Management Plan (TMP) should be prepared through the assistance of the road authority's Traffic Engineer. The TMP should be developed and implemented in sustained consultation with stakeholders (e.g., other transportation agencies, railroad agencies/operators, transit providers, freight movers, utility suppliers, police, fire, emergency medical services, schools, business communities, and regional transportation management centers).

Tasks include listing all potential work zone impacted services, businesses or specific traffic types and the estimated volumes and durations. Refer to the Attachment "A" titled "Work Zone Impact Considerations Worksheet" for examples of potential work zone impacted services, businesses and traffic types. The FHWA document #2: "**Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects"** provides guidance on developing procedures to assess and manage work zone impacts of road projects, as well as examples and practices of how agencies are currently assessing and managing work zone impacts. The FHWA also requires that work zone impacts and mitigating strategies be discussed in the project's environmental document.
ATTACHMENT A: http://www.dot.state.mn.us/trafficeng/workzone/wzmobility/AttachmentA-considerations.pdf
FHWA Doc #2: http://www.ops.fhwa.dot.gov/wz/resources/final_rule/wzi_guide/index.htm

Mitigation strategies for each identified work zone impact should be identified and incorporated into the TMP. Many work zone impact management strategies can be used to minimize traffic delays, improve mobility, maintain or improve motorist and worker safety, complete road work in a timely manner, and maintain access for businesses and residents. Attachment "B" titled "Work Zone Impact Management Strategies" contains a listing of examples of typical measures utilized to reduce work zone impacts. Refer to the FHWA document #3: "**Developing and Implementing Transportation Management Plans for Work Zones"** for information about developing and implementing Transportation Management Plans (TMP), including information on how and where a TMP fits into project-level processes and procedures, a list of components that can be considered for inclusion in a TMP, descriptions of work zone management strategies, and examples and practices of how agencies are currently using TMPs.
ATTACHMENT B: http://www.dot.state.mn.us/trafficeng/workzone/wzmobility/AttachmentB-strategies.pdf
FHWA Doc #3: http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/index.htm

<u>Components of the TMP</u>
Various work zone management strategies are found within a TMP. The three primary management components are listed below:

Temporary Traffic Control (**TTC**)
- Control Strategies
- Traffic control devices
- Project coordination, contracting and innovative construction strategies

Transportation Operations (**TO**)
- Demand management strategies
- Corridor/network management (traffic operations) strategies
- Traffic/incident management and enforcement strategies

Public Information (**PI**)
- Public awareness strategies
- Motorist information strategies

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Temporary Traffic Control (TTC) Plan:
The TTC plan is a component of the TMP which identifies the strategies for handling traffic through a specific highway or street, work zone or an incident area. The TTC plan plays a vital role in providing continuity of reasonably safe and efficient road user flow and highway worker safety when a work zone, incident, or other event temporarily disrupts normal road user flow. A TTC plan may range in scope from a simple reference to an appropriate layout in the MN MUTCD Field Manual (or the road authority's adopted TTC manual) up to a very detailed plan designed solely for a specific project with standard specifications. The degree of detail in the TTC plan will depend on the project complexity and traffic interference with construction or maintenance activity.

The TTC plan shall be consistent with the provisions under Part 6 of the MN MUTCD and with the work zone hardware recommendations in Chapter 9 of the **AASHTO Roadside Design Guide** titled: ``Traffic Barriers, Traffic Control Devices, and Other Safety Features for Work Zones''. In developing and implementing the TTC plan, pre-existing roadside safety hardware shall be maintained at an equivalent or better level than existed prior to project implementation. If there is no approved safety hardware to make extensions or additions to the existing safety hardware, experimental hardware may be used to accomplish roadside safety and project goals.

Traffic Operations (TO) Plan:
The TO plan is a component of the TMP that organizes the strategies that will be used to mitigate impacts on the operation and management of the transportation system within the work zone. Typical TO strategies may include, but are not limited to, demand management, corridor/network management, work zone safety management, and traffic/incident/enforcement management. The scope of the TO component should be determined by the project characteristics, and the transportation operations and safety strategies identified by the State.

Public Information (PI) Plan:
The PI plan is a component of the TMP which identifies the anticipated communications strategies that will be utilized to inform affected road users, the general public, area residences and businesses, and appropriate public entities about the project, the expected work zone impacts, and the changing conditions on the project. This may include motorist/traveler information strategies. The scope of the PI component should be determined by the project characteristics. Public information should be provided through methods best suited for the project, and may include, but not be limited to, information on the project characteristics, expected impacts, closure details, and commuter alternatives.

Scope of the TMP

Depending upon the project's impact assessment, the scope of the TMP may range from very minimal requirements on many projects to a very formal and complex on large projects, which attempts to mitigate significant mobility and safety impacts utilizing the components listed above. Although many projects will not create significant impacts, they may still require a basic level of TMP consideration due to the project duration. Shorter duration projects may not require any formal TMP.

A Basic TMP, which is minimal in scope, shall have provisions for a TTC plan. The Basic TMP shall contain documentation of the basic work zone mobility impacts, such as excessive delays and project duration. The Basic TMP shall include details on the required minimum mitigation strategies to avoid or reduce any mobility restrictions and to provide public information.

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As an example, the Basic TMP should consist of the following:

- TTC – a selection of an appropriate combination of TTC plan layouts from the long-term TTC templates or plan sheets developed specifically for the project. Some projects may utilize modified layouts from the MN MUTCD Field Manual.
-
- Traffic Operations – a detour plan and/or access plan as needed, with an appropriate work schedule to minimize delay
- Public Information – a process for contacting potentially affected services, businesses and/or residents

Projects having relatively insignificant work zone impacts, as detailed in the attached work zone mobility impact assessment decision tree, do not require a formal TMP beyond a TTC plan. This plan may simply reference the MN MUTCD Field Manual for the "TTC General Guidelines" and typical TTC layouts, or may include TTC plan sheets and special provisions designed for the project. The "TTC General Guidelines" list many responsibilities which include:

- informing adjacent property owners of access limitations
- coordinating with all the road authorities
- receiving permission or permits for the work
- selecting proper TTC layout
- installing, maintaining and documenting proper TTC devices
- removing TTC devices when they are no longer needed

Plans, Specifications, and Estimates (PS&Es)

The Plans, Specifications, and Estimates (PS&Es) shall include the appropriate provisions of the TMP (the TTC plan, TO and/or PI components) or provisions for contractors to develop a TMP at the most appropriate project phase as applicable to the chosen contracting methodology for the project. Generally the agency develops the TMP. A contractor developed TMP shall be subject to the approval of the Road Authority, and shall not be implemented before it is approved.

Detailed final design should involve the traffic engineering, construction and maintenance personnel and appropriate FHWA personnel as the final detail plans are being developed so the necessary details for traffic control and mobility are included in the construction plan and proposal. If the complexity of a project warrants, a traffic control layout may be prepared and be included in the P.S. & E. On some projects it may be appropriate to provide broad TTC plan parameters in the P.S. & E., then permit the successful bidder to develop a detailed TTC plan and use it if the road authority and/or FHWA find it acceptable. Development of detailed time and traffic provisions should involve design, traffic engineering, and construction personnel. The pay items to be included in the plans must be determined during design.

Pay Items

The PS&Es shall include appropriate pay item provisions for implementing the TMP. Designers are encouraged to use appropriate pay items to the fullest extent practical, either through end based or performance based specifications.

(1) For end-based specifications individual pay items, lump sum payment, or a combination thereof may be used.

(2) For performance based specifications, applicable performance criteria and standards may be used (e.g., safety performance criteria such as number of

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crashes within the work zone; mobility performance criteria such as travel time through the work zone, delay, queue length, traffic volume; incident response and clearance criteria; work duration criteria).

Responsible persons

The road authority and the contractor shall each designate a trained person, at the project level, who has the responsibility and sufficient authority for implementing the TMP and other safety and mobility aspects of the project.

The responsible persons should insure, among other things, that the following activities are completed:

- Appropriate project personnel are familiar with the MN MUTCD, the contract plans and special provisions, the current Minnesota Standard Specifications for Highway Construction and its supplements.
- Personnel assigned to the project implement proper techniques of traffic safety and traffic operations prior to beginning construction and specifically how they relate to the TTC plan.
- Ensure that all affected agencies such as State Patrol, local police, fire departments, sheriff's office, hospital, ambulance services, local government, post office, school districts, etc., are informed of the scope of the project and how it may affect their individual needs and services. This public relations work is extremely critical in the case of a total detouring of traffic.
- Notify the major local news media (TV, radio stations, newspapers, etc.), local tourism associations, AAA, local legislators, etc. of the scope of the project prior to beginning operations. Cooperation with the contractor and any involved local government agencies is advised. All items of interest should be included. These include:
    - Type of work to be performed.
    - Hours the highway will be fully opened to traffic.
    - Hours of restricted usage.
    - Type and place delays can be expected.
    - Duration of the project.
    - Location of the detour, if applicable.
    - Anticipated completion date of project.
    - A name and phone number the public can contact for information or to make comments about the project.
- Regularly review field observations, available work zone crash data, and operational information and use the data and information to manage work zone impacts for the project, including revising the TTC plan, during construction.
- Insure that traffic operations are reviewed through the project limits, including the condition of all traffic control devices on a regular basis. The frequency of these reviews should vary with the complexity of the projects. On some projects, it may be necessary to change the TTC plan during construction, depending on the contractor's schedule, progress of utility work, etc.
- Ensure that current documentation is maintained as to when deficiencies were noted in the implementation of the TTC plan and how and when they were corrected.

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Project TTC Field Observations

Field observations (generally regular drive through reviews) shall be made to assure that traveler information is accurate and up-to-date. This includes:

- Warning, Guide, and Information signing;
- Changeable Message Sign (portable and non-portable) messaging;
- Temporary Traffic Control devices; and
- Pavement Markings.

Revisions to the TTC plans shall be reviewed to determine if they comply with all standards in the MN MUTCD, Special Provisions and Specifications. For major revisions this review should include consultation with traffic engineering staff before the revision is implemented.

While adjustments to the temporary traffic controls are anticipated on all projects, a revision to the TTC Plan is less common. Revisions to the TTC plans shall be "properly" documented in the project file. Proper documentation may range from a daily diary entry to marked up TTC plan sheets.

DISTRICT OR LOCAL AGENCY LEVEL PROCESS AND PROCEDURES

Each District or Local Agency is encouraged to establish a Work Zone Safety Coordinator. This Coordinator should be responsible for:

- Making periodic reviews of maintenance and construction projects to determine the adequacy of the TTC plan and to assist project and maintenance personnel with compliance to the plan.
- Ensuring proper documentation is maintained when deficiencies are noted and the corrective action that was taken.
- Regularly obtain and keep a record of all known crashes within a work zone. This record should include all available information, such as: time of day, probable cause, location, pictures, sketches, weather conditions, interferences to traffic, etc. These records should be sent to project personnel.
- Making recommendations to design, construction, maintenance and management regarding temporary traffic controls.
- Working with design and field personnel on the development of TMP and TTC plans for maintenance and construction projects.

If the District or Local Agency does not establish a Work Zone Safety Coordinator the above responsibilities should be delegated to the appropriate personnel.

Operational Information

Operational information shall be used to determine if temporary traffic controls and traffic control schemes are meeting the safety and mobility goals for the project or field operation. This provision requires the use of available data and information to take action in a timely manner to correct potential safety or mobility issues in the field. This information may include:

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- Incident Response Time. The time from notification to initial response and the time from notification to all lanes clear to determine if project level goals are being met.

- Delay Time. Total delay during construction or maintenance should be compared to the anticipated total delay estimated for the project. The anticipated total delay, due to construction activities and reduced capacity should be calculated for typical traffic patterns including peak periods.

- Traffic Measures. When Intelligent Work Zone (IWZ) systems are used, the traffic data collected should be complied and analyzed to determine if project level goals are being met.

Work Zone Crash Data Reviews

Work zone crash data shall be analyzed on a District or Local Agency level. Analysis includes:

- Reviewing all fatal and life-changing crashes. Take into account crashes that occur within a project or on the roadways immediately entering a project.
- Determine if improvements in District or Local Agency temporary traffic control practices are indicated.
- Report deficiencies within current statewide standards or guidelines that should be considered for modification.

STATE LEVEL PROCESSES AND PROCEDURES

This section consists of processes and procedures to implement and sustain work zone safety and mobility policies. These processes and procedures, data and information resources, training, and periodic evaluation enable a systematic approach for addressing and managing the safety and mobility impacts of work zones.

Statewide Work Zone Data

Field observations, available work zone crash data, and operational information to manage work zone impacts for specific projects during implementation shall be used. This data shall be used to continually pursue improvement of work zone safety and mobility by analyzing work zone crash and operational data from multiple projects to improve these processes and procedures. Each road authority should maintain elements of the data and information resources that are necessary to support these activities.

Work Zone Crash Data:
Statewide analysis is accomplished by reviewing work zone crash records contained in the TIS (Transportation Information System) data base. Annual reporting of these crashes on all road systems shall be conducted by the Office of Traffic, Safety and Technology.

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Statewide Field Reviews

The Office of Construction and Innovative Contracting (OCIC) and the Office of Maintenance (OM) will conduct regular field reviews of temporary traffic controls in each district. The purpose of these reviews is to:

- Determine adequacy of temporary traffic controls
- Identify areas that need improvement

Training

Personnel involved in the development, design, implementation, operation, inspection, and enforcement of work zone related transportation management and traffic control shall be trained, appropriate to the job decisions each individual is required to make. Periodic training updates that reflect changing industry practices and State processes and procedures shall be required.

Available training can be found at http://www.dot.state.mn.us/const/wzs/training.html

Process Feed-Back Discussions

To assess the effectiveness of work zone safety and mobility procedures annual process feed-back discussions will be conducted. This discussion may include the evaluation of work zone data at the State level, and/or results of OCIC/OM field reviews.

Appropriate personnel (stakeholders) who represent the project development stages and the different offices within the State, and the FHWA should participate in these discussions. Other non-State stakeholders may also be included as appropriate. The discussion team members are listed below.

The primary purpose of these discussions is to identify best practices that facilitate improvements in work zone processes, procedures and data and information resources that enhance efforts to address safety and mobility on projects. Through an annual report to the team sponsor, these discovered best practices can then be shared with other stakeholders. The team should also consider making presentations to other groups (SWZSC, TEO, Resident Engineers, Design Engineers, etc.) as appropriate to share this information.

A secondary purpose of these discussions is to discover issues that should be addressed on a statewide basis. Another source that identifies these issues are the reviews conducted by OCIC and OM during their normal field reviews. All of these observations and concerns discovered during these reviews and discussions will be used to make improvements in the statewide processes, procedures and training programs.

<u>Discussion Team</u>

The discussion team will consist of the following team sponsor, team leader and team members:

Team Sponsor – MnDOT State Traffic Engineer – Sue Groth
Team Leader – Work Zone, Pavement Marking, and New Products Engineer – Ken Johnson

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Team Members:

- FHWA Safety Engineer – Will Stein
- OCIC Representative – Craig Mittelstadt
- OM Representative – Sue Lorentz
- OTST Representative – Ted Ulven

Primary stakeholders include:

- District Engineers
- District Construction
- District Maintenance
- District Planning
- District Design
- District Traffic Engineering
- Local Road Authorities
- Law Enforcement

Discussion Schedule

It is anticipated these two day visits will be conducted in 2-3 MnDOT Districts per year resulting in completing statewide visits every three years. Each District visit will consist of:

- Initial meeting with all Stakeholders
- Individual interviews with Stakeholders
- Identification of Observations
- Closing report to all Stakeholders
- Final written report to District/Road Authority

Statewide Group Activities

There are four statewide groups that are active in work zone traffic control and safety in Minnesota. They are:

- Statewide Work Zone Safety Committee
- Special Provisions Annual Update
- Traffic Engineering Organization Temporary Traffic Control Committee
- Resident Engineers Work Zone Safety Advisory Committee

They are included in this document to illustrate the level of commitment and ability of MnDOT to provide continual improvement in the area of work zone traffic control and safety. These groups are also involved with and responsible for implementing many of the recommendations of field observations and process reviews.

Statewide Work Zone Safety Committee

The MnDOT Statewide Work Zone Safety Committee (SWZSC) includes key MnDOT employees and stakeholders external to MnDOT and focuses on Work Zone Safety issues. Its purpose is to provide a forum for:

- Identifying Work Zone Safety problems, safety areas, and help set priorities;
- Acting as a sounding board;
- Brainstorming ideas; and
- Recommending direction to the Office of Construction and Innovative Contracting, Office of Maintenance, and Office of Traffic, Safety and Technology.

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The mission of the SWZSC is to influence the actions of these involved with Work Zones through the information that is shared and through the innovations and best practices that are identified so that we achieve safety Work Zones and fewer fatal and life changing crashes.

Special Provisions Annual Update

MnDOT's Office of Construction and Innovative Contracting conducts an annual workshop to review and improve the Standard Special Provisions for time and traffic and traffic controls used for the development of construction projects. This workshop uses the results of observations detailed in these procedures to make improvements to these standard special provisions. Participants in this workshop include Central Office and District Construction and Traffic Engineering personnel and traffic control industry representatives.

Traffic Engineering Organization Temporary Traffic Control Committee

MnDOT's Traffic Engineering Organization (TEO) has formed a Temporary Traffic Control Committee that reviews and approves traffic engineering standards and guidelines related to temporary traffic controls. Members of this committee include representatives from all District Traffic Offices, Resident Engineers group representative, OCIC, OM, OTST, and Metro District Maintenance.

Resident Engineers Work Zone Safety Advisory Committee

MnDOT's Resident Engineers has formed a Work Zone Safety Advisory Committee that reviews and approves work zone safety and TTC special provisions and project related issues. Members of this committee include representatives from OCIC, OTST and the Resident Engineers group.

Related Standards, Guidelines and Procedures

There are many standards, guidelines and procedures that have been established to aid in providing safety and mobility in highway work zones. These include:

- Part 6 of the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD);
- The Standard Specifications for Construction;
- Time and Traffic sample special provisions;
- Work Zone Mobility Impact Assessment Decision Tree;
- Federal Highway Administration Guidance Documents:

1. *"Implementing the Rule on Work Zone Safety and Mobility"*
   http://www.ops.fhwa.dot.gov/wz/rule_guide/index.htm

2. *"Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects"*
   http://www.ops.fhwa.dot.gov/wz/resources/final_rule/wzi_guide/index.htm

3. *"Developing and Implementing Transportation Management Plans for Work Zones"*
   http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/index.htm

4. *"Work Zone Public Information and Outreach Strategies"* (pdf)
   http://ops.fhwa.dot.gov/wz/info_and_outreach/public_outreach_guide.pdf

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WORK ZONE IMPACT CONSIDERATIONS WORKSHEET

Work Zone Impacts Considerations	Project Design Notes
Project Characteristics	
• Project type. • Project size, extent, duration, and complexity. • Roadway classification. • Area type (urban, suburban, rural).	
Travel and Traffic Characteristics	
• Traffic demand and volumes. • Seasonal and temporal variations in demand (hourly, daily, or weekly). • Occurrence of special events. • Percentages of different vehicular volumes (autos – Single-Occupancy Vehicle, High-Occupancy Vehicle; trucks; or buses). • Type of travel (commuter or tourist), freight corridor, transit corridor. • Public and private facility access issues. • Potential impacts of weather. • Other such similar characteristics.	
Corridor, Network, and Community Issues	
• Impacts of the project at both the corridor and network levels including parallel corridors, alternate routes, the transportation network, other modes of transportation, and impacts of other work zones in the vicinity of the project, either at the corridor level or the network level. • Impacts on nearby transportation infrastructure such as key intersections and interchanges, railroad crossings, public transit junctions, and other junctions in the transportation network. • Impacts on evacuation routes in the vicinity of critical transportation or other infrastructure. • Impacts on affected public properties, including parks, recreational facilities, fire stations, police stations, and hospitals. • Impacts of the project on affected private properties, including businesses and residences.	

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WORK ZONE IMPACT CONSIDERATIONS WORKSHEET

Design, Procurement and Construction Options	
• Temporal alternatives for work performance such as season, month, day of week (weekend versus weekday), and time of day (night time versus day, off-peak versus peak). • Alternative lane closure strategies such as full closure, partial closure, crossovers, multiple lane closure, single lane closure, and impact of alternative traffic management strategies on lane-closure decisions. • Alternative design solutions that address the durability and economy of maintenance of the roadway. • Alternative design solutions and strategies that impact decision-making on right-of-way (ROW) acquisition. • Alternative construction staging plans, and construction techniques and methodologies (e.g., accelerated construction techniques) that may have varying types and severity of work zone impacts. • Alternative contracting methodologies such as design-build, A+B bidding, and incentive/disincentive contracting.	
Work Zone Design and Safety Issues	
• Cross-sectional issues such as lane widths, shoulder availability and widths, and number of lanes available for travel. • Longitudinal issues such as taper widths, taper lengths, and stopping sight distance. • Horizontal and vertical sight distance. • Project signing and advance warning. • Roadside devices and safety. • Work area separation, channelization, and protection (e.g., positive separation, barrels, cones, clear zone considerations, construction zone intrusion detection). • Work area and worker delineation (visibility, retroreflectivity, etc.). • Work site access and access points. • Visibility issues (e.g., night-time work, lighting, fog). • Curvature and gradient – vertical and horizontal. • Speed – posted speed limits, speed zoning, etc. • Work zone enforcement (e.g., use of uniformed police officers and/or patrol cars, active enforcement using radar guns and/or automated enforcement).	

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WORK ZONE IMPACT CONSIDERATIONS WORKSHEET

T.T.C. Strategy Considerations	
• Traffic safety and capacity requirements. • Alternate route scenarios. • Potential impacts on other corridors, nearby intersections/interchanges, and the larger transportation network. • Lane closure types and strategies (full-closure, lane-width restrictions, cross-overs, positive separation, etc.). • Work zone and work area configurations. • Traffic safety and control checklists for developing a TMP.	
T.O. Strategy Considerations	
• Deployment of ITS technologies for work zone traffic monitoring and management. • Provision of real-time traveler information to the public, including web-based information. • Application of transportation systems management (TSM) and corridor management strategies, including mitigation treatments for alternate routes (e.g., traffic signal timing adjustment on affected corridors), and alternate modes (e.g., public transit subsidies, incentives, and special programs). • Coordination of transportation management with existing regional transportation management centers (TMCs). • Conduct of mobility and safety reviews and audits. • Speed enforcement and management in work zones using either police officers or automated techniques. • Traffic incident management plans for work zones. • Policies on work zone traffic management during emergencies (e.g., hurricane evacuations).	
P.I. Strategy Considerations	
• Provision of project and work zone information prior to the commencement of the work in order to make the public aware of the expected work zone impacts and the State's actions to mitigate the impacts. • Recommendations to the public on commuter alternatives, such as information on alternate routes and/or modes. • Provision of information on changing conditions on the project during implementation (e.g., changes in lane closure scenarios, construction staging, construction times, or alternate routing).	

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WORK ZONE IMPACT CONSIDERATIONS WORKSHEET

• Obtaining public input for the development of appropriate work zone impacts management strategies during the planning and design phases of the project; refinement of work zone management strategies during project implementation; and feedback on performance of the work zone and the project following the completion of the project. • Dissemination of information through brochures, pamphlets, and media sources including newspapers, television, radio channels, and web sites. • Public meetings and hearings. • Coordination and cooperation with affected public and private parties.	

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Work Zone Management Strategies	I. Temporary Traffic Control (TTC)	
A. Control Strategies	**B. Traffic Control Devices**	**C. Project Coordination, Contracting, and Innovative Construction Strategies**
IA1. Construction phasing/staging IA2. Full roadway closures IA3. Lane shifts or closures • Reduced lane widths to maintain number of lanes (constriction) • Lane closures to provide worker safety • Reduced shoulder width to maintain number of lanes • Shoulder closures to provide worker safety • Lane shift to shoulder/median to maintain number of lanes IA4. One-lane, two-way operation IA5. Two-way traffic on one side of divided facility (crossover) IA6. Reversible lanes IA7. Ramp closures/relocation IA8. Freeway-to-freeway interchange closures IA9. Night work IA10. Weekend work IA11. Work hour restrictions for peak travel IA12. Pedestrian/bicycle access improvements IA13. Business access improvements IA14. Off-site detours/use of alternate routes	IB1. Temporary signs • Warning • Regulatory • Guide/ information IB2. Changeable message signs (CMS) IB3. Arrow panels IB4. Channelizing devices IB5. Temporary pavement markings IB6. Flaggers and uniformed traffic control officers IB7. Temporary traffic signals IB8. Lighting devices	IC1. Project coordination • Coordination with other projects • Utilities coordination • Right-of-way coordination • Coordination with other transportation infrastructure IC2. Contracting strategies • Design-build • A+B bidding • Incentive/disincentive clauses • Lane rental IC3. Innovative construction techniques (precast members, rapid cure materials)

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Work Zone Management Strategies	**II. Public Information (PI)**
A. Public Awareness Strategies	**B. Motorist Information Strategies**
IIA1. Brochures and mailers	IIB1. Traffic radio
IIA2. Press releases/media alerts	IIB2. Changeable message signs (CMS)
IIA3. Paid advertisements	IIB3. Temporary motorist information signs
IIA4. Public information center	IIB4. Dynamic speed message sign
IIA5. Telephone hotline	IIB5. Highway advisory radio (HAR)
IIA6. Planned lane closure web site	IIB6. Extinguishable signs
IIA7. Project web site	IIB7. Highway information network (web-based)
IIA8. Public meetings/hearings	IIB8. 511 traveler information systems (wireless, handhelds)
IIA9. Community task forces	IIB9. Freight travel information
IIA10. Coordination with media/schools/businesses/ emergency services	IIB10. Transportation management center (TMC)
IIA11. Work zone education and safety campaigns	
IIA12. Work zone safety highway signs	
IIA13. Rideshare promotions	
IIA14. Visual information (videos, slides, presentations) for meetings and web	

REFER TO FHWA DOCUMENT TITLED: *"Developing and Implementing Transportation Management Plans for Work Zones"* (pdf) Chapter 4 for an explanation of each of the strategies.

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Work Zone Management Strategies	III. Transportation Operations (TO)		
A. Demand Management Strategies	**B. Corridor/Network Management Strategies**	**C. Work Zone Safety Management Strategies**	**D. Traffic/Incident Management and Enforcement Strategies**
IIIA1. Transit service improvements	IIIB1. Signal timing/coordination improvements	IIIC1. Speed limit reduction/variable speed limits	IIID1. ITS for traffic monitoring/management
IIIA2. Transit incentives	IIIB2. Temporary traffic signals	IIIC2. Temporary traffic signals	IIID2. Transportation management center (TMC)
IIIA3. Shuttle services	IIIB3. Street/intersection improvements	IIIC3. Temporary traffic barrier	IIID3. Surveillance [Closed-Circuit Television (CCTV), loop detectors, lasers, probe vehicles]
IIIA4. Ridesharing/carpooling incentives	IIIB4. Bus turnouts	IIIC4. Movable traffic barrier systems	IIID4. Helicopter for aerial surveillance
IIIA5. Park-and-ride promotion	IIIB5. Turn restrictions	IIIC5. Crash-cushions	IIID5. Traffic screens
IIIA6. High-occupancy vehicle (HOV) lanes	IIIB6. Parking restrictions	IIIC6. Temporary rumble strips	IIID6. Call boxes
IIIA7. Toll/congestion pricing	IIIB7. Truck/heavy vehicle restrictions	IIIC7. Intrusion alarms	IIID7. Mile-post markers
IIIA8. Ramp metering	IIIB8. Separate truck lanes	IIIC8. Warning lights	IIID8. Tow/freeway service patrol
IIIA9. Parking supply management	IIIB9. Reversible lanes	IIIC9. Automated Flagger Assistance Devices (AFADs)	IIID9. Total station units
IIIA10. Variable work hours	IIIB10. Dynamic lane closure system	IIIC10. Project task force/committee	IIID10. Photogrammetry
IIIA11. Telecommuting	IIIB11. Ramp metering	IIIC11. Construction safety supervisors/inspectors	IIID11. Coordination with media
	IIIB12. Temporary suspension of ramp metering	IIIC12. Road safety audits	IIID12. Local detour routes
	IIIB13. Ramp closures	IIIC13. TMP monitor/inspection team	IIID13. Contract support for incident management
	IIIB14. Railroad crossings controls	IIIC14. Team meetings	IIID14. Incident/emergency management coordinator
	IIIB15. Coordination with adjacent construction site(s)	IIIC15. Project on-site safety training	IIID15. Incident/emergency response plan
		IIIC16. Safety awards/incentives	IIID16. Dedicated (paid) police enforcement
		IIIC17. Windshield surveys	IIID17. Cooperative police enforcement
			IIID18. Automated enforcement
			IIID19. Increased penalties for work zone violations

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2.7 Temporary Traffic Control Planning and Implementation

2.7.1 TEM Handout

The following is a handout from TEM Chapter 8, Section 8-4.00. The TEM can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

It is important that the holder of this manual checks the above link for updates.

The information covered in the TEM Section 8-4.00 include:

- ✓ Temporary Traffic Control Goals
- ✓ Transportation Management Plans (TMPs)

Additional information on Traffic Management Plans (TMPs) can be obtained from:

www.dot.state.mn.us/trafficeng/training/tmp.html

Supplemental information on TMPs are found in this manual in Section **2.8**.

The goals, scope and PMP are described in the TEM are an important component in temporary traffic control.

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Minnesota Statutes Sections 169.06, Subd. 1-4 and 169.07 establishe the legal authority for MnDOT and local units of government to: (1) place and maintain markings, (2) require obedience to official markings, (3) prohibit the display of unauthorized markings, and (4) prohibit interference with official markings. Markings shall be placed only by the authority of the public body having jurisdiction over the highway, road, or street for the purpose of regulating, warning, or guiding traffic. Pavement and curb markings, object markers, and delineators are all normally within highway, road, or street rights-of-way and, therefore, should never be installed except under public authority.

Construction contractors and public utility companies are permitted to erect temporary construction and maintenance signs and place temporary pavement markings at work sites to protect the public, equipment, and workers provided that such signs and markings conform to the standards of the MN MUTCD and the proper authority has been given by MnDOT.

Minn. Stat. Sec. 169.14, Subd. 5d allows the establishment of a Workers Present Speed Limit. Refer to the document "Speed Limits in Work Zones Guidelines" located on the Speed Limits in Minnesota website for additional information.

8-4.00 TEMPORARY TRAFFIC CONTROL PLANNING AND IMPLEMENTATION

8-4.01 Temporary Traffic Control Goals

During planning for temporary traffic control (TTC) zones, the greatest payoff in terms of safety and convenience at a cost commensurate with the hazards and problems involved should be the goal. A properly installed temporary traffic control zone will allow traffic to pass through or around a work zone safely. It requires time and effort for planning, installation, and maintenance.

Work zone traffic control planning is based upon analysis of the work activity as it relates to the provision of adequate safety and capacity. Questions to consider include: What is the likelihood of motorists failing to negotiate the work zone safely? What are the consequences of such action on workers, traveling public, and other road users (including pedestrians and bicyclists)?

Planning for traffic control through a construction work zone may be more involved than for maintenance or utility zones because of the differences in traffic disruption and duration of the work. The exposure of traffic to potential hazards is a function of the traffic volume and the length of time that the closure will be in effect. The goals common to all temporary traffic control zones are to:

- Protect the workers,
- Minimize crashes and crash severity, and
- Minimize inconvenience and conflicts as a result of the work.

Federal regulations also require that workers are as safe as practicable through the use of:

- Exposure control measures such as road and ramp closures, median crossovers, detours, and accelerated construction techniques,
- Positive protection devices such as barrier, truck/trailer mounted attenuators, and vehicle arresting systems,
- Other traffic control measures such as credible signing, portable changeable message signs, arrow boards, rumble strips, pilot cars, etc.

8-4.02 Transportation Management Plans (TMPs)

A Transportation Management Plan is a plan that lays out a set of coordinated strategies and describes how these strategies will be used to manage the impacts of a project during construction. It includes the:

1. Temporary Traffic Control Plan (TTCP),
2. Transportation Operations Plan (TOP), and
3. Public Information Plan (PIP), if needed.

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The scope of the project will dictate the level of effort and detail of the TMP. The TMP can range from the citation of a specific layout from the Field Manual that is being followed, to a full report that includes a TTCP, TOP (including traffic modeling), and PIP.

The development of the TMP will take into consideration the safety and mobility of workers and all users of the transportation system (motorists, pedestrians, and bicyclists). The TMP process is detailed in Technical Memorandum 12-03-T-02 Minnesota Work Zone Safety and Mobility (WZSM) Policy. This process includes a Work Zone Mobility Impact Assessment that will identify the appropriate level of TMP for the project. The level of TMP will then dictate the necessary documentation for the project. This could be as little as identifying the appropriate layout from the Field Manual, to a full Temporary Traffic Control Plan, a Traffic Operations Plan (possibly including traffic modeling), and a separate Public Information Plan. These components of the TMP are listed in the Tech Memo, as well as overall guidance in the development of each of the components. Each district should develop templates and procedures to develop these components to meet their district needs and characteristics.

The following is additional guidance that may be used as the TMP is being followed through the project development process:

Responsibility

Involvement from each of the functional areas is needed to insure that adequate consideration is given to proper temporary traffic control for all operations. In order to assure that this commitment is met, it will require early involvement by all parties including project management, pre-design, design, traffic, maintenance, and construction. Typical guidelines have been developed for the various stages.

Scoping and Environmental Documentation

During the scoping/preliminary design development phase, the Project Manager should review the scope of the project with staff from Traffic, Construction, and Detail Design to determine traffic control concepts for the proposed construction. Construction staging should be determined by the traffic carrying capacities of the roadway under construction, bypasses, or detours. Consideration should be given for other construction work in the proposed highway corridor or general vicinity by other than MnDOT forces such as cities and counties.

Metro District has created a TMP Scoping Worksheet that allows the documentation of possible work zone mobility impacts. Districts are encouraged to develop their own version of this worksheet so that impacts to traffic are considered in the Scoping phase. The TMP Scoping Worksheet can be found at the Metro District Traffic Engineering Work Zones and Pavement Marking page.

The Federal Highway Administration (FHWA) also requires that traffic control considerations and effects be mentioned in the environmental documentation. Traffic operations analyses (such as modeling) may need to be performed to assess the mobility of the proposed temporary traffic control, depending on the level of TMP for the project. Commitments made to stakeholders that impact the mobility of road users should be entered into the TMP which is initiated in this phase.

Detail Design

The Detail Design staff should involve staff from Traffic, Construction, and appropriate FHWA personnel as the final detail plans are being developed so that the necessary details for traffic control are worked into the TMP. This may range in scope from a very detailed plan (or proposal) designed solely for a specific project, to a reference to a standard specification, a section of the MN MUTCD, or a standard agency manual. The TMP requirements shall be incorporated into the plans, specifications, and estimate (P.S.& E). If the complexity of a project warrants, a traffic control layout may be prepared by the District Traffic Engineer and be included in the P.S. & E.

On some projects it may be appropriate to provide broad TTC Plan parameters in the P.S. & E., and then permit the successful bidder to develop a detailed TTC Plan and use it if MnDOT and FHWA find it acceptable.

The Detail Design staff should involve staff from Traffic, Construction, and the District Work Zone Safety Coordinator personnel to develop detailed time and traffic provisions.

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The pay items to be included in the plans must be determined by the district during design. Individual projects may have varying pay items depending on size, complexity, and location. Districts are encouraged to use appropriate pay items to the fullest practical extent.

Construction

During the construction stage, the resident/project engineer will generally be the MnDOT person responsible for implementing the TMP and reviewing the temporary traffic control. The resident/project engineer may delegate this authority. This should be done at or before the pre-construction conference.

The responsible person should have the following duties:

- Develop a familiarity with the MN MUTCD, the contract plans and special provisions, the current Minnesota Standard Specifications for Highway Construction and its supplements.
- Coordinate MnDOT personnel assigned to the project relative to proper techniques of traffic safety and traffic operations prior to beginning construction and specifically how they relate to the TTC Plan. The District Traffic Engineer and others shall be available to assist in this task.
- Ensure that all affected agencies such as State Patrol, local Police, fire departments, sheriff's office, hospital, ambulance services, local government, post office, school districts, etc., are informed of the scope of the project and how it may affect their individual needs and services. The Public Information Plan (PIP) of the TMP is extremely critical in the case of a total detouring of traffic. The District Public Affairs Coordinator and/or the Office of Communications may be of help in this responsibility.
- As identified in the PIP, notify the major local news media (TV, radio stations, newspapers, etc.), local tourism associations, AAA, local legislators, etc. of the scope of the project prior to beginning operations. Cooperation with the Contractor and any involved local government agencies is advised. All items of interest should be included:
  - Type of work to be performed.
  - Hours the highway will be fully opened to traffic.
  - Hours of restricted usage.
  - Type and place delays can be expected.
  - Suggested alternate routes.
  - Duration of the project.
  - Location of the detour, if applicable.
  - Anticipated completion date of project.
  - A name and phone number the public can contact for information or to make comments about the project.

  At appropriate times during the life of the project the responsible person should update the information mentioned above so that the public is kept current on the status of the project. The Public Affairs Coordinator may be of help in this responsibility.
- Update 511 at the start of construction, listing details on how traffic is affected.
- Monitor the Contractor's operations with regard to traffic and safety operations and enforce the requirements of the contract. On some projects, it may be necessary to change the TTC Plan during construction, depending on the contractor's schedule, progress of utility work, etc. If this is done, the TMP needs to be modified as well.
- Review traffic operations through the project limits, including the condition of all traffic control devices on a regular basis.

8-5.00 TEMPORARY TRAFFIC CONTROL STRATEGIES AND CONTROLLING CRITERIA

2.8 TMP Supplemental Information to the TEM

TMP development begins during systems planning and progresses through the design phase of a project. Existing project development processes can provide valuable information to guide TMP development.

Information on TMP development can be found in a variety of resources provided by the Federal Highway Administration (FHWA). MnDOT has included links to these materials on the following webpage:

www.dot.state.mn.us/trafficeng/training/tmp.html

2.8.1 TMP Development Tips

In January of 2011, the FHWA presented a Transportation Management Plan training (slides and materials included in the link shown above). Of note for this manual are tips on TMP development. These tips are drawn from the experiences of six States who have been very active in TMP development.

- ✓ **Start early.** TMP development should start as early in the project development process as possible so that TMP strategies can be accounted for in the budgeting/scoping process.
- ✓ **Coordinate early.** An effective TMP is one that has input from all of the key players in the project development process (e.g., operations, construction, planning, design, safety, maintenance, public affairs, technical specialists, FHWA, local transportation agencies, enforcement agencies, utility providers, emergency services, local businesses, community groups, etc.). Ensure all of these people are involved from the start of TMP development so that important strategies are not initially overlooked and projects are coordinated.
- ✓ **Use templates, guidance and other tools**. Templates, guidance, and other standardized agency resources help ensure that TMPs within an agency are consistent. These tools also simplify TMP development by helping those developing TMPs understand what is expected for agency TMPs.
- ✓ **Provide TMP Training for personnel involved in TMP development and implementation.** This helps ensure consistent TMPs, but also helps personnel understand why TMPs are important. It also can also help gain management buy-in for TMPs, as management support is needed for effective TMP efforts.
- ✓ **Assess, Monitor, and Update the TMP.** Include funding for monitoring traffic conditions during construction to track TMP effectiveness. This can be a challenge because it requires additional time beyond just developing the TMP. However, monitoring and updating the TMP as the project progresses or new potential impacts are discovered is important to ensuring the TMP remains effective at increasing work zone safety and mobility.
- ✓ **Document everything.** The TMP becomes a written history of the project. If design and development decisions are well documented, time, energy and money can be saved in the development of the project, as well as future projects. A brief standardized report at the completion of major projects that describes the TMP development and implementation process and outcomes can be very beneficial to future projects.
- ✓ **Understand diversion rates.** Accurate estimates of diversion rates can be very useful when developing the TMP. When people are aware of a construction project, some of them will divert to an alternate route. This reduction in demand may make a broader range of construction and MOT options feasible, possibly reducing project or TMP cost.

- ✓ **Facilitate use of alternate routes.** Begin looking into the feasibility of alternate routes early in the TMP process. If improvements are needed to alternate routes, schedule that work at least a year prior to the project so that the alternate routes can be ready for use once the project begins.
- ✓ **Use strategies that keep lanes open, especially during peak traffic times.** Some examples are imposing damages for late lane opening; contract incentives/disincentives; narrowing lane widths or occasionally using shoulders during peak periods to maintain the number of lanes; night work.
- ✓ **Consider using extended closures or full closures versus numerous night closures.** Extended and full closures can greatly reduce overall construction time and in many studies, it has been found that the public prefers one long-term closure to numerous smaller closures because the work can be completed sooner.

2.8.2 Metro District TMP Resource

The Metro district maintains a website with TMP resources at:

http://www.dot.state.mn.us/metro/trafficeng/control_striping.html

Items include:

- ✓ TMP Process and Components
- ✓ TMP Scoping Worksheet
- ✓ TMP Worksheet
- ✓ TMP Template
- ✓ Red Flag Checklist
- ✓ Work Zone Mobility Impact Assessment Worksheet

This information is included as a handout in the Appendix, Section **7.1.**

It is important to contact the district you are working in prior to starting a TMP. They may have forms and templates unique to them for use.

2.9 Temporary Traffic Control Strategies and Controlling Criteria

2.9.1 TEM Handout

The following is a handout from TEM Chapter 8, Section 8-5.00 regarding TTC Strategies and Controlling Criteria. The TEM can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

It is important that the holder of this manual checks the above link for updates.

Items include:

- ✓ Lane Width (also see Section **2.10.2**)
- ✓ Crossovers and Bypasses (Diversions)
- ✓ Closures and Detours
- ✓ Delay Time
- ✓ Flagging Operations
- ✓ Speed Limits in Work Zones (also see Section **2.10.3**)
- ✓ Positive Protection
- ✓ Cable Median Barrier
- ✓ Lighting
- ✓ Drop-offs
- ✓ Zipper Merge
- ✓ Intelligent Work Zones
- ✓ Innovative Contracting Methods (also see Section **2.10.4**)
- ✓ Other Travel Mode Considerations (such as Pedestrians, also see Section **2.12**)
- ✓ Clear Zones
- ✓ Business Impact Mitigation
- ✓ Public Information

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The pay items to be included in the plans must be determined by the district during design. Individual projects may have varying pay items depending on size, complexity, and location. Districts are encouraged to use appropriate pay items to the fullest practical extent.

Construction

During the construction stage, the resident/project engineer will generally be the MnDOT person responsible for implementing the TMP and reviewing the temporary traffic control. The resident/project engineer may delegate this authority. This should be done at or before the pre-construction conference.

The responsible person should have the following duties:

- Develop a familiarity with the MN MUTCD, the contract plans and special provisions, the current Minnesota Standard Specifications for Highway Construction and its supplements.
- Coordinate MnDOT personnel assigned to the project relative to proper techniques of traffic safety and traffic operations prior to beginning construction and specifically how they relate to the TTC Plan. The District Traffic Engineer and others shall be available to assist in this task.
- Ensure that all affected agencies such as State Patrol, local Police, fire departments, sheriff's office, hospital, ambulance services, local government, post office, school districts, etc., are informed of the scope of the project and how it may affect their individual needs and services. The Public Information Plan (PIP) of the TMP is extremely critical in the case of a total detouring of traffic. The District Public Affairs Coordinator and/or the Office of Communications may be of help in this responsibility.
- As identified in the PIP, notify the major local news media (TV, radio stations, newspapers, etc.), local tourism associations, AAA, local legislators, etc. of the scope of the project prior to beginning operations. Cooperation with the Contractor and any involved local government agencies is advised. All items of interest should be included:
  - Type of work to be performed.
  - Hours the highway will be fully opened to traffic.
  - Hours of restricted usage.
  - Type and place delays can be expected.
  - Suggested alternate routes.
  - Duration of the project.
  - Location of the detour, if applicable.
  - Anticipated completion date of project.
  - A name and phone number the public can contact for information or to make comments about the project.

  At appropriate times during the life of the project the responsible person should update the information mentioned above so that the public is kept current on the status of the project. The Public Affairs Coordinator may be of help in this responsibility.
- Update 511 at the start of construction, listing details on how traffic is affected.
- Monitor the Contractor's operations with regard to traffic and safety operations and enforce the requirements of the contract. On some projects, it may be necessary to change the TTC Plan during construction, depending on the contractor's schedule, progress of utility work, etc. If this is done, the TMP needs to be modified as well.
- Review traffic operations through the project limits, including the condition of all traffic control devices on a regular basis.

8-5.00 TEMPORARY TRAFFIC CONTROL STRATEGIES AND CONTROLLING CRITERIA

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8-5.01 Lane Width

For temporary traffic control purposes, a minimum lane width of 10 feet shall be provided. The lane width should be no less than 11 feet on multi-lane roads. Reduced widths should be analyzed for the off-tracking of the design vehicle. AutoTurn within MicroStation, or other comparable methods, may be used for the analysis.

When shoulders are provided, the minimum width should be no less than one foot. When barrier is used, a lateral buffer of at least two feet should be provided.

8-5.02 Crossovers and Bypasses (Diversions)

A crossover is a construction staging technique used to shift traffic from one side of a divided roadway onto a portion of roadway not under construction, typically sharing the remaining roadway with opposing traffic. A specific type of crossover, known as a bypass (or diversion), moves traffic onto a temporary alignment constructed either in the median or adjacent to the original alignment. Crossovers are an effective method for completing construction of a roadway by replacing or repairing the roadway or a structure while maintaining traffic in both directions.

As mentioned in Section 8-4.01 Temporary Traffic Control Goals, recent federal regulations highlight the importance of worker safety through a variety of methods, one of which is exposure control measures. Crossovers and bypasses are an effective means for providing long-term positive separation between workers and live traffic. Strong consideration should be given to this exposure control method.

Crossovers are typically used on freeways, but may be used on divided highways with limited at-grade accesses. Lane closures and traffic shifts are typically used on multi-lane divided expressways, but crossovers are an option for long-term stationary work.

Construction of a bypass typically consists of a temporary roadway alignment (possibly construction of a temporary structure as well). The limits of the bypass extend from the initial reverse curve leaving the existing roadway to the final reverse curve tying the alignment back into the existing roadway.

8-5.02.01 Design Speed for Crossovers and Bypasses

As stated in the MN MUTCD Part 6, design speed for the reverse curves used in a crossover or bypass should be no less than 10 miles per hour below the posted speed prior to work starting. If unusual site conditions require that a lower design speed be used, the signing should reflect an advisory speed determined by engineering judgment or study.

8-5.02.02 Roadway Lighting for Crossovers and Bypasses

On long term projects, the use of roadway lighting may be beneficial and should be considered especially when there are unusual site conditions that would require a lower design speed.

8-5.02.03 Crossed-Over - Two-Lane, Two-Way Traffic on One Side of Divided Facility

Once the traffic has been crossed over to the roadway not under construction, how to divide traffic must be considered. There are a few options available:

- Pavement Markings
  The use of pavement markings alone should only be used on low speed facilities.
- Surface Mounted Delineators (see MN MUTCD, Part 6F.65.1)
  These are used to supplement pavement markings and should be used on higher speed facilities such as expressways or freeways.
- Temporary Barrier
  Temporary barrier is a consideration where a physical barrier is desired between the traffic flows. Traffic volume, travel speed, geometrics, and duration are all factors to consider when evaluating the

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use of barrier.

One design element to be aware of is to protect hazards from both directions of travel – the TTC design should incorporate protection measures (barrier, attenuation, etc.).

8-5.03 Closures and Detours

As mentioned in Section 8-4.01 Temporary Traffic Control Goals, recent federal regulations highlight the importance of worker safety through a variety of methods, one of which is exposure control measures. Temporary road closures and detours are an effective method of exposure control. Strong consideration should be given to this exposure control method.

Temporary road closures are being used more commonly even on major freeways where parallel routes exist. These closures should generally take place during off peak travel times, such as nights and weekends.

8-5.03.01 Establishing and Maintaining Detours

A traffic detour can be a very effective traffic control measure. By closing the road to live traffic, positive protection for workers is maximized. Detours can also allow for improved finished products as contractors can work in a single work space without the need to construct the project in multiple smaller pieces. Possible considerations for establishing a detour follow:

- The physical work area cannot support live traffic and construction activities concurrently.
- When the accelerated completion of a project is desired, having uninterrupted use of the entire work site can facilitate a time-critical schedule.
- Construction constraints (e.g. vehicle weight or size restrictions) require specific vehicle classes to be precluded from the work zone.

Effective detour designs must consider, address, and incorporate the following:

- Detour routes must accommodate height, width, weight, length, off-tracking, and other physical characteristics of the design vehicle (the largest vehicle expected to use the detour). The designer of the temporary traffic control plan should coordinate with the Office of Freight & Commercial Vehicle Operations Overdimension Permits.
- Appropriate and adequate detour signing for the entire route in both directions.
- For conditional or periodic detours, using multiple portable changeable message signs (PCMSs) can provide real-time advance warnings or notifications.
- Coordination with the Regional Traffic Management Center (RTMC) for considerations with 511 traveler information.
- Coordination with local road agencies for proposed detour route(s). This should look at proposed work that the local road agency is performing that may impact the detour route.
- Agreements with local road agencies regarding the payment for the road life used by the detour, and if MnDOT or the local road agencies will maintain the roadway during the life of the detour.

8-5.03.01.01 Governing Laws Regarding Temporary Roads and Detours

Applicable laws for establishing and maintaining detours are found in Minn. Stat. Sec. 160.12, 160.16, Subd. 2, 160.2715, 161.24, Subd. 3, and 161.25.

8-5.03.01.02 Detailed Detour Procedures

The following information provides a general overview of the process for establishing and maintaining detours. Details on establishing a detour or haul road can be found in the:

- MnDOT Right of Way Manual, Sections 115.6 and 115.7, and

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- MnDOT Construction Tools - Haul Roads & Detours website.

Details on detour agreement procedures can be found at:

- Cost Participation and Maintenance Responsibilities with Local Units of Government Manual, Section III.B.2 Detour,
- Technical Memorandum No. 13-19-MAT-01, Detour Restoration Road Life Analysis using the Equivalent Overlay Method, and
- Technical Memorandum No. 10-09-TS-03, Revised Detour Restoration Road Life Formula for the Gas Tax Method.

8-5.03.01.03 Selection of a Detour Route and Detour Agreement Development

When a route is to be selected for a detour, the appropriate personnel should be consulted as soon as possible for review of the proposed route. The district should designate a person to coordinate this review. The review team may include the District Traffic Engineer, District State Aid Engineer, District Design Engineer, Project Engineer, Area Maintenance Engineer, as well as the local road authorities of the road(s) which will be affected. The information obtained in this review should include a detailed surface condition report, recommendations for reinforcement or modification of the proposed route, and recommendations for traffic control and signing on the proposed route.

Detour Agreement

A Detour Agreement is required to compensate the local road authority for the road life consumed by the detoured traffic. The district will write simple detour agreements. The Cooperative Agreements Unit of the Office of Project Management & Technical Support will author complex detour agreements. See MnDOT's iHUB Project Management and Technical Support - Cooperative Agreements website for Detour Agreement Boiler Plates.

Detour Traffic Control Devices

Once the detour route has been established and the Detour Agreement initiated, the Traffic Engineer and the Area Maintenance Engineer should work together to develop the signing layout and have the necessary signs prepared. The Project Engineer should consult with the Traffic and Area Maintenance Engineers to determine the advance notice needed before the detour is to go into effect. The advance notice should allow enough time to have all signing and other traffic control devices properly installed and reviewed before traffic is diverted onto the detour. Traffic control devices (particularly signing and pavement markings) along the detour should be brought to State Highway standards – this work is usually performed by the contractor of the construction project.

The detour will become a temporary trunk highway on the date the trunk highway markers are erected and will remain in effect until the markers are removed and the local road authority has been compensated per the terms of the Agreement.

Detour Documents

The detour documents (primarily the map of the detour) will be kept by the Project Engineer for the duration of the detour. A copy of the document is sent to the permit office at CO, Rm 153, Mailstop 420. The Project Engineer will notify the local road authority, by letter, when the detour signing is removed. Once the detour is released, the date of the release and the signature of the local road authority is affixed to the document. The District Engineer or designee will also sign the document. The documents are then submitted to the Legal Descriptions/Commissioner's Order Unit (Mailstop 632) of the Office of Land Management for a Commissioner's Order to be assigned and entered into the permanent record.

When a detour is found to be necessary after actual construction has begun and is requested by the contractor, the above procedure is followed except that generally the Project Engineer coordinates the route review. In addition, a Supplemental Agreement will have to be written documenting the change from the original contract.

8-5.03.01.04 511 Notification of a Detour

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For construction projects, district staff (either Construction or Public Affairs) should notify 511 staff of the detour through the use of a faxed-in lane closure form. Currently each district has their own form. The 511 Traveler Information Protocol Website contains more detailed information. More formal 511 notification methods will be forthcoming.

8-5.03.01.05 Maintenance of a Detour

Unless other arrangements are made in the construction contract, it will be assumed that the detour is to be maintained by state forces (see MnDOT Maintenance Manual, Chapter 11, Section 4.02 Maintenance Work on Detours). However, if conditions make it advisable to have local authorities maintain their own roads, such arrangements are made in the Detour Agreement at the time the route negotiations are conducted. See the MnDOT Maintenance Manual, Chapter 11, Section 4.0 Detour Agreement, for specific instructions on maintenance agreements.

8-5.03.01.06 Unofficial Detours

Unofficial detours are when a portion of traffic is not found to follow the official detour and local roads are being used – this can lead to degradation of the local roads. An unofficial detour agreement is written with a local unit of government, most often a township, to allow MnDOT to compensate them for increased maintenance costs, over and above the average expenditures associated with local or through-traffic using local roads rather than an official detour route that was established as part of a construction or reconstruction project. Increased costs of maintenance on the local roadway, not including improvement costs, are documented by the local road authority and submitted to the MnDOT district for payment consideration.

If the district concurs with the additional costs, an unofficial detour agreement is written to provide payment to the local road authority. If MnDOT and the local road authority cannot agree upon the amount of additional maintenance costs that should be paid, the "Gas Tax Method" (Technical Memorandum No. 10-09-TS-03) may be used for determining payment for a detour placed on paved roadways. An agreement or payment will not be written for less than $500. Unofficial Detour Agreements are written by the district or the Cooperative Agreements Unit in the Office of Project Management & Technical Support.

8-5.03.01.07 Haul Roads

Follow the guidance and procedures found on the Construction Tools - Haul Roads and Detours website.

8-5.03.01.08 Emergency Detours

Follow the guidance stated in the MnDOT Maintenance Manual, Chapter 11, Section 5.0 Emergency Detours.

8-5.03.02 Road Closed, Open to Local Traffic

When the ROAD CLOSED, LOCAL TRAFFIC ONLY sign or the ROAD CLOSED TO THRU TRAFFIC sign is used, the portion of road beyond that sign is still open to the residents and businesses beyond. The road needs to meet the overall standards and guidelines of safe travel.

The ROAD CLOSED sign on barricades across the road width indicates a full closure point beyond which construction activities may proceed without interference from traffic. Traffic control devices may not be necessary in this area.

8-5.04 Delay Time

In general, traffic should not be delayed by more than 15 minutes. If it is expected (through traffic flow modeling or experience) that traffic will be delayed more than this, the TMP will need to consider additional public information efforts and demand management strategies (see Technical Memorandum No. 12-03-T-02 dated February 6, 2012 - Minnesota Work Zone Safety and Mobility Policy).

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8-5.04.01 Detour Delay Time

In long term work zones, the overall travel time due to detours may exceed 15 minutes; however, additional public information efforts should be identified in the TMP and implemented. Unless the travel time is exceedingly high, demand management strategies are not necessary.

8-5.04.02 Maximum Flagger Hold Time

Flagging operations should limit the hold time to 15 minutes and should coordinate to reduce the delay.

8-5.05 Flagging Operations

Flagging procedures, when used, can provide positive guidance to the motorist traversing the work area. Part 6 of the MN MUTCD contains methods, procedures, and specifications for flagging. Refer to the Minnesota Flagging Handbook found on the Work Zone Safety Tools website for overall state standards and procedures.

MnDOT has additional clothing requirements for work on the State Highway system. Flaggers shall wear:

- ANSI Class 2 vest, shirt, or jacket
- ANSI Class 2 hat
- ANSI Class E long pants

All high visibility apparel must be worn in the manner for which it was designed. All apparel worn on the torso must be closed in the front to provide contiguous 360 degree visibility. If a worker's high visibility apparel becomes faded, worn, torn, dirty, or defaced, reducing the conspicuity of the apparel, the apparel shall be removed from service and replaced with new apparel.

8-5.05.01 Approach Lanes to Flagging Operation

Flagging operations are most effective when a single lane of traffic approaches the flagger. Due to this, multi-lane roads should include a lane reduction prior to the flagger station. At intersections with dedicated turn lanes, the flagger station should be located at the beginning of the furthest upstream taper location.

8-5.05.02 Flagger Station Lighting

As stated in the MN MUTCD, Part 6E.8, flagger stations shall be illuminated at night. The average maintained illuminance should be a minimum of 5 foot candles (54 lux). Balloon lighting or floodlights may be used; however, if floodlighting is used, it shall not produce a disabling glare condition for approaching road users, flaggers, or other workers.

Vehicle headlights shall not be used to illuminate the flagger station.

8-5.05.03 Delay Times due to Flagging Operation

As stated in Section 8-5.04.02, flagging operations should limit the hold time to 15 minutes and flaggers should coordinate to limit the delay to the traveling public.

8-5.05.04 Flagging at Signalized Intersections

When flagging a signalized intersection, the signal must be turned off or turned to flashing mode. Only a licensed uniformed law enforcement officer may override a fully operational traffic control signal system.

8-5.05.05 Flagging on Freeways

Flaggers should not be used to control traffic on a freeway due to the potential of creating a speed differential which could result in a higher risk of rear-end crashes or vehicular evasive maneuvers that result in work area intrusions.

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When a full closure is needed on a freeway for a very limited time (i.e. to set bridge beams), a flagging operation may be used at night when volumes are low; however, a law enforcement officer shall be used and the duration of the operation should be less than 15 minutes. See Layout 83 in the Field Manual.

8-5.05.06 Side Roads Within the Temporary Traffic Control Zone

For lengthy flagging areas that contain side roads, a flagger and/or appropriate signing for each intersecting side road within the limits of the active work area should be considered. Also consider provisions to contact and notify individual private residences along the highway within the work area of the process for entering and exiting their property.

8-5.05.07 Temporary Stop Signs Alternative to Flagging

Temporary stop signs are an acceptable alternative to flagging on roads with less than 1500 ADT and clear sight between the stop areas. See Layout 6J-12 located in Part 6, of the MN MUTCD.

8-5.05.08 Pilot Car Operations

Pilot Cars may be used in conjunction with flaggers to guide platoons of vehicles through lengthy two-way, one-lane work areas. Pilot cars may be considered when:

- Lane closures exceed ½ mile and sight distance between the flagger stations is obscured,
- Workers are immediately adjacent to the traveled lane,
- There are multiple isolated activities occurring throughout the work area.

When used, it may be worthwhile to notify residents along the corridor of the proper way to enter the highway while the pilot car is in operation. This should be considered as the public information plan of the TMP is being developed.

8-5.05.08.01 Pilot Car Maximum Speeds

Limiting the travel speed of the pilot car should be considered for the flagging operation, particularly when the pilot car is passing workers in the lane adjacent to traffic. If the travel speed of the pilot car is limited to 45 mph near workers, the project may not need to implement a Workers Present Speed Limit of 45 mph.

8-5.05.09 Automated Flagger Assistance Devices (AFADs)

The AFAD is an automated, trailer-mounted device used as an option for flagging within a two-way, one-lane work zone operation. These devices are controlled by either one or two flaggers, depending on the visibility of the queues controlled by each AFAD. An advantage of AFADs is that they remove the flaggers from the flagging stations. Two types of AFADs are available:

4) STOP/SLOW AFAD
   This type uses a STOP/SLOW sign, similar to a flagger paddle, that alternately displays the STOP face and the SLOW face, depending on the direction of the flagging operation.

5) Red/Yellow Lens AFAD
   This type displays either a steadily illuminated CIRCULAR RED lens or a flashing CIRCULAR YELLOW lens, depending on the direction of the flagging operation.

The general requirements for each can be found in Part 6E of the MN MUTCD. MnDOT also requires that a gate arm be included for either option when used on the state highway system. Compared to portable signals, AFADs may allow more flexibility to react to varying queues as they are controlled by a flagger(s).

8-5.05.10 Portable Signals

Portable signals are an alternative to a standard flagging operation. A portable signal operation requires that district traffic staff set up the timing of the signals. Compared to AFADs, portable signals require fewer employees to staff the work zone as flaggers are not necessary. Portable signals are also useful for alternating

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one way traffic operations in unattended work zones.

8-5.06 Speed Limits in Work Zones

There are several methods of signing available for speed control in work zones. These methods are:

- Advisory Speeds,
- Workers Present Speed Limits, and
- 24/7 Construction Speed Limits.

Under certain conditions, a Workers Present Speed Limit is required by Minnesota Statute. For additional information, details, and typical layouts, see "Speed Limits in Work Zones Guidelines" found on MnDOT's Speed Limits in Minnesota website.

8-5.07 Positive Protection

As mentioned in Section 8-4.01 Temporary Traffic Control Goals, recent federal regulations highlight the importance of worker safety through a variety of methods, one of which is the use of positive protection devices. Strong consideration should be given to this exposure control method.

The FHWA defines "Positive Protection Devices" as devices that contain and/or redirect vehicles and meet the crashworthiness evaluation criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH). The determination of when to use positive protection is based on engineering judgment. Numerous products and devices can be used to provide different degrees of positive protection, devices more commonly used in Minnesota are described in this section.

8-5.07.01 Temporary Barriers for Positive Protection

While portable concrete barrier has historically been the primary choice in Minnesota, other options are available. The options and considerations include:

- Portable Concrete Barrier
  - Usually used for long-duration activities where work space is limited and either worker/traffic exposures or road user/work area hazard exposures are present on a regular basis.
  - Adequate space is required for barrier deflection or the barrier needs to be pinned to the pavement surface.
  - Adequate space is needed for equipment to install/move/remove the barrier.
  - Barrier must be placed on rigid pavement surface (bituminous or concrete) to remain crashworthy.
  - Adequate contractor ingress/egress points will be needed either at barrier ends or mid-run.
  - All exposed ends must be treated with some manner of impact attenuation or protection.
- Steel Barrier
  - While not widely used, steel barrier options are on MnDOT's Approved/Qualified Products for Temporary Barrier List (APL). It has several advantages over portable concrete barrier - including ease and reduced cost of transport, speed of installation, durability, portability once on-site, and weight per foot to minimize bridge dead-loading.
  - When anchored, steel barrier equals concrete barrier in providing a safe and effective positive protection device with minimal deflection; however, unanchored, steel barrier has significantly higher deflection.
  - On shorter term projects, steel barrier may be more cost-effective than portable concrete

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barrier due to the reduced transportation costs and set up time.

- End treatment is still necessary.

- Water-Filled Barrier
  - Also not widely used, water-filled barrier options are on MnDOT's APL. It also has some advantages over portable concrete barrier - including ease and reduced cost of transport, speed of installation, and portability once on-site.
  - Water-filled barrier has higher deflection than portable concrete barrier and steel barrier.
  - Some types of water-filled barrier can act as its own end treatment.
- Moveable Barrier
  - Moveable barrier has been used successfully on a few MnDOT projects and there is an option on MnDOT's APL.
  - Moveable barrier is most effective for projects where lane configurations must change regularly (e.g. reversing peak traffic flows, lane reductions during non-peak hours, multiple longitudinal work areas (e.g. micro-silica deck pours, bridge deck joint replacements)) and other locations where barrier is warranted, but the shorter duration of the activity makes placement of standard concrete barrier challenging and risky.
  - Advance coordination, communication, and project planning is needed to include in a construction project.

8-5.07.02 Protection Vehicles and Truck/Trailer Mounted Attenuators (TMAs)

Protection vehicles may be used to provide positive protection in work areas where intrusions are a concern. Protection vehicles may be equipped with a TMA; however, any protection vehicles operating totally or partially within a traffic lane should be equipped with a TMA. Protection vehicles with TMAs are primarily used for mobile and short duration activities.

Long term work zones may also benefit from the use of protection vehicles, including situations such as:

- Isolated areas of work in a long work area where workers are in the lane adjacent to traffic,
- Road closure locations where intrusions are a concern.

8-5.08 Cable Median Barrier

Forthcoming

8-5.09 Lighting

Lighting of nighttime work zones should be considered carefully as it can enhance the overall safety of the temporary traffic control area; however, the negative impacts of glare on the driver needs to be minimized. The following are some objectives of nighttime work zone lighting:

- To provide the appropriate level of lighting that allows construction work to be completed safely and effectively,
- To reinforce both the intent of the traffic control plan as well as provide better guidance for drivers traveling through the work zone, and most importantly,
- To improve the overall safety of the workers and traveling public.

8-5.09.01 Roadway Lighting

Forthcoming

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8-5.09.02 Work Area Lighting

Work area lighting can enhance the safety of workers and the traveling public. NCHRP Report 498 Illumination Guidelines for Nighttime Highway Work examined this in detail and developed some recommendations. This section contains guidelines from this report that may be used if work area lighting is being considered.

Three categories were recommended based on considerations such as minimum lighting levels recommended by the Illuminating Engineering Society (IES), federal and state lighting requirements and guidelines, research, and expert opinions. Researchers found these categories to adequately account for a majority of highway and bridge-related construction and maintenance activities. Examples of work zone tasks and their associated recommended illumination levels are summarized below.

Recommended Illumination Levels by Task

Examples of Tasks	Illuminiation Level	Average Minimum Maintained Illuminance
All work operations areas; • setup of lane or road closures, • lane closure tapers, and • flagging stations.	Level I	54 lux (5 foot-candles*)
Areas on or around construction equipment; • asphalt paving, • milling, and • concrete placement/removal.	Level II	108 lux (10 foot-candles)
Pavement or structural crack/ pothole filling; • joint repair, • pavement patching/repairs, • installation of signal/electrical/ mechanical equipment.	Level III	215 lux (20 foot-candles)
A foot candle (fc) is defined as unit of illumination that is equal to one lumen per square foot, or 10.764 lux.		

Level I

Level I illuminance is important in areas where the work crew is in motion, moving from spot to spot. This level of illuminance is appropriate for tasks requiring low accuracy, involving slow-moving equipment, and where there are large objects to be seen.

Level II

Level II illuminance is recommended for areas on or around construction equipment to provide a safer environment for the workers operating the equipment, allowing them to perform tasks that require a moderate level of accuracy, as described above.

Level III

Level III illuminance is appropriate for those tasks that require a greater level of visual acuity or for tasks with a higher level of difficulty.

The following types of work zones and factors should be considered when selecting the types of lighting that are best suited for the work zone.

- Mobile work zones, such as a paving operation

  If the work zone is mobile, the length of the work activity for one night may dictate either that the lighting plan be continuous for the length of the work zone or that a mobile system be used so that the lighting moves with the various work activities.

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- Stationary work zones

  Work duration would determine the type of lighting in this situation. A long-duration work zone could use roadway luminaires mounted on temporary poles, while shorter duration work zones could use trailer-mounted light towers or balloon lighting at fixed locations.

- Glare

  Glare from the lighting systems should be minimized for both the workers and any adjacent motorist. Glare should be considered from each direction and on all approaching roadways and opposing lanes of traffic, even those separated by grass medians.

- Light Trespass

  Trespass occurs when light spills onto private property. This could be a problem in a residential area and could require shielding as a preventative measure.

8-5.09.03 Vehicle Lighting for Temporary Traffic Control

Appropriate vehicle lighting is required to enhance the conspicuity of vehicles within temporary traffic control zones. This applies to both day and night time operations. All mobile equipment, operating within the limits of a TTC zone with potential exposure to passing traffic, shall be equipped with operable warning lights that meet the appropriate requirements of the SAE specifications listed below. This would include closed roads that are open to local traffic only. This also includes any vehicle that enters the traveled roadway at any time. MnDOT maintains an APL for Vehicle Safety Lights – all vehicle lighting packages must be from this APL.

- 360 Degree Rotating Lights - SAE Specification J845
- Flashing Lights - SAE Specification J595
- Flashing Strobe Lights - SAE Specification J1318

Lights shall be mounted so that at least one light is visible at all times from a height of 3.5 feet and from a 60-foot radius about the equipment. In order to meet the 360 degree at 60-foot radius requirement supplemental lighting may be used. All supplemental lights must be SAE Class 1 certified.

Per the MN MUTCD, vehicle warning lights shall be operating and visible when a vehicle decelerates to enter a construction work zone and again when a vehicle leaves the work zone and enters the traveled traffic lane.

8-5.10 Drop-offs

Drop-offs or abrupt edges are inevitable during some construction activities. Protecting or not protecting drop-offs with temporary concrete barrier within the clear zone depends on the depth of the drop, the proximity to live traffic, speeds, volumes, roadway geometry, and duration of the exposed hazard. The Field Manual contains longitudinal drop-off guidelines for drop-offs of less than 12 inches (See Figure 6K-3 Longitudinal Drop-off Guidelines).

For drop-offs of greater than 12 inches, see the MN MUTCD, Part 6F.85 Temporary Traffic Barriers for guidance regarding the placement of temporary barrier, particularly Table 6F-5.

When temporary barrier is used, anchorage is required if the temporary barrier is close to the drop-off. MnDOT Standard Plan 5-297.680 covers portable concrete barrier anchoring and requires anchoring when the portable concrete barrier is within two feet of the drop-off. If steel barrier is used to protect the drop-off, consult the manufacturer's specifications for anchoring requirements.

8-5.11 Zipper Merge

The Zipper Merge is a method of merging where drivers are encouraged to use both lanes up to a defined merge point and then take turns merging. This is typically used with a lane reduction in a congested work zone. Early merging is still being encouraged when drivers are traveling at highway speeds as that gives drivers a better opportunity to find a gap in the through lane prior to the lane reduction. Districts are encouraged to

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incorporate the Zipper Merge TTC when volumes are expected to exceed 1500 vehicles per hour. There are two methods for implementing a Zipper Merge in a lane reduction:

1) Active Zipper Merge
   An Active Zipper Merge uses Intelligent Work Zones elements (detection, algorithms, and communication) to actively direct drivers when to use both lanes and where to merge. This type of Zipper merge is shown in the Minnesota IWZ Toolbox document in the layout *Dynamic Late Merge* and the templates *Active Zipper Merge* (Right Lane Closure & Left Lane Closure) found on OTST's TTC – Template Sheets website.

2) Passive Zipper Merge
   A Passive Zipper Merge uses signs and/or PCMSs to notify drivers that both lanes should be used when there are backups. This leaves the decision to the driver as to whether a backup exists or not. This type of Zipper Merge is shown on Layout 6K-46 for a Mobile Lane Closure and Layout 6K-54 for a Standard Lane Closure in the Field Manual . There are also templates on OTST's TTC – Template Sheets website for Passive Zipper Merge Right Lane Closure and Passive Zipper Merge Left Lane Closure.

The Active Zipper Merge has been found to lead to higher compliance among drivers than the Passive Zipper Merge, but both methods have been shown to be successful - particularly in longer term work zones.

8-5.12 Intelligent Work Zones

Intelligent Work Zones (IWZ) use standard system components (detection, analysis, and communication) to provide a real-time notification system to provide drivers, project personnel, and the agency with information about work zone conditions. OTST has published the Minnesota IWZ Toolbox as a guideline for selecting an appropriate IWZ System for existing work zone traffic issues and to mitigate anticipated issues on scheduled projects. The IWZ System descriptions contained in the toolbox are intended as brainstorming material and should lead to practical solutions to a project's unique expected conditions. The layouts and examples are purposely left void of many dimensions, except where particular distances are highly recommended, and engineering judgment is required to customize the system to a project.

8-5.13 Innovative Contracting Methods

Innovative contracting methods (such as Lane Rentals, ABC, Best-Value, etc) are initiatives to reduce construction time and delivery of projects, improve quality, and develop new processes to administer projects. These supplement traditional low-bid, design-bid-build contracting. See MnDOT's Office of Construction and Innovative Contracting website for guidelines and full descriptions of the innovative contracting methods.

8-5.14 Other Travel Mode Considerations

Temporary traffic control plans are generally focused on vehicular traffic; however, there are other modes of travel that must be considered and should be incorporated into the plan documents.

8-5.14.01 Pedestrians

Pedestrians need to be considered in the development of the TTC plan. The MN MUTCD states:

> **MN MUTCD Part 6D.1 – Pedestrian Considerations**
> **Standard**: If the TTC (temporary traffic control) zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.
>
> **MN MUTCD Part 6D.2 – Accessibility Considerations**
> **Standard**: When existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features

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present in the existing pedestrian facility.

Due to these Standard statements, the districts are highly encouraged to include a Pedestrian TTC Plan within the TMP documents (this could typically be in the overall TTC plan). If not within the project documents, contractors have difficulty implementing pedestrian routes within construction projects.

In general, the Pedestrian TTC Plan should clearly show pedestrian diversion routing and necessary traffic control devices with locations of sidewalk barricades, pedestrian channelizers, temporary curb ramps, temporary walkway surfaces, and communication devices (signing and audible/tactile devices, as needed). If a detour is provided, include signing for the detour.

Sidewalks or multi-use trails that are direct routes should be detoured as little as possible. As stated in the MN MUTCD, Part 6, Chapter 6D, "Pedestrians should be provided with a convenient and accessible path that replicates as nearly as practical the most desirable characteristics of the existing sidewalk(s) or a footpath(s)." This includes keeping the re-routing as short as is practical. The routing order of preference should be:

1. Provide the Alternate Pedestrian Route (APR) on the same side of the street as the disrupted route utilizing bypasses.
2. Where it is not feasible to provide a same side APR, provide an APR on the other side of the street.
3. Where it is not feasible to provide an APR on the other side of the street, provide an APR detour with trailblazing signs.

Recreational trails may have longer detours as these are generally used for recreation, not direct access routes.

OTST has published template sheets for Alternate Pedestrian Routes (APR) bypasses/detours and Temporary Pedestrian Access Route (TPAR) devices. These may be modified and inserted into plans or used as a reference in developing a Pedestrian TTC plan.

8-5.14.02 Bicyclists

Bicyclists need to be considered in the development of the TTC plan. The MN MUTCD states:

> **MN MUTCD Part 6A.1 – General**
> **Standard**: The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel (see definition in Section 1A.13), including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.
>
> **MN MUTCD Part 6G.5 – Work Affecting Pedestrian and Bicycle Facilities**
> It is not uncommon, particularly in urban areas, that road work and the associated TTC will affect existing pedestrian or bicycle facilities. It is essential that the needs of all road users, including pedestrians with disabilities, are considered in TTC zones.

Dedicated bike lanes should be addressed in the TTC plan. Minn. Stat. Sec. 169.18, Subd. 7(d) states:

> Whenever a bicycle lane has been established on a roadway, any person operating a motor vehicle on such roadway shall not drive in the bicycle lane except to perform parking maneuvers in order to park where parking is permitted, to enter or leave the highway, or to prepare for a turn as provided in section 169.19, subdivision 1.

If a TTC setup directs vehicular traffic into the marked bike lane, the bike lane needs to be closed prior to this location and the bikes either need to be diverted/detoured or share the road warning signs need to be placed.

8-5.15 Clear Zones

The clear zone concept applied to work zones differs from clear zone concepts applied to permanent roadways.

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Due to the nature of a work zone, the amount of horizontal clearance is often limited. Further, driver awareness is often heightened. As a result, lateral clear zone requirements are generally less. Work zone clear zones do not override the permanent clear zone - meaning existing roadside features should not be removed to meet work zone clear zone requirements; however, if work activities expose hazards which were not previously in the clear zone (such as in crossovers) then protections should be provided. Engineering judgment is regularly used to determine tolerable clear zone widths in work zones. Depending on site restrictions, it may only be feasible to provide an operational clearance - often as little as two feet.

Staging needs and opportunities for positive separation between workers and traffic should be considered. Actual clear zone distances should be maximized, where possible. When clear zone distances are critical within a given project or stage, distances should be identified within the project documents.

Clear zone determinations should take into account traffic speeds, volumes, roadway geometry, available right of way, and duration of work. Any specific clear zone widths needed for construction should be documented in the project file.

Stockpiled materials and inactive construction equipment and vehicles not behind barrier should be stored a minimum of 30 feet from the traveled way for all projects. The work zone clear zone concept applies to exposed hazards in the work zone - exposed barrier ends, stored equipment, drop-offs, fixed objects, etc. For practicality purposes, the work zone clear zone concept does not apply to construction vehicles and materials being used for active construction operations.

Clear zones also apply to Drop-off conditions, see Section 8-5.10 Drop-offs for further information.

8-5.16 Business Impact Mitigation

Business impact mitigation is an important part of MnDOT's public involvement and project development processes, and is also addressed in Minnesota Statute 160.165, Mitigating Transportation Project Impacts on Business. The purpose of business impacts mitigation is to:

- Involve businesses more in the project development process,
- Keep businesses informed regarding project issues,
- Help businesses understand a project and its potential impacts,
- Mitigate construction impacts to businesses as feasible (includes reducing and, if practical, preventing negative impacts to businesses).

Substantial business impacts is defined as "Impairment of road access, parking, or visibility for one month or longer, for one or more businesses". If the project is expected to cause substantial business impacts, specific actions need to be performed by the Project Manager and/or identified in the TMP. See Business Impact Mitigation from MnDOT's Highway Project Development Process for additional information and guidance.

The statute requires that one of the mitigation efforts that must be considered is signage. See "Temporary Business Signing in Work Zones" in Section 8-6.02.02 for guidance.

8-5.17 Public Information

The Minnesota Work Zone Safety and Mobility Policy, Technical Memorandum No. 12-03-T-02, requires that public information be included in the TMP for projects of certain levels of impact. Some strategies are identified in this section.

8-5.17.01 Traveler Information - 511

511 is a public service of MnDOT to help drivers access information about road conditions, work zones, traffic incidents, commercial vehicle restrictions, and weather information via the phone, the web, or handheld

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devices. Most TTC projects that are expected to impact traffic are included in 511. The use of 511 satisfies the public information requirements on many projects. TTC implementations that are anticipated to impact traffic are sent to 511 staff, which then enters the data into 511. 511 notifications are generally provided to the Regional Traffic Management Center (RTMC) during the construction project.

8-5.17.02 Advance Notice of Construction

This generally consists of MnDOT Public Affairs staff notifying the public of upcoming projects using a variety of means including pre-season construction kick-offs, project website updates, constant contact emails, print media, and press releases.

When used, Public Information methods should be identified in the TMP.

8-5.17.02.01 Temporary Signing Options

On method of advance notice uses some of the Construction Information (G20) series of signs found in the MnDOT Standard Signs Summary. In particular, the following are often used:

- G20-X1 - Closure Notice
- G20-X2 - Work Zone Advance Notice
- G20-X15 - Ramp Closure Advance Notice

These are used to notify drivers that regularly use that road that construction will be starting. This may help drivers determine if alternate routes should be used once construction begins. These signs are typically installed five to seven days in advance of the actual start of construction.

8-5.17.03 Portable Changeable Message Sign (PCMS) Strategies

PCMSs may be used in addition to or instead of the advance notice signs listed above. See the 2012 CMS Manual of Practice for the appropriate use of PCMS as well as approved messages.

8-6.00 TEMPORARY TRAFFIC CONTROL DEVICES

8-6.01 General Requirements of Temporary Traffic Control Devices

All TTC devices used on MnDOT street and highway construction or maintenance work shall conform to the specifications of the latest edition of the MN MUTCD, the MnDOT Standard Specifications for Construction, and all other appropriate MnDOT technical manuals.

8.6.01.01 Crashworthiness of TTC Devices

MnDOT requires that all TTC devices used (with the exception of Category 4) are crashworthy in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features" or the American Association of State Highway and Transportation Officials (AASHTO) "Manual for Assessing Safety Hardware (MASH)".

Under the NCHRP Report 350 and MASH standards for crash testing, work zone devices have been classified into four categories, each having its own testing requirements:

- **Category 1** - Low-mass devices such as channelizing devices. Devices typically self-certified for crashworthiness.
- **Category 2** - Devices with higher mass that are frequently crash tested. Examples include permanent and portable sign supports, barricade supports, and small portable (balloon) lighting.
- **Category 3** - Much higher mass and requires correct installation and protection. Mandatory crash-testing. Examples include temporary barrier and TMAs.

2.10 TTC Strategies and Controlling Criteria Supplemental Information to the TEM

2.10.1 Oversize/Overweight Vehicles

When planning for temporary traffic control in a work zone, oversize/overweight (OSOW) vehicles need to be considered. Due to the temporary traffic conditions it may be difficult or impossible for OSOW vehicles to navigate through the work zone. In cases where OSOW vehicles will have problems, be sure to contact the permits department.

> Information for the 511 system is often 3 days. OSOW permits are often granted 7 days ahead of time. Therefore, it is important to check to ensure an OSOW permit is not, or is being planned if this cannot be handled.

2.10.2 Lane Width

In some TTC areas, reduced lane widths are used to maintain the number of lanes. This involves reducing the width of one or more lanes in order to maintain the existing number of lanes on the facility while permitting work access to part of the facility. In cases where the lane width is considered, it is important to determine this through communication with all interested departments, including, but not limited to traffic, construction and design. For traffic control purposes, a minimum lane width of 10 feet shall be provided.

2.10.3 Speed Limits in Work Zones

MN Statutes 169.14, Subd. 5d went into effect August 1, 2014. This statute modified speed limits in work zones. It requires a reduction under certain conditions; allows a road agency to set without an engineering study and includes a modified fine.

The statute states "the speed limit on a road having an established speed limit of 50 miles per hour or greater is adjusted to 45 miles per hour in a work zone when (1) at least one lane or portion of a lane of traffic is closed in either direction, and (2) workers are present." There are exceptions when:

- ✓ Positive barriers are placed between workers and the traveled portion of the highway;
- ✓ The work zone is in place for less than 24 hours;
- ✓ A different speed limit for the work zone is determined by the road authority following an engineering and traffic investigation and based on accepted engineering practice; or
- ✓ A different speed limit for the work zone is established by the road authority as defined in the following paragraph.
    - The commissioner, on trunk highways and temporary trunk highways, and local authorities, on streets and highways under their jurisdiction, may authorize the use of reduced maximum speed limits in work zones when workers are present, without an engineering and traffic investigation required. The work zone speed limit must not reduce the speed limit on the affected street or highway by more than:
        - 20 miles per hour on a street or highway having an established speed limit of 55 miles per hour or greater; and
        - 15 miles per hour on a street or highway having an established speed limit of 50 miles per hour or less.

- A work zone speed limit is effective on erection of appropriate regulatory speed limit signs. The signs must be removed or covered when they are not required. A speed in excess of the posted work zone speed limit is unlawful.

A person convicted of operating a motor vehicle in violation of a speed limit in a work zone, or any other provision of this section while in a work zone, shall be required to pay a fine of $300.

The provision of "fines double" no longer applies to violations within work zones. The MN MUTCD will allow turning the existing posted speed limits into a work zone speed limit assembly. If the contractor requests not to, then don't use Workers Present Speed Limit pay item.

The types of projects that may be affected by this new law include:

- ✓ Pavement rehabilitation (reclaim and overlay, mill and overlay, overlay, chip seals, micro surfaces)
- ✓ Pavement patching and crack sealing
- ✓ Reconstruction projects
- ✓ Multi-day culvert replacement (at one location)
- ✓ Bridge construction/repair
- ✓ Installation of an intersection traffic control device (e.g. traffic signal or roundabout)

Speed Limits in Work Zones Website

The speed limits in work zones website is, http://www.dot.state.mn.us/speed/. This contains the Speed Limits in work zone guidelines. This (PDF) booklet outlines the guidelines, proper layouts and procedures for implementing various speed limit types to be used in work zones. In addition, see work zone advisory and temporary speed limit sign standards linked on the website.

2.10.4 Innovative Contracting Methods

Innovative Contracting incorporates new practices to supplement traditional low-bid, design-bid-build contracting. Innovative contracting can decrease project delivery time, reduce construction time, improve safety, incorporate innovation, and reduce costs.

The following is a handout, 2008 Innovative Contracting Guidelines. The manual can be downloaded from the following website:

www.dot.state.mn.us/const/tools/innovativecontract.html

HANDOUT

Office of Construction and Innovative Contracting

INNOVATIVE CONTRACTING GUIDELINES

A+B Bidding

Lane Rentals

Incentives/
Disincentives

Constructability Reviews

Locked Incentive Dates

Design-Build

Warranties

Pay for Performance

CPM Schedules

MINNESOTA DEPARTMENT OF TRANSPORTATION

www.dot.state.mn.us/const/tools/innovativecontract.html Dec, 2008

HANDOUT

Introduction

This manual provides guidance to Mn/DOT, counties, cities and other agencies construction and design personnel in identifying projects that can utilize innovative contracting techniques. Mn/DOT's Innovative Contracting website provides additional tools such as specification templates, sample specifications, and case histories. (www.dot.state.mn.us/const/tools/innovativecontract.html)

Innovative contracting starts early during the design phase. Design and construction staff need to work closely together during the development of preliminary (30%) and final plans.

Mn/DOT currently uses the following types of innovative contracting processes:

A+B Bidding A+B bidding reduces contract time on projects. Contractors bid the time to complete the project and a dollar amount for work items. The contract is awarded to the lowest combination of time and cost.

Lane-Rental Lane-rental reduces impacts to the traveling public by minimizing the time lanes are closed. Contractors are charged a fee for closing lanes and shoulders due to construction activities. The concept focuses on the time that the public is affected, NOT the overall contract time.

Incentives/Disincentives The contractor is paid for early completion of a project as provided for in the contract. If the contractor completes the project later than the time allowed, disincentive money is subtracted from payments due.

Constructability Reviews The industry provides valuable feedback into key areas that the Agency may not be able to quantify during the project development process. Feedback on preliminary plans has the potential to significantly reduce project costs and construction timelines.

Locked Incentive Date A locked incentive date provides an incentive if the contractor completes the work done early. Contractors are not allowed any extensions in the completion date, regardless if extensions are owner caused or not.

Design-Build Design and construction phases overlap, allowing faster overall project delivery.

Pay-for-Performance Pay-for-performance specifications rely on final outcomes measured against performance criteria set forth in the contract. If the contractor fails to meet minimum performance criteria, payment is withheld and corrective action is required.

Warranties Warranties require contractors to guarantee all or portions of a construction project to be free of defects in materials and workmanship for a period of time. The contractor is required to correct deficiencies that occur during the warranty period.

Critical Path Method (CPM Schedules). Critical Path Method (CPM) schedules are excellent tools for both the contractor and Mn/DOT to monitor contract time during a construction project.

A+B

HANDOUT

A+B Projects

Description

Cost-plus-time bidding, more commonly referred to as the A+B factors time plus cost to determine the low bid. Under the A+B method, each bid submitted consists of two components:

- 'A' - Traditional dollar amount for the contract items
- 'B' - Days bid to complete the work

The number of 'B' days is multiplied by the road user cost furnished by the owner and added to the 'A' component to obtain the total bid.

(A) + (B x [Road-User Cost / Day]) = Total Bid

This formula only determines the lowest bid for award, not the payment to the contractor.

Benefits

- Improved coordination between prime and sub-contractors
- Reduced construction time minimizes impacts to users.
- Contractors are required to put together a well conceived schedule.

Drawbacks

- Contract changes are magnified; too many changes nullify the advantages of A+B.
- Acceleration techniques may require more resources for contract administration.
- More hours and over-time budget required from district staff.
- Negotiations for additional work are more intense since time being a bigger issue.

Project Selection

A+B bidding should focus on projects with significant impacts to motorists, businesses, emergency services, or other groups that will be directly impacted by the project.

Good Candidates

- Mill and Overlay
- Un-bonded concrete overlays
- Detour projects
- New construction and reconstruction (grading and structures)
- Bridge painting
- Intersection upgrades
- Bridge rehabilitation (if confident with quantities)

Poor Candidates

- Traffic Management System (TMC) (Mn/DOT-provided items can cause delay)
- Steel fabrication (minimal benefit to public)
- Concrete rehabilitation (due to high probability of overruns)
- Signal systems (Mn/DOT provided items can cause delay)
- Landscaping (minimal disruption to traffic)
- Signing Projects

A+B

HANDOUT

IMPLEMENTING A+B PROJECTS

Follow these steps to implement A+B bidding:

Step 1: Is My Project a Good Candidate for A+B?

YES	NO	
		RIGHT OF WAY
☐	☐	Will all right-of-way be secured prior to letting date?
☐	☐	If not, do the staging plans allow the contractor to sequence work around the conflicts and is a right-of-way time determination schedule in the special provisions?
		PLANS
☐	☐	Is there high confidence in the design?
☐	☐	Has a thorough field review been conducted?
☐	☐	Has design coordinated with construction at various stages (e.g. 30%, 90%)?
☐	☐	Has a constructability and bid-ability review been conducted by design and construction?
		UTILITIES
☐	☐	There is ***little or no chance*** that utilities will significantly delay the contractor.
☐	☐	Are utility conflicts clearly identified in the plan and special provisions?
		THIRD-PARTY AGREEMENTS
☐	☐	Will all permits be secured by the letting date?
☐	☐	Will all municipal agreements be secured by the letting date?
		PROGRAM IMPACTS
☐	☐	Have you considered the district wide impacts of using an accelerated schedule? Have you considered the potential cost and delivery to other projects?
		SOIL CONDITIONS
☐	☐	There is ***little*** risk of contaminated or poor soils adding significant extra work.

A+B

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☐	☐	**TRAFFIC CONDITIONS** Do construction traffic impacts relate to any of the following conditions? • Lengthy detours • Significant delays to motorists • Significant impacts to businesses, schools, or emergency services
☐ ☐	☐ ☐	**STAFFING CONSIDERATIONS** Do you have the staff available if the contractor has an aggressive schedule? Do you have the budget for any additional overtime?

If the answer is **YES** to most of the above questions, the project may be suitable for A+B. If you answered **NO** to some of the questions, your project may still be a good candidate for A+B, but give careful consideration to the items with a **NO** response.

Step 2: Determine How to Use A+B

A+B techniques can be applied to many aspects of a project. Determine how you can best use A+B on your project.

☐ *Entire contract length*

☐ *Intermediate dates*
- Detour duration
- Interchange closure period
- Lane closure timeframe
- Stages

☐ *Multiple timeframes (A+B+C)*

☐ *Any other project aspect*

Step 3: Determine Road User Costs

☐ Obtain Road-User Costs (RUC) from Mn/DOT's Office of Investment Management (OIM). The contact is Ed Idzorek (651) 205-4391.

☐ Project engineer/supervisor needs to weigh how the RUC may affect the bid to determine the appropriate balance between the 'A' and 'B' portions of the bid. Adjust the RUC if necessary.

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HANDOUT

Example: RUC calculated by OIM = $75,000 per day

Bidder #1: $1,000,000 at 50 Days (A+B = $4,750,000)
Bidder #2: $1,500,000 at 40 Days (A+B = $4,500,000) – Awarded Contract

Question: Are you willing to spend an extra 50 percent to complete the project 10 days early? Adjusting the RUC may minimize this effect.

A+B

HANDOUT

Step 4: Determine Contract Time

- ☐ Perform a constructability review on the plan set.
- ☐ Assess the time, manpower and equipment impacts to other projects in the area.
- ☐ Determine the Contract Type
  - Working Days (recommended for projects <100 working days)
  - Calendar Days (recommended on multi-year projects)
  - If using a CPM schedule, use Calendar Days.
- ☐ Determine the amount of contract time and any intermediate dates. Use this as the maximum amount of time Mn/DOT would allow.
- ☐ Consider adding a minimum number of days. This will likely be required if the RUC is not equal to the disincentive.

> ***Note:*** If you calculate an overly aggressive schedule, you might not see a significant reduction in the days bid, or you may see an increase in the $ portion.

Step 5: Determine Incentives and Disincentives

Incentives (Optional)

- ☐ Do I want to include an incentive? Check with management.
- ☐ Determine incentive amount
  - Often equal or less than RUC
  - Incentive should be capped by the days and/or dollar amount)
  - Total incentive < 5 percent of the engineers estimate

Disincentives

- ☐ Should be considered
- ☐ Should not be used in lieu of liquidated damages.
- ☐ Determine disincentive amount
  - No limit is recommended
  - Should ALWAYS equal RUC.

Step 6: Draft Special Provisions

- ☐ Use standard template on the Innovative Contracting Website:

  http://www.dot.state.mn.us/const/tools/innovativecontract.html

- ☐ Inform the design squad so that contract time can be added as a bid item.
- ☐ Special Provisions 1806 & 1807 must be clear and concise.

> ***Note:*** It is recommended that a liquidated damage (LD) be used on all projects. A disincentive may also be used in combination with a LD. Make sure your specs are clear and identify each separately.

A+B

HANDOUT

Step 7: Construction Considerations

- ☐ Consider using a CPM Schedule to help administer contract time.
- ☐ Prepare staff for aggressive contractor schedules.
- ☐ Obtain frequent schedules updates if needed.
- ☐ Resolve issues proactively to reduce owner delayed time.
- ☐ Minor work orders, supplemental agreements and change orders need to be processed in a timely manner.
- ☐ Minor work orders, supplemental agreements and change orders need to be address contract time extensions/reductions.
- ☐ Work with the contractor to revise the schedule if plan additions occur
- ☐ Consider safety impacts to the roadway user, contractor personnel and Mn/DOT staff during construction. Consider impact to clear zones during construction, drop-off requirements, and lane-closure requirements.

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HANDOUT

Lane Rental

Lane Rental

Description

Lane rentals encourage contractors to minimize road-user impacts. Contractors pay a rental fee for closing lanes and shoulders to do construction work. A rental fee is included in the contract.

Lane-rental fees are based on the estimated cost of delay or inconvenience to the road-user during the rental period. The fee is assessed for the time that the contractor occupies or obstructs part of the roadway, and is deducted from the monthly progress payments.

Lane Rental should **NOT** be used to reduce overall contract time but to focus on the time that roadways users are impacted by construction traffic.

Benefits

- Better coordination of prime and sub-contractors
- Minimized impact to traveling public
- Better public perception due to fewer un-utilized lane closures

Drawbacks

- Extra effort by staff to monitor lane rental
- Negotiating lane rental adjustments can be difficult with contract changes
- Potential added costs to the project

Safety Considerations

Safety needs to be addressed with every lane-rental project. Plans and specifications should identify cases when lane closures (clear-zones, drop-offs) will be required to reduce the chance that contractors will take safety risks to reduce lane-rental charges.

District 1 included a plan sheet on a recent project to specify when lane closures would be allowed. The plan sheet eliminated confusion or disagreements with the contractors and preserved safety on the project.

Assessing Lane Rentals (Incentives/Disincentives)

On a lane-rental project, the contractor bids a lump-sum amount for lane rental. Mn/DOT specifies lane rental rates and the contractor estimates the number of hours in each lane-rental category.

Lane-rental use is tracked by the project personnel as the project progresses. At the end of the project, contractors receive either an incentive or disincentive as determined below:

Incentive – An incentive is usually paid for the difference between the lump-sum bid amount and actual lane-rental use. The incentive encourages contractors to reduce traffic impacts during construction.

Disincentive - A disincentive will be charged if the contractor exceeds the lump-sum bid amount.

HANDOUT

Lane Rental

HANDOUT

Project Selection

Lane rental should be used on projects with significant impacts to motorists. Here are general guidelines for using lane-rental.

Good Candidates

- Bituminous mill and overlay (short duration only)
  - Two-lane roadways with flagging operations
  - Intersection impacts
- Grading projects with intermittent **TEMPORARY** lane closures
  - Temporary widening with lane closures
  - Traffic switches
  - Striping (permanent or temporary)
  - Lane closures for delivery of goods and equipment
- Guardrail projects
- Signing projects
- Striping applications
- Bridge painting
- Crack sealing
- Signal systems
- Traffic management projects (ITS)

Poor Candidates

- Concrete rehabilitation (high probability of overruns)
- Detour projects (use A+B instead)
- Projects with long-term **PERMANENT** lane closures (use A+B instead)
- Bridge re-deck or overlays (Consider A+B)
- New construction projects (off alignment)
- Long-term projects that would be difficult for contractors to accurately bid the number of lane-rental hours.

Lane Rental

HANDOUT

Including Lane Rental

Use the following procedure to incorporate lane rental in your project.

Step 1: Is My Project Suitable for Lane Rental?

YES	NO	
☐	☐	**CONTRACTOR BIDDING** Can the contractor accurately predict the duration of activities that will impact a lane?
☐	☐	**THIRD-PARTY AGREEMENTS** There are ***little or no*** utility or third-party impacts that can delay aspects of the project relative to lane-rental?
☐	☐	**TRAFFIC CONSIDERATIONS** Traffic restrictions or lane closures with no or limited alternate routes that result in a high user cost. or Opportunities exist to reduce closure times (e.g. staging or construction of temporary work that will impact traffic). or User fees are substantial enough to offset the potential cost increase.
☐	☐	**SAFETY** The plan and/or special provisions can accurately insure that the safety of the construction operations will not be jeopardized by using lane-rental.
☐	☐	**DESIGN UNCERTAINTIES** Confidence that plan additions and significant overruns that may impact lane closure times have been minimized

If the answer is **YES** to most of the above questions, the project may be suitable for lane rental. If you answered **NO** to some of the questions, your project may still be a good candidate for lane rental, but give careful consideration to the items with a **NO** response.

Step 2: When and Where do I Use Lane Rental?

Determine locations for lane-rental

- ☐ *Mainline*
- ☐ *Shoulders*
- ☐ *Ramps*
- ☐ *Turn lanes*
- ☐ *Signal systems impacted*

Determine time-frames for lane-rental

- ☐ *Peak hour (recommendation: do not allow lane rental during this time)*
- ☐ *Off-peak hour*
- ☐ *Weekends*
- ☐ *Nights*

Lane Rental

HANDOUT

Step 3: Determine Road User Costs

- ☐ Obtain Road-User Costs (RUC) from Mn/DOT's Office of Investment Management (OIM). The contact is Ed Idzorek (651) 234-7717.
- ☐ Hourly road-user costs should be applied to various times and locations.

Example: Mainline closure on an interstate highway

Peak hours	No Lane Closure Allowed*
7:00 to 9:00 PM	RUC = $3,000/Hour
9:00 PM to 6:00 AM	RUC = $1,000/Hour
Weekends	RUC = $1,000/Hour
Shoulders	RUC = $500/Hour

* Lane rentals may be allowed in peak hours where traffic levels are low.

Step 4: Estimate Contractor Bid Amount

- ☐ Estimate the hours that a typical contractor will bid. Provide this number to Mn/DOT's estimate unit for inclusion in the Engineer's Estimate.

Step 5: Draft Special Provisions

- ☐ Use standard templates on the Innovative Contracting Website:

http://www.dot.state.mn.us/const/tools/innovativecontract.html

Step 6: Construction Considerations

- ☐ Consider using a Critical Path Method (CPM) Schedule to help administer contract time.
- ☐ Prepare staff for monitoring the lane-rental schedule.
- ☐ Review the requirements with the contractor at the pre-construction meeting.
- ☐ Work with the contractor to revise the schedule if plan additions occur.
- ☐ Consider safety impacts to the roadway user, contractor personnel and Mn/DOT staff during construction. Consider impact to clear zones during construction, drop-off requirements, and lane closure requirements.

Incentives

HANDOUT

Incentive / Disincentive Projects

Description

Incentive/Disincentive is a process where the contractor is paid an incentive for completing a project earlier than the time specified in the contract. If the contractor completes the project later than the time allowed, disincentive money is subtracted from payments due.

Incentive/Disincentives can be used in a wide variety of projects. It is best applied when Mn/DOT is willing to pay the contractor to expedite the work to reduce the contract time. It is similar to the A+B in that it works well with urban reconstruction and bridge-related projects

Benefits

- Reduced construction time
- Potential for lower contract administration costs
- Improved public relations by information businesses/residents that you are committed to completing the project as quickly as possible.
- Better control of project acceleration compared to A+B

Drawbacks

- May require additional funding
- Contract changes can lead to disputes regarding incentive payments

Project Types

Good Candidates

- Projects with high road-user or business impacts
  - Urban reconstruction projects
  - Bridge replacement projects
  - Detour projects
  - Urban pavement rehabilitation projects (if confident with quantities)
  - Interstate (high volume) projects with major traffic impacts
- A+B projects
- Bridge rehabilitation projects
- Projects with commitments to open a roadway as quickly as possible.

Poor Candidates

- New construction projects with minimal impacts to road users
- Projects where right-of-way or utilities are not clearly identified
- Traffic Management System (TMC)
- Steel fabrication (minimal benefit to public)
- Landscaping (minimal disruption to traffic)

HANDOUT

Types of Incentive / Disincentive Contracts

Linear –Contractor receives the same daily amount regardless of the number of days completed, early or late.

Non-Linear (Escalating) – The earlier a job is completed, the greater the daily amount paid to the contractor.

> ***Escalating Example:*** For each day that all work under this contract is completed before August 1, 2006, the contractor will obtain an incentive in accordance with the following schedule:
>
> | | |
> |---|---|
> | 1-5 Days | $0 per calendar day |
> | 6-10 Days | $5,000 per calendar day (Maximum of $25,000) |
> | Over 10 Days | $10,000 per calendar day (Maximum of $100,000) |
>
> Incentives will not be paid cumulatively. For example, if a contractor completes the work 13 days early, the maximum amount of incentive is $100,000. The contractor will not receive an additional incentive of $25,000 for completing the project within the 6-to 10-day incentive period.

Incentive / Disincentive Amounts

- Incentives should be based on items such as Road-User Costs (RUC). Contact Ed Idzorek at OIM (651) 234-7717 for a RUC.
- Incentives must be sufficient to encourage contractor interest, stimulate innovative ideas, and increase profitability of meeting tight schedules. Recent experience indicates that daily incentives between $5,000 and $10,000 with caps in excess of $50,000 are substantial amounts for contractors.
- If incentives are not sufficient to cover the contractor's cost for the extra effort, there is little motivation for the contractor to accelerate production.
- Maximum incentive should not exceed 5 percent of the total contract amount.
- Incentive should be equal to or less than the disincentive rate.
- A maximum incentive should be specified.

Contract Administration Considerations

- ☐ Consider using a CPM schedule.
- ☐ Time extensions should not be given unless overruns occur on critical path.
- ☐ Prepare staff for an aggressive contract schedule.

Special Provisions

- Use standard templates on the Innovative Contracting Website:
  http://www.dot.state.mn.us/const/tools/innovativecontract.html

HANDOUT

HANDOUT

Constructability Reviews

Constuctability Reviews

Description

Industry representatives can provide valuable information into many keys areas that Mn/DOT may not be able to quantify during the project development process. Feedback on preliminary plans has the potential to significantly reduce project costs and construction timelines.

Benefits

There are many benefits to using constructability reviews during the plan development process.

Lower Construction Costs

- Contractors can identify cost savings situations or alternative designs
- Contractors can help Mn/DOT identify areas of potential risk
- Mn/DOT can provide detailed background into the project that can not be relayed on a set of plans, thereby reducing risk.

Construction Schedule

- Contractors can provide valuable input into construction timelines/production rates.

Industry wants to do this!

- At this point, industry is open to meeting with Mn/DOT at no cost
- *"If value is added we should continue with similar programs in the future…..there is nothing our members like more than interacting with the customer where both parties benefit"* Dave Semerad, Minnesota AGC, commenting on TH 36 Constructability Review

Drawbacks

- Needs to be accomplished early in design process (approximately 50%)

Project Types

Good Candidates

- Complex or large projects with staging concerns
- Project with tight construction timelines
- Projects with new methods being proposed
- Projects when contractors can add innovation

Guidelines

- If you are considering utilizing a constructability review, contact the Project Development Engineer (Kevin Kosobud) at 218-828-5822.

Locked Incentive Date

HANDOUT

Locked Incentive Date (LID)

A Locked Incentive Date provides an incentive if the contractor completes a phase of a project on or before a date specified within the contractor. With the LID spec, the contractors are not allowed any extensions in the date even if an owner caused delay occurs. Examples of owner caused delays are utility delays, plan overruns, and extra work.

Contractors have the option of either pursuing the incentive or not. If a contractor chooses not to pursue the incentive, the Contractor has the right to seek time extensions in accordance with Mn/DOT standard specifications. If the contractor chooses the incentive, he/she also agrees to waive all claims for work done to date on the project.

A Locked Incentive Date should only be used on unique projects. If you are considering using a LID provision, contact the Project Development Engineer (Kevin Kosobud) at 218-828-5822.

Benefits

- Reduced construction time
- Increased contractor concern for the project schedule
- Eliminates claims
- Better coordination between the owner, contractor, and subcontractors, the use of more innovative techniques and the development of more realistic bids

Drawbacks

- The dollar amount for the LID has to be substantial enough for contractors to pursue. The dollar amount will be substantially higher compared to a normal incentive contract. This can add costs to your project.
- Quality of work may suffer when a contractor rushes to meet a bonus date.
- No-excuse clauses can strain owner-contractor relations.
- Difficulty in negotiating owner-initiated change orders and supplemental agreements due to the fixed timeline

Minnesota Law

- Minnesota law prevents public works contracts which include language “that waives, releases, or extinguishes the rights of a contractor to seek recovery for costs or damages, or seek an equitable adjust, for delays, disruption, or acceleration in performing the contract is void and unenforceable if the delay, disruption, or acceleration is caused by acts of the contracting public entity….”

Design-Build

HANDOUT

Design-Build

Description

Design-build differs from traditional methods by overlapping design and construction, allowing construction to begin after only a portion of the design has been completed. Typically, design-build contracts are awarded after Mn/DOT has completed the layout (30% design), the environmental process is complete (or nearly complete) and right-of-way is in the process of being secured.

Design-build also has a different approach to risk management and project responsibilities. The contractor often has more responsibility for Quality Control (QC) and Quality Assurance (QA) of the project; Mn/DOT provides verification.

Project Selection

Mn/DOT's design-build program is currently tailored to large construction projects, but can be modified for smaller projects.

For projects being considered for design-build, contact Mn/DOT's Design-build director as soon as possible. The district and the design-build director will need to coordinate efforts to define the scope of work and begin the design-build team selection process. The selection of the design-build team often requires an extensive Request for Qualifications (RFQ) and Request for Proposal (RFP).

Benefits

- Shortened completion time by overlapping design and construction
- Construction can begin before all design details are final
- Greater innovation in selecting design, materials and construction methods
- Reduced claims due to design errors
- Accelerated response time and dispute resolution through a team effort
- Single contact point for quality, cost and schedule from design through construction
- Shortened project delivery time which can reduce user costs
- Use of best-value project award selection criteria which evaluates both technical and financial elements

Drawbacks

- High learning curve because design-build changes stakeholders' roles
- Parties are familiar with traditional methods
- Bidding process more expensive for design-build teams
- Coordination is more challenging due to faster pace

Project Types

Good Candidates

- Projects that need to be "fast-tracked" for public safety or political reasons
- Projects that allow for innovation in the design and construction efforts
- Projects with funding "sun-set" dates where traditional bid-build delivery may not be able to achieve these dates
- Projects where in-house staffing cannot meet the project demands
- Emergency projects with tight time constraints

Want more Information?

Contact Mn/DOT Design-build director at 651-366-4210.

HANDOUT

Pay for Performance

Pay-for-Performance

Pay for Performance is a process where the contractor is paid for work on a graduated scale based on the quality and longevity of the work over time. Pay-for-performance specifications rely on final outcomes that can be measured against performance criteria set forth in the contract. If the contractor fails to meet minimum performance criteria, payment is withheld and corrective action is required.

Unlike traditional specifications when Mn/DOT prescribes the methods and/or means of producing or constructing an item, if the contractor complies with specifications, but the final outcome is not acceptable, the contractor is not responsible for corrective action.

Benefits

- Eliminates blame when there is a problem with the quality of a specific work item
- Shifts the risk of providing a quality product to the contractor
- Provides higher quality products for a longer duration

Drawbacks

- Time is needed after project completion to ensure product performance
- Longer project close-out (completing finals)
- Product monitoring and inspection is time-consuming
- Contractor may be required to finance a portion of the work during the performance period.

Pay-for-Performance Example

- Pavement markings (Used on I-494 Design-Build) – Measured reflectivity over time

How to use a Pay-for-Performance Items

Contract the Project Development Engineer at (218) 828-5822. The Office of Construction and Innovative Contracting (OCIC) can provide guidance and possibly some example specifications.

Warranties

HANDOUT

Warranties

Description

Warranties require contractors to guarantee all or portions of a construction project to be free of defects in materials and workmanship for a period of time. The contractor is required to correct deficiencies that occur during the warranty period.

Benefits

- Quality and durability of selected work items guaranteed for a specific time
- Longer timeframe for acceptance means agency can ensure contractor is performing high-quality work
- Decreased inspection level on warranty projects allows states to allocate resources elsewhere

Drawbacks

- Owner must ensure that warranty guidelines are reasonable and enforceable
- Warranty may not be collectable if guidelines are too restrictive or place undue burden on contractor
- Requires additional staffing to monitor the warranty after construction

Project Types

Warranties can be used on a variety of different construction items. Listed below are a few items that are good candidates for warranties.

Warranty Candidates
- Bituminous
- Grading (settlement)
- Culvert (settlement)
- Route and seal
- Concrete pavement

Warranty Period

- The length of the warranty period can vary on each project and warranty item.
- The longer a warranty, the more difficult to enforce.
  - **Recommended warranty length is to 2-3 years**.
  - Maximum warranty length: 5 years.

Warranty Enforcement

Monitoring the warranty is the responsibility of the district and not Mn/DOT's specialty offices such as the bituminous or concrete office. Specialty offices may assist with assessing the products during the warranty period, but the ultimate responsibility is with the district.

HANDOUT

Warranty Dates

- Establishing a clear date when the warranty begins is essential to enforcing the warranty.

> ***Recommendation:*** **Warranty start date (Final Construction Acceptance [FCA]) should start when construction is complete and the roadway is open to the public without restrictions.**

- **Long Term (Multi-Stage Projects)**

  Consider starting the warranty at the completion of various stages

> ***Example.*** **A 3-year construction project has 2-year bituminous warranty.**
>
> **Contractor completes concrete paving on eastbound in Stage 1 and switches traffic over to the new pavement. Two years later, the contractor completes westbound during Stage 2 and opens the roadway to un-restricted traffic. The warranty should be broken into two segments:**
>
> **Eastbound – Warranty period should begin at the end of stage 1**
> **Westbound – Warranty period should begin at the end of stage 2**

- Vague terms such as "substantial completion" or "all work is completed" should not be used in the contract. These are items that are open to interpretation and can significantly change the FCA date.

Warranty Criteria

Warranty threshold criteria must be established within the contract in order for the warranty to be enforceable. In addition, Mn/DOT may also want to indicate corrective actions required if the threshold limits are exceeded.

- ☐ Warranty criteria should be developed in conjunction with Mn/DOT's specialty offices (e.g. Bituminous or Concrete Units).
- ☐ Warranty criteria should be compared to other past projects. Enforcing a warranty will be difficult if criteria changes from project to project.

Warranty Specifications

- Warranty specifications should be similar in format. Several examples are available on Mn/DOT's Innovative Contracting Website.
- Contact the specialty office or OCIC's director of innovative contracting to obtain the latest specifications if you are using an established warranty specification item.

HANDOUT

Warranties

HANDOUT

Contract Administration Considerations

- ☐ Establish a firm and clear date when the warranty period begins
- ☐ Notify the contractor of the date that the warranty period begins.
- ☐ Notify the OCIC Contract Administration Engineer prior to award to insure that the warranty bond is submitted.
- ☐ Notify Mn/DOT maintenance of the warranty. This will preclude maintenance from doing work that will void the warranty.
- ☐ Identify a district person to monitor the work during the warranty period. Mn/DOT specialty offices will **not** monitor the work during the warranty period.
- ☐ Review work periodically during the warranty period. Document deficiencies.
- ☐ Notify OCIC Contract Administration Engineer if you need to invoke the warranty bond during construction.

HANDOUT
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HANDOUT

HANDOUT

CPM Schedule

CPM Schedules

Description

Critical Path Method (CPM) schedules are excellent tools for both the contractor and Mn/DOT to monitor contract time during a construction project. Unlike a traditional bar chart schedule, CPM schedules use logic to link activities and define the critical path and project duration.

Benefits

- Improved tool to monitor contract time
- Tool to assist with quantifying and mitigating project impacts
- Contractors are required to put together a well thought-out schedule.
- Provides an opportunity for owner "buy-in"
- Identifies sufficient weather and duration contingency

Drawbacks

- Requires experienced personnel to oversee the contractor's schedule.
- Requires experienced contractor personnel to develop a schedule
- Owner acceptance of the schedule may assume unnecessary liability
- Additional contract requirements to enforce

Project Selection

CPM should be used on complex projects or projects with critical timelines. Due to the level of experience required for both the contractor and Mn/DOT, CPM schedules are not recommended on lower cost, simpler projects, at this time.

If CPM is not used, the contract should never waive the schedule requirements of Mn/DOT 1803.1. The schedule should contain a level of detail as to communicate a well-thought-out plan that matches the complexity of the job.

Good Candidates

- New construction and reconstruction projects (>$5,000,000).
- Time-sensitive projects when commitments have been made.
- Phase or staged construction.
- Multi-year projects
- Projects with significant claim potential.
- A+B(+C) projects.
- Early completion incentive projects.

Poor Candidates

- Projects that do not require continual work effort.
- Projects that do not significantly impact the public
  - Traffic Management System (TMC)
  - Mill-and-Overlay Projects
  - Signal systems
  - Landscaping

HANDOUT

CPM Schedule

Draft Special Provisions

Contact Mn/DOT's Project Control Engineer (651) 366-4239 for the latest special provisions. The special provisions can be modified to meet your project type.

Contract Administration Considerations

- ☐ Consider hiring a consultant to help with administering CPMs. This is highly recommended on large, complex projects that will require significant staffing.
- ☐ Mn/DOT staff should be properly trained in administering a CPM schedule. If not administered properly, a CPM schedule could significantly hurt Mn/DOT during a claim.
- ☐ Be consistent with administering the CPM special provision.
- ☐ Work with the contractor to revise the schedule if plan additions occur

Updated changes to contact information can be found at:
http://www.dot.state.mn.us/const/tools/iccontacts.html .

2.10.5 Business Impact Mitigation

Business impact mitigation is an important part of MnDOT's public involvement and project development processes and is also addressed in Minnesota Statute 160.165. The purpose of business impacts mitigation is to:

- ✓ Involve businesses more in the project development process
- ✓ Keep businesses informed regarding project issues
- ✓ Help businesses understand a project and its potential impacts
- ✓ Mitigate construction impacts to businesses as feasible
  (Includes reducing and, if practical, preventing negative impacts to businesses)

Business impact mitigation should occur from the start of TMP development (see Section **2.8**) so that important strategies are not initially overlooked and projects are coordinated.

The following document handout is information on Business Impact Mitigation from the Highway Project Development Process (HPDP) website. This can be obtained from:

www.dot.state.mn.us/planning/hpdp/

HANDOUT

Business Impact Mitigation

Contact

Vanessa Levingston
vanessa.levingston@state.mn.us
Public Involvement Consultant
Office of External Partnering, MS 670
395 John Ireland Boulevard
St. Paul, MN 55155
Phone: (651) 366-3177

Purpose

Business impact mitigation is an important part of Mn/DOT's public involvement and project development processes, and is also addressed in Minnesota Statute 160.165. The purpose of business impacts mitigation is to:

- Involve businesses more in the project development process
- Keep businesses informed regarding project issues
- Help businesses understand a project and its potential impacts
- Mitigate construction impacts to businesses as feasible
  (Includes reducing and, if practical, preventing negative impacts to businesses)

Threshold Criteria

Is the project anticipated to cause *substantial business impacts*?

> *Substantial business impacts*: Impairment of road access, parking, or visibility for one month or longer, for one or more businesses. (A one month impact is the **minimum** period that triggers required mitigation, but give due consideration regardless of the impact period).

If yes (substantial business impacts are anticipated):

- Designate a project Business Liaison
  (Someone accessible that affected businesses can contact directly)
- Use the Business Impact Mitigation Checklist to ensure and to document business impact mitigation.
- Follow the guidelines in the *Guidelines* section (below).

HANDOUT

Responsibilities of the Business Liaison include:

- Consult with affected businesses before and during construction.
- Investigate means of mitigating project impacts to businesses.
  Mitigation considered must include signage.
  (Work with District Traffic Engineer)
- Provide information to the businesses before and during construction.
  This information includes:
  - Project overview, duration and timetables
  - Lane and road closures
  - Detours
  - Access impacts
  - Customer parking impacts
  - Visibility
  - Noise, dust, and vibration
  - Public participation opportunities
  - Business Liaison and Project Manager contact information

Guidelines

Use the Business Impact Mitigation Checklist

Temporary Business Signing in Work Zones
(New approved language for Traffic Engineering Manual, 8-5.02.030)

Identify Businesses
Early in Scoping, identify small businesses in the project area (not just within the project termini). List potentially-affected businesses and their contact information – both property owners and tenants. This information may be found during other project activities (EA/EIS), or from local government resources or business organizations (e.g., Chamber of Commerce, community planning councils, etc.).

Contact Business Owners
Provide information on the project in written format. (See guidelines/examples in Appendix F of the Report on Mitigation of Transportation Construction Impacts).

Provide contact information for the Business Liaison (e.g., business card, project brochure, etc.).

HANDOUT

Work with businesses to identify potential concerns, and determine preferred methods for future project communications

Identify Potential Impacts
Identify potential impacts to businesses. Determine the resources needed to identify and evaluate potential impacts. Does the project have unique characteristics? Do businesses in the area have any unique issues? Is there a need for specific expertise? Does the project scale warrant extra resources?

Contact Local Governments
Consult with city and county governments to identify potential impacts and discuss potential mitigation measures.

Contact MN Department of Employment and Economic Development (DEED)
Contact DEED for assistance in determining a list of business-development organizations that may offer resources to affected businesses.

Contact Business Assistance Organizations
Contact representative organizations (e.g., Chamber of Commerce, business associations, etc.).

Create a Project Information Packet
Create a project information packet suitable for businesses. Include the following:

- Project overview, duration and timetables
- Anticipated changes/impacts, such as:
  - Parking
  - Traffic
  - Access
  - Lane and road closures
  - Detours
  - Visibility
  - Noise, dust, vibration
- Public participation opportunities
- Business Liaison and Project Manager contact information

Tailor the information packet to the project and businesses. Include information on why the project is being done (e.g., to address safety, capacity, etc.), to help businesses see project benefits.

HANDOUT

See examples of business outreach materials in the appendix of the Mitigation of Transportation Construction Impacts Report (the appendix can be found at Road Construction Impacts on Small Businesses).

Mn/DOT Tools/Resources

Business Impact Mitigation Checklist

Traffic Engineering Manual (TEM)
Go to Ch 8, Section 8-5.02.03 – Business Signing in Work Zones
Temporary Business Signing in Work Zones
(New approved language for TEM 8-5.02.030)

Public & Stakeholder Participation – Hear Every Voice

Mn/DOT's Business Impacts Resources

Website: Road Construction Impacts on Small Businesses

Report: Report on Mitigation of Transportation Construction Impacts

Sample Business Outreach Materials (from the above report):
Business Assessment Form
Business Assessment Summary
Business Outreach Meetings Summary

Business Packet Content (Examples)
This sample packet includes the following:
Open for Business: A Workbook for Businesses
(Used on the TH 36 reconstruction project)

Highway 10 Connect Detroit Lakes Project
(Developed by Mn/DOT District 4 to describe project benefits)

3rd Avenue in Alexandria, MN Open for Business brochure
(Developed by Mn/DOT District 4 to communicate project-related detours)

HANDOUT

Medians & Access Management brochure
(Developed by Anoka County Highway Department to educate stakeholders on the need for transportation improvements)

TH 65 Detour Map
(Developed by Anoka County for the TH 54/County Road Reconstruction Project to communicate project-related detours)

Legal Basis

Minnesota Statute 160.165: Mitigating Transportation Construction Impacts on Business

Agencies Involved

Minnesota Department of Employment and Economic Development (DEED)
Assists in determining a list of business-development organizations that may offer support or resources to affected businesses.

2.11 Roadside Safety

2.11.1 Positive Work Zone Protection

Title 23 CFR 630.1108(a) indicates that the need for longitudinal traffic barrier and other positive protection devices shall be based on an engineering study. The engineering study may be used to develop positive protection guidelines for the agency, or to determine the measures to be applied on an individual project. At a minimum, positive protection devices shall be considered in work zone situations that place workers at increased risk from motorized traffic, and where positive protection devices offer the highest potential for increased safety for workers and road users. In addition:

- ✓ Use positive protective measures to separate workers on highway construction projects from motorized traffic in work zones conducted under traffic in areas that offer workers no means of escape (such as tunnels and bridges).
- ✓ Use temporary longitudinal traffic barriers to protect workers on highway construction projects in long-duration stationary work zones when the project design speed is anticipated to be high & the nature of the work requires workers to be within 1 lane-width from the edge of a live travel lane.
- ✓ When positive protective devices are necessary, those devices are paid for on a unit-pay basis, unless doing so would create a conflict with innovative contracting approaches, such as design build or some performance-based contracts.

Section 630.1108 includes the following definition for Positive Protection Devices:

Positive Protection Devices means devices that contain and/or redirect vehicles and meet the crashworthiness evaluation criteria contained in National Cooperative Highway Research Program (NCHRP) Report 350, Recommended Procedures for the Safety Performance Evaluation of Highway Features, 1993, Transportation Research Board, National Research Council. The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. This document is available for inspection and copying at FHWA, 1200 New Jersey Avenue, SE., Washington, DC 20590, as provided in 49 CFR part 7. You may also inspect a copy at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call (202) 741 6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html*.

2.11.2 Work Zone Drop-Offs

Additional channelizing devices should be placed in areas that may be considered hazardous to the public or workers. Temporary traffic barriers are used to channelize vehicles away from pavement drop-offs are covered in Section 6F.85 of the MN MUTCD. Refer to the handout in Section **3.13**.

These areas include but are not limited to:

A. Full longitudinal channelizing, as stated in Section 6F.58 (Channelizing Devices), when traffic is adjacent to longitudinal drop-offs greater than 4 inches.
B. Full longitudinal channelizing, as stated in Section 6F.58 (Channelizing Devices), and barriers, as stated in Section 6F.81 (Temporary Traffic Barriers), when traffic is adjacent to longitudinal drop-offs greater than 12 inches.
C. Full longitudinal channelizing, as stated in Section 6F.58 (Channelizing Devices), when roadway geometry, dust, weather, or darkness restricts visibility of the open travel lane.

2.11.3 Clear Zone Requirements

Clear Zones (from the Road Design Manual)

"The roadside clear zone is the distance from the edge of the travel lane which should be free of any non-traversable hazard such as steep slopes or fixed objects. The clear zone distances are targeted towards allowing approximately 80 to 85 percent of all run-off-the-road vehicles to recover or come to a safe stop. The width of a clear zone along the horizontal alignment is dependent on roadside geometry, design speed, radius of horizontal curve, and the ADT. Higher speeds mean vehicles will travel farther before recovering. Horizontal curvature increases the likelihood of a vehicle leaving the highway and increases the distance it will travel off the highway, as will steeper fill slopes. In general, hazards within the clear zone which cannot be removed, relocated, or made breakaway will warrant guardrail.

The designer should not apply rigid adherence to the calculated clear zone distance. If a formidable hazard lies just beyond the clear zone, it should be removed or shielded if costs are reasonable. Conversely, the designer should not have the philosophy that the clear zone should be achieved at all costs. Limited right of way or unacceptable construction costs may lead to installation of a barrier or, perhaps, no protection at all if there are many hazards along the entire length of the roadway inside the calculated clear zone.

The designer should not use the clear zone distances as boundaries for introducing roadside hazards such as bridge piers, non-breakaway sign supports, or trees. These should be placed as far from the roadway as practical."

Clear Zone Information from Field Manual

"The work zone clear zone is the unobstructed (clear of obstructions, hazards, or fixed objects), relatively flat area impacted by construction that extends outward from the edge of the traveled way. Because of the limited horizontal clearance available and the heightened awareness of motorists through work zones, recommended clear zones are less than those for the non-construction conditions. Table 6K-1 gives typical clear zone widths that should be provided when roadside space is available (see Roadside Safety in General Guidelines, page 6K-n for more information)."

Table 6K-1: Recommended Clear Zones

Speed (mph)	Width (ft)
60 or greater	30
45-55	20
40	15
35 or less	10

Source: Minnesota Temporary Traffic Control Field Manual, January 2018

2.12 Pedestrian Treatments

When pedestrian facilities are impacted due to maintenance or construction, pedestrian accommodations must be provided to the maximum extent feasible. These accommodations may be made detectable and must have accessibility features up to the level of the disturbed route. Signage and devices, as necessary, must be provided to direct pedestrians safely through the work zone. A Temporary Pedestrian Access Route (TPAR) is a temporary pedestrian route that is fully accessible and meets the standards and guidelines.

The project does not necessarily need to be tearing up the pedestrian route to require a pedestrian detour. There may be issues, such as sand-blasting, that would be unsafe for pedestrians.

In addition, ensure that any pedestrian detour does not reroute past construction activities that could be harmful to them.

2.12.1 Background

The need to create an inclusive environment for pedestrian facilities is required by the Americans with Disabilities Act of 1990 (particularly in Title II and Title III). In order to accomplish this, MnDOT has chosen to adopt the guidelines published under the "Public Right-Of-Way Accessibility Guidelines (PROWAG)" first published in November 2005. This was adopted through Technical Memo 10-02-TR-01 "Public Rights of Way Accessibility Guidance". This Tech Memo applies to MnDOT construction/maintenance projects and work that other agencies/permit holders perform on MnDOT right of way. In addition, the Minnesota MUTCD Part 6D requires that pedestrian accessibility be maintained whenever the facility is restricted or realigned due to a construction or maintenance project. It applies to all public roads (and all private roads open to the public) in Minnesota. Read more about accessibility and MnDOT.

2.12.2 Public Rights-of -Way Accessibility Guidance Tech Memo

The following is a handout Technical Memorandum 15--02-TR-01. The memo can be downloaded from the following web link:

https://techmemos.dot.state.mn.us/

It is important that the holder of this manual checks the above link for updates.

HANDOUT

MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
Technical Memorandum No. 15--02-TR-01
February 10, 2015

To: Electronic Distribution Recipients

From: Nancy T. Daubenberger, P.E. NTD
Division Director, Engineering Services

Subject: Adoption of Public Rights-of -Way Accessibility Guidance (PROWAG)

Expiration and Purpose
This Technical Memorandum extends the expiration date of Technical Memorandum 10-02-TR-01 to February 10, 2017 unless superseded prior this date.

Guidelines
See Attachment: TM 10-02-TR-01 Adoption of Public Rights-of -Way Accessibility Guidance (PROWAG).

Questions
Any questions regarding the technical provisions of this Technical Memorandum can be addressed to the following:

- **Kristie Billiar,** ADA Implementation Coordinator, at **651-366-3174**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards Unit, DesignStandards.DOT@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

To add, remove, or change your name on the Technical Memoranda mailing list, please visit the web page http://techmemos.dot.state.mn.us/subscribe.aspx

Attachment:
TM 10-02-TR-01 Adoption of Public Rights-of -Way Accessibility Guidance (PROWAG).

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HANDOUT

MINNESOTA DEPARTMENT OF TRANSPORTATION
Engineering Services Division
Technical Memorandum No. 10-02-TR-01
February 11, 2010

To: Distribution 57, 612, 618, and 650

From: Khani Sahebjam, P.E.
Deputy Commissioner / Chief Engineer

Subject: Public Rights-of -Way Accessibility Guidance

Expiration
This Technical Memorandum supersedes Technical Memorandum 08-13-TS-05, and shall continue in force until February 11, 2015 unless superseded or suspended.

Implementation
The guidance contained in this Technical Memorandum is effective immediately. This Technical Memorandum affect projects in the design in construction phase and all work in Mn/DOT rights-of-way, including work done under permit or by agreement by other agencies or private entities.

These guidelines must be incorporated into all new construction, reconstruction, and alteration projects.

Projects that may directly or indirectly affect a qualified Historic Facility or District must be reviewed by the Cultural Resources Unit to determine if the proposed alteration may threaten or destroy the historic significance of the property. (See additional guidance under Guidelines)

A public agency is only exempt from fully meeting the Americans with Disabilities Act (ADA) standard where physical terrain or site conditions restrict the construction or altering the facility to the required standard. In such circumstances, the Design Project Manager must provide accommodation to the maximum extent feasible, document the instance with a memo signed by a direct supervisor, and place the documentation in the project file for reference and added to Mn/DOT's Transition Plan.

Accessibility improvements are to be planned, designed, and constructed to proceed at the same time as project roadway improvements. An addendum or supplemental agreement may be necessary for projects currently under construction.

If a Mn/DOT District Engineer determines that incorporating a new or updated accessible feature (or features) into a construction project will cause significant letting delays, the District Engineer (or designee) will direct the Resident Construction Engineer to issue a supplementary agreement to remedy the installation of the feature.

Local Road authorities are encouraged to adopt these or similar guidelines.

Introduction
Pedestrian facilities on public rights-of-way are required to be accessible to persons with disabilities through the following federal statutes:

- Section 504 of the Rehabilitation Act of 1973 (Section 504) (29 U.S.C. 5794) and
- Title II of the Americans with Disabilities Act of 1990 (ADA) (42 U.S.C. 59 12131-12164)

Title II of the ADA governs all state and local governments and their agencies and facilities, regardless of the funding source. All pedestrian facilities within the public rights-of-way designed, constructed, and/or altered on behalf of or for the use of a public entity must be readily accessible to and usable by persons

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with disabilities. Mn/DOT's Strategic Plan and the Statewide Transportation Plan recognize accessibility as an integral part of the State's transportation networks.

Purpose
This Technical Memorandum sets forth interim planning and design guidance for accessible pedestrian facilities through the implementation of the Access Board's *Draft Public Rights of Way Accessibility Guidelines* (*PROWAG) 2005*. This implementation of PROWAG does not include the provisions for multilane roundabouts which are being analyzed by a separate roundabout committee.

The full text of PROWAG can be found at: http://www.access-board.gov/prowac/draft.pdf. A separate mailing of PROWAG will not be made.

Guidelines

Scoping
Project Managers are required to identify all accessible pedestrian facility needs in the scoping phase of project development for all new construction, reconstruction, and alteration projects.

New construction and reconstruction
All pedestrian facilities in new construction and reconstruction roadway projects are required to meet the accessibility guidance in PROWAG. All newly constructed and reconstructed standalone pedestrian facilities {e.g. trails, sidewalks, and sidewalk segments} located in the public right-of-way are required to meet the design guidance in PROWAG.

Alteration Projects
All alteration projects must, at a minimum, address all curb ramps in the curb radius by providing ramps where they are required and do not currently exist and to bring existing curb ramps into compliance with detectable warnings, cross slope, running slope, and landings. Curb ramp improvements must comply to the maximum extent feasible without regard to cost.

In an alteration project the scope of the initiating project determines which additional accessible features are included in the project and the extent to which additional accessible features must be addressed. Where pre-existing site conditions would require expanding the project's scope to purchase of right-of-way, relocate utilities, provide drainage work, etc. there is no expectation that the scope of work be expanded to provide the accessible feature. Pre-existing conditions include, but are not limited to, underlying terrain, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature. When other pedestrian facilities are within the right-of-way but are not part of the scope of the alteration project it is not required that work be done on those features. Any accessible feature that is not built to PROWAG standard must be documented with a memo signed by a direct supervisor, and placed in the project file and added to Mn/DOT's Transition Plan.

When developing the scope for an alteration project, project managers are encouraged to look at the total function and accessibility of the pedestrian network, including transit facilities such as bus stops and shelters. Project Managers are encouraged to identify and correct any accessibility barriers within the project limits to the maximum extent feasible, not just curb ramps. Addressing multiple elements or spaces within a facility may provide a cost-effective opportunity to make the entire facility, or a significant portion of it, accessible. Jurisdictions should consult their Transition Plans to determine if related work has been identified as needed to achieve program accessibility in existing facilities at the same location.

Alteration projects include all types of resurfacing work. Only the work types identified in the preventative maintenance section that follows are excluded from providing ADA improvements.

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Preventative maintenance projects
Pedestrian facility upgrades and accessibility improvements are not required on preventative maintenance projects where the primary purpose of the project is to maintain the existing roadway without increasing the structural capacity of the system.

Preventative Maintenance:

- *Asphalt crack sealing*
- *Bituminous pavement seal coat*
- *Chip sealing*
- *Isolated concrete dowel-bar retrofit*
- *Concrete repair: Isolated, partial and/or full-depth repairs to restore functionality of the slab; e.g., edge spalls, corner breaks*
- *Concrete joint sealing*
- *Concrete pavement surface planing / diamond grinding*
- *Slurry or micro-surfacing*
- *Bridge substructure preservation: concrete and steel*
- *Bridge superstructure activities: Painting, joint replacement, bearing rehabilitation/replacement and barrier/guardrail/railing restoration.*

Preventative maintenance projects are typically applied to pavements in good condition with significant remaining service life. These activities include actions that are intended to retard future deterioration and maintain the functional condition of the roadway without increasing structural capacity. In general, these improvements do not appreciably affect the roadway or pedestrian access route surface. A pedestrian access route is defined as: a continuous and unobstructed walkway within a pedestrian circulation route specifically designed for ADA –accessible travel.

Historical Properties
All new construction, reconstruction, and alterations that may directly or indirectly affect a qualified Historic Facility or District must be reviewed by the Cultural Resources Unit to determine if the proposed alteration may threaten or destroy the historic significance of the property. The Cultural Resources Unit, OES, will make a determination of impact and recommend accessible feature location and design solutions that will preserve the historic significance of the property.

Accessibility during construction
When a pedestrian access route is disrupted, closed, or relocated during construction, maintenance work, or other temporary condition, the alternative pedestrian access route shall include pedestrian ramps to maintain accessibility. See the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD) for further guidance on the requirements for establishing an alternative pedestrian access route for temporary traffic control. See also the "Pedestrian Accessibility Considerations in Temporary Traffic Control Zones Check List" in the MN MUTCD.

Questions
For information on the technical contents of this memorandum, please contact **Kristie Billiar, ADA Implementation Coordinator, at (651) 366-3174**

Any questions regarding publication of this Technical Memorandum should be referred to the Design Standards unit, designstandards.dot@state.mn.us. A link to all active and historical Technical Memoranda can be found at http://techmemos.dot.state.mn.us/techmemo.aspx.

To add, remove, or change your name and/or address on the Technical Memoranda mailing list, write or call the Mn/DOT Central Office Mail Room G-18 Transportation Building, 395 John Ireland Blvd., St. Paul, MN 55155, phone number (651) 366-3051.

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2.12.3 Pedestrian Accessibility Considerations in Temporary Traffic Control Zones Check List

The following is a handout Pedestrian Accessibility Considerations in Temporary Traffic Control Zones Check List. This checklist is found in the MN MUTCD. The MN MUTCD can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/workzone/wzmanual.html

It is important that the holder of this manual checks the above link for updates.

HANDOUT

Pedestrian Accessibility Considerations in Temporary Traffic Control Zones
Check List

This project has been reviewed for the various temporary traffic control provisions for pedestrian accessibility considerations contained in MN MUTCD Part 6. These provisions have been applied by knowledgeable persons after appropriate evaluation and engineering judgment. Considerations as listed below have been reviewed and where applicable, deviations and/or exceptions from Part 6 are documented.

Engineer's Signature : _____ **Date :** _____

Project Number: _____ **Project Location:** _____

IS IT REASONABLE TO EXPECT THAT PEDESTRIANS WILL BE PRESENT WITHIN THE VICINITY OF THE PROPOSED TEMPORARY TRAFFIC CONTROL ZONE?

Consider features such as schools, parks, paths / trails, transit stops, commercial property, residential areas, assisted living centers, office complexes, or other pedestrian generators in the area. Special events during the time of construction must also be considered, such as community festivals or other unusual situations that generate temporary pedestrian traffic.

☐ **YES** - complete the following checklist
☐ **NO** - document your conclusion

MN MUTCD 6D.01 Standard:
The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a temporary traffic control zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.

MN MUTCD 6D.02 Standard:
When existing pedestrian facilities (routes) are disrupted, closed, or relocated in a temporary traffic control zone, the temporary facilities **shall be** detectable and include accessibility features consistent with the features present in the existing pedestrian facility.

Guidance:
To accommodate the needs of pedestrians, including those with disabilities, many considerations should be addressed when temporary pedestrian pathways in temporary traffic control zones are designed or modified. Use the following checklist to document your decisions. **Refer to the MN MUTCD Part 6 for additional standards, and guidance and/or clarification on pedestrian and ADA requirements in temporary traffic control zones.**

A. Will a reasonably safe, convenient, and accessible path be provided that replicates as much as practical the desirable characteristics of the existing pedestrian facilities?
☐ **YES** ☐ **NO (partially) document your decision**

B. Will access be provided to current or temporary transit stops?
☐ **YES** ☐ **NO (partially) document your decision**

C. Will all pedestrian facilities near temporary traffic control zones be separated from the worksite by appropriate barriers that maintain the accessibility and detectability for pedestrians with disabilities?
☐ **YES** ☐ **NO (partially) document your decision**

Figure 6D-1 Pedestrian Accessibility Checklist
(Sheet 1 of 2)

HANDOUT

D. Will blocked routes, alternate crossings, sign and signal information be communicated to pedestrians with visual disabilities?

- Devices should include audible information devices, accessible pedestrian signals, or barriers / channelizing devices that are detectable to the pedestrians traveling with the aid of a long cane or who have low vision.
- Where pedestrian traffic is detoured to a temporary traffic control signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals should be considered for crossings along an alternate route.

☐ **YES** ☐ **NO (partially) document your decision**

E. Will sidewalk(s) be closed properly with advance notification to the maintaining agency?

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

☐ **YES** ☐ **NO (partially) document your decision**

F. Will channelization with continuous edging be used to delineate a pedestrian pathway throughout the length of the facility such that pedestrians using a long cane can follow it?

- These detectable edgings should adhere to the provisions of Section 6F.68.

☐ **YES** ☐ **NO (partially) document your decision**

G. Will a smooth, continuous hard surface that will not cause tripping or restrict wheelchair use be provided throughout the entire length of the temporary pedestrian facility?

☐ **YES** ☐ **NO (partially) document your decision**

H. Will the width of the existing pedestrian facility be provided for the temporary facility?

- Where it is not possible to maintain a minimum width of 1500 mm (60 in) throughout the entire length of the pedestrian pathway, a 1500x1500 mm (60 x 60 in) passing space should be provided at least every 60 m (200 ft), to allow individuals in wheelchairs to pass.

☐ **YES** ☐ **NO (partially) document your decision**

I. Will traffic control devices and other construction materials and features NOT intrude into the usable width of the sidewalk, temporary pathway, or other pedestrian facility?

- Signs and other devices mounted lower than 2.1 m (7 ft) above the temporary pedestrian pathway should not project more than 100 mm (4 in) into accessible pedestrian facilities.
- Barricade rail supports should not project into pedestrian circulation routes more than 100 mm (4 in) from the support between 675 mm (27 in) and 2000 mm (80 in) from the surface. Ballast **shall not** extend into the accessible passage width of 1500 mm (60 in). Refer to Section 6F.63 for more details.

☐ **YES** ☐ **NO (partially) document your decision**

Figure 6D-1 Pedestrian Accessibility Checklist

(Sheet 2 of 2)

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3. TTC DEVICES

3.1 TTC Zone Devices

All traffic control devices used on MnDOT street and highway construction or maintenance work shall conform to the specifications of the latest edition of the MN MUTCD, the MnDOT Standard Specifications for Construction; and all other appropriate MnDOT technical manuals.

All devices shall be placed where they will convey their messages most effectively so the driver will have adequate time to react. All traffic control devices must be kept clean to insure proper effectiveness and retroreflectivity. All devices shall conform to the quality standards of the MN MUTCD Field Manual.

This section will summarize some of the common devices used for temporary traffic control.

> This chapter discusses some common devices used for temporary traffic control. The devices listed are not intended to be an all-inclusive list.

The devices discussed in this section include the following:

- ✓ Traffic Signing (Section **3.2**)
- ✓ Pavement Markings in Temporary Traffic Control Zones (Section **3.3**)
- ✓ Channelizing Devices (Section **3.5**)
- ✓ Temporary Traffic Barriers (Section **3.6**)
- ✓ Portable Signal Systems (Section **3.8**)
- ✓ Automated Flashing Assist Device (Section **3.9**)
- ✓ Flashing Arrow Boards (Section **3.10**)
- ✓ Approved Products List (Section **3.12**)

3.2 Traffic Signing

TTC zone signs convey both general and specific messages by means of words or symbols and have the same three categories as all road user signs: regulatory, warning, and guide. Additional details on signing in a TTC area can be found in the MN MUTCD Parts 6F.2 through 6F.59 (See the MN MUTCD Handout starting on page **3-46**).

3.2.1 Guide Signs

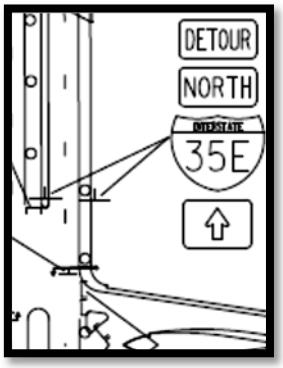
The placement and revision of guide signs is important to providing traffic control through work zones. However, placement of these signs should not interfere with necessary regulatory and warning signs. One commonly used guide sign is the advance notice guide sign. It is used to provide notice of when and where construction or maintenance will occur. There are two types of advance notice guide signs:

1. those signs that inform motorists of a date when construction and/or closures will begin, and
2. those signs that inform motorists of exact location(s) of construction that is underway.

Beside addition of special guide signs to highway work zones it is important that in-place guide signs be covered or modified to reflect actual conditions. For example if a ramp is closed, all advance guide signs

should be properly modified to inform the motorist of the closure. For short term closures this signing is impractical and warning signs may be used to provide this information.

Exhibit 3-1 Sample Guide Signs for TTC



"G" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
END ROAD WORK	G20-2A	BLACK ON ORANGE	48" X 24"
35W ROAD WORK HWY 694 TO COUNTY J BEGINS month da ENDS month 1998	G20-X2	BLACK ON ORANGE	168" X 132"

3.2.2 Regulatory and Warning Signs

Refer to the MN MUTCD Parts 2 and 6 for standards on regulatory and warning signs in work zones. Portions of Part 6 are included as a handout in Section **3.13**.

Exhibit 3-2 Sample Regulatory and Warning Signs

"R" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
SPEED LIMIT 55	R2-1	BLACK ON WHITE	48" x 60"

"W" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
ROAD WORK AHEAD	W20-1	BLACK ON ORANGE	48" x 48"

3.2.3 Supplemental Sign Plates

Separate demountable plates were introduced to allow greater flexibility in some cases of work zone signing. However, demountable legend plates should meet all of the following standards:

1. Legend plates shall have proper legend.
2. The legends shall be of proper letter size and series in accordance with the sign they are being attached to.
3. They shall be properly fastened to the sign face and shall have plastic spacers behind them to provide a minimum clearance of 1/4 inch from the existing legend.
4. The plates shall be made from the same type of retroreflective material as the sign face.
5. The sign sheeting shall be oriented the same as the sign face material.

The following signs are allowed to utilize demountable legend plates as detailed in the Standard Signs Manual.

1. Lane Reduction Transition (Right or Left) Sign (W4-2)
2. MERGE w/Arrow Sign (W20-X3)
3. RIGHT/LEFT TWO LANES CLOSED Sign (W20-X13)
4. Vehicle Mounted Signs for Mobile Operations Sign (W21-X4)
5. RIGHT/LEFT LANE CLOSED Sign (W21-X5)

3.2.4 Temporary Sign Covering

When it is necessary to cover an in place sign, care must be taken to preserve the in place sign since some coverings may cause permanent damage to the sign face sheeting. Avoid the use of ropes, wire fasteners or strapping that may abrade the sign sheeting surface. Do not apply tape to the sign sheeting surface because sunlight will cause it to bond permanently. Pre-mask or application tape must be removed prior to exposure to sunlight. Do not use paper or plastic covers as heat and moisture entrapment can cause permanent damage to the reflective sheeting on the sign face.

Refer to the Sign Framing, Installation, and Covering Details at the following link:

http://www.dot.state.mn.us/trafficeng/workzone/ttctemplates.html.

The above referenced typical detail includes a designer note. This note is intended as information for the designer and it should be removed when using this sheet for a plan set.

3.2.5 Sign Panel Overlays

When it is necessary to cover an in place sign; care must be taken to preserve the in place sign. Coverings for overhead sign should be sheet aluminum and installed according to the sheeting manufacturer's instructions.

It is important to review all signing for the project. It is possible, or probably, that relevant signing exists outside of the project limits.

3.2.6 Additional Signing Information

For additional details on signing, refer to the MN MUTCD Part 6F handout starting on page **3-46**.

3.2.7 Business Signing

The following is a handout from the TEM Section 8-6.02. The TEM can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

It is important that the holder of this manual checks the above link for updates.

HANDOUT

8-6.01.04 Sheeting Requirements of TTC Devices

Some TTC devices (signs, channelizing devices, etc) include sheeting and there are requirements based on their use. The Sign Sheeting Materials APL includes the sheeting type requirements for each application/ device.

8-6.01.05 Quality Standards of TTC Devices

The use of temporary traffic control zone devices subjects them to wear which does not occur with permanent devices. Although errant vehicles cause much of the damage to the devices, they also deteriorate in appearance from wear occurred during their storage, shipment, installation, relocation, and removal. Whenever a high number of these worn and damaged devices appear on the same project, the general appearance of the Temporary Traffic Control Zone deteriorates, reducing the level of safety provided to the workers, pedestrians, and traveling public.

Quality standards have been developed in an effort to offset the deterioration in the appearance of TTC devices. A determination of the condition of device quality should be made at several stages: while in storage, during preparation for delivery to the Temporary Traffic Control Zone, during initial set up, and periodically during the course of the work. Suppliers and contractors are encouraged to apply this standard prior to delivery of devices to the job site. Doing so will minimize agency involvement and reduce costs related to on-site replacement.

The Quality Standards section of the Field Manual includes Quality Classifications and Requirements for the majority of temporary traffic control devices, while considering the duration of the work zone. These standards are intended to address the day-to-day operations of traffic control within a Temporary Traffic Control Zone and are not meant to cover the needs of emergency situations.

8-6.02 Signs

The primary means by which the agency communicates with road users is through the use of signs. In order to be effective, there needs to be some distance between signs for the driver to be able to read, understand, and if necessary, react to the message communicated by the sign. Refer to the MN MUTCD Parts 2 and 6 for standards on signs.

8-6.02.01 Regulatory and Warning Signs

Regulatory signs communicate laws and warning signs communicate conditions of which the driver needs to be aware. These signs take precedence over guide signs when placing along a TTC route.

8-6.02.02 Guide Signs

The placement and revision of guide signs is important to providing traffic control through work zones. However, placement of these signs should not interfere with construction information signs or necessary regulatory and warning signs.

A. Construction Information Signs

One commonly used construction information sign is the advance notice guide sign. It is used to provide notice of when and where construction or maintenance will occur. There are two types of advance notice guide signs:

1. Signs that inform motorists of a date or a day when construction and/or closures will begin, and
2. Signs that inform motorists of exact location(s) of construction that is underway.

It is important that in-place guide signs be covered or modified to reflect actual conditions. For example if a ramp is closed, all advance guide signs should be properly modified to inform the motorist of the closure. For short term closures this signing is impractical and warning signs may be used to provide this information.

HANDOUT

B. Temporary Business Signing in Work Zones

MnDOT construction projects have frequently caused disruption of traffic patterns in business areas and have sometimes caused difficulty and confusion for motorists attempting to reach specific businesses or groups of businesses. This has resulted in the development of temporary business signs for use in construction areas.

Temporary business signs are used to improve driver guidance, create safer operations, and reduce the impact on businesses created by construction activities and detours. When temporary business signs are deemed necessary, they should be included as part of the Traffic Control Plan (TCP) for the construction project.

Properly placed and designed temporary business signing may alleviate business impacts due to the construction project. Inadequately designed signs with illegible messages may become traffic safety hazards and reflect poorly on the project and the businesses. The guidelines described in the following sections for temporary business signing have been developed with a balance between the standards utilized for permanent signing and the need for temporary supplemental signing during construction to guide motorists to businesses that depend upon the normal traffic flow for customers. Allowing a sign for a specific business during a construction project will not be justification for permanent business signing as governed by other parts of the TEM and MN MUTCD.

Location and Installation of Temporary Business Signs

Temporary business signs, classified as supplemental guide signs, shall not interfere with permanent or construction signing. As commonly practiced, when space becomes restricted, the hierarchy for sign installation is regulatory, warning (permanent and construction), and guide signs, in that order, over supplemental guide signs. All temporary business signs should conform to the MN MUTCD, this Manual, and Minnesota's standards for guide sign design to the extent practical and possible. All temporary business signing shall be removed when the impact to traffic ends, or at such time that permanent changes in the affected area are completed.

A system of temporary business signs should be designed such that multiple sign structures are not required in a single location. However, in situations where a second structure is required, the structures should be placed a minimum distance apart along the right-hand side of the roadway as shown in Table 8-1 below. Temporary business sign structures shall not be combined with other signs on one structure and shall be installed in accordance with current practices for temporary construction signs, including all crashworthy standards.

Posted Speed Limit	Minimum Distance Between Business Signs
< 45 mph	100 feet
45 - 55 mph	150 feet
> 55 mph	300 feet

Table 8-1 Temporary Business Sign Structure Spacing

Business signing should not be installed on freeways except as needed to replace existing signage for major traffic generators or regional shopping centers. Refer to Chapter 6 of this Manual, Section 6-7.09 Supplemental Guide Signing Programs.

All temporary business signing that is proposed by MnDOT to guide traffic will be funded by MnDOT and installed by MnDOT or contract forces. Any additional temporary business signing proposed by the businesses and allowed by MnDOT shall be funded by the businesses. All temporary business signs shall comply with Minnesota Statutes, Chapter 173, Signs and Billboards Along Highways. Any signs installed off state right-of-way shall conform to any local ordinances for advertising and/or business signing.

Temporary Business Signing Plan Guidelines

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The district should study all local businesses to estimate the extent of the work zone impact on each business and determine which should be classified as "traffic sensitive" or "regionally significant". Traffic sensitive businesses may lose a large portion of their patrons to similar businesses with easier access. These businesses typically include fuel/convenience stores, restaurants/cafes/fast food, and lodging/camping. Other typical businesses may be those previously identified through Supplemental Guide Signing Programs. Regionally significant businesses are visited by non-local traffic, and the traveling public would be impacted if the access was reduced. These areas may include retail centers, transportation hubs, recreational centers, or geographical areas. A district may develop other uniform guidelines to determine whether a business is "traffic sensitive" and what types of "regionally significant" businesses may qualify in their regional part of the state.

Temporary business signing is an option for alleviating the project's work zone impact on traffic sensitive or regionally significant business areas. MnDOT districts and partnering jurisdictions or organizations should work with businesses to suggest marketing plans to encourage continued customer patronage during construction. The marketing plans for individual businesses and/or business areas may include special advertisements via local media to inform customers of the appropriate directional information.

Types of Temporary Business Signs

Temporary business signing should be designed such that motorists are guided to the businesses through a series of easy decisions. Routes to the area businesses should be trailblazed in successive steps such that the signing may remain understandable and legible. The first type of business signing to be encountered should be generic in regards to the business names and provide the most practical signage that easily directs traffic to any type of business or group of businesses. These signs are Business Access signs or Business Service signs. To provide the motorist adequate information to make route decisions, Business Identification signs to specific business (or business area) locations or entrances may be required.

BUSINESS SIGN LETTER AND STRUCTURE SIZES:

Although many signage options are available for temporary business sign structures, there are maximum allowable sign structure sizes and minimum letter size requirements. The maximum height of the temporary business sign structure is determined by the U-Post Wind-load charts for typical Type 'D' sign sizes without using breakaway I-Beam construction. Refer to the following tables for typical sign structure sizes based upon recommended letter sizes and maximum number of messages allowed per structure.

The lettering sizes are chosen to provide legibility based upon traffic speed and typical distances to the signs. Although standard sign series fonts shall be used, the standard word and line spacing on the temporary business signs may be reduced to help fit longer business names onto the standard sign blanks. Refer to the following tables for recommended letter sizes. The alternate smaller letter sizes should only be used when a resulting narrower sign structure is required due to lateral space restrictions.

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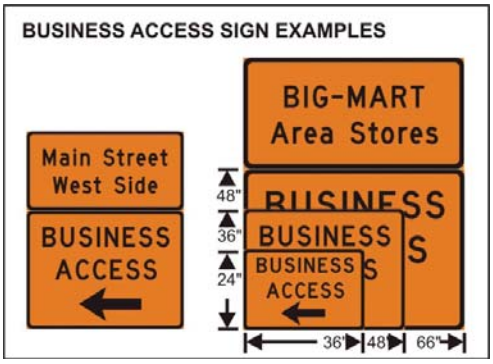
BUSINESS ACCESS SIGNS:

The BUSINESS ACCESS (G20-X6) sign should be provided as the primary trailblazing sign option. This sign is listed in the MnDOT Standard Signs Manual G-Series, in three standard sizes, making it readily available for short term detour and business access situations.

The G20-X6 sign may be supplemented with a plaque to provide guidance to a specific business center or portion of a business area through an understandable name/designation. A business area may be designated by a larger anchor business, geographic location, recognizable business area name, or a temporary project name or logo associated with local advertising.

Refer to Table 8-2 below for sizes.



Roadway Type	Posted Speed Limit	G20-X6	
		width	height
2 Lane - 2 Way	40 mph or less	36”	24”
	45 mph or greater	48”	36”
Multi-Lane	40 mph or less	48”	36”
	45 mph or greater	66”	48”

Table 8-2 Temporary Business Access Signs

HANDOUT

BUSINESS SERVICE SIGNS:

A BUSINESS SERVICE (G20-X8) sign may be installed indicating the types of business services that are available, with a limit of six categories per sign. The major business service types include gas, food, lodging, camping, grocery, and shopping, but when space allows, other generic types may be included such as mall or hardware. If needed for clarification the sign may include a destination. The destination may be a city name, an area designation such as SOUTH SIDE, a street name, or shopping center name.

Refer to Table 8-3 below for typical font and letter heights for various roadway types.

Roadway Type	Posted Speed Limit	Recommended Font	Minimum Font	G20-X8 Typical Panel Width (1)	
				1 column	2 column
2 Lane - 2 Way	40 mph or less	5” C	4” C	42”	60”
	45 mph or less	5” C	5” C	42”	60”
Multi-Lane	40 mph or less	6” C	5” C	60”	72”
	45 mph or greater	8” C	6” C	84”	96”
Note (1): Widths may vary. See the examples which show various combinations of messages.					

Table 8-3 Temporary Business Services Signs

HANDOUT

BUSINESS IDENTIFICATION SIGNS:

Businesses may require temporary business identification signs. These are generally needed when the business' normal signing is not visible from the trailblazing route. These signs may be designed as either individual panels or as a single panel guide sign.

Examples of typical businesses that may be approved for identification are Major Traffic Generators such as shopping centers or recreational centers. Businesses, attractions, and other destinations currently signed through several of the "Requestor Pay" Supplemental Guide Signing Programs may be approved for signing.

Temporary Business Panel Signs:

Although the alternative font sizes and panel sizes are shown to provide flexibility when selecting a sign size, the following guidelines should be followed:

- Sign Assembly designs may inter-mix single line signs with double line signs while not exceeding the maximum assembly height.
- Business names should be listed in order of distance from sign. When arrows are used for each business, then the order should be through-left-right.
- Font sizes and series shall not be mixed on a sign assembly.

Refer to Table 8-4 on the following page for typical font and letter heights for various roadway types.

HANDOUT

Font Series			2 Lane 2 Way		Multi-Lane	Major Generator (3)	
	Posted Speed Limit		≤ 40 mph	ALL	ALL	≤ 40 mph	ALL
C Series all caps	Minimum Letter Size		4"	5" (4)	5" (4)	6"	8"
	Single Line Panel Sizes (2)		48 x 9	72 x 12	72 x 12	72 x 12	96 x 15
	Double Line Panel Size (2)		48 x 15	72 x 18	72 x 18	72 x 21	96 x 27
	Characters per Line (5)	w/arrow (6)	12	14	14	11	11
		w/o arrow	15	18	18	15	15
D Series upper and lower case			2 Lane 2 Way		Multi-Lane	Major Generator (3)	
	Posted Speed Limit		≤ 40 mph	ALL	ALL	≤ 40 mph	ALL
	Minimum Letter Size		4 – 3"	6 – 4.5"	6 – 4.5"	6 – 4.5"	8 – 6"
	Single Line Panel Sizes (2)		48 x 9	72 x 15	72 x 15	72 x 15	96 x 18
	Double Line Panel Size (2)		48 x 15	72 x 21	72 x 21	72 x 21	96 x 30
	Characters per Line (5)	w/arrow (6)	11	11	11	11	11
		w/o arrow	15	15	15	15	15
Maximum number of Single Line Panels per Structure			**6**	**6**	**5**	**4**	**4**
Maximum number of Double Line Panels per Structure			**4**	**6**	**4**	**3**	**2**
Maximum Structure Assembly Height (1)			**90"**	**84"**	**84"**	**84"**	**72"**

NOTE 1	The maximum combined height of the panels is based upon the U-Post Wind-load Chart restrictions as published in the MnDOT Guide Sign Design Manual. However, for the 4" letter size, the max height has been restricted by number of panels rather than wind-load chart for legibility.
NOTE 2	Three widths (48, 72, & 96") are standardized for typical post spacing. Panel widths and heights may be modified for usually low or high number of characters within a line of text.
NOTE 3	Businesses qualifying as Major Traffic Generators and/or Regional Shopping Centers should be trail blazed with larger font sizes (reference TEM Chapter 6).
NOTE 4	Reference the Minnesota Standard Signs Manual D9-X6 for the typical design details.
NOTE 5	Approximation made using the recommended panel width with an average character width, with and without a standard directional arrow (left or right) included on the text line.
NOTE 6	Refer to the Standard Signs Manual for proper arrow sizes depending upon orientation and placement.

Table 8-4 Temporary Business Panel Signs

HANDOUT

Temporary Business Guide Signs:

A temporary business sign structure made up of individual panels may be replaced by a single panel guide sign. Although the maximum sign size remains the same as the combined panel signs, since the borders between business names may be removed, additional lines of text or a logo may be placed on the sign.

Design options may be utilized to optimize the legibility and clarity of the message. The options include but are not limited to:

- Use the business center name or refer to the anchor businesses' names.
- Use easily recognizable business center logos.
- Use a special project logo to identify business areas.
- Use horizontal lines or borders to separate names.
- Repositioning the arrow may provide for longer business names.

Refer to Table 8-5 on the following page for typical font and letter heights for various roadway types.

HANDOUT

	2 Lane – 2 Way		Multi-lane	Major Traffic Generator (3)	
	ALL Speeds	≤ **40** mph	ALL Speeds	ALL Speeds	≤ **40** mph
Minimum Font Size and Series (5)	6-4.5" D	4 – 3" D	6-4.5" D	8 – 6" D	6-4.5" D
Approx. No. of Characters per Line (1)	10	11	10	11	10
No. of Characters per Line w/o Arrow (2)	14	14	14	14	14
Maximum No. Lines of Text Allowed	**6**	**6**	**5**	**4**	**4**
Recommended Sign Panel Width (4)	72"	48"	72"	96"	72"

NOTE 1	Approximation made using the recommended panel width with an average character width, and a standard directional arrow (left or right) included on the text line.
NOTE 2	Approximation made using the recommended panel width with an average character width, and the directional arrow is placed at the bottom of the sign replacing one of the lines of text.
NOTE 3	Businesses qualifying as Major Traffic Generators and/or Regional Shopping Centers should be trail blazed with larger font sizes (reference TEM Chapter 6).
NOTE 4	Three widths (48, 72, & 96") are standardized for typical post spacing. Larger signs may be designed if required.
NOTE 5	Refer to the Standard Signs Manual for proper arrow sizes depending upon orientation and placement.

Table 8-5 Temporary Business Guide Signs

8-6.02.03 Sign Mounting in TTC Zones

Refer to MN MUTCD Part 6F for standards on placement and mounting post-mounted and portable mounted signs. Whenever possible, all temporary signs should be post mounted using the currently accepted crashworthy supports as detailed in Layout 20 of the TTC Plan Sheet templates.

Temporary signs that will remain in place for 30 days or less may be mounted on portable crashworthy support structures as defined in MN MUTCD Part 6F. See Minnesota Design Temporary Sign Supports passing NCHRP 350 for non-proprietary NCHRP Report 350 tested and approved temporary sign support structures.

Any portable signs placed on a sidewalk must:

- Allow a 48 inch clear walkway adjacent to the portable sign.
- Not be a tripping hazard. Any portable sign supports that extend into the walkway shall be no greater than ½ inch in height; if the support is greater than ¼ inch, then the support must be tapered between the ¼ inch and ½ inch dimensions. Alternatively, a detectable edge may be placed around the sign supports.
- Allow no portion of the sign to extend any greater than 4 inches into the clear walkway between the heights of 27 inches and 80 inches.
    - If there are sidewalk intrusion issues, consider post-mounting the temporary sign or use the NCHRP 350 Compliant 5 Feet Portable Sign Stand for 48" x 48" Diamond portable sign.

Unless designed and crash tested with other ballasting systems, the ballast system for use on portable support mounted signs is sandbags. See Section 8-6.05 Ballast for more information.

8-6.02.04 Sign Overlays and Coverings

When it is necessary to cover an inplace sign, or place an overlay on existing or work zone sign, care must be taken to preserve the sheeting on the existing sign.

3.3 Pavement Markings in Temporary Traffic Control Zones

These guidelines apply to all MnDOT construction and maintenance activities. They will apply to any temporary traffic control zone of at least 350 feet in length on tangent sections and of 50 feet in length or longer on curves of 6 degrees or greater.

3.3.1 TEM Handout

The following is a handout from TEM Chapter 8, Section 8-6.03 regarding TTC Strategies and Controlling Criteria. The TEM can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

It is important that the holder of this manual checks the above link for updates.

Items included in the handout are:

- ✓ Interim Pavement Marking Guidelines
- ✓ Temporary Pavement Markings Guidelines
- ✓ Temporary Raised Pavement Markers (TRPMs)
- ✓ Pavement Marking Removals
- ✓ Final Pavement Marking Guidelines

HANDOUT

Partial Sign Overlay on TTC Sign

Separate demountable plates were introduced to allow greater flexibility in some cases of rigid work zone signing. Demountable legend plates should meet all of the following standards:

- Legend plates shall have proper legend.
- The legends shall be of proper letter size and series.
- The plates shall be properly fastened to the sign face and shall have plastic spacers behind them to provide a minimum clearance of 1/8 inch from the existing legend.
- The plates shall be made from the same type of retroreflective material as the sign face.
- The sign sheeting shall be oriented the same as the sign face material.

The following signs are allowed to utilize demountable legend plates as detailed in the MnDOT Standard Signs Manual.

- Lane Reduction Transition (Right or Left) Sign (W4-2)
- MERGE w/Arrow Sign (W20-X3)
- RIGHT/LEFT TWO LANES CLOSED Sign (W20-X13)
- Vehicle Mounted Signs for Mobile Operations Sign (W21-X4)
- RIGHT/LEFT LANE CLOSED Sign (W21-X5)

Signing for moving operations also allows the use of demountable legend plates.

All work zone signs not listed above shall have the legend directly applied to the sign face as detailed in MnDOT specifications 3352.2.A.5.c Screen Processed Painted Legend and 3352.2.A.5.d Pigmented Plastic Film Legend. See MnDOT Standard Specifications for Construction for details.

The sign face and partial overlay shall maintain a uniform color and brilliance when viewed during both daytime and nighttime hours.

Temporary Sign Covering

When it is necessary to cover an inplace sign, care must be taken to preserve the inplace sign since some coverings may cause permanent damage to the sign face sheeting. Burlap, ropes, wire fasteners, or strapping should not be used as they may abrade the sign sheeting surface. Tape should not be applied to the sign sheeting surface because sunlight will cause it to bond permanently. Pre-mask or application tape must be removed prior to exposure to sunlight. Paper or plastic covers should not be used as heat and moisture entrapment can cause permanent damage to the reflective sheeting on the sign face.

Sign covers shall be rigid panel (such as sheet aluminum or plywood) and provide a minimum spacing of 1/8 inch (1 inch maximum) between the overlay panel and the sign. The spacers shall be a material that will not harm the sign sheeting face (such as plastic or rubber). For more detail on rigid sign covers for smaller signs, see TTC Template Typical Temporary Sign Framing and Installation Details.

Sign Panel Overlays

When it is necessary to modify the legend of an inplace sign, care must be taken to preserve the sign. A legend revision, such as EXIT CLOSED, on an overhead sign should be sheet aluminum and installed with minimum 1/8 inch spacers. The spacers shall be a material that will not harm the sign sheeting face (such as plastic or rubber).

8-6.03 Pavement Markings in Temporary Traffic Control Zones

Through many work zones, traffic is moved from one lane to another. Traffic must be given clear direction as to which pathway to follow. Pavement markings such as center lines and edge lines provide direction for the

HANDOUT

motorist. Pavement marking modifications are required in long term TTC Zones (which are in place for 3 days or more) that contain transitions or alignment change areas - see Layout 6J-1 in the MN MUTCD. Edge lines through transition and alignment change areas shall be marked with temporary pavement markings with wet retroreflective/recoverable properties. See Section 8-6.03.03 Temporary Pavement Markings Guidelines for more details.

This section applies to all MnDOT construction and maintenance activities with TTC zones of at least 350 feet in length on tangent sections and of 50 feet in length or longer on curves of 6 degrees or greater. As stated in Section 8-6.01.02 Approved Product List/Qualified Product List (APL/QPL), pavement markings have a QPL (see MnDOT Approved/Qualified Products List) upon which only these pavement marking materials are allowed to be used on the State Highway system. This includes interim, temporary, and final pavement marking installations.

Following are the minimum requirements for pavement markings prior to opening a road to traffic (for exceptions, see Section 8-6.03.02 Interim Pavement Marking Guidelines):

- Multi-lane Undivided Roadways - all double yellow centerlines, lane lines, and broken line stripe pavement markings.
- Multi-lane Divided Roadways - all lane lines.
- Three and Five Lane Roadways with Two-Way Left Turn Lanes - all solid yellow lines with yellow, broken line stripe pavement markings and lane lines (for five lane sections).
- Two Lane Undivided Roadways - all centerlines.

8-6.03.01 Pavement Marking Definitions

See Section 8-2.00 Glossary for definitions of pavement markings used in TTC zones.

8-6.03.02 Interim Pavement Marking Guidelines

When in plan design, this is a lump sum pay item. The designer will break this down give the contractor info on how many lineal feet is being placed.

Interim pavement markings are any pavement markings that are not the final marking or are temporarily placed for staging purposes. Interim broken line stripe pavement markings shall use the same cycle length as final pavement markings (50 feet) and shall be a minimum of 2 feet in length. If the cycle length is not 50 feet and the section to be striped in greater than 350 feet in length but less than 1¼ miles in length, the interim marking shall match the cycle length at either end of the project. See Interim Pavement Marking Template Sheets and MN MUTCD Part 6, Figure 6F-8b.

Material specifications and tolerances for interim pavement markings will be the same as for final pavement markings, with the following exception. When final pavement markings are to be epoxy, and paint is used for interim solid lines, a 10-mil thick layer application of paint shall be used. In this case, beads should be applied at a rate of 6 lbs/gal. Removal of this thin layer of paint is not required prior to placing the epoxy.

Temporary raised pavement markers (TRPMs), when used as interim pavement markings, shall be installed in accordance with Section 8-6.03.04 Temporary Raised Pavement Markers (TRPMs) of this chapter.

In areas where paint or tape will not adhere to the surface (i.e. chip or sand seal operations), temporary raised pavement markers may be used to simulate a centerline as detailed in Section 8-6.03.04 Temporary Raised Pavement Markers (TRPMs) of this chapter.

The minimum required interim pavement markings shall be installed prior to opening the roadway to traffic and should not be left in place for more than 14 calendar days unless they meet the requirements of temporary or final markings. Minimum required interim pavement markings include:

- Multi-lane Undivided Roadways - all double yellow centerlines, interim lane lines, and interim broken line stripe pavement markings.
- Multi-lane Divided Roadways - all interim lane lines.
- Three and Five Lane Roadways with Two-Way Left Turn Lanes - all solid yellow lines with yellow interim broken line stripe pavement markings and interim lane lines (for five lane sections).

HANDOUT

- Two Lane Undivided Roadways - all centerlines, turn lanes, bypass lanes, and outlines for any painted islands.

If the Average Daily Traffic (ADT) is less than 1500 and the Project Engineer determines that it is not possible or practical to install interim pavement markings on Two Lane Undivided Roadways before opening the road to traffic, Figure 6F-8a in Part 6 of the MN MUTCD may be followed, also shown in Interim Pavement Marking Template Sheets. If the ADT is greater than 400, then this layout shall be limited to three days.

8-6.03.03 Temporary Pavement Markings Guidelines

Will have criteria that pavement markings in work zones should be wet reflective. Regular pavement markings with raised markings is considered wet reflective.

Typically, the markings placed for staging purposes on long term projects are temporary, meaning they will eventually be covered by surfacing materials or removed completely. The material used for temporary pavement markings should be selected based upon whether the marking is placed on the final surface (such as a lane shift crossing the final surface) or not, as well as how long the marking needs to last. Temporary pavement markings are to be installed to the same specifications as final pavement markings. To increase pavement marking conspicuity in work zones, temporary pavement markings in tapers and transitions should be installed at a minimum of six inches in width. Removable preformed pavement marking tape, paint, or epoxy are typically used.

Temporary or final markings and all other pavement markings including edge lines, channelizing lines, lane reduction transitions, gore markings, and other longitudinal markings, and the various non-longitudinal markings (stop lines, railroad crossings, crosswalks, words, symbols, etc) should be installed within 14 calendar days.

The time limitations for installing temporary or final markings begin when construction operations first remove the inplace markings from the roadway. The time limitations restart any time temporary or final markings are restored.

Edge lines through transition and alignment change areas shall be marked with temporary pavement markings with Wet Retroreflective/Recoverable (WR) Properties. Transition and alignment change areas include: lane closure tapers, lane shifts, sharp curves, shifts onto temporary roadways or detours, etc. The following WR pavement markings consist of a combination of one or more products to achieve the required properties.

- Temporary pavement marking tape lines supplemented with temporary raised pavement markings (TRPMs).
- Temporary WR pavement marking tape lines.
- Pavement marking paint or epoxy lines supplemented with TRPMs.
- Pavement marking paint or epoxy lines with WR elements

As with other pavement markings, there is an APL for TRPMs and a QPL for WR Pavement Markings.

There is a high risk of damage or removal of WR products by snow plowing operations. Therefore, pavement markings which are applied for winter carry-over in transition and alignment change areas should be applied as wide markings and additional WR properties may be omitted.

8-6.03.04 Temporary Raised Pavement Markers (TRPMs)

TRPMs are normally used with construction zone markings. They are commonly referred to as “temporary markers” or “TRPMs”. TRPMs are glued to the roadway with a bitumen or epoxy adhesive. Most markers of this type consist of a plastic body with a reflective surface.

TRPMs are to be replaced when they become damaged or have been removed by traffic. These markers will be inspected on a routine basis and replaced as necessary. TRPMs shall not be used as an interim pavement marking between October 1 and May 1 because of snowplowing operations.

Another general type of temporary raised marker is the “peel and stick” type. These typically have a paper backing that is removed to expose a butyl/adhesive pad. The marker is then applied to the roadway and firmly pressed in place.

HANDOUT

TRPMs may be used to simulate solid lines without the use of any other pavement marking material, or they may be used to supplement other types of pavement markings. See Interim Pavement Marking Template Sheets and Layout 6J-2 in Part 6 of the MN MUTCD for guidelines on how to use TRPMs to simulate and supplement pavement markings.

TRPMs are classified into four types as follows:

- TRPM Type 1 - These markers are acceptable for use on all roadways for short or long term projects. They may be used to supplement or simulate solid or broken lines.
- TRPM Type 2 - These markers are acceptable for use on projects with Average Daily Traffic (ADT) of less than 3000. They may be used to supplement or simulate solid or broken lines.
- TRPM Type 3 - These markers are acceptable for use on all roadways for short or long term projects. They may be used to supplement solid or broken lines. These markers are NOT acceptable to simulate solid or broken lines. If these markers do not conform to the color requirements herein they shall not be placed directly on the pavement marking line.
- TRPM Type 4 - These markers are acceptable for use on chip or sand sealing operations. These markers are designed to be placed prior to the sealing operation with a protective cover that is removed after the seal coat is applied.

As with other pavement markings, there is an APL for TRPMs.

8-6.03.05 Pavement Marking Removals

The removal of pavement markings must be done with care, especially within a TTC zone where excessive scarring can mislead drivers. See TEM Chapter 7, Pavement Markings for more information.

8-6.03.06 Final Pavement Marking Guidelines

Standard final striping plan sheets shall be included in each Project Construction Plan. Refer to TEM Chapter 7, Pavement Markings for more information.

For pay items, pavement marking removal is paid in 4" increments. Right now, temporary wet reflective tape is paid the same way. The designer will need to know this for quantities.

8-6.04 Channelizing Devices

Overall channelizing device standards and guidelines can be found in the MN MUTCD, Part 6. Refer to this section for the categorization and different types of channelizing devices. More specific standards are found on Standard Plate 8000j, which shall be used in construction projects.

As with other devices, all channelizing devices need to be crashworthy. There are proprietary and non-proprietary crashworthy designs for barricades available. Documentation should be provided from the vendor/contractor to verify crashworthiness. See the MnDOT Type III Crashworthy Barricade Designs for designs of non-proprietary crashworthy Type III barricades.

8-6.05 Ballast

Ballast is important so that TTC devices have limited movement due to wind caused by weather or vehicles. It is also important that the entire system of the device and ballast is crashworthy.

Sandbags are the most common ballast for TTC devices. When sandbags are used, they should be constructed so they will not readily rot or allow the sand to leach when exposed to the highway environment. Also, the sandbag should be constructed of a material which will allow the bag to break and disperse its contents when struck by an errant vehicle. Sandbags should not be filled to the extent that they become too heavy to be readily moved when a traffic control device is relocated. The number and size of sandbags used as traffic control device ballast should be kept to the minimum needed to provide stability for the device. During freezing conditions, the sand for bags shall be mixed with a deicer to prevent the sand from freezing. Sandbags shall not be suspended from the traffic control device. For proprietary devices, check with the manufacturer for ballasting requirements.

3.4 Pavement Marking Supplemental Information to the TEM

3.4.1 Definitions

See the Glossary of Terms on page **1-3**.

Pavement marking plan sheets are found in the Pavement Marking section of the plan set, not the traffic control section.

3.4.2 Interim Pavement Marking Guidelines

For the latest notes on what is required for interim pavement markings, refer to the notes on the "Interim Striping" pdf at: http://www.dot.state.mn.us/trafficeng/pavement/typicaldetail/index.html.

For interim pavement markings, what is required is, centerline, no passing zones, painted islands, lane lines (including turn lane lines) and edge lines after 14 days. Does not require cross hatching. Interim markings has to go where the final PM will go.

The easy way to determine quantities for Interim Pavement Markings on a divided road is to take the permanent striping quantities and subtract the left edge line.

3.4.3 Temporary Pavement Marking Guidelines

Refer to the TEM for full details.

Wet Retroreflective Properties

A temporary pavement marking that has wet retroreflective properties (commonly called Wet Retroreflective Pavement Markings) retains retroreflectivity, presence, and color when wet or submerged in water. The following wet retroreflective pavement markings consist of a combination of one or more products to achieve the required properties:

1. Solid temporary pavement marking tape lines supplemented with TRPMs (temporary raised pavement markings) or
2. Solid temporary wet retroreflective pavement marking tape lines or
3. Solid pavement marking paint or epoxy lines supplemented with TRPMs (temporary raised pavement markings) or
4. Solid wet retroreflective pavement marking paint or epoxy lines.

For approved Removable Tape, TRPM, and Wet Retroreflective Removable Tape products, see the Temporary Traffic Control Approved Product List on the Qualified Products web page listed below.

For approved Wet Retroreflective Marking Paint or Epoxy products, see the Pavement Markings Approved Product List on the Approved Products web page listed below.

There is a high risk of damage or removal of wet retroreflective products by snow plowing operations. Therefore pavements markings which are applied for winter carry-over in transition and alignment change areas should be applied as double width markings and additional wet retroreflective properties may be omitted.

3.4.4 Final Pavement Markings

Refer to the TEM Chapter 7 on Pavement Markings, for more information on final pavement markings.

3.4.5 Temporary Raised Pavement Markers (TRPMs)

TRPMs may be used to simulate solid lines without the use of any other pavement marking material, or they may be used to supplement other types of pavement markings. See the Standards for TRPMs as posted on the Approved Products web page for guidelines on how to use TRPMs to simulate and supplement pavement markings. The website is:

www.dot.state.mn.us/products/pavementmarkings/reflectiveelementsforpavementmarkings.html.

3.4.6 Pavement Marking Removal Scarring

Markings that are no longer applicable for roadway conditions or restrictions and that might cause confusion for the road user shall be removed or obliterated to be unidentifiable as a marking as soon as practical.

Overly aggressive removal techniques leave scars that can confuse drivers during night and wet conditions. Do not allow excessive scarring. Any excessive scarring should be repaired to avoid wet weather confusion.

Exhibit 3-3 Pavement Marking Removal Scarring

Typically, sandblasting, grinding, and high pressure water jet have been used to remove markings, but the results at times have been less than desirable. For larger projects, truck-mounted, hydraulically controlled, dual scarifying drums with a built-in vacuum system could be considered. A trailing sweeper/vacuum unit recovers the coarser paint/surface waste mixture.

Markings may be temporarily masked with black tape (not paint) until they can be removed or obliterated.

Lines and scars from line removal may look different at night or in an east/west roadway do to time of day and overcast conditions. Nighttime inspections are desirable to determine that the pavement markings are visible and understandable under day and night conditions.

Exhibit 3-4 Spec Book Section 2102 – Pavement Marking Removal

2102 PAVEMENT MARKING REMOVAL

2102.1 DESCRIPTION

This work consists of removing temporary and permanent pavement markings, except for removable preformed plastic pavement markings, that conflict with revised traffic patterns.

2102.2 MATERIALS — (BLANK)

2102.3 CONSTRUCTION REQUIREMENTS

Before making a change in traffic pattern, remove conflicting pavement markings as required by the contract and as directed by the Engineer without damaging the pavement structure or surface texture. If determined by the Engineer, repair damaged areas as directed by the Engineer at no additional cost to the Department.

Control or restrict operations to avoid exposing traffic to hazardous conditions in accordance with 1701, "Laws to be Observed," 1707, "Public Convenience and Safety," and 1717, "Air, Land, and Water Pollution." Remove expended materials or agents used in the pavement marking removal process from the pavement surface as the work progresses. Dispose of removed marking material in accordance with 1701, "Laws to be Observed," and 1717, "Air, Land, and Water Pollution."

Removed pavement marking material shall become the property of the Contractor.

2102.4 METHOD OF MEASUREMENT

The Engineer will measure *Pavement Marking Removal* by area or length of the original markings as removed.

The Engineer will measure removal areas on the basis of nominal widths and actual lengths as originally applied and still visible at the time of pavement marking removal. The Engineer will enclose irregularly shaped markings within rectangular boundaries of least dimension as determined by the Engineer.

The Engineer will measure removal length by the actual length of each 4 in [100 mm] wide pavement marking removed. The Engineer will measure longitudinal pavement marking removal quantities greater than 4 in [100 mm] wide based on a ratio of actual pavement marking width relative to 4 in [100 mm]. The Engineer will not include the gap between the broken lines in the removal length measurement.

The Department will include the cost of removing removable preformed pavement marking tape with the relevant contract unit prices in accordance with 2581, "Removable Preformed Pavement Marking Tape."

2102.5 BASIS OF PAYMENT

The contract unit price for *Pavement Marking Removal* includes the cost of obliterating the markings as required by the contract and for restoring the original pavement texture as directed by the Engineer.

Unless the contract requires otherwise, the Department will pay for the removal of markings of all types under a single contract item.

The Department will pay for pavement marking removal on the basis of the following schedule:

Item No.:	Item:	Unit:
2102.501	Pavement Marking Removal	square foot [square meter]
2102.502	Pavement Marking Removal	linear foot [linear meter]

It is suggested that on projects where pavement scarring and leaving deceptive markings is a potential concern, and/or you know the inspector will ask the Contractor to utilize water-blasting and/or sandblasting equipment that it should be spelled out ahead of time in the Special Provisions. This will help ensure the job is bid appropriately, while also giving the inspector the assurance that the Contractor has clear expectations.

The language below is what is currently provided in MnDOT's Boiler Plate Special Provisions for those situations.

Exhibit 3-5 Special Provisions – Pavement Marking Removal (No Lead)

Use S-.2 when there is any pavement marking removal on the job.

S-73.2 MnDOT 2102.3 is hereby deleted and replaced with the following:

Before making a change in traffic pattern, remove conflicting pavement markings as required by the contract and as directed by the Engineer without damaging the pavement structure or surface texture. If determined by the Engineer, repair damaged areas as directed by the Engineer at no additional cost to the Department.

Remove pavement markings on the basis of nominal widths and actual lengths as originally applied and still visible at the time of pavement marking removal. Remove irregularly shaped markings by enclosing them within rectangular boundaries of least dimension as determined by the Engineer.

Control or restrict operations to avoid exposing traffic to hazardous conditions in accordance with 1701, "Laws to be Observed," 1707, "Public Convenience and Safety," and 1717, "Air, Land, and Water Pollution." Remove expended materials or agents used in the pavement marking removal process from the pavement surface as the work progresses. Dispose of removed marking material in accordance with 1701, "Laws to be Observed," and 1717, "Air, Land, and Water Pollution."

Removed pavement marking material shall become the property of the Contractor.

Construction needs to choose which option shown below is to be used.

All pavement marking removal shall be done utilizing either waterblasting or sandblasting equipment. GRINDER-TYPE CUTTING HEADS SHALL NOT BE USED for pavement marking removal.

OR

All Pavement marking removal shall be done utilizing either grinding, water-blasting, or sandblasting equipment.

OR

All Pavement marking removal shall be done utilizing water-blasting equipment.

Another option includes using Temporary Raised Pavement Markers to simulate markings or temporary tape. Temporary tape is more expensive than liquid markings, but can be cost-effective. To illustrate this issue, MnDOT had a project with significant scarring on a concrete freeway from different traffic stages during construction. This required planning the entire concrete surface to remove the scars before installing final markings and fully opening the roadway to traffic.

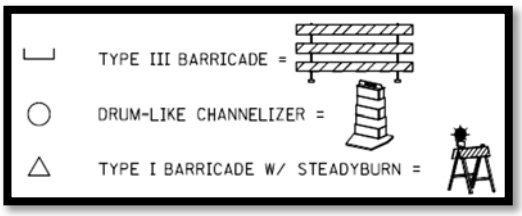
When using temporary tape, MnDOT requires the use of primer, regardless of product specifications. The following language is found in the Special Provisions for all temporary tape uses:

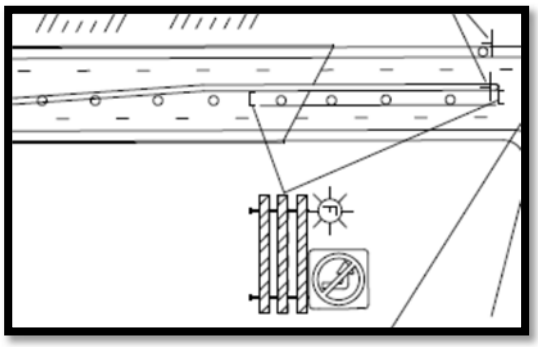
> "The Contractor will be required to use primer prior to the installation of all tape regardless of weather or pavement conditions or Manufacturer's specifications. All other installation procedures and materials used shall follow the manufacturer's specifications. Application of the primer shall be incidental to the cost of installing the tape."

3.5 Channelizing Devices

Channelizing devices are classified into 3 types. Type A channelizing devices include cones, surface mounted delineators, tubular delineators, weighted channelizers, and opposing traffic lane dividers. Type B channelizers include drums, Type I & II barricades and direction indicator barricades. Type C channelizers include Type III barricades. Refer to the MN MUTCD Part 6 for proper spacing, applications, sizes, color, and retroreflective sheeting requirements. See the Approved Products web page listed below for examples of NCHRP Report 350 tested and approved Type III barricades.

Exhibit 3-6 Channelizing Devices for TTC





3.5.1 Surface Mounted (Centerline) Delineators

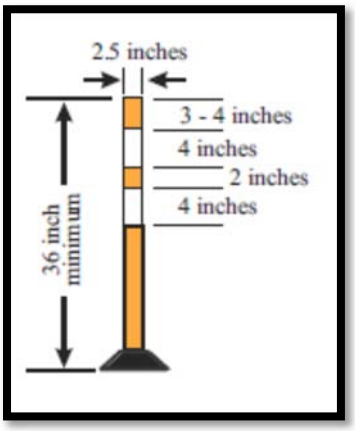
Surface mounted delineators are delineation devices that may be used as center lane dividers to separate opposing motor vehicle traffic on a two-lane, two-way operation.

Surface mounted delineators may also be used to provide other traffic delineation. Refer to the MN MUTCD Part 6F.65.1 and the APL at http://www.dot.state.mn.us/products/temporarytrafficcontrol/index.html.

In addition, there are separate pay items for “Tube Delineator” and “Replace Tube Delineator”. The “Replace” is used to for delineator hits, deterioration, etc.

TUBE DELINEATOR	EACH
REPLACE TUBE DELINEATOR	EACH

Exhibit 3-7 Surface Mounted Delineators for TTC



3.5.2 Channelizer Quick Reference Chart

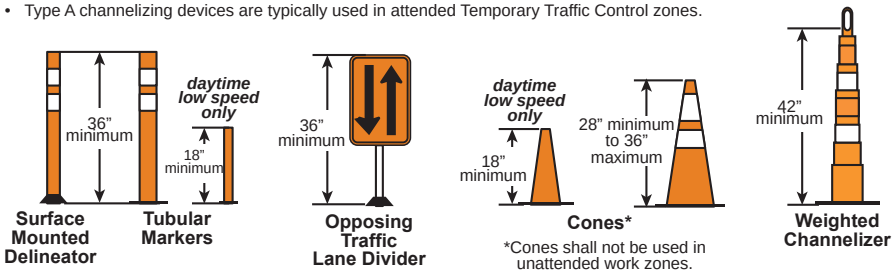
The following handout is a reference chart on channelizer devices from Park 6K of the MN MUTCD (Field Manual):

http://www.dot.state.mn.us/trafficeng/workzone/wzmanual.html

HANDOUT

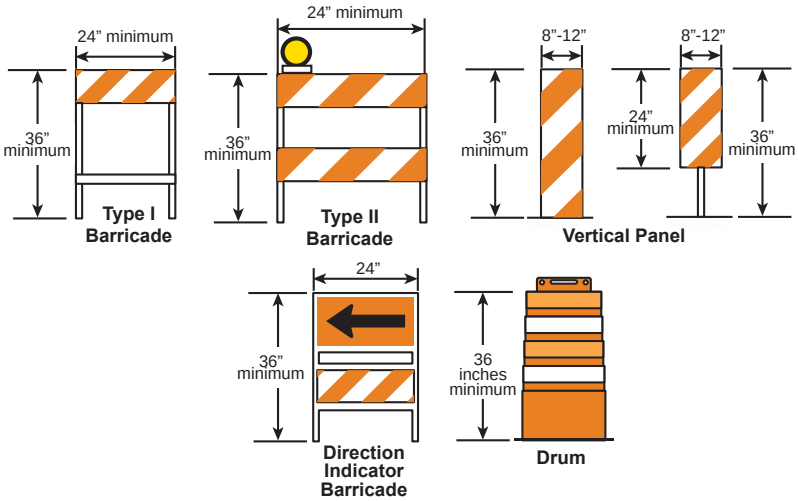
TYPE A CHANNELIZERS

- Type A channelizing devices are typically used in attended Temporary Traffic Control zones.



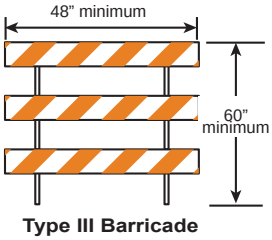
TYPE B CHANNELIZERS

- Channelizers used on high speed roadways shall have a minimum of 270 square inches of retroreflective area facing road users.
- Orange diagonals shall slope down toward the traffic side.
- Type B channelizing devices shall be used if the Temporary Traffic Control zone will be installed for more than 12 hours or if it is left unattended. Weighted channelizers may be used in lieu of a Type B channelizer with the permission of the road authority.
- Type A Flashing Warning Lights may be used - place on the side with traffic.



TYPE C CHANNELIZER

- Orange diagonals shall slope down toward the traffic side.
- Signs mounted on Type III barricades should not cover more than 50 percent of the top two rails or 33 percent of the total area of the three rails.
- Type A Flashing Warning Lights may be used - place on the side with traffic.



Types of Channelizing Devices
Figure 6K-3

6K-t

HANDOUT

3.6 Temporary Barrier Guidance

Several temporary barriers are used for temporary traffic control. Approved temporary barriers are listed at, www.dot.state.mn.us/products/temporarytrafficcontrol/temporarybarriers.html. Proper temporary barrier system selection and design involves the consideration of several specific factors including:

- ✓ The NCHRP Report 350 test level needed to accommodate expected impact conditions (devices are classified into categories in the report based on characteristics such as the weight of the device).
- ✓ Duration and ease of installation, maintenance, and removal.
- ✓ Exposure and safety risks for workers and road users during installation, repair, and removal.
- ✓ Expected frequency and severity of impacts (based in part on crash data).
- ✓ Available space for barrier installation and lateral deflection (perpendicular to traffic flow).

The AASHTO Manual for Assessing Safety Hardware (MASH) is the new state of the practice for the crash testing of safety hardware devices for use on the National Highway System (NHS). It is phasing out NCHRP Report 350 and older versions of MASH.

Per the MN MUTCD Section 6F.85, there are five primary functions of temporary traffic barriers:

- ✓ To keep motor vehicle traffic from entering work areas, such as excavations or material storage sites;
- ✓ To separate workers, bicyclists, and pedestrians from motor vehicle traffic;
- ✓ To separate opposing directions of motor vehicle traffic; and
- ✓ To separate motor vehicle traffic, bicyclists, and pedestrians from the work area such as false work for bridges and other exposed objects; and
- ✓ To protect drop-offs of greater than 12 inches on longer term projects when a suitable buffer lane cannot be provided.

3.6.1 Crashworthiness

Crashworthy is a characteristic of roadside devices that have been successfully crash tested in accordance with a national standard such as the National Cooperative Highway Research Program Report 350, “Recommended Procedures for the Safety Performance Evaluation of Highway Features.”

All temporary traffic control devices, including Type A and Type B channelizing devices, Type III barricades, ballast systems and sign support structures, used on any roadway open to public travel shall be crashworthy when installed facing traffic or turned away from traffic. FHWA policy requires that all roadside appurtenances, including temporary traffic control devices, have been successfully crash tested in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features" or the American Association of State Highway and Transportation Officials (AASHTO) “Manual for Accessing Safety Hardware (MASH).”

Some key points regarding MASH are:

- ✓ All new testing will be done following MASH evaluation techniques.
- ✓ Hardware accepted under NCHRP Report 350 is appropriate for replacement and new installation. Retesting is not required.

- ✓ As of January 1, 2011, all new products must be tested using MASH crash test criteria for use on the National Highway System (NHS).

3.6.2 Anchoring

To control or eliminate lateral deflection close to pavement edge drop-offs and in other situations where deflection space is limited, barrier sections may be anchored to the pavement. On bridge decks, overpasses, retaining walls or any other large edge drop off where no deflection can be accommodated, anchoring of the barrier by bolting it is required. Placing an anchor behind a PCB is not allowed, as it does not provide significant rollover resistance and could result in the barrier overturning on impact.

Also note that the Bridge Department has a memo, "Interim Guidance for Installation of Temporary Barriers on Bridges and Approach Panels". This can be found at, www.dot.state.mn.us/bridge/pdf/lrfdmanual/memo/Memo2011-03.pdf.

It is important to work with the Bridge Office to get a recommendation on anchoring on bridges.

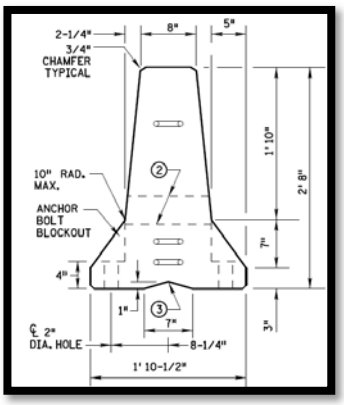
3.6.3 Portable Precast Concrete Barrier (PPCB)

Many temporary barriers used in Minnesota are portable precast concrete barriers. See the MN MUTCD Part 6 for application information and spacing requirements (200' is the minimum distance allowed).

MnDOT has no Approved Products List for these devices. However, MnDOT has an approved specification found at,
http://standardplates.dot.state.mn.us/StdPlate.aspx,

Standard Plates 8337C1, 8337C2 and 8337C3. Other barrier designs will be allowed if certified by the FHWA as meeting or exceeding the NCHRP 350, TL-3. Different barrier designs shall not be connected.

Exhibit 3-8 Portable Precast Concrete Barriers for TTC



3.6.4 Moveable Barrier

Exhibit 3-9 Moveable Barrier System for TTC

Source: Barrier Systems Inc.

Consider the placement of the moving machine in non-use operation.

3.6.5 Portable Non-Concrete Barrier

In Minnesota and throughout the US, the PPCB is the most widely used positive protection device in use today. The PPCB does have a low initial cost and are readily available; however, they also are quite heavy. This creates issues when required on a bridge project and during transport. Other barrier systems (such as steel) are available that are typically lighter. Generally these systems have a higher upfront cost but may be advantageous in some situations such as a bridge project. A listing of the approved portable non-concrete barriers are found on the APL, http://www.dot.state.mn.us/products/temporarytrafficcontrol/temporarybarriers.html.

Exhibit 3-10 Portable Non-Concrete Barriers (Steel)

3.6.6 Water-Filled Barrier

Water-filled barrier systems are also shown on the APL. The barriers shall be certified by the FHWA as meeting or exceeding the requirements of the NCHRP 350, TL-3. The installer shall install according to the manufacturer's installation instructions.

Exhibit 3-11 Water-Filled Barrier

Note that there are also longitudinal channelizing devices for pedestrians. Information can be found at,

http://www.dot.state.mn.us/trafficeng/workzone/apr.html.

3.6.7 Barrier End Treatments

All upstream leading ends that are present shall be appropriately flared or protected with properly installed and maintained crashworthy cushions. Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles, either by smoothly decelerating the vehicle to a stop when hit head-on, or by redirecting the errant vehicle. A typical barrier end treatment can be found at, http://www.dot.state.mn.us/trafficeng/workzone/doc/PCBendtreatment.pdf.

It is important to attenuate both ends of barriers on undivided roadways as the barrier can be impacted from both directions.

Barrier Flare

The barrier run may be flared to the limits of the clear zone. The existing shoulder slope or median slope may be too steep for this type of installation. If this is the case, temporary grading should be provided or a different end treatment should be used.

Stationary Crash Cushions

This section discusses stationary crash cushions used to protect the end(s) of temporary traffic barriers in highway work zones. The crash cushions shall be one of two types.

1. Non-Redirective (Gating)
2. Redirective (Non-Gating)

A gating device is one designed to allow controlled penetration of the vehicle when impacted between the end and the beginning of the length of need (LON) of the device. The widely used breakaway cable terminal

(BCT) is a gating device. A non-gating device is designed to contain and redirect a vehicle when impacted downstream from the end of the device. A terminal or crash cushion with redirection capabilities along its entire length is a non-gating device.

Refer to the manufacturers specifications for information on installation for various speeds.

Refer to the Approved/Qualified Products (APL/QPL) for the acceptable products to be used. The APL/QPL is located at, www.dot.state.mn.us/products/.

Include a section on barrier access.

3.6.8 Truck/Trailer Mounted Attenuators

Truck-mounted attenuators are energy-absorbing devices attached to the rear of shadow trailers or trucks. When used, the shadow vehicle with the attenuator is located in advance of the work area, workers, or equipment to reduce the severity of rear-end crashes from errant vehicles. The vehicle is positive protection for the workers and the attenuator is positive protection for the driver.

Exhibit 3-12 Truck Mounted Attenuator

3.6.9 Temporary Barrier Guidance Manual

The following is a handout the Temporary Barrier Guidance Manual that can be downloaded from the following web link:

http://www.dot.state.mn.us/trafficeng/workzone/wzmanual.html

It is important that the holder of this manual checks the above link for updates.

HANDOUT

1. INTRODUCTION

The use of the terms 'shall', 'should', and 'may' in this document follow the conventions of the Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD).

1.1 Temporary Barrier Use Applications

Temporary barrier is effective in providing positive separation between traffic and work areas; it is primarily used for protecting vehicles from severe hazards (e.g. drop-offs, embankments, fixed objects), protecting workers from errant vehicles, and to separate opposing directions of traffic in certain temporary traffic control applications. When used appropriately, temporary barrier has the potential to reduce the severity of crashes; however, care should be used in the application of temporary barrier since:

- the temporary barrier itself can be considered a hazard, but when used appropriately it protects from a more serious hazard, and
- the placement and removal of the temporary barrier adds exposure and risk to both the traveling public and the workers placing and removing the barrier.

Due to the above reasons, the following alternatives should be strongly considered before placing temporary barrier:

- Remove the hazard when the hazard is within the Work Zone Clear Zone
- Utilize closures and detours to allow the work to be done without the presence of vehicular traffic
- Provide buffer spaces
- Nightly backfill of excavations

1.2 Definitions

Deflection – Also known as lateral deflection. The distance the barrier travels laterally during impact, under the guidance of crash testing standards. Note that lateral deflection can be expected whether the barriers are anchored or unanchored.

Fixed Object - Hazards that are firm, unyielding, and greater than 4 inches in height along the roadside such as bridge piers, abutments, footings, walls, posts, trees, construction equipment, supplies, stockpiles, and large boulders.

Lateral offset to obstruction – In urban environments, a lateral offset to vertical obstructions (e.g. signs, fire hydrants, etc.), including breakaway devices, is needed to accommodate motorists operating on the roadway. Urban environments with lower operating speeds tend to have sidewalks beginning at the face of the curb, enclosed drainage, numerous fixed objects (e.g., signs, utility poles, luminaire supports, fire hydrants, sidewalk furniture), and frequent traffic stops.

Longitudinal Drop-off – Any slope steeper than 1V:3H.

HANDOUT

Portable Concrete Barrier (PCB) - Specifically Type "F" concrete barrier per the latest version of MnDOT Standard Plate No. 8337.

Posted Speed Limit - The posted speed indicates the posted speed limit in force prior to construction or the recommended speed due to engineered work zone geometry.

Traveled Way - The portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.

Work Zone Clear Zone - The unobstructed (clear of obstructions, hazards, or fixed objects), relatively flat (1V:4H slope or flatter) area impacted by construction that extends outward from the edge of the traveled way. The clear zone concept applied to work zones differs from clear zone concepts applied to permanent roadways.

2. WORK ZONE CLEAR ZONE AND ROADSIDE SAFETY

The Work Zone Clear Zone concept does not apply to preexisting conditions unless the work operation moves the traffic flows such that the preexisting condition is subsequently within the Work Zone Clear Zone. An example of this would be a crossover such that a multi-lane divided is converted to a two-way, two-lane operation--fixed objects and blunt ends (bridge railings, barrier, guardrails, sign bases, etc.) may now be in the Work Zone Clear Zone for the opposing direction.

Table 6K-1 from the Minnesota Temporary Traffic Control Field Manual (duplicated following this paragraph) indicates the minimum Work Zone Clear Zone distances for MnDOT projects. For urban areas with curbs, a wide clear zone is more difficult to achieve; in these areas with speeds ≤ 35 mph, a minimum of 1.5 feet (called the **lateral offset to obstruction**) should be provided behind the curb face.

Table 2-1: Clear Zone distances for work zones

Speed (mph)	Width (ft)
≤35	10*
40	15
45-55	20
≥60	30

* or 1.5 feet behind the curb face in curbed urban sections

2.1 Fixed Objects

In construction projects, the use of temporary barrier shall be permitted only if shown in the plan or if approved by the Engineer.

During nonworking hours, fixed objects (including equipment and materials) shall not be within the Work Zone Clear Zone unless they are protected by properly installed temporary barrier. If the Engineer agrees that it is not practical to provide temporary barrier or to move fixed objects, the fixed objects shall be delineated with Type B channelizing devices.

HANDOUT

During hours of work, unless protected as described above, only materials necessary to the work shall be within the Work Zone Clear Zone and only equipment necessary to the work shall be allowed within the Work Zone Clear Zone or allowed to stop or park on the shoulder of the roadway.

When temporary barrier is used, the deflection distance should be clear during non-working hours. During working hours, as much deflection distance should be clear as the work allows.

Work vehicles within 15 feet of the traveled way should operate vehicle warning lights. Nonessential and private vehicles shall not park within the Work Zone Clear Zone at any time unless protected as described above.

Trailer mounted traffic control devices, such as Arrow Boards and Portable Changeable Message Signs (PCMSs), are exempt from the temporary barrier requirement when in operation. If practical, PCMSs should be placed off the shoulder and behind a traffic barrier. When trailer mounted devices are deployed and operating on the shoulder, they shall be placed and delineated per Layout 7 of the Minnesota Temporary Traffic Control Field Manual. When not in use, they should be relocated such that they are outside of the clear zone or shielded behind a traffic barrier and turned away from traffic. If relocation or shielding is not practical, they shall be placed and delineated per the aforementioned Layout 7.

2.2 Longitudinal Drop-offs

Longitudinal drop-offs up to 1 foot shall be delineated and treated as shown in Figure 6K-7 (Longitudinal Drop-off Guidelines) of the Minnesota Temporary Traffic Control Field Manual.

Longitudinal drop-offs greater than 1 foot may require temporary barrier. See Temporary Barrier for Hazard Protection – Placement and Deflection Distance Guidance section for guidance and requirements.

3. TEMPORARY BARRIER FOR HAZARD PROTECTION - PLACEMENT AND DEFLECTION DISTANCE GUIDANCE

Due to the reasons mentioned in the Temporary Barrier Use Applications section, engineering judgment should be exercised regarding the placement of temporary barrier for hazard protection.

3.1 Protection from Fixed Objects

Work should be planned to keep fixed objects and other hazards outside of the Work Zone Clear Zone following the Work Zone Clear Zone and Roadside Safety section. If the duration of the work is greater than 3 days, temporary barrier should be used if fixed objects that are not practical to remove are present within the Work Zone Clear Zone.

3.2 Protection from Longitudinal Drop-offs

- Longitudinal drop-offs up to 1 foot shall be delineated and treated as shown in Figure 6K-7 (Longitudinal Drop-off Guidelines) of the Minnesota Temporary Traffic Control Field Manual.
- Anchored Temporary barrier shall be used when bridge barrier is removed and the bridge is open to traffic.

HANDOUT

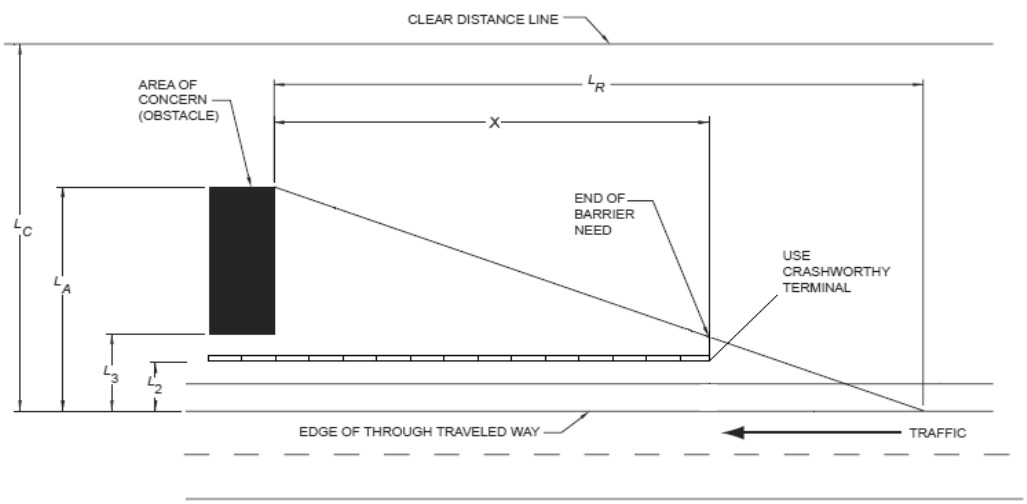
- Temporary barrier shall be used when the following longitudinal drop-offs depths are within 8 feet of the edge of the traveled way, unless otherwise approved by the Engineer:
  - Greater than 3 feet when the posted speed limit is ≤ 30 MPH
  - Greater than 1 foot when the posted speed limit is ≥ 35 MPH
  - When temporary barrier is not used, channelizing devices shall be used to delineate the longitudinal drop-off.
- When temporary barrier is used, deflection distance (see section 3.4) shall be provided between the barrier and the longitudinal drop-off.

3.3 Length of Need Calculation

The length of need is defined as the length of temporary barrier needed in advance (upstream) of a fixed object hazard or to prevent a vehicle that has left the roadway from reaching the shielded feature, it is not the total length of barrier required for a hazard. It is determined by selecting the appropriate variables and using the formula to calculate the Length of Need. Provide the temporary barrier for the calculated length of need; a minimum run of 100' of portable concrete barrier should be placed before and after the hazard for which the barrier is placed.

For construction staff to verify enough PCB has been placed, a PCB Length of Need Field Check Procedure has been included in Appendix A.

Figure 3-a: Approach Barrier Layout Variables



Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Figure 5-39, pg. 5-49.

L_C = **Clear zone,** design clear zone width as shown in Table 2-1
L_A = **Lateral Extent of the Area of Concern,** distance from edge of traveled way to back of obstacle or design clear zone width, whichever is less.
L_R = **Runout length,** distance measured along the edge of the travel lane as shown in the diagram based on design speed and ADT (Table 3-1).
L_2 = Distance from edge of travel lane to face of traffic barrier measured at obstacle.
L_3 = Distance from edge of through traveled way to obstruction.
X = Length of Need for traffic barrier from upstream face of obstacle to the effective point of the end treatment.

HANDOUT

Table 3-1: Runout Length

	Runout Length (L_R) for Given Traffic Volume (ADT) (ft)			
Design Speed (MPH)	**>10,000 veh/day**	**5,000 – 10,000 veh/day**	**1,000 – 5,000 veh/day**	**<1,000 veh/day**
80	470	430	380	330
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Chapter 5, Table 5-10(b), Pg. 5-50.

3.3.1 Length of Need Procedure

1. Choose an appropriate L_A as it is a critical part of the design process. This distance should include all features or hazards that need to be shielded, up to the design clear zone at each site.
2. Select a Runout Length (L_R) from Table 3-1.
3. For parallel installations i.e. no flare rate, the equation is:

$$Length\ of\ need, X = \frac{L_A - L_2}{\left(L_A / L_R\right)}$$

Example calculation for length of need:

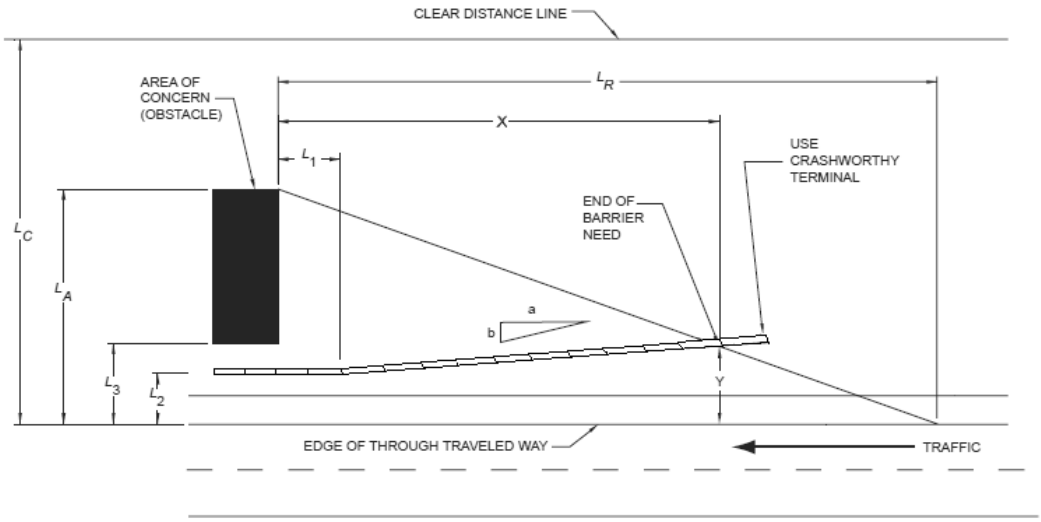
Design Speed = 40 MPH
ADT = 11,000 veh/day
L_A = Clear zone = 15 ft
L_2 = Distance from edge of travel lane to face of traffic barrier measured at obstacle = 2 ft
L_R = Runout length (from table 3-1) = 160 ft

$Length\ of\ need, X = \frac{15-2}{(15/160)}$ = **138.66 ft.** A minimum of 100' behind the hazard is also needed, so a total of **238.66 ft** of barrier is required to shield the area of concern. (Keep in mind this assumes a single point area of concern, the length of the area of concern would also need to be added to this value)

HANDOUT

3.3.2 Length of Need Procedure for Barrier Flare

Figure 3-b: Approach Barrier Layout Variables for barriers with flare



Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Figure 5-39, pg. 5-49.

See Figure 3-a for other variables required for the calculation.

b/a = Flare rate for the selected design speed (not shown in the diagram, use if the run out barriers need to be flared) (Table 4-1).

L_1 = Tangent section in advance of obstacle (transitions should be tangent).

1. If the barrier is flared away from the roadway, the maximum recommended flare rate shown on Table 4-1, should not be exceeded.
2. If a semi rigid barrier is connected to a rigid barrier, the tangent length (L_1) should be at least as long as the transition section.
3. Once the appropriate variables have been selected, the required length-of-need (X) in advance of the area of concern for straight or nearly straight sections of roadway can be calculated with the following:

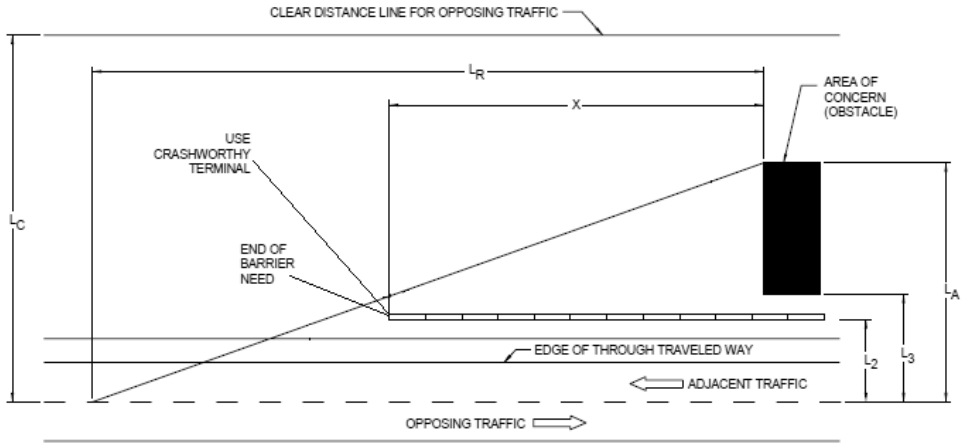
$$Length\ of\ need, X = \frac{L_A + (b/a)(L_1) - (L_2)}{(b/a) + (L_A/L_R)}$$

HANDOUT

3.3.3 Length of Need for Opposing Traffic

The following is the procedure required to adjust Length of Need for opposing traffic:

Figure 3-c: Approach Barrier Layout for Opposing Traffic



Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Figure 5-42, pg. 5-54.

- Length of need (X) is determined using the same equation as in section 3.3.1.
- All lateral dimensions are measured from the centerline for a two-lane roadway.
- Three ranges of clear zone width (L_C) deserve special attention for an approach barrier for opposing traffic:
    - If the barrier is beyond the appropriate clear zone, no additional barrier and no crashworthy terminals are needed.
    - If the barrier is within the appropriate clear zone but the area of concern is beyond it, no additional barrier is needed, but a crashworthy terminal should be used.
    - If the area of concern extends well beyond the appropriate clear zone (e.g., a river), the designer may choose to shield only that portion that lies within the clear zone by setting L_A equal to L_C.

3.4 Required Deflection Distance for Portable Concrete Barrier (PCB)

MnDOT has significant experience in the application of portable concrete barrier, specifically Type "F" Barrier per the latest version of MnDOT Standard Plate No. 8337. The tables in this section are based on this design of portable concrete barrier. If proprietary temporary barriers are used, refer to manufacturer for design assistance. Barrier segments must be connected together to be effective.

When used, place portable concrete barrier such that the deflection distance in the following tables is provided.

HANDOUT

Table 3-2: Deflection distance for Unanchored Portable Barrier

Deflection Distance Required Behind Unanchored Portable Concrete Barrier						
		Longitudinal Drop-off Depth				Fixed Object
		<1’	1’ - 3’	>3’ – 8’	Edges of bridges and drop-offs >8’	
Posted Speed (MPH)	≤ 30	Barrier not required for hazard protection		2’	3’	3’ [2]
	35 - 50	0.5’ [1]	2’	3’	6’	6’[2]
	≥ 55	2’ [1]	2’	4’	8’	8’

Table 3-3: Deflection distance for Anchored Portable Barrier

Deflection Distance Required Behind Anchored Portable Concrete Barrier						
		Longitudinal Drop-off Depth				Fixed Object
		<1’	1’ - 3’	>3’ – 8’	Edges of bridges and drop-offs >8’	
Posted Speed (MPH)	≤ 30	Barrier not required for hazard protection		0.5’	0.5’	0.5’ [2]
	35 - 50	0.5’ [1]	0.5’	1’	1.5’ (2’ [3])	[1.5’ (2’ [3])][2]
	≥ 55	0.5’ [1]	1’	2’	2’ (4’ [3])	2’ (4’ [3])

[1] Temporary barrier is optional if the work is less than 50 feet in length and the duration is ≤ 3 calendar days. Follow delineation requirements of Figure 6K-7 in the Minnesota Temporary Traffic Control Field Manual.
[2] If the fixed object is beyond 1.5 feet from an in place curb and the posted speed limit is ≤ 35 mph, temporary barrier is optional.
[3] Denotes deflection distance for the Tie-Down Strap anchoring system, which is **NOT** to be used on bridge decks. See notes below and MnDOT Standard Plan 5-297.680 for more details on anchorage system required according to type of surface below the Portable Barriers.

HANDOUT

3.4.1 Notes:

- These tables were developed based on crash tests (FHWA Eligibility Letters B-180 & B-215), reports (MwRSF Research Report No. TRP-03-115-02 & TRP-03-134-03), and construction experience. Some deflections in these tables are reduced from the crash tested values because work zones often reduce the width of traveled way and available shoulders, which likely reduces the angle of incidence and crash severity.
- Temporary barrier deflection distance should be clear during non-working hours. During working hours as much deflection distance should be clear as work allows.
- If Engineering Judgement is being used to modify the required deflection distance for Anchored PCB, the PCB shall be anchored with a minimum of 6” of full-depth pavement behind the barrier.
- Anchoring in a head-to-head situation is only allowed when using the Tie-Down Strap Anchor system on concrete pavements.
- Anchoring or increasing deflection distance should be considered if:
    - Alignment is not tangent;
    - Placing in roads and bridges where travel speeds may significantly exceed the posted speed limit;
    - Work continues longer than one season; or
    - Truck presence is above normal (>10%).
- Types of anchoring that should be considered include:
    - **Bolt-Down Anchor:** This system is used with concrete pavements and bridge decks. It consists of three 1 ⅛” diameter MnDOT Spec. 3385 Type A anchor rods with adhesives per barrier segment on the traffic side which is bolted to reinforced concrete. See MnDOT Standard Plate B920 for bridge deck applications. See MnDOT Standard Plan 5-297.680 for approach panels and other concrete pavement applications.
    - **Thru-Bolt Anchor:** This system is used with bridge decks. It consists of three 1 ⅛” diameter MnDOT Spec. 3385 Type A anchor rods per barrier segment on the traffic side which are bolted through bridge deck. See MnDOT Standard Plate B920.
    - **Tie-Down Strap Anchor:** This system is used with concrete pavements. It consists of a tie down strap (MnDOT Standard Plate 8347) which connects the barrier and the concrete pavement using ¾” diameter drop-in anchors on both sides of the barrier. Tie-Down Strap Anchor shall not be used on bridge decks.
    - **Bituminous Anchorage:** This system is used with bituminous pavements. It consists of three 3’ long and 1 ½” diameter ASTM A36 Rods driven into bituminous pavement on the traffic side. See MnDOT Standard Plan 5-297.680 for more details.
- Anchoring should be used for portable concrete barrier left in place on a bridge over winter if an unprotected longitudinal drop-off is behind it.
- Sheet pile or other temporary retaining wall systems are not permitted within the deflection distance limits.

HANDOUT

4. PORTABLE CONCRETE BARRIER (PCB) DESIGN DETAILS AND REQUIREMENTS

1. Portable Concrete Barrier shall follow Standard Plate No. 8337.
2. Portable Concrete Barrier shall follow MnDOT Standard Plan 5-297.680 and MnDOT Standard Bridge Detail B920 for barrier anchoring.
3. Portable Concrete Barrier should be placed on pavement. The barriers may be placed on compacted aggregate if a paved surface is not available. The surface must be able to bear traffic. This also applies to the deflection area.
4. Provide the temporary barrier for the calculated length of need approaching the hazard for which the barrier is placed; a minimum run of 100' of portable concrete barrier should be placed before and after the hazard.
5. In order to keep the angle of impact with the barrier from being too severe and to mitigate the effect of striking the end of a temporary traffic barrier, the end shall be appropriately flared until it is outside the acceptable clear zone or protected with properly installed and maintained crashworthy cushions/end treatments. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly. The minimum flare rate values shown in the table below should be followed.

Table 4-1: Flare Rates

Posted Speed (MPH)	Flare rate for concrete barrier
≥45	15:1
40-45	12:1
≤35	8:1

Ref: MN MUTCD Figure 6F-9

Note: For Portable Concrete Barriers, the flare rates in the table above can be used. However, Portable Concrete Barriers were only tested on paved surfaces. Since a flare will likely run into a non-paved soil surface, designers are recommended to consider more conservative flare rates when placing portable concrete barrier on compacted aggregate. Also, the compacted aggregate surface must be able to bear traffic.

6. Adequate transitions shall be made between temporary barriers of differing flexibility or between temporary and permanent barriers. To shield the blunt end of the portable concrete barrier rail section, a transition consisting of a steel plate (such as a Thrie Beam Guardrail Connection) and a special precast concrete barrier transition section that connects to the permanent concrete median barrier should be used. See MnDOT Standard Plan 5-297.680 (page 2) and MnDOT Standard Plate No. 8350A for Thrie Beam Anchorage Plate details. Any transition system used must be crashworthy.
7. In case of a PCB overlap with other barriers (temporary or permanent), a minimum of 100' overlap between the PCB and the overlapped barrier should be provided. The barriers should be spaced 6”-12” from each other.

8. Placement near curbs should be evaluated on a case-by-case basis using engineering judgment. Curbs may cause the PCB to tip over, so adequate deflection distance should be provided between the PCB and the curb. If this cannot be achieved, remove the curb. Do not place temporary barrier directly in front of curb face, if necessary place PCB on top of the curb, flush with the face of it. The deflection area must meet the requirements of section 3.4 Required Deflection Distance for PCB.

HANDOUT

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5. APPENDIX

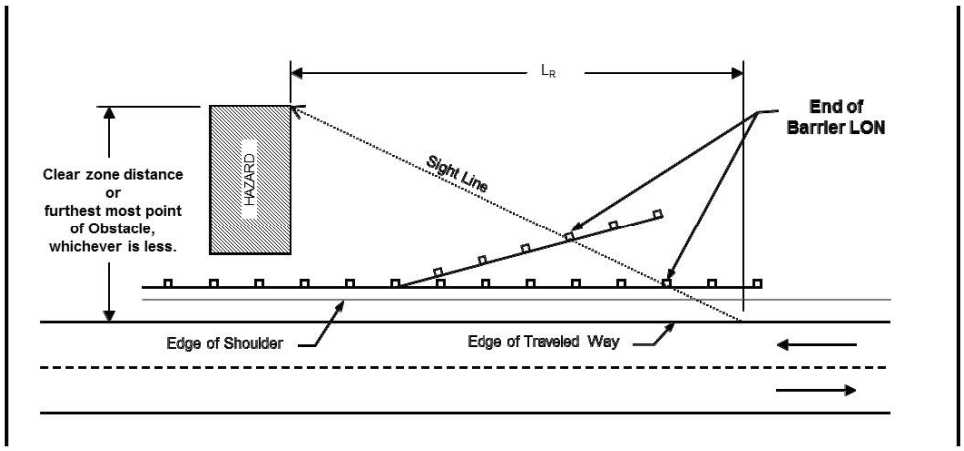
5.1 PCB Length of Need Field Check

Walk upstream along the edge of traveled way from the edge of the hazard, a distance of L_R (known as, runout length) as shown in the table below.

From this position sight downstream toward the hazards's furthest corner, or toward a point along the obstacle at the Clear Zone distance, whichever is less.

If the PCB length is sufficient, the PCB should intercept the sight line.

Figure 5: Length of Need Approach Barrier Layout



Ref: Federal Lands Highway Division Guardrail Field LON Card, 2016, Pg. 1.

Table 5-1: PCB Field Check Runout Length

	Runout Length (L_R) for Given Traffic Volume (ADT) (ft)			
Design Speed (MPH)	**>10,000 veh/day**	**5,000 – 10,000 veh/day**	**1,000 – 5,000 veh/day**	**<1,000 veh/day**
70	360	330	290	250
65	330	290	250	225
60	300	250	210	200
55	265	220	185	175
50	230	190	160	150
45	195	160	135	125
40	160	130	110	100
35	135	110	100	100
30	110	100	100	100

Ref: Federal Lands Highway Division Guardrail Field LON Card, 2016, Pg. 2.

3.7 Portable Changeable Message Signs (PCMS)

Exhibit 3-13 illustrates a PCMS. See Section **2.6.9** for information on the CMS Manual of Practice.

Exhibit 3-13 Portable Changeable Message Sign

3.7.1 Definitions

Change Interval - The time interval which occurs between displays of each panel (during this time no message is displayed).

Character - It is composed of 35 pixels. The pixels are arranged in a seven high by five wide matrix.

Font - The pixel description of the alphanumeric character. The format used for highways for all alpha-numeric characters (with the exception of the letter "I" and the number "1" is seven units high by five units wide.

Message sign panel - It presents or delivers the message to the motoring public. The message is displayed by forming various alpha-numeric characters.

Panel - A message (of up to three lines) displayed on a message sign panel.

Pixel – A pixel is one element of a total of 35 elements per character. A pixel changes its color electronically, which in turn will show the desired alpha-numeric character.

PCMS (Portable Changeable Message Sign) - A traffic control device with the flexibility to display a variety of messages to fit the needs of highway and street authorities. The components of a PCMS include: message sign panel, control system, power source and mounting and transporting equipment.

If permanent message signs are available, coordinate with the district for use during TTC periods.

3.7.2 Message Sign Panel

The message sign panel shall meet the following requirements under both day and night conditions:

Field Setup -- The sign shall be placed to be visible from a minimum of 800 feet. When locked in place, the front panel shall be tilted forward 3 to 5 degrees to reduce daylight and headlight glare on the sign face.

Minimum Performance Standard -- The message shall become legible a minimum of 800 feet for traffic on all lanes of the roadway. The message shall remain legible for at least 750 feet from the nearest travel lane from the message sign panel.

For approved PCMS products, see the Temporary Traffic Control Approved Product List on the Approved Products web page listed below.

The 750 feet distance is based on the ability of a driver to read two complete messages of two 2-second panels, which includes the change interval (0.5 seconds maximum) between panels, for a total of 8.0 seconds.

3.8 Portable Signal Systems

Portable Traffic Control Signals are either Trailer Mounted or Pedestal Mounted. Approved products and specifications for portable signal systems can be found on the APL.

3.9 Automated Flagging Assist Device

Automated Flagging Assistance Devices (AFADs) enable the operator to be positioned out of the lane of traffic and are used to control road users through temporary, one-lane, two-way traffic control zones. These devices are capable of displaying a STOP message followed by a SLOW message without the need for a flagger in the immediate vicinity of the sign or on the roadway. They can be remotely operated by a one operator at a central location or by separate operators near each device location. A single operator may only be used on roadways with unobstructed sight lines.

3.10 Flashing Arrow Boards

Any flashing arrow board used for purposes of traffic control shall meet criteria as defined in Part 6 of the MN MUTCD.

For approved Flashing Arrow Board products, see the Temporary Traffic Control Approved Product List on the Approved Products web page listed below.

3.11 Little Known Resources

MnDOT may have resources available for use in temporary traffic control. Check with the districts on the availability and applicability of these resources. A few examples include, but are not limited to:

- ✓ A MnDOT owned temporary bridge
- ✓ Temporary overhead sign structure (District 6)
- ✓ Dynamic Speed Display Signs (DSDS)
- ✓ Automated flagger assistance device (AFADs)

3.12 Approved/Qualified Products (APL/QPL)

A list of approved products of each type is available on the Qualified Products List (QPL) for Work Zones, posted on the Office of Traffic, Security and Technology website at:

www.dot.state.mn.us/products/

Exhibit 3-14 Approved/Qualified Products Website

Elements of signing related to temporary traffic control (such as sheeting materials and surface mount delineators) are in the signing product list.

3.13 MN MUTCD Chapter 6F - Temporary Traffic Control Zone Devices

The following is a handout from the MN MUTCD Chapter on TTC Zone Devices. The MN MUTCD can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

In Section 6F.1, note the information on crashworthiness. FHWA policy requires that all roadside appurtenances such as traffic barriers, barrier terminals and crash cushions, bridge railings, sign and light pole supports, and work zone hardware used on the National Highway System meet the crashworthy performance criteria contained in the National Cooperative Highway Research Program (NCHRP) Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features".

HANDOUT

PART 6. TEMPORARY TRAFFIC CONTROL
Chapter 6F. Temporary Traffic Control Zone Devices

6F.1 Types of Devices

GUIDANCE:

The design and application of TTC devices used in TTC zones should consider the needs of all road users (motorists, bicyclists, and pedestrians), including those with disabilities.

SUPPORT:

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

Various Sections of the MUTCD require certain traffic control devices, their supports, and/or related appurtenances to be crashworthy. Such MUTCD crashworthiness provisions apply to all streets, highways, and private roads open to public travel. Also, State Departments of Transportation and local agencies might have expanded the NCHRP Report 350 crashworthy criteria to apply to certain other roadside appurtenances.

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

As defined in Section 1A.13, "crashworthy" is a characteristic of a roadside appurtenance that has been successfully crash tested in accordance with a national standard such as the NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

STANDARD:

Traffic control devices shall be defined as all signs, signals, markings, and other devices used to regulate, warn, or guide road users, placed on, over, or adjacent to a street, highway, private roads open to public travel (see definition in Section 1A.13), pedestrian facility, or bikeway by authority of a public body or official having jurisdiction.

All traffic control devices used for construction, maintenance, utility, or incident management operations on a street, highway, or private road open to public travel (see definition in Section 1A.13) shall comply with the applicable provisions of this Manual.

All signs, barricades, drums, weighted channelizers, and vertical panels shall be retroreflectorized. Cones and tubes shall be retroreflectorized if used at night.

Devices that are excessively worn, bent, damaged or have lost a significant amount of their retroreflectivity shall be promptly removed (see Chapter 6K, Quality Standards on pages 6K-87 through 6K-104).

GUIDANCE:

Particular attention should be given to assuring that all traffic control devices are maintained and kept clean, visible, and properly positioned at all times.

6F.2 General Characteristics of Signs

SUPPORT:

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

STANDARD:

The colors for regulatory signs shall follow the Standards for regulatory signs in Table 2A-5 and Chapter 2B. Warning signs in TTC zones shall have a black legend and border on an orange background, except for the Grade Crossing Advance Warning (W10-1) sign which shall have a black legend and border on a yellow background, and except for signs that are required or recommended in Parts 2 or 7 to have fluorescent yellow-green backgrounds. Colors for guide signs shall follow the Standards in Table 2A-5 and Chapter 2D, except for guide signs as otherwise provided in Section 6F.55.

OPTION:

Where the color orange is required, the fluorescent orange color may also be used.

SUPPORT:

The fluorescent version of orange provides higher conspicuity than standard orange, especially during twilight.

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OPTION:

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

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

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

STANDARD:

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

Except as provided in Section 2A.11, the sizes for TTC signs and plaques shall be as shown in Table 6F-1 and in Appendix C of this Manual. The sizes in the minimum column shall only be used on local streets or roadways where the 85th-percentile speed or posted speed limit is less than 35 mph.

OPTION:

The dimensions of signs and plaques shown in Table 6F-1 may be increased wherever necessary for greater legibility or emphasis.

STANDARD:

Deviations from standard sizes as prescribed in this Manual shall be in 6-inch increments.

SUPPORT:

Sign design details are contained in the MnDOT Standard Signs Manual and the FHWA "Standard Highway Signs and Markings" book (see Section 1A.11).

Section 2A.6 contains additional information regarding the design of signs, including an Option allowing the development of special word message signs if a standard word message or symbol sign is not available to convey the necessary regulatory, warning, or guidance information.

STANDARD:

All signs used at night shall be retroreflective with a material that has a smooth, sealed outer surface to show the same shape and similar color both day and night.

The requirement for sign illumination shall not be considered to be satisfied by street, highway, or strobe lighting.

OPTION:

Sign illumination may be either internal or external.

Signs may be made of rigid or flexible material.

STANDARD:

Mesh nonretroreflective signs shall not be used.

6F.3 Sign Placement

GUIDANCE:

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

OPTION:

Where special emphasis is needed, signs may be placed on both the left-hand and right-hand sides of the roadway. Signs mounted on portable supports may be placed within the roadway itself. Signs may also be mounted on or above Type III barricades.

SUPPORT:

The provisions of this Section regarding mounting height apply unless otherwise provided for a particular sign elsewhere in this Manual.

STANDARD:

The minimum height, measured vertically from the bottom of the sign to the elevation of the near edge of the pavement, of signs installed at the side of the road in rural areas shall be 5 feet (see Figure 6F-1).

The minimum height, measured vertically from the bottom of the sign to the top of the curb, or in the absence of curb, measured vertically from the bottom of the sign to the elevation of the near edge of the traveled way, of signs installed at the side of the road in business, commercial, or residential areas where parking or pedestrian movements are likely to occur, or where the view of the sign might be obstructed, shall be 7 feet (see Figure 6F-1).

The minimum height, measured vertically from the bottom of the sign to the sidewalk, of signs installed above sidewalks shall be 7 feet.

OPTION:

The height to the bottom of a secondary sign mounted below another sign may be 1 foot less than the height provided in the previous Standard.

HANDOUT

Sign or Plaque	Sign Designation	Section	Conventional Road	Freeway or Expressway	Minimum
Stop	R1-1	6F.6	30 x 30 *	---	---
Stop (on Stop/Slow Paddle)	R1-1	6E.3	18 x 18	---	---
Yield	R1-2	6F.6	36 x 36 x 36	48 x 48 x 48	30 x 30 x 30
To Oncoming Traffic	R1-2aP	6F.6	36 x 30	48 x 36	24 x 18
Speed Limit	R2-1	6F.12	24 x 30 *	36 x 48	---
Fines Higher (plaque)	R2-6P	6F.12	24 x 18	36 x 24	---
Fines Double (plaque)	R2-6aP	6F.12	24 x 18	36 x 24	---
$XX Fine (plaque)	R2-6bP	6F.12	24 x 18	36 x 24	---
Begin Higher Fines Zone	R2-10	6F.12	24 x 30	36 x 48	---
End Higher Fines Zone	R2-11	6F.12	24 x 30	36 x 48	---
End Work Zone Speed Limit	R2-12	6F.12	24 x 36	36 x 54	---
Movement Prohibition	R3-1,2,3,4,18,27	6F.6	24 x 24 *	36 x 36	---
Mandatory Movement (1 lane)	R3-5	6F.6	30 x 36	---	---
Optional Movement (1 lane)	R3-6	6F.6	30 x 36	---	---
Right (Left) Lane Must Turn Right (Left)	R3-7	6F.6	30 x 30 *	---	---
Advance Intersection Lane Control	R3-30	6F.6	Varies x 30	---	---
Do Not Pass	R4-1	6F.6	24 x 30	36 x 48	---
Pass With Care	R4-2	6F.6	24 x 30	36 x 48	---
Keep Right	R4-7	6F.6	24 x 30	36 x 48	---
Narrow Keep Right	R4-7c	6F.6	18 x 30	---	---
Stay in Lane	R4-9	6F.11	24 x 30	36 x 48	---
Do Not Enter	R5-1	6F.6	30 x 30 *	36 x 36	---
Wrong Way	R5-1a	6F.6	36 x 24 *	42 x 30	---
One Way	R6-1	6F.6	36 x 12 *	54 x 18	---
One Way	R6-2	6F.6	24 x 30 *	36 x 48	---
No Parking (symbol)	R8-3	6F.6	24 x 24	36 x 36	---
Pedestrian Crosswalk	R9-8	6F.13	36 x 18	---	---
Sidewalk Closed	R9-9	6F.14	24 x 12	---	---
Sidewalk Closed, Use Other Side	R9-10	6F.14	24 x 12	---	---
Sidewalk Closed Ahead, Cross Here	R9-11	6F.14	24 x 18	---	---
Sidewalk Closed, Cross Here	R9-11a	6F.14	24 x 12	---	---
Wait on Stop/Go on Slow	R10-X1	6E.5	24 x 30	24 x 30	---
Road Closed	R11-2	6F.8	48 x 30	---	---
Road Closed, Local Traffic Only	R11-3a,3b,4	6F.9	60 x 30	---	---
Weight Limit	R12-1,2	6F.10	24 x 30	36 x 48	---
Weight Limit (with symbols)	R12-5	6F.10	24 x 36	36 x 48	---
Turn and Curve Signs	W1-1,2,3,4	6F.16	36 x 36	48 x 48	30 x 30
Reverse Curve (2 or more lanes)	W1-4b,4c	6F.48	36 x 36	48 x 48	30 x 30
One-Direction Large Arrow	W1-6	6F.16	48 x 24	60 x 30	---
Chevron Alignment	W1-8	6F.16	18 x 24	30 x 36	---
Stop Ahead	W3-1	6F.16	36 x 36	48 x 48	30 x 30
Yield Ahead	W3-2	6F.16	36 x 36	48 x 48	30 x 30
Signal Ahead	W3-3	6F.16	36 x 36	48 x 48	30 x 30
Be Prepared to Stop	W3-4	6F.16	36 x 36	48 x 48	30 x 30
Reduced Speed Ahead	W3-5	6F.16	36 x 36	48 x 48	30 x 30
XX MPH SpeedZone Ahead	W3-5b	6F.16	36 x 36	48 x 48	30 x 30
Traffic Control Change Ahead	W3-X5	6F.30	36 x 36	48 x 48	30 x 30

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* See Table 2B-1 for minimum size required for signs facing traffic on multi-lane conventional roads

Notes: 1. Larger signs may be used wherever necessary for greater legibility or emphasis.

Table 6F-1 Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 1 of 3)

HANDOUT

Sign or Plaque	Sign Designation	Section	Conventional Road	Freeway or Expressway	Minimum
Merging traffic	W4-1,1a,5	6F.16	36 x 36	48 x 48	36 x 36
Lane Ends	W4-2	6F.24	36 x 36	48 x 48	30 x 30
Added Lane	W4-3,6	6F.16	36 x 36	48 x 48	30 x 30
No Merge Area (plaque)	W4-5P	6F.16	18 x 24	24 x 30	---
Road Narrows	W5-1	6F.16	36 x 36	48 x 48	30 x 30
Narrow Bridge	W5-2	6F.16	36 x 36	48 x 48	30 x 30
One Lane Bridge	W5-3	6F.16	36 x 36	48 x 48	30 x 30
Ramp Narrows	W5-4	6F.26	36 x 36	48 x 48	30 x 30
Divided Highway	W6-1	6F.16	36 x 36	48 x 48	30 x 30
Divided highway Ends	W6-2	6F.16	36 x 36	48 x 48	30 x 30
Two-Way Traffic	W6-3	6F.32	36 x 36	48 x 48	30 x 30
Two-Way Traffic	W6-4	6F.76	12 x 18	12 x 18	---
Hill (symbol)	W7-1	6F.16	36 x 36	48 x 48	30 x 30
Next XX Miles (plaque)	W7-3aP	6F.53	24 x 18	36 x 30	---
Bump	W8-1,1a	6F.16	36 x 36	48 x 48	30 x 30
Dip	W8-2	6F.16	36 x 36	48 x 48	30 x 30
Pavement Ends	W8-3	6F.16	36 x 36	48 x 48	30 x 30
Soft Shoulder	W8-4	6F.44	36 x 36	48 x 48	30 x 30
Slippery When Wet	W8-5	6F.16	36 x 36	48 x 48	30 x 30
Truck Crossing	W8-6	6F.36	36 x 36	48 x 48	30 x 30
Loose Gravel	W8-7	6F.16	36 x 36	48 x 48	30 x 30
Rough Road	W8-8	6F.16	36 x 36	48 x 48	30 x 30
Low Shoulder	W8-9	6F.44	36 x 36	48 x 48	30 x 30
Shoulder Drop-Off	W8-9a	6F.44.1	36 x 36	48 x 48	30 x 30
Uneven Lanes	W8-11	6F.45	36 x 36	48 x 48	30 x 30
No Center Stripe	W8-12a	6F.47	36 x 36	48 x 48	30 x 30
Fallen Rocks	W8-14	6F.16	36 x 36	48 x 48	30 x 30
Grooved Pavement	W8-15	6F.16	36 x 36	48 x 48	30 x 30
Motorcycle (plaque)	W8-15P	6F.54	24 x 18	30 x 24	---
Road May Flood	W8-18	6F.16	36 x 36	48 x 48	24 x 24
No Shoulder	W8-23	6F.44.3	36 x 36	48 x 48	30 x 30
Steel Plate Ahead	W8-24	6F.46	36 x 36	48 x 48	30 x 30
Shoulder Ends	W8-25	6F.16	36 x 36	48 x 48	30 x 30
Lane Ends	W9-1,2	6F.16	36 x 36	48 x 48	30 x 30
Grade Crossing Advance Warning	W10-1	6F.16	36 Diameter	---	---
Truck	W11-10	6F.36	36 x 36	48 x 48	30 x 30
Double Arrow	W12-1	6F.16	30 x 30	---	---
Low Clearance	W12-2	6F.16	36 x 36	48 x 48	30 x 30
Advisory Speed (plaque)	W13-1P	6F.52	24 x 24	30 x 30	18 x 18
On Ramp (plaque)	W13-4P	6F.25	36 x 36	36 x 36	---
No Passing Zone (pennant)	W14-3	6F.16	48 x 48 x 36	64 x 64 x 48	40 x 40 x 30
Emergency Scene Ahead	W14-X15	6I.1	36 x 36	48 x 48	---
XX Feet (plaque)	W16-2P	6F.16	24 x 18	30 x 24	---
Road Work Ahead	W20-1	6F.18	36 x 36	48 x 48	30 x 30
Detour Ahead	W20-2	6F.19	36 x 36	48 x 48	30 x 30
Road (Street) Closed Ahead	W20-3	6F.20	36 x 36	48 x 48	30 x 30
Trail Closed Ahead	W20-3a	6F.20.1	18 x 18	---	---

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* See Table 2B-1 for minimum size required for signs facing traffic on multi-lane conventional roads

Notes: 1. Larger signs may be used wherever necessary for greater legibility or emphasis.
2. Dimensions are shown in inches and are shown as width x height.

Table 6F-1 Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 2 of 3)

HANDOUT

HANDOUT

Sign or Plaque	Sign Designation	Section	Conventional Road	Freeway or Expressway	Minimum
One Lane Road Ahead	W20-4	6F.21	36 x 36	48 x 48	30 x 30
Flagger (symbol)	W20-7	6F.31	36 x 36	48 x 48	30 x 30
Slow (on Stop/Slow Paddle)	W20-8	6E.3	18 x 18	---	---
Merge	W20-X3	6F.24.1	36 x 36	48 x 48	30 x 30
Bypass Ahead	W20-X6	6F.50	36 x 36	48 x 48	30 x 30
Narrow Lane (width shown)	W20-X11	6F.50	36 x 36	48 x 48	30 x 30
Right Two Lanes Closed	W20-X13	6F.22	36 x 36	48 x 48	30 x 30
Lanes Narrow	W20-X17	6F.50	36 x 36	48 x 48	30 x 30
Workers	W21-1	6F.33	36 x 36	48 x 48	30 x 30
Fresh Oil (Tar)	W21-2	6F.34	36 x 36	48 x 48	30 x 30
Road Machinery Ahead	W21-3	6F.35	36 x 36	48 x 48	30 x 30
Slow Moving Vehicle	W21-4	6G.6	36 x 18	---	---
Shoulder Work	W21-5	6F.37	36 x 36	48 x 48	30 x 30
Shoulder Closed	W21-5a	6F.37	36 x 36	48 x 48	30 x 30
Survey Crew	W21-6	6F.38	36 x 36	48 x 48	30 x 30
Survey Crew Ahead	W21-6a	6F.38	36 x 36	48 x 48	30 x 30
Utility Work Ahead	W21-7	6F.39	36 x 36	48 x 48	30 x 30
Mowing Ahead	W21-8	6G.6	36 x 36	48 x 48	30 x 30
Right (Left) Lane Closed	W21-X5	6F.22	36 x 36	48 x 48	30 x 30
Center Lane Closed	W21-X5c	6F.23	36 x 36	48 x 48	30 x 30
Crew Working Ahead	W21-X6	6F.38.1	36 x 36	48 x 48	30 x 30
High Shoulder	W21-X9	6F.44.2	36 x 36	48 x 48	30 x 30
Blasting Zone Ahead	W22-1	6F.41	36 x 36	48 x 48	30 x 30
Turn Off 2-Way Radio and Cell Phone	W22-2	6F.42	42 x 36	42 x 36	---
End Blasting Zone	W22-3	6F.43	42 x 36	42 x 36	36 x 30
Slow Traffic Ahead	W23-1	6F.27	48 x 24	48 x 24	---
New Traffic Pattern Ahead	W23-2	6F.30	36 x 36	48 x 48	30 x 30
Double Reverse Curve (1 lane)	W24-1	6F.49	36 x 36	48 x 48	30 x 30
Double Reverse Curve (2 lanes)	W24-1a	6F.49	36 x 36	48 x 48	30 x 30
Double Reverse Curve (3 lanes)	W24-1b	6F.49	36 x 36	48 x 48	30 x 30
All Lanes (plaque)	W24-1cP	6F.49	24 x 18	30 x 24	---
Road Work Next XX Miles	G20-1	6F.56	36 x 18	48 x 24	---
End Road Work	G20-2	6F.57	36 x 18	48 x 24	---
Pilot Car Follow Me	G20-4	6F.58	36 x 18	---	---
Work Zone (plaque)	G20-5aP	6F.12	24 x 18	36 x 24	---
Road Closed Beginning XXXX XX	G20-X1	6F.56.1	72 x 60	90 x 78	---
Exit Open	E5-2	6F.28	48 x 36	48 x 36	---
Exit Closed	E5-2a	6F.28	48 x 36	48 x 36	---
Exit Only	E5-3	6F.29	48 x 36	48 x 36	---
Detour	M4-8	6F.59	24 x 12	30 x 15	---
End Detour	M4-8a	6F.59	24 x 18	24 x 18	---
End	M4-8b	6F.59	24 x 12	24 x 12	---
Detour	M4-9	6F.59	30 x 24	48 x 36	---
Bike/Pedestrian	M4-9a	6F.59	30 x 24	---	---
Pedestrian Detour	M4-9b	6F.59	30 x 24	---	---
Bike Detour	M4-9c	6F.59	30 x 24	---	---
Detour	M4-10	6F.59	48 x 18	---	---

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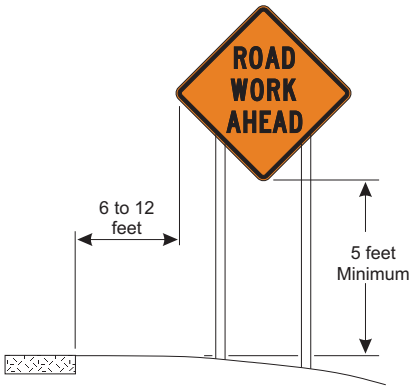
* See Table 2B-1 for minimum size required for signs facing traffic on multi-lane conventional roads

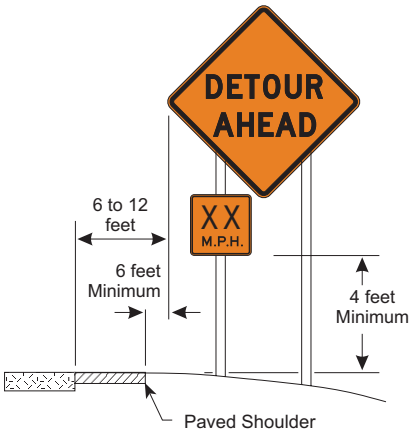
Notes: 1. Larger signs may be used wherever necessary for greater legibility or emphasis.
2. Dimensions are shown in inches and are shown as width x height.

Table 6F-1 Temporary Traffic Control Zone Sign and Plaque Sizes (Sheet 3 of 3)

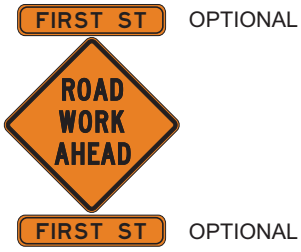
HANDOUT



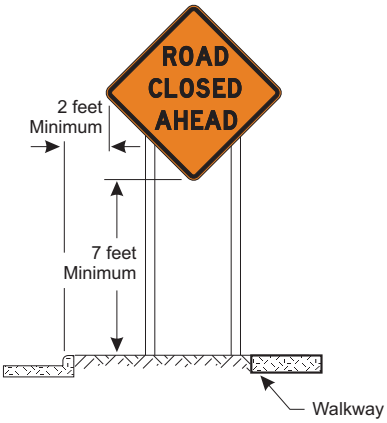
A. RURAL AREA



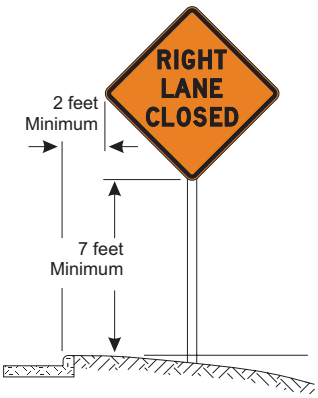
B. RURAL AREA WITH ADVISORY SPEED PLATE



Advance street name plaques or route markers nay be installed above or below warning signs



C. BUSINESS, COMMERCIAL, OR RESIDENTIAL AREA



D. BUSINESS, COMMERCIAL, OR RESIDENTIAL AREA (WITHOUT CURB)

HANDOUT

HANDOUT

HANDOUT

HANDOUT

Figure 6F-1 Height and Lateral Location of Signs - Typical Installations

HANDOUT

6F.13 PEDESTRIAN CROSSWALK Sign (R9-8)

R9-8

OPTION:

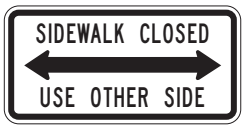
The PEDESTRIAN CROSSWALK (R9-8) sign may be used to indicate where a temporary crosswalk has been established.

STANDARD:

If a temporary crosswalk is established, it shall be accessible to pedestrians with disabilities in accordance with Section 6D.2.

6F.14 SIDEWALK CLOSED Signs (R9-9, R9-10, R9-11, R9-11a)

R9-9



R9-10

R9-11

R9-11a

GUIDANCE:

SIDEWALK CLOSED signs should be used where pedestrian flow is restricted or rerouted by work activities. Bicycle/Pedestrian Detour (M4-9a) signs or Pedestrian Detour (M4-9b) signs should be used where pedestrian flow is rerouted (see Section 6F.59).

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

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

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

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

SUPPORT:

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

6F.15 Special Regulatory Signs

OPTION:

Special regulatory signs may be used based on engineering judgment consistent with regulatory requirements.

GUIDANCE:

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

6F.16 Warning Sign Function, Design, and Application

SUPPORT:

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

STANDARD:

TTC warning signs shall comply with the Standards for warning signs presented in Part 2 and in the MnDOT Standard Signs Manual and the FHWA "Standard Highway Signs and Markings" book (see Section 1A.11). Except as provided in the following Option, TTC warning signs shall be diamond-shaped with a black symbol or message and border on an orange background, except for the W10-1 sign which shall have a black legend and border on a yellow background, and except for signs that are required or recommended in Parts 2 or 7 to have fluorescent yellow-green backgrounds.

HANDOUT

OPTION:

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

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

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

GUIDANCE:

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

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

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

SUPPORT:

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

OPTION:

Advance warning signs may be used singly or in combination.

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

6F.16.1 Roll-Up Warning Signs

OPTION:

Roll-up warning signs may be used to provide advance warning signing for TTC zones.

STANDARD:

Roll-up warning signs shall have a black legend on a reflectorized orange or reflectorized fluorescent orange background. They may be used for daytime or nighttime only when workers are present to monitor the signs.

The mounting height of roll-up signs shall conform to the standards as shown in Section 6F.3.

GUIDANCE:

A 1 foot minimum height will be allowed for roll-up warning signs, but the signs should be mounted higher in order to improve their visibility.

6F.17 Position of Advance Warning Signs

GUIDANCE:

Where highway conditions permit, warning signs should be placed in advance of the TTC zone at varying distances depending on roadway type, condition, and posted speed. Table 6C-1 contains information regarding the spacing of advance warning signs. Where a series of two or more advance warning signs is used, the closest sign to the TTC zone should be placed approximately 100 feet for low-speed urban streets to 1,000 feet or more for freeways and expressways.

Where multiple advance warning signs are needed on the approach to a TTC zone, the ROAD WORK AHEAD (W20-1) sign should be the first advance warning sign encountered by road users.

OPTION:

Other similar signs such as BRIDGE WORK AHEAD (W20-X9) or SURVEY CREW AHEAD (W21-6a) may be used as a substitute for the ROAD WORK AHEAD (W20-1) sign.

SUPPORT:

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

OPTION:

As an alternative to a specific distance on advance warning signs, the word AHEAD may be used.

SUPPORT:

At TTC zones on lightly-traveled roads, all of the advance warning signs prescribed for major construction might not be needed.

OPTION:

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

GUIDANCE:

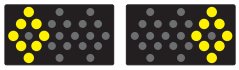
Utility, maintenance, and minor construction signing and TTC should be coordinated with the governing road authority so that road users are not confused or misled by the TTC devices.

HANDOUT

Figure 6F-4 Other Warning Signs That May be Found in Temporary Traffic Control Zones

HANDOUT

HANDOUT

Operating Mode	Panel Display *
1. At least one of the following two modes shall be provided:	(Right arrow is shown, left arrow is similar)
Flashing Arrow	**Move/Merge Right**
Sequential Arrow	**Move/Merge Right**
Sequential Chevron	**Move/Merge Right**
2. The following mode shall be provided:	
Flashing Double Arrow	**Move/Merge Right or Left**
3. At least one of the following three modes shall be provided:	
Flashing Four Corners	
Flashing Bar	
Alternating Flashing Diamonds	 **Caution**

* Element layout for Type C panel shown

Panel Type	Minimum Size inches	Minimum Legibility Distance miles	Minimum Number of Elements	Recommended Usage
A	48 x 24	0.5	12	Low speed streets
B	60 x 30	0.75	13	Conventional roadways
C	96 x 48	1.0	15	Freeways and Expressways

Arrow Stick

Arrow Sticks may supplement other TTC devices, but shall not be used in place of arrow boards

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Advance Warning Arrow Board Specifications

Figure 6F-6 Advance Warning Arrow Display Specifications

HANDOUT

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

Cones shall not be used on unattended work sites.

OPTION:

Traffic cones may be used to mark hazards or close roadways for short term emergency situations.

Traffic cones may be used in short term and intermediate term TTC zones to channelize road users, divide opposing motor vehicle traffic lanes, divide lanes when two or more lanes are kept open in the same direction, and delineate short term maintenance and utility work.

GUIDANCE:

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

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

OPTION:

Cones may be doubled up to increase their weight.

SUPPORT:

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

GUIDANCE:

Ballast should be kept to the minimum amount needed.

6F.65 Tubular Markers

SUPPORT:

Tubular markers are portable devices constructed with weighted bases, or weights such as sandbag rings that can be dropped over the tubes and onto the base to provide added stability.

STANDARD:

Tubular markers shall be tubular, shall be predominantly orange, and shall be made of a material that can be struck without causing damage to the impacting vehicle (see Figure 6F-7). For daytime and low-speed roadways, tubular markers shall not be less than 18 inches high and 2 inches in diameter. When tubular markers are used on freeways and other high-speed highways or at night on all highways, or when more conspicuous guidance is needed, tubular markers shall be a minimum of 36 inches high and 4 inches in diameter.

For nighttime use, tubular markers shall be retroreflectorized or equipped with lighting devices for maximum visibility. Retroreflectorization of 36 inch or larger tubular markers shall be provided by a white band 4 inches wide located 3 to 4 inches from the top of the marker and an additional 4 inch wide white band approximately 2 inches below the 4 inch band.

Tubular markers shall not be used to mark hazards or close roadways.

GUIDANCE:

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

Tubular markers should be stabilized by affixing them to the pavement, by using weighted bases, or weights such as sandbag rings that can be dropped over the tubular markers and onto the base to provide added stability. The weighted base should weigh at least 12 pounds.

OPTION:

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

6F.65.1 Surface Mounted Delineators

OPTION:

Surface mounted delineators are delineation devices that may be used as center lane dividers to separate opposing motor vehicle traffic on a two-lane, two-way operation.

Surface mounted delineators may also be used to provide other traffic delineation.

STANDARD:

Surface mounted delineators shall be predominantly orange, and shall be made of a material that can be struck without causing damage to the impacting vehicle (see Figure 6F-7). Surface mounted delineators shall be attached to the pavement surface to assure they remain inplace. If a non-cylindrical tubular marker is used, it shall be attached to the pavement in a manner to display a minimum 2.5 inch width to all approaching road users.

HANDOUT

Surface mounted delineators shall not be less than 36 inches high and 2.5 inches wide facing road users. The delineator shall be retroreflectorized for nighttime visibility with a white band 4 inches wide located 3 to 4 inches from the top of the delineator and an additional 4 inch wide white band approximately 2 inches below the 4 inch band.

6F.65.2 Weighted Channelizers

STANDARD:

Weighted Channelizers used for road user warning or channelization shall be predominantly orange in color and shall be constructed of lightweight, deformable materials (see Figure 6F-7). They shall be a minimum of 42 inches in height having a conical cross section a minimum of 4 inches wide at the top, regardless of orientation, and a minimum cross sectional area of 200 square inches. The weighted base shall be a minimum of 16 pounds.

The markings on weighted channelizers shall be horizontal, circumferential, alternating orange and white retroreflective stripes 4 to 6 inches wide with the top stripe being orange. Any non-retroreflective spaces between the horizontal orange and white stripes shall not exceed 2 inches in width.

OPTION:

Weighted channelizers may have a handle or lifting device, which extends above the 42 inch minimum device height.

GUIDANCE:

Weighted channelizers have less visible area than other devices and should therefore be used only where space is limited or the presence of larger devices will restrict sight.

The spacing of weighted channelizers should not exceed a distance in feet equal to the posted speed limit in mph when used for taper channelization. The spacing of weighted channelizers should not exceed a distance in feet equal to 2.0 times the posted speed limit in mph when used for tangent channelization.

OPTION:

Weighted channelizers may be used effectively to divide opposing lanes of traffic and delineate the edge of pavement drop-offs. Although weighted channelizers are most commonly used to channelize or delineate road user flow, they may also be used alone or in groups to mark specific locations.

6F.66 Vertical Panels

STANDARD:

Vertical panels (see Figure 6F-7) shall have retroreflective striped material that is 8 to 12 inches in width and at least 24 inches in height. They shall have alternating diagonal orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction vehicular traffic is to pass.

Vertical panels used on expressways, freeways, and other high-speed roadways shall have a minimum of 270 square inches retroreflective area facing motor vehicle traffic.

Where the height of the retroreflective material on the vertical panel is 36 inches or more, a stripe width of 6 inches shall be used.

OPTION:

Where the height of the retroreflective material on the vertical panel is less than 36 inches, a stripe width of 4 inches may be used.

Where space is limited, vertical panels may be used to channelize vehicular traffic, divide opposing lanes, or replace barricades.

6F.67 Drums

STANDARD:

Drums used for road user warning or channelization shall be constructed of lightweight, deformable materials (see Figure 6F-7). . They shall be a minimum of 36 inches in height and have at least an 18-inch minimum width regardless of orientation. Metal drums shall not be used. The markings on drums shall be horizontal, circumferential, alternating orange and white retroreflective stripes 4 to 6 inches wide. Each drum shall have a minimum of two orange and two white stripes with the top stripe being orange. Any non-retroreflectorized spaces between the horizontal orange and white stripes shall not exceed 2 inches wide. Drums shall have closed tops that will not allow collection of construction debris or other debris.

SUPPORT:

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

HANDOUT

OPTION:

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

GUIDANCE:

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

STANDARD:

Ballast shall not be placed on the top of a drum.

6F.68 Type I, II, or III Barricades

SUPPORT:

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

Barricades are classified as Type I, Type II, or Type III. (see Figure 6F-7)

STANDARD:

Stripes on barricade rails shall be alternating orange and white retroreflective stripes sloping downward at an angle of 45 degrees in the direction road users are to pass. Except as noted in the following Option, the stripes shall be 6 inches wide.

OPTION:

When rail lengths are less than 36 inches, 4-inch wide stripes may be used.

STANDARD:

The minimum length for Type I and Type II Barricades shall be 24 inches and the minimum length for Type III Barricades shall be 48 inches. Each barricade rail shall be 8 to 12 inches wide. Barricades used on expressways, freeways and other high-speed roadways shall have a minimum of 270 square inches of retroreflective area facing road users.

GUIDANCE:

Where barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which road users must turn.

Where both right and left turns are provided, the barricade stripes should slope downward in both directions from the center of the barricade or barricades.

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

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

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

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

OPTION:

For Type I Barricades, the support may include other unstriped horizontal panels necessary to provide stability.

GUIDANCE:

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

OPTION:

Sandbags may be placed on the lower parts of the frame or the stays of barricades to provide the required ballast.

STANDARD:

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

SUPPORT:

Type I or Type II Barricades are intended for use in situations where road user flow is maintained through the TTC zone.

OPTION:

Barricades may be used alone or in groups to mark a specific condition or they may be used in a series for channelizing road users.

Type I barricades may be used on conventional roads or urban streets.

HANDOUT

GUIDANCE:

Type II or Type III Barricades should be used on freeways and expressways or other high-speed roadways. Type III Barricades should be used to close or partially close a road.

OPTION:

Type III Barricades used at a road closure may be placed completely across a roadway or from curb to curb.

GUIDANCE:

Where provision is made for access of authorized equipment and vehicles, the responsibility for Type III Barricades should be assigned to a person to ensure proper closure at the end of each workday.

SUPPORT:

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

STANDARD:

When a highway is legally closed but access must still be allowed for local traffic, a sign shall be installed with the appropriate legend concerning permissible use by local road users (see Section 6F.9). Adequate visibility of the barricades from both directions shall be provided by;

1. installing retroreflective sheeting on both sides of the barricade boards; or
2. by installing barricade boards back-to-back on the barricade.

OPTION:

Signs may be installed on barricades (see Section 6F.3).

6F.69 Direction Indicator Barricades

STANDARD:

The Direction Indicator Barricade shall consist of a retroreflective One-Direction Large Arrow (W1-6) sign mounted above a diagonal striped, horizontally aligned, retroreflective rail (see Figure 6F-7).

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

OPTION:

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

GUIDANCE:

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

6F.70 Temporary Traffic Barriers as Channelizing Devices

SUPPORT:

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

STANDARD:

Temporary traffic barriers serving as TTC devices shall conform to requirements for such devices as set forth throughout Part 6.

Temporary traffic barriers (see Section 6F.85) shall not be used solely to channelize road users, but also to protect the work space. If used to channelize vehicular traffic, the temporary traffic barrier shall be supplemented with delineation, pavement markings, or channelizing devices for improved daytime and nighttime visibility.

GUIDANCE:

Temporary traffic barriers should not be used for a merging taper except in low-speed urban areas. Temporary traffic barriers should not be used for a constricted/restricted TTC zone.

When it is necessary to use a temporary traffic barrier for a merging taper in low-speed urban areas or for a constricted/restricted TTC zone, the taper shall be delineated and the taper length should be designed to optimize road user operations considering the available geometric conditions.

STANDARD:

When it is necessary to use a temporary traffic barrier for a merging taper in low-speed urban areas or for a constricted/ restricted TTC zone, the taper shall be delineated.

GUIDANCE:

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

HANDOUT

6F.71 Longitudinal Channelizing Barricades

SUPPORT:

Longitudinal channelizing devices are lightweight, deformable devices that are highly visible, have good target value, and can be connected together.

STANDARD:

If used singly as Type 1, 2, or 3 barricades, longitudinal channelizing devices shall comply with the general size, color, stripe pattern, retroreflectivity, and placement characteristics established for the devices described in this Chapter.

GUIDANCE:

If used to channelize vehicular traffic at night, longitudinal channelizing devices should be supplemented with retroreflective material or delineation for improved nighttime visibility.

OPTION:

Longitudinal channelizing barricades may be used instead of a line of cones, drums, or barricades.

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

Longitudinal channelizing devices may be used for pedestrian traffic control.

STANDARD:

If used for pedestrian traffic control, longitudinal channelizing devices shall be interlocked to delineate or channelize flow. The interlocking devices shall not have gaps that allow pedestrians to stray from the channelizing path.

GUIDANCE:

Longitudinal channelizing devices have not met the crashworthy requirements for temporary traffic barriers and should not be used to shield obstacles or provide positive protection for pedestrians or workers.

6F.72 Temporary Lane Separators

OPTION:

Temporary lane separators may be used to channelize road users, to divide opposing vehicular traffic lanes, to divide lanes when two or more lanes are open in the same direction, and to provide continuous pedestrian channelization.

STANDARD:

Temporary lane separators shall be crashworthy. Temporary lane separators shall have a maximum height of 4 inches and a maximum width of 1 foot, and shall have sloping sides in order to facilitate crossover by emergency vehicles.

OPTION:

Temporary lane separators may be supplemented with any of the approved channelizing devices contained in this Chapter, such as tubular markers, vertical panels, and opposing traffic lane dividers.

STANDARD:

If appropriate channelizing devices are used to supplement a temporary lane separator, the channelizing devices shall be retroreflectorized to provide nighttime visibility. If channelizing devices are not used, the temporary lane separator shall contain retroreflectorization to enhance its visibility.

GUIDANCE:

A temporary lane separator should be stabilized by affixing it to the pavement in a manner suitable to its design, while allowing the unit to be shifted from place to place within the TTC zone in order to accommodate changing conditions.

STANDARD:

At pedestrian crossing locations, temporary lane separators shall have an opening or be shortened to provide a pathway that is at least 60 inches wide for crossing pedestrians.

6F.73 Other Channelizing Devices

OPTION:

Channelizing devices other than those described in this Chapter may be used in special situations based on an engineering study.

GUIDANCE:

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

6F.74 Detectable Edging for Pedestrians

SUPPORT:

Individual channelizing devices, tape or rope used to connect individual devices, other discontinuous barriers and devices, and pavement markings are not detectable by persons with visual disabilities and are incapable of providing detectable path guidance on temporary or realigned sidewalks or other pedestrian facilities.

GUIDANCE:

When it is determined that a facility should be accessible to and detectable by pedestrians with visual disabilities, a continuously detectable edging should be provided throughout the length of the facility such that it can be followed by pedestrians using long canes for guidance. This edging should protrude at least 6 inches above the surface of

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the sidewalk or pathway, with the bottom of the edging a maximum of 2 inches above the surface. This edging should be continuous throughout the length of the facility except for gaps at locations where pedestrians or vehicles will be turning or crossing. This edging should consist of a prefabricated or formed-in-place curbing or other continuous device that is placed along the edge of the sidewalk or walkway. This edging should be firmly attached to the ground or to other devices. Adjacent sections of this edging should be interconnected such that the edging is not displaced by pedestrian or vehicular traffic or work operations, and such that it does not constitute a hazard to pedestrians, workers, or other road users.

SUPPORT:

Examples of detectable edging for pedestrians include:

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

GUIDANCE:

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

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6F.74.1 Temporary Walkway Surface

SUPPORT:

There are areas of a work zone where an accessible pedestrian pathway will cross short segments of rough, soft or uneven ground or hazards. In addition, work vehicles might need to cross an accessible pedestrian pathway.

GUIDANCE:

As stated in 6D.1, a smooth, continuous hard surface should be provided throughout the entire length of a temporary pedestrian pathway.

A temporary walkway surface should be used to facilitate pedestrian movement through:

A. Short segments of rough, soft or uneven ground surfaces; and
B. segments where vehicles may cross the temporary pedestrian pathway and a detectable edge is not feasible, such as work vehicle access points.

OPTION:

If clear direction is not given for a temporary crosswalk by the grade break of the curb ramp (temporary or permanent), a temporary walkway surface may be provided to guide pedestrians along the temporary crosswalk to the receiving curb ramp or intended destination.

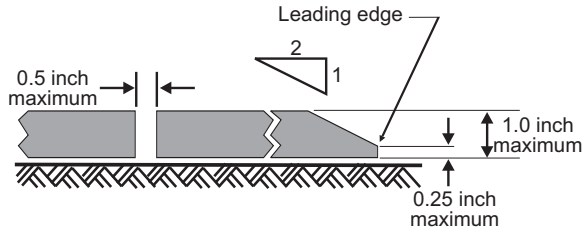
STANDARD:

The temporary walkway surface shall be firm, stable and slip resistant. The width of the temporary walkway surface shall be a minimum of 4 feet. Lateral joints between segments of the walkway surface shall be less than 0.5 inches.

If detectable edges (6F.74) are not used on a temporary walkway surface, the edges shall be marked with a contrasting 2- to 4-inch wide marking.

GUIDANCE:

Changes between the segments of the walkway surface should not exceed 0.5 inches. The side edges of the walkway surface should be between 0.25 inches and 1.0 inches thick. The leading and departing edges of the temporary walkway surface should follow the dimensions shown in Figure 6F-10 Temporary Walkway Surface Dimension.



Leading and departing edges are the same

Figure 6F-10 Temporary Walkway Surface Dimensions

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6F.75 Temporary Raised Islands

STANDARD:

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

OPTION:

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

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

GUIDANCE:

Temporary raised islands should have the basic dimensions of 4 inches high by 12 inches wide and have rounded or chamfered corners.

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

STANDARD:

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

6F.76 Opposing Traffic Lane Divider and sign (W6-4)

W6-4

SUPPORT:

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

STANDARD:

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

The Opposing Traffic Lane Divider (W6-4) sign (see Figure 6F-4) shall be an upright, retroreflective orange-colored sign placed on a flexible support and sized at least 12 inches wide by 18 inches high.

6F.77 Pavement Markings

SUPPORT:

Pavement markings are installed or existing markings are maintained or enhanced in TTC zones to provide road users with a clearly defined path for travel through the TTC zone in day, night, and twilight periods under both wet and dry pavement conditions.

GUIDANCE:

The work should be planned and staged to provide for the placement and removal of the pavement markings in a way that minimizes the disruption to traffic flow approaching and through the TTC zone during the placement and removal process.

STANDARD:

Existing pavement markings shall be maintained in all long-term stationary (see Section 6G.2) TTC zones in accordance with Chapters 3A and 3B, except as otherwise provided for temporary pavement markings in Section 6F.78. Pavement markings shall match the alignment of the markings in place at both ends of the TTC zone. Pavement markings shall be placed along the entire length of any paved detour or temporary roadway prior to the detour or roadway being opened to road users.

For long-term stationary operations, pavement markings in the temporary traveled way that are no longer applicable shall be removed or obliterated as soon as practical. Pavement marking obliteration shall remove the non-applicable pavement marking material, and the obliteration method shall minimize pavement scarring. Painting over existing pavement markings with black paint or spraying with asphalt shall not be accepted as a substitute for removal or obliteration.

OPTION:

Removable, non-reflective, preformed tape that is approximately the same color as the pavement surface may be used where markings need to be covered temporarily.

HANDOUT

6F.78 Interim Pavement Markings

SUPPORT:

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

GUIDANCE:

Interim pavement markings should not be in place for more than 14 calendar days unless justified by an engineering study.

White lane lines and yellow centerlines, including no passing zones should be installed before opening the roadway to traffic. If it is not possible or practical to install these markings before opening the roadway to traffic the interim markings should be installed at the end of each working day or provided by signing in accordance with the provisions of this section.

GUIDANCE:

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

STANDARD:

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

Except as otherwise provided in this Section, all interim pavement markings for no-passing zones shall comply with the requirements of Chapters 3A and 3B. All interim broken-line pavement markings shall use the same cycle length as permanent markings and shall have line segments that are at least 2 feet long.

GUIDANCE:

All pavement markings and devices used to delineate road user paths should be reviewed during daytime and nighttime periods.

OPTION:

Half-cycle lengths with a minimum of 2-foot stripes may be used on roadways with severe curvature (see Section 3A.6) for broken line center lines in passing zones and for lane lines.

For temporary situations of 14 calendar days or less, for a two- or three-lane road, no-passing zones may be identified by using DO NOT PASS (R4-1), PASS WITH CARE (R4-2), and NO PASSING ZONE (W14-3) signs (see Sections 2B.28, 2B.29, and 2C.45) rather than pavement markings. Also, DO NOT PASS, PASS WITH CARE, and NO PASSING ZONE signs may be used instead of pavement markings on roads with low volumes for longer periods in accordance with the State's or highway agency's policy.

GUIDANCE:

If used, the DO NOT PASS, PASS WITH CARE, and NO PASSING ZONE signs should be placed in accordance with Sections 2B.28, 2B.29, and 2C.45. MN Rev. 1

If used, the NO CENTER STRIPE sign should be placed in accordance with Section 6F.47.

OPTION:

On low volume roads with an ADT (Average Daily Traffic) of less than 400 vehicles, the signs may be used in lieu of pavement markings for up to 14 calendar days (see Section 5A.1).

STANDARD:

If no passing zone signing is used in lieu of pavement markings the following shall be installed before opening the roadway to traffic:

- If no interim markings are used A NO CENTER STRIPE sign (W8-12a) shall be used for each direction of travel in accordance with Section 6F.47. This sign shall be repeated at major intersections or on one-mile intervals, whichever is greater.
- If interim no passing zone markings are not installed but interim broken markings are installed a NO CENTER STRIPE sign (W8-12a) shall be installed in advance of each no passing zone.
- If not already in place, a DO NOT PASS sign (R4-1) shall be installed on the right side of the road at the beginning of the zone opposite of the NO PASSING ZONE sign (W14-3).
- A PASS WITH CARE sign (R4-2) shall be installed on the right side of the road at the end of the no passing zone.

6F.79 Temporary Raised Pavement Markers

OPTION:

Retroreflective or internally illuminated raised pavement markers, or non-retroreflective raised pavement markers supplemented by retroreflective or internally illuminated markers, may be substituted for markings of other types in TTC zones.

HANDOUT

STANDARD:

If used, the color and pattern of the raised pavement markers shall simulate the color and pattern of the markings for which they substitute.

If temporary raised pavement markers are used to substitute for broken line segments, a group of at least three retroreflective markers shall be equally spaced at no greater than N/10 (see Section 3B.14). The value of N for a broken or dotted line shall equal the length of one line segment plus one gap.

If temporary raised pavement markers are used to substitute for solid lines, the markers shall be equally spaced at no greater than N/5, with retroreflective or internally illuminated units at a spacing no greater than N/2. The value of N referenced for solid lines shall equal the N for the broken or dotted lines that might be adjacent to or might extend the solid lines (see Section 3B.11).

OPTION:

Temporary raised pavement markers may be used to substitute for broken line segments by using at least two retroreflective markers placed at each end of a segment of 2 to 5 feet in length, using the same cycle length as permanent markings.

GUIDANCE:

Temporary raised pavement markers used on 2- to 5-foot segments to substitute for broken line segments should not be in place for more than 14 days unless justified by engineering judgment.

Raised pavement markers should be considered for use along surfaced diversions (bypasses) or temporary roadways, and other changed or new travel-lane alignments, because of the need to accentuate changed travel paths and their wet weather capabilities.

OPTION:

Retroreflective or internally illuminated raised pavement markers, or non-retroreflective raised pavement markers supplemented by retroreflective or internally illuminated markers, may also be used in TTC zones to supplement markings as prescribed in Chapters 3A and 3B.

6F.80 Post-Mounted Delineators

STANDARD:

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

GUIDANCE:

Spacing along roadway curves should be as set forth in Section 3F.4 and should be such that several delineators are always visible to the driver.

OPTION:

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

6F.81 Lighting Devices

GUIDANCE:

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

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

OPTION:

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

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

STANDARD:

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

6F.82 Floodlights

SUPPORT:

Utility, maintenance, or construction activities on highways are frequently conducted during nighttime periods when motor vehicle traffic volumes are lower. Large construction projects are sometimes operated on a double-shift basis requiring night work.

GUIDANCE:

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

HANDOUT

STANDARD:

Except in emergency situations, flagger stations shall be illuminated at night.

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

GUIDANCE:

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

SUPPORT:

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

6F.83 Warning Lights

SUPPORT:

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

STANDARD:

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

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

GUIDANCE:

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

SUPPORT:

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

OPTION:

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

STANDARD:

Except for the sequential flashing warning lights that are described in Paragraphs 8 and 9, flashing warning lights shall not be used for delineation, as a series of flashers fails to identify the desired vehicle path.

OPTION:

A series of sequential flashing warning lights may be placed on channelizing devices that form a merging taper in order to increase driver detection and recognition of the merging taper.

STANDARD:

If a series of sequential flashing warning lights is used, the successive flashing of the lights shall occur from the upstream end of the merging taper to the downstream end of the merging taper in order to identify the desired vehicle path. Each flashing warning light in the sequence shall be flashed at a rate of not less than 55 or more than 75 times per minute.

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

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

SUPPORT:

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

OPTION:

Type A warning lights may be mounted on channelizing devices.

SUPPORT:

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

OPTION:

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

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

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GUIDANCE:

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

6F.83.1 Steady-Burn Electric Lamps

SUPPORT:

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

OPTION:

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

6F.83.2 Roadway Lighting

SUPPORT:

On long term projects, the use of roadway lighting may be beneficial. Areas that may benefit from the installation of roadway lighting include high hazard areas, high volume areas, crossovers, diversions (bypasses), areas with sudden alignment changes, curves, intersections and transitions from multi-lane divided roadways to two-lane, two-way roadways.

STANDARD:

When possible, all roadway lighting shall be protected or have breakaway bases.

6F.84 Temporary Traffic Control Signals

STANDARD:

Temporary traffic control signals (see Section 4D.32) used to control road user movements through TTC zones and in other TTC situations shall meet the applicable provisions of Part 4.

SUPPORT:

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

STANDARD:

A temporary traffic control signal that is used to control traffic through a one-lane, two-way section of roadway shall comply with the provisions of Section 4H.2.

GUIDANCE:

Where pedestrian traffic is detoured to a temporary traffic control signal, engineering judgment should be used to determine if pedestrian signals or accessible pedestrian signals (see Section 4E.9) are needed for crossing along an alternate route.

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

OPTION:

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

GUIDANCE:

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

HANDOUT

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SUPPORT:

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

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

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

GUIDANCE:

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

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

If a temporary traffic control signal is located within 1/2 mile of an adjacent traffic control signal, consideration should be given to interconnected operation.

STANDARD:

Temporary traffic control signals shall not be located within 200 feet of a grade crossing unless the temporary traffic control signal is provided with preemption in accordance with Section 4D.27, or unless a uniformed officer or flagger is provided at the crossing to prevent vehicles from stopping within the crossing.

6F.85 Temporary Traffic Barriers

SUPPORT:

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

There are five primary functions of temporary traffic barriers:

A To keep motor vehicle traffic from entering work areas, such as excavations or material storage sites;
B. To separate workers, bicyclists, and pedestrians from motor vehicle traffic;
C. To separate opposing directions of motor vehicle traffic; and
D. To separate motor vehicle traffic, bicyclists, and pedestrians from the work area such as false work for bridges and other exposed objects; and
E. To protect drop-offs of greater than 12 inches on longer term projects when a suitable buffer lane cannot be provided.

OPTION:

Temporary traffic barriers may be used to separate two-way motor vehicle traffic.

GUIDANCE:

Because of the risks to the driver and the risks involved in placement and removal of temporary traffic barriers, the following alternatives to using them should be strongly considered:

A. Buffer lane closures;
B. Nightly backfill of excavations;
C. Temporary tapers;
D. Temporary detours or crossovers;
E. For lower speed projects, additional or closer spacing of channelizing devices in conjunction with extra delineation (TRPM's, pavement markings) and extra warning signs (in advance and within work area).

Because the protective requirements of a TTC situation have priority in determining the need for temporary traffic barriers, their use should be based on an engineering study. The following factors should be considered before using temporary traffic barriers:

A. Speed/volume of traffic;
B. Vertical/horizontal roadway alignment;
C. Severity of hazard/excavation/obstacle;
D. Lateral clearance to hazard;
E. Duration of exposure;
F. Duration of the TTC zone;
G. Hazard presented by barrier itself once inplace;
H. Hazard presented to workers and traffic during barrier placement.

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Tables 6F-5a and 6F-5b should be used to determine when temporary traffic barrier in edge drop-off situations.

Lateral Offset * feet	Depth of Drop-off inches
0 - 4	12 - 24
4 - 8	24 - 36
8 - 20	>36

* Lateral offset is measured from the edge of the traffic carrying lane to the edge of the vertical drop-off.

Table 6F-5a Drop-offs to Commonly Justify PCB Non-Construction Speed Limits of 45-55 mph

Lateral Offset * feet	Depth of Drop-off inches
0 - 4	12 - 24
4 - 12	24 - 36
12 - 20	>36

* Lateral offset is measured from the edge of the traffic carrying lane to the edge of the vertical drop-off.

Table 6F-5b Drop-offs to Commonly Justify PCB Non-Construction Speed Limits of 60-70 mph

STANDARD:

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

All temporary traffic barriers shall be crashworthy.

Each type of temporary traffic barrier (steel , water-filled or concrete, etc.) requires a specific basic minimum length to achieve its crashworthy compliance. Refer to the barrier's crash testing results to determine the minimum length for predicted crash deflections. Shorter intermittent segments of temporary traffic barrier shall not be used because they nullify the containment and re-directive capabilities of the temporary traffic barrier, increase the potential for serious injury both to vehicle occupants and pedestrians, and encourage the presence of blunt, leading ends. All upstream leading ends that are present shall be appropriately flared or protected with properly installed and maintained crashworthy cushions. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly.

In order to mitigate the effect of striking the end of a temporary traffic barrier, the end shall be installed in accordance with AASHTO's "Roadside Design Guide" (see Section 1A.11) by flaring until the end is outside the acceptable clear zone or by providing crashworthy end treatments (see Section 6F.76). See Figure 6F-9 for temporary traffic barrier placement and end treatments.

OPTION:

End attenuation may be necessary at both ends of barrier used on a two-lane two-way roadway.

GUIDANCE:

Since the barrier itself is a hazard, the use of it should be toward the overall safety benefit.

Excessive/acute tapers and pronounced turns/corners should be avoided. Tapers should be made as smooth as possible.

Sufficient area should be maintained behind the barrier to allow for deflection. Barriers should not typically be butted up to, or mounted on top of curbs or medians. Placing barriers across a curb section should be avoided.

Temporary traffic barriers should be anchored in any location that does not allow adequate area for deflection.

SUPPORT:

Temporary traffic barriers are designed to deflect when struck by a vehicle. Tapers, transition areas and barrier used outside of horizontal curves will see more deflection because of possibility higher angle hits. Tangent areas will generally see less deflection.

STANDARD:

Different designs of barrier shall not be intermixed on the same run of temporary traffic barrier. Barrier runs of different designs on the same project are acceptable, but the barrier runs shall not be connected.

GUIDANCE:

Separate shorter runs with different barrier design types should be discouraged if a longer run of one type is possible.

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STANDARD:

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

OPTION:

Warning lights or steady-burn electric lamps may be mounted on temporary traffic barrier installations. When in transition/taper areas or close to traffic lanes, retroreflective barrier markers or tape may be placed on barriers.

Depending on roadway geometrics, temporary speed reduction may be used in barrier areas.

GUIDANCE:

When serving the additional function of channelizing motor vehicle traffic, temporary traffic barriers should be a light color for increased visibility.

SUPPORT:

Temporary traffic barrier is subjected to considerable abuse. The placement process itself can causes damage to the base and ends. Connection loops can be bent and deformed when being placed. Temporary traffic barrier can also degrade over the long term. Barrier is often in place for long periods and is subject to winter road salt spray and snow plows. Over a period, delamination can result, often to the point of section loss. Also, the repeated process of transport and handling causes a good deal of longitudinal flexure, which can cause cracking.

GUIDANCE:

Barrier sections and connections should be routinely inspected for damage.

SUPPORT:

Movable barriers are capable of being repositioned laterally using a transfer vehicle that travels along the barrier. Movable barriers enable short-term closures to be installed and removed on long-term projects. Providing a barrier-protected work space for short-term closures and providing unbalanced flow to accommodate changes in the direction of peak-period traffic flows are two of the advantages of using movable barriers.

Figure 6H-45 shows a temporary reversible lane using movable barriers. The notable feature of the movable barrier is that in both Phase A and Phase B, the lanes used by opposing traffic are separated by a barrier.

Figure 6H-34 shows an exterior lane closure using a temporary traffic barrier. Notes 7 through 9 address the option of using a movable barrier. By using a movable barrier, the barrier can be positioned to close the lane during the off-peak periods and can be relocated to open the lane during peak periods to accommodate peak traffic flows. With one pass of the transfer vehicle, the barrier can be moved out of the lane and onto the shoulder. Furthermore, if so desired, with a second pass of the transfer vehicle, the barrier could be moved to the roadside beyond the shoulder.

More specific information on the use of temporary traffic barriers is contained in Chapters 8 and 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11).

6F.86 Crash Cushions

SUPPORT:

Crash cushions are systems that mitigate the effects of errant vehicles that strike obstacles, either by smoothly decelerating the vehicle to a stop when hit head-on, or by redirecting the errant vehicle. The two types of crash cushions that are used in TTC zones are stationary crash cushions and truck-mounted attenuators. Crash cushions in TTC zones help protect the drivers from the exposed ends of barriers, fixed objects, shadow vehicles, and other obstacles. Specific information on the use of crash cushions can be found in AASHTO's "Roadside Design Guide" (see Section 1A.11).

STANDARD:

Crash cushions shall be crashworthy. They shall also be designed for each application to stop or redirect errant vehicles under prescribed conditions. Crash cushions shall be periodically inspected to verify that they have not been hit or damaged. Damaged crash cushions shall be promptly repaired or replaced to maintain their crashworthiness.

SUPPORT:

Stationary crash cushions are used in the same manner as permanent highway installations to protect drivers from the exposed ends of barriers, fixed objects, and other obstacles. More detailed information on the use of portable barriers and crash cushions can be obtained from Figure 6F-9.

STANDARD:

Stationary crash cushions shall be designed for the specific application intended.

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Truck-mounted attenuators shall be energy-absorbing devices attached to the rear of shadow trailers or trucks. If used, the shadow vehicle with the attenuator shall be located in advance of the work area, workers, or equipment to reduce the severity of rear-end crashes from errant vehicles.

SUPPORT:

Trucks or trailers are often used as shadow vehicles to protect workers or work equipment from errant vehicles. These shadow vehicles are normally equipped with flashing arrows, changeable message signs, and/ or high-intensity

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rotating, flashing, oscillating, or strobe lights located properly in advance of the workers and/or equipment that they are protecting. However, these shadow vehicles might themselves cause injuries to occupants of the errant vehicles if they are not equipped with truck-mounted attenuators.

GUIDANCE:

The shadow truck should be positioned in advance of the workers or equipment being protected so that there will be sufficient distance, but not so much so that errant vehicles will travel around the shadow truck and strike the protected workers and/or equipment.(see Chapter Part 6K-Temporary Traffic Control Zone Layouts for the recommended distance charts)

SUPPORT:

Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11) contains additional information regarding the use of shadow vehicles.

GUIDANCE:

If used, the truck-mounted attenuator should be used in accordance with the manufacturer's specifications.

6F.87 Rumble Strips

SUPPORT:

Transverse rumble strips consist of intermittent, narrow, transverse areas of rough-textured or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to unusual vehicular traffic conditions. Through noise and vibration they attract the driver's attention to such features as unexpected changes in alignment and to conditions requiring a stop.

Longitudinal rumble strips consist of a series of rough-textured or slightly raised or depressed road surfaces located along the shoulder to alert road users that they are leaving the travel lanes.

STANDARD:

If it is desirable to use a color other than the color of the pavement for a longitudinal rumble strip, the color of the rumble strip shall be the same color as the longitudinal line the rumble strip supplements.

If the color of a transverse rumble strip used within a travel lane is not the color of the pavement, the color of the rumble strip shall be white, black, or orange.

OPTION:

Intervals between rumble strips may be reduced as the distance to the approached conditions is diminished in order to convey an impression that a closure speed is too fast and/or that an action is imminent. A sign warning drivers of the onset of rumble strips may be placed in advance of any rumble strip installation.

GUIDANCE:

Transverse rumble strips should be placed transverse to motor vehicle traffic movement. They should not adversely affect overall pavement skid resistance under wet or dry conditions.

In urban areas, even though a closer spacing might be warranted, transverse rumble strips should be designed in a manner that does not promote unnecessary braking or erratic steering maneuvers by road users.

Transverse rumble strips should not be placed on sharp horizontal or vertical curves.

Rumble strips should not be placed through pedestrian crossings or within marked bicycle lanes.

Transverse rumble strips should not be placed on roadways used by bicyclists unless a minimum clear path of 4 feet is provided at each edge of the roadway or on each paved shoulder as described in AASHTO's "Guide to the Development of Bicycle Facilities" (see Section 1A.11).

Longitudinal rumble strips should not be placed on the shoulder of a roadway that is used by bicyclists unless a minimum clear path of 4 feet is also provided on the shoulder.

6F.88 Screens

SUPPORT:

Screens are used to block the road users' view of activities that can be distracting. Screens might improve safety and motor vehicle traffic flow where volumes approach the roadway capacity because they discourage gawking and reduce headlight glare from oncoming motor vehicle traffic.

GUIDANCE:

Screens should not be mounted where they could adversely restrict motorist visibility and sight distance and adversely affect the safe operation of vehicles.

OPTION:

Screens may be mounted on the top of temporary traffic barriers that separate two-way motor vehicle traffic.

GUIDANCE:

Design of screens should be in accordance with Chapter 9 of AASHTO's "Roadside Design Guide" (see Section 1A.11).

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4. WORK ZONE APPLICATIONS

4.1 Common Work Zone Projects

A wide variety of projects require temporary traffic control for the work zone. The following project types are a sample of some that may require TTC. This list is not an all-inclusive list.

- ✓ Mill and Overlay
- ✓ Concrete repair
- ✓ Left turn lane construction
- ✓ Bridge deck repair
- ✓ ADA jobs
- ✓ Full reconstruction (cross-over and detour)
- ✓ Culvert jobs
- ✓ Bridge painting
- ✓ Centerline Rumbles

4.1.1 Work Zone Management Strategies Matrix

The Federal Highway Administration has developed the manual, *Developing and Implementing Transportation Management Plans for Work Zones*. The information contained in appendix B is intended to support transportation agencies in the selection of work zone management strategies described in Section 2.2.1, Step 4 and Section 3.7 of the referenced manual. For the various work zone impact management strategies, Table B.1 presents some guidance for which strategies are anticipated to lead to an improvement in mobility or safety (motorist and worker), what project characteristics may trigger a strategy for consideration, pros and cons associated with the strategy, and other considerations.

The full document is available from the MnDOT's Transportation Management Plan (TMP) Course website, http://www.dot.state.mn.us/trafficeng/training/tmp.html.

4.2 Control Strategies

Temporary traffic control strategies, devices, and contracting/construction techniques and coordination are used to facilitate traffic flow and safety through and around work zones. Standards, guidance, and other information defining the proper use of the traffic control strategies and devices are provided in the field manual. Some of the typical TTC strategies are defined in the following sections.

4.2.1 Construction Phasing/Staging

Staging typically refers to how the contractor will position the equipment and materials. Phasing refers to the sequencing of the aspects of a project, completing portions of the project one part at a time. The impacts of a work zone on traffic may be minimized by using operationally-sensitive phasing and staging throughout the life of the project.

4.2.2 Full Roadway Closures

This strategy involves complete closure of the roadway for various time periods to minimize the duration of the project and improve worker safety by reducing traffic conflicts. Full closures may be brief (e.g.,

intermittent, off-peak), short-term (e.g., night, weekend), or long-term (e.g., continuous for the duration of the project).

Lane shifts or closures. Lane shifts or closures last for varying durations of time. They may be intermittent, off-peak, night, weekend, for a single project phase, or continuous for the duration of the project. This strategy involves multiple approaches including:

4.2.3 Reduced Lane Widths to Maintain Number of Lanes (Constriction)

This involves reducing the width of one or more lanes in order to maintain the existing number of lanes on the facility while permitting work access to part of the facility.

- ✓ Lane closures to provide worker safety. This strategy closes one or more existing traffic lanes to accommodate work activities.
- ✓ Reduced shoulder width to maintain number of lanes. This involves reducing the width of the inside and/or outside shoulder to maintain the existing number of lanes on the facility while allowing access for the work activities to take place.
- ✓ Shoulder closures to provide worker safety. This strategy closes the shoulder for use by the public, making it available to accommodate the work activities.
- ✓ Lane shift to shoulder/median to maintain number of lanes. This strategy involves diverting traffic onto the shoulder, or a portion of the shoulder, for use as a traffic lane.

4.2.4 One-Lane, Two-Way Operation

One lane, two-way traffic control involves using one lane for both directions of traffic, allowing work activities to occur in the other lane that is now closed.

4.2.5 Two-Way Traffic on One Side of Divided Facility (Crossover)

This strategy involves closing one side of a divided facility to permit the work to proceed without traffic interference while both directions of traffic are accommodated on the opposing side of the roadway.

4.2.6 Reversible Lanes

This strategy, also known as variable lanes or contra-flow lanes, involves sharing lane(s) of travel to accommodate peak-period traffic flow. The direction of travel in the shared lane varies by time of day or day of the week.

4.2.7 Ramp Closures/Relocation

Ramp closure involves closing one or more ramps in or near the work zone for specific time periods or construction phases to allow work access or improve traffic flow on the mainline.

4.2.8 Freeway-To-Freeway Interchange Closures

This strategy involves closing one or more freeway-to-freeway interchange connectors over a period of time.

4.2.9 Night Work

Work is performed at night (end of evening peak period to beginning or morning peak period) to minimize work zone impacts on traffic and adjacent businesses.

4.2.10 Weekend Work

Construction work (all or individual phases) is restricted to weekend periods from the end of the Friday afternoon peak period to the beginning of the Monday morning peak period.

4.2.11 Work Hour Restrictions for Peak Travel

This involves restricting work hours such that work that impacts traffic does not occur during periods of peak travel demand and congestion (e.g., peak hours, holidays, special events).

4.2.12 Pedestrian/Bicycle Access Improvements

This strategy involves providing alternate facilities for bicyclists and pedestrians (including those with disabilities in accordance with the Americans with Disabilities Act of 1990) in places where the work zone impacts their accessibility.

If there is a signed bicycle route, continuity needs to be maintained. Bicycles need to be taken in consideration during design.

A tool for seeing known bicycle routes (developed by users) can be found at the following link:

https://www.openstreetmap.org/#map=12/44.9887/-93.3115&layers=C

Use the layers link on the right for Cycle Map.

4.2.13 Business Access Improvements

Some projects will have a direct impact on businesses, particularly to accessibility. Accessibility improvements for businesses may include signage or information to direct motorists to the business(es) and/or relocation of access locations.

4.2.14 Off-Site Detours/Use of Alternate Routes

This strategy involves re-routing some or all traffic off the roadway under construction and to other existing roadways. Refer to the appendix of the Minnesota Work Zone Safety and Mobility Policy Tech Memo.

4.2.15 Type of Temporary Traffic Control Zone Activities

The following is a handout from the MN MUTCD Chapter 6G, Type of Temporary Traffic Control Zone Activities. The MN MUTCD can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

It is important that the holder of this manual checks the above link for updates.

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PART 6. TEMPORARY TRAFFIC CONTROL

Chapter 6G. Type of Temporary Traffic Control Zone Activities

6G.a Introduction

SUPPORT:

The purpose of temporary traffic control is to balance the need for safe and effective work spaces with the need to warn, control, protect, and expedite vehicular and pedestrian traffic. To accomplish this, the respect of the driver must be earned by appropriate and prudent use of traffic control devices. Proper engineering judgment is the key factor in making the temporary traffic control zone both safe and efficient.

GUIDANCE:

Advance planning is necessary for any successful temporary traffic control zone. Before setting up any zone, the appropriate layout and number of devices must be determined. Any major changes from the typical layouts should be documented. For major projects, emergency operation plans should be developed in the event of a total road closure.

OPTION:

Important aspects of the planning stage include consideration of alternate routes and the use of public information.

STANDARD:

It is essential to notify emergency services (i.e. police, fire, etc.) of any road closures and route changes.

SUPPORT:

In this chapter, the factors which affect the selection of the typical temporary traffic control zone layouts are explained. Chapter 6H details the layouts which are found in Chapter 6J, Traffic Control for Long Term Temporary Traffic Control Zones and in Chapter 6K Short Term Temporary Traffic Control Zones (*the Field Manual*).

STANDARD:

For most projects, especially long term projects, it will be necessary to prepare a project specific Traffic Control Plan (TCP). A TCP may range from a reference to Chapter 6K (the Field Manual) to a detailed set of plans and specifications.

GUIDANCE:

In developing any TCP the following items should be considered:

A. Suitable detours
   - Weight, height and width restrictions
   - Capacity
   - Geometrics
   - Maintenance of the detour
B. Access and signage to businesses
C. Conflict with standard routes and accommodations for:
   - School buses
   - Public transit
   - Fire
   - Ambulance
   - Postal Service
D. Restriction of capacity during peak hours
E. Alternate routes and other construction and/or maintenance activities in the area that may affect alternate routes.
F. Restrictions on overweight, overheight and overwidth permits
G. Inplace signing, lighting and signal modifications
H. Trail crossings, pedestrians, bicyclists
I. Utility work
J. Special events, holidays, etc.
K. Local ordinances

6G.1 Typical Applications

SUPPORT:

Each TTC zone is different. Many variables, such as location of work, highway type, geometrics, vertical and horizontal alignment, intersections, interchanges, road user volumes, road vehicle mix (buses, trucks, and cars), and road user speeds affect the needs of each zone. A TTC zone includes the section of roadway between the first advance warning sign through the last traffic control device, where traffic returns to its normal path and conditions. The goal of TTC in work zones is safety with minimum disruption to road users. The key factor in promoting TTC zone safety is proper judgment.

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Typical layouts include a variety of temporary traffic control methods, but do not include a layout for every conceivable work situation.

Well-designed TTC plans for planned special events will likely be developed from a combination of treatments from several of the typical applications.

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GUIDANCE:

For any planned special event that will have an impact on the traffic on any street or highway, a TTC plan should be developed in conjunction with and be approved by the agency or agencies that have jurisdiction over the affected roadways.

Typical applications should be altered, when necessary, to fit the conditions of a particular TTC zone. When modifications are made, factors such as traffic volume, speed, sight distance, type of work, etc. should be considered.

OPTION:

The typical layouts illustrated in Chapter 6K (*the Field Manual*) generally represent typical highway agency activities. Other devices may be added to supplement the devices shown in the typical layouts, while others may be deleted. Sign spacings and taper lengths may be increased to provide additional time or space for driver response. In some situations, however, such as an urban setting, too many devices can spread signing over too long a distance to be fully effective.

Other devices may be added to supplement the devices shown in the typical applications, while others may be deleted. The sign spacings and taper lengths may be increased to provide additional time or space for driver response. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

SUPPORT:

Selecting the most appropriate typical layout and modifications for a TTC zone requires knowledge and understanding of the zone. Although there are many ways of categorizing temporary traffic control zone layouts, roadway type, location of the work, volume, duration of work, and speed have been used to characterize the typical drawings illustrated in Chapter 6K (*the Field Manual*).

6G.2 Work Duration

SUPPORT:

Work duration is a major factor in determining the number and types of devices used in TTC zones. The duration of a TTC zone is defined relative to the length of time a work operation occupies a spot location.

STANDARD:

The five categories of work duration and their time at a location are as follows:

A. Long-term TTC zone - any temporary traffic control zone that occupies a location more than 3 days.
B. Intermediate-term/night TTC zone - any TTC zone that occupies a location during hours of darkness or up to 3 days.
C. Short-term TTC zone - any TTC zone that occupies a location for less than twelve (12) hours.
D. Short duration TTC zone - any TTC zone that occupies a location (area) for less than one (1) hour.
E. Mobile TTC zone - any TTC zone that occupies a location (area) for less than fifteen (15) minutes.

6G.2.1 Long-Term Temporary Traffic Control Zone

SUPPORT:

At long-term stationary TTC zones, there is ample time to install and realize benefits from the full range of TTC procedures and devices that are available for use. Generally, larger channelizing devices, temporary roadways, and temporary traffic barriers are used. Larger channelizing devices have more retroreflective material and offer better nighttime visibility. The larger devices are also less likely to be displaced or tipped over-an important consideration during those periods when the work crew is not present.

STANDARD:

Since long-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in long-term stationary TTC zones.

GUIDANCE:

Temporary roadways and barriers may be provided, and inappropriate markings should be removed and replaced with temporary markings. Temporary signs should be post-mounted.

STANDARD:

Any conflicting signs shall be covered.

OPTION:

A long-term TTC zone may range in duration from several days to several years.

GUIDANCE:

Traffic control procedures and devices should be chosen to accommodate the varying seasonal, climactic and visibility situations that may arise during the length of the project. Consideration should also be given to devices that are durable and easily maintained.

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SUPPORT:

Layouts for long-term TTC zones are not included in Chapter 6K (*the Field Manual*), but examples of long-term applications are shown in Chapter 6J. Normally, a long-term TTC zone will require a project specific Traffic Control Plan (TCP). Implementing a Traffic Control Plan requires advance planning and consultation with the local road authority and Traffic Engineering professionals. Advance notice and good public relations are helpful.

6G.2.2 Intermediate-Term/Night Temporary Traffic Control Zone

SUPPORT:

In intermediate-term/night TTC zones, it might not be feasible or practical to use procedures or devices that would be desirable for long-term temporary traffic control zones, such as altered pavement markings, barriers, and temporary roadways. The increased time to place and remove these devices in some cases could significantly lengthen the project, thus increasing exposure time. In other instances, there might be insufficient pay-back time to economically justify more elaborate temporary traffic control measures.

Night work presents special problems and requires extra-ordinary precautions. Night temporary traffic control zones may be inplace for only a few hours. During this time, traffic volumes may be lighter than during daylight hours. However, additional devices such as warning lights and larger more reflective devices are necessary because drivers are more likely to be impaired and inattentive. Driver impairment may be due to drugs, alcohol, or fatigue.

STANDARD:

Since intermediate-term operations extend into nighttime, retroreflective and/or illuminated devices shall be used in intermediate-term stationary TTC zones.

GUIDANCE:

In addition to floodlighting the flagger stations and the work space, the work vehicles should also be made more visible.

SUPPORT:

Typical characteristics of intermediate-term/night temporary traffic control zones are:

A. Signs mounted on temporary supports,
B. Minimal covering of inplace signs,
C. Additional devices used to override inplace signs, and/or
D. Conflicting pavement markings normally not removed except for multiple lane shifts.

STANDARD:

If multiple lanes are being shifted, then the inplace lane markings shall be removed and temporary markings installed.

6G.2.3 Short-Term Temporary Traffic Control Zones

SUPPORT:

Most maintenance and utility operations fall into the category of short-term TTC zones. The work crew is present to maintain and monitor the TTC zone. Signs are mounted on portable stands and pavement markings are generally not removed.

Within Chapter 6K (*the Field Manual*), several TTC zone layouts when used for a short-term duration have devices which may be either omitted or perhaps substituted with a lower level device depending upon whether the work space will be either attended or occupied. A work space is considered to be attended when the TTC devices are reviewed for knock-downs or other needed adjustments on a hourly basis. A work space is considered to be occupied when workers are present within the work space and TTC devices should continuously be reviewed by workers and adjustments made as needed.

6G.2.4 Short Duration Temporary Traffic Control Zones

SUPPORT:

Quick repair, installation or inspection activities fall into the category of short duration temporary traffic control zones. The work crew will perform a quick operation and leave the area and generally have little or no effect on the traffic.

During short duration work, it often takes longer to set up and remove the traffic control than to perform the work. Workers face hazards in setting up and taking down the temporary traffic control zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed.

OPTION:

Considering these factors, simplified control procedures may be warranted for short-duration work. A reduction in the number of devices may be offset by the use of other more dominant devices such as rotating lights or strobe lights on work vehicles.

HANDOUT

GUIDANCE:

Work that may require a complete closure for a short period of time (15 minutes or less) should be scheduled for non-peak hours. A portable changeable message sign should be considered to warn motorists approaching the closure. Care must be taken to ensure that advance warning signs extend beyond any possible queue. If the closure is done during nighttime hours, uniformed officers should be used for flagging.

6G.2.5 Mobile Temporary Traffic Control Zones

SUPPORT:

Mobile operations are work activities that move along the road. Mobile operations often involve frequent short stops, each as much as 15 minutes long, for activities such as pothole patching, crack sealing or utility operations and are similar to short duration operations. Mobile operations also include work activities in which workers and equipment move along the road without stopping, usually at slow speeds.

As compared to stationary operations, mobile operations are activities that might involve different treatments. Devices having greater mobility might be necessary, such as signs mounted on trucks. Devices that are larger, more imposing, or more visible can be used effectively and economically. The mobility of the TTC zone is important.

Maintaining safe work and road user conditions is a paramount goal in carrying out mobile operations.

During mobile work, it often takes longer to set up and remove the traffic control than to perform the work. Workers face hazards in setting up and taking down the TTC zone. Also, since the work time is short, delays affecting road users are significantly increased when additional devices are installed and removed.

GUIDANCE:

If a mobile operation does not move at least the decision sight distance (See Table 6E-1) every 15 minutes it should be considered a stationary TTC zone and the appropriate stationary layout used. If sight distance is limited or volumes high, a stationary layout should also be considered.

Under high-volume conditions, consideration should be given to scheduling mobile operations work during off-peak hours and parking may be prohibited.

OPTION:

Considering these factors, simplified control procedures may be warranted for mobile work. A reduction in the number of devices may be offset by the use of other more dominant devices, as detailed for mobile operations in Chapter 6K (*the Field Manual*), and may include rotating lights or strobe lights on work vehicles and vehicles augmented with signs or arrow panels.

Flaggers may be used for mobile operations that often involve frequent short stops.

STANDARD:

Mobile operations on a high speed travel lane of a multi-lane divided highway shall use arrow boards.

GUIDANCE:

When the mobile operation is continually moving along the road, the traffic should be directed to pass safely. A shadow vehicle or protection vehicle equipped as a sign truck, with an appropriately used arrow board, should follow the work vehicle as detailed in the layouts.

Work and shadow vehicles should be equipped with such devices such as flags, rotating/strobe vehicle lights, truck-mounted attenuators, and appropriate signs. These devices may be required individually or in various combinations, or all of them, as determined necessary.

STANDARD:

Mobile operations shall have appropriate devices on the equipment (that is, high-intensity rotating, flashing, oscillating, or strobe lights, signs, or special lighting), or shall use a separate vehicle with appropriate warning devices.

OPTION:

For mobile operations that move at speeds less than 3 mph, mobile signs or portable stationary signing that is periodically retrieved and repositioned in the advance warning area to keep them near the work space may be used.

HANDOUT

HANDOUT

6G.3 Location of Work

SUPPORT:

Chapter 6D and Sections 6F.74 and 6G.5 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

The choice of TTC needed for a TTC zone depends upon where the work is located. As a general rule, the closer the work is to road users (including bicyclists and pedestrians), the greater the number of TTC devices that are needed. Procedures are described later in this Chapter for establishing TTC zones in the following locations:

A. Outside the shoulder,
B. On the shoulder with no encroachment,
C. On the shoulder with minor encroachment,
D. Within the median, and
E. Within the traveled way.

STANDARD:

The exact location or locations of the work shall be known prior to selecting the layout.

When the work space is within the traveled way, except for short-duration and mobile operations, advance warning shall provide a general message that work is taking place and shall supply information about highway conditions. TTC devices shall indicate how vehicular traffic can move through the TTC zone.

6G.4 Modifications to Fulfill Special Needs

SUPPORT:

The typical applications in Chapter 6K illustrate commonly encountered situations in which TTC devices are employed.

OPTION:

Other devices may be added to supplement the devices provided in the typical applications, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

GUIDANCE:

When conditions are more complex, typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6B and by incorporating appropriate devices and practices from the following list:

A. Additional devices:
   1. Signs
   2. Arrow boards
   3. More channelizing devices at closer spacing (see Section 6F.74 for information regarding detectable edging for pedestrians)
   4. Temporary raised pavement markers
   5. High-level warning devices
   6. Portable changeable message signs
   7. Temporary traffic control signals (including pedestrian signals and accessible pedestrian signals)
   8. Temporary traffic barriers
   9. Crash cushions
   10. Screens
   11. Rumble strips
   12. More delineation
B. Upgrading of devices:
   1. A full complement of standard pavement markings
   2. Brighter and/or wider pavement markings
   3. Larger and/or brighter signs
   4. Channelizing devices with greater conspicuity
   5. Temporary traffic barriers in place of channelizing devices
C. Improved geometrics at detours or crossovers
D. Increased distances:
   1. Longer advance warning area
   2. Longer tapers
E. Lighting:
   1. Temporary roadway lighting
   2. Steady-burn lights used with channelizing devices
   3. Flashing lights for isolated hazards
   4. Illuminated signs
   5. Floodlights
F. Pedestrian routes and temporary facilities
G. Bicycle diversions and temporary facilities

OPTION:

Other devices may be added to supplement the devices indicated in the typical applications, and device spacing may be adjusted to provide additional reaction time. When conditions are less complex than those depicted in the typical applications, fewer devices may be needed.

HANDOUT

6G.5 Work Affecting Pedestrian and Bicycle Facilities

SUPPORT:

It is not uncommon, particularly in urban areas, that road work and the associated TTC will affect existing pedestrian or bicycle facilities. It is essential that the needs of all road users, including pedestrians with disabilities, are considered in TTC zones.

In addition to specific provisions identified in Sections 6G.06 through 6G.14, there are a number of provisions that might be applicable for all of the types of activities identified in this Chapter.

GUIDANCE:

Where pedestrian or bicycle usage is high, the typical applications should be modified by giving particular attention to the provisions set forth in Chapter 6D, this Chapter, Section 6F.74, and in other Sections of Part 6 related to accessibility and detectability provisions in TTC zones.

Pedestrians should be separated from the worksite by appropriate devices that maintain the accessibility and detectability for pedestrians with disabilities.

Bicyclists and pedestrians should not be exposed to unprotected excavations, open utility access, overhanging equipment, or other such conditions.

Except for short duration and mobile operations, when a highway shoulder is occupied, a SHOULDER WORK (W21-5) sign should be placed in advance of the activity area. When work is performed on a paved shoulder 8 feet or more in width, channelizing devices should be placed on a taper having a length that conforms to the requirements of a shoulder taper. Signs should be placed such that they do not narrow any existing pedestrian passages to less than 48 inches.

Pedestrian detours should be avoided since pedestrians rarely observe them and the cost of providing accessibility and detectability might outweigh the cost of maintaining a continuous route. Whenever possible, work should be done in a manner that does not create a need to detour pedestrians from existing routes or crossings.

STANDARD:

Where pedestrian routes are closed, alternate pedestrian routes shall be provided.

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

6G.6 Work Outside of the Shoulder

SUPPORT:

When work is being performed off the roadway (beyond the shoulders, but within the right-of-way), little or no TTC might be needed. TTC generally is not needed where work is confined to an area 15 feet or more from the edge of the traveled way. However, TTC is appropriate where distracting situations exist, such as vehicles parked on the shoulder, vehicles accessing the worksite via the highway, and equipment traveling on or crossing the roadway to perform the work operations (for example, mowing). For work beyond the shoulder, see Figure 6K-2.

GUIDANCE:

Where the situations described in the previous Support exist, a single warning sign, such as ROAD WORK AHEAD (W20-1), should be used. If the equipment travels on the roadway, the equipment should be equipped with appropriate flags, high-intensity rotating, flashing, oscillating, or strobe lights, and/or a SLOW MOVING VEHICLE (W21-4) sign.

An advance warning sign should be used when any of the following conditions occur:

A. Work will be performed on the shoulder at certain stages of the activity.
B. Equipment may be moved along or across the highway.
C. Motorists may be distracted by the work activity.

OPTION:

A typical sign for this situation may be ROAD WORK AHEAD.

If work vehicles are on the shoulder, a SHOULDER WORK (W21-5) sign may be used. For mowing operations, the sign MOWING AHEAD (W21-8) may be used.

GUIDANCE:

Where the activity is spread out over a distance of more than 2 miles, the SHOULDER WORK (W21-5) sign should be repeated every 1 mile.

OPTION:

A supplementary plaque with the message NEXT XX MILES (W7-3aP) may be used.

GUIDANCE:

A general warning sign, like Workers sign (W21-1a), should be used if workers and equipment must occasionally move closer to the traveled way.

HANDOUT

If the equipment travels on or crosses the roadway, it should be equipped with appropriate flags, flashing lights, and/or a SLOW MOVING VEHICLE symbol. If vehicles are using the shoulder, a ROAD WORK AHEAD (W20-1) or SHOULDER WORK (W21-5) sign is appropriate.

6G.7 Work on the Shoulder with No Encroachment

SUPPORT:

The provisions of this Section apply to short-term through long-term stationary operations.

GUIDANCE:

Parking lanes should be treated the same as shoulders. They should be posted for any restrictions at least 24 hours prior to commencing work.

STANDARD:

If the parking lane is normally open to vehicle travel during the time of day the closure will be in effect, the parking lane shall be considered a traveled lane.

When a highway shoulder is occupied, warning is needed to advise the driver and protect the workers. A single warning sign SHOULDER WORK or ROAD WORK AHEAD shall be used.

When paved shoulders having a width of 8 feet or more are closed, at least one advance warning sign shall be used. In addition, channelizing devices shall be used to close the shoulder in advance to delineate the beginning of the work space and direct motor vehicle traffic to remain within the traveled way.

GUIDANCE:

When paved shoulders having a width of 8 feet or more are closed on freeways and expressways, road users should be warned about potential disabled vehicles that cannot get off the traveled way. An initial general warning sign, such as ROAD WORK AHEAD (W20-1), should be used, followed by a RIGHT or LEFT SHOULDER CLOSED (W21-5a) sign. Where the downstream end of the shoulder closure extends beyond the distance that can be perceived by road users, a supplementary plaque bearing the message NEXT XX FEET (W16-4P) or MILES (W7-3aP) should be placed below the SHOULDER CLOSED (W21-5a) sign. On multi-lane, divided highways, signs advising of shoulder work or the condition of the shoulder should be placed only on the side of the affected shoulder.

When an improved shoulder is closed on a high-speed roadway, it should be treated as a closure of a portion of the road system because road users expect to be able to use it in emergencies. Road users should be given ample advance warning that shoulders are closed for use as refuge areas throughout a specified length of the approaching TTC zone. The sign(s) should read SHOULDER CLOSED (W21-5a) with distances indicated. The work space on the shoulder should be closed off by a taper or channelizing devices with a length of 1/3 L using the formulas in Tables 6C-3 and 6C-4.

When the shoulder is not occupied but work has adversely affected its condition, other warning signs and devices are appropriate. The LOW SHOULDER (W8-9), NO SHOULDER (W8-23), HIGH SHOULDER (W21-X9) or SOFT SHOULDER (W8-4) sign should be used. See Figures 6K-3, 4, and 5 in the Field Manual for longitudinal drop offs and Sections 6F-44.2 through 6F-44.4. In areas where the speed limit is greater than 30 mph and the condition extends over a distance in excess of one mile, the sign should be repeated at one mile intervals. In areas where the speed limit is 30 mph or less, the sign should be repeated at 1/4 mile increments. MN Rev. 3

OPTION:

In addition, a supplementary plaque bearing the message NEXT XX MILES (W7-3aP) may be placed below the first such warning sign. Temporary traffic barriers may be needed to inhibit encroachment of errant vehicles into the work space and to protect workers.

GUIDANCE:

Signs advising of shoulder work or the condition of the shoulder should be placed only on the side of the affected shoulder.

STANDARD:

When used for shoulder work, arrow boards shall operate only in the caution mode.

OPTION:

If work is directly adjacent to the travel lane, workers need to be protected. In some instances, this may require the use of portable barriers.

6G.8 Work on the Shoulder with Minor Encroachment

SUPPORT:

Chapter 6D and Sections 6F.74 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

HANDOUT

GUIDANCE:

When work takes up part of a lane, vehicular traffic volumes, vehicle mix (buses, trucks, cars, and bicycles), speed, and capacity should be analyzed to determine whether the affected lane should be closed. Unless the lane encroachment permits a remaining lane width of 10 feet, the lane should be closed.

Truck off-tracking should be considered when determining whether the minimum lane width of 10 feet is adequate.

Traffic should not be directed onto a lane that is only partially paved.

OPTION:

A lane width of 9 ft may be used for short-term stationary work on intermediate volume, low-speed roadways when motor vehicle traffic does not include longer and wider heavy commercial vehicles.

6G.9 Work Within the Median

SUPPORT:

Chapter 6D and Sections 6F.68 and 6G.5 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

OPTION:

If the work is in a narrow median of a divided highway, traffic control for both directions of travel may be necessary.

GUIDANCE:

If work in the median of a divided highway is within 15 feet from the edge of the traveled way for either direction of travel, TTC should be used through the use of advance warning signs and channelizing devices.

If the work is long term, the use of portable barriers should be considered.

6G.9.1 Detours and Diversions

SUPPORT:

Detour signing is usually designed by the traffic engineer with authority over the closed roadway because it is considered a traffic routing problem. Detour signs are used to direct traffic onto another roadway. At diversions, road users are directed onto a temporary roadway or alignment placed within or adjacent to the right-of-way. Typical applications for detouring or diverting road users on two-lane highways are shown in Layouts 6J-16, 6J-17, and 6J-18. Layout 6J-15 illustrates the controls around an area where a section of roadway has been closed and a diversion has been constructed. Channelizing devices and pavement markings are used to indicate the transition to the temporary roadway.

GUIDANCE:

A diversion (bypass) should be designed the same as a crossover (see Section 6G.16).

OPTION:

A diversion may carry either one direction or both directions of traffic.

GUIDANCE:

When the detour is long, Detour (M4-8, M4-9) signs should be installed periodically and at major intersections to remind and reassure drivers that they are still on a detour.

When a roadway is closed at some point beyond the detour, traffic should be advised as to what location the road is open. If local road users are allowed to use the roadway up to the closure, the ROAD CLOSED AHEAD, LOCAL TRAFFIC ONLY (R11-3a) sign should be used. The portion of the road open to local road users should have adequate signing, marking, and delineation.

Detours should be signed so that traffic will be able to get through the entire detour area and back to the original roadway.

When an entire roadway is closed, as illustrated in Layout 6J-19, a detour should be provided and road users should be warned in advance of the closure, which in this example is a closure 16 km (10 mi) from the intersection.

6G.10 Work Within the Traveled Way of a Two-Lane Highway

SUPPORT:

Chapter 6D and Sections 6F.68 and 6G.5 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Techniques for one lane, two-way traffic control are described in Section 6C-10.

STANDARD:

When one lane of a two lane road is closed, the remaining lane shall accommodate both lanes of travel. A minimum lane width of 10 feet shall be maintained at all times (see Section 6H-3).

OPTION:

On intermediate volume residential streets, traffic may be self regulating.

Where conditions permit, parking may be prohibited and traffic shifted into the parking lanes.

HANDOUT

Flaggers may be used as shown in Layout 6K-8.

STOP/YIELD sign control may be used on intermediate volume roads as shown in Layout 6K-20.

A temporary traffic control signal may be used as shown in Layout 6J-19.

6G.10.1 Work Within the Traveled Way of a Rural Highway

OPTION:

For short term temporary traffic control zones that cover a relatively long segment of roadway (up to 3 miles) but do not meet the requirements for a mobile temporary traffic control zone, flagger signs may be installed at one mile increments.

STANDARD:

A supplementary plaque indicating NEXT X MILES shall be used.

GUIDANCE:

Crossroads should be adequately signed for any driver entering the temporary traffic control zone from the crossroad. For work in intersections, see Section 6G.13.

STANDARD:

The driver expects to enter a turn lane at or near the posted speed limit. Therefore it is necessary to provide adequate advance warning of work in the turn lane.

6G.11 Work Within the Traveled Way of an Urban Street

SUPPORT:

Chapter 6D and Sections 6F.74 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

In urban TTC zones, decisions are needed on how to control vehicular traffic, such as how many lanes are required, whether any turns need to be prohibited at intersections, and how to maintain access to business, industrial, and residential areas.

Pedestrian traffic needs separate attention. Chapter 6D contains information regarding pedestrian movements near TTC zones.

STANDARD:

If the TTC zone affects the movement of bicyclists, adequate access to the roadway or shared-use paths shall be provided (see Part 9).

Where transit stops are affected or relocated because of work activity, both pedestrian and vehicular access to the affected or relocated transit stops shall be provided.

GUIDANCE:

If a designated bicycle route is closed because of the work being done, a signed alternate route should be provided. Bicyclists should not be directed onto the path used by pedestrians.

Worksites within the intersection should be protected against inadvertent pedestrian incursion by providing detectable channelizing devices.

SUPPORT:

Utility work takes place both within and outside the roadway to construct and maintain services such as power, gas, light, water, or telecommunications. Operations often involve intersections, since that is where many of the network junctions occur. The work force is usually small, only a few vehicles are involved, and the number and types of TTC devices placed in the TTC zone is usually minimal.

STANDARD:

All TTC devices shall be retroreflective or illuminated if utility work is performed during nighttime hours.

SUPPORT:

TTC zones in urban areas present many problems. Frequent intersections and driveways, parking, congestion, visual clutter and lack of space to install signs make the devices more difficult to install.

OPTION:

Engineering judgment is required to modify the typical layouts for specific situations. These modifications usually include variations in the spacing of devices to provide adequate sight distance for the driver. Modifications may also include the use of high level warning devices in urban areas, in place of or in addition to the work vehicle or Type III barricade.

GUIDANCE:

As discussed under short-duration projects, however, the reduced number of devices in utility work zones should be offset by the use of high-visibility devices, such as high-intensity rotating, flashing, oscillating, or strobe lights on work vehicles or high-level warning devices.

HANDOUT

6G.12 Work Within the Traveled Way of a Multi-Lane, Non-Access Controlled Highway

SUPPORT:

Chapter 6D and Sections 6F.74 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Work on multi-lane (two or more lanes of moving motor vehicle traffic in one direction) highways is divided into right-lane closures, left-lane closures, interior-lane closures, multiple-lane closures, and closures on five-lane roadways.

STANDARD:

When a lane is closed on a multi-lane road for other than a mobile operation, a transition area containing a merging taper shall be used.

GUIDANCE:

When justified by an engineering study, temporary traffic barriers (see Section 6F.70) should be used to prevent incursions of errant vehicles into hazardous areas or work space.

If morning and evening peak hour vehicular traffic volumes in the two directions are uneven and the greater volume is on the side where the work is being done in the right-hand lane, consideration should be given to closing the inside lane for opposing vehicular traffic and making the lane available to the side with heavier vehicular traffic.

If the larger vehicular traffic volume changes to the opposite direction at a different time of the day, the TTC should be changed to allow two lanes for opposing vehicular traffic by moving the devices from the opposing lane to the center line. When it is necessary to create a temporary center line that is not consistent with the pavement markings, channelizing devices should be used and closely spaced.

OPTION:

If the work activity can be contained entirely within the left (or inside) lane, it may be appropriate to close only that lane on low speed streets or highways.

When closing a left lane on a multi-lane undivided road, as vehicular traffic flow permits, the two interior lanes may be closed, as shown in Layout 6K-35, to provide drivers and workers additional lateral clearance and to provide access to the work space.

STANDARD:

When only the left lane is closed on undivided roads, channelizing devices shall be placed along the center line as well as along the adjacent lane.

GUIDANCE:

Channelizing devices should be placed along the centerline and outside of the work space to give advance warning to the opposing traffic.

When an interior lane is closed, an adjacent lane should also be considered for closure to provide additional space for vehicles and materials and to facilitate the movement of equipment within the work space.

When multiple lanes in one direction are closed, a capacity analysis should be made to determine the number of lanes needed to accommodate motor vehicle traffic needs. Vehicular traffic should be moved over one lane at a time. As shown in Layout 6K-56, the tapers should be separated by a distance of 2L, with L being determined by the formulas in Table 6C-2.

OPTION:

If operating speeds are 40 mph or less and the space approaching the work area does not permit moving traffic over one lane at a time, a single continuous taper may be used.

STANDARD:

When a directional roadway is closed, inapplicable WRONG WAY signs and markings, and other existing traffic control devices at intersections within the temporary two-lane, two-way operations section shall be covered, removed, or obliterated.

OPTION:

When half the road is closed on an undivided highway, both directions of motor vehicle traffic may be accommodated as shown in Layout 6K-41. When both interior lanes are closed, temporary traffic controls may be used as indicated in Layout 6K-35. When a roadway must be closed on a divided highway, a median crossover may be used (see Section 6G.16).

An alternative is to close the two center lanes to give motorists and workers additional protection and to provide easier access to the work space. Overall safety needs, evaluated on the basis of existing traffic volumes and speeds in each direction, is the main factor for determining alternatives.

SUPPORT:

Temporary traffic control for lane closures on five-lane roads is similar to other multi-lane undivided roads. Layouts 6K-25 and 6K-26 can be adapted for use on five-lane roads. Layout 6K-31 can be used on a five-lane road for short duration and mobile operations.

HANDOUT

GUIDANCE:

For roadways having either center two-way left turn lanes or exclusive left turn lanes, a transition area should be provided for vehicles entering or exiting the turn lanes.

6G.13 Work Within the Traveled Way at an Intersection

SUPPORT:

Chapter 6D and Sections 6F.74 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

The typical layouts for intersections are classified according to the location of the work space with respect to the intersection area (as defined by the extension of the curb or edge lines). The three classifications are near side, far side, and in-the-intersection. Work spaces often extend into more than one portion of the intersection. For example, work in one quadrant often creates a near-side work space on one street and a far-side work space on the cross street. In such instances, an appropriate TTC plan is obtained by combining features shown in two or more of the intersection and pedestrian typical applications.

TTC zones in the vicinity of intersections might block movements and interfere with normal road user flows. Such conflicts frequently occur at more complex signalized intersections having such features as traffic signal heads over particular lanes, lanes allocated to specific movements, multiple signal phases, signal detectors for actuated control, and accessible pedestrian signals and detectors.

GUIDANCE:

The effect of the work upon signal operation should be considered, and temporary corrective actions should be taken, if necessary, such as revising signal phasing and/or timing to provide adequate capacity, maintaining or adjusting signal detectors, and relocating signal heads to provide adequate visibility as described in Part 4.

Prior to working in a signalized intersection, the traffic engineering staff having jurisdiction should be contacted for signal timing modifications.

STANDARD:

When work will occur near an intersection where operational, capacity, or pedestrian accessibility problems are anticipated, the highway agency having jurisdiction shall be contacted.

GUIDANCE:

For work at an intersection, advance warning signs, devices, and markings should be used as appropriate on all roadway approaches to the intersection as appropriate.

When work will occur near non-signalized intersections where operational and capacity problems are anticipated, the highway agency having jurisdiction should be contacted.

For work at an intersection, advance warning signs, devices, and markings should be used on all cross streets, as appropriate. The typical applications depict urban intersections on arterial streets. Where the posted speed limit, the off-peak 85th-percentile speed prior to the work starting, or the anticipated speed exceeds 40 mph, additional warning signs should be used in the advance warning area.

Pedestrian crossings near TTC sites should be separated from the worksite by appropriate barriers that maintain the accessibility and detectability for pedestrians with disabilities.

A. Work Space on the Near Side of Intersections

SUPPORT:

Near side work spaces are simply handled as a midblock lane closure. When a lane is closed on the approach side of an intersection, standard lane closure and taper techniques apply. A problem that may occur with a near-side lane closure is a reduction in capacity, which during certain hours of operation, could result in congestion and backups.

OPTION:

When near-side work spaces are used, A exclusive turn lane may be converted for use as a through traffic lane.

Where space is restricted in advance of near-side work spaces, as with short block spacings, two warning signs may be used in the advance warning area, and a third action-type warning or a regulatory sign (such as a Keep Left sign) may be placed within the transition area.

B. Work Space on the Far Side of Intersections

SUPPORT:

Far-side work spaces require additional treatment because road users typically enter the activity area by straight-through and left or right turning movements.

GUIDANCE:

When a lane through an intersection must be closed on the far side, it should also be closed on the near-side approach to preclude merging movements within the intersection. Merging movements within the intersection should be avoided. Whenever possible, a taper should be provided in the closed lane for turning vehicles.

HANDOUT

OPTION:

If there are a significant number of vehicles turning from a near-side lane that is closed on the far side, the near-side lane may be converted to an exclusive turn lane.

C. Work Space Within the Intersection

SUPPORT:

Layout 6K-42 provides guidance on applicable procedures for work performed within the intersection.

OPTION:

If the work is within the intersection, any of the following strategies may be used:

1. A small work space so that road users can move around it;
2. Flaggers or uniformed law enforcement officers to direct road users;
3. Work in stages so the work space is kept to a minimum; and.
4. Road closures or upstream diversions to reduce road user volumes.

GUIDANCE:

Depending on road user conditions, a flagger(s) and/or a uniformed law enforcement officer(s) should be used to control road users.

6G.14 Work Within the Traveled Way of a Freeway or Expressway

SUPPORT:

Due to the physical characteristics of these facilities, unique problems are encountered. Work under high-speed, high-volume motor vehicle traffic on a controlled access highway is complicated by the roadway design and operational features.

The presence of median dividers that establish separate roadways for directional traffic may also prohibit the closure of that roadway or the diverting of traffic to other lanes. Lack of access to and from adjacent roadways prohibits rerouting of traffic away from the activity area in many cases.

A major consideration in the establishment of traffic control is the vehicular speed differential which exists and the limited time available for drivers to react safely to unusual conditions while still providing a work space that protects workers.

Other conditions exist where work must be limited to night hours, thereby necessitating increased use of warning lights, illumination of work spaces, and advance warning systems.

Problems of TTC might occur under the special conditions encountered where vehicular traffic must be moved through or around TTC zones on high-speed, high-volume roadways. Although the general principles outlined in the previous Sections of this Manual are applicable to all types of highways, high-speed, access controlled highways need special attention in order to accommodate vehicular traffic while also protecting road users and workers.

The road user volumes, road vehicle mix (buses, trucks, cars, and bicycles, if permitted), and speed of vehicles on these facilities require that careful TTC procedures be implemented, for example, to induce critical merging maneuvers well in advance of work spaces and in a manner that creates minimum turbulence and delay in the vehicular traffic stream. These situations often require more conspicuous devices than specified for normal rural highway or urban street use. However, the same important basic considerations of uniformity and standardization of general principles apply for all roadways.

Work under high-speed, high-volume vehicular traffic on a controlled access highway is complicated by the roadway design and operational features. The presence of a median that establishes separate roadways for directional vehicular traffic flow might prohibit the closing of one of the roadways or the diverting of vehicular traffic to the other roadway. Lack of access to and from adjacent roadways prohibits rerouting of vehicular traffic away from the work space in many cases. Other conditions exist where work must be limited to night hours, thereby necessitating increased use of warning lights, illumination of work spaces, and advance warning systems.

TTC for a typical lane closure on a divided highway is shown in Layout 6K-52. Temporary traffic controls for short duration and mobile operations on freeways are shown in Layout 6K-45. A typical application for shifting vehicular traffic lanes around a work space is shown in Layout 6K-59. TTC for multiple and interior lane closures on a freeway is shown in Layouts 6K-56 and 6K-57.

GUIDANCE:

The method for closing an interior lane when the open lanes have the capacity to carry vehicular traffic should be as shown in Layout 6K-52 When the capacity of the other lanes is needed, the method shown in Layout 6K-51 should be used.

HANDOUT

6G.15 Two-Lane, Two-Way Traffic on One Roadway of a Normally Divided Highway

SUPPORT:

Two-lane, two-way operation on one roadway of a normally divided highway is a typical procedure that requires special consideration in the planning, design, and work phases, because unique operational problems (for example, increasing the risk of head-on crashes) can arise with the two-lane, two-way operation.

STANDARD:

When two-lane, two-way traffic control must be maintained on one roadway of a normally divided highway, opposing vehicular traffic shall be separated with either temporary traffic barriers (concrete safety-shape or approved alternate), channelizing devices, or a temporary raised island throughout the length of the two-way operation. The use of markings and complementary signing, by themselves, shall not be used.

SUPPORT:

Layouts 6J-3, 6J-4, and 6J-5 shows the procedure for two-lane, two-way operation. Treatments for entrance and exit ramps within the two-way roadway segment of this type of work are shown in Figures 6J-7 and 6J-8.

GUIDANCE:

The following items should be considered during the decision-making process:

A. Suitable detours
B. Characteristics of the traffic
C. Intersection closures and/or the perpetuation of turn lanes
D. Maintaining traffic on the shoulder
E. Construction of temporary lanes in the median
F. Construction of emergency pullouts in the two-lane, two-way section
G. Closing only one directional lane
H. Hazards to temporary traffic control zone personnel
I. Shortest contract time
J. Most efficient construction practice and least cost
K. Width or height restrictions
L. Condition of the pavement and the shoulders in the proposed TLTWO section.

STANDARD:

The traffic control plan shall include provisions for separation of opposing traffic whenever two-way traffic must be maintained on one roadway of a normally divided highway. When traffic must be maintained on one roadway of a normally divided highway, opposing traffic shall be separated either with portable barriers, or with channelizing devices throughout the length of the two-way operation.

OPTION:

Striping, raised pavement markers, and signing, either alone or in combination, are used to complement separation devices. Alone or in combination, they do not meet the requirements for traffic separation.

STANDARD:

When the directional roadway is closed, inapplicable WRONG WAY signs and markings, and other existing traffic control devices within the temporary two-lane, two-way operations section, and at intersections shall be covered, removed, or obliterated.

SUPPORT:

In a TLTWO, diverting traffic to the opposing left lane exposes the traffic to unprotected roadside hazards. These hazards may include unprotected bridge piers, bridge rail, and guard rail ends.

STANDARD:

Prior to diverting traffic, these roadside hazards shall be delineated and/or protected per the AASHTO Roadside Design Guide.

The TLTWO shall be used only after careful consideration of other available methods of traffic control.

OPTION:

It may be necessary to laterally shift one or more lanes of traffic.

STANDARD:

If more than one lane is being shifted, even for a short term operation, in-place markings shall be covered or removed and temporary markings shall be installed.

HANDOUT

6G.16 Crossovers

GUIDANCE:

The following are good guiding principles for the design of crossovers:

A. Tapers for lane drops should be separated from the crossovers.
B. Crossovers should be designed for speeds not less than 10 miles per hour below the posted speed prior to work starting. If unusual site conditions require that a lower design speed be used, the signing should reflect an advisory speed determined by engineering judgment or study.
C. A good array of channelizing devices, delineators, and full-length, properly placed pavement markings should be provide drivers with a clearly defined travel path.
D. The design of the crossover should accommodate all roadway traffic including trucks and buses.
E. A clear area should be provided adjacent to the crossover.

SUPPORT:

Temporary traffic barriers and the excessive use of TTC devices cannot compensate for poor geometric and roadway cross-section design of crossovers.

6G.17 Interchanges

GUIDANCE:

Access to interchange ramps on limited-access highways should be maintained even if the work space is in the lane adjacent to the ramps. Access to exit ramps should be clearly marked and delineated with channelizing devices. For long-term projects, conflicting pavement markings should be removed and new ones placed. Early coordination with officials having jurisdiction over the affected cross streets and providing emergency services should occur before ramp closings.

OPTION:

If access is not possible, ramps may be closed by using signs and Type 3 Barricades. As the work space changes, the access area may be changed, as shown in Layout 6K-60. A TTC zone in the exit ramp may be handled as shown in Layout 6K-63.

When a work space interferes with an entrance ramp, a lane may need to be closed on the highway. Work in the entrance ramp may require shifting ramp vehicular traffic. TTC for both operations is shown in Layouts 6K-61 and 6K-62.

GUIDANCE:

Egress to exit ramps should be clearly marked and outlined with channelizing devices.

Advance warning sign spacing is dependent upon the length of the ramp and the exact location of signs is determined in the field. Spacing of the signs should be as long as practicable. A minimum lane width of 10 feet on exit ramps should be maintained.

6G.18 Work in the Vicinity of a Grade Crossing

STANDARD:

When grade crossings exist either within or in the vicinity of a TTC zone, lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.

SUPPORT:

Layout 6J-14 shows work in the vicinity of a highway-rail grade crossing.

GUIDANCE:

Early coordination with the railroad company or light rail transit agency should occur before work starts.

6G.19 Temporary Traffic Control During Nighttime Hours

SUPPORT:

Chapter 6D and Sections 6F.74 and 6G.05 contain additional information regarding the steps to follow when pedestrian or bicycle facilities are affected by the worksite.

Conducting highway construction and maintenance activities during night hours could provide an advantage when traditional daytime traffic control strategies cannot achieve an acceptable balance between worker and public safety, traffic and community impact, and constructability. The two basic advantages of working at night are reduced traffic congestion and less involvement with business activities. However, the two basic conditions that must normally be met for night work to offer any advantage are reduced traffic volumes and easy set up and removal of the traffic control patterns on a nightly basis.

Shifting work activities to night hours, when traffic volumes are lower and normal business is less active, might offer an advantage in some cases, as long as the necessary work can be completed and the worksite restored to essentially normal operating conditions to carry the higher traffic volume during non-construction hours.

HANDOUT

Although working at night might offer advantages, it also includes safety issues. Reduced visibility inherent in night work impacts the performance of both drivers and workers. Because traffic volumes are lower and congestion is minimized, speeds are often higher at night necessitating greater visibility at a time when visibility is reduced. Finally, the incidence of impaired (alcohol or drugs), fatigued, or drowsy drivers might be higher at night.

Working at night also involves other factors, including construction productivity and quality, social impacts, economics, and environmental issues. A decision to perform construction or maintenance activities at night normally involves some consideration of the advantages to be gained compared to the safety and other issues that might be impacted.

GUIDANCE:

Considering the safety issues inherent to night work, consideration should be given to enhancing traffic controls (see Section 6G.4) to provide added visibility and driver guidance, and increased protection for workers.

In addition to the enhancements listed in Section 6G.4, consideration should be given to providing additional lights and retroreflective markings to workers, work vehicles, and equipment.

OPTION:

Where reduced traffic volumes at night make it feasible, the entire roadway may be closed by detouring traffic to alternate facilities, thus removing the traffic risk from the activity area.

GUIDANCE:

Because typical street and highway lighting is rarely adequate to provide sufficient levels of illumination for work tasks, temporary lighting should be provided where workers are active to supply sufficient illumination to reasonably safely perform the work tasks.

Temporary lighting for night work should be designed such that glare does not interfere with driver visibility, or create visibility problems for truck drivers, equipment operators, flaggers, or other workers.

Consideration should be given to stationing uniformed law enforcement officers and lighted patrol cars at night work locations where there is a concern that high speeds or impaired drivers might result in undue risks for workers or other drivers.

STANDARD:

Except in emergencies, temporary lighting shall be provided at all flagger stations.

SUPPORT:

Desired illumination levels vary depending upon the nature of the task involved. An average horizontal luminance of 5 foot candles can be adequate for general activities. An average horizontal luminance of 10 foot candles can be adequate for activities around equipment. Tasks requiring high levels of precision and extreme care can require an average horizontal luminance of 20 foot candles.

6G.20 Installation, Maintenance and Inspection of Temporary Traffic Control

GUIDANCE:

Prior to installing any traffic control device, it should be inspected for condition, reflectorization and standard shape, size, color and message. If the device is not standard or in good condition, it should be replaced immediately. See Section 6K (the Field Manual) for Quality Standards.

Existing signs that do not apply or conflict with temporary traffic control should be removed or covered. If the sign is removed it should be carefully stored for re-installation when the temporary traffic control zone is removed.

SUPPORT:

When covering a sign, care should be taken not to damage the sign face. When placing another hard material over the sign face, plastic spacers need to be inserted to avoid scratching the sign face. Translucent materials and materials that may become damaged by the weather are not acceptable coverings.

Temporary traffic control zone signs that are installed prior to the start of work also need to be covered, rotated or folded to avoid giving the driver an erroneous message.

STANDARD:

When work is not in progress and the hazard no longer exists, devices shall be covered or removed.

Traffic control devices shall be installed in the order that drivers will see them, starting with the sign or device that is furthest from the work space.

OPTION:

If traffic in both directions will be affected, such as work in the center lanes, the devices can be placed in both directions at the same time.

HANDOUT

GUIDANCE:

When one direction of traffic will be directed into the opposing lanes of traffic, all traffic controls for the opposing traffic should be installed first.

The devices should be removed as soon as the work is completed and they are no longer needed. Devices should be removed in the opposite order from which they were installed. Devices closest to the work space should be removed first.

SUPPORT:

After the temporary traffic control zone is inplace, it is helpful to inspect the zone by driving through the zone. Driver's actions and reactions should be noted and if any problems are encountered, they should be quickly corrected.

GUIDANCE:

Any major modifications to the Traffic Control Plan or standard layouts and the reasons for the modifications should be documented.

SUPPORT:

During the life of a temporary traffic control zone, maintenance is needed. On short term operations, vehicles may knock over cones which then need to be placed upright. For intermediate term and long term operations, accidents, weather, dirt and vandalism may affect the traffic control devices.

GUIDANCE:

A regular plan for inspection and maintenance should be implemented to ensure that all devices remain functional and in good repair throughout the life of the temporary traffic control zone. If problems are encountered, they should be corrected immediately and documented.

Any hazard (i.e. pothole, washout, damaged guardrail) should be repaired as soon as possible. However, when the hazard cannot be immediately repaired, or is not directly in the traveled way, it should be marked. Hazards should be marked with a reflectorized drum(s) or Type I or Type II barricade(s) with a Type A, low intensity flashing warning light attached.

SUPPORT:

Other problems may be noted during routine inspections which may indicate a problem with the driver's perception of the zone. Skid marks, broken glass and devices continually knocked over may indicate a lack of advance warning or other problem with the temporary traffic control.

GUIDANCE:

The zone should be reviewed during day and night to determine the problem and take appropriate corrective action.

SUPPORT:

The frequency of inspection and maintenance will vary depending on the project size, duration, volume of traffic and complexity of the zone. Good communication and clear lines of responsibility will assist in resolving problems promptly.

HANDOUT

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4.3 Common Work Zone Layout

The following is a handout from the MN MUTCD Chapter 6J, Long Term Temporary Traffic Control Zone Layouts. These pages are the typical layouts for various roadway types. These are represented in plan sheet form as shown in Section **4.4**. The MN MUTCD can be downloaded from the following web link:

www.dot.state.mn.us/trafficeng/publ/index.html

It is important that the holder of this manual checks the above link for updates.

MnDOT OTE has several common layout templates available at,

http://www.dot.state.mn.us/trafficeng/workzone/ttctemplates.html.

HANDOUT

PART 6. TEMPORARY TRAFFIC CONTROL
Chapter 6J. Long Term Temporary Traffic Control Zone Layouts

6J-1 General

SUPPORT:

This section illustrates typical layouts which provide additional guidance for individuals with traffic engineering expertise.

GUIDANCE:

These layouts should be used during the development of detailed traffic control plans. They should only be used under the direction of a traffic engineering professional. They should be combined with the principles and figures contained elsewhere in this manual.

OPTION:

Some of these layouts may be used on short term construction or maintenance projects.

SUPPORT:

The concepts shown in the following layouts are only intended to be guidelines.

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Symbols	Meaning
	Flagger or Operator of Automated Flagging Assistance Device
AFAD	Automated Flagging Assistance Device (AFAD)
	Flashing Arrow Board
CHANGEABLE MESSAGE SIGN (PCMS) / RIGHT LANE CLOSED	Portable Changeable Message Sign (PCMS)
E	Portable Equipment - includes testing devices, detection, surveying, etc.
	Portable Traffic Signal
	360-Degree Yellow Flashing Vehicle Light(s)
	Longitudinal Channelizer
	Type III Barricade
ROAD WORK AHEAD	Traffic Control Sign
	Reboundable Sign Support
F	Type A Flashing Warning Light
	Surface mounted delineator
	Channelizing Device.
	A combination of Type A and B channelizing devices
	Direction of Traffic
6	See Note; i.e. See Note 6
	Work Space

Figure 6J-1 Symbols Used in Typical Layouts

HANDOUT

Temporary Traffic Control Distance Charts

Posted Speed Limit Prior to Work Starting (mph)		Advance Warning Sign Spacing (A) feet	Decision Sight Distance (D) feet	Taper Length (*12 ft lane*) (L) feet	Shifting Taper (L/2) feet	Typical Shoulder Taper (L/3) feet
0 - 30	G = 25 ft	250	550	200	100	75
35 - 40		325	700	325	175	125
45 - 50	G = 50 ft	600	900	600	300	200
55		750	1200	700	350	250
60 - 65		1000	1400	800	400	275
70 - 75		1200	1600	900	450	300

Posted Speed Limit Prior to Work Starting (mph)		Buffer Space (B) feet	Shadow Vehicle Following Distance (F) feet	Protection Vehicle Roll-Ahead Buffer Distance (with or without TMA) (R) Moving (15 mph max) feet	Stopped feet
0 - 30	G = 25 ft	200	250 - 550	100	100
35 - 40		305	325 - 700	100	100
45 - 50	G = 50 ft	425	600 - 900	175	125
55		500	750 - 1200	175	125
60 - 65		650	1000 - 1400	225	175
70 - 75		820	1200 - 1600	225	175

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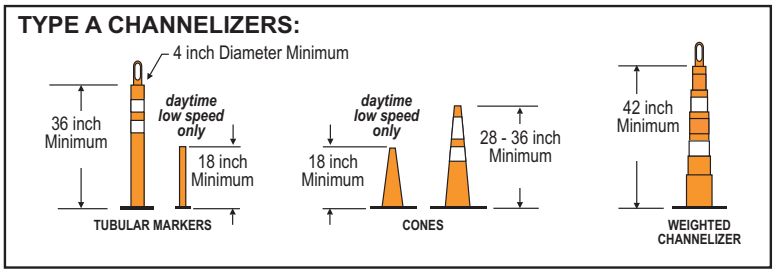
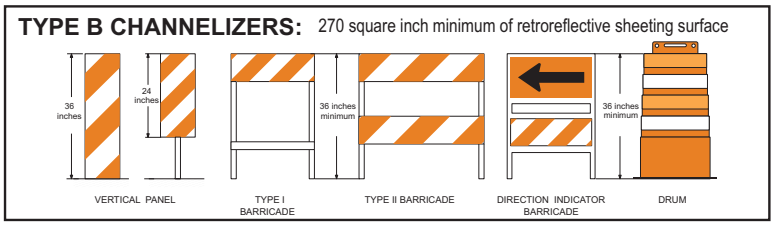
Type A channelizing devices are typically used in attended temporary traffic control zones.*



Type B channelizing devices shall be used if the temporary traffic control zone will be installed for more than 12 hours or if it is left unattended. *



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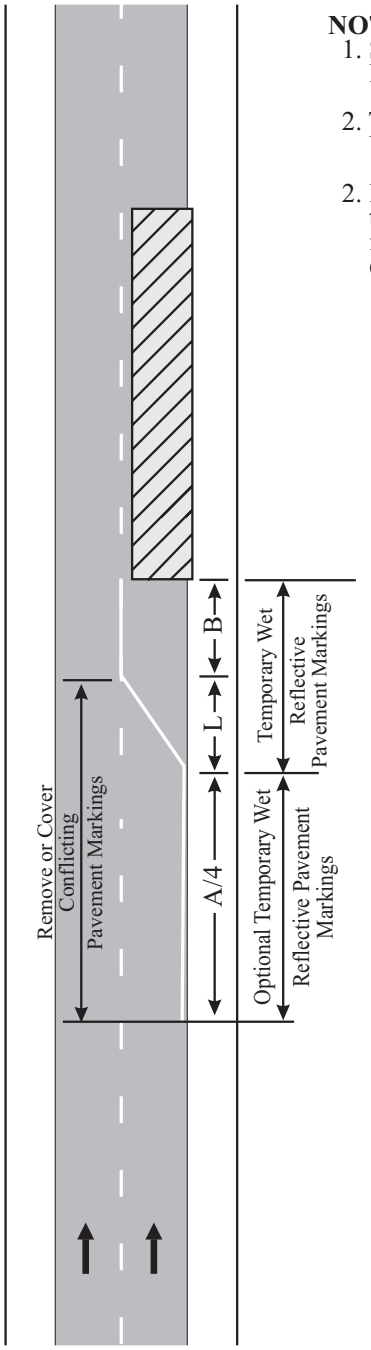
* See the MN MUTCD, Part 6F for more details on application restrictions.

Figure 6J-2 Temporary Traffic Control Devices and Distance Charts

HANDOUT



NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Traffic control devices are not shown. Use appropriate lane closure.
2. Install wet reflective edgelines through the transition and alignment change areas including lane closure tapers, sharp curves, exits, shifts onto temporary roadways, etc.

TYPICAL STRIPING AND STRIPE REMOVAL FOR LANE CLOSURE
MULTILANE DIVIDED ROAD

LONG TERM

LAYOUT 6J-1

6J-1

December, 2011

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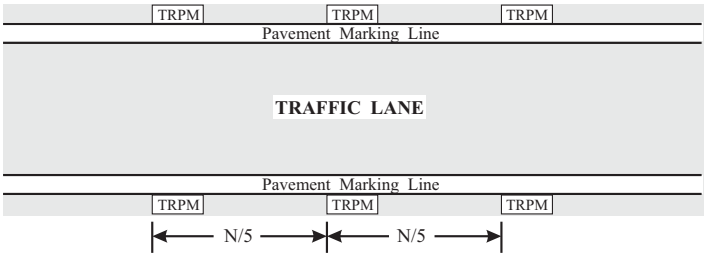
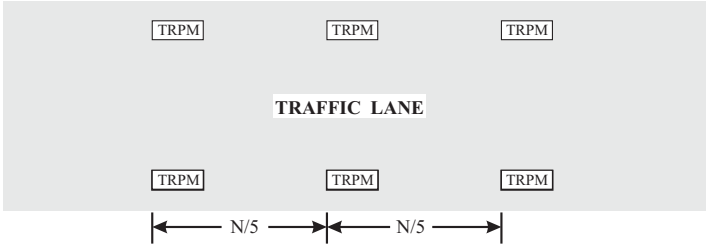


SUPPLEMENTING A SOLID LINE



SIMULATING A SOLID LINE

SUPPLEMENTING A BROKEN LINE

SIMULATING A BROKEN LINE

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N = the length of one line segment plus one gap

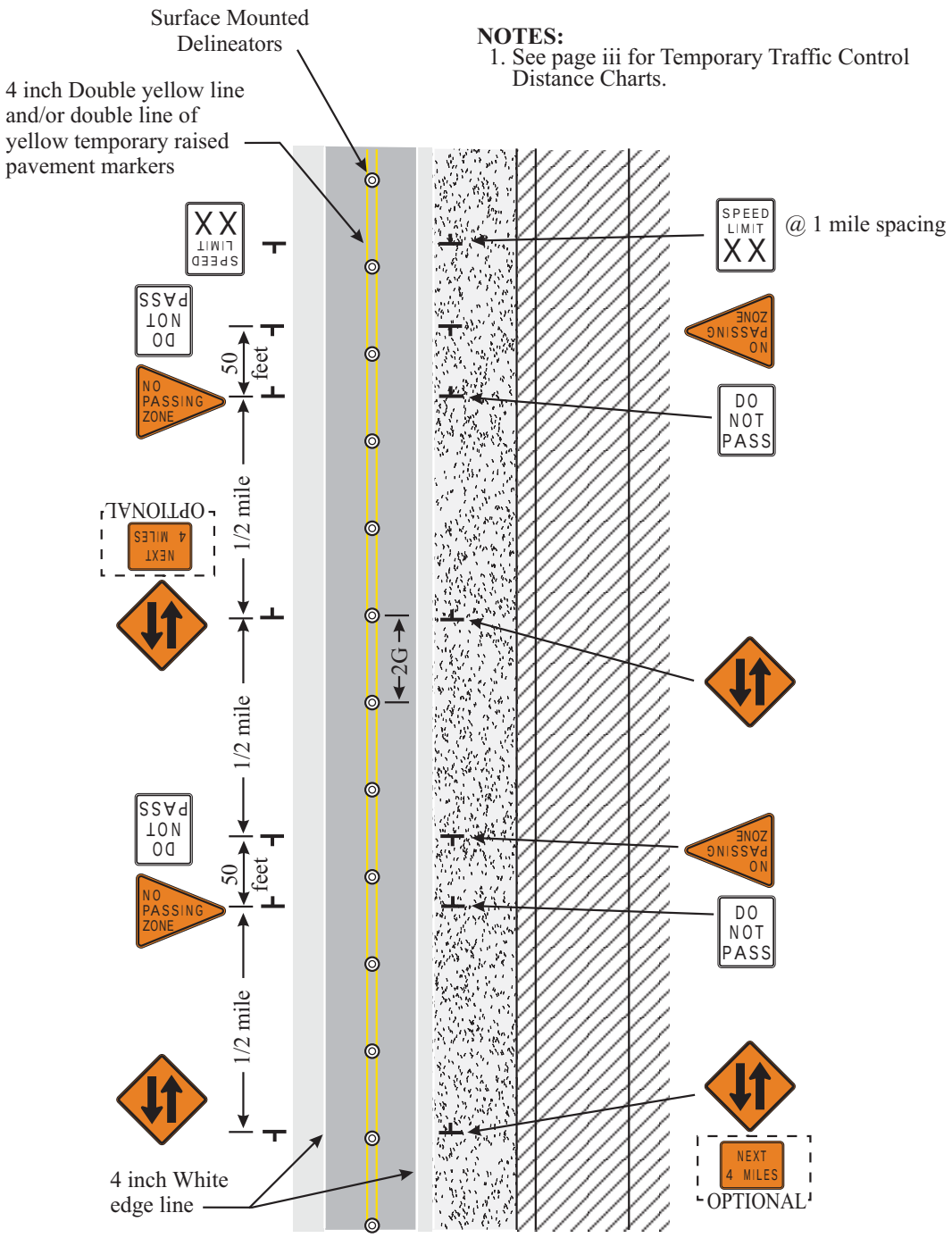
PLACEMENT AND SPACING OF TEMPORARY RAISED PAVEMENT MARKERS (TRPMs)

LONG TERM LAYOUT 6J-2

January, 2014 6J-2

HANDOUT

HANDOUT



NOTES:
1. See page iii for Temporary Traffic Control Distance Charts.

@ 1 mile spacing

TYPICAL SECTION FOR TWO-LANE, TWO-WAY OPERATIONS MULTILANE DIVIDED ROAD

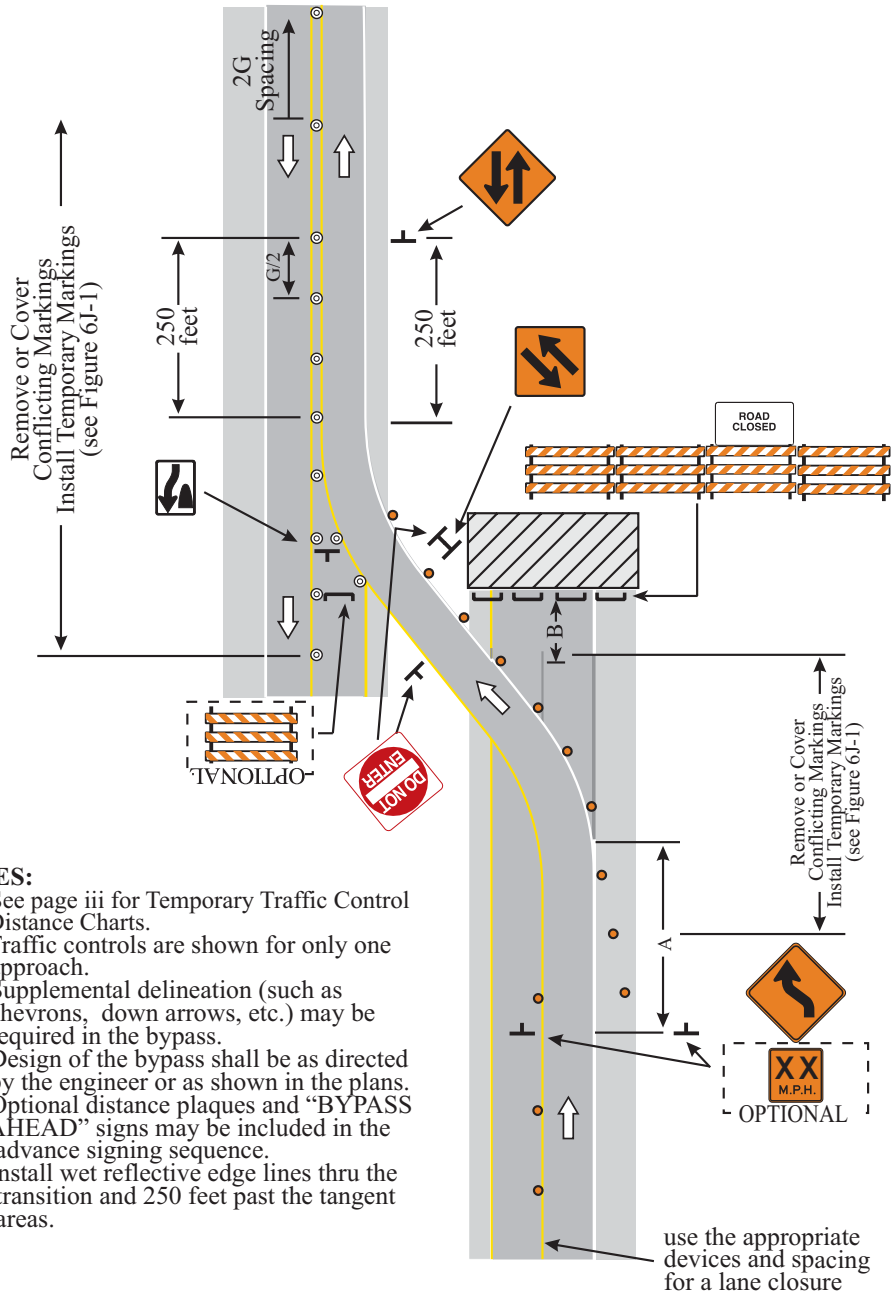
LONG TERM

LAYOUT 6J-3

6J-3

December, 2011

HANDOUT



NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Traffic controls are shown for only one approach.
3. Supplemental delineation (such as chevrons, down arrows, etc.) may be required in the bypass.
4. Design of the bypass shall be as directed by the engineer or as shown in the plans.
5. Optional distance plaques and "BYPASS AHEAD" signs may be included in the advance signing sequence.
6. Install wet reflective edge lines thru the transition and 250 feet past the tangent areas.

TYPICAL CROSSOVER TO TWO-LANE, TWO-WAY OPERATIONS
MULTILANE DIVIDED ROAD

LONG TERM

LAYOUT 6J-4

January, 2014

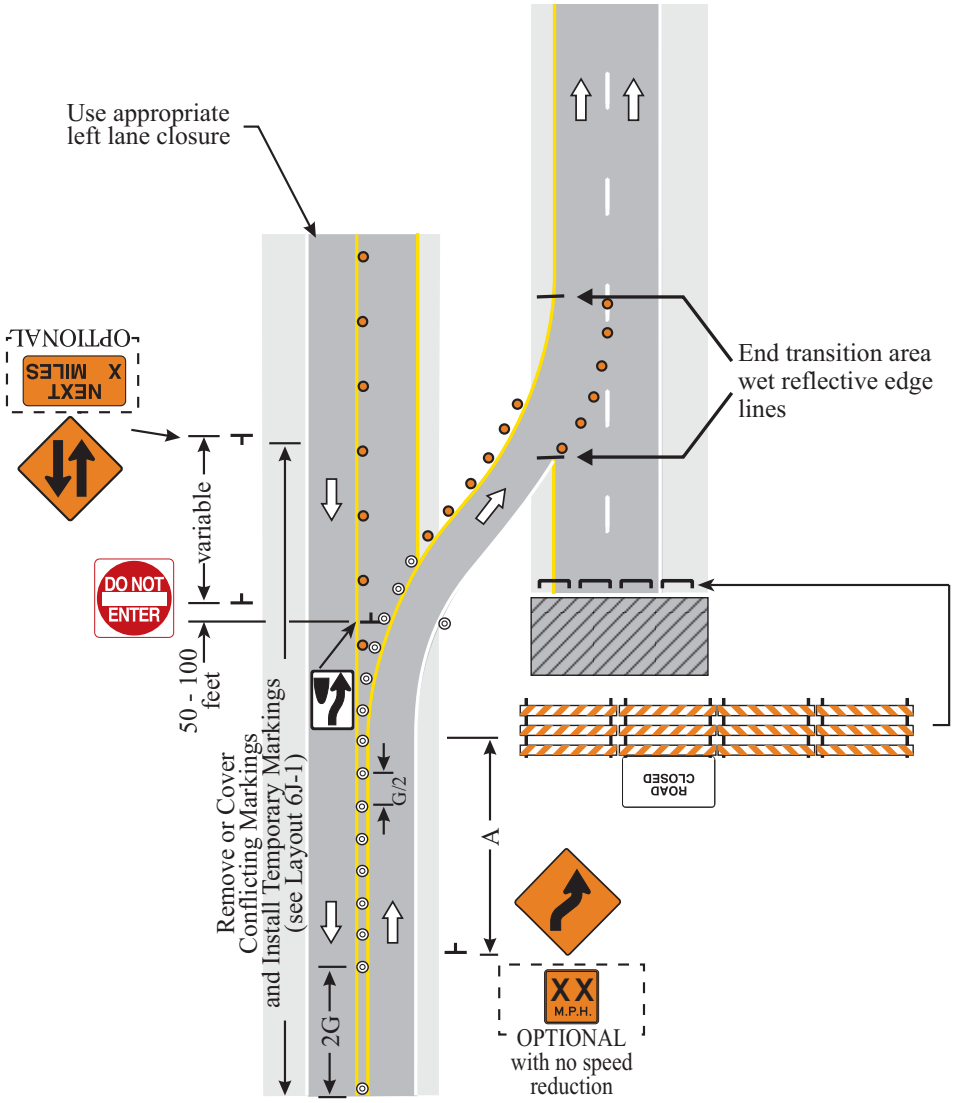
6J-4

HANDOUT

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Traffic controls are shown for only one approach.
3. Supplemental delineation (such as chevrons, down arrows, etc.) may be required in the bypass.
4. Install wet reflective edge lines thru the transition and 250 feet past the tangent areas.



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TYPICAL CROSSOVER FROM A TWO-LANE, TWO-WAY OPERATION
MULTILANE DIVIDED ROAD

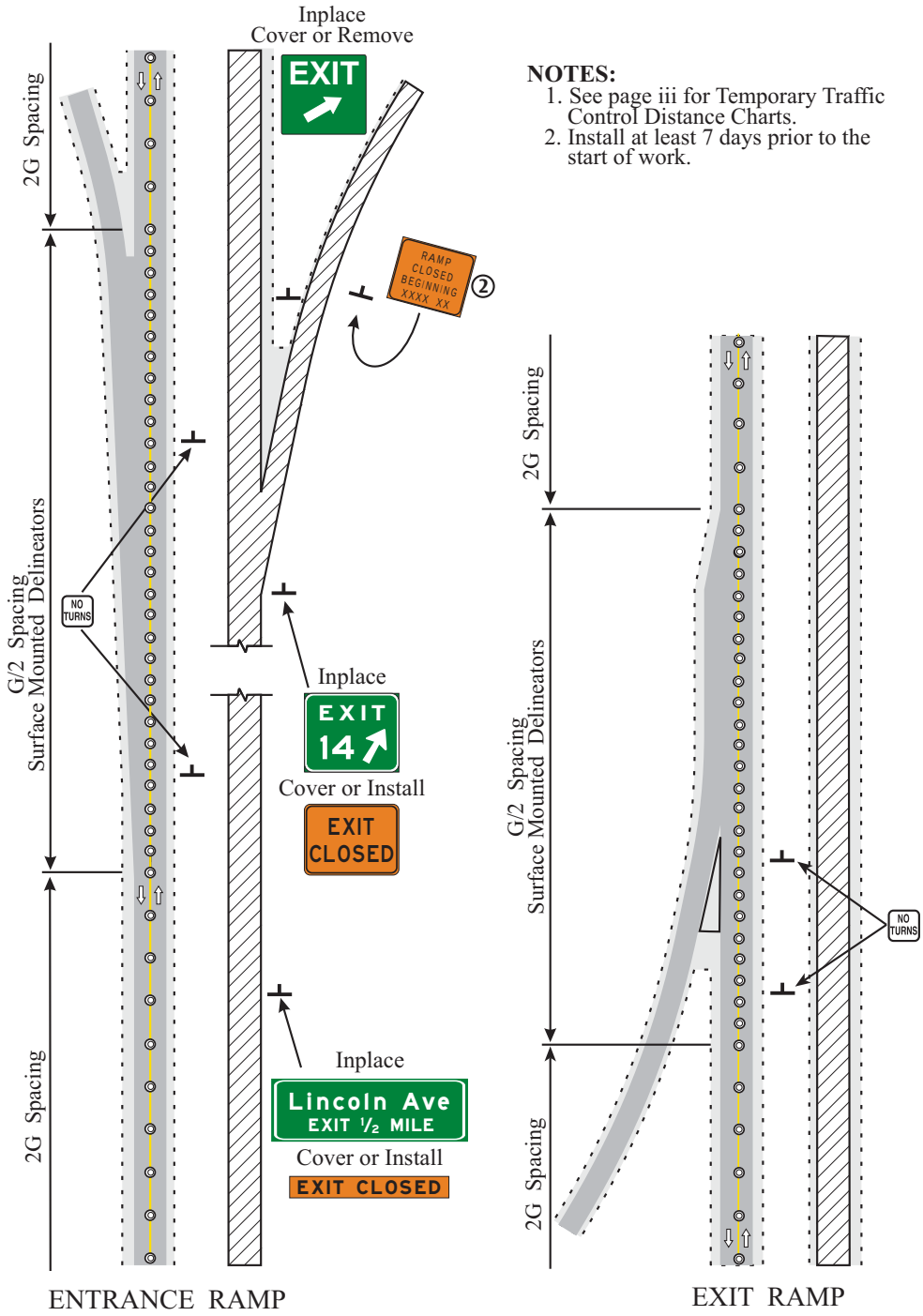
LONG TERM

LAYOUT 6J-5

6J-5

January, 2014

HANDOUT



NOTES:
1. See page iii for Temporary Traffic Control Distance Charts.
2. Install at least 7 days prior to the start of work.

TWO-LANE, TWO-WAY OPERATIONS
AT RAMPS ON OPEN ROADWAY

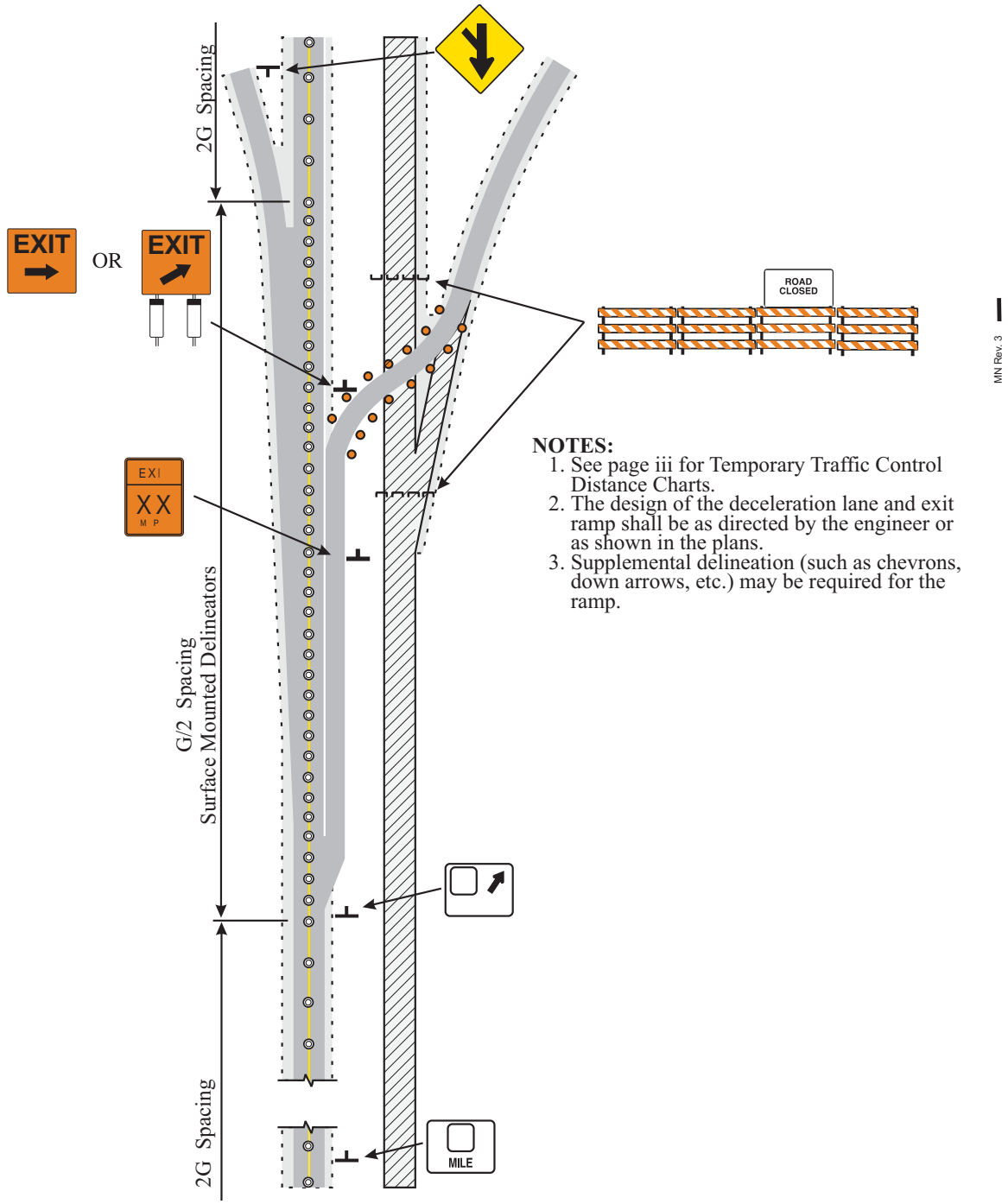
LONG TERM

LAYOUT 6J-6

December, 2011

6J-6

HANDOUT



NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. The design of the deceleration lane and exit ramp shall be as directed by the engineer or as shown in the plans.
3. Supplemental delineation (such as chevrons, down arrows, etc.) may be required for the ramp.

TWO-LANE, TWO-WAY OPERATION AT EXIT RAMP ACROSS CLOSED ROADWAY

LONG TERM

LAYOUT 6J-7

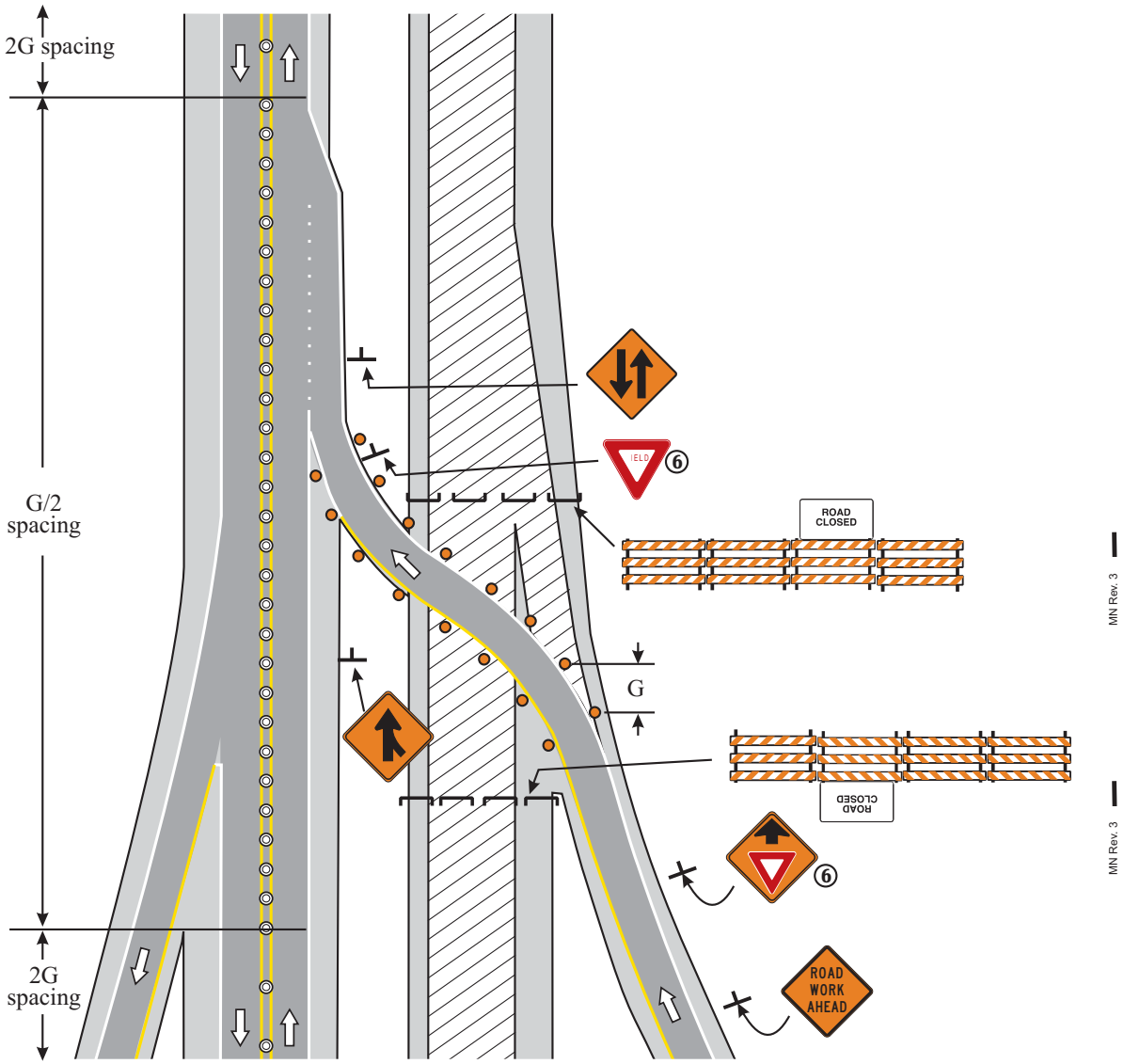
6J-7

January, 2014

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. The design of the acceleration lane and entrance ramp shall be as directed by the engineer or as shown in the plans.
3. Supplemental delineation (such as chevrons, down arrows, etc.) may be required for the ramp.
4. The advance warning sign spacing is dependent on the ramp length and the location of inplace signing. The spacing should be as long as is practical.
5. Remove conflicting pavement markings and install temporary markings (see Figure 6J-1).
6. When an adequate acceleration lane is provided, this sign should be omitted.



TWO-LANE, TWO-WAY OPERATION AT ENTRANCE RAMP ACROSS CLOSED ROADWAY

LONG TERM

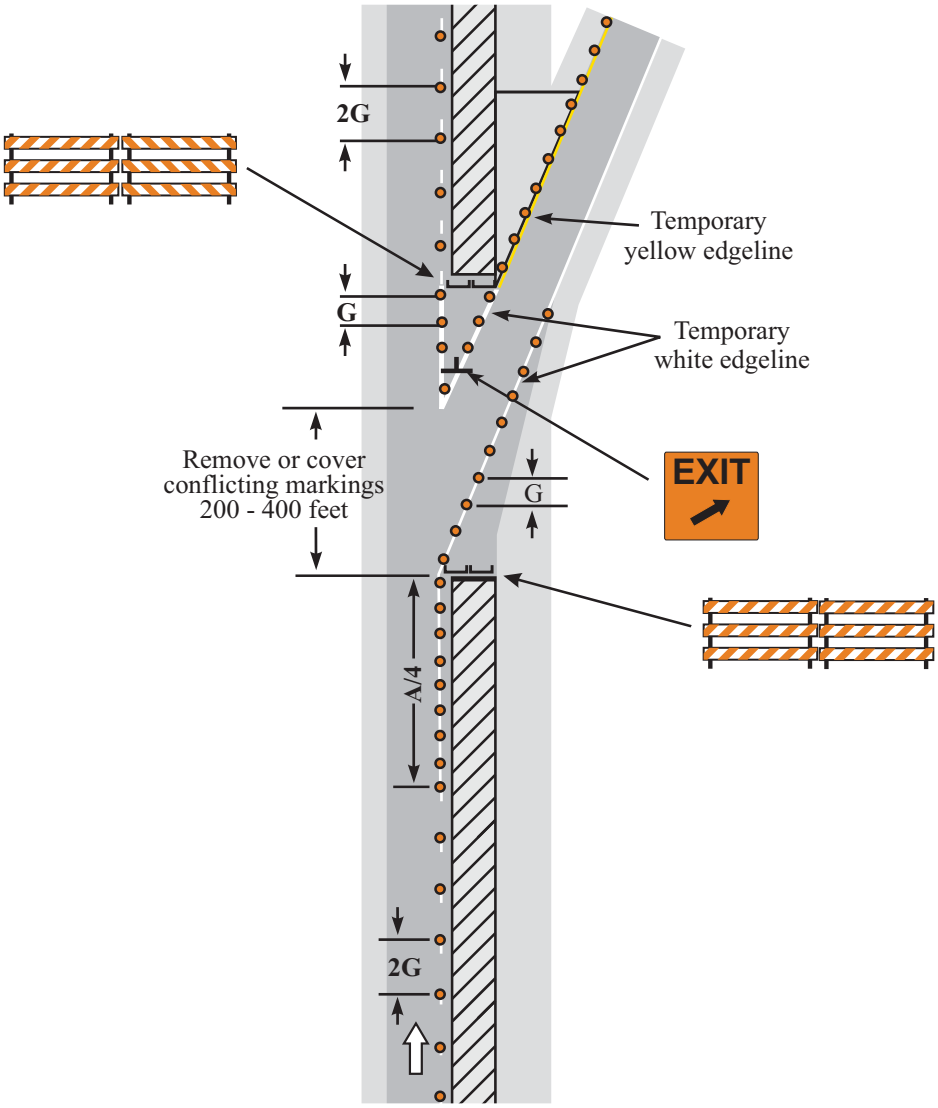
LAYOUT 6J-8

January, 2014

6J-8

HANDOUT

NOTES:
1. See page iii for Temporary Traffic Control Distance Charts.
2. The design of the deceleration lane and the exit ramp shall be as directed by the engineer or as shown in the plans.
3. The advance warning sign spacing is dependent on the ramp length and the location of inplace signing. The spacing should be as long as is practical.



Use appropriate devices and spacing for lane closure.

MAINLINE RIGHT LANE CLOSED
EXIT RAMP OPEN

LONG TERM

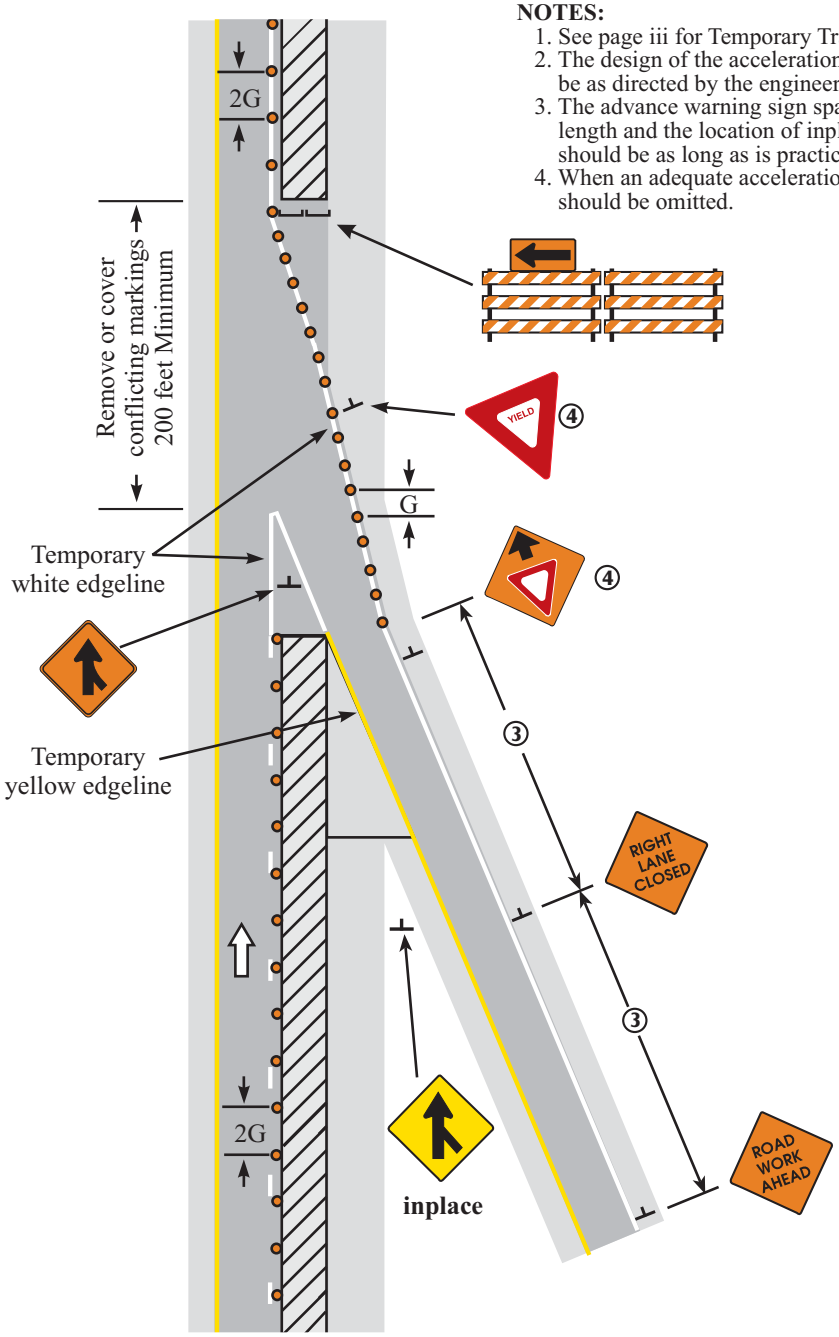
LAYOUT 6J-9

6J-9

December, 2011

HANDOUT

NOTES:
1. See page iii for Temporary Traffic Control Distance Charts.
2. The design of the acceleration lane and the entrance ramp shall be as directed by the engineer or as shown in the plans.
3. The advance warning sign spacing is dependent on the ramp length and the location of inplace signing. The spacing should be as long as is practical.
4. When an adequate acceleration lane is provided, this sign should be omitted.



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Use the appropriate devices and spacing for a lane closure.

MAINLINE RIGHT LANE CLOSED
ENTRANCE RAMP OPEN

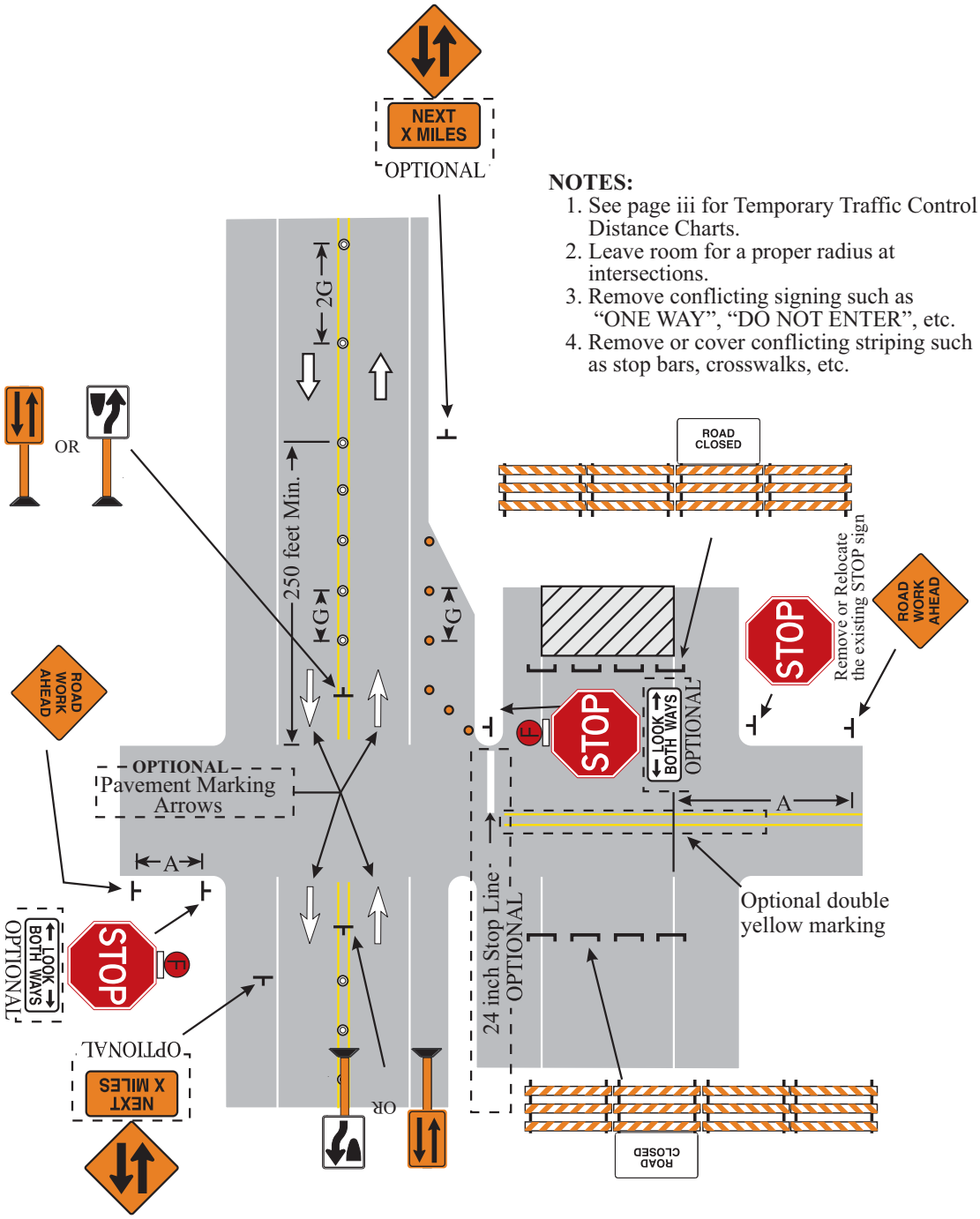
LONG TERM

LAYOUT 6J-10

January, 2014

6J-10

HANDOUT



NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Leave room for a proper radius at intersections.
3. Remove conflicting signing such as "ONE WAY", "DO NOT ENTER", etc.
4. Remove or cover conflicting striping such as stop bars, crosswalks, etc.

TWO-LANE, TWO-WAY OPERATION THROUGH TYPICAL INTERSECTION

LONG TERM

LAYOUT 6J-11

6J-11

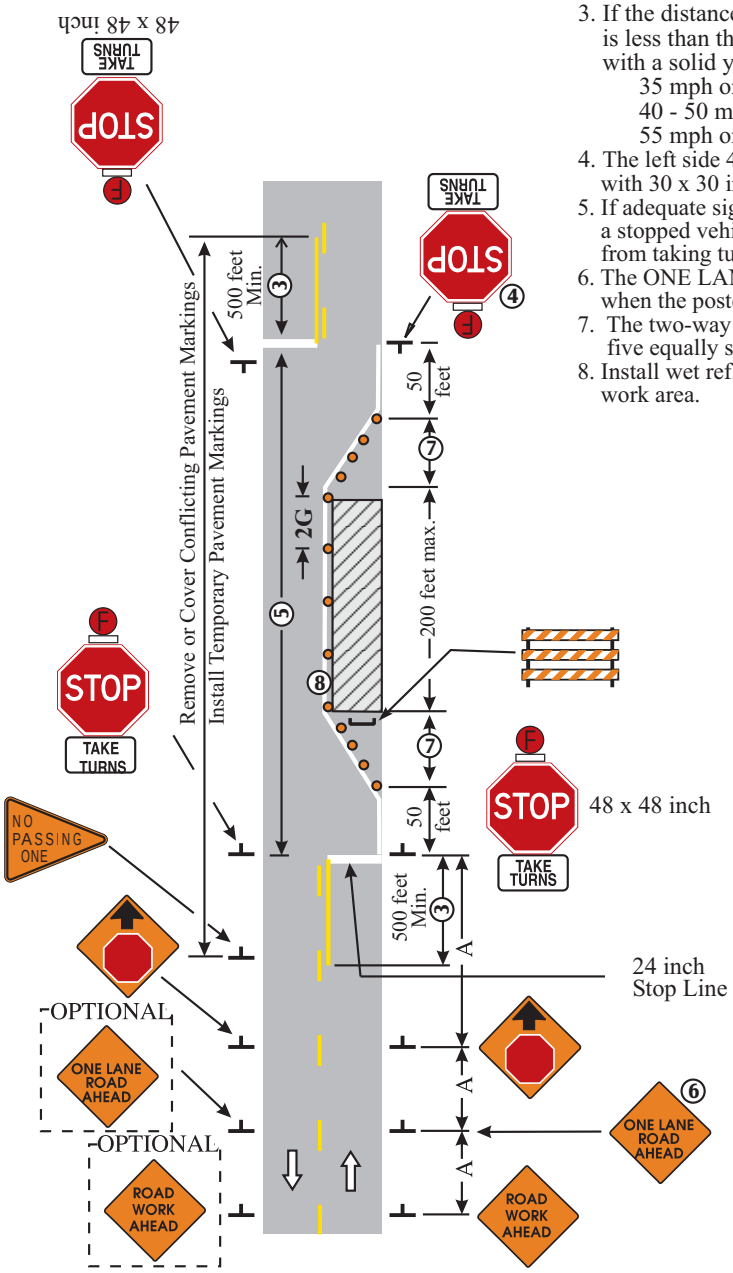
January, 2014

HANDOUT

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Approach signs and marking is the same in both directions.
3. If the distance from an inplace "NO PASSING ZONE" is less than the following, the zones shall be connected with a solid yellow line:
   35 mph or less - 500 feet
   40 - 50 mph - 600 feet
   55 mph or greater - 800 feet
4. The left side 48 x 48 inch STOP signs may be replaced with 30 x 30 inch STOP signs.
5. If adequate sight distance is not available to recognize a stopped vehicle or traffic volume restricts vehicles from taking turns through the open lane, use Layout 6J-13.
6. The ONE LANE ROAD AHEAD sign may be omitted when the posted speed limit is 40 mph or less.
7. The two-way taper should be 50 feet in length using five equally spaced channelizing devices.
8. Install wet reflective edgeline through tapers and the work area.



LANE CLOSURE WITH STOP SIGNS
TWO-LANE, TWO-WAY ROAD

LONG TERM

LAYOUT 6J-12

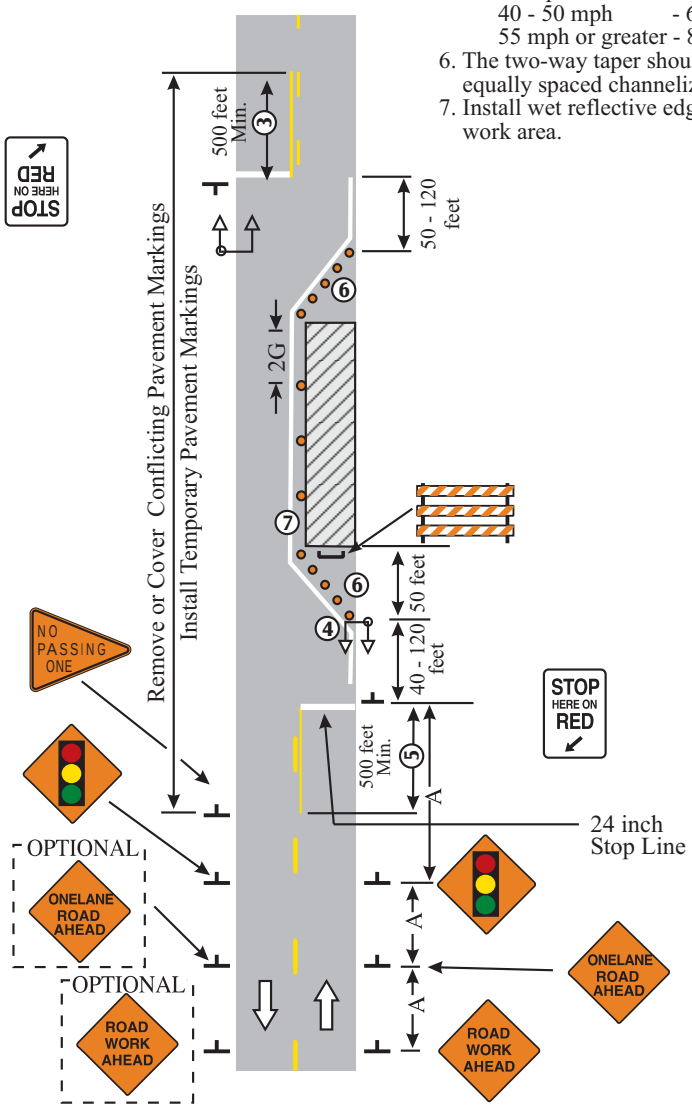
December, 2011

6J-12

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Approach signing and marking is the same in both directions.
3. Signal timing shall be established by qualified personnel.
4. Two signal heads shall be installed per approach. The first shall be installed on the right shoulder. The second signal head may be installed on either the left shoulder or mounted over head on the same structure as the first signal head.
5. If the distance from an inplace "NO PASSING ZONE" is less than the following, the zones shall be connected with a solid yellow line:
   35 mph or less - 500 feet
   40 - 50 mph - 600 feet
   55 mph or greater - 800 feet
6. The two-way taper should be 50 feet in length using five equally spaced channelizing devices.
7. Install wet reflective edgeline through tapers and the work area.



LANE CLOSURE WITH SIGNALS
TWO-LANE, TWO-WAY ROAD

LONG TERM

LAYOUT 6J-13

6J-13

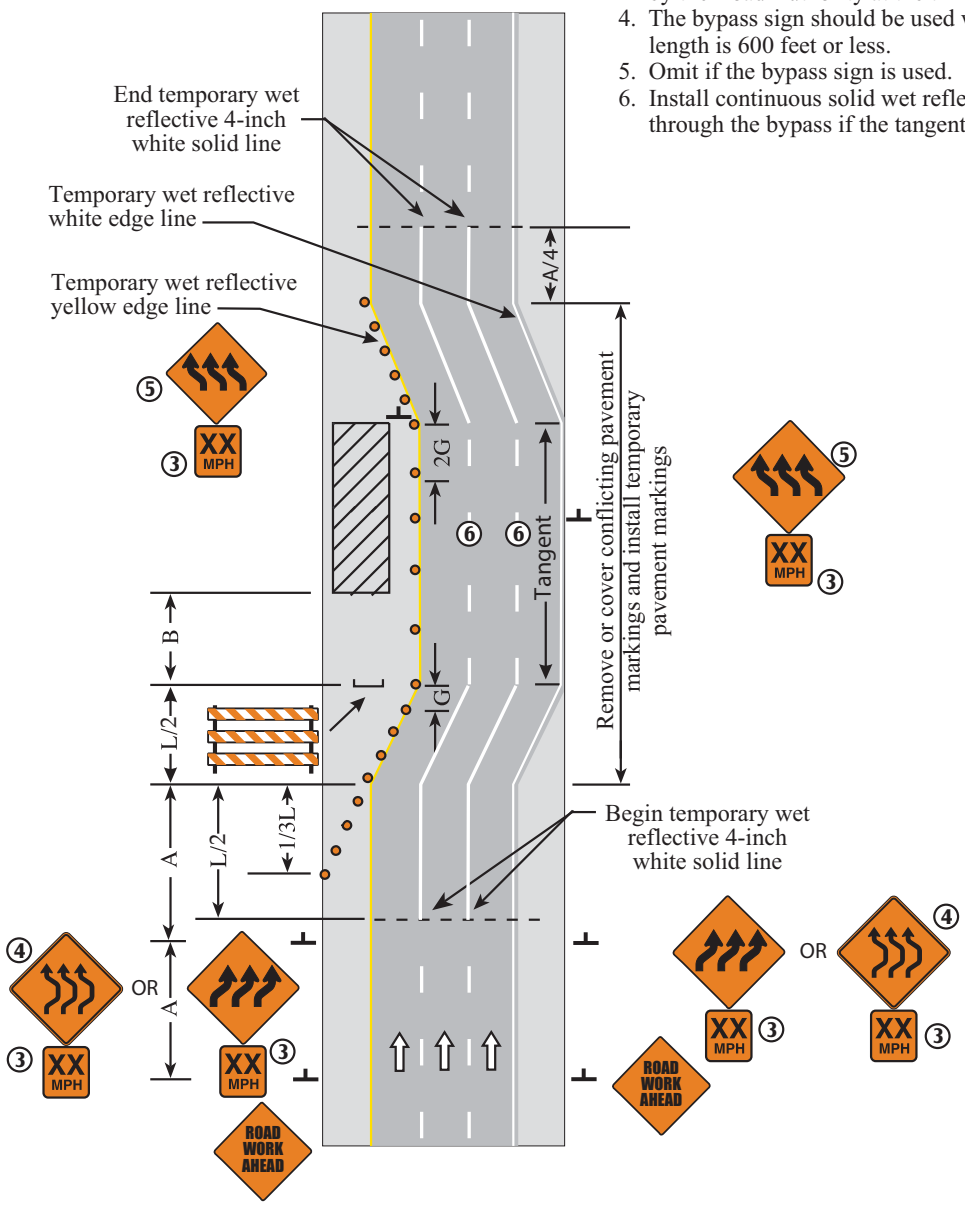
December, 2011

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. The minimum lane width shall be 10 feet.
3. The curve advisory speed will be determined by the Road Authority at the time of installation.
4. The bypass sign should be used when the tangent length is 600 feet or less.
5. Omit if the bypass sign is used.
6. Install continuous solid wet reflective lane lines through the bypass if the tangent is 600 feet or less.

MN Rev. 3



LANE SHIFT
MULTILANE DIVIDED ROAD

LONG TERM

LAYOUT 6J-14

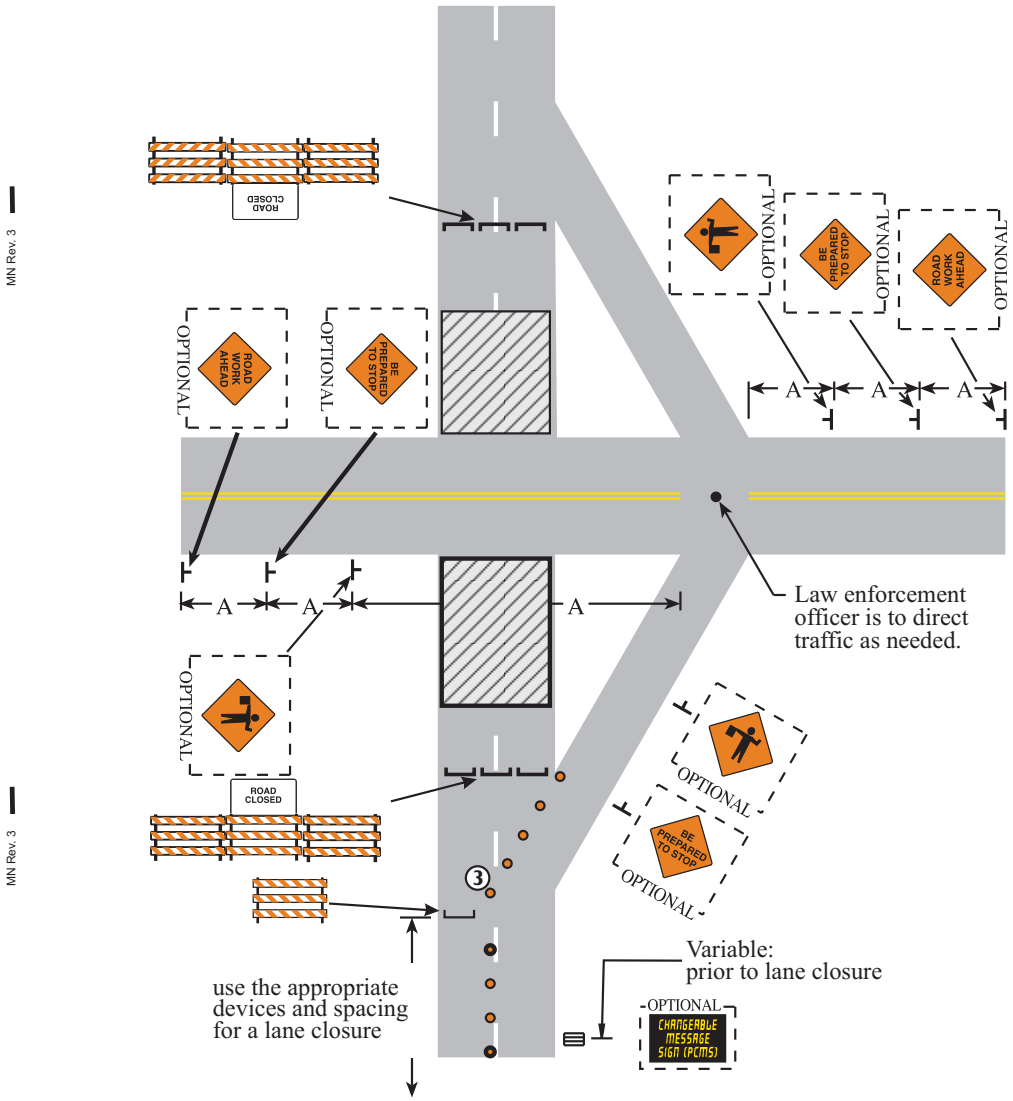
January, 2014

6J-14

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. The closed road volume should be below 800-1000 vehicles per hour.
3. Supplemental delineation such as chevrons, down arrows, etc. may be required in the bypass.



ROAD CLOSURE AT INTERCHANGE

SHORT TERM
LONG TERM

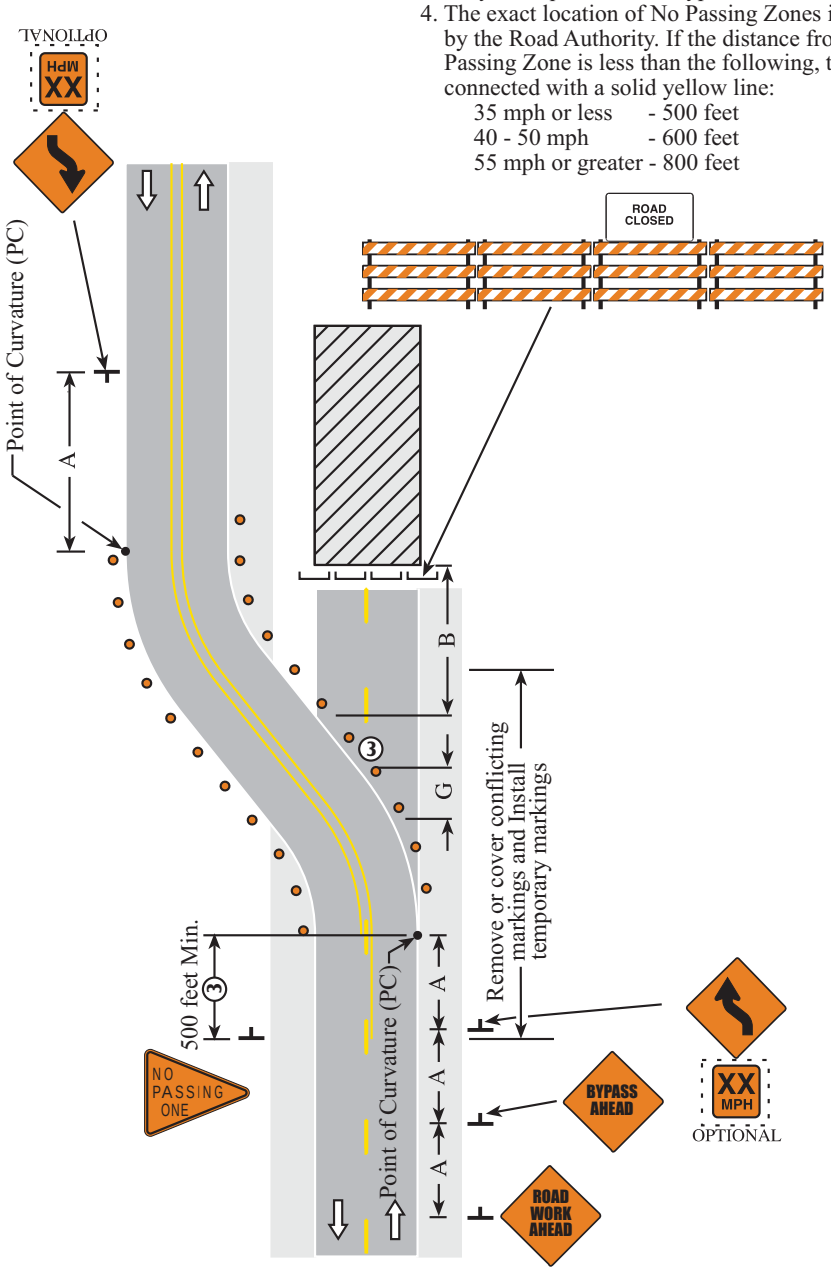
LAYOUT 6J-15

6J-15 January, 2014

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Typical traffic control is shown for one approach only.
3. Supplemental delineation (such as chevrons, down arrows, etc.) may be required on the bypass.
4. The exact location of No Passing Zones is to be determined by the Road Authority. If the distance from an inplace No Passing Zone is less than the following, the zones shall be connected with a solid yellow line:
   35 mph or less - 500 feet
   40 - 50 mph - 600 feet
   55 mph or greater - 800 feet



MN Rev. 3

ROAD CLOSURE WITH DIVERSION (BYPASS)
TWO-LANE, TWO-WAY ROAD

LONG TERM

LAYOUT 6J-16

January, 2014

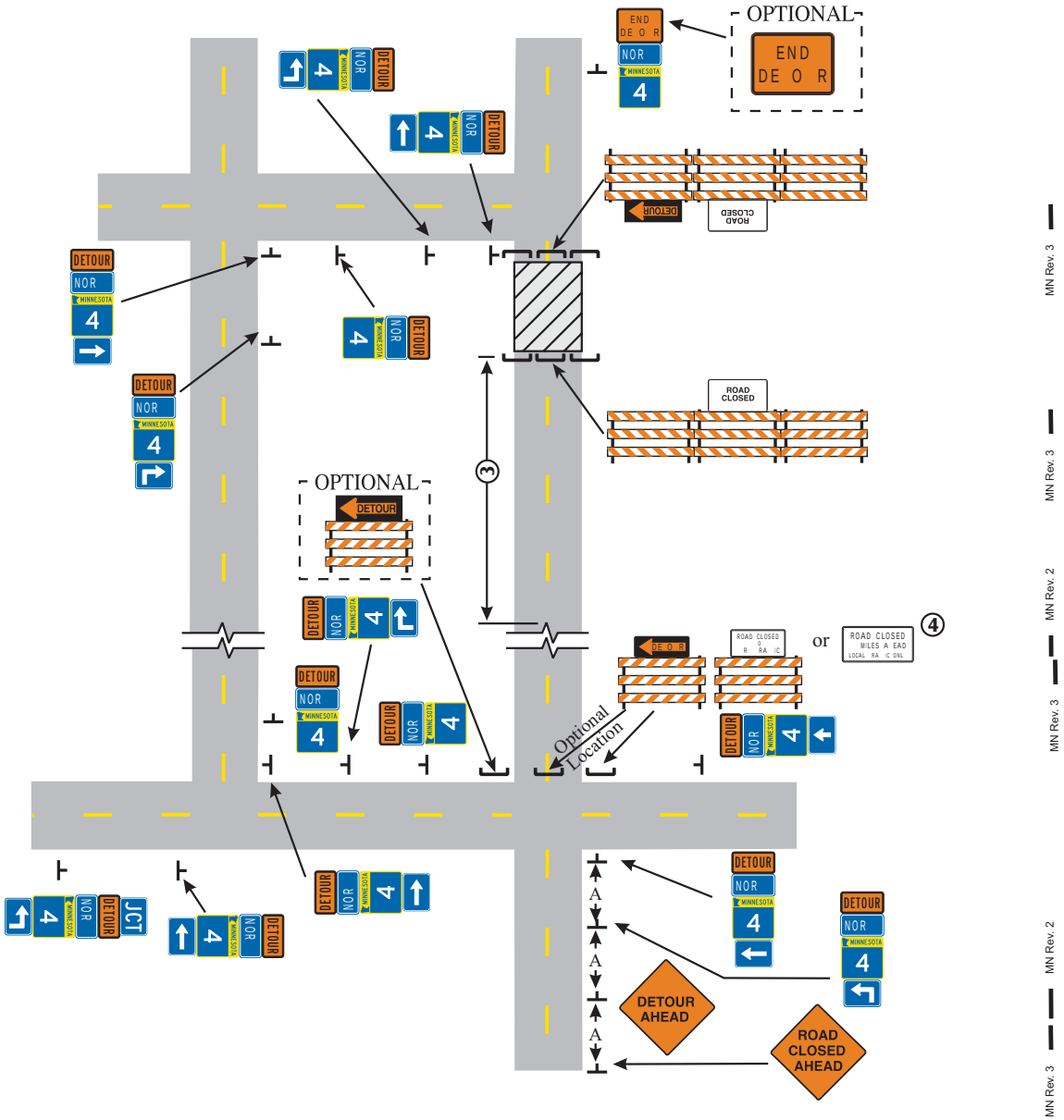
6J-16

HANDOUT

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Detour signing is shown for one direction only. The other direction shall be similar.
3. See Long Term Layout 6J-20 for devices and spacing.
4. Use this sign when it is 2 miles or greater to the road closure.



ROAD CLOSURE WITH DETOUR

LONG TERM

LAYOUT 6J-17

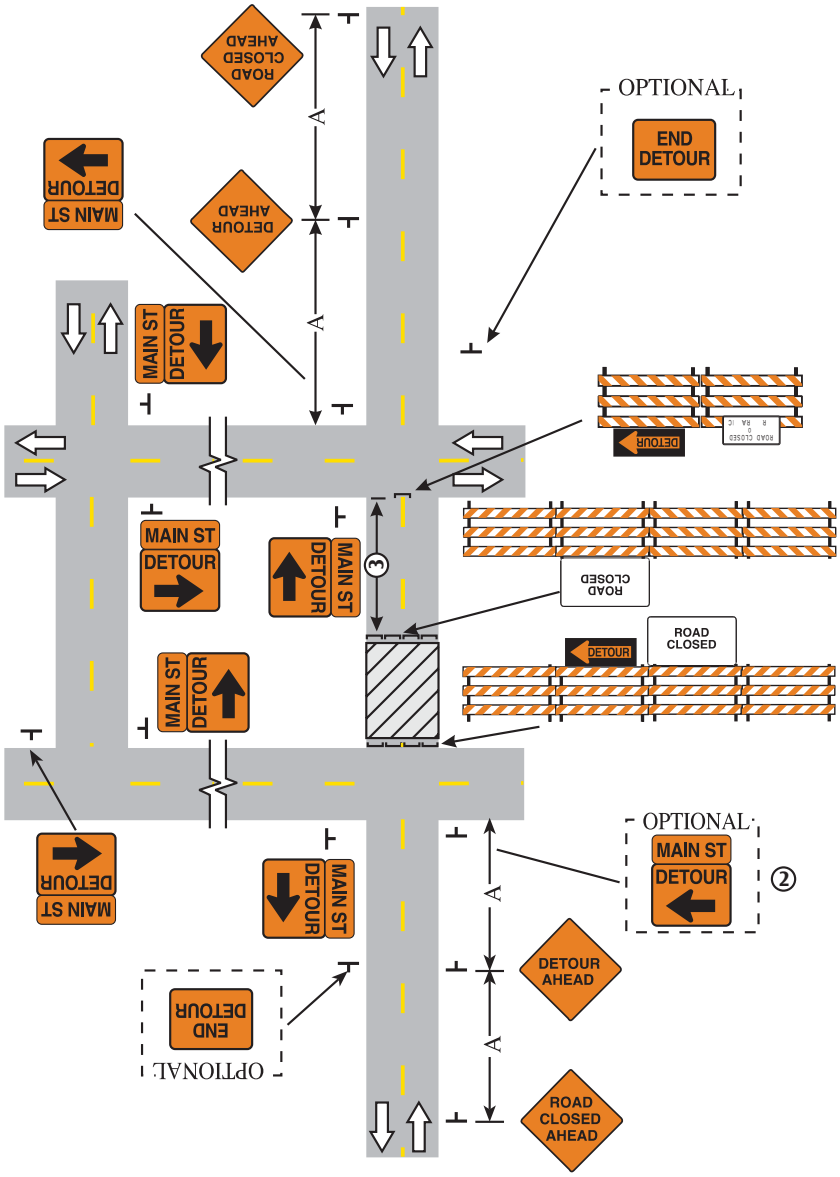
6J-17

January, 2014

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. A M4-9 Detour Sign with an advance turn arrow may be used in advance of a turn. On multi-lane streets, such signs should be used.
3. See Long Term Layout 6J-20 for devices and spacing.



MN Rev. 3

MN Rev. 3

DETOUR FOR CLOSED STREET

LONG TERM

LAYOUT 6J-18

January, 2014

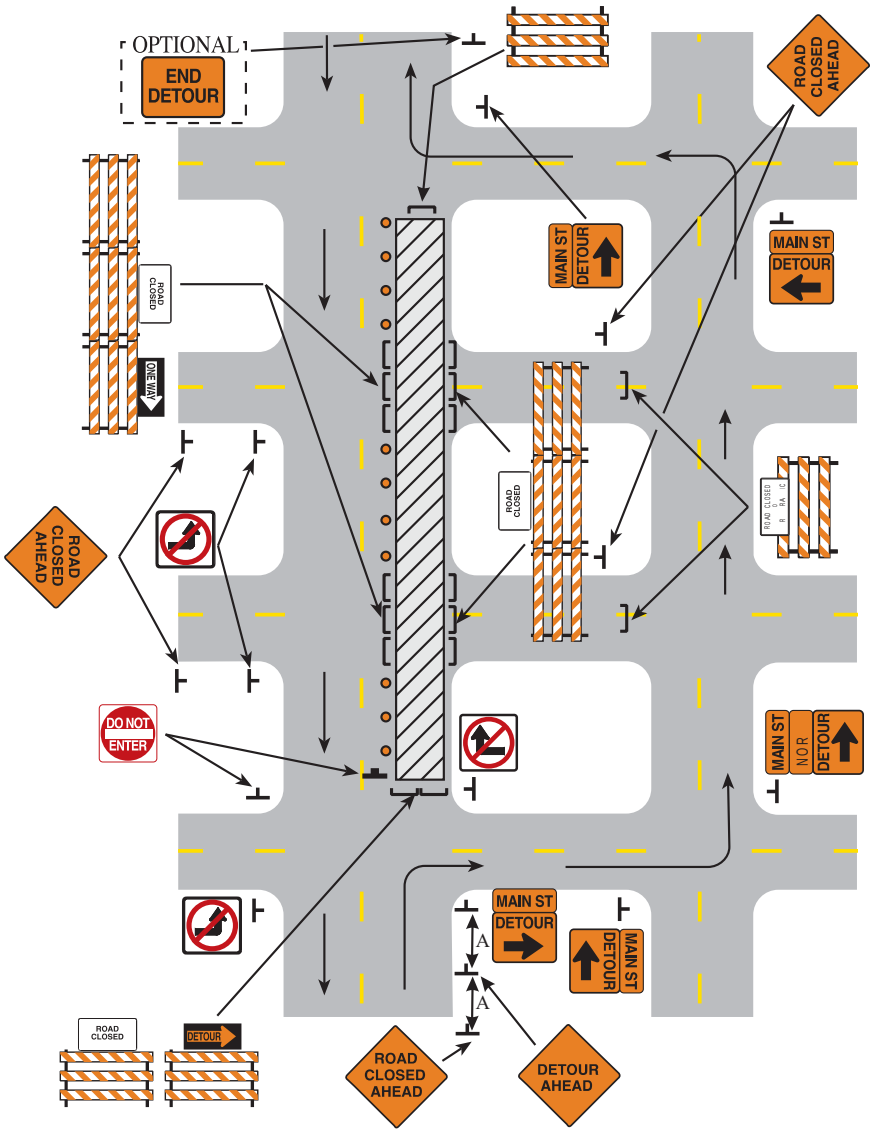
6J-18

HANDOUT

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Additional "DO NOT ENTER" signs may be desirable at intersections with intervening streets.
3. For sidewalk and crosswalk closures, see Layouts 6K-24 and 6K-25.
4. Additional side street signs may be required.



MN Rev. 3

DETOUR FOR ONE TRAVEL DIRECTION

LONG TERM

LAYOUT 6J-19

6J-19

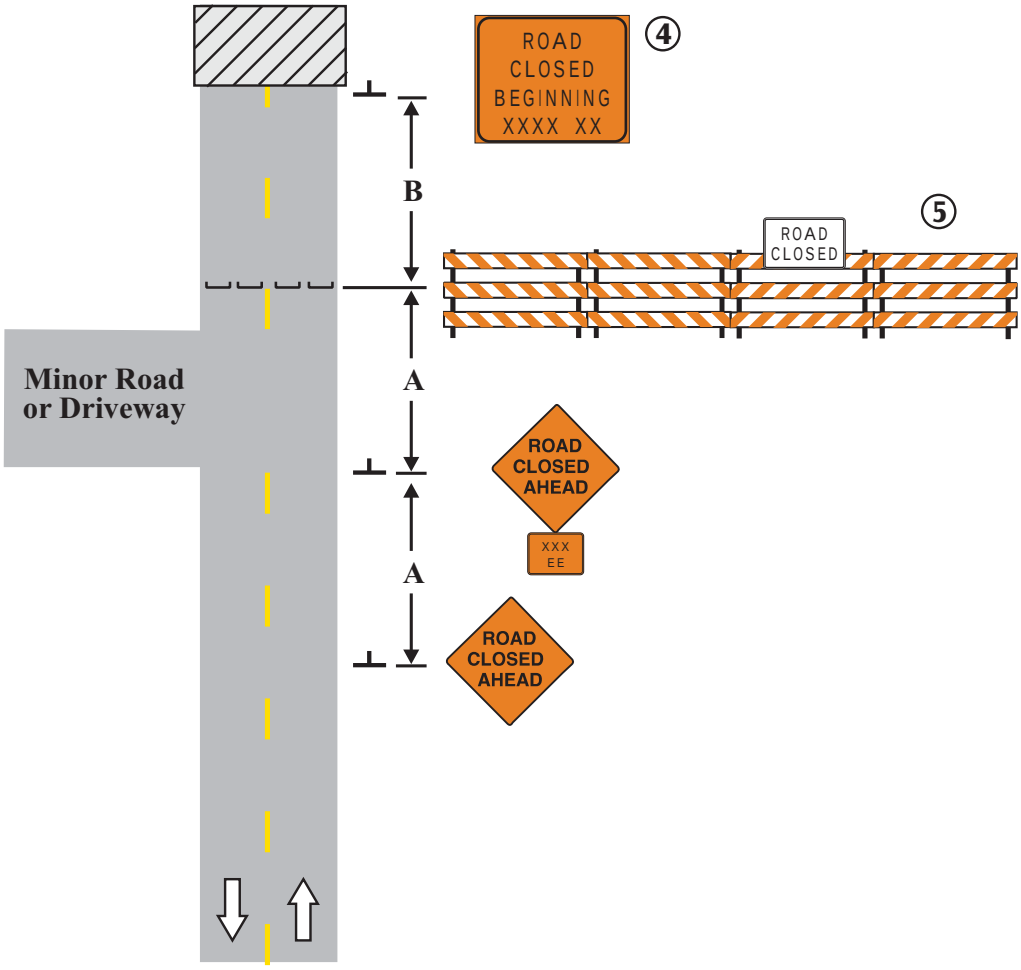
January, 2014

HANDOUT

MN Rev. 3

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. All devices are shown for one direction. Devices for the other direction should be similar.
3. The Road Authority will determine if a detour is required and specify the detour route.
4. Advance warning signs should be used seven days in advance of the closure.
5. Install at the last driveway or intersection beyond which there is no public access.



MN Rev. 3

MN Rev. 3

MN Rev. 3

TYPICAL SIGNING FOR ROAD CLOSURE

LONG TERM

LAYOUT 6J-20

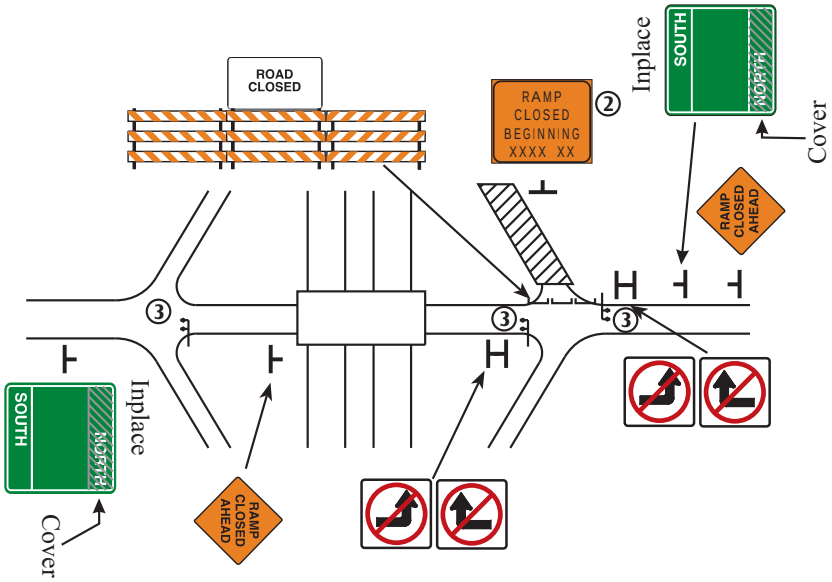
January, 2014

6J-20

HANDOUT

NOTES:

1. See page iii for Temporary Traffic Control Distance Charts.
2. Advance warning signs should be used seven days in advance of the closure.
3. Cover all directional signing for the closed ramp.



MN Rev. 3

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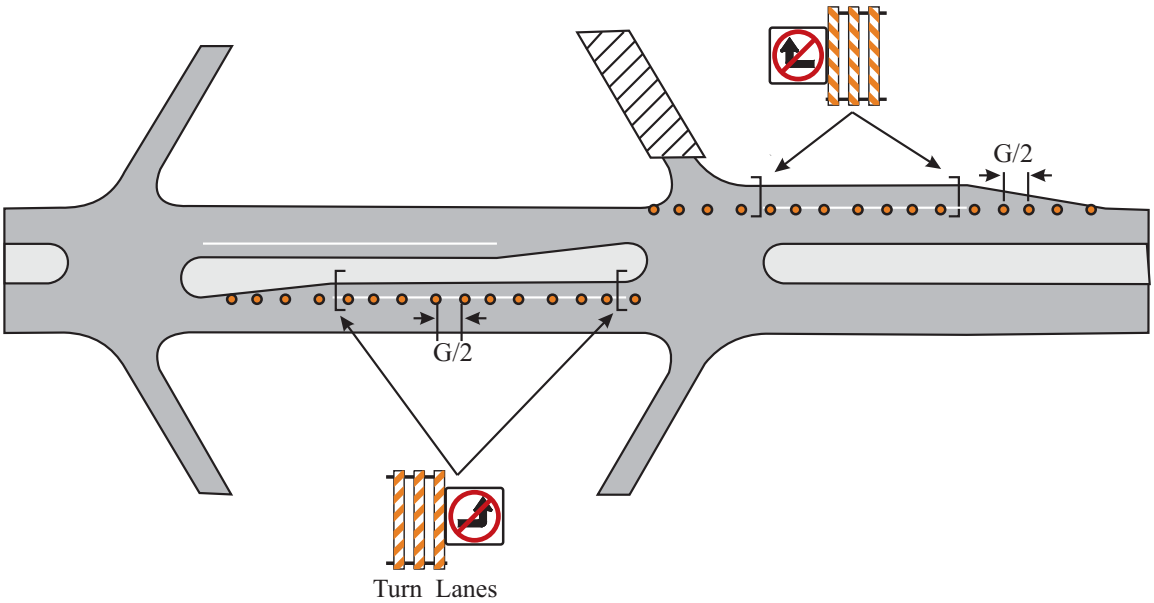


MN Rev. 3

MN Rev. 3

ENTRANCE RAMP CLOSURES

LONG TERM

LAYOUT 6J-21

6J-21

January, 2014

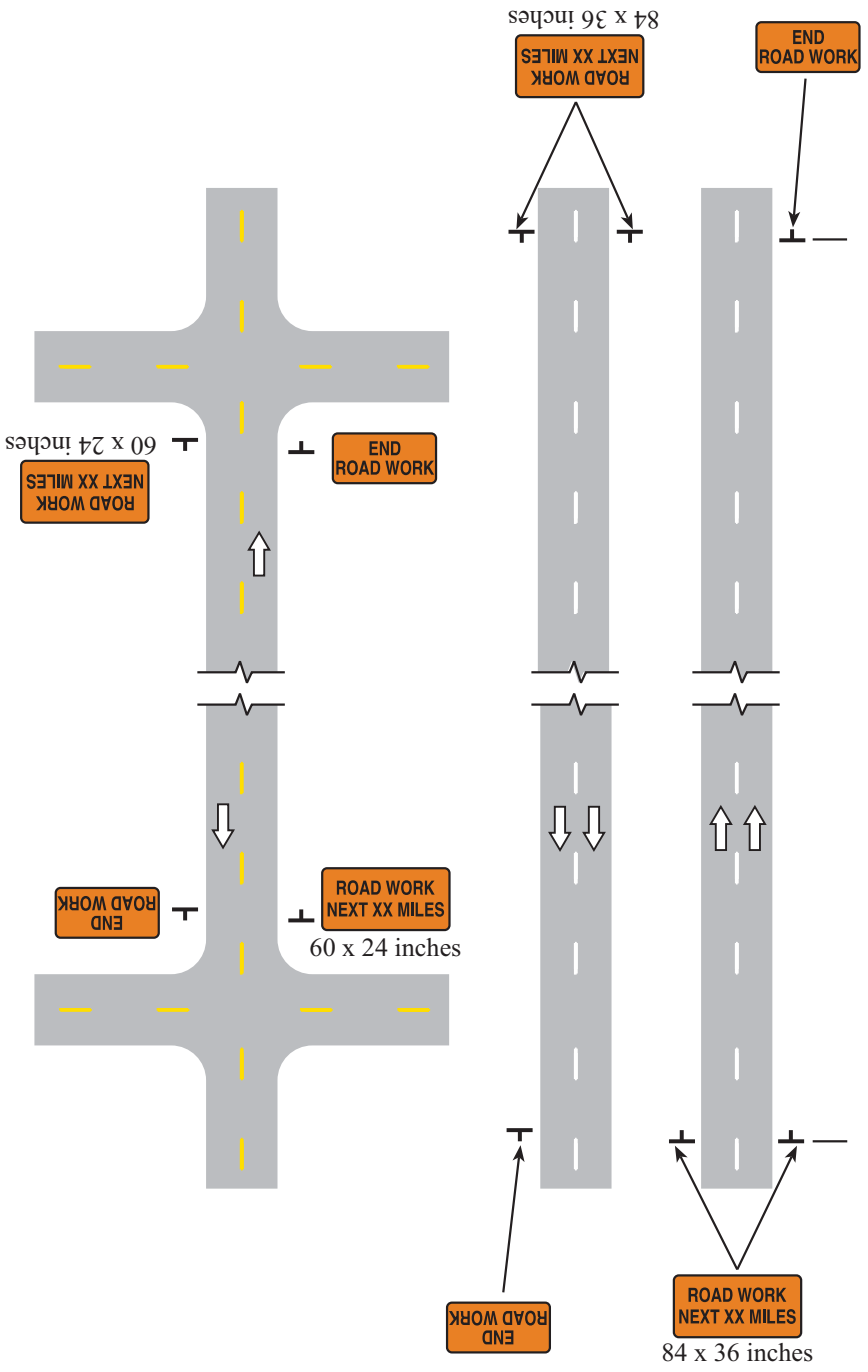
HANDOUT

HANDOUT

HANDOUT

HANDOUT

HANDOUT



TYPICAL TERMINI SIGNING

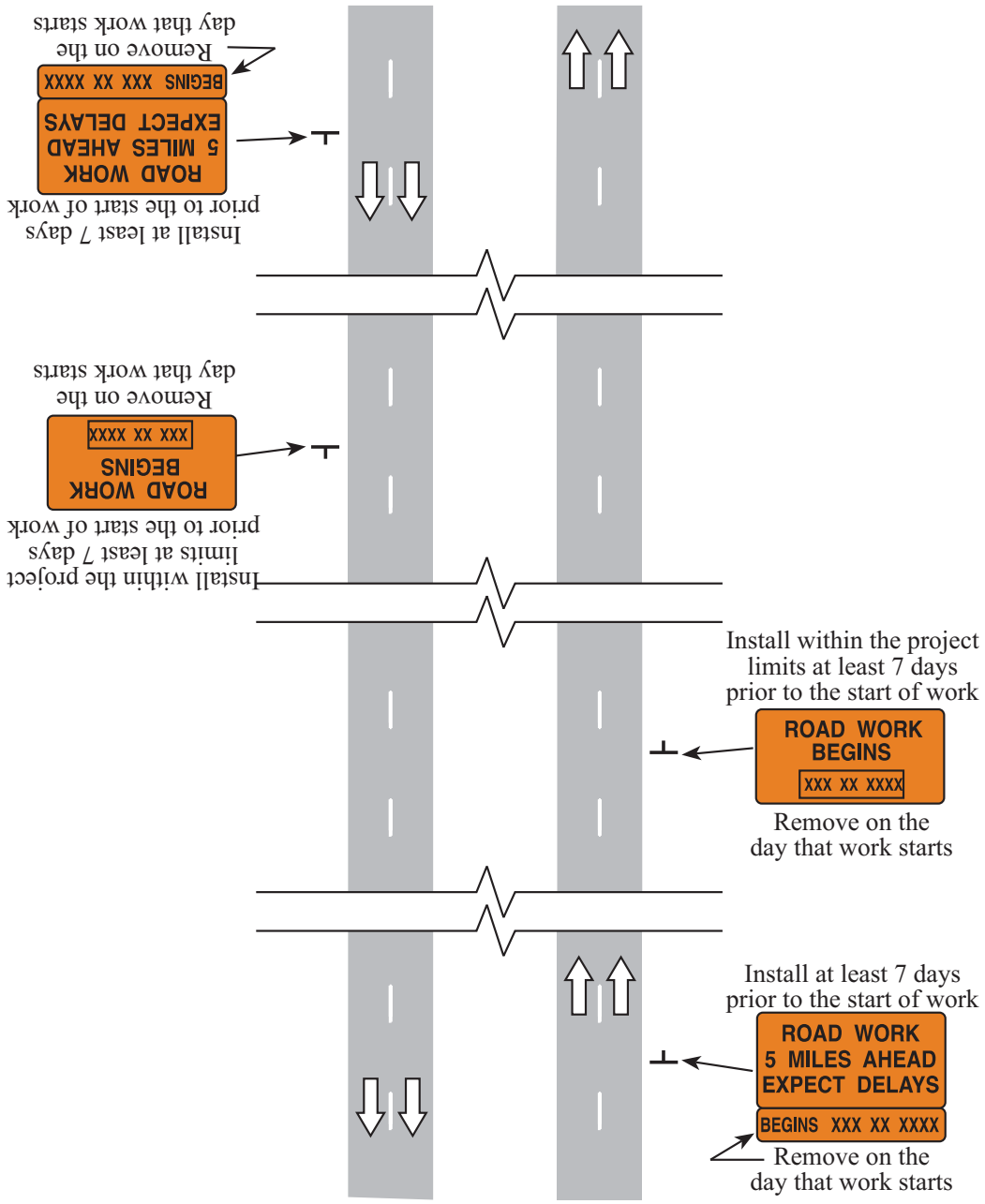
LONG TERM

LAYOUT 6J-22

December, 2011

6J-22

HANDOUT



TYPICAL ADVANCE SIGNING

LONG TERM

LAYOUT 6J-23

6J-23

December, 2011

HANDOUT

HANDOUT

MN Rev. 3

NOTES:

1. When crosswalks, sidewalks or other pedestrian facilities are blocked, closed or relocated, temporary facilities shall include accessibility features consistent with the features present in the existing pedestrian facility.

2. The examples show only key typical dimensions. Refer to the MnDOT "Temporary Pedestrian Access Route" (TPAR) website (http://www.dot.state.mn.us/trafficeng/workzone/tpar.html) for standards, guidance and options when blocking, closing, or relocating pedestrian facilities.

3. Only traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets.

4. An approved audible message device or tactile message should be provided for sight-impaired pedestrians. When used, a message device should provide a complete physical description of the temporary pedestrian detour including duration, length of (and/or distance to) the bypass, any restrictions or hazards and project information as listed in note 5 below. The number and location of devices should be determined for each project prior to starting work. Devices may be placed prior to sidewalk work to warn regular users of the planned work.

5. Typical sign message for a temporary pedestrian detour should include information such as the duration of the walkway restrictions (beginning and/or end dates) and a project contact number for 24/7 questions or reporting hazards.

6. The International Symbol of Accessibility should be displayed when any walkway through a work zone has been determined to be TPAR compliant. The Symbol of Accessibility shall not be displayed if persons with disabilities should not use the primary temporary pedestrian detour. The reason for the non-compliance should be posted and an alternate route should be posted when the primary temporary pedestrian detour is non-complaint to TPAR standards.

7. Conditions that are beyond recommended standards should be documented. A walkway is non-compliant if it is missing key ADA elements such as curb ramp(s), truncated domes, and detectable edging. Other restrictions or hazards may include insufficient width or pinch-point widths, traffic conflicts, steep grades, non-continuous railings, tripping hazards, or uneven/rough/soft surface conditions, etc.

8. Pedestrian traffic signal displays controlling closed crosswalks shall be covered. Temporary pedestrian signals should be considered when creating a new crossing location.

9. Curb marking shall be prohibited for a minimum of 30 feet in advance of the mid-block pedestrian crossing. Crosswalk marking shall be installed and conflicting marking removed or covered. Curb ramps with detectable warnings shall be provided to transition from the sidewalk to the crosswalk.

10. Pedestrian detour trailblazing signs should be used if the pedestrian detour is located someplace other than across the street from the sidewalk closure.

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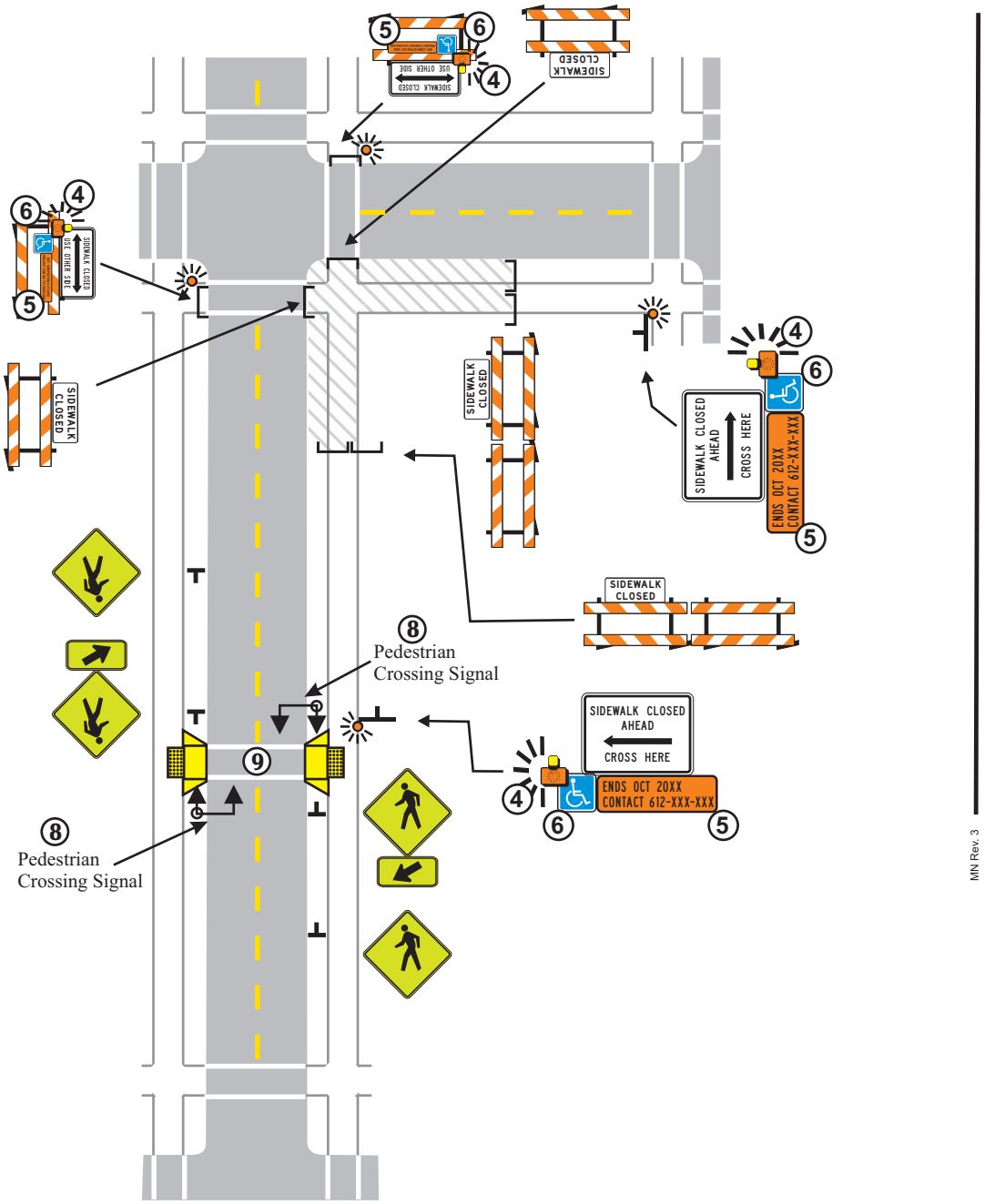
CROSSWALK CLOSURES AND PEDESTRIAN DETOURS

LONG TERM LAYOUT 6J-24a

January, 2014 6J-24a

HANDOUT



CROSSWALK CLOSURES AND PEDESTRIAN DETOURS

LONG TERM

LAYOUT 6J-24b

6J-24b

January, 2014

HANDOUT

HANDOUT

MN Rev. 3

NOTES:

1. When crosswalks, sidewalks or other pedestrian facilities are blocked, closed or relocated, temporary facilities shall include accessibility features consistent with the features present in the existing pedestrian facility.

2. The examples show only key typical dimensions. Refer to the MnDOT "Temporary Pedestrian Access Route" (TPAR) website (**http://www.dot.state.mn.us/trafficeng/workzone/tpar.html**) for standards, guidance and options when blocking, closing, or relocating pedestrian facilities.

3. Where high speeds and/or high traffic volumes are anticipated, barrier should be used to separate the temporary pedestrian walkway from vehicular traffic. When used, barriers shall be installed as detailed in the MN MUTCD, Part 6F.

4. Only traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets.

5. When both sides of a temporary pedestrian bypass require channelizing devices, then the devices should be a similar type (railing system, barricade, or fencing system), excluding when TTC barrier (such as concrete barrier) is used to protect pedestrians from an open traffic lane.

6. An approved audible message device or tactile message should be provided for sight-impaired pedestrians. When used, a message device should provide a complete physical description of the temporary pedestrian by-pass including duration, length of (and/or distance to) the bypass, any restrictions or hazards and project information as listed in note 7 below. The message device(s) may also describe an alternate route. The number and location of devices should be determined for each project prior to starting work. Devices may be placed prior to sidewalk work to warn regular users of the planned work.

7. Typical sign message for a temporary pedestrian bypass should include information such as the duration of the walkway restrictions (beginning and/or end dates) and a project contact number for 24/7 questions or reporting hazards.

8. The International Symbol of Accessibility should be displayed when any walkway through a work zone has been determined to be TPAR compliant. The Symbol of Accessibility shall not be displayed if persons with disabilities should not enter the temporary pedestrian bypass. An alternate route should be posted when the temporary pedestrian bypass is non-complaint to TPAR standards.

9. Conditions that are beyond recommended standards should be documented. A walkway is non-compliant if it is missing key ADA elements such as curb ramp(s), truncated domes, and detectable edging. Other restrictions or hazards may include insufficient width or pinch-point widths, traffic conflicts, steep grades, non-continuous railings, tripping hazards, or uneven/rough/soft surface conditions, etc.

10. When a sidewalk is closed but workers are present who will provide assistance or directions to pedestrians, then the devices as shown are not required.

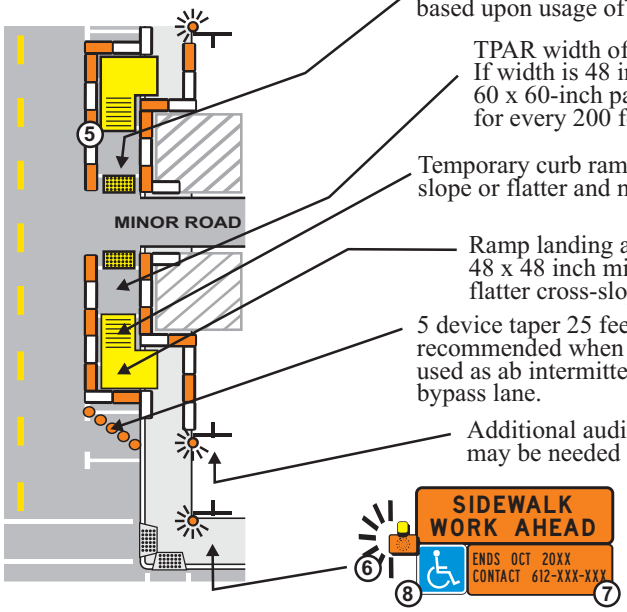
SIDEWALK BYPASS

LONG TERM LAYOUT 6J-25a

January, 2014 **6J-25a**

HANDOUT

LOW-SPEED ROADWAY



Temporary truncated domes, optional based upon usage of cross-street

TPAR width of 60 inches is preferred. If width is 48 inch, then at least one 60 x 60-inch passing space is required for every 200 feet of length.

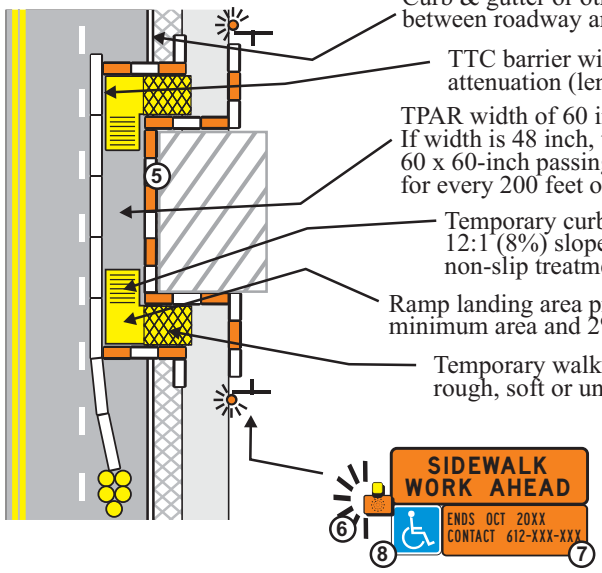
Temporary curb ramp providing 12:1 (8%) slope or flatter and non-slip treatment added

Ramp landing area providing 48 x 48 inch minimum area and 2% or flatter cross-slope

5 device taper 25 feet long (1 stall), recommended when the closed area was used as ab intermittent traffic lane or bypass lane.

Additional audible message devices may be needed for route information

HIGH-SPEED ROADWAY or LOW-SPEED MULTI-LANE



Curb & gutter or other transition between roadway and sidewalk

TTC barrier with taper and attenuation (length as required)

TPAR width of 60 inches is preferred. If width is 48 inch, then at least one 60 x 60-inch passing space is required for every 200 feet of length.

Temporary curb ramp providing 12:1 (8%) slope or flatter and non-slip treatment added

Ramp landing area providing a 48 x 48 inch minimum area and 2% or flatter cross-slope

Temporary walkway surface covering rough, soft or uneven ground or hazards

MN Rev. 3

SIDEWALK BYPASS

LONG TERM

LAYOUT 6J-25b

6J-25b

January, 2014

HANDOUT

4.4 TTC Template Sheets for Stationary Work Zones

Temporary Traffic Control Plans for MnDOT projects follow a general format of style and information. Therefore, MnDOT maintains and provides a series of template layout sheets in DGN and PDF formats. These templates can be obtained from the following webpage:

http://www.dot.state.mn.us/trafficeng/workzone/ttctemplates.html.

The template sheets listed on the website may be added to a TTC Plan as needed for a project. The template sheet files (DGN format) may be imported into any TTC plan, but each template must be edited to comply with project specific construction situations. DESIGN NOTES are included on most template sheets and the designer should use them to make appropriate design considerations. When the final traffic control sheets are placed into the construction plans, all variables should be determined and entered on the sheet(s) directly, the engineering should sign this and all the designer notes and charts should be removed from the sheets.

Exhibit 4-1 TTC Plan Template Sheets Website

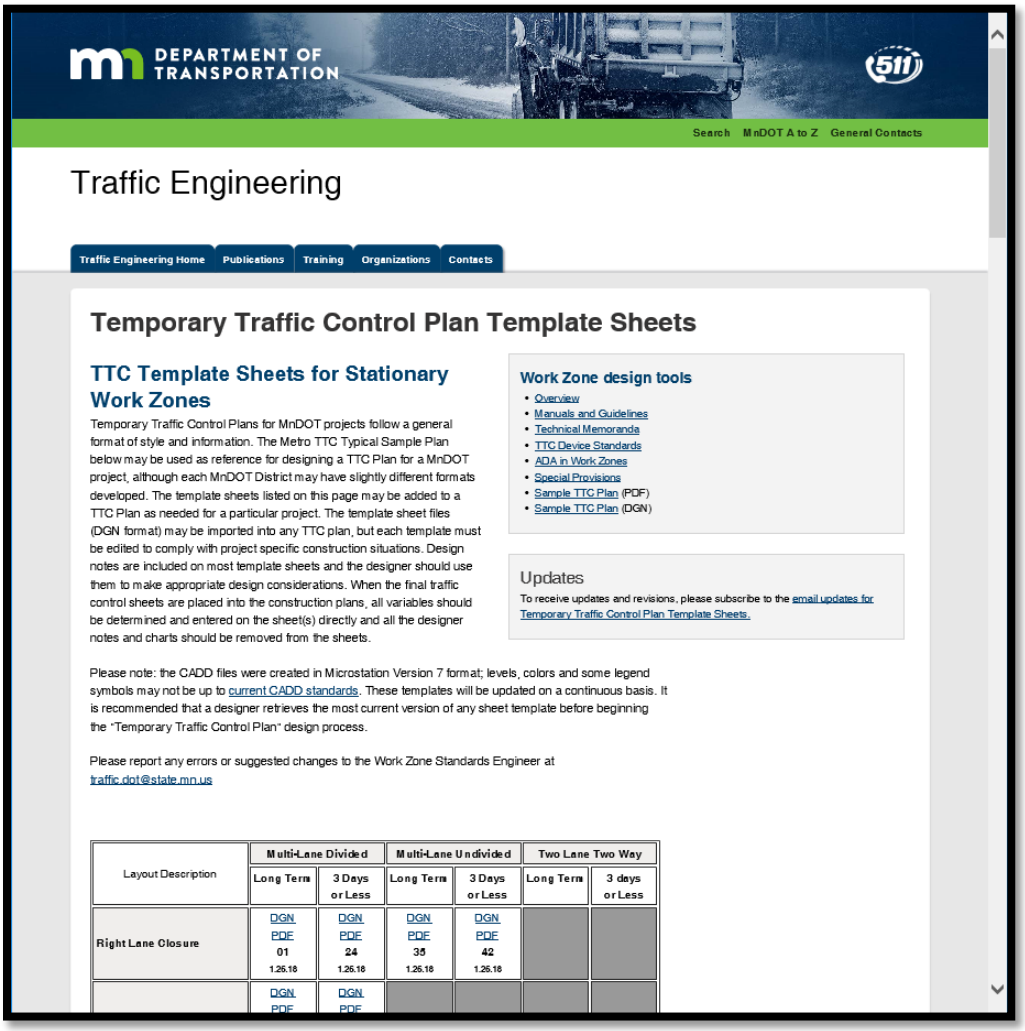
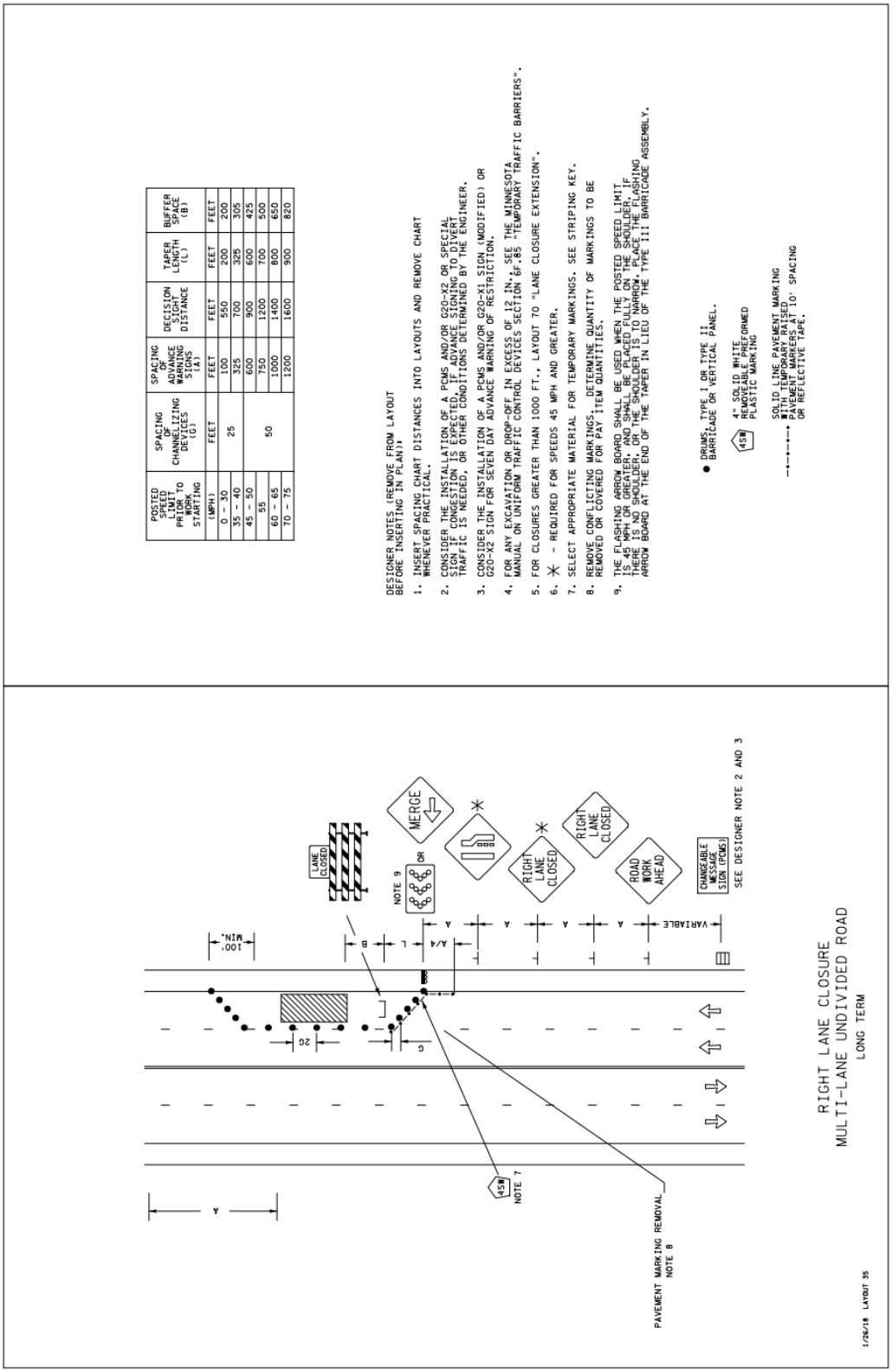


Exhibit 4-2 Sample Template, Right Lane Close, Multi-Lane Undivided (Long Term)



POSTED SPEED LIMIT PRIOR TO WORK STARTING (MPH)	SPACING OF CHANNELIZING DEVICES (G)	SPACING OF ADVANCE WARNING SIGNS (A)	DECISION SIGHT DISTANCE	TAPER LENGTH (L)	BUFFER SPACE (B)
	FEET	FEET	FEET	FEET	FEET
0 – 30	25	100	550	200	200
35 – 40		325	700	325	305
45 – 50	50	600	900	600	425
55		750	1200	700	500
60 – 65		1000	1400	800	650
70 – 75		1200	1600	900	820

DESIGNER NOTES (REMOVE FROM LAYOUT BEFORE INSERTING IN PLAN)

1. INSERT SPACING CHART DISTANCES INTO LAYOUTS AND REMOVE CHART WHENEVER PRACTICAL.
2. CONSIDER THE INSTALLATION OF A PCMS AND/OR G20-X2 OR SPECIAL SIGN IF CONGESTION IS EXPECTED, SPEEDS ARE HIGH, OR THE TRAFFIC IS NEEDED, OR OTHER CONDITIONS DETERMINED BY THE ENGINEER.
3. CONSIDER THE INSTALLATION OF A PCMS AND/OR G20-X1 SIGN (MODIFIED) OR G20-X2 SIGN FOR SEVEN DAY ADVANCE WARNING OF RESTRICTION.
4. FOR ANY EXCAVATION OR DROP-OFF IN EXCESS OF 12 IN., SEE THE MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES SECTION 6F.85 "TEMPORARY TRAFFIC BARRIERS".
5. FOR CLOSURES GREATER THAN 1000 FT., LAYOUT TO "LANE CLOSURE EXTENSION".
6. ✳ - REQUIRED FOR SPEEDS 45 MPH AND GREATER.
7. SELECT APPROPRIATE MATERIAL FOR TEMPORARY MARKINGS. SEE STRIPING KEY.
8. REMOVE CONFLICTING MARKINGS. DETERMINE QUANTITY OF MARKINGS TO BE REMOVED OR COVERED FOR PAY ITEM QUANTITIES.
9. THE FLASHING ARROW BOARD SHALL BE USED WHEN THE POSTED SPEED LIMIT IS 45 MPH OR GREATER, AND SHALL BE PLACED FULLY ON THE SHOULDER. IF THERE IS NO SHOULDER, OR THE SHOULDER IS TO NARROW, PLACE THE FLASHING ARROW BOARD AT THE END OF THE TAPER IN LIEU OF THE TYPE III BARRICADE ASSEMBLY.

● DRUMS, TYPE I OR TYPE II, BARRICADE OR VERTICAL PANEL.

4" SOLID WHITE PREFORMED PLASTIC MARKING

SOLID LINE PAVEMENT MARKING WITH TEMPORARY RAISED PAVEMENT MARKERS AT 10' SPACING OR REFLECTIVE TAPE.

Exhibit 4-3 Sample Template, Active Zipper, Left Lane Closed, Multi-Lane Divided

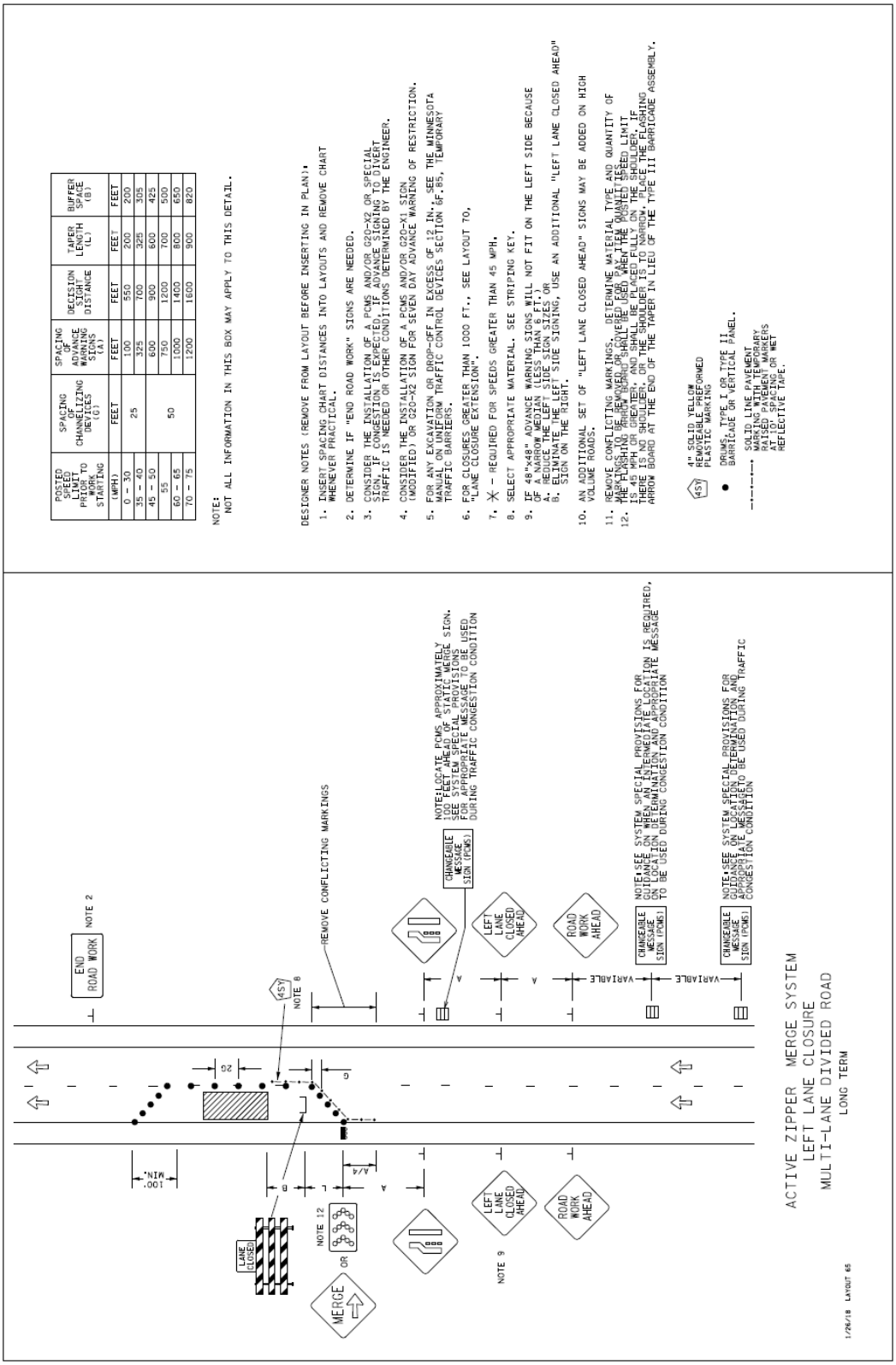


Exhibit 4-4 Sample Template, Multi-Lane Shift, Multi-Lane Divided

POSTED SPEED LIMIT PRIOR TO WORK STARTING	SPACING OF CHANNELIZING DEVICES (S)	SPACING OF ADVANCE WARNING SIGNS (A)	DECISION SIGHT DISTANCE	TAPER LENGTH (L)	BUFFER SPACE (B)
(MPH)	FEET	FEET	FEET	FEET	FEET
0 – 30	25	100	550	200	200
35 – 40		325	700	325	305
45 – 50	50	600	900	600	425
55		750	1200	700	500
60 – 65		1000	1400	800	650
70 – 75		1200	1600	900	820

NOTE:
NOT ALL INFORMATION IN THIS BOX MAY APPLY TO THIS DETAIL.

DESIGNER NOTES (REMOVE FROM LAYOUT BEFORE INSERTING IN PLAN):

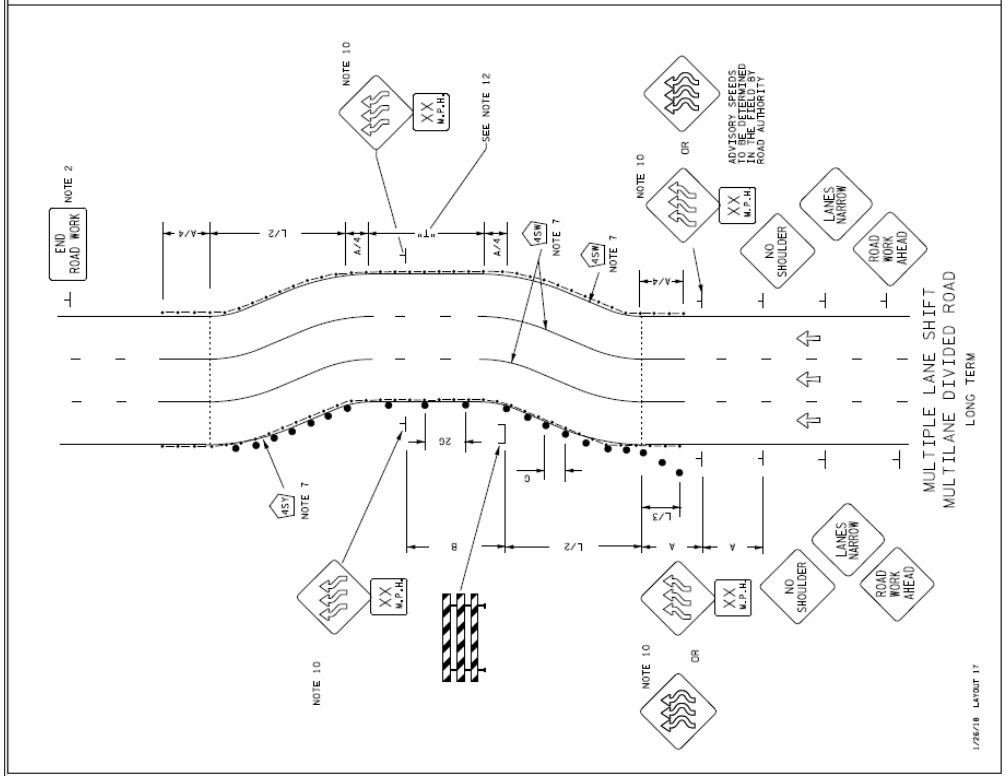
1. INSERT SPACING CHART DISTANCES INTO LAYOUTS AND REMOVE CHART WHENEVER PRACTICAL.
2. DETERMINE IF "END ROAD WORK" SIGNS ARE NEEDED.
3. CONSIDER THE INSTALLATION OF A PCMS AND/OR CRC-V2 OR SPECIAL SIGNS WHEN ADVANCE WARNING OF UNUSUAL OR HEAVY TRAFFIC IS NEEDED OR OTHER CONDITIONS DETERMINED BY THE ENGINEER.
4. CONSIDER THE INSTALLATION OF A PCMS AND/OR CRC-X1 SIGN (MODIFIED) OR CRC-X2 SIGN FOR SEVEN DAY ADVANCE WARNING OF RESTRICTION.
5. FOR ANY EXCAVATION OR DROP-OFF IN EXCESS OF 12 IN., SEE THE MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES SECTION 6F.85 "TEMPORARY TRAFFIC BARRIERS".
6. FOR CLOSURES GREATER THAN 1000 FT., SEE LAYOUT TO, "LANE CLOSURE EXTENSION".
7. SELECT APPROPRIATE MATERIAL FOR TEMPORARY MARKINGS. SEE STRIPING KEY.
8. LIST ALL DIRECTIONAL SIGNING THAT MUST BE COVERED, REMOVED OR MODIFIED BECAUSE OF RESTRICTIONS.
9. REMOVE CONFLICTING MARKINGS. DETERMINE QUANTITY OF MARKINGS TO BE REMOVED OR COVERED FOR PAY ITEM QUANTITIES.
10. IF "T" IS LESS THAN 600' USE THE BYPASS SIGN. IF "T" IS GREATER THAN 600' USE THE REVERSE CURVE SIGN.
11. THE MINIMUM LANE WIDTH SHALL BE 10 FEET.
12. USE SKIP MARKING IF "T" IS GREATER THAN 600. IF "T" IS LESS THAN 600' USE STANDARD MARKING. CONSIDER ON SHARP CURVES, PAVEMENT COLOR CONFLICTS, REDUCTION OF SPEED (10-15 MPH BELOW POSTED), OR IF OVER WINTER.

4" SOLID YELLOW REMOVEABLE PREFORMED PLASTIC MARKING

4" SOLID WHITE REMOVEABLE PREFORMED PLASTIC MARKING

DRUMS, TYPE I OR TYPE II BARRICADE OR VERTICAL PANEL.

SOLID LINE PAVEMENT MARKING WITH TEMPORARY RAISED PAVEMENT MARKERS AT 40' SPACING OR WET REFLECTIVE TAPE.



5. WORK ZONE PLAN SETS

Typical layout detail sheets for traffic control plans can be found on the OTE website: www.dot.state.mn.us/trafficeng/

Traffic control plans are generally a portion of a larger construction project. They will be included in the overall project plans and will have sheet numbers that begin with "TC" (i.e., TC1, TC2, etc.).

Some of the sheets found on a TTC plan include, but are not limited to:

- ✓ Title Sheet
  - For Overall Plan
  - For TC Section
- ✓ Pay Item Tabulation Sheet
- ✓ Traffic Control Tabulation Sheet
- ✓ Special Signs
- ✓ Narrative
- ✓ Advanced Signing
- ✓ Detours
- ✓ Traffic Control Staging Sheets (Layout Sheets)
- ✓ Typical Sheets (Refer to Section 4.4)
- ✓ Standard Plan Sheets

Standard Plates used on the project should be identified on the Title Sheet.

The licensed professional engineer responsible for or under whose supervision the work is performed shall sign the title sheet.

A traffic control plan should be developed for any 3-day or more effort. For 3 days or less, the field manual may be used.

When plans are used, the field manual can be referenced. Even if the event is less than 3-days, a plan may still be required due to complexity.

A sample plan set is included in the Appendix on page 7-1. Most of the images shown in this Chapter come from the sample plan set. To see them in larger detail, refer to the Appendix handout. In addition, a few of the images come from other sources to illustrate items that may not be included in the sample plan. The MnDOT Work Zone website includes a small sample plan that can be downloaded from:

www.dot.state.mn.us/trafficeng/workzone/index.html

5.1 TTC Plan Development

5.1.1 General Information

During the roadway plan development, designers must be aware of the need for a Traffic Control Plan. The Plan will contain temporary traffic control devices (See Chapter **3, TTC Devices**). These devices include barrels, cones, barricades, temporary signing, temporary striping, etc. and are used to direct and assist drivers in safely moving through the construction area.

It is important to note that the Project Manager is responsible for the TMP (see Section **2.7** and **2.8**). This TMP will be valuable when developing the traffic control plans.

To develop the Traffic Control Plan, coordination meetings between Design, Construction and the Traffic Engineering Section are recommended throughout the duration of the project. The number and extent of these meetings will depend on the complexity, length, and duration of the project. Construction is a valuable resource since they can provide the time frames necessary for construction activities.

The Designer will likely need to provide construction sheets or general layout sheets (hard copy or electronic copy) to the Traffic Engineering Section for them to use as a base map to draft their traffic control plan.

The Traffic Engineering Section will develop their temporary traffic control plans based on three documents: the Traffic Engineering Manual, most recent date, the Minnesota Manual on Uniform Traffic Control Devices for Streets and Highways, most recent date and the Transportation Management Plan (TMP) for the project (See Section **2.4**).

Designers can expect from the Traffic Engineering Section, a plan, a list of construction items and quantities to include into the Estimated Quantities tabulation. Note that the pay item numbers associated with the construction items should only be shown once, in the Estimated Quantities tabulation.

The Traffic Engineering Section should provide tabulation (within their plan) of their construction items for Design to reference and include in the Estimated Quantities tabulation.

The Designer should also add any Traffic Control Standard Plates i.e. 8000, 8337, etc. on to the list of project specific Standard Plates or make a reference to them.

The Traffic Control Plan sheets should also be included in the plan as shown on the Title Sheet's index. Page numbers for the Traffic Control Plan sheets will need to be coordinated after they are determined.

5.1.2 Standard Plates

Standard plates are approved by Department staff and Federal Highway Administration for the various structures essential to highway design and construction. They are for use by manufacturing firms in supplying products of culverts, sewers, erosion controls, signals, lights, guardrails, fences, etc. Also, standard drawings are used by contractors in constructing pavement, curb and gutters, retaining walls, miscellaneous structures, and in installing traffic barriers, fences, signals, lights, etc. The most current Standard Plates can be found at the following website:

http://standardplates.dot.state.mn.us/StdPlate.aspx.

5.1.3 MnDOT Plan Assembly Steps

As the designer progresses through the following numbered sequential steps in assembling a complete plan, refer to the appropriate sheets in the sample plans for clarification. The sample plan may be downloaded from the MnDOT OTE website in whole or in parts (e.g. the entire plan is saved in Adobe Reader Format .pdf and portions of the plan are available in Microstation Design File Format .dgn, such that these sheets may be included directing into a new plan).

1. To begin the **MnDOT** process, you'll start with ProjectWise.
2. Obtain the existing construction plans, including any staging.
3. Eliminate levels of detail (buildings, lot lines, etc) on roadway plan sheets.

   REASON: So placement of traffic control devices on roadway sheets are not cluttered by underlying details.

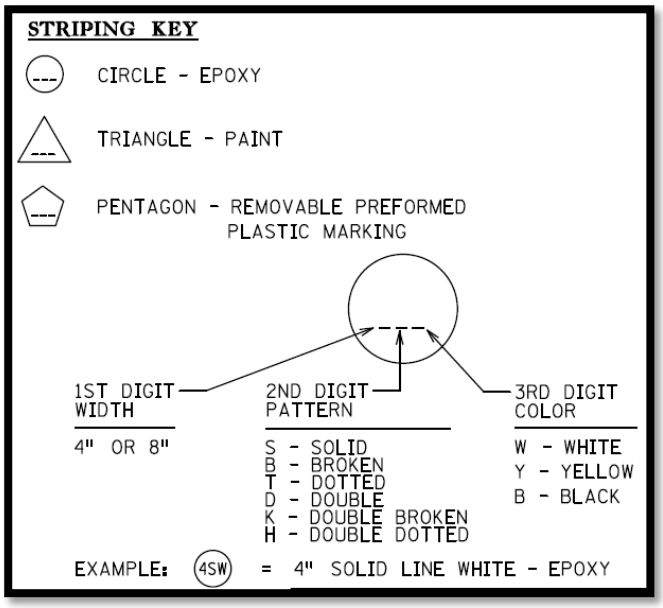
4. Organize roadway plan sheets: all mainline roadway comes first with stationing generally increasing from left to right (include roadway through interchanges for depicting mainline TC through the interchange; next are interchange/intersection layouts for indicating TC on cross streets and at ramp terminals).

   REASON: Consistency in design.

5. Place traffic control elements on the roadway plan sheets for each direction of travel. Refer to the discussions in Chapter 3 (**TTC Devices**) and Chapter 4 (**Work Zone Applications**). Also refer to the typical drawings, TEM Chapter 8, the MUTCD Chapter 6 and other sources as noted in Section **2.4)**. Place signs on plan sheets as the signs would appear to a motorist (placement and spacing of signs are detailed in the MN MUTCD and the TEM, Chapter 6).

   NOTE: It is important for the designer to make a field review to confirm the layout and discover issues that are not shown on the plan set.

6. Label each type of pavement marking with the following numbering system:



   REASON: The uniqueness of each pavement marking material is bid differently by contractors.

   NOTE: These keys do change over time. Be sure to ensure that the latest convention is used.

7. For a detour plan, a circled note below the sign on the layout sheet indicates the action to take with the sign. Typical notes show include:

NOTES:
1. F. & I.
2. INPLACE
3. SALVAGE
4. REMOVE
5. REMOVE SIGN TYPE C
6. INSTALL
7. F. & I. SIGN PANEL OVERLAY(S)

F. & I. = Furnish and Install

INPLACE = Signs to keep inplace

SALVAGE = Signs that should be salvaged

REMOVE = Signs that should be removed

INSTALL = Signs that should be installed

8. Prepare list of standard plates applicable to project.
9. Prepare list of estimated quantities using the total quantity from each of the data boxes.
10. Assemble all necessary typical sheets.
11. Complete the title sheet.
12. Assemble ALL the plan sheets in the proper order.
13. Number the roadway sheets sequentially beginning with the Title Sheet as Sheet TC1.
14. Fill in, and check, all sheet cross referencing throughout the plan.

The following is a simplified checklist for your plan set.

TRAFFIC CONTROL PLAN --------- CHECKLIST

____ 1. Stationing shown

____ 2. Roadways Labeled

____ 3. North Arrow

____ 4. Bypasses shown and labeled

____ 5. Temporary Traffic Control Devices shown

____ 6. Staged construction shown, if applicable

____ 7. Legend

____ 8. Pay Items correspond with those shown in AASHTOware

____ 9. Detours shown, if applicable

____ 10. Tab Letter and Sheet Numbers

____ 11. Bar Scale

____ 12. Cross references to other sheets (as applicable)

____ 13. Traffic Engineer's signature

Item 8 references the AASHTOWare list for Pay Items. The AASHTOWare list can be found at: http://bidlet.dot.state.mn.us/ItemSearch.aspx.

5.1.4 Metro District Traffic Control Plan Checklist

The following pages are the Metro District Traffic Control checklist that can be used during plan set development. The first sheet is the Plan Set Order. The original document can be found at:

http://www.dot.state.mn.us/trafficeng/workzone/doc/TrafficControlChecklist.pdf

HANDOUT

Traffic Control Plan

Metro Standard Order

May 2012

- Title sheet
- Pay items tab
- Sign tab
- Special sign design
- Narrative *
- Advance signing (G20-X2)
- Detours (all) **
- TPAR
- Business (when not incorporated into staging sheets)
- Staging
- Typical sheets
- Sign installation typical
- Interim pavement marking

*Format and when to use TBD

**Use stick map (keep to 1 or 2 sheets)

In place signs to be shown only if needed.

Use typical layout with narrative then detail where needed.

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HANDOUT

HANDOUT

CHECKLIST FOR TRAFFIC CONTROL

DATE _____

S.P. _____

LOCATION _____

LETTING DATE _____

DETOUR (Preliminary Design Stage)

	Yes	No	N/A	Spec Prov	Plan Det.
1. Will traffic be detoured? If no, go to #7.	☐	☐	☐	☐	☐
2. Are various detours adequate in terms of:	☐	☐	☐	☐	☐
A. Weight - Spring restrictions, height, width?	☐	☐	☐	☐	☐
B. Wide loads and oversized?	☐	☐	☐	☐	☐
C. Capacity and adequate traffic control devices?	☐	☐	☐	☐	☐
D. Railroad crossings and controls?	☐	☐	☐	☐	☐
E. Geometrics (turning radii, etc.) ?	☐	☐	☐	☐	☐
F. Bridge restrictions and other structures?	☐	☐	☐	☐	☐
G. Conflict with other detour in the area?	☐	☐	☐	☐	☐
H. Other local motorist routes available?	☐	☐	☐	☐	☐
I. Can the detour be carried over winter (snow removal) ?	☐	☐	☐	☐	☐
3. If the detour is to be established on other than trunk highways, has the preliminary contact been made with:					
A. County, City, or Townships?	☐	☐	☐	☐	☐
B. Who will stripe the detour?					
C. Does the signing require upgrading?					
D. Who will be responsible for routine maintenance I(i.e. patching)?					
4. Will all fronting businesses have acceptable ingress and egress and will other municipalities be served?	☐	☐	☐	☐	☐
A. Are TOD'S necessary for businesses?	☐	☐	☐	☐	☐

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	Yes	No	N/A	Spec Prov	Plan Det.
5. Should the following be contacted?	☐	☐	☐	☐	☐
A. School Bus	☐	☐	☐	☐	☐
B. Public Transit	☐	☐	☐	☐	☐
C. Police	☐	☐	☐	☐	☐
D. Fire	☐	☐	☐	☐	☐
E. Ambulance	☐	☐	☐	☐	☐
F. Postal Route	☐	☐	☐	☐	☐
6. Is a public information meeting required?	_____				
TRAFFIC CARRIED THROUGH THE PROJECT					
7. Will capacity be restricted during the peak hours (Lane Closure)?	☐	☐	☐	☐	☐
A. Will alternate routes handle the diverted traffic?	☐	☐	☐	☐	☐
B. Have local governments been contacted?	☐	☐	☐	☐	☐
C. Number of lanes or reversible lanes needed?	_____				
8. Consider staging (i.e. lengths of permitted construction)	☐	☐	☐	☐	☐
A. Include in plans or let the contractor plan?	☐	☐	☐	☐	☐
B. Can contractor stage work differently than planned?	☐	☐	☐	☐	☐
9. Bypasses or temporary widening needed?	☐	☐	☐	☐	☐
A. What standards are used?	_____				
B. What locations?	_____				
C. Design speed?	_____				
10. Minimum width?	_____				
11. Will oversized load permits be affected?	☐	☐	☐	☐	☐
If yes, will it be signed?	☐	☐	☐	☐	☐
12. Will the project be inplace over the winter months? If yes,	☐	☐	☐	☐	☐
A. Are traffic control devices adequate for winter?	☐	☐	☐	☐	☐
B. Are there provisions for the TCD's to be maintained over winter suspension?	☐	☐	☐	☐	☐
If yes, who will maintain them?	_____				

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GENERAL CHECKLIST (Detailed Design Stage)	Yes	No	N/A	Spec Prov	Plan Det.
13. Signing (State or Contractor)					
A. Who maintains or inspects?					
B. How often					
C. TCP provided by State or Contractor?					
D. Are any special signs needed	☐	☐	☐	☐	☐
If yes, where?					
E. Is cross road signing needed?	☐	☐	☐	☐	☐
If yes, by whom (State or Contractor)					
14. Are temporary signals needed?	☐	☐	☐	☐	☐
A. If yes, what type?					
Manual					
Fixed time					
Actuated					
15. Can inplace signals be shutdown?	☐	☐	☐	☐	☐
If yes, during what hours?					
Does a local municipality need to be contacted?	☐	☐	☐	☐	☐
16. Is temporary street lighting needed?	☐	☐	☐	☐	☐
If yes,					
A. Who will install? (State or Contractor)					
If State, is request letter needed?	☐	☐	☐	☐	☐
B. Are breakaway or non-breakaway poles needed?	☐	☐	☐	☐	☐
C. How will power be furnished?					
D. Is an agreement needed with the power company?	☐	☐	☐	☐	☐
E. Does inplace lighting need to be kept operational?	☐	☐	☐	☐	☐
17. Is temporary barrier needed?	☐	☐	☐	☐	☐
If yes,					
A. Who will furnish, install, and maintain?					
B. Barrier justification					
High ADT					
Excessive drop-off					
C. Will it be incorporated into existing permanent barrier?	☐	☐	☐	☐	☐
D. How will the barrier be delineated?					
Warning lights (type)					
Delineators (type)					
E. How will the barrier ends be protected?					
Taper buried out to the clear zone					
GREAT attenuator					
Barrel attenuator					
F. Is a spare attenuator needed?	☐	☐	☐	☐	☐

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	Yes	No	N/A	Spec Prov	Plan Det.
18. Are equipment traffic controls going to be used?	☐	☐	☐	☐	☐
If yes, has the proper permission been obtained?	☐	☐	☐	☐	☐
19. Is the Contractor's equipment permitted to use crossovers?	☐	☐	☐	☐	☐
If yes, what type?					
A. Which ones?	_____				
B. Do the Contractor's vehicles need to be marked?	☐	☐	☐	☐	☐
20. Can the Contractor store equipment, material, and waste material on the construction site?	☐	☐	☐	☐	☐
If yes, must they follow AASHTO guidelines?	☐	☐	☐	☐	☐
If no, where?	_____				
21. Can the Contractor's workers park their vehicles on the construction site?	☐	☐	☐	☐	☐
If yes, where?	_____				
If no, where?	_____				
22. Are temporary pavement markings required?	☐	☐	☐	☐	☐
A. Who will furnish, install, and maintain?	_____				
B. What type?					
Paint _____					
Tape _____					
TRPM _____					
23. Do inplace stripes need to be replaced?	☐	☐	☐	☐	☐
A. If yes, where?					
Centerline _____					
Edgeline _____					
B. How will they be removed?	_____				
C. Who will accomplish this?	_____				
24. Is temporary post-mounted delineation needed?	☐	☐	☐	☐	☐
If yes, who will furnish, install, and maintain?	_____				
25. Will drop-offs and excavations exist?	☐	☐	☐	☐	☐
If yes,					
A. Will the drop-off exceed 50 mm (2 inches)?	☐	☐			
B. Will the drop-off exceed 100 mm (4 inches)?	☐	☐			
C. Will the drop-off exceed 150 mm (6 inches)?	☐	☐			

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	Yes	No	N/A	Spec Prov	Plan Det.
26. Do inplace signs have to be removed or relocated?	☐	☐	☐	☐	☐
If yes, by whom?					
27. Are flagging operations required?	☐	☐	☐	☐	☐
If yes,					
A. What type of operation is being considered?					
Radio communication _____					
Pilot car _____					
Flag carrying _____					
B. Will the flagging operation be continued during daylight hours?	☐	☐	☐	☐	☐
If yes, is supplemental lighting needed?	☐	☐	☐	☐	☐
28. Is a construction or work zone speed limit needed?	☐	☐	☐	☐	☐
If yes, will they use advisories or regulatories?					
29. Will the project require any special devices	☐	☐	☐	☐	☐
Changeable Message Signs, how many?					
30. Will extra protection be required for other road users?	☐	☐	☐	☐	☐
pedestrians _____					
bicyclists _____					
snowmobiles _____					
trail users _____					
schools _____					
parks _____					
31. Do utility operations affect traffic control?	☐	☐	☐	☐	☐
32. Will the project require dust control?	☐	☐	☐	☐	☐
33. Are there any restrictions for traffic control which can not be inplace concurrently? (i.e. fire, police, and traffic routing)	☐	☐	☐	☐	☐
If yes, by where?					

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	Yes	No	N/A	Spec Prov	Plan Det.
34. Will the source of material on or off the project interfere with traffic or a certain type of traffic?	☐	☐	☐	☐	☐
35. Does the Contractor have to give advance notice of traffic control changes?	☐	☐	☐	☐	☐
36. Is the starting or completion date controlled by a school, special events, or holidays? If yes, (event and date)	☐	☐	☐	☐	☐
37. Is a working day other than as specified, such as an 18 hour day? What is the work week?	☐	☐	☐	☐	☐
38. Is there as conflict between working hours and local ordinances due to noise, air, or water restrictions?	☐	☐	☐	☐	☐
39. Is there an incentive clause needed in the contract?	☐	☐	☐	☐	☐
40. Will working days be charged between November 15 and April 15 or suspended by a work order? (See 1806)					
41. Should there be other than ordinary liquidated damages such as additional penalties? (See 1807)	☐	☐	☐	☐	☐
42. Is there a possibility that another contract will delay the work of this project?	☐	☐	☐	☐	☐

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5.2 Process A vs Process B

Prior to beginning the plan set, the decision of the letting process type needs to be determined (Process A or Process B). Process A or B is based on a set of rules, such as how many sheets. The Project Manager makes the determination. Information (internal to MnDOT) can be found at,

http://ihub/projectdelivery/files/intro/append/Project-Delivery-Process.pdf

The process A projects are small projects, which are minor in scope. These projects contain no more than 50 plan sheets and comprise less than 20 pay items. Process A MAY be 8 ½ x 11 inch sheets. If process A, coordinate with the main plan designers on what they are doing.

The typical process B project consists of plans that need Central Office approval. Typical process B projects constitute approximately 75% - 80% of the current Pre-Letting workload. The typical process B project may require special provisions (such as lighting, signals, TMC, and signing) prepared by the District specialty units. The typical process B project will require utility coordination, and possible agreements.

5.3 Common TTC Plan Set Issues

The following is a list of some of the common issues with TTC plan sets from MnDOT reviewers. These are not in any order of importance.

- ✓ The designer uses PLACE instead of INSTALL. Whenever INSTALL is used by itself it implies that the material is either salvaged or supplied. It is preferred to use PLACE, FURNISH AND INSTALL (F & I), or CONSTRUCT.
    - INSTALL by itself implies that material is either salvaged or supplied. If this IS the case, it is OK to leave it (usually, this is not the case). When it is not INSTALL, and as previously noted, use PLACE, F & I, or CONSTRUCT.
- ✓ When using reference points, they need to be written in the standard format of XXX+XX.XXX.
- ✓ Ensure to label the mainline and cross streets as well as bridges and what the bridges cross over/under.
    - For Bridge labeling, use the Bridge Number as shown in the rest of the plan. Also label what it is over/under such as roadway, railroad, river name, etc.
- ✓ Check that the labelling at the bottom of the sheet matches the rest of the plan (e.g. SP XXXX-XX (TH XX)).
- ✓ The Begin/End starting points don't have to be on the traffic control sheets. If they are, then both are needed and they must match the rest of the plan. Since they are not necessary, it is suggested to not show them.
- ✓ Make sure the legend matches what is shown in the plan (e.g. the legend shows solid circle and plan shows darkened circle for drums).
- ✓ Check that the sheet numbers in the signature block are correct and that they include their printed name.
- ✓ Ensure that pay items agree with what's shown on the plan and that all items are accounted for.
- ✓ It is helpful to estimate the sign quantities as lump sum.

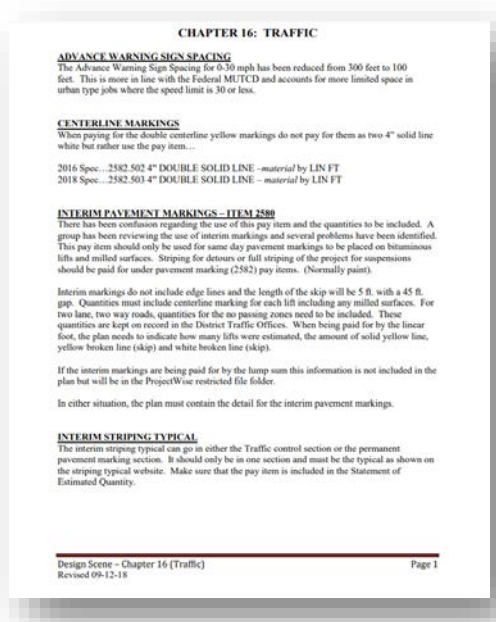
- ✓ Often, impact attenuators are not paid for correctly and are shown incorrectly on the plan (e.g. barrels vs systems).
- ✓ Be sure to show the test level on the attenuators and whether they are permanent or temporary.
- ✓ Labelling impact attenuators for TL and Temporary or permanent installation. Pay for barrels as each and the systems as assembly. See the Design Scene Chapter 14.
- ✓ Take into account guardrail (end treatments and design specials) if traffic will be re-routed to the other roadway (mainly applies to split roadways).
- ✓ Raised pavement markers need to state the color and if they are one way or two way.
- ✓ Often there is confusion on the APR items, e.g., what does/doesn't go in a plan and how it's paid for. Review the resources available in this manual and the MnDOT Work Zone website.
- ✓ Make sure all signs are accounted for in the tab/summary, especially the special signs.
- ✓ Manual details are not necessary in the plan as they are in the manuals. If they are, make sure the notes and references all make sense.

5.3.1 Design Scene

Design Scene is a guidance document for designers, technicians and engineers to help improve the quality and reduce cost and time of plan preparation. The Design Scene website is,

http://www.dot.state.mn.us/pre-letting/scene/.

An example of the Design Scene newsletter, and some select Design Scene topics are included as a handout in the Appendix (see Section **7.2**).



CHAPTER 16: TRAFFIC

ADVANCE WARNING SIGN SPACING
The Advance Warning Sign Spacing for 0-30 mph has been reduced from 300 feet to 100 feet. This is more in line with the Federal MUTCD and accounts for more limited space in urban type jobs where the speed limit is 30 or less.

CENTERLINE MARKINGS
When paying for the double centerline yellow markings do not pay for them as two 4" solid line white but rather use the pay item…

2016 Spec…2582.502 4" DOUBLE SOLID LINE –*material* by LIN FT
2018 Spec…2582.503 4" DOUBLE SOLID LINE – *material* by LIN FT

INTERIM PAVEMENT MARKINGS – ITEM 2580
There has been confusion regarding the use of this pay item and the quantities to be included. A group has been reviewing the use of interim markings and several problems have been identified. This pay item should only be used for same day pavement markings to be placed on bituminous lifts and milled surfaces. Striping for detours or full striping of the project for suspensions should be paid for under pavement marking (2582) pay items. (Normally paint).

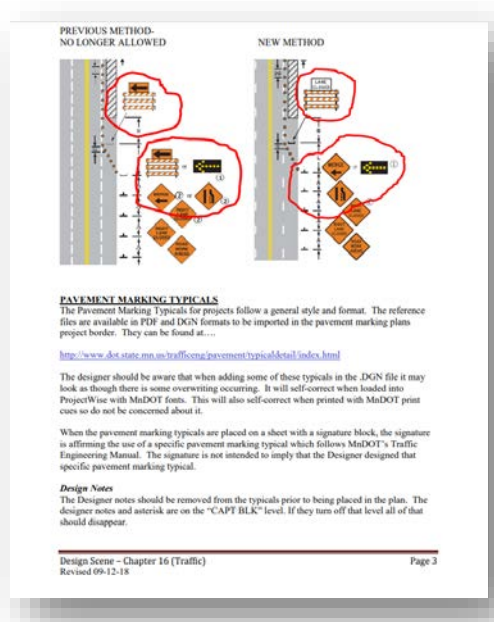
Interim markings do not include edge lines and the length of the skip will be 5 ft. with a 45 ft. gap. Quantities must include centerline marking for each lift including any milled surfaces. For two lane, two way roads, quantities for the no passing zones need to be included. These quantities are kept on record in the District Traffic Offices. When being paid for by the linear foot, the plan needs to indicate how many lifts were estimated, the amount of solid yellow line, yellow broken line (skip) and white broken line (skip).

If the interim markings are being paid for by the lump sum this information is not included in the plan but will be in the ProjectWise restricted file folder.

In either situation, the plan must contain the detail for the interim pavement markings.

INTERIM STRIPING TYPICAL
The interim striping typical can go in either the Traffic control section or the permanent pavement marking section. It should only be in one section and must be the typical as shown on the striping typical website. Make sure that the pay item is included in the Statement of Estimated Quantity.

Design Scene – Chapter 16 (Traffic) Page 1
Revised 09-12-18



PREVIOUS METHOD-
NO LONGER ALLOWED

NEW METHOD

PAVEMENT MARKING TYPICALS
The Pavement Marking Typicals for projects follow a general style and format. The reference files are available in PDF and DGN formats to be imported in the pavement marking plans project border. They can be found at….

http://www.dot.state.mn.us/trafficeng/pavement/typicaldetail/index.html

The designer should be aware that when adding some of these typicals in the .DGN file it may look as though there is some overwriting occurring. It will self-correct when loaded into ProjectWise with MnDOT fonts. This will also self-correct when printed with MnDOT print cues so do not be concerned about it.

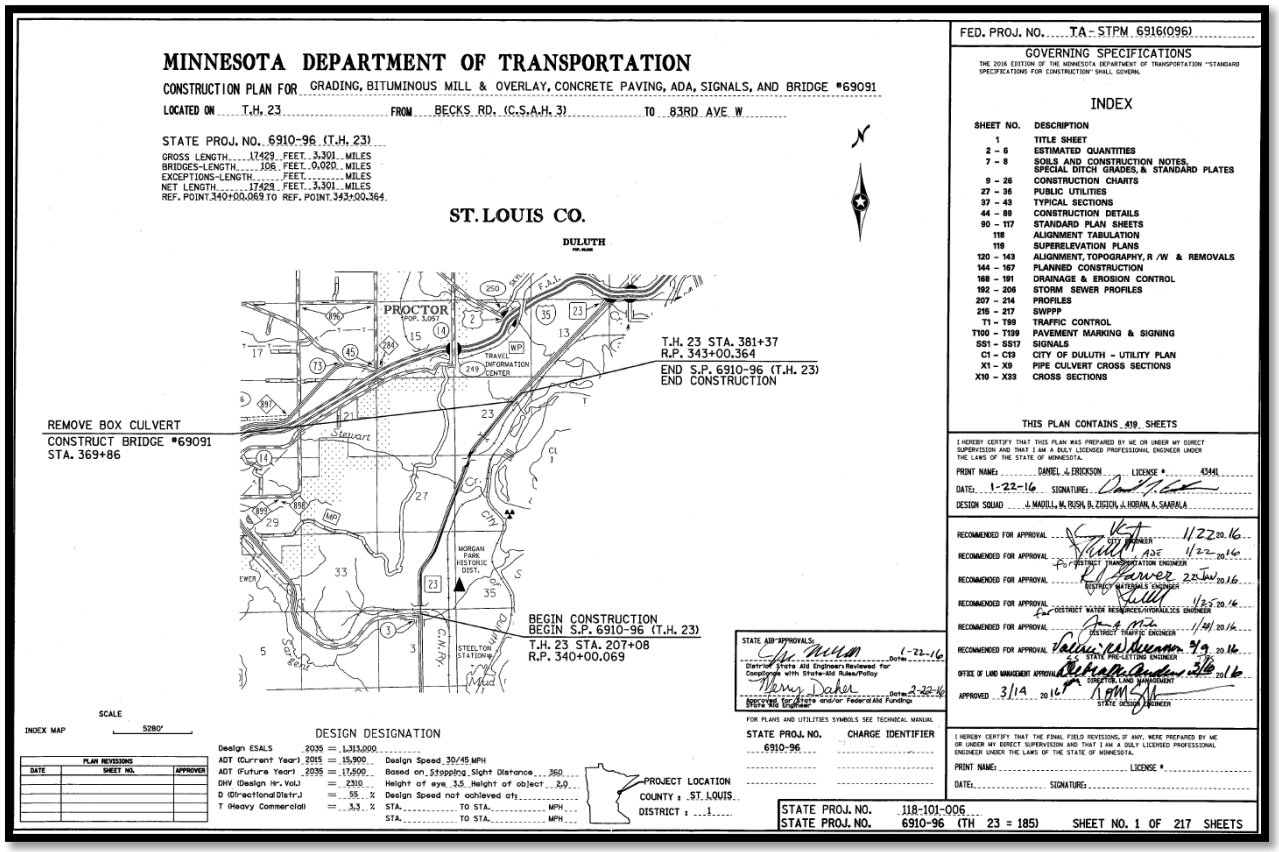
When the pavement marking typicals are placed on a sheet with a signature block, the signature is affirming the use of a specific pavement marking typical which follows MnDOT's Traffic Engineering Manual. The signature is not intended to imply that the Designer designed that specific pavement marking typical.

Design Notes
The Designer notes should be removed from the typicals prior to being placed in the plan. The designer notes and asterisk are on the "CAPT BLK" level. If they turn off that level all of that should disappear.

Design Scene – Chapter 16 (Traffic) Page 3
Revised 09-12-18

5.4 Construction Plan Title Sheet

The Title Sheet (first sheet of the construction plan set) includes information such as the title block, project location, governing specifications, etc. A sample title sheet is shown below from a sample construction plan. This image is not a part of the full size sample plan in the appendix; however, the important elements are highlighted in the following sections.



5.4.1 Plan Description and Location

This defines the type of work being performed and the location of the work. The location identified should list intersections from west to east or south to north.

5.4.2 Project Number(s)

In the block you will find the state project number(s) that are applicable to the project. In addition, the following information is provided (by SP number):

- ✓ Gross Length (Feet and Miles)
- ✓ Bridges – Length (Feet and Miles)
- ✓ Exceptions Length (Feet and Miles)
- ✓ Net Length (Feet and Miles)
- ✓ Starting Reference Point (Station)
- ✓ Ending Reference Point (Station)

STATE PROJ. NO. 6910-96 (T.H. 23)
GROSS LENGTH 17429 FEET 3.301 MILES
BRIDGES-LENGTH 106 FEET 0.020 MILES
EXCEPTIONS-LENGTH FEET MILES
NET LENGTH 17429 FEET 3.301 MILES
REF. POINT 340+00.069 TO REF. POINT 343+00.364.

STATE PROJ. NO. 8821-202 (TH 23)
GROSS LENGTH 107147 FEET 20.293 MILES.
BRIDGES-LENGTH 308 FEET 0.058 MILES
EXCEPTIONS-LENGTH N/A FEET N/A MILES
NET LENGTH 107147 FEET 20.293 MILES
REF POINT 315+00.500 TO REF POINT 335+00.793

STATE PROJ. NO. 8821-202 (TH 65)
GROSS LENGTH 55229 FEET 10.460 MILES.
BRIDGES-LENGTH N/A FEET N/A MILES
EXCEPTIONS-LENGTH N/A FEET N/A MILES
NET LENGTH 55229 FEET 10.460 MILES
REF POINT 96+00.940 TO REF POINT 107+00.400

STATE PROJ. NO. 8821-202 (TH 210)
GROSS LENGTH 117876 FEET 22.325 MILES.
BRIDGES-LENGTH 471 FEET 0.089 MILES
EXCEPTIONS-LENGTH N/A FEET N/A MILES
NET LENGTH 117876 FEET 22.325 MILES
REF POINT 196+00.233 TO REF POINT 218+00.558

5.4.3 Governing Specifications and Index of Sheets

This defines the governing specifications for the project, the project funding and the index of the sheets contained within the plan set. Generally, it is located in the upper right hand corner of the title sheet, under the Federal Project number or statement "STATE FUNDS".

INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2 – 6	ESTIMATED QUANTITIES
7 – 8	SOILS AND CONSTRUCTION NOTES, SPECIAL DITCH GRADES, & STANDARD PLATES
9 – 26	CONSTRUCTION CHARTS
27 – 36	PUBLIC UTILITIES
37 – 43	TYPICAL SECTIONS
44 – 89	CONSTRUCTION DETAILS
90 – 117	STANDARD PLAN SHEETS
118	ALIGNMENT TABULATION
119	SUPERELEVATION PLANS
120 – 143	ALIGNMENT, TOPOGRAPHY, R /W & REMOVALS
144 – 167	PLANNED CONSTRUCTION
168 – 191	DRAINAGE & EROSION CONTROL
192 – 206	STORM SEWER PROFILES
207 – 214	PROFILES
215 – 217	SWPPP
T1 – T99	TRAFFIC CONTROL
T100 – T139	PAVEMENT MARKING & SIGNING
SS1 – SS17	SIGNALS
C1 – C13	CITY OF DULUTH – UTILITY PLAN
X1 – X9	PIPE CULVERT CROSS SECTIONS
X10 – X33	CROSS SECTIONS

Be sure to use the appropriate governing specification year for your project. The sample here is from an older plan set.

5.4.4 Plan Preparation Certification Note

This identifies:

- ✓ Who the plan set was developed by (or under the direct supervision of)
- ✓ That individual's state registration information.

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: _____ LICENSE _____

DATE: _____ SIGNATURE: _____

DESIGN SQUAD: _____

5.4.5 Project Numbers and Sheet Numbers

The project numbers and sheet numbers are shown in the lower right hand corner of the title sheet and on all other sheets.

A SP in the project number stands for State Project. A SP is necessary for any project on a trunk highway signal. A SAP is a State Aid Project number indicating that the local agency is using State Aid funds to finance their share of the project. If the project has federal funding the SAP becomes a SP. All state aid numbers should be listed on all sheets to which they apply.

The general format for a SP is "CCNN-A". CC is the county number in alphabetical order (i.e., Anoka County is 02). NN is the control section number within the county unique to the roadway in the County. A is the number of the project on that control section (i.e., -269 means that there have been 268 other projects on this section of roadway prior to this project).

The general format for an SAP is CCC-NNN-A. CCC is a 3-digit city number, a two digit number is a county number. NNN is a number related to the roadway and project type. A is the number of the project in that city or county of that type.

STATE PROJ. NO. 0208-146 (T.H. 65 = 5) SHEET NO. 1 OF 106 SHEETS

5.4.6 Signature Block

The Designer should consult with the MnDOT project manager to ensure that the appropriate signature block is used.

I HEREBY CERTIFY THAT SHEETS 1-25 WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME: _____ LICENSE # _____

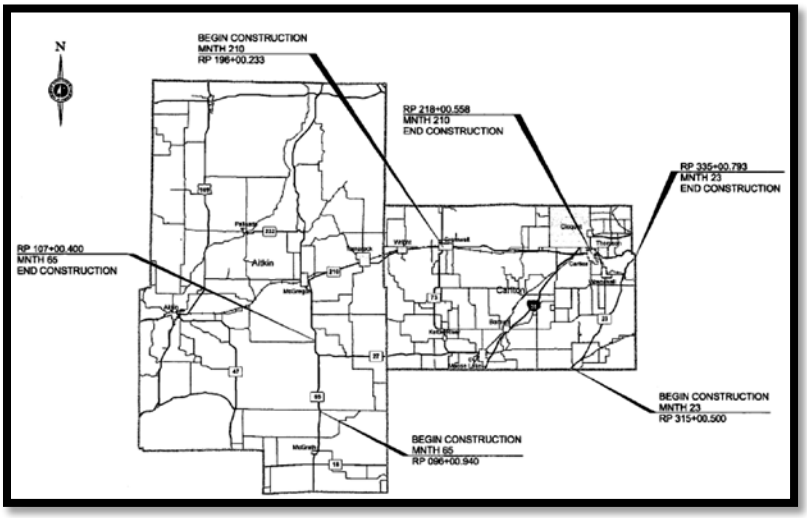
DATE: _____ SIGNATURE: _____

DESIGN SQUAD _____

5.4.7 Index Map

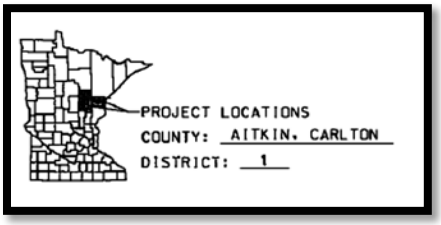
The index map is used to identify the location of the project(s). Provide leader lines from the beginning and end of the project limits to the appropriate points on the map. This is generally located near the center of the title sheet.

If appropriate, identify all State Aid project numbers applicable to the project. Also, label all traffic signal systems.



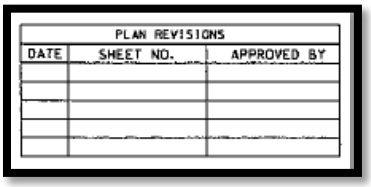
5.4.8 Project Location

The information included in this block is the generalized location (county and city). This is generally located in the lower right part of the title sheet, left of the signature block and above the project number block.



5.4.9 Plan Revisions Block

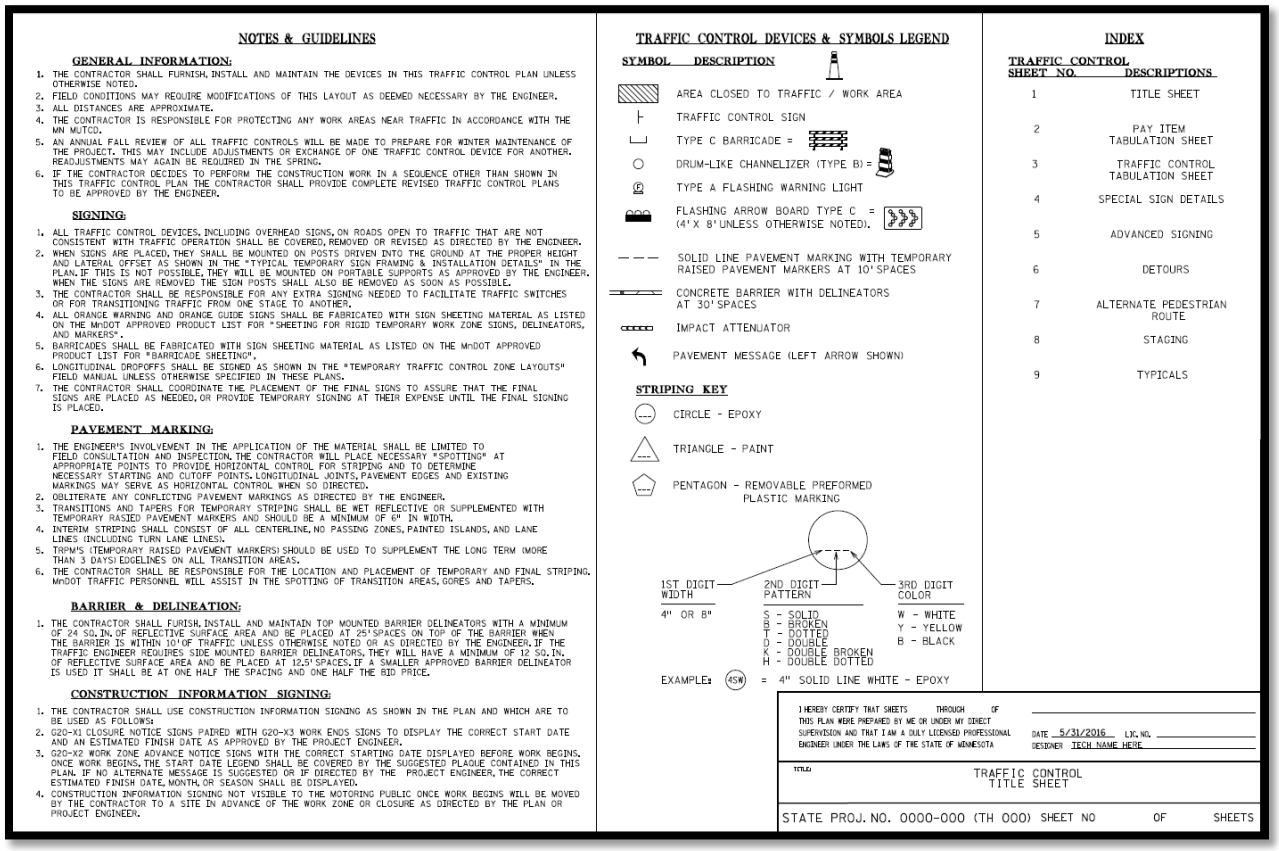
The block is included so that future plan revisions can be documented. This is generally located in lower portion of the title sheet. Pencil in the charge identifier number. MnDOT plan processing will edit this as necessary.



PLAN REVISIONS		
DATE	SHEET NO.	APPROVED BY

5.5 Traffic Control Plan Title Sheet

As noted earlier, the traffic control (TC) sheets are part of a larger construction project. The first sheet of the plan is the plan sheet (see the previous section) and the image below shows an example of the first sheet for the portion on temporary traffic control. The most current version of this plan set is available on the MnDOT Work Zone website, www.dot.state.mn.us/trafficeng/workzone/index.html.



NOTES & GUIDELINES

GENERAL INFORMATION:

1. THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN THE DEVICES IN THIS TRAFFIC CONTROL PLAN UNLESS OTHERWISE NOTED.
2. FIELD CONDITIONS MAY REQUIRE MODIFICATIONS OF THIS LAYOUT AS DEEMED NECESSARY BY THE ENGINEER.
3. ALL DISTANCES ARE APPROXIMATE.
4. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ANY WORK AREAS NEAR TRAFFIC IN ACCORDANCE WITH THE MN MUTCD.
5. AN ANNUAL FALL REVIEW OF ALL TRAFFIC CONTROLS WILL BE MADE TO PREPARE FOR WINTER MAINTENANCE OF THE PROJECT. THIS MAY INCLUDE ADJUSTMENTS OR EXCHANGE OF ONE TRAFFIC CONTROL DEVICE FOR ANOTHER. READJUSTMENTS MAY AGAIN BE REQUIRED IN THE SPRING.
6. IF THE CONTRACTOR DECIDES TO PERFORM THE CONSTRUCTION WORK IN A SEQUENCE OTHER THAN SHOWN IN THIS TRAFFIC CONTROL PLAN THE CONTRACTOR SHALL PROVIDE COMPLETE REVISED TRAFFIC CONTROL PLANS TO BE APPROVED BY THE ENGINEER.

SIGNING:

1. ALL TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS, ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTENT WITH TRAFFIC OPERATION SHALL BE COVERED, REMOVED OR REVISED AS DIRECTED BY THE ENGINEER.
2. WHEN SIGNS ARE PLACED, THEY SHALL BE MOUNTED ON POSTS DRIVEN INTO THE GROUND AT THE PROPER HEIGHT AND LATERAL OFFSET AS SHOWN IN THE "TYPICAL TEMPORARY SIGN FRAMING & INSTALLATION DETAILS" IN THE PLAN. IF THIS IS NOT POSSIBLE, THEY WILL BE MOUNTED ON PORTABLE SUPPORTS AS APPROVED BY THE ENGINEER. WHEN THE SIGNS ARE REMOVED THE SIGN POSTS SHALL ALSO BE REMOVED AS SOON AS POSSIBLE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY EXTRA SIGNING NEEDED TO FACILITATE TRAFFIC SWITCHES OR FOR TRANSITIONING TRAFFIC FROM ONE STAGE TO ANOTHER.
4. ALL ORANGE WARNING AND ORANGE GUIDE SIGNS SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MnDOT APPROVED PRODUCT LIST FOR "SHEETING FOR RIGID TEMPORARY WORK ZONE SIGNS, DELINEATORS, AND MARKERS".
5. BARRICADES SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MnDOT APPROVED PRODUCT LIST FOR "BARRICADE SHEETING".
6. LONGITUDINAL DROPOFFS SHALL BE SIGNED AS SHOWN IN THE "TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS" FIELD MANUAL UNLESS OTHERWISE SPECIFIED IN THESE PLANS.
7. THE CONTRACTOR SHALL COORDINATE THE PLACEMENT OF THE FINAL SIGNS TO ASSURE THAT THE FINAL SIGNS ARE PLACED AS NEEDED, OR PROVIDE TEMPORARY SIGNING AT THEIR EXPENSE UNTIL THE FINAL SIGNING IS PLACED.

PAVEMENT MARKING:

1. THE ENGINEER'S INVOLVEMENT IN THE APPLICATION OF THE MATERIAL SHALL BE LIMITED TO FIELD CONSULTATION AND INSPECTION. THE CONTRACTOR WILL PLACE NECESSARY "SPOTTING" AT APPROPRIATE POINTS TO PROVIDE HORIZONTAL CONTROL FOR STRIPING AND TO DETERMINE NECESSARY STARTING AND CUTOFF POINTS. LONGITUDINAL JOINTS, PAVEMENT EDGES AND EXISTING MARKINGS MAY SERVE AS HORIZONTAL CONTROL WHEN SO DIRECTED.
2. OBLITERATE ANY CONFLICTING PAVEMENT MARKINGS AS DIRECTED BY THE ENGINEER.
3. TRANSITIONS AND TAPERS FOR TEMPORARY STRIPING SHALL BE WET REFLECTIVE OR SUPPLEMENTED WITH TEMPORARY RASIED PAVEMENT MARKERS AND SHOULD BE A MINIMUM OF 6" IN WIDTH.
4. INTERIM STRIPING SHALL CONSIST OF ALL CENTERLINE, NO PASSING ZONES, PAINTED ISLANDS, AND LANE LINES INCLUDING TURN LANE LINES.
5. TRPM'S (TEMPORARY RAISED PAVEMENT MARKERS) SHOULD BE USED TO SUPPLEMENT THE LONG TERM (MORE THAN 3 DAYS) EDGELINES ON ALL TRANSITION AREAS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION AND PLACEMENT OF TEMPORARY AND FINAL STRIPING. MnDOT TRAFFIC PERSONNEL WILL ASSIST IN THE SPOTTING OF TRANSITION AREAS, GORES AND TAPERS.

BARRIER & DELINEATION:

1. THE CONTRACTOR SHALL FURISH, INSTALL AND MAINTAIN TOP MOUNTED BARRIER DELINEATORS WITH A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 25' SPACES ON TOP OF THE BARRIER WHEN THE BARRIER IS WITHIN 10' OF TRAFFIC UNLESS OTHERWISE NOTED OR AS DIRECTED BY THE ENGINEER. IF THE TRAFFIC ENGINEER REQUIRES SIDE MOUNTED BARRIER DELINEATORS, THEY WILL HAVE A MINIMUM OF 12 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 12.5' SPACES. IF A SMALLER APPROVED BARRIER DELINEATOR IS USED IT SHALL BE AT ONE HALF THE SPACING AND ONE HALF THE BID PRICE.

CONSTRUCTION INFORMATION SIGNING:

1. THE CONTRACTOR SHALL USE CONSTRUCTION INFORMATION SIGNING AS SHOWN IN THE PLAN AND WHICH ARE TO BE USED AS FOLLOWS:
2. G20-X1 CLOSURE NOTICE SIGNS PAIRED WITH G20-X3 WORK ENDS SIGNS TO DISPLAY THE CORRECT START DATE AND AN ESTIMATED FINISH DATE AS APPROVED BY THE PROJECT ENGINEER.
3. G20-X2 WORK ZONE ADVANCE NOTICE SIGNS WITH THE CORRECT STARTING DATE DISPLAYED BEFORE WORK BEGINS. ONCE WORK BEGINS, THE START DATE LEGEND SHALL BE COVERED BY THE SUGGESTED PLAQUE CONTAINED IN THIS PLAN. IF NO ALTERNATE MESSAGE IS SUGGESTED OR IF DIRECTED BY THE PROJECT ENGINEER, THE CORRECT ESTIMATED FINISH DATE, MONTH, OR SEASON SHALL BE DISPLAYED.
4. CONSTRUCTION INFORMATION SIGNING NOT VISIBLE TO THE MOTORING PUBLIC ONCE WORK BEGINS WILL BE MOVED BY THE CONTRACTOR TO A SITE IN ADVANCE OF THE WORK ZONE OR CLOSURE AS DIRECTED BY THE PLAN OR PROJECT ENGINEER.

TRAFFIC CONTROL DEVICES & SYMBOLS LEGEND

SYMBOL DESCRIPTION

AREA CLOSED TO TRAFFIC / WORK AREA
TRAFFIC CONTROL SIGN
TYPE C BARRICADE =
DRUM-LIKE CHANNELIZER (TYPE B) =
TYPE A FLASHING WARNING LIGHT
FLASHING ARROW BOARD TYPE C = (4' X 8' UNLESS OTHERWISE NOTED).
SOLID LINE PAVEMENT MARKING WITH TEMPORARY RAISED PAVEMENT MARKERS AT 10' SPACES
CONCRETE BARRIER WITH DELINEATORS AT 30' SPACES
IMPACT ATTENUATOR
PAVEMENT MESSAGE (LEFT ARROW SHOWN)

STRIPING KEY

CIRCLE - EPOXY
TRIANGLE - PAINT
PENTAGON - REMOVABLE PREFORMED PLASTIC MARKING

1ST DIGIT WIDTH	2ND DIGIT PATTERN	3RD DIGIT COLOR
4" OR 8"	S - SOLID B - BROKEN T - DOTTED D - DOUBLE K - DOUBLE BROKEN H - DOUBLE DOTTED	W - WHITE Y - YELLOW B - BLACK

EXAMPLE: 4SW = 4" SOLID LINE WHITE - EPOXY

INDEX

TRAFFIC CONTROL SHEET NO.	DESCRIPTIONS
1	TITLE SHEET
2	PAY ITEM TABULATION SHEET
3	TRAFFIC CONTROL TABULATION SHEET
4	SPECIAL SIGN DETAILS
5	ADVANCED SIGNING
6	DETOURS
7	ALTERNATE PEDESTRIAN ROUTE
8	STAGING
9	TYPICALS

I HEREBY CERTIFY THAT SHEETS THROUGH OF THIS PLAN WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

DATE 5/31/2016 LIC. NO.
DESIGNER TECH NAME HERE

TITLE: TRAFFIC CONTROL TITLE SHEET

STATE PROJ. NO. 0000-000 (TH 000) SHEET NO OF SHEETS

5.5.1 Notes and Guidelines

An important element for the traffic control plan is the notes and guidelines. Methods and materials are constantly changing regarding traffic control; therefore, these notes are an important element of the plan. Be sure to visit the OTE website for the most current sample plan set with the narrative references.

The following sections illustrate the notes on:

- ✓ General Information
- ✓ Signing Notes
- ✓ Pavement Marking Notes
- ✓ Barrier and Delineation Notes
- ✓ Construction Information Signing Notes

Any unused notes should be removed from the template samples.

General Information

GENERAL INFORMATION:

1. THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN THE DEVICES IN THIS TRAFFIC CONTROL PLAN UNLESS OTHERWISE NOTED.
2. FIELD CONDITIONS MAY REQUIRE MODIFICATIONS OF THIS LAYOUT AS DEEMED NECESSARY BY THE ENGINEER.
3. ALL DISTANCES ARE APPROXIMATE.
4. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ANY WORK AREAS NEAR TRAFFIC IN ACCORDANCE WITH THE MN MUTCD.
5. AN ANNUAL FALL REVIEW OF ALL TRAFFIC CONTROLS WILL BE MADE TO PREPARE FOR WINTER MAINTENANCE OF THE PROJECT. THIS MAY INCLUDE ADJUSTMENTS OR EXCHANGE OF ONE TRAFFIC CONTROL DEVICE FOR ANOTHER. READJUSTMENTS MAY AGAIN BE REQUIRED IN THE SPRING.
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Signing Notes

SIGNING:

1. ALL TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS, ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTENT WITH TRAFFIC OPERATION SHALL BE COVERED, REMOVED OR REVISED AS DIRECTED BY THE ENGINEER.
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6. LONGITUDINAL DROPOFFS SHALL BE SIGNED AS SHOWN IN THE "TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS" FIELD MANUAL UNLESS OTHERWISE SPECIFIED IN THESE PLANS.
7. THE CONTRACTOR SHALL COORDINATE THE PLACEMENT OF THE FINAL SIGNS TO ASSURE THAT THE FINAL SIGNS ARE PLACED AS NEEDED, OR PROVIDE TEMPORARY SIGNING AT THEIR EXPENSE UNTIL THE FINAL SIGNING IS PLACED.

Pavement Marking Notes

PAVEMENT MARKING:

1. THE ENGINEER'S INVOLVEMENT IN THE APPLICATION OF THE MATERIAL SHALL BE LIMITED TO FIELD CONSULTATION AND INSPECTION. THE CONTRACTOR WILL PLACE NECESSARY "SPOTTING" AT APPROPRIATE POINTS TO PROVIDE HORIZONTAL CONTROL FOR STRIPING AND TO DETERMINE NECESSARY STARTING AND CUTOFF POINTS. LONGITUDINAL JOINTS, PAVEMENT EDGES AND EXISTING MARKINGS MAY SERVE AS HORIZONTAL CONTROL WHEN SO DIRECTED.
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4. INTERIM STRIPING SHALL CONSIST OF ALL CENTERLINE, NO PASSING ZONES, PAINTED ISLANDS, AND LANE LINES (INCLUDING TURN LANE LINES).
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6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION AND PLACEMENT OF TEMPORARY AND FINAL STRIPING. MnDOT TRAFFIC PERSONNEL WILL ASSIST IN THE SPOTTING OF TRANSITION AREAS, GORES AND TAPERS.

Barrier and Delineation Notes

BARRIER & DELINEATION:

1. THE CONTRACTOR SHALL FURISH, INSTALL AND MAINTAIN TOP MOUNTED BARRIER DELINEATORS WITH A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 25' SPACES ON TOP OF THE BARRIER WHEN THE BARRIER IS WITHIN 10' OF TRAFFIC UNLESS OTHERWISE NOTED OR AS DIRECTED BY THE ENGINEER. IF THE TRAFFIC ENGINEER REQUIRES SIDE MOUNTED BARRIER DELINEATORS, THEY WILL HAVE A MINIMUM OF 12 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 12.5' SPACES. IF A SMALLER APPROVED BARRIER DELINEATOR IS USED IT SHALL BE AT ONE HALF THE SPACING AND ONE HALF THE BID PRICE.

Construction Information Signing Notes

CONSTRUCTION INFORMATION SIGNING:

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4. CONSTRUCTION INFORMATION SIGNING NOT VISIBLE TO THE MOTORING PUBLIC ONCE WORK BEGINS WILL BE MOVED BY THE CONTRACTOR TO A SITE IN ADVANCE OF THE WORK ZONE OR CLOSURE AS DIRECTED BY THE PLAN OR PROJECT ENGINEER.

5.5.2 Traffic Control Plan Index

INDEX

TRAFFIC CONTROL SHEET NO.	DESCRIPTIONS
1	TITLE SHEET
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3	TRAFFIC CONTROL TABULATION SHEET
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6	DETOURS
7	ALTERNATE PEDESTRIAN ROUTE
8	STAGING
9	TYPICALS

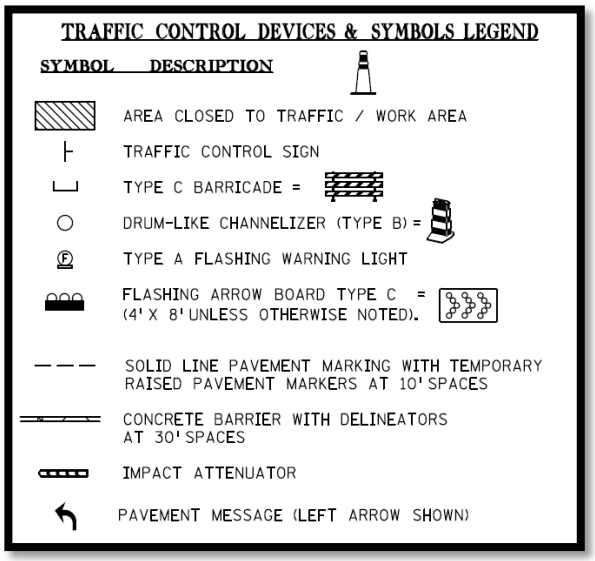
From Sample on OTE Website

INDEX

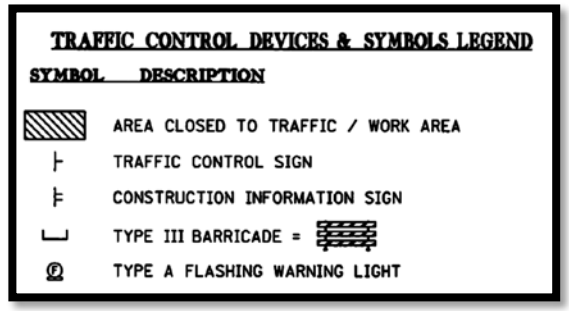
TRAFFIC CONTROL SHEET NO.	DESCRIPTIONS
24	TRAFFIC CONTROL TITLE AND PAY ITEM TABULATION SHEET
25	TRAFFIC CONTROL TABULATION SHEET
26 - 28	TRAFFIC CONTROL SPECIAL SIGN DETAILS
29	TRAFFIC CONTROL DETOUR PLAN - EXISTING SIGNS
30	TRAFFIC CONTROL DETOUR LAYOUT
31	TRAFFIC CONTROL DETOUR LAYOUT - ROAD CLOSURE
32	TRAFFIC CONTROL TEMPORARY SIGN FRAMING AND INSTALLATION DETAILS

From a Detour Plan Set

5.5.3 Traffic Control Devices and Symbols Legend



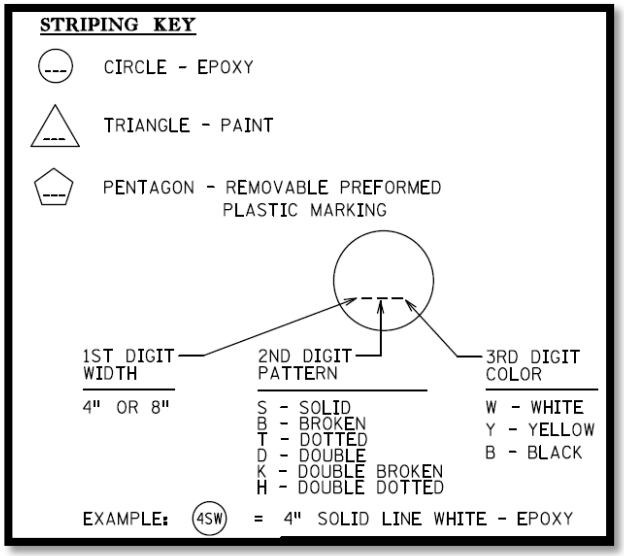
From Sample on OTE Website



From a Detour Plan Set

The TTC Plan includes symbols and materials and devices that need to be described. The legends shown above are shown on the TC title sheet. This includes items such as traffic cones, closed area, barricades, etc.

5.5.4 Traffic Control Key Legend



From Sample on OTE Website

The striping key legend could include:

- ✓ Symbols used (crosswalk, arrows, HOV markings, air plane markers, etc.)
- ✓ A striping key symbol (only include items that are used on the project)
  - o Circle indicates epoxy

- Square indicates poly preform
- Triangle is for paint
- Pentagon for removable preformed plastic

✓ A three digit striping key

- First digit is for width
- Second digit is for pattern
- Third digit is for color

5.5.5 Title, Signature, Project Number and Sheet Number Block

I HEREBY CERTIFY THAT SHEETS THROUGH OF THIS PLAN WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

DATE 5/31/2016 LIC. NO. _____
DESIGNER TECH NAME HERE

TITLE: TRAFFIC CONTROL TITLE SHEET

STATE PROJ. NO. 0000-000 (TH 000) SHEET NO OF SHEETS

For the TC title sheet, a separate block is included for the plan certification signature. It also includes the sheet title, project number and plan sheet number. Notice that TC sheets are number with "TC" at the beginning of the number (i.e., TC1, TC2, etc.).

5.6 Traffic Control Tabulation

TRAFFIC CONTROL TABULATION

ITEM	UNIT	STAGE ONE	STAGE TWO	STAGE THREE	STAGE FOUR	TOTAL
PORTABLE PRECAST CONC BARRIER DES 8337	LIN FT					
RELOCATE PORT PRECAST CONC BAR DES 8337	LIN FT					
IMPACT ATTENUATOR BARRELS	EACH					
RELOCATE IMPACT ATTENUATOR BARRELS	EACH					
IMPACT ATTENUATOR ASSEMBLY	AMBY					
RELOCATE IMPACT ATTENUATOR ASSEMBLY	AMBY					
TUBE DELINEATOR	EACH					
REPLACE TUBE DELINEATOR	EACH					
TRAFFIC CONTROL	LUMP SUM					
PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY					
MEDIAN BARRIER DELINEATOR	EACH					
RAISED PAVEMENT MARKER TEMP.	EACH					
4" SOLID LINE PAINT	LIN FT					
4" BROKEN LINE PAINT	LIN FT					
8" DOTTED LINE PAINT (WR)	LIN FT					
8" SOLID LINE PAINT (WR)	LIN FT					
PAVEMENT MARKING REMOVAL	SQ FT					
PAVEMENT MARKING REMOVAL	LIN FT					
POLICE OFFICER	HOUR					
PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY					
WORKERS PRESENT SPEED LIMIT	UNIT DAY					
DYNAMIC MERGE SYSTEM	UNIT DAY					
TRAFFIC CONTROL SUPERVISOR	HOUR					
TRAFFIC CONTROL SUPERVISOR	EACH					
TRAFFIC CONTROL SUPERVISOR	LUMP SUM					
REMOVABLE PREFORMED PAVEMENT MARKING TAPE	LIN FT					
REMOVABLE PREFORMED PLASTIC MASK (BLACK)	LIN FT					

TRAFFIC CONTROL QUANTITIES (1) Ⓐ									AA
ITEM	UNIT	QUANTITY							
		STAGE 1	STAGE 2	STAGE 3	PHASE 1	PHASE 2	PHASE 3	TOTAL	
PAVEMENT MARKING REMOVAL	SQ FT	96	240					336	
PAVEMENT MARKING REMOVAL	LIN FT	4649	5382	749				10780	
IMPACT ATTENUATOR NO. 2	ASSEMBLY						2	2	(2)
TUBE DELINEATOR	EACH		20					20	
REPLACE TUBE DELINEATOR	EACH		10					10	
TEMPORARY SIGNAL SYSTEM	SYSTEM		1	1				1	(3)
REMOVABLE PREFORMED PLASTIC MARKING 4" WET REMOVABLE TAPE- SOLID WHITE	LIN FT	3322	560	2660				6542	
REMOVABLE PREFORMED PLASTIC MARKING 4" WET REMOVABLE TAPE- SOLID YELLOW	LIN FT	2494	1550	2314				6358	
REMOVABLE PREFORMED PLASTIC MARKING 24" WET REMOVABLE TAPE- SOLID WHITE	LIN FT		44	44				88	(4)
REMOVABLE PREFORMED PLASTIC MASK (BLACK)	LIN FT	70	70	70				210	
4" SOLID LINE WHITE PAINT	LIN FT	1604						1604	
4" SOLID LINE YELLOW PAINT	LIN FT			395				395	
4" DOUBLE SOLID LINE YELLOW PAINT	LIN FT	14561	16792	16383	2267			50003	

SPECIFIC NOTES:
(1) SOME QUANTITIES SHOWN IN STAGE 1 WILL REMAIN INPLACE FOR STAGE 2 AND SOME QUANTITIES SHOWN IN STAGE 2 WILL REMAIN INPLACE FOR STAGE 3.
(2) TEST LEVEL 2 REQUIRED.
(3) TEMPORARY SIGNAL SYSTEM INCLUDES 3 TRAILER MOUNTED SIGNALS. THE TRAILER MOUNTED SIGNALS SHALL BE OPERATED AS A SYSTEM TO CONTROL TRAFFIC AT THE INTERSECTION OF ARBOR STREET AND T.H. 23. SEE SPECIAL PROVISIONS FOR SPECIFIC REQUIREMENTS.
(4) PAID FOR AS EQUIVALENT LENGTH OF 4" MATERIAL.
EQUIVALENT LENGTH = 528 LIN FT. QUANTITY BASED ON 88' OF 24" MATERIAL PRORATED AS 4" MATERIAL (88' X 24")/4= 528 LIN FT.

There is a difference between a specific note and note. Specific note is specifically for that sheet.

From a Sample Plan Set

Shown on the sheet T1 of the sample plan included in the Appendix are the estimated quantities. This will include the ITEM name, UNIT, QUANTITY (by Stage and Phase) and TOTAL amount. If staging occurs (as is done in this plan, the staging quantities are listed in separate columns. These elements can be estimated with GEOPAK. The PAY ITEM description used should match Short Description shown in the AASHTOWare Project Item List (http://bidlet.dot.state.mn.us/ItemSearch.aspx).

5.6.1 Traffic Control Supervisor

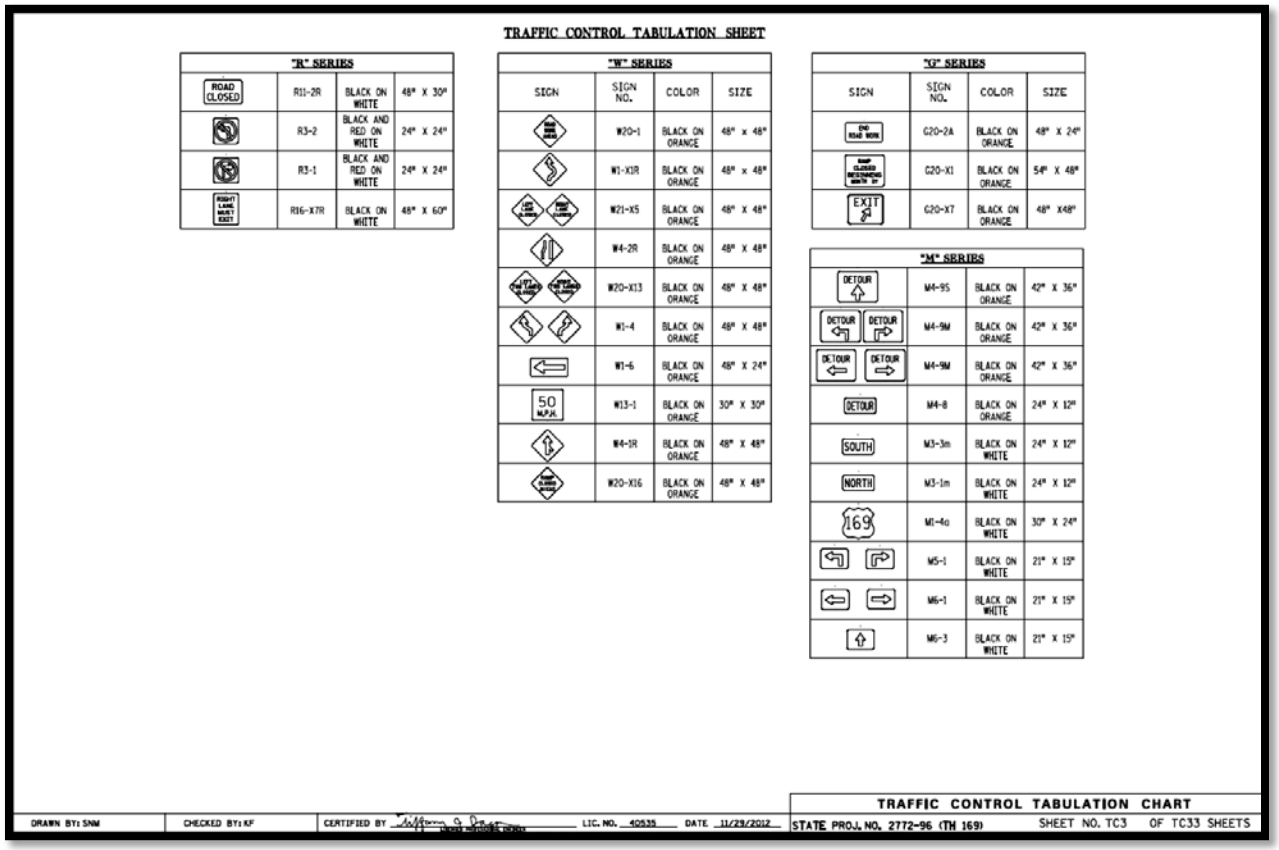
The Traffic Control Supervisor is a pay item that can have three different units (Hour, Each, Lump Sum). This is to be used when you have complex traffic control or a switch. It has been noted that this pay item seems to be over used. If you use lump sum, technically this person is always needed. Using 'Hour' is more flexible.

Be sure to talk to the project engineer beforehand related to this item. If no project engineer has been identified, talk to the resident engineer. In addition, talk with the construction office during the design phase to determine what/if this is required.

TRAFFIC CONTROL SUPERVISOR	HOUR
TRAFFIC CONTROL SUPERVISOR	EACH
TRAFFIC CONTROL SUPERVISOR	LUMP SUM

5.7 Traffic Control Tabulation Charts Sheet

The tabulation charts include a summary of signs that are included within the project.



TRAFFIC CONTROL TABULATION SHEET

"R" SERIES

ROAD CLOSED	R11-2R	BLACK ON WHITE	48" X 30"
	R3-2	BLACK AND RED ON WHITE	24" X 24"
	R3-1	BLACK AND RED ON WHITE	24" X 24"
RIGHT LANE MUST EXIT	R16-X7R	BLACK ON WHITE	48" X 60"

"W" SERIES

SIGN	SIGN NO.	COLOR	SIZE
ROAD WORK AHEAD	W20-1	BLACK ON ORANGE	48" x 48"
	W1-X1R	BLACK ON ORANGE	48" x 48"
LEFT LANE CLOSED / RIGHT LANE CLOSED	W21-X5	BLACK ON ORANGE	48" X 48"
	W4-2R	BLACK ON ORANGE	48" X 48"
LEFT LANE CLOSED / RIGHT LANE CLOSED	W20-X13	BLACK ON ORANGE	48" X 48"
	W1-4	BLACK ON ORANGE	48" X 48"
	W1-6	BLACK ON ORANGE	48" X 24"
50 M.P.H.	W13-1	BLACK ON ORANGE	30" X 30"
	W4-1R	BLACK ON ORANGE	48" X 48"
RAMP CLOSED BEGINNING MONTH DY	W20-X16	BLACK ON ORANGE	48" X 48"

"G" SERIES

SIGN	SIGN NO.	COLOR	SIZE
END ROAD WORK	G20-2A	BLACK ON ORANGE	48" X 24"
RAMP CLOSED BEGINNING MONTH DY	G20-X1	BLACK ON ORANGE	54" X 48"
EXIT	G20-X7	BLACK ON ORANGE	48" X48"

"M" SERIES

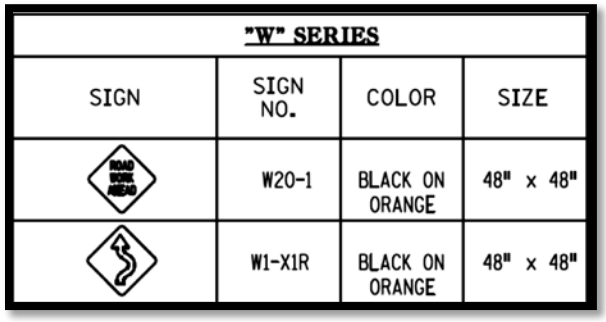
DETOUR	M4-9S	BLACK ON ORANGE	42" X 36"
DETOUR / DETOUR	M4-9M	BLACK ON ORANGE	42" X 36"
DETOUR / DETOUR	M4-9M	BLACK ON ORANGE	42" X 36"
DETOUR	M4-8	BLACK ON ORANGE	24" X 12"
SOUTH	M3-3m	BLACK ON WHITE	24" X 12"
NORTH	M3-1m	BLACK ON WHITE	24" X 12"
169	M1-4a	BLACK ON WHITE	30" X 24"
	M5-1	BLACK ON WHITE	21" X 15"
	M6-1	BLACK ON WHITE	21" X 15"
	M6-3	BLACK ON WHITE	21" X 15"

DRAWN BY: SNM | CHECKED BY: KF | CERTIFIED BY [illegible] | LIC. NO. 40535 | DATE 11/29/2012

TRAFFIC CONTROL TABULATION CHART
STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC3 OF TC33 SHEETS

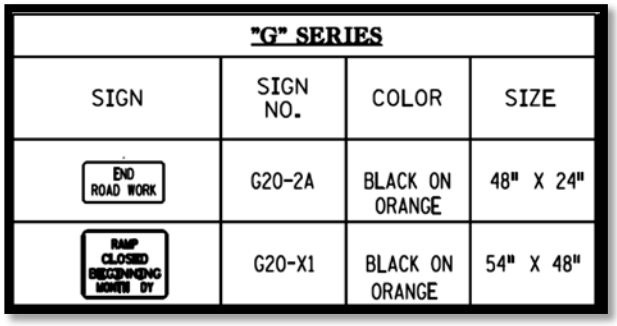
The tables include the SIGN, SIGN NO., COLOR and SIZE. Each sign shown on the plans will be summarized in these tables. These tables will be created after the signs have been placed on the layout sheets.

Do NOT put quantities on this sheet.



"W" SERIES

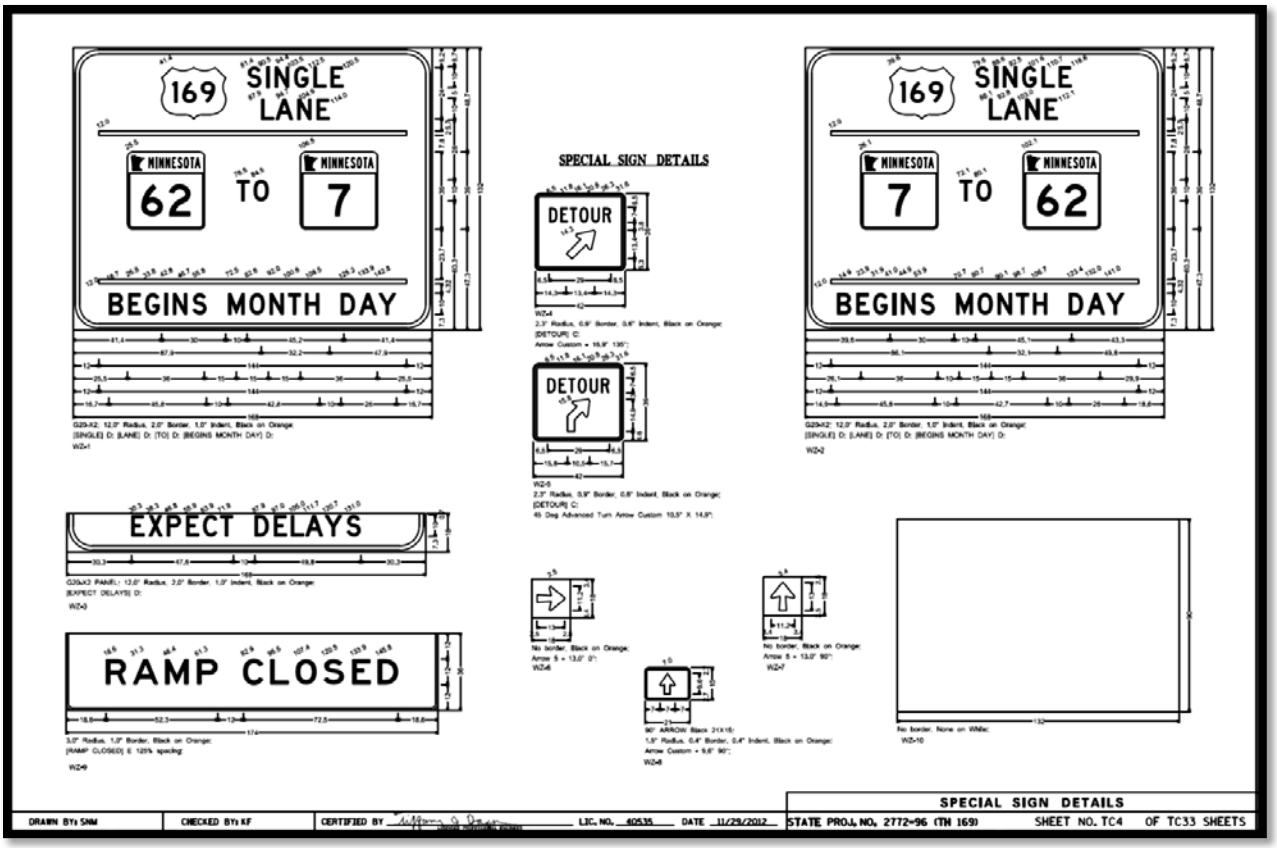
SIGN	SIGN NO.	COLOR	SIZE
ROAD WORK AHEAD	W20-1	BLACK ON ORANGE	48" x 48"
	W1-X1R	BLACK ON ORANGE	48" x 48"



"G" SERIES

SIGN	SIGN NO.	COLOR	SIZE
END ROAD WORK	G20-2A	BLACK ON ORANGE	48" X 24"
RAMP CLOSED BEGINNING MONTH DY	G20-X1	BLACK ON ORANGE	54" X 48"

5.8 Special Sign Details



When sign panels exist, the layout details will be shown on these sheets. MnDOT uses the software SignCad® to layout guide signs.

5.9 Narrative Sheet

Below are sample narratives of the traffic control plan set. It is a summary of the work that is being performed and the TC for each stage of the project. It may be possible to fit this on the title sheet, if not too long.

TRAFFIC CONTROL NARRATIVE

STAGE 1
CONSTRUCTION:
- CURB & GUTTER AND SIDEWALK ON OUTSIDE LANES (NB & SB), UTILITIES AND BRIDGE #69091.

TRAFFIC:
- CLOSE OUTSIDE LANES (NB & SB).
- MAINTAIN TRAFFIC ON INSIDE LANES (NB & SB).

STAGE 2
CONSTRUCTION:
- MILL & OVERLAY NB LANES, UTILITIES AND BRIDGE #69091.

TRAFFIC:
- CLOSE NB LANES.
- MAINTAIN 2 WAY TRAFFIC ON SB LANES.

STAGE 3
CONSTRUCTION:
- MILL & OVERLAY SB LANES, UTILITIES AND BRIDGE #69091.

TRAFFIC:
- CLOSE SB LANES.
- MAINTAIN 2 WAY TRAFFIC ON NB LANES.

STAGES 1-3 ON GOING DURING PHASES 1-3
FOR MEDIAN REMOVAL STA. 313+00 TO 333+00.

PHASE 1
CONSTRUCTION:
- PROFILE CHANGE ON SB LANES, MILL & OVERLAY SB LANE.

TRAFFIC:
- CLOSE SB LANES.
- MAINTAIN 2 WAY TRAFFIC ON NB LANES.

PHASE 2
CONSTRUCTION:
- REMOVE MEDIAN AND GUARDRAIL.

TRAFFIC:
- CLOSE INSIDE LANES (NB & SB).
- MAINTAIN TRAFFIC ON OUTSIDE LANES (NB & SB).

PHASE 3
CONSTRUCTION:
- CURB & GUTTER AND SIDEWALK ON OUTSIDE LANES (NB & SB).

TRAFFIC:
- CLOSE OUTSIDE LANES (NB & SB).
- MAINTAIN TRAFFIC ON INSIDE LANES (NB & SB).

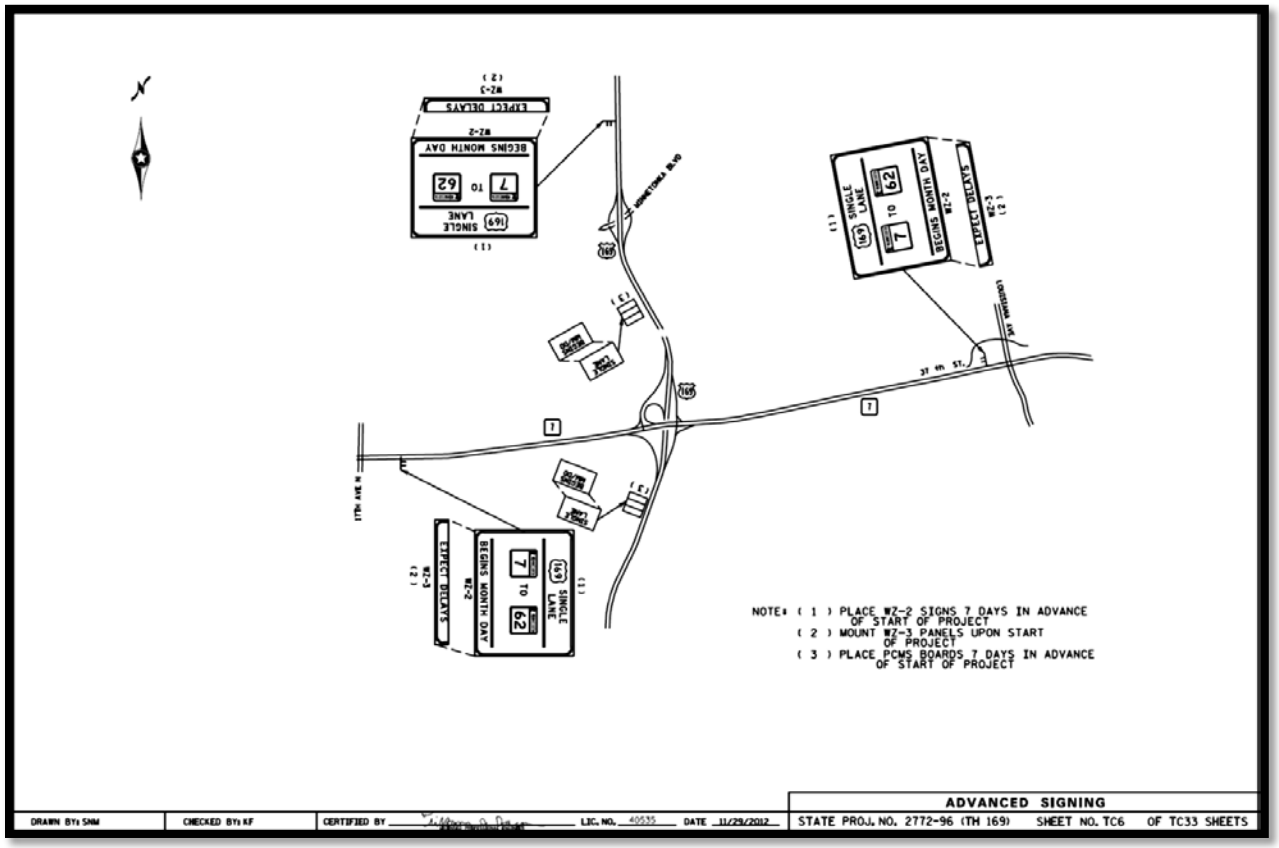
Below is an additional Narrative example (not included as a sample plan set):

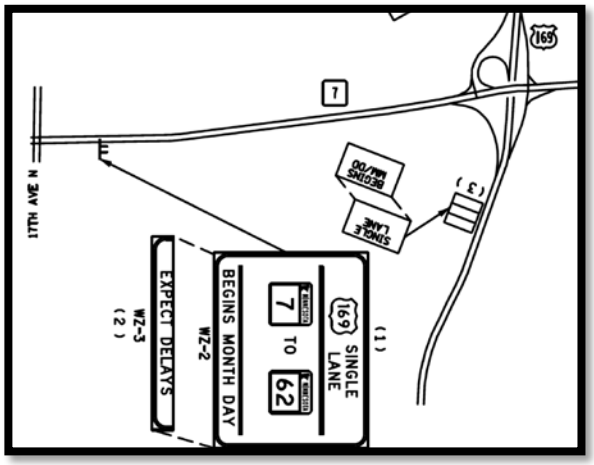
STAGING NARRATIVE

1. PIPE REPLACEMENT CROSSING OAKLAND AVE AT TH105 WILL BE DONE USING THE DETOUR ON SHEET T3.
2. PIPE REPLACEMENTS CROSSING 2ND AVE. AND 8TH AVE. WILL BE DONE WITH ROAD CLOSURES AS SHOWN ON SHEET T4.
3. PED RAMPS AND OTHER PIPE WORK WILL BE COMPLETED USING SHOULDER/PARKING LANE CLOSURES. ALL OTHER WORK WILL BE COMPLETED USING SHORT TERM LANE CLOSURES IN MULTI-LANE SECTIONS AND FLAGGERS IN 2 LANE SECTIONS.

5.10 Advanced Signing

(Image below is not part of example plan)





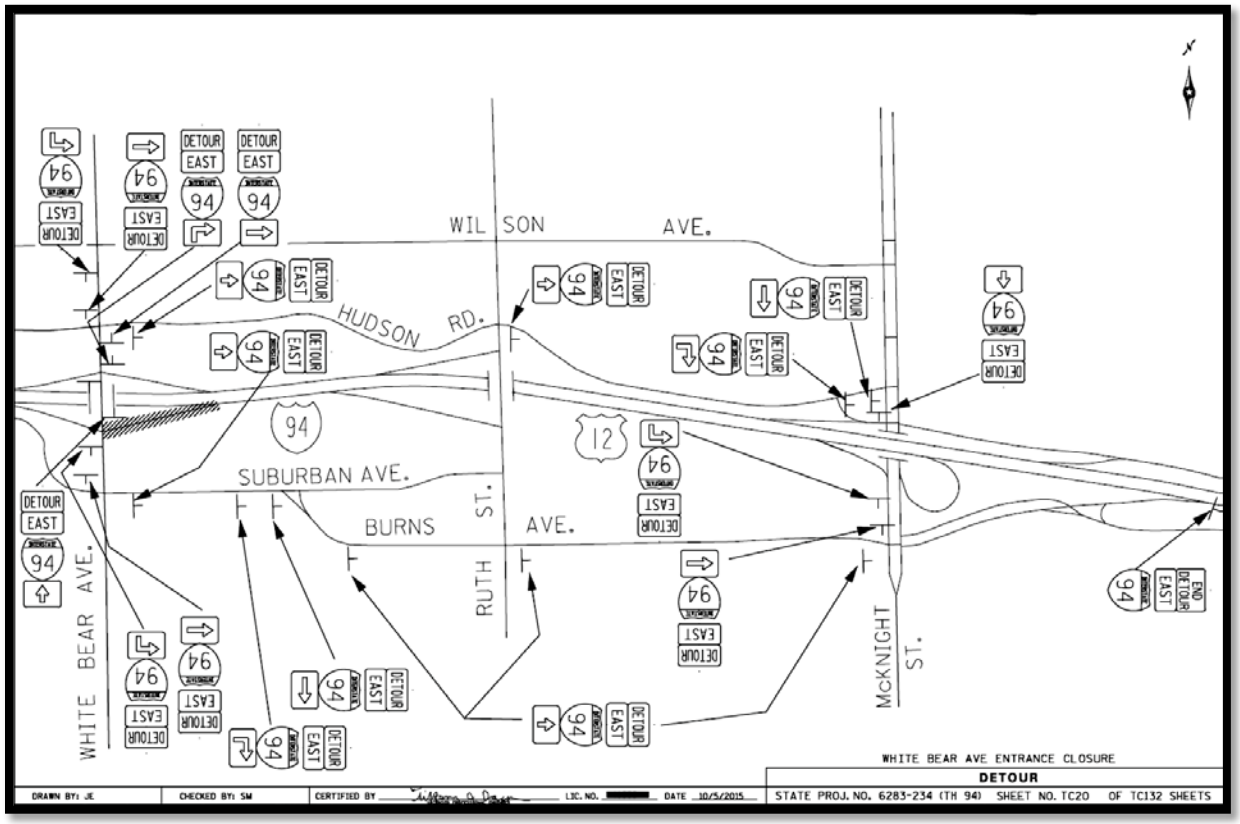
(1) PLACE WZ-2 SIGNS 7 DAYS IN ADVANCE OF START OF PROJECT
(2) MOUNT WZ-3 PANELS UPON START OF PROJECT
(3) PLACE PCMS BOARDS 7 DAYS IN ADVANCE OF START OF PROJECT

Advanced Signing Sheets illustrate the signs in advance of the work zone. As the notes indicate, the signs will be placed in advance of the project start date. This example also illustrates the use of Portable Changeable Message Signs (PCMS).

If PCMS is conveying a timeframe, avoid using dates when the timeframe of condition is under 7 days.

5.11 Detour Sheets

(Image below is not part of example plan)

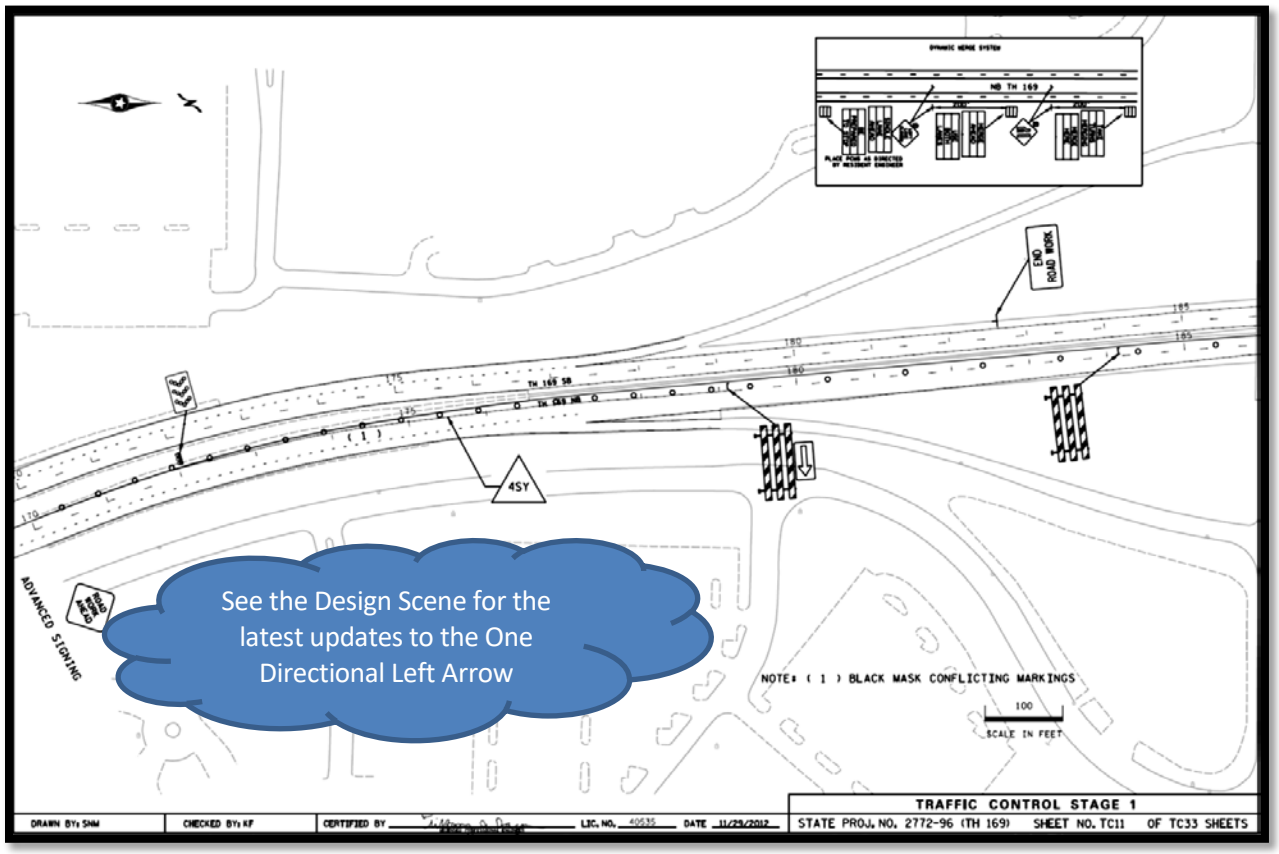


The Detour Sheets layout the detour for the various stages of the project.

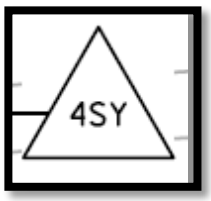
For these sheets, they need to be understandable for individuals in the field. Numbers for the sign assembly's don't work well for them. Make sure the signs are big enough that they can be read.

5.12 TC Layout Sheets

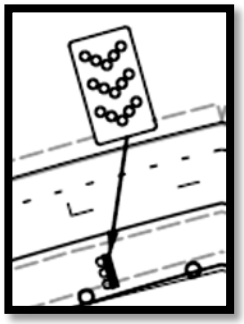
The following are a few select examples from the traffic control plan layouts. The first example is sheet TC11 illustrating details during stage 1.



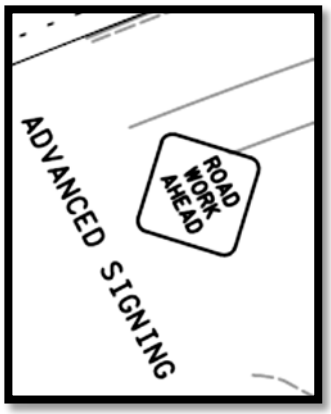
The following items are found on this sheet. Use the Symbols and Materials Legend discussed earlier.



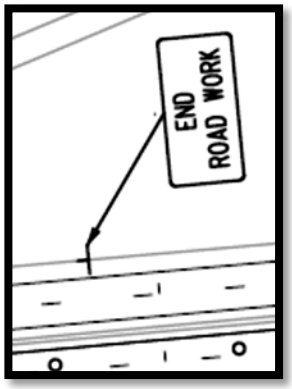
- ✓ The triangle represents Paint
- ✓ 1st Digit "4" indicates a 4 inch line
- ✓ 2nd digit "S" indicates a Solid line
- ✓ 3rd digit "Y" indicates a Yellow line



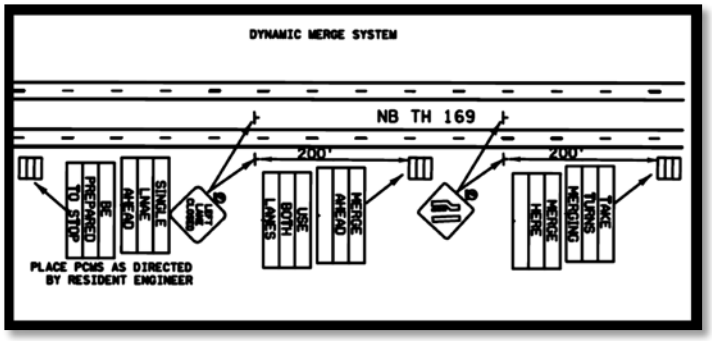
- ✓ Illustrates a FLASHING ARROW BOARD TYPE C (4’ x 8’)



- ✓ A W20-1 ROAD WORK AHEAD sign

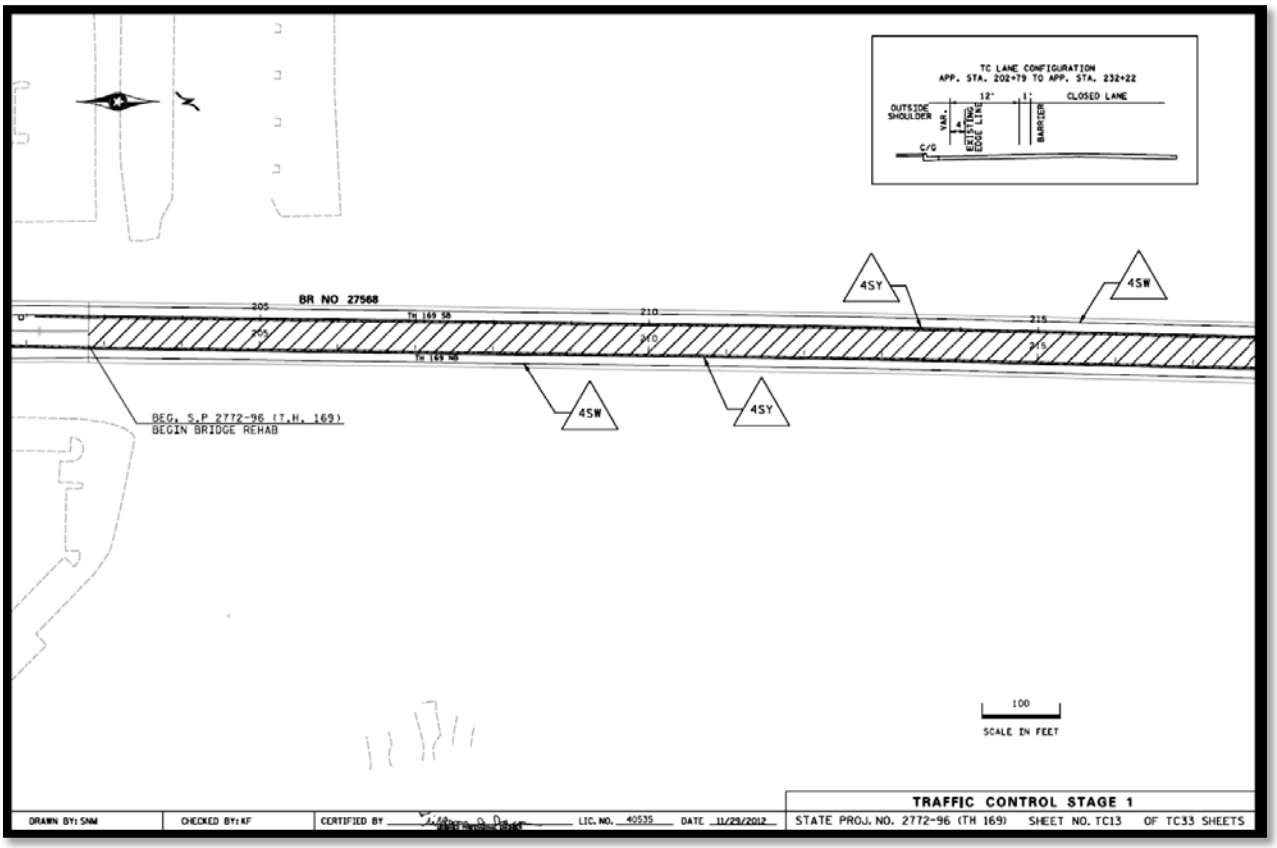


- ✓ A G20-2A END ROAD WORK sign

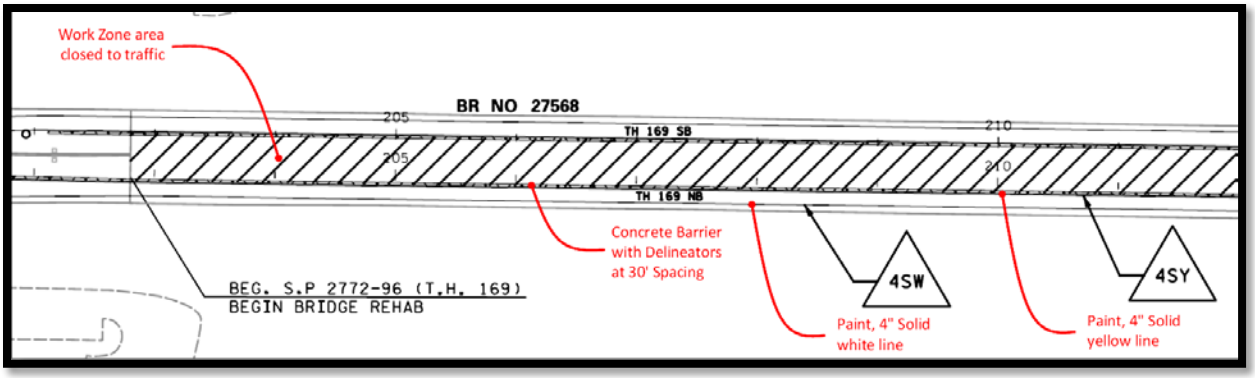


- ✓ Project includes a DYNAMIC MERGE SYSTEM with Portable Changeable Message Signs (PCMS).
- ✓ Location is directed by engineer

The example below is from the same project S.P. 2772-96 (TH 169) Sheet number TC 13.

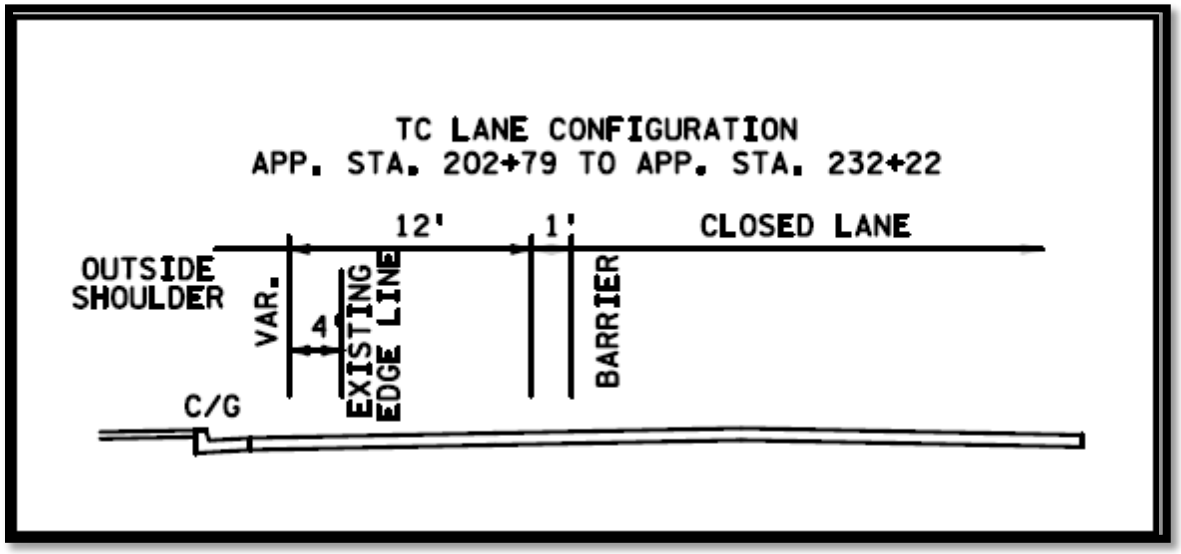


The image below illustrates some of the elements shown on the plan sheet TC13.

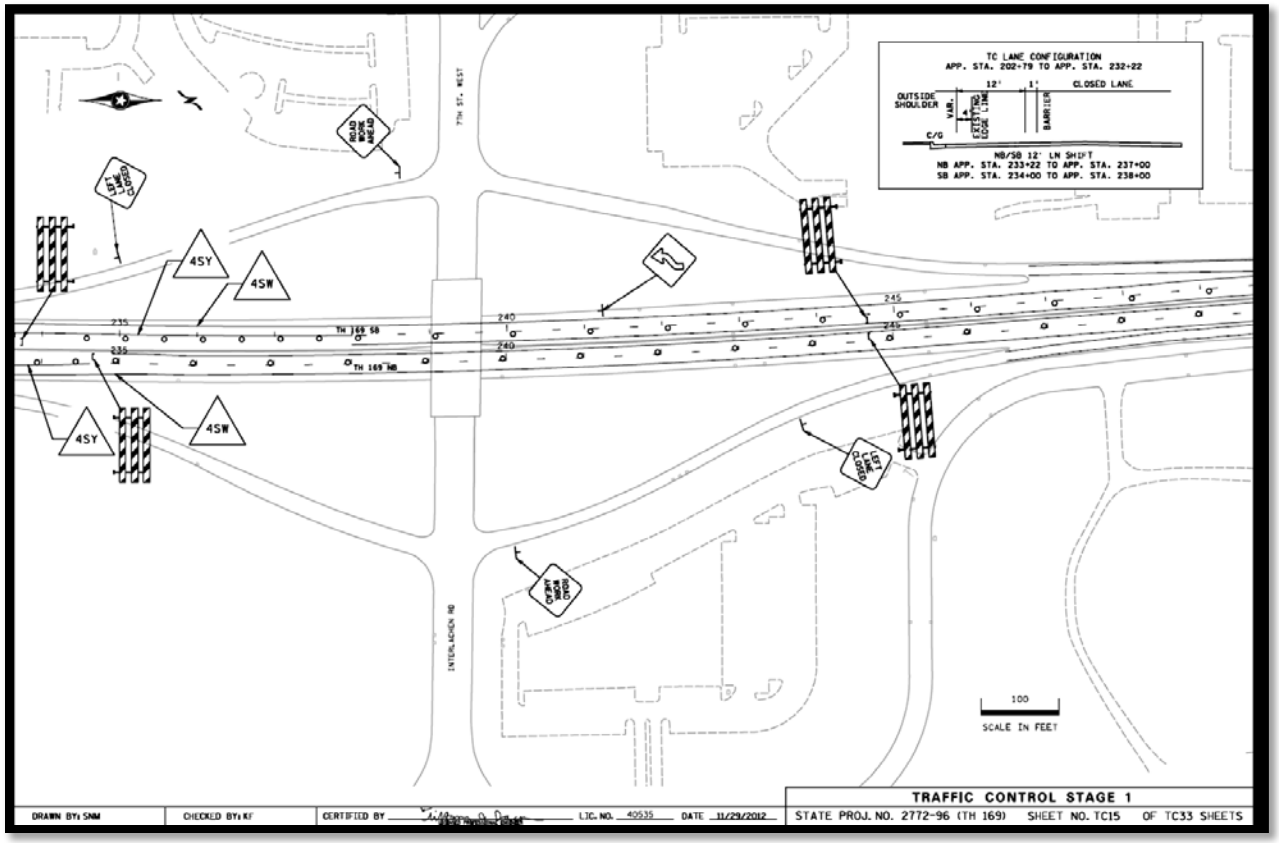


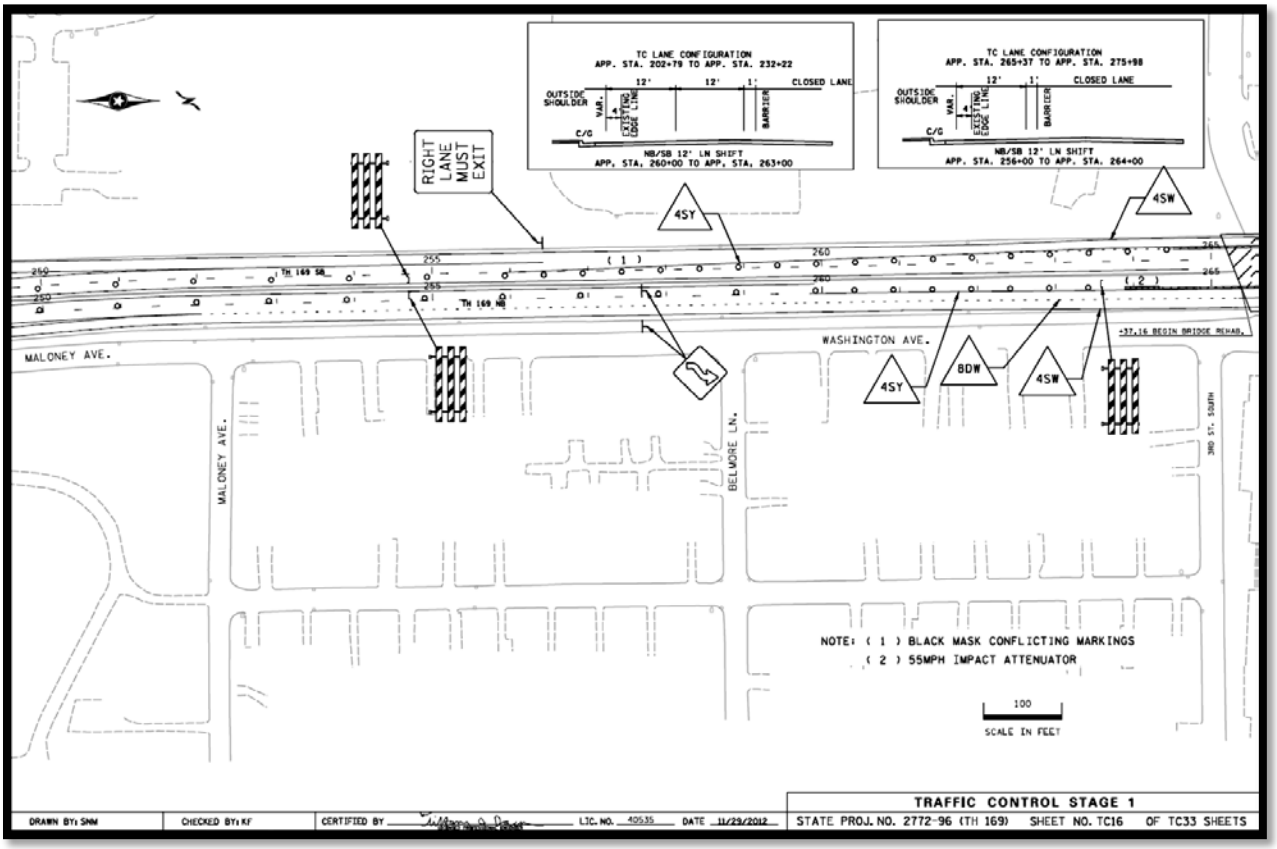
The example below is from the same S.P. 2772-96 (TH 169) Sheet number TC 13.

The plan also shows a cross-section with the TC lane configuration.

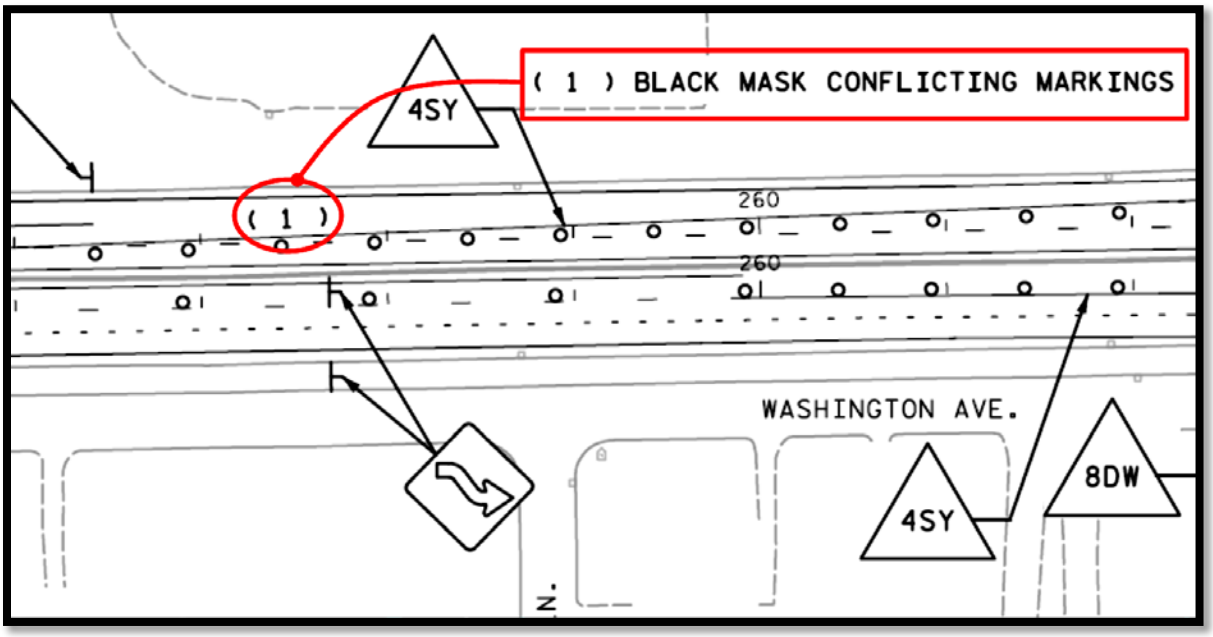


Sheet TC15 illustrates TC in the vicinity of an interchange. Notice the signing on the ramps.

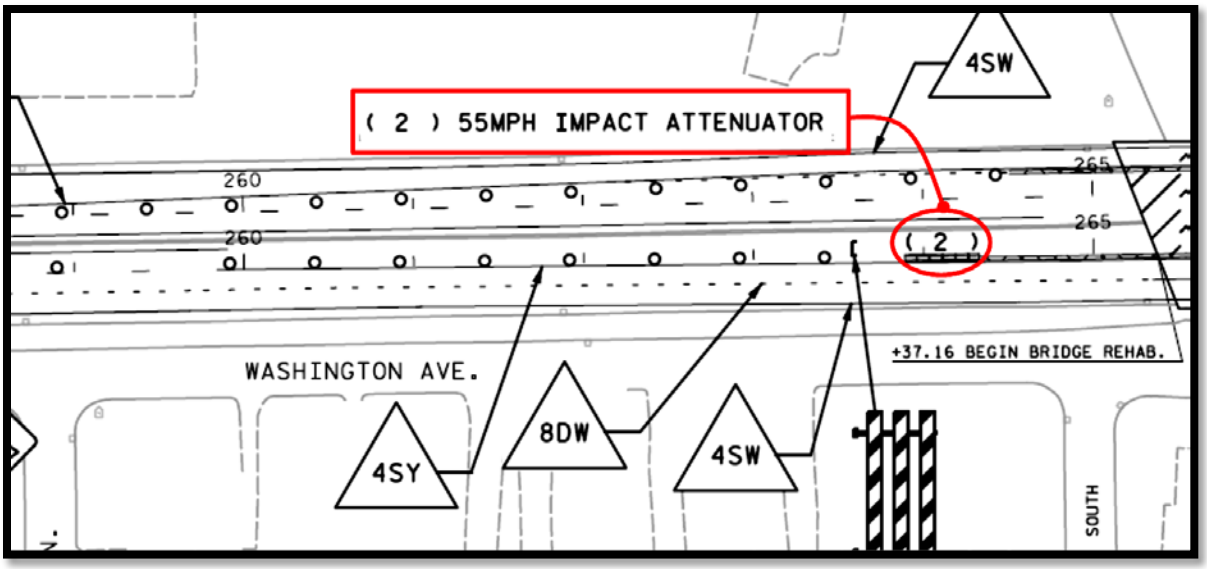




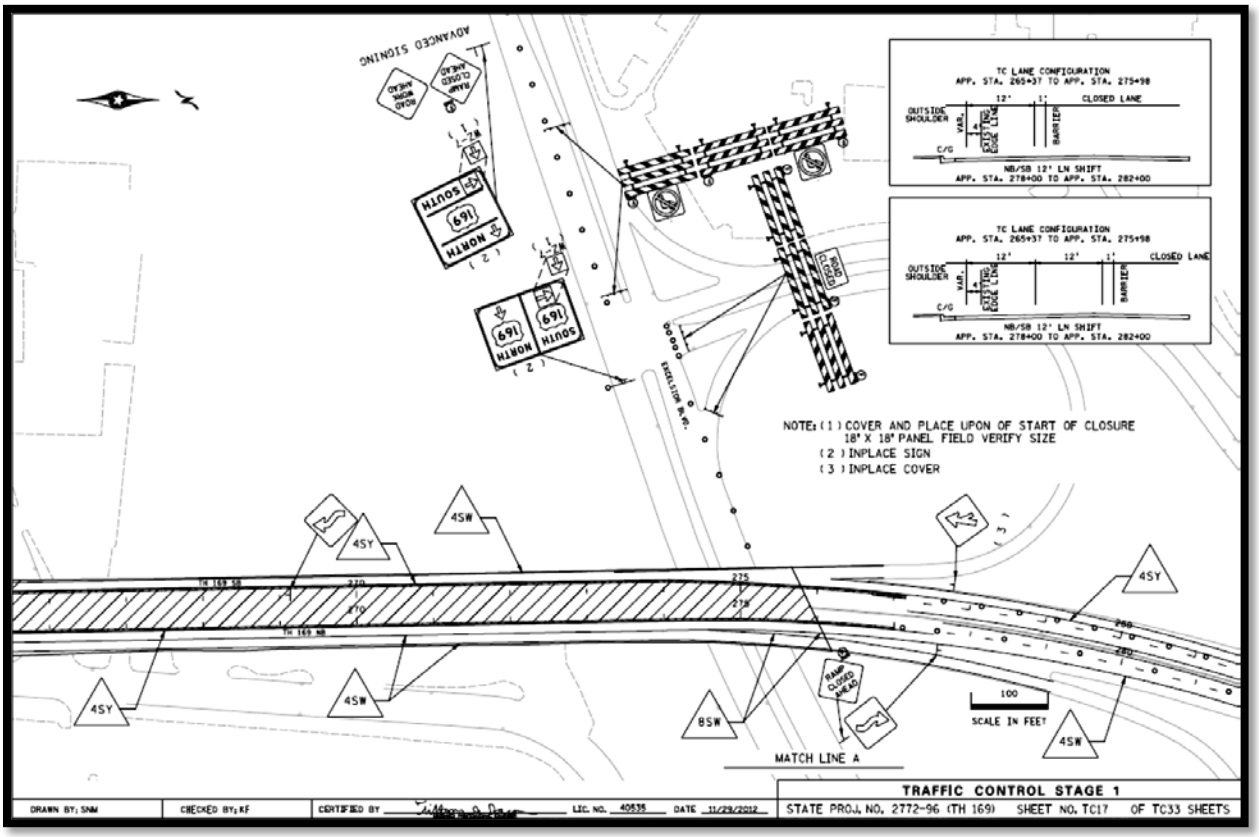
Notice the notes on sheet TC16. Note (1) indicates black mask conflicting markings.



Note (2) indicates a 55 MPH Impact Attenuator. This sample is from an older plan. **The note should now include the attenuator level (TL-2 or TL-3)**.



Sheet TC17 shows a ramp closure.

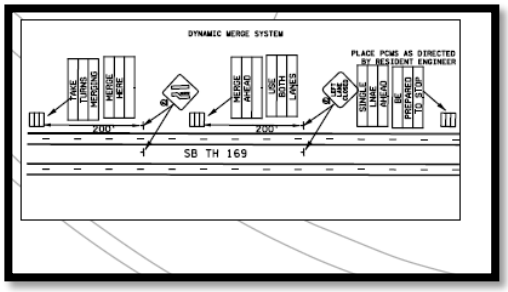


Additional sheets show similar elements for the stage 2 TC plan. Refer to the sample plan in the Appendix.

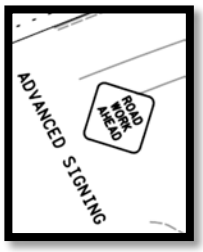
5.12.1 Layout Sheet Tips

- ✓ On the Layout sheets, all the extra elements are not needed (like parking lots).

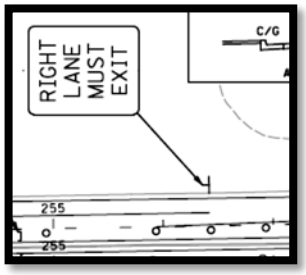
- ✓ Don't be afraid to us insets.
- ✓ If possible, can break in half and show two sheets on one.



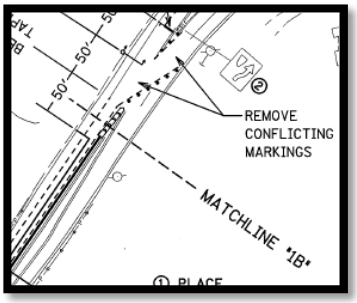
- ✓ Avoid having sheets with limited information on it. For instance, Advanced Signing may be the only thing on a sheet (if break lines are not used). This helps to remove unnecessary sheets that just show one sign. A distance isn't needed since it can be found in other references already stated in this material.



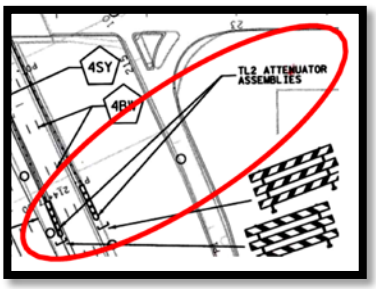
- ✓ If the "Right Lane Must Exit" is permanent, this should be noted such.
- ✓ Not all signs need to be shown, just the ones that are impacted by the TC plan.
- ✓ If a sign is being covered, that should be noted.
- ✓ If anything is in-place and relative to the installation, show it. An example such as Adopt a Highway would not be shown.

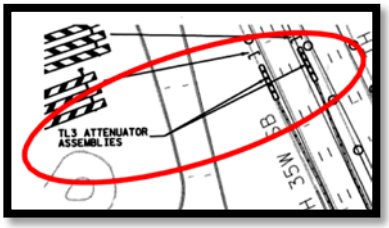


- ✓ Use match-lines or break-lines when possible or feasible.
- ✓ Dimensions instead of a scale can be used.
- ✓ When you have sheets that have redundant info, such as pavement marking, don't need to show every single pavement marking. Include typicals and break lines in-between.



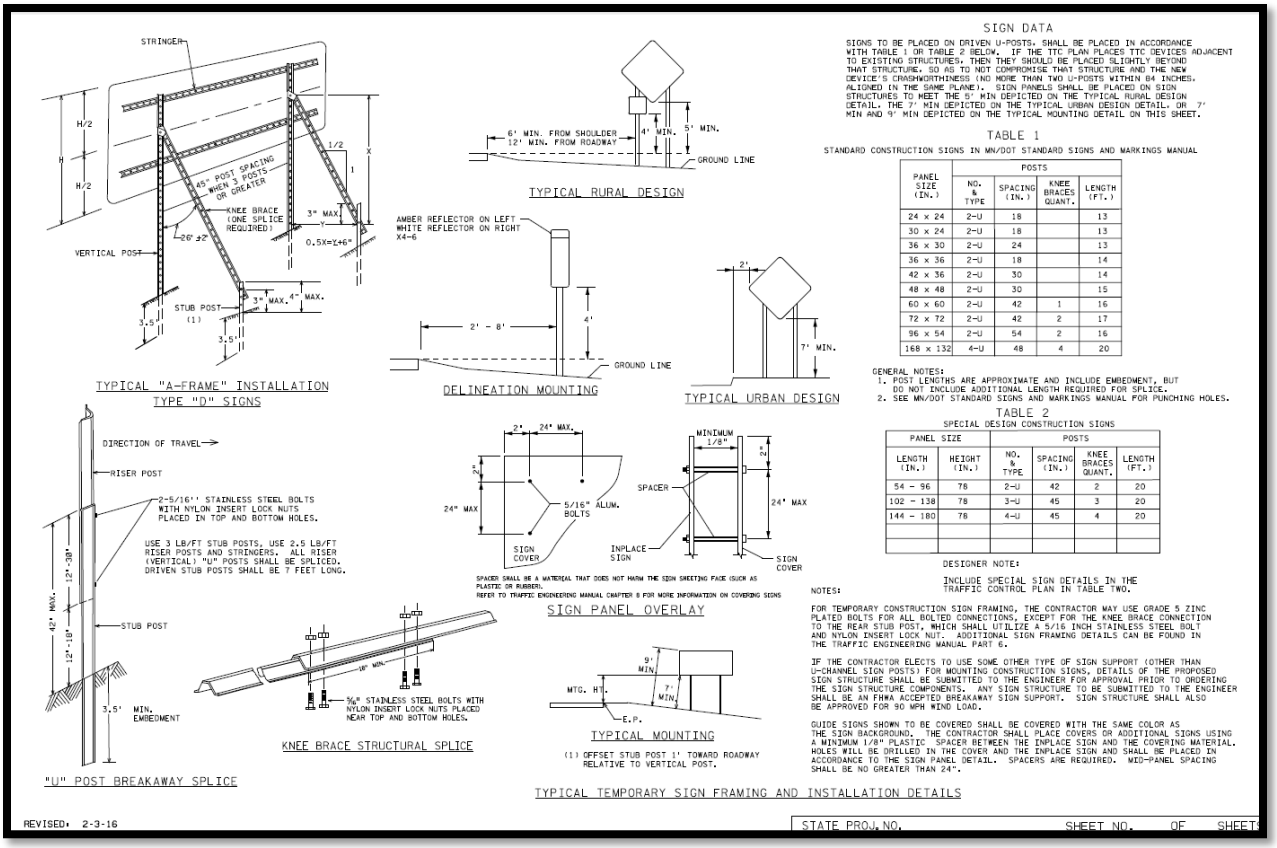
- ✓ As a test, printout sheets and look at them on paper. Do this early and make sure it is readable on paper, not just the screen.
- ✓ If there is a cross street, show the name of the cross street to give a reference point.
- ✓ If TL2 and TL3 attenuators are being used, need to call these out on the plan. If only one type is being used on the full plan, do not need to call these out.



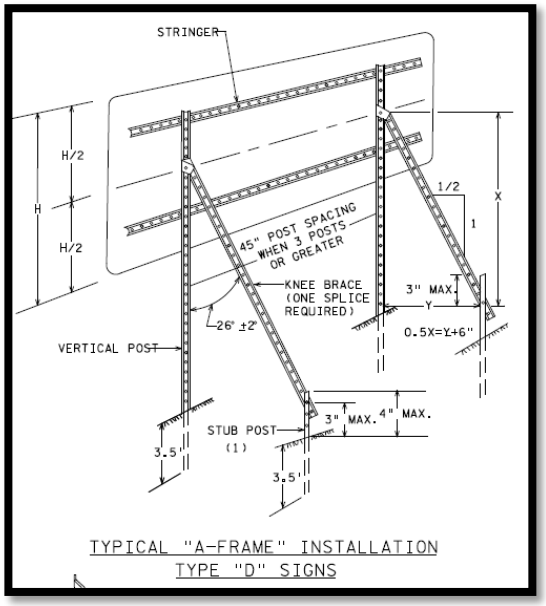


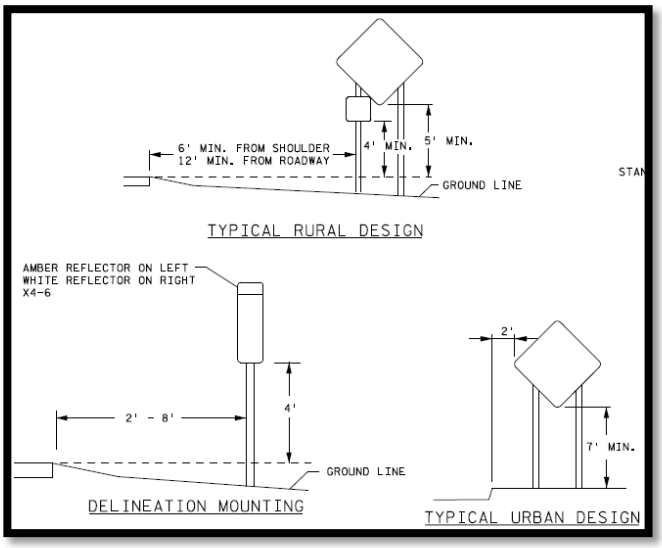
5.13 Typical Drawings

The following are typical drawings from the OTE.



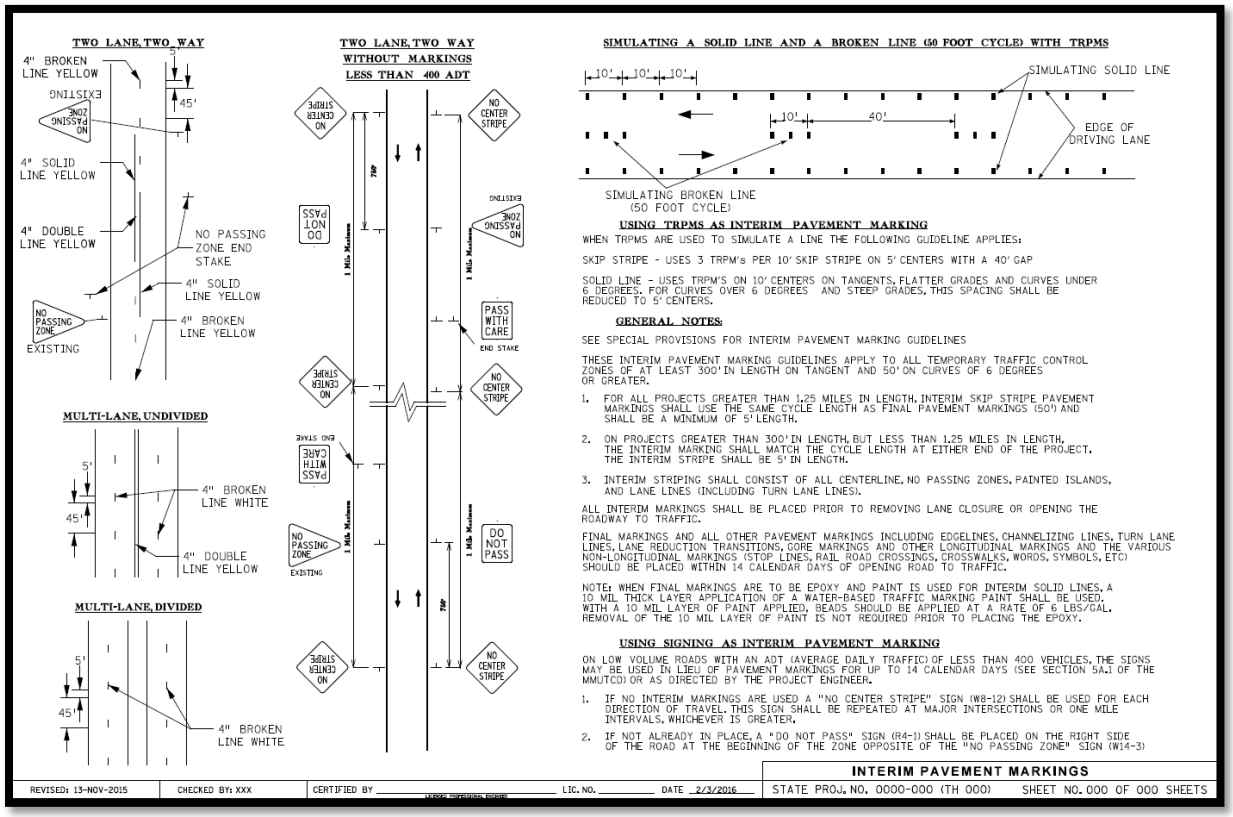
Below are sample blowups from the above sheet.



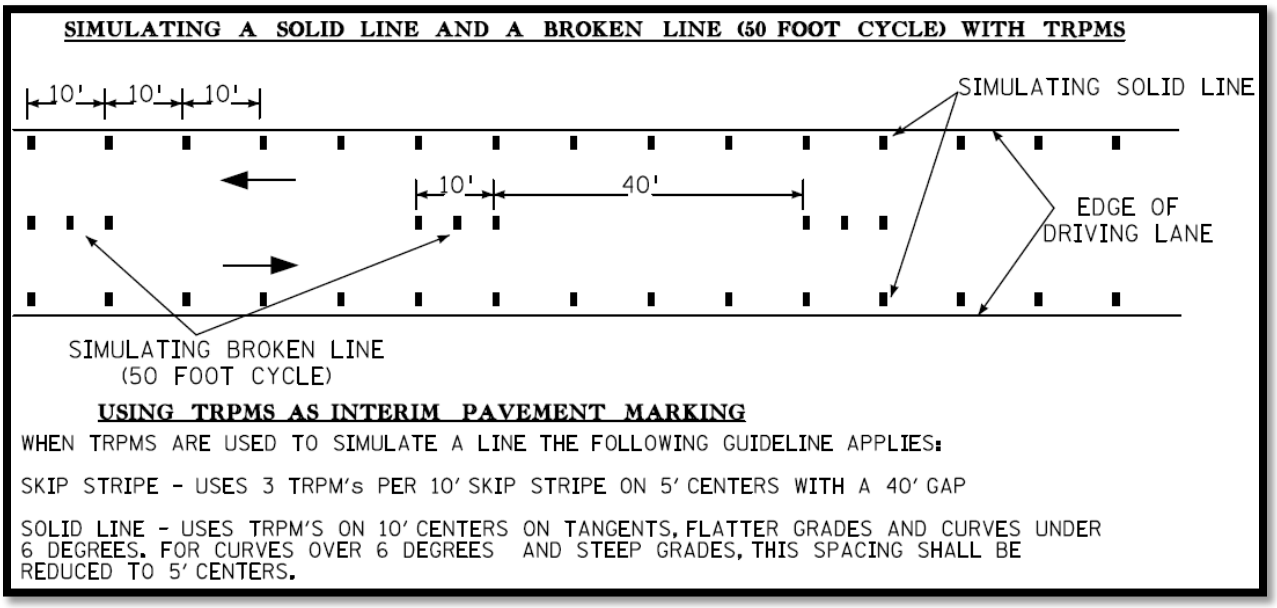


5.13.1 Interim Pavement Markings

The image below is from the sample TC plan on the website illustrating interim pavement markings. Note, this sheet is being updated to a Standard Plan.

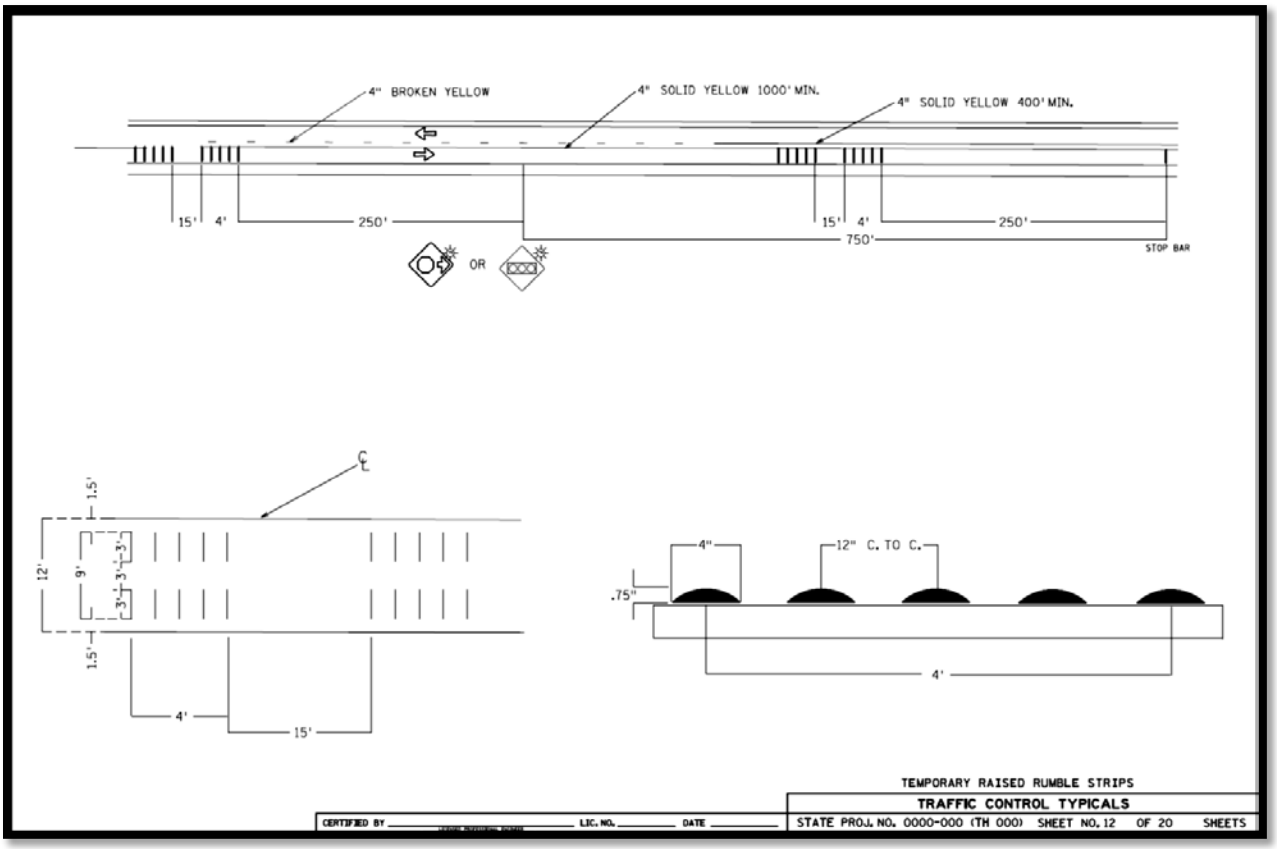


Below is an enlarged sample from the above plan sheet.

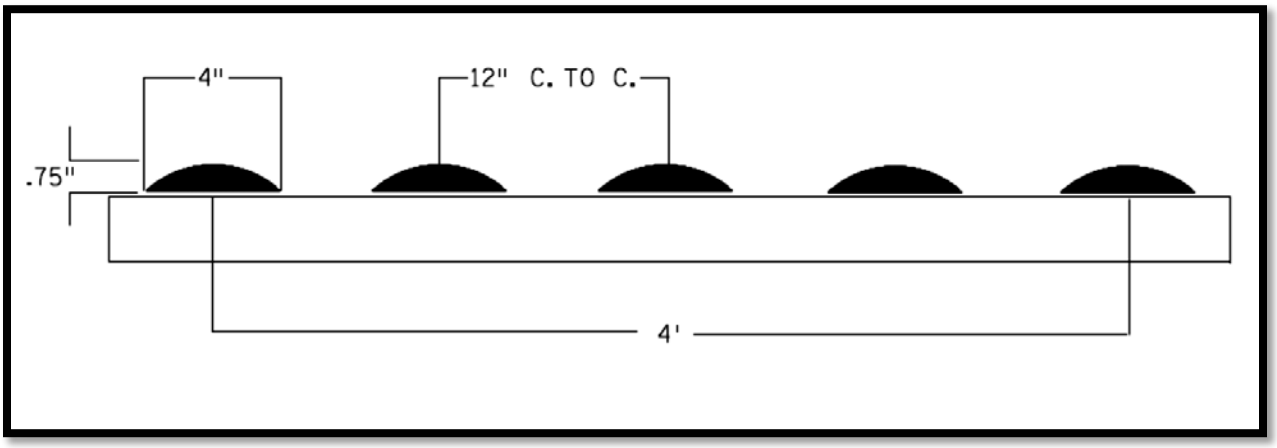


5.13.2 Temporary Raised Rumble Strips

The image below illustrates the typical drawing for Temporary Raised Rumble Strips.



Below is an enlarged sample from the above plan sheet.



6. SPECIFICATIONS AND SPECIAL PROVISIONS

6.1 MnDOT Standard Specification for Construction Book (Spec Book)

The "Spec Book" contains standard specifications to be used and referred to in the design of plans and in the preparing of Special Provisions. Plan designers need to be aware of the specifications contained in the Spec Book that may apply to their individual project.

The Spec Book includes both metric and non-metric units of measure conversions. The Spec book includes modifications to the prior Spec Book.

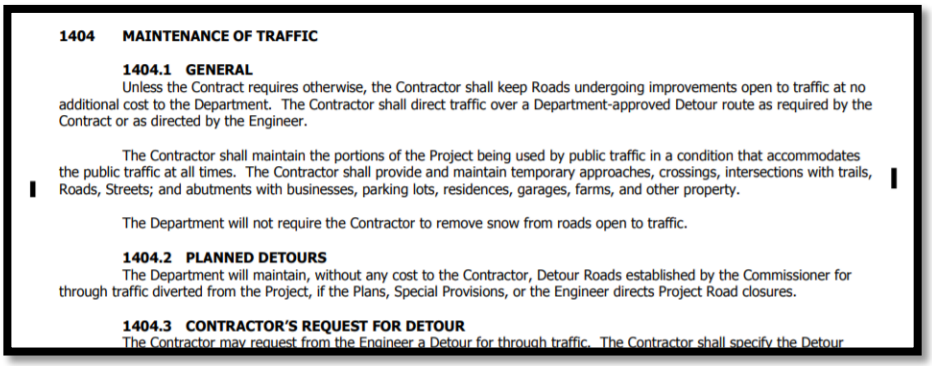
Exhibit 6-1 Standard Specifications for Construction Book (Spec Book)

MINNESOTA

DEPARTMENT OF TRANSPORTATION
ST. PAUL, MINNESOTA

STANDARD
SPECIFICATIONS
FOR
CONSTRUCTION

2018 EDITION


1404 MAINTENANCE OF TRAFFIC

1404.1 GENERAL
Unless the Contract requires otherwise, the Contractor shall keep Roads undergoing improvements open to traffic at no additional cost to the Department. The Contractor shall direct traffic over a Department-approved Detour route as required by the Contract or as directed by the Engineer.

The Contractor shall maintain the portions of the Project being used by public traffic in a condition that accommodates the public traffic at all times. The Contractor shall provide and maintain temporary approaches, crossings, intersections with trails, Roads, Streets; and abutments with businesses, parking lots, residences, garages, farms, and other property.

The Department will not require the Contractor to remove snow from roads open to traffic.

1404.2 PLANNED DETOURS
The Department will maintain, without any cost to the Contractor, Detour Roads established by the Commissioner for through traffic diverted from the Project, if the Plans, Special Provisions, or the Engineer directs Project Road closures.

1404.3 CONTRACTOR'S REQUEST FOR DETOUR
The Contractor may request from the Engineer a Detour for through traffic. The Contractor shall specify the Detour

6.1.1 Format of the "Spec Book"

The Spec Book is made of three divisions:

- ✓ Division I - General Requirements and Covenants
- ✓ Division II - Construction Details
- ✓ Division III - Materials

DIVISION I — General Requirements and Covenants

Each Division I Specification number begins with "1" (1101 - 1911). Note that each section of Division I is given a numeric series. For example, Scope of Work is the 1400 series (1401 - 1408). This Division is divided into nine (9) sections, the following is a closer look at two of these sections:

- ✓ 1404 MAINTENANCE OF TRAFFIC
- ✓ 1710 TRAFFIC CONTROL DEVICES

http://www.dot.state.mn.us/pre-letting/spec/index.html.

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1404 MAINTENANCE OF TRAFFIC

1404.1 GENERAL

Unless the Contract requires otherwise, the Contractor shall keep Roads undergoing improvements open to traffic at no additional cost to the Department. The Contractor shall direct traffic over a Department-approved Detour route as required by the Contract or as directed by the Engineer.

The Contractor shall maintain the portions of the Project being used by public traffic in a condition that accommodates the public traffic at all times. The Contractor shall provide and maintain temporary approaches, crossings, intersections with trails, Roads, Streets; and abutments with businesses, parking lots, residences, garages, farms, and other property.

The Department will not require the Contractor to remove snow from roads open to traffic.

1404.2 PLANNED DETOURS

The Department will maintain, without any cost to the Contractor, Detour Roads established by the Commissioner for through traffic diverted from the Project, if the Plans, Special Provisions, or the Engineer directs Project Road closures.

1404.3 CONTRACTOR'S REQUEST FOR DETOUR

The Contractor may request from the Engineer a Detour for through traffic. The Contractor shall specify the Detour routes and submit justification information with the Detour request. The Department will consider and may, at its sole discretion, approve the Detour request and establish a Detour in accordance with the following:

(1) The Contractor shall design, provide, install, maintain, and remove traffic control devices on the Detour Roads at no additional cost to the Department. The Contractor shall submit the proposed Detour layout to the Engineer for approval at least 7 calendar days before the Contractor begins to use the Detour.

(2) The Contractor shall maintain and restore Detour Roads at no additional cost to the Department. The Department will remove snow from Detour Roads at the Department's expense.

(3) The Contractor shall provide, install, and maintain traffic control devices and other traffic protection measures required to maintain local traffic.

1404.4 CONTRACTOR'S REQUEST FOR TEMPORARY BY-PASSES

The Contractor shall design, construct, maintain, and remove other Temporary By-pass facilities requested by the Contractor and accepted by the Engineer at no additional cost to the Department.

1404.5 CONTRACTOR'S USE OF CROSSOVERS

Unless otherwise prohibited by the Engineer and in accordance with pertinent traffic laws and regulations, the Contractor may use freeway or expressway maintenance crossovers in or near the construction area to change the travel direction of the construction equipment.

1404.6 TRAFFIC CONTROL DURING AND AFTER WINTER SUSPENSION

As directed by the Engineer during periods of winter suspension, the Contractor shall open the Project's Roads to traffic to eliminate the need to accommodate traffic on Detour Roads during the suspension period.

During authorized winter suspension, the Department will maintain traffic control devices in accordance with 1710, "Traffic Control Devices." If Contractor-owned traffic control devices are damaged or destroyed, the Department will pay the Contractor for the value of the traffic control device as determined by the Engineer.

The Contractor shall not suspend operations for the winter until meeting the requirements of 1710, "Traffic Control Devices," and 1803.6, "Temporary Suspensions."

When resuming Work after winter suspension, the Contractor shall remove and replace, or correct Work lost or damaged during the suspension, as directed by the Engineer, and must remove, items used for Road maintenance in accordance with 1514, "Maintenance During Construction". The Department will pay for this work at the Contract Unit Prices or as Extra Work in accordance with 1402, "Contract Revisions."

1405 USE OF MATERIALS FOUND ON THE PROJECT

The Contractor shall not destroy or use Materials found on the Right of Way or on other land acquired for the Project for any other purposes than those specified in the Contract.

The Engineer may authorize the Contractor, in writing, to temporarily use Materials salvaged for the Department from existing structures. The Contractor is responsible for all damage to the Materials used temporarily. The Contractor shall repair, replace, or otherwise correct by means acceptable to the Engineer the Materials damaged by the temporary use, or the Department will deduct, from any moneys due or becoming due to the Contractor, an amount equivalent to the reasonable value or replacement cost of the Material.

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The Contractor shall obtain special permission from the Railroad Company before moving heavy or cumbersome objects or Equipment across a temporary crossing that could damage the track structure.

Unless the Contract requires otherwise, the Department will reimburse the Railroad Company for the costs of necessary flagging, other protective services and devices required to protect the Railroad Company's facilities, personnel, equipment, and traffic.

1709 NAVIGABLE WATERWAYS

The Contractor shall not interfere with free navigation of waterways or impair existing navigable depths when performing Work on navigable waters, unless authorized by permit. For information regarding permits that are required for this Work, contact the MnDOT Office of Freight and Commercial Vehicle Operations.

1710 TRAFFIC CONTROL DEVICES

1710.1 GENERAL

The Contractor shall provide traffic control devices and methods meeting the requirements of the MN MUTCD, Part I and Part II of the Minnesota Standard Signs Manuals, and the applicable Material Specifications. The Contractor shall also provide traffic control devices and methods in accordance with the following:

(1) Reflectorize all signs, paddles, and other traffic control devices, including those used for daytime operations; and
(2) Signs shall meet the crash testing requirements of NCHRP 350 as specified by the MN MUTCD and the Manual for Assessing Safety Hardware (MASH).

The Project Engineer may require the Contractor to provide a Letter of Compliance stating that all of the Contractors devices are NCHRP 350 compliant and also meet the requirements of MASH. The Letter of Compliance must also include approved drawings of the different signs and devices.

1710.2 PROVIDE, MAINTAIN, AND REMOVE

The Contractor shall provide and maintain traffic control devices as required by the Department in accordance with the contract and the MN MUTCD that perform the following functions:

(1) Advise, warn, and alert the traveling public of construction in advance of the Project termini and on all Roads, Streets, and public trails approaching or crossing the Project;
(2) Control and guide traffic through the Project, which may include using flag persons and pilot vehicles as required by the Contract; and
(3) Protect, warn, and exclude traffic and protect workers at all work sites.

If the Contractor fails to properly provide, install, maintain, or remove any of the required traffic control devices, the Department reserves the right to correct the deficiency and to deduct the costs from any moneys due or becoming due to the Contractor in accordance with 1512, “Unacceptable and Unauthorized Work.”

1710.3 PLANNED DETOURS

The Department, at its expense, will design traffic control devices necessary to control and guide traffic over planned Detours required by the Contract.

1710.4 (BLANK)

1710.5 TEMPORARY BY-PASSES

The Contractor shall construct, maintain, and remove traffic control devices on other temporary by-passes requested by the Contractor and approved by the Engineer at no additional cost to the Department.

1710.6 CONTRACTOR’S RESPONSIBILITY

The Engineer’s approval of the traffic control devices and the Contractor's method of application of traffic control measures as specified in this section will not relieve the Contractor of responsibility for protecting the work, the workers, and the traveling public in accordance with 1511, “Inspection of Work.”

The Contractor shall protect traffic signs not removed or relocated by the Department before construction in their original location for the duration of the work, except as otherwise approved by the Engineer. The Contractor may adjust or remove and reset a sign interfering with construction to a temporary location, if approved by the Engineer and if the original location is not critical and the Contractor resets the sign at the permanent location as soon as construction operations allow. The Contractor shall notify the Engineer before removing or disturbing a traffic sign.

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The Department will make no direct payment for removing, protecting, and replacing traffic signs as specified in this section unless provided for elsewhere in the Contract. The Department will not provide additional compensation to the Contractor for delays, inconvenience, or damage from special construction required performing the work in the presence of traffic signs.

1710.7 ENGINEER'S AUTHORITY

In accordance with 1501, "Authority of the Engineer," the Engineer will accept or reject a traffic control device provided by the Contractor, but not incorporated in the final construction, based on acceptable day and night performance.

If requested by the Engineer, the Contractor shall provide representative samples or remove traffic control devices for testing at no additional cost to the Department.

1710.8 (BLANK)

1711 USE OF EXPLOSIVES

If using explosives to complete the Work, the Contractor shall not endanger life, property, or new Project Work. The Contractor is responsible for property damage, personal injury, and death resulting from the use of explosives.

The Contractor shall use explosives, securely store explosives, and mark explosive storage locations in accordance with applicable laws. If laws do not identify storage requirements, the Contractor shall store explosives at least 1,000 ft away from the Road or from places of human occupancy.

The Contractor shall notify property owners and public utility companies in the vicinity of the proposed detonation before using explosives to allow the property owners and public utility companies to protect property.

The Department advises the Contractor of the potential hazard of premature explosion of electric blasting caps due to propagation of radio frequency energy by transmitters of radio and related services such as television, radar, and wireless communications. The Contractor shall provide advance notification of blasting operations and any other precautions in accordance with Minnesota Rule 7500.1200.

1712 PROTECTION AND RESTORATION OF PROPERTY

1712.1 PROPERTY

The Contractor is responsible for the preservation of all public and private property of any character in performing the Work.

A Monuments

The Contractor shall preserve all land and property corner monuments, Right Of Way monuments, and vertical and horizontal control point monuments indicated in the Contract or provided in writing by the Engineer before the start of Work in the vicinity of the monument. If the Engineer determines that a monument designated for preservation was disturbed during construction activities, the Department will deduct a charge of $1,000.00 per monument from the moneys due or becoming due the Contractor. The Engineer will determine the number of monuments disturbed or destroyed by the Contractor. If the Engineer determines that a monument requires removal to allow construction, the Department will not deduct the charge of $1,000.00 per monument from moneys due or becoming due the Contractor.

B Utilities 1507

C Protection and Restoration of Vegetation 2572

D Preservation of Historical Objects 1406

1712.2 ADVANCE NOTICE

The Contractor shall give advance notice to the owners of all private property where the Contractor's operations will interfere with the property. The notice shall advise the private property owners of the nature of the interference and indicate the Contractor's intention to arrange for the protection of their property.

1712.3 (BLANK)

1712.4 GENERAL LIABILITY

The Contractor is responsible for all damages to property of any character, resulting from any act, omission, neglect, or misconduct in the execution or nonexecution of the Work. The Contractor will not be responsible for property within the Project Site if:

(1) The Contract did not specify the existence and approximate location of the underground property, and
(2) The Contractor fulfilled its obligations under Minnesota Statute Chapter 216D.

A section of Division I that all designers need to be particularly aware of is shown in **Exhibit 6-2**.

Exhibit 6-2 Spec Book 1504, Coordination of Contract Documents

1504 COORDINATION OF CONTRACT DOCUMENTS

A requirement appearing in one of the Contract documents is as binding as though the requirement appears in all. If discrepancies exist between the Contract documents, the following order of precedence applies:

(1) Addenda,
(2) Special Provisions,
(3) Project-Specific Plan Sheets,
(4) Supplemental Specifications,
(5) Standard Plan Sheets and Standard Plates,
(6) Standard Specifications.

If discrepancies exist between dimensions in the Contract documents, the following order of precedence applies:

(1) Plan dimensions,
(2) Calculated dimensions,
(3) Scaled dimensions.

The Department and Contractor shall inform each other as to any discrepancy or defect they discover. Neither the Contractor nor the Engineer shall take advantage of any discrepancy or defect. The Engineer will review the alleged discrepancy or defect to determine if a contract revision is necessary in accordance with 1402, "Contract Revisions." The Engineer will decide all issues concerning a discrepancy or defect.

DIVISION II — Construction Details

Each Division II Specification number begins with "2" (2021 - 2582) and as in Division I, each section is given a numeric series. This Division is divided into six sections:

1. General (2021 - 2051)
2. Grading (2101 - 2131)
3. Pavement Marking Removal (2102)
4. Base Construction (2211- 2232)
5. Pavement Construction (2301 - 2399)
6. Bridges and Structures (2401 - 2481)
7. Miscellaneous (2501 - 2582)

Each section is generally divided into the following sections:

1. Description
2. Materials
3. Construction Requirements
4. Method of Measurement
5. Basis of Payment

6.1.2 DIVISION III — Materials

Each Division III Specification number begins with "3" (3101 - 3973) and as in Divisions I and II, each section is given a numeric series. This Division is divided into eighteen sections. Division II cross references various sections of this Division.

6.2 MnDOT Contract Proposal

6.2.1 Contents

Each MnDOT project has a proposal. The proposal contains items such as:

- ✓ Addendums
- ✓ Notices to Bidders
- ✓ Appendices
- ✓ Special Provisions (by division, for example: Division A, Divisions S, Division SS, Division SL, Division ST, etc.)
- ✓ Attachments
- ✓ Contract Schedule (Bid Prices)

6.3 Special Provisions

Special Provisions are defined as:

> "Additions and revisions to the Standard and Supplemental Specifications covering conditions peculiar to an individual project."

Special Provisions are just that: **"SPECIAL"** provisions. If an item(s) is adequately addressed or specified in the Spec Book, Standard Plates, Plan, or other Contract documents, then that item(s) should not be duplicated within the Special Provisions.

Topics that are always covered by Special Provisions include:

- ✓ Construction Start Dates
- ✓ Completion Dates
- ✓ Traffic Control
- ✓ Special Pay Items (those where the digit after the period is a '6')

The Special Provisions need to cover every special pay item from the Plan. A special pay item is any item whose fifth digit is a '6' (this is the digit after the period). If the Spec. Book adequately described the work to be done, and what is included in the item, then all that is needed is how the item is to be measured and paid for.

Division S is for general projects. Special Provisions may be formatted into more than one S section. For example:

<u>Time and Traffic (Division S)</u>

- ✓ S-1 Contact Information
- ✓ S-2 (2563) Temporary Traffic Managment
- ✓ S-3 (1710) Traffic Control Devices
- ✓ S-4 (1806) Determination and Extension of Contract Time
- ✓ S-5 (1807) Failure to Complete The Work on Time
- ✓ S-6 (2563) Traffic Control Supervisor

A typical set of Special Provisions are formatted like the Spec Book; however, the actual format of the Special Provisions may vary somewhat when compared to the Spec Book format. The following sections can be found in the Special Provisions:

- ✓ Opening Descriptive Paragraph
- ✓ General Section
- ✓ Materials
- ✓ Construction Requirements
- ✓ Measurement and Payment

Special Provisions may also include detail drawings that are pertinent to the specific project.

6.3.1 Special Provision Boiler Plates

Standard special provisions have been developed for use on MnDOT Construction projects. These can be obtained from the following website:

www.dot.state.mn.us/pre-letting/prov/

The following is a handout of the "boilerplate" for:

- ✓ Time & Traffic Provisions
  - (1404) MAINTENANCE OF TRAFFIC
  - (1803) LIMITATION OF OPERATIONS - NIGHT CONSTRUCTION
  - (1806) DETERMINATION AND EXTENSION OF CONTRACT TIME
  - (1806) DETERMINATION AND EXTENSION OF CONTRACT TIME (LANDSCAPING)
  - (1807) FAILURE TO COMPLETE THE WORK ON TIME
  - (2102) PAVEMENT MARKING REMOVAL
  - (2563) TRAFFIC CONTROL SUPERVISOR
  - (2563) INTELLIGENT WORK ZONE SYSTEM
  - (2563) ALTERNATE PEDESTRIAN ROUTE
  - (2563) WORKERS PRESENT SPEED LIMIT
  - (2563) TRUCK/TRAILER MOUNTED IMPACT ATTENUATOR (TMA)
  - (2582) TEMPORARY PAVEMENT MARKINGS
- ✓ Boiler Plate SP2016
  - (2554) TRAFFIC BARRIERS
  - (2557) FLEXIBLE PLASTIC GLARE SCREEN

The Lane Rental rate per lane per mile per hour (lane/mile/hour) will be assessed for each hour (or any portion of an hour) that a lane closure is in effect, and for each lane mile (or portion of a lane mile) that is affected. Any fraction of a mile or an hour shall be considered a full mile and/or full hour. If any portion of an hour spans two or more assessment rates, the Contractor will be charged the highest of the rates. The lane closure will be measured from the placing of the first device in a lane until all devices are removed from the traveling lanes such that the roadway is safely re-opened to traffic.

The Department will record Lane Rental assessments on a daily basis, and submit a weekly tabulation to the Contractor the following week. The Contractor must submit to the Engineer any disputes of the Lane Rental assessments within one week of receipt of the weekly tabulation.

S-3.4 EXTRA WORK

When possible, Extra Work shall be completed concurrently with regular Contract work shown in the Plan. When Extra Work is completed concurrently with regular Contract work, the Lane Rental charges shall be prorated based on the relative value of work performed.

If, in the opinion of the Engineer, Extra Work can not be completed concurrently with regular Contract work shown in the Plan, no Lane Rental charges will be assessed. The Contractor shall comply with the Lane Restriction section of this Special Provision and shall make every attempt to minimize disruptions to traffic.

S-3.5 PREPARATION OF PROPOSAL

The bidder shall establish the number of hours of lane closures for each type to complete the work required under this Contract. Using the hours established by the bidder and the rates shown in the tables above, the bidder shall enter the total lump sum value of Lane Rental as Bid Item 2016.601 (Lane Rental).

Use the following clause when you want to include a maximum amount they can bid.

The Lump Sum value of Lane Rental shall not exceed $XX,XXX. Bids showing the Lane Rental value in excess of this amount will be considered non-responsive and will be rejected.

S-3.6 CONSIDERATION OF BIDS

Each bid submitted shall consist of two parts:

(1) The Contract amount of construction pay items (not including item 2016.601 (Lane Rental)).

(2) The lane rental value entered by the bidder to complete all work required in this Contract as specified in this Special Provision (Bid Item 2016.601 (Lane Rental)). In the Schedule of Prices, in the Unit Price column, the bidder shall enter the Lump Sum value of Lane Rental as indicated above.

OR

(2) The lane rental value entered by the bidder to complete all work required in this Contract as specified in this Special Provision (Bid Item 2016.601 (Lane Rental)). In the Schedule of Prices, in the Unit Price column, the bidder shall enter the Lump Sum value of Lane Rental as indicated above. Bidders shall be aware of the maximum bid amount for the Lane Rental item as indicated above in this Special Provision.

The successful bid will then be determined by the Department as the lowest combination of (1) and (2). This combination will be used only to determine the successful bidder and will not be used to determine the Contract award amount nor final payment to the Contractor when the project is completed. Only construction

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pay item unit prices will be used to determine final payment to the Contract, except as may be adjusted as indicated elsewhere in this Contract.

S-3.7 PAYMENT

No direct payment will be made for Item 2016.601 (Lane Rental) Lump Sum.

At the conclusion of the Project, the Contractor will receive an incentive payment or disincentive monetary deduction equal to the amount of the "Lane Rental Working Fund", (which is equal to the amount bid by the Contractor for Item 2016.601 (Lane Rental), minus the amount of the total of all Lane Rental assessments for the entire Project.) The total incentive amount will not exceed $YY,000 (xxxx dollars). Payment of the incentive will be made on the first partial estimate voucher processed after the Completion of Work has concluded.

S-4 (1301) CONSIDERATION OF PROPOSALS (A+B METHOD)

District to determine if needed. Note: Consult with Kevin Kosobud, Project Development Engineer, Office of Construction and Innovative Contracting, before incorporating this special provision.

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The Provisions of Mn/DOT 1301 are hereby supplemented as follows:

S-4.1 GENERAL

The process for the consideration of proposals for the award of this Project will take into account not only the Contract amount bid for construction items, but also the bidder's proposed number of Calendar Days to complete all work required as defined in Section S-X.2(4) of this Special Provision. This method, as described below, shall be used to determine the successful bidder. It shall not be used to determine the award amount nor final payment to the Contractor when the Project is completed.

S-4.2 DEFINITION OF TERMS

For this Project the following definitions apply:

(1) Calendar Day – {define your criteria, clarify if it conflicts with 1803.5}

(2) Contract Amount -- The summation of the products of the quantities shown in the bid schedule multiplied by the unit bid prices (excluding Item 2016.621 (Contract Time)).

(3) Daily Road User Cost – The amount which represents the average daily cost of inconvenience to the road users. The Daily Road User Cost is ***$x,xxx.00.***

OR use the following if A+B is applied to the contract as a whole:

(3) Daily Road User Cost - The amount which represents the average daily cost of inconvenience to the road users plus liquidated damages. The Daily Road User Cost is ***$x,xxx.00.***

(4) Completion of Work -- All work required to complete ***{define scope of work to be completed. This is the only area you need to enter the scope of work}.***

S-4.3 PREPARATION OF PROPOSAL

The bidder shall establish the number of Calendar Days to be used for the Completion of Work as defined in Section S-X.2 of this Special Provision.

The total number of Calendar Days established by the bidder shall be less than or equal to **XX Calendar Days** but not less than **YY Calendar Days.** Bids showing the Completion of Work specified in Section S-X.2 of this Special Provision in excess of **XX Calendar Days**, or less than **YY Calendar Days** will be considered

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non-responsive and will be rejected. Any decision by a bidder to bid less than **XX Calendar Days** is entirely at the bidder's own risk; the Department does not warrant that the Completion of Work can be completed in less than **XX Calendar Days**.

The bidder shall enter the number of Calendar Days bid as Item 2016.621 (Contract Time) on the Proposal Site Page of the Schedule of Prices, in the # of Days column.

S-4.4 CONSIDERATION OF BIDS
Each bid submitted shall consist of two parts:

(a) The Contract Amount of construction pay items (not including Item 2016.621 (Contract Time)).

(b) Bid Item 2016.621 (Contract Time): Total number of Calendar Days proposed by the bidder for the Completion of Work specified in Section S-X.2 of this Special Provision.

The successful bid will then be determined by the Department as the lowest combination of (a) and (b) according to the following formula:

(a) + ((b) x (RUC))= bid amount for award consideration.

Where RUC = Daily Road User Cost

The preceding formula will be used to determine the successful bidder and will not be used to determine the Contract award amount nor final payment to the Contractor when the Project is completed. Only the Contract Amount will be used to determine final payment to the Contractor, except as may be adjusted under the conditions of the Contract.

S-4.5 DISINCENTIVE
Failure to complete the work within the established number of Calendar Days stated by the Contractor will be subject to monetary deductions and/or damages as shown in Section S-1807 (FAILURE TO COMPLETE THE WORK ON TIME) of these Special Provisions.

Use the following clause only if you are including an incentive for early completion.

S-4.6 INCENTIVE
In the event that the Completion of Work as defined in Section S-X.2 of this Special Provision is completed in advance of established number of Calendar Days stated by the Contractor in Item 2016.621 (Contract Time), payment otherwise due in the Contract will be adjusted with an incentive as shown in Section S-1806 (DETERMINATION OF CONTRACT TIME) of these Special Provisions.

S-5 (2563) TEMPORARY TRAFFIC MANAGEMENT

NEW WRITE-UP 12/05/18 ◄DO NOT REMOVE THIS "NEW WRITE-UP" DATE.. IT NEEDS TO STAY IN FOR THE CONTRACTORS.

- ***The following write-up was created by the Traffic Control Specification Review Committee. Whomever in the District is putting together the time and traffic for the job, needs to go through the following write-up and pick and choose which portions are needed on the job.***
- ***THE SPECIAL PROVISIONS UNIT CAN NOT DO THIS FOR YOU.***

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S-5.1 DESCRIPTION

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Furnish, install, maintain, and remove all traffic control devices required to provide safe movement of traffic and pedestrians through the Project at all times from commencement of the Work until Project Acceptance. Do not close highways or pedestrian facilities, except as authorized. The Engineer may modify the requirements for traffic control as deemed necessary.

All temporary traffic management must conform to and be installed in accordance with:

- the "Minnesota Manual on Uniform Traffic Control Devices" (MN MUTCD);
- the "Minnesota Temporary Traffic Control Field Manual" (Field Manual);
- the "Speed Limits in Work Zones Guidelines";
- the "Minnesota Flagging Handbook";
- the "MnDOT Standard Signs and Markings Manual";
- the Plan;
- all applicable standard specifications and special provisions.

Manuals listed above may be found at: http://www.dot.state.mn.us/trafficeng/publ/index.html

S-5.2 MATERIALS

A Temporary Signs and Devices
Reflectorize all signs, paddles, and other traffic control devices including those used for daytime operations. Fabricate temporary rigid signs and devices with retroreflective sheeting material of the appropriate color listed on the Approved/Qualified Products List (APL/QPL) for either "Sheeting for Rigid Temporary Work Zone Signs, Delineators, and Markers (Type IX and XI)" or "Sheeting for Rigid Permanent Signs, Delineators, and Markers (Type IX and XI)". The sheeting materials APL/QPL is located at the following link: http://www.dot.state.mn.us/products/signing/sheeting.html.

Inplace signs that still apply during temporary operations need no change in sign sheeting.

B Vehicle Conspicuity Tape
The Approved Products List for "Conspicuity Vehicle Sheeting (Type VII)" is found at: http://www.dot.state.mn.us/products/signing/sheeting.html

C Truck/Trailer Mounted Attenuators
The Approved Products List for "Mobile Crash Attenuators" is found at: http://www.dot.state.mn.us/products/temporarytrafficcontrol/mobilecrashattenuators.html

Per the Memo "6" REFLECTIVE SHEETING ON WORK ZONE DRUMS" to Resident Engineers dated 5/10/17, (D) is to be used:

- ***For jobs being let in 2018 – Use on all Metro projects and all multi-year projects being let throughout the state.***
- ***For jobs being let in 2019 – All projects in Districts 6, 7, 8, and Metro; and multi-year projects statewide.***
- ***For jobs being let in 2020 – All projects statewide.***

D Drum Sheeting
On Projects requiring drums per MnDOT Standard Plate No. 8000J (Channelizers – Type B), provide all drums with six inch fluorescent orange and white sheeting material with no gap between sheeting layers.

E Crashworthy Signs, Traffic Control Devices, and Ballast
Signs and traffic control devices must meet the crash testing requirements of NCHRP 350 as specified in the MN MUTCD or the Manual for Assessing Safety Hardware (MASH). The Department may require a letter of compliance stating that all signs and traffic control devices comply with NCHRP 350 or MASH

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requirements. The Letter of Compliance must include drawings of the different signs and devices along with a copy of their FHWA eligibility letter.

The approved ballast system for signs and devices mounted on temporary portable supports is sandbags, unless it is designed, crash tested, and approved for the specific device. Add a deicer during freezing conditions to prevent the sand from freezing. Place sandbags at the base of the sign or traffic control device. Do not use any ballast that causes a sign or traffic control device to become hazardous to motorists or workers.

Use the following paragraph if longitudinal Temporary Pavement Markings are anticipated to be used. Also include pay item and quantity under 2582 using wet-reflective (WR) markings on the TRAFFIC CONTROL TABULATION.

F Temporary Pavement Markings

Any temporary pavement markings installed must follow the requirements of MnDOT 2582, "Pavement Markings" and utilize Wet Reflective (WR) materials.

S-5.3 CONSTRUCTION REQUIREMENTS

A Traffic Control Plan, Maintenance, and Inspection

A.1 Submit a proposed traffic control plan to the Engineer for acceptance if traffic control is not present in the Plan, or if the Contractor modifies the traffic control plan. Submit the proposed traffic control plan at least seven days before implementation. If Field Manual layouts are used, specify layout number(s) but do not submit the layouts from the Field Manual. Do not implement the proposed traffic control modification until accepted by the Engineer.

A.2 Immediately repair or replace all traffic control devices that become damaged, moved or destroyed, and all ballasts that are damaged, destroyed, or otherwise fail to stabilize the device.

A.3 Meet the traffic control device quality standards as required in the Field Manual. Immediately replace unacceptable traffic control devices. Signs that are dirty and result in a noticeable loss of reflectivity at night are considered unacceptable and must be cleaned or replaced. Respond promptly to any call from the Engineer concerning the notification of unacceptable traffic control devices.

A.4 Provide the names, addresses, and phone numbers of at least three individuals responsible for placing and maintaining traffic control devices to the Engineer at the Pre-construction Conference. These individuals will be "on call" 24 hours per day, seven days per week during the times any temporary traffic control devices are in place.

A.5 Inspect all traffic control devices on a daily basis, including one nighttime inspection per week. Verify that the devices are placed in accordance with the Traffic Control Plan, these Special Provisions, and the MN MUTCD. Immediately correct discrepancies between the actual placement and the required placement. Respond immediately to any call from the Engineer concerning any request for improving or correcting traffic control devices.

A.6 Make a daily log of required inspections. This log must indicate the date and time any changes in the stages, phases, or portions go into effect. The log must identify the location and verify that the devices are placed as directed or corrected in accordance with the Plan. The person making the inspection must sign the log and include the date and time of the entry. Provide copies of the inspection logs on a weekly basis and at the request of the Engineer.

B Traffic Control Signs and Devices

B.1 Roll-up signs are not allowed unless authorized by the Engineer.

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B.2 Cover, modify, or remove all signs that are not consistent with traffic operations. Cover the entire sign or that part of the legend that is inappropriate. Sign covers must conform to the Typical Temporary Sign Covering Details Sheet found in the Plan or at the following link:
http://www.dot.state.mn.us/trafficeng/workzone/wz-templets/pdf/layout%2020A.pdf

B.3 Maintain street identification signage at all times. Signs may be installed on temporary supports if the permanent sign structures are affected by operations. This is necessary to maintain the 911 emergency system.

B.4 Post mount all signs that will remain in the same location for more than 30 consecutive days as shown on the Typical Temporary Sign Framing and Installation Detail Sheet. This does not include portable signs which are set up and taken down at the beginning and end of each work shift. The detail sheet may be found in the plan or at the following link: http://www.dot.state.mn.us/trafficeng/workzone/wz-templets/pdf/layout%2020.pdf

When the proper location of a sign is on pavement, do not core through the surface. If there is a conflict with underground utilities, attempt to move the sign while maintaining its visibility to traffic. If it is not possible to drive posts into the ground, mount signs on portable supports as approved by the Engineer.

When signs are removed, the sign posts and stub posts must also be removed from the right of way. Posts left in place for future use or removal at a later date must be properly delineated with tubular markers, flags, or other delineation as approved by the Engineer at no additional cost.

Use B.5 only if it applies to the Project.

B.5 At the beginning of the Project, store at least _____ extra Type III barricades and _____ extra retroreflective drums to be used at the Engineer's discretion. Store the devices at a location approved by the Engineer.

If the Engineer orders additional devices, beyond the quantity specified above, the Department will compensate the Contractor according to S-2562 (ADDITIONAL TRAFFIC CONTROL DEVICES AND EXTENDED USE OF TRAFFIC CONTROL DEVICES) of these Special Provisions.

Districts should use the following to designate which operations, if any, will be allowed to utilize the Type A channelizers instead of drums.

B.6 On _____ operations, the Engineer may allow weighted channelizers to be used in place of drums for delineation in non-transition areas or to delineate drop-offs of four inches or less. When used, the spacing of weighted channelizers should be reduced by 50%.

AND/OR

On _____ operations, the Engineer may allow 36 inch tubular markers to be used in place of drums for delineation in non-transition areas or to delineate drop-offs of four inches or less. When used, the spacing of weighted channelizers should be reduced by 50%.

B.7 All in place signs and delineators that interfere with the Contractor's normal operation may be temporarily relocated by the Contractor at the direction of the Engineer. Store salvaged signs in such a manner as to protect the sign from scratching, fading, or other harmful effects until the signs are reinstalled. After completing work at each sign location, or at the direction of the Engineer, replace the signs as near to their original locations as possible or to a location designated by the Engineer. Reinstall sign structures according to the Type C & D Sign Structural Details Sheet located at the following link:
http://www.dot.state.mn.us/trafficeng/signing/plansheets/groundmounted.pdf

Signs and structures damaged by the Contractor shall be replaced at the Contractor's expense.

HANDOUT

C Traffic Safety

C.1 Do not suspend material, equipment, tools or personnel over lanes or pedestrian facilities open to traffic.

C.2 Protect traffic and pedestrians from excavations, drop-offs, falling objects, splatter or other potential construction hazards.

C.3 Do not store materials or equipment in the clear zone unless approved by the Engineer. If materials or equipment must be stored within the clear zone, provide Type B channelizers, barricades or barriers, and place near the object to warn and protect traffic.

C.4 Do not park vehicles or construction equipment in the clear zone or any location that obstructs traffic control devices. Workers are not allowed to park their private vehicles within the Project limits unless approved by the Engineer.

C.5 Do not load or unload material or equipment on the shoulders of any roadway without a full shoulder closure using signs and channelizing devices shown on Layout 8 in the Field Manual.

D High Visibility Apparel

During night work or low light conditions, all workers must wear high visibility Class E long pants and retro-reflective headgear in addition to the ANSI Class 2 or 3 vest, shirt, or jacket.

All high visibility apparel must be worn in the manner for which it was designed. All apparel worn on the torso must be closed in the front to provide 360 degree visibility. A worker's high-visibility apparel must be removed from service and replaced if it becomes faded, worn, torn, dirty, or defaced, reducing the conspicuity of the apparel.

E Night Work

Night work is not permitted on this project without prior approval of the Engineer.

OR

Coordinate with the requirements of Section S-1804 (LIMITATION OF OPERATIONS – NIGHT CONSTRUCTION) of these Special Provisions. Meet all appropriate practices and requirements for work performed between the official hours of sunset and sunrise. Provide sufficient numbers of light plants to illuminate the work area and flagger stations. Mark heavy equipment such as rollers, pavers, and mills, with two inch wide highly reflective vehicle conspicuity marking tape.

F Vehicle Warning Light Specification

All vehicles and equipment operating in the trunk highway right of way, must have operable warning lights that meet the appropriate SAE specification. The SAE specification requirements are as follows:

- Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles- SAE Specification J845.
- Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles - SAE Specification J595.

Details on SAE Specification can be found at: http://www.dot.state.mn.us/const/wzs/lighting.html

G Lane Closure Requirements

Use only the paragraphs that apply to this Project.

Use for Metro District

G.1 Temporary lane closures or other traffic restrictions by the Contractor, during work hours and consistent with the time restrictions, will be permitted only during those hours and at those locations approved by the Engineer. Request temporary lane closures at least two business days prior to the closure.

Contact the Regional Transportation Management Center (RTMC) at 651-234-7093 at the time when a freeway lane or ramp closure begins and again at the time when the freeway lane or ramp closure ends and at the beginning and end times of full freeway roadway closures.

Use for all other Districts

G.1 Temporary lane closures or other traffic restrictions by the Contractor, during work hours and consistent with the time restrictions, will be permitted only during those hours and at those locations approved by the Engineer. Request temporary lane closures at least 24 hours prior to such closures.

Optional: Use this paragraph when RTMC manages 511 and CMS's in the district.

Contact the Regional Transportation Management Center (RTMC) at 651-234-XXXX at the time when a freeway lane or ramp closure begins and again at the time when the freeway lane or ramp closure ends and at the beginning and end times of full freeway roadway closures.

G.2 The Engineer may lengthen, shorten, or otherwise modify the following periods of restrictions as warranted by actual traffic conditions.

Choose the appropriate G.2.1

G.2.1 Temporary lane restrictions will only be allowed as described in (1) and (2) below. If (1) and (2) conflict, the more restrictive condition will apply.

(1) Work that will restrict or interfere with traffic will not be permitted between the hours of ____ A.M. and ____ A.M. and between the hours of ____ P.M. and ____ P.M.

(2) Temporary lane closures will be permitted in accordance with the hours and number of lanes allowed as indicated in the Metro Lane Closure Manual, http://www.dot.state.mn.us/metro/trafficeng/laneclosure/index.html. Lane closures that cross segments as defined in the Manual shall follow the more restrictive limits.

OR

G.2.1 Work that will restrict or interfere with traffic will not be permitted between the hours of ____ A.M. and ____ A.M. and between the hours of ____ P.M. and ____ P.M.

OR

G.2.1 Temporary lane closures will be permitted in accordance with the hours and number of lanes allowed as indicated in the Metro Lane Closure Manual: http://www.dot.state.mn.us/metro/trafficeng/laneclosure/index.html. Lane closures that cross segments as defined in the Manual shall follow the more restrictive limits.

OR

G.2.1 Temporary lane closures will be permitted in accordance with the hours and number of lanes allowed as indicated in the District 6 Lane Closure Manual: http://www.dot.state.mn.us/d6/trafficlaneclosuremanual/.

Lane closures that cross segments as defined in the Manual shall follow the more restrictive limits. Any time frames where the late merge (Zipper Merge) is "recommended" are changed to "required".

OR

G.2.1 Temporary lane closures or other traffic restrictions will only be permitted between the official hours of sunrise and sunset.

OR

G.2.1 Maintain traffic as follows at the locations and times listed below:

THERE SHALL BE NO INTERFERENCE WITH TRAFFIC AT THE FOLLOWING LOCATIONS AND TIMES (24 HOUR CLOCK):						
T.H. (direction)	**Location**	**Sun.**	**Mon.**	**T, W, Th.**	**Fri.**	**Sat.**

Use as appropriate for roadway closures for overhead work.

G.2.2 Temporary lane restrictions and closures for removing and/or erecting overhead structures are permitted between the hours of _____ A.M. and _____ A.M. as approved by the Engineer. If the Contractor requests to close the road and the Engineer approves that it is necessary to temporarily detour traffic in order to remove or set the structures, the Contractor must furnish the detour as directed by the Engineer. The temporary detour costs are incidental.

OR

G.2.2 Traffic may be stopped on any road open to traffic to erect or remove overhead structures for periods not to exceed fifteen minutes only from 1:30 A.M. to 5:00 A.M. Allow sufficient clearance time between stopped periods to minimize the delay to traffic.

G.3 Work that will restrict or interfere with traffic shall not be performed between 12:00 noon on the day preceding and 9:00 A.M. on the day following any consecutive combination of a Saturday, Sunday and legal holiday.

G.4 **If the Contractor fails to adhere to the established time schedules, the Department may assess an hourly charge of $500.00 per hour for each hour or portion of an hour that the Engineer determines that the Contractor has not complied.**

G.5 Place traffic control devices in any temporary lane closure that is adjacent to traffic and extends beyond 1000 feet as shown on Layout 61 of the Field Manual. When the lane closure is in place three days or longer, use only Type III barricades.

G.6 Use Drum Channelizers in all lane closure tapers and in any shifts in traffic alignment.

G.7 No center lane closures will be permitted.

G.8 Maintain a minimum of two miles between temporary lane closures.

G.9 Temporary lane closures will not be permitted during inclement weather, nor any other time when, in the opinion of the Engineer, the lane closure will be a greater than normal hazard to traffic.

HANDOUT

Optional: Use the appropriate (G.10) paragraph when there will be work performed in areas that have minimal shoulder or median widths and high speeds and volumes.

G.10 When working on the shoulder or median, provide a lane closure on mainline adhering to the above lane closure restrictions.

OR

G.10 When working on the shoulder or median, provide traffic control according to Layout 8 (Work on Shoulder) of the Field Manual.

H Truck/Trailer Mounted Attenuators (TMAs) For Mobile/Short Duration Operations

Truck/Trailer Mounted Attenuators (TMA) must be used on all shadow and protection vehicles operating totally or partially in a traffic lane if any temporary traffic control zone is defined as "Mobile/Short Duration" by the Field Manual. All references to "should" in the Field Manual in regards to TMA use for Mobile/Short Duration layouts are hereby changed to "shall". This requirement applies to all operations utilizing Field Manual layouts 9, 12, 13, 36, 41, 49, 50, 51, 54, 55, 63, 76, 77, 78, and 79. Providing TMAs for "Mobile/Short Duration" work zones is incidental.

I Flagging Operations

I.1 Flaggers must attend a training session taught by a MnDOT-Qualified Flagger Trainer. The trainer must have completed a "MnDOT Flagger Train the Trainer Session" within the last five years and be on file as a qualified Trainer with MnDOT. Provide the Flagger Trainer's name and qualification number at the pre-construction meeting. Provide all flaggers with the MnDOT Flagging Handbook. Flaggers must be in possession of the handbook while flagging on the Project. Furnish the signed "Checklist for Flagger Training" or "Flagger Qualification Card" to the Engineer any time a new flagger reports to work on the Project. The "Checklist for Flagger Training" and other forms and information is found at:
http://www.dot.state.mn.us/const/wzs/flagger.html

I.2 All signs associated with the flagging operation must be removed or covered when flagging operations are not present.

I.3 Coordinate the flagging operations in a manner that causes minimum delay to the traveling public. The maximum delay time is **10 minutes**. If the operation exceeds the maximum delay time, the operation must be discontinued until a new traffic control plan is developed which meets the maximum delay requirement.

Use I.4 if the Project uses a pilot car.

I.4 Furnish at least one pilot car and driver for leading traffic through the work zone. Pilot Car operations must be in accordance with the following:

1. Pilot cars will be utilized on all two-lane two-way roadways.
2. Pilot Vehicles must:
   (a) Be capable of being turned around quickly in a small area.
   (b) Have a standard sign G20-4, "PILOT CAR, FOLLOW ME", mounted on the rear of the vehicle. Minimum mounting height of sign is one foot above the ground.
3. Flaggers must have portable radio communication with the pilot car.
4. Take necessary precautions to prevent any traffic that enters the highway between Flaggers from going in the opposite direction as the pilot car caravan. Do not allow or force traffic onto the shoulders without prior approval of the Engineer.
5. Work equipment and vehicles must follow in line and use the roadway in a manner similar to all other through traffic during the time of pilot car operations.

HANDOUT

I.5 Furnish Flaggers in sufficient quantity to control each approach to the work area including intersecting crossroads that are open to traffic.

Use only the paragraphs in J that apply to the Project.

J Milling, Sealcoating, and Paving Operations

Use the (J.1) paragraph that applies to the Project.

J.1 Milling and paving operations must be completed over the full width of all traffic carrying lanes, including turn lanes, bypass, etc., under construction at the end of each day's production.

OR

J.1 Schedule milling and bituminous paving operations so that milled areas will be covered with a wear course within 24 hours of completion of the milling.

OR

J.1 Traffic will be allowed on the milled surface.

J.2 When traffic is allowed to drive on the milled and newly paved surfaces, install interim striping and provide appropriate warning signs such as "GROOVED PAVEMENT" and "BUMP" with "Advisory Speed" plaques as shown on Layouts 35 and 66 of the Field Manual.

J.3 Taper and/or chamfer any drop-off where traffic will cross from or to the inplace surface, or from or to the milled surface, so as to provide for the safe passage of traffic.

J.4 Schedule construction operations to minimize traffic exposure to uneven lanes, milled edges, and edge drop-offs. If these conditions cannot be avoided, provide and maintain the appropriate traffic control in accordance with the "DROP OFF GUIDELINES" in the Field Manual.

J.5 Do not mill any notches for surfacing tapers until immediately prior to paving. The Engineer may allow notches if temporary bituminous is installed and maintained to provide for the safe passage of traffic until the surfacing is completed. Constructing and milling tapers and/or chamfers is incidental.

J.6 Maintain traffic with a minimum of delay during milling and paving operations at intersections controlled by signals or by all-way stop signs. Provide off-duty police officers to direct and control traffic at intersections with fully operating traffic control signal systems. See Section S-2563 (POLICE OFFICER) of these Special Provisions for specific requirements, measurement, and payment information.

J.7 Intersecting streets, other than intersections controlled by signals or all-way stop signs, may be closed during milling and paving operations in the intersection if there are adequate alternate routes for the intersecting street traffic. Do not close adjacent intersecting streets to traffic concurrently. Notify the local road authorities of its schedule to close intersecting streets 48 hours in advance of the closure.

Use (J.8) on seal coating projects

J.8 When traffic is allowed to drive on the sealed surface, provide and install "LOOSE GRAVEL" and "FRESH OIL" signs with "Advisory Speed" plaques as shown on Layouts 35 and 66 of the Field Manual.

K should only be used when signals systems may be impacted by the Project

K Signal Systems

K.1 Do not interfere with the operation of any traffic signal system, except as required by the Contract. Notify the Engineer at least 24 hours prior to beginning any work that will interfere with any traffic signal system or its detection system.

K.2 The in place signal system(s) must remain in operation until the new signal system(s) become operational.

K.3 Provide off-duty police officers to direct and control traffic during such times as the existing or temporary signal system at each location is out of operation. Off-duty police officers must be furnished in such numbers as deemed necessary by the Engineer to direct traffic. See Section S-2563 (POLICE OFFICER) of these Special Provisions for specific requirements, measurement, and payment information.

OR

K.3 During the period when the existing signal system is not operational and the new signal system is operational, provide, erect, and maintain "Stop Ahead" and "Stop" signs. The Engineer will determine the quantity and size of the temporary signs as well as their placement in the field.

Use only the paragraphs in L that apply to the Project

L Maintenance and Staging of Traffic Control

L.1 Maintain the existing traffic movements at the following intersections: _____; _____; and _____.

L.2 Pedestrian traffic must be maintained and guided through the Project at all times.

Use (L.3) if signs are not shown in the Traffic Control Plan:

L.3 Provide, install, and maintain G20-1 "ROAD WORK NEXT ____ MILES" signs and G20-2A "END ROAD WORK" signs in advance of and beyond each end of the construction limits.

L.4 Maintain a minimum lane width of **11** feet on all roadways. Traffic must not be allowed or forced onto the shoulders without prior approval of the Engineer.

L.5 Parking may be banned within the construction limits _____. Notify the City of _____, phone number _____ at least 24 hours prior to posting any parking ban within the City. Provide and install the necessary signing 24 hours prior to the parking ban. Remove signs as soon as the work in the area has been completed.

L.6 Submit plans for access to and from the project site for approval by the Engineer at least one week before implementation.

S-5.4 METHOD OF MEASUREMENT

All traffic control required to complete the Project as shown in the Plans and specified in these Special Provisions will be made as a lump sum payment under Item 2563.601 (Traffic Control). Payment includes all costs associated with furnishing, installing, maintaining, relocating and subsequently removing traffic control devices (including flaggers) as required. No additional measurement for payment will be made for individual activities and devices that constitute Traffic Control, except for other traffic control Bid items specifically listed in the Statement of Estimated Quantities.

Traffic Control layouts and devices not shown in the plan or stated in these Special Provisions, that are necessary to facilitate traffic switches or for transitioning traffic from one stage to another, are included in the lump sum traffic control item. If the Contractor requests a change in traffic control and these changes are implemented, there will be no increase or decrease in the lump sum payment for traffic control. If the Engineer

orders a change in traffic control because of a Plan error, omission, changed condition or change of project scope, payment for such changes will be made as Extra Work.

If the Contractor fails to properly provide, install, maintain, or remove any of the required traffic control devices, the Department may correct the deficiency and to deduct the costs from any moneys due or becoming due to the Contractor in accordance with MnDOT 1512, "Unacceptable and Unauthorized Work".

Payout percentages may be changed.

S-5.5 BASIS OF PAYMENT

Partial payments for lump sum Item 2563.601 (Traffic Control) will be made as follows:

Table 2563-1 Traffic Control Partial Payments	
Percent of Original Contract Completed	**Pay this Percentage of Traffic Control**
5	50
10	75
50	95
All Work Completed And All Traffic Control Removed	100

OR

This may be used when Traffic Control is allocated by stage in the TTC plan.

Partial payments for lump sum Item 2563.601 (Traffic Control) will be made as follows:

(1) When all traffic control devices for an individual stage, as shown on the Traffic Control Layouts, have been installed, 75% of the Contract Unit Price for that stage will be paid.

(2) When all work in an individual stage and all traffic control devices for that stage are removed, the remaining 25% of the Contract Unit Price for that stage will be paid.

S-6 (2562) ADDITIONAL TRAFFIC CONTROL DEVICES AND EXTENDED USE OF TRAFFIC CONTROL DEVICES

NEW WRITE-UP 12/05/18 ◄DO NOT REMOVE THIS "NEW WRITE-UP" DATE.. IT NEEDS TO STAY IN FOR THE CONTRACTORS.

The following write-up was created by the Office of Construction and Innovative Contracting. Use for all Projects. The items shown below are in addition to what is covered by the traffic control pay item. Therefore nothing needs to be deleted. (For example, if flaggers are incidental they should still be left in this section. The flaggers listed here are in addition to the flaggers covered by the traffic control pay item.)

SP2018-20.2

S-6.1 DESCRIPTION

The Engineer is authorized to:

- Require extra traffic control devices in addition to the traffic control devices shown in the Traffic Control plan or in the Field Manual.
- Require additional traffic control devices for EXTRA WORK.

6.4 Addendum

At times it may become necessary to provide additional information, corrections, additions, or deletions to the Special Provisions, Plans, and/or Spec Book after the Project is put on sale, but before the actual letting of the Project. This information is provided to bidders by creating an "addendum". This addendum is then sent out to Contractors, suppliers, etc. that have purchased the Contract documents for the specific project. This addendum is sent out with enough lead time to allow bidders the opportunity to consider the addendum in preparing their bid. The *addendum will be located in the front portion of the MnDOT project proposal.*

6.5 Supplemental Agreements

It is important that Plans and Special Provisions are clear, accurate, and adequately indicate the work that the Contractor is required to perform. However, when that does not happen, or if some item(s) is inadvertently omitted from the project documents, MnDOT will negotiate a supplemental agreement with the Contractor to rectify the situation. There are occasions when supplemental agreements are necessary due to field conditions that were not apparent at the time of the project design. It is, however, in the best interest of everyone to try and keep supplemental agreements to a minimum.

6.6 Pay Items

Information on Pay Items can be obtained from the AASHTOWare Project Item List website:

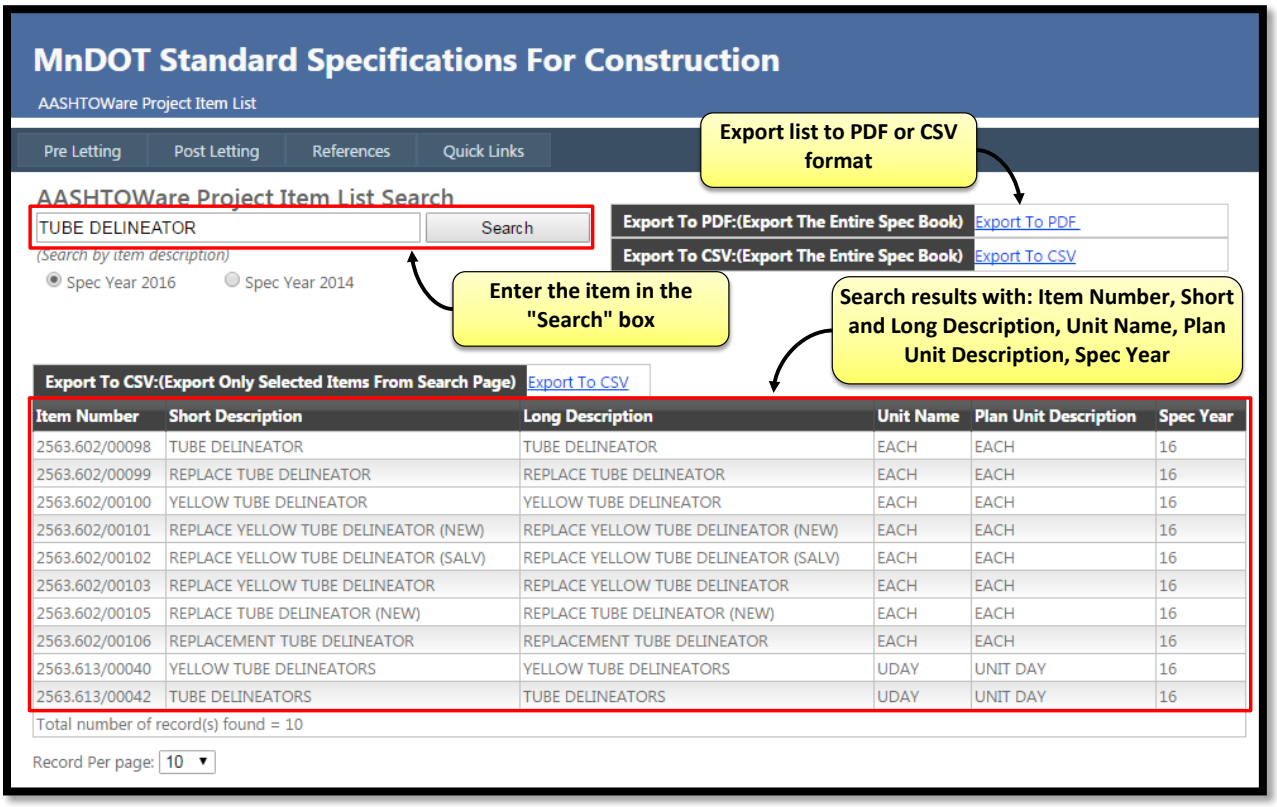
http://bidlet.dot.state.mn.us/ItemSearch.aspx

The website includes a search box to look for individual items (See **Exhibit 6-3**). The results will list the item by:

- ✓ Item Number
- ✓ Short Description
- ✓ Long Description
- ✓ Unit Name
- ✓ Plan Unit Description
- ✓ Specification Year

The results, or the entire AASHTOware list can be export to PDF and CSV formats.

Exhibit 6-3 AASHTOware Website



Item Number	Short Description	Long Description	Unit Name	Plan Unit Description	Spec Year
2563.602/00098	TUBE DELINEATOR	TUBE DELINEATOR	EACH	EACH	16
2563.602/00099	REPLACE TUBE DELINEATOR	REPLACE TUBE DELINEATOR	EACH	EACH	16
2563.602/00100	YELLOW TUBE DELINEATOR	YELLOW TUBE DELINEATOR	EACH	EACH	16
2563.602/00101	REPLACE YELLOW TUBE DELINEATOR (NEW)	REPLACE YELLOW TUBE DELINEATOR (NEW)	EACH	EACH	16
2563.602/00102	REPLACE YELLOW TUBE DELINEATOR (SALV)	REPLACE YELLOW TUBE DELINEATOR (SALV)	EACH	EACH	16
2563.602/00103	REPLACE YELLOW TUBE DELINEATOR	REPLACE YELLOW TUBE DELINEATOR	EACH	EACH	16
2563.602/00105	REPLACE TUBE DELINEATOR (NEW)	REPLACE TUBE DELINEATOR (NEW)	EACH	EACH	16
2563.602/00106	REPLACEMENT TUBE DELINEATOR	REPLACEMENT TUBE DELINEATOR	EACH	EACH	16
2563.613/00040	YELLOW TUBE DELINEATORS	YELLOW TUBE DELINEATORS	UDAY	UNIT DAY	16
2563.613/00042	TUBE DELINEATORS	TUBE DELINEATORS	UDAY	UNIT DAY	16

7. APPENDIX

7.1 Metro Website TMP Resources

The following information is from MnDOT Metro district's work zone website. The information is located at: http://www.dot.state.mn.us/metro/trafficeng/control_striping.html.

The following are included:

- ✓ TMP Process and Components
- ✓ TMP Scoping Worksheet
- ✓ TMP Worksheet
- ✓ TMP Template
- ✓ Red Flag Checklist
- ✓ Work Zone Mobility Impact Assessment Worksheet

7.1.1 TMP Process and Components

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Metro District Transportation Management Plan (TMP) Process

TMP Development During Scoping and Design

1. The Project Manager is the steward of the TMP-related documents during scoping and design and is responsible for ensuring that they get completed, with responsibilities as described under "components of TMP".
    a. Project Manager will work with MnDOT Offices of Construction, Traffic, Public Affairs, Business Liaison, Area Engineer, RTMC, and FHWA as needed (this group will be the TMP team).
2. The TMP Scoping Worksheet will be completed during project scoping. This worksheet consists of the Work Zone Mobility Impact Assessment Worksheet, Red Flag Checklist (including consideration of ABC techniques), and TMP Scoping Conclusions. The Work Zone Mobility Impact Assessment Worksheet will determine whether the Red Flag Checklist needs to be completed during scoping, and whether a TMP, Basic TMP, or no TMP is needed during project development.
3. For projects that do not go through the MnDOT scoping process, the Work Zone Mobility Impact Assessment Worksheet and Red Flag Checklist will be completed.
4. If it is determined that a TMP or Basic TMP is needed for a project, a first run of the TMP worksheet will be done prior to 30% plan completion.
    a. It is recommended that the Project Manager has a meeting with the TMP team to discuss known or possible impacts and mitigation considerations.
    b. If answers to items are not yet known, "Possible" can be entered in the checklist. **When the checklist is complete, all "Possible" items must be changed to "Yes", "No" or "N/A".**
5. If a TMP is needed, a draft TMP will be sent to FHWA (for federally funded projects) prior to the 60% plan completion.
6. For locally led projects, a draft TMP will be submitted with the 60% submittal and the "final" TMP will be submitted with the 90% submittal.
7. The MnDOT Metro Traffic Work Zone group will work directly with RTMC regarding RTMC and ITS traffic mitigation measures, and to coordinate RTMC and work zone traffic control.
8. When the MnDOT Metro Construction office is preparing the Time and Traffic special provisions, the construction Project Engineer will refer to the TMP worksheet to confirm provisions/commitments that were made. If there are conflicts between the T&T and the TMP worksheet, the TMP team will discuss.

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TMP Modifications During Construction (projects with MnDOT Metro contract administration)

9. After the project is let, the Resident Engineer will become the steward of the document for construction administration. If other functional areas have additional documentation (RTMC changes, monitoring, etc), they will add it to the TMP folder in ProjectWise.
10. If any significant changes are made during construction that conflict with provisions or commitments made in the TMP, the Project Engineer will document this as a "Change to the TMP".
    a. Prior to making these changes, the Project Engineer will discuss them with the applicable TMP Modification Contacts. The TMP Modification Contacts will be listed in the TMP document, and will include the Project Manager, Traffic Work zone supervisor, Area Engineer, Project Business Liaison, Resident Engineer and others as needed.
    b. Examples of changes requiring documentation include
        i. Significant revision of duration of ramp or lane closures
        ii. Closing ramps or lanes that were noted in the TMP as remaining open
        iii. Closing access to residences or businesses that were noted in the TMP as being maintained
        iv. Extending allowed maximum time for ramp, road, or staged lane closures that were noted in the TMP
        v. Increase in established number of mainline road closures
        vi. Other significant changes as needed
    c. The details regarding the change, and the reason for the change, will be documented and e-mailed to a list of TMP Modification Contacts. The MnDOT Metro Traffic office will add this information to the TMP folder in ProjectWise.
11. If performance standards for mobility and safety that were established in the TMP are not met, the additional mitigation strategy recommendations will be documented as a "Change to the TMP" and sent to the TMP Modifications Contacts by the MnDOT Metro Traffic office.

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Components of TMP (with responsible team member)

1. Title Sheet (PM)
2. Table of Contents (PM)
3. Project Description (PM)
    a. Corridor discussion and project scope
    b. TMP team
4. TMP Scoping Worksheet (PM)*
5. TMP worksheet (assigned to TMP team by PM)
6. Traffic Analysis (as needed) (Traffic)
7. Traffic and Staging Discussion (Traffic)
8. Time and Traffic special provisions discussion (Traffic)
9. Public Information Communications Plan (PAC)
10. TMP Modifications Process (PM)
11. Appendices
    a. Modeling output
    b. Meeting minutes
    c. Correspondence
    d. Traffic Control plans
    e. Time and Traffic Special Provisions
    f. Modifications to TMP (Construction/Traffic)
    g. Others as needed

The size of the document will be dependent on the complexity of the project. For projects with relatively minor traffic impacts, the TMP will be simple. For complex projects with major traffic impacts, the TMP will be more detailed, with more analysis, discussion, and mitigations.

Components of Basic Transportation Management Plan (with responsible team member)

1. TMP Scoping Worksheet (PM)*
2. TMP Worksheet (assigned to TMP team by PM)**
3. Traffic Control Plans (if applicable) (Traffic)
4. Time and Traffic Special Provisions (Construction)

*If project did not go through MnDOT scoping process, include Work Zone Mobility Impact Assessment Worksheet and Red Flag Checklist

** If project does not impact traffic flow or access (such as shoulder work), a summary of the traffic control and description of work may be substituted for the TMP worksheet.

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7.1.2 TMP Scoping Worksheet

HANDOUT

TMP Scoping Worksheet

WORK ZONE MOBILITY IMPACT ASSESSMENT WORKSHEET

Prepared By: Date:

Project Information:

SP:	TH:	Let Date:	Project Length:
Project Description (work type, area type, anticipated duration):			

1. Project has an effect on which type of roadway?
   ☐ Effect is on 2 lane – 2 way roadway – go to line 2
   ☐ Effect is on a multi-lane roadway – go to line 3
   ☐ Has no effect on roadway – **STOP; Red Flag Checklist, Transportation Management Plan or Basic Transportation Management Plan are not needed.**

2. Will traffic be delayed for greater than 15 minutes?
   ☐ Yes – go to line 6
   ☐ No – go to line 7

3. Is the project location included within the MnDOT Metro Lane Closure Manual (LCM)?
   ☐ Yes – go to line 4
   ☐ No – go to line 5

4. Is the work in accordance with the LCM?
   ☐ Yes – go to line 7
   ☐ No – go to line 6

5. Will demand be greater than 1800 veh/lane/hr for the open lanes?
   ☐ Yes – go to line 6
   ☐ No – go to line 7

6. Can the lane closure or traffic delay be re-staged or rescheduled to avoid the lane closure and/or delay restriction(s)?
   ☐ Yes – go to line 7
   ☐ **No – Continue to Red Flag Checklist and Prepare Transportation Management Plan with traffic analysis * during project development**

7. Is work planned to take more than 3 consecutive days at one location?
   ☐ **Yes – Continue to Red Flag Checklist and prepare Basic Transportation Management Plan during project development.**
   ☐ **No – STOP; Red Flag Checklist is not needed. Basic Transportation Management Plan can consist of 1404 special provisions and appropriate layouts in the Field Manual.**

*Coordinate with MnDOT Metro Traffic office regarding level of analysis for projects with Metro Trunk Highway impacts.

TMP Scoping Worksheet SP XXXX-XX

Page **1** of **6**

10/22/2015 tjd

HANDOUT

TMP Scoping Worksheet

TMP SCOPING RED FLAG CHECKLIST

Make a preliminary determination during scoping of whether the following issues are present or should be considered during project development.

Prepared By: Date:

Project Information:

SP:	TH:	Let Date:	Project Length:
Project Description (work type, area type, anticipated duration):			

	Yes	No	Needs further study	N/A	Comments
1. Is the existing shoulder in good enough condition to support traffic during construction?	☐	☐	☐	☐	
2. Could temporary structures and/or additional width be needed on culverts, bridges or shoulders to maintain traffic on the existing route or a detour route?	☐	☐	☐	☐	
3. Is there a pedestrian/bicycle path, trail, or access that needs to be maintained during construction?	☐	☐	☐	☐	
4. Will a Temporary Pedestrian Access Route (TPAR) be required (route meets ADA and PROWAG standards)?	☐	☐	☐	☐	
5. Are there critical features or services on the route that need to be considered (e.g. hospital, emergency services, transit, school buses)?	☐	☐	☐	☐	
6. Could crossovers be needed?	☐	☐	☐	☐	
7. Are there any issues regarding construction timeframes (e.g. time of day, time of year limits, major events, permits, bird nesting, fish spawning, high water)?	☐	☐	☐	☐	

HANDOUT

TMP Scoping Worksheet

	Yes	No	Needs further study	N/A	Comments
8. Could there be a need to maintain railroad traffic?	☐	☐	☐	☐	
9. Might temporary traffic signals be required?	☐	☐	☐	☐	
10. Does it appear that maintenance of traffic will require additional right-of-way?	☐	☐	☐	☐	
11. Will/Can the traffic be detoured? If yes, list proposed routes and answer the following:	☐	☐	☐	☐	
a. Is the local alternate detour route in good condition?	☐	☐	☐	☐	
b. Will the detour route have a detrimental impact on emergency vehicles, school buses, or other sensitive traffic?	☐	☐	☐	☐	
c. Are there bridge/culvert width or height restrictions on the detour?	☐	☐	☐	☐	
d. Are there issues regarding the suitability of the detour route (load limit restrictions, length, speed limit, travel time, etc)?	☐	☐	☐	☐	
e. Are modifications needed at intersections on detour/alternate routes?	☐	☐	☐	☐	
12. Could construction have business impacts that could affect project staging and/or require mitigation?	☐	☐	☐	☐	
13. Could Intelligent Work Zone (IWZ) devices be needed to mitigate traffic impacts?	☐	☐	☐	☐	

HANDOUT

TMP Scoping Worksheet

	Yes	No	Needs further study	N/A	Comments
14. Could moveable barrier be needed/desirable to mitigate traffic impacts or for constructibility?	☐	☐	☐	☐	
15. Are there other projects in the area that should be coordinated or avoided?	☐	☐	☐	☐	
16. Are there geotechnical issues (poor soils, contaminated material, etc) that may affect construction?	☐	☐	☐	☐	
17. Are there utility issues that may affect construction staging?	☐	☐	☐	☐	
18. Is the delay to traffic anticipated to be greater than 10 minutes?	☐	☐	☐	☐	
19. Could the project benefit from innovative contracting (if Yes, contact OCIC to schedule a procurement method selection meeting)?	☐	☐	☐	☐	

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HANDOUT

TMP Scoping Worksheet

Consideration of Accelerated Bridge Construction (ABC) Techniques

Complete this section if project includes bridge construction (this checklist may need to be completed multiple times if multiple bridges with different staging complexity are included in project).

Bridge No.:	SP:	TH:	ADT On:	ADT Under:

Question/Issue	Yes	No	Needs further study	N/A	Comments
20. Is it likely that this project will include complex traffic control schemes, long detours, or significant user impacts due to bridge construction?	☐	☐	☐	☐	
21. Is it likely that this project will have an extended duration (more than one construction season, or extend into late fall) due to bridge construction?	☐	☐	☐	☐	
22. Is bridge construction on the critical path of this project?	☐	☐	☐	☐	
23. Does the existing bridge have features that make it difficult to accommodate staging (truss bridge, slab span, beam spacing issues, etc)?	☐	☐	☐	☐	
24. Are there significant risks or other factors (site complexity) that could be mitigated by accelerating bridge construction?	☐	☐	☐	☐	

ABC Consideration Conclusion:**

Based on the findings & comments above, further consideration of accelerated bridge construction is warranted:

☐ **YES** ☐ **NO** **Project Manager Name: _____ Date: _____**

If further consideration is warranted the Project Manager should contact the Bridge Office Preliminary Plans Unit and the Regional Bridge Construction Engineer for assistance in selecting appropriate ABC alternatives and techniques.

*****Please send a completed copy of this page to the Preliminary Plans Unit at MS 610.***

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TMP Scoping Worksheet

TMP Scoping Conclusions:

1. Describe proposed base staging plan and estimated cost using traditional construction/staging methods, then go to line 2.

2. Based on the answers to red flag questions above, might additional mitigation be needed or can the project be constructed/staged using the proposed base staging plan?
   ☐ Proposed base staging plan acceptable – STOP, and include cost above in scoping database
   ☐ Additional mitigation may be needed – go to line 3

3. Is a recommended alternate staging concept known that addresses the concerns raised in the Red Flag Checklist?
   ☐ Yes – go to line 4
   ☐ No – go to line 5

4. Describe the alternate staging and additional estimated cost compared to proposed base staging (including mitigation measures such as schedule acceleration, ABC, IWZ systems, moveable barrier, improvements to alternate routes,…), then STOP, and include proposed base staging cost plus additional mitigation cost in scoping database.

5. Can TMP analysis be conducted using available internal resources or might a Consultant contract for TMP analysis be needed during predesign to determine and analyze staging alternatives?
   ☐ Consultant contract may be needed needed – go to line 6
   ☐ Available internal resources can conduct analysis – go to line 7

6. Describe analysis needed, estimated cost and timeframe needed for analysis, then go to line 7

7. Estimate the cost of additional traffic mitigation measures (if sufficient information is not known, use 5% of project cost as a value) and STOP, then create a Need in the scoping database without contingency (PM to create Need), and include proposed base staging cost plus additional mitigation cost in scoping database.

7.1.3 TMP Worksheet

HANDOUT

TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Prepared By (PM): Date:

Project Information:

SP:	TH:	Let Date:	Project Length:
Project Description (work type, area type, anticipated duration):			

WORK ZONE DESIGN, SAFETY AND IMPACT CONSIDERATIONS

For internal MnDOT projects, section completed by PM	**Prepared By:**
Yes , No, Poss, NA	
Choose an item.	**1. Temporal variations in demand (hourly, daily or weekly):** *Comment for Yes response*
Choose an item.	**2. Seasonal variations in demand:** *Comment for Yes response*
Choose an item.	**3. Special events:** *Comment for Yes response*
	4. Type of Travel
Choose an item.	**a. Commuter:** *Comment for Yes response*
Choose an item.	**b. Tourist:** *Comment for Yes response*
Choose an item.	**c. Freight:** *Comment for Yes response*
Choose an item.	**d. Transit:** *Comment for Yes response*
Choose an item.	**e. Pedestrian/Bicycle:** *Comment for Yes response*
Choose an item.	**f. Permit/House Moving Route:** *Comment for Yes response*
Choose an item.	**g. Farming considerations:** *Comment for Yes response*
	5. Impacts on parallel corridors, alternate routes, transportation Network or other modes of transportation:
Choose an item.	**a. Local:** *Comment for Yes response*
Choose an item.	**b. Regional:** *Comment for Yes response*
	6. Project coordination
Choose an item.	**a.** Coordination w/ other projects: *Comment for Yes response*
Choose an item.	**b.** State Projects: *Comment for Yes response*
Choose an item.	**c.** Local Projects: *Comment for Yes response*
Choose an item.	**d.** Utilities coordination: *Comment for Yes response*
Choose an item.	**e.** R/W coordination: *Comment for Yes response*
Choose an item.	**f.** Coordination with other transportation infrastructure: *Comment for Yes response*

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TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Choose an item. Choose an item. Choose an item. Choose an item.	**7. Impacts on nearby transportation infrastructure** **c. Key intersections/interchanges:** *Comment for Yes response* **d. Railroad crossings:** *Comment for Yes response* **e. Public transit junctions:** *Comment for Yes response* **f. Malls, distribution centers, etc.:** *Comment for Yes response*
Choose an item. Choose an item. Choose an item. Choose an item. Choose an item. Choose an item.	**8. Impacts on other infrastructure** **a. Evacuation Routes:** *Comment for Yes response* **b. Parks/Recreation Areas:** *Comment for Yes response* **c. Fire Stations:** *Comment for Yes response* **d. Police Stations:** *Comment for Yes response* **e. Hospitals:** *Comment for Yes response* **f. Schools:** *Comment for Yes response*
Choose an item.	**9. Impacts on pedestrians/bicyclists:** *Comment for Yes response*
Choose an item.	**10. Impacts on private and public property access:** *Comment for Yes response*
Choose an item.	**11. Cross-sectional issues (lane width, shoulder availability and width, number of lanes):** *Comment for Yes response*
Choose an item.	**12. Longitudinal issues (taper widths, taper lengths, stopping sight distance):** *Comment for Yes response*
Choose an item.	**13. Horizontal and vertical sight distance issues:** *Comment for Yes response*
Choose an item.	**14. Work area separation and delineation:** *Comment for Yes response*
Choose an item.	**15. Work site access issues:** *Comment for Yes response*
Choose an item.	**16. Local ordinance issues:** *Comment for Yes response*
Choose an item.	**17. Speed issues:** *Comment for Yes response*
Choose an item.	**18. Traffic incident management issues:** *Comment for Yes response*
Choose an item.	**19. Business liaison needs:** *Comment for Yes response*

WORK ZONE MANAGEMENT STRATEGY CONSIDERATIONS

I. Temporary Traffic Control (TTC)

For internal MnDOT projects, TTC section completed by Traffic	**Prepared By:**
Yes , No, Possible, Not Applicable	**IA. Control Strategies**
Choose an item.	**IA1. Construction phasing/staging** *Comment for Yes/No responses*
Choose an item.	**IA2. Full roadway closures** *Comment for Yes/No responses*
Choose an item.	**IA3. Lane shifts or closures** *Comment for Yes/No responses*
Choose an item.	Reduced lane widths to maintain number of lanes *Comment for Yes/No responses*
Choose an item.	Lane closures *Comment for Yes/No responses*
Choose an item.	Short-term *Comment for Yes/No responses*
Choose an item.	Long-term *Comment for Yes/No responses*

HANDOUT

TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Choose an item.	Shoulder closures *Comment for Yes/No responses*
Choose an item.	Lane shift to shoulder/median to maintain number of lanes *Comment for Yes/No responses*
Choose an item.	**IA4. One-lane, two-way operation** *Comment for Yes/No responses*
Choose an item.	**IA5. Two-way traffic on one side of divided facility (crossover)** *Comment for Yes/No responses*
Choose an item.	**IA6. Reversible lanes** *Comment for Yes/No responses*
Choose an item.	Moveable barrier *Comment for Yes/No responses*
Choose an item.	**IA7. Ramp closures/relocation** *Comment for Yes/No responses*
Choose an item.	**IA8. Freeway-to-freeway interchange closures** *Comment for Yes/No responses*
Choose an item.	**IA9. HOV lane closures** *Comment for Yes/No responses*
Choose an item.	**IA10. Bus shoulder closures** *Comment for Yes/No responses*
Choose an item.	**IA11. Night work** *Comment for Yes/No responses*
Choose an item.	**IA12. Weekend work** *Comment for Yes/No responses*
Choose an item.	**IA13. Work hour restrictions during peak travel** *Comment for Yes/No responses*
Choose an item.	**IA14. Pedestrian/bicycle access improvements (due to construction)** *Comment for Yes/No responses*
Choose an item.	**IA15. Business access improvements (due to construction)** *Comment for Yes/No responses*
Choose an item.	**IA16.Detours/use of alternate routes** *Comment for Yes/No responses*
Choose an item.	**IA17. Traffic Control Supervisor** *Click here to enter text.*
Choose an item.	**IA18. Temporary Pedestrian Access Route (TPAR)** *Click here to enter text.*

Yes , No, Possible, Not Applicable	IB. TTC Devices
Choose an item.	**IB1. Changeable message signs (CMS)** *Click here to enter text.*
Choose an item.	Permanent *Comment for Yes response*
Choose an item.	Temporary *Comment for Yes/No responses*
	***Note**: Temporary CMS is part of many information components. Please define the purpose and identify who will manage the temporary CMS.*
Choose an item.	**IB2. Channelizing devices** *Click here to enter text.*
Choose an item.	**IB3. Pedestrian barricade** *Comment for Yes/No responses*
Choose an item.	**IB4. Pedestrian curb ramp** *Click here to enter text.*
Choose an item.	**IB5. Temporary pavement markings** *Click here to enter text.*
Choose an item.	**IB6. Flaggers and/or uniformed traffic control officers** *Click here to enter text.*

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TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Choose an item.	**IB7. Temporary traffic signals** *Click here to enter text.*
Choose an item.	**IB8. Temporary lighting** *Comment for Yes/No responses*

Yes , No, Possible,	IC. Contracting, and Innovative Construction Strategies
Choose an item.	**IC1. Contracting strategies** *Comment for Yes/No responses*
Choose an item.	Design-build *Comment for Yes/No responses*
Choose an item.	A+B bidding *Comment for Yes/No responses*
Choose an item.	Incentive/disincentive *Comment for Yes/No responses*
Choose an item.	Lane rental *Comment for Yes/No responses*
Choose an item.	Maintenance of Traffic (MOT) performance spec *Comment for Yes/No responses*
	***Guidance**: Consider if ITS/IWZ is part of separate project or construction contract. Please provide adequate time for ITS/IWZ installation and testing to ensure system is fully operational prior to construction start date.*
Choose an item.	Other: *Comment for Yes/No responses*
Choose an item.	**IC2. Innovative construction techniques (precast members, rapid cure materials)** *Click here to enter text.*

II. Transportation Operations

	Prepared By: *For internal MnDOT projects, section completed by Traffic*
Yes , No, Possible, Not Applicable	**IIA. Corridor Network Management**
Choose an item.	**IIA1. Signal timing/coordination improvements** *Comment for Yes/No responses*
Choose an item.	**IIA2. Temporary traffic signals (due to increased demand)** *Comment for Yes/No responses*
	***Guidance:** Consider if temp signal will significantly reduce delay of rerouted traffic or improve potential safety issue*
Choose an item.	**IIA3. Street/intersection improvements (due to increased demand)** *Comment for Yes/No responses*
Choose an item.	**IIA4. Bus turnouts** *Comment for Yes/No responses*
Choose an item.	**IIA5. Turn restrictions** *Comment for Yes/No responses*
Choose an item.	**IIA6. Emergency pull offs** *Comment for Yes/No responses*
Choose an item.	**IIA7. Parking restrictions** *Comment for Yes/No responses*
Choose an item.	**IIA8. Truck/heavy vehicle restrictions** *Comment for Yes/No responses*
Choose an item.	**IIA9. Separate truck lanes** *Comment for Yes/No responses*
Choose an item.	**IIA10. Ramp closures (to reduce delay)** *Comment for Yes/No responses*
Choose an item.	**IIA11. Zipper Merge (dynamic or static)** *Click here to enter text.*

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TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

	***Guidance**: Consider if backups are anticipated as a result of the lane closure.*
Choose an item.	**IIA12. Dynamic speed display sign** *Click here to enter text.*
	***Guidance**: Consider if excessive speed in the work zone is a concern.*
Choose an item.	**IIA13. Highway advisory radio (HAR)** *Comment for Yes response*

	Prepared By: *For internal MnDOT projects, section completed by Traffic*
Yes , No, Possible, Not Applicable	**IIB. Work Zone Safety Management**
Choose an item.	**IIB1. Speed limit reduction** *Comment for Yes/No responses*
Choose an item.	Construction *Comment for Yes/No responses*
Choose an item.	Work Zone *Comment for Yes/No responses*
Choose an item.	Advisory *Click here to enter text.*
Choose an item.	**IIB2. Temporary traffic barrier** *Comment for Yes/No responses*
Choose an item.	**IIB3. Impact attenuators** *Comment for Yes/No responses*
Choose an item.	**IIB4. Temporary rumble strips** *Comment for Yes/No responses*
Choose an item.	**IIB5. Queue warning system** *Comment for Yes/No responses*
	***Guidance:** Consider in areas where reoccurring congestion or stopped traffic is not common/expected during normal conditions*
Choose an item.	**IIB6. Intrusion alarms** *Comment for Yes/No responses*
	***Guidance:** Consider in areas where traffic cannot be barrier separated from workers present in work zone*
Choose an item.	**IIB7. Automated Flagger Assistance Devices (AFADs)** *Comment for Yes/No responses*
Choose an item.	**IIB8. On-site project work zone safety group** *Comment for Yes/No responses*
Choose an item.	**IIB9. Work zone traffic control inspection/review** *Comment for Yes/No responses*

	Prepared By: *For internal MnDOT projects, section completed by Traffic*
Yes , No, Possible, Not Applicable	**IIC. Enforcement**
Choose an item.	**IIC1. Dedicated (paid) police enforcement** *Comment for Yes/No responses*
Choose an item.	**IIC2. Cooperative police enforcement** *Comment for Yes/No responses*

	Prepared By: *For internal MnDOT projects, section completed by PM*
Yes , No, Possible,	**IID. Demand Management**

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TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Not Applicable	
Choose an item.	**IID1. Transit service improvements** *Comment for Yes/No responses*
Choose an item.	**IID2. Transit incentives** *Comment for Yes/No responses*
Choose an item.	**IID3. Shuttle services** *Comment for Yes/No responses*
Choose an item.	**IID4. Ridesharing/carpooling incentives** *Comment for Yes/No responses*
Choose an item.	**IID5. Park-and-ride promotion** *Comment for Yes/No responses*
Choose an item.	**IID6. MnPASS/HOV lanes** *Comment for Yes/No responses*
Choose an item.	**IID7. Promote variable work hours** *Comment for Yes/No responses*
Choose an item.	**IID8. Promote teleworking** *Comment for Yes/No responses*

	Prepared By: *For internal MnDOT projects, section completed by RTMC*
Yes , No, Possible, Not Applicable	**IIE. Traffic/Incident Management**
Choose an item.	**IIE1. Closed circuit television (CCTV)** *Comment for Yes/No responses*
	Guidance: *Consider if connection of video to RTMC is possible and there is need to monitor performance and/or incident management is important*
Choose an item.	**IIE2. Temporary detection/ travel time signs** *Comment for Yes/No responses*
	Guidance: *Consider if delays are expected to change daily and/or if the corridor already has existing travel time signs.*
Choose an item.	**IIE3. Ramp metering (due to increased demand)** *Comment for Yes/No responses*
	Guidance: *Consider for work zones if they replace permanent meters during construction or if an unmetered location would benefit from a ramp meter during construction. Coordinate and confirm design needs with RTMC.*
Choose an item.	**IIE4. Temporary suspension of ramp metering** *Comment for Yes/No responses*
Choose an item.	**IIE5. Interconnect PCMS** *Comment for Yes/No responses*
	Guidance: *Answer **No,** if PCMS is covered in other systems (e.g. queue warning).*
Choose an item.	**IIE6. Enhanced mile-post markers** *Comment for Yes/No responses*
Choose an item.	**IIE7. Tow/FIRST** *Comment for Yes/No responses*
Choose an item.	**IIE8. Local detour routes during incidents** *Comment for Yes/No responses*
	Guidance: *Consider if incident management is critical and local routes may have approval from local agency*
Choose an item.	**IIE9. Contract support for incident mgmt.** *Comment for Yes/No responses*
Choose an item.	**IIE10. Incident/emergency response plan** *Comment for Yes/No responses*

III. Public Information (PI)

For internal MnDOT projects, PI section completed by PAC	**Prepared By:**

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TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Yes , No, Possible, Not Applicable	IIIA. Control Strategies
Choose an item.	**IIIA1. Brochures and mailers** *Comment for Yes/No responses*
Choose an item.	**IIIA2. Press releases/media alerts** *Comment for Yes/No responses*
Choose an item.	**IIIA3. Paid advertisements** *Comment for Yes/No responses*
Choose an item.	**IIIA4. Walk-in office** *Comment for Yes/No responses*
Choose an item.	**IIIA5. Project web site** *Comment for Yes/No responses*
Choose an item.	**IIIA6. Public meetings/hearings** *Comment for Yes/No responses*
Choose an item.	**IIIA7. Community task forces** *Comment for Yes/No responses*
Choose an item.	**IIIA8. Coordination with schools/businesses/ emergency services** *Comment for Yes/No responses*
Choose an item.	**IIIA9. Coordination with other Public Agencies** *Comment for Yes/No responses*
Choose an item.	**IIIA10. Coordination with other Transportation Districts/Agencies** *Comment for Yes/No responses*
Choose an item.	**IIIA11. Coordination with other Government Agencies (township, city, county, tribal)** *Comment for Yes/No responses*
Choose an item.	**IIIA12. Coordination with Transit providers.** *Comment for Yes/No responses*
Choose an item.	**IIIA13. Work zone education and safety campaigns** *Comment for Yes/No responses*
Choose an item.	**IIIA14. Rideshare promotions** *Comment for Yes/No responses*
Choose an item.	**IIIA15. Visual information (videos, slides, presentations) for meetings and web** *Comment for Yes/No responses*
Choose an item.	**IIIA16. Public Communications Coordinator** *Comment for Yes/No responses*
Choose an item.	**IIIA17. Public Affairs consultants** *Comment for Yes/No responses*
Choose an item.	**IIIA18. Media interviews** *Comment for Yes/No responses*
Choose an item.	**IIIA19. Freight travel information [North/West Passage (I-94, I-494, I-694), GLRTOC (I-94, I-494, I-694, I-35, I-35E, I-35W)]** *Comment for Yes/No responses*
Choose an item.	**IIIA20. Social media outreach** *Comment for Yes/No responses*

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TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

PERFORMANCE STANDARDS FOR MOBILITY AND SAFETY

For internal MnDOT projects, TTC section completed by Traffic	**Prepared By:**
Yes, No	**Traffic Monitoring**
Choose an item.	**1. Monitor delay on impacted roadways (*define method of monitoring*)** *Comments*
	Guidance: *Consider this may require temporary detection systems and data archiving systems*
Choose an item.	**2. Monitor queue length on impacted roadways (*define method of monitoring*)** *Comments*
	Guidance: *Consider* using ITS/ IWZ systems for real time monitoring of queue length
Choose an item.	**3. If delay exceeds XX min above base delay of XX min after the first 7-10 calendar days of impact, consider additional mitigation strategies.** *Comments*
Choose an item.	**4. If queues exceed XX miles after the first 7-10 calendar days of impact, consider additional mitigation strategies.** *Comments*

Yes, No	Crash Data Review
Choose an item.	**1. Review available crash data on impacted roadways** *Comments*
Choose an item.	**2. Review available crash data on alternate routes** *Comments*
Choose an item.	**3. Compare to existing crash data. If significant increase in crashes on corridor or at a location is observed, consider additional mitigation strategies.** *Comments*

Possible , No, Not Applicable	Additional Mitigation Strategies (*Possible indicates that the item may be considered by an evaluation team)*
Choose an item.	**1. Assemble team to evaluate strategies based on actual conditions encountered** *Comments*
Choose an item.	**2. Adjust traffic control devices** *Comments*
Choose an item.	**3. Provide additional traffic control devices** *Comments*
	Guidance: *Consider ITS/IWZ systems for mitigation of unique conditions to enhance safety, worker protection, routing, distracted driving, or delay*
Choose an item.	**Static devices** *Comments*
Choose an item.	**IWZ devices** *Comment for Yes response*
	Guidance*: Review IWZ Toolbox. Then, please consult with Traffic Engineer, RTMC, or OTST for unique situations not covered by IWZ Toolbox.*
Choose an item.	**4. Revise geometrics** *Comments*
Choose an item.	**5. Provide additional/revised public awareness strategies** *Comments*
Choose an item.	**6. Adjust signal/ramp meter timing** *Comments*
Choose an item.	**7. Close ramp/loop** *Comments*

HANDOUT

TRANSPORTATION MANAGEMENT PLAN (TMP) WORKSHEET

Choose an item.	**8. Restrict movements at intersections** *Comments*
Choose an item.	**9. Adjust lane closure requirements** *Comments*
Choose an item.	**10. Provide/enhance police enforcement** *Comments*
Choose an item.	**11. Provide law enforcement to direct traffic for specific times or locations** *Comments*
Choose an item.	**12. Reevaluate staging** *Comments*
Choose an item.	**13. Alternate route traffic control modifications** *Comments*

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7.1.4 TMP Template

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Transportation Management Plan

Expected Construction:
DATES

Title and Location of Project

SP Number

Insert map of project location

Your Destination...Our Priority

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Hard copy of document printed on: **1/30/2017**

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Project Description

This section includes information on <project background and project scope> as well as a description and listing of membership on the TMP Team.

Letting date: insert date
Anticipated construction schedule: insert date

Corridor Discussion and Project Scope

Discussion of background of corridor and proposed scope. Background should include need and purpose of project and description of previous work in the area.

TMP Team

Insert description of TMP Team members and meeting schedule.

Each TMP team will include representation from the following areas (with specific personnel for this project in parentheses):

- Project Manager (personnel)
- Construction (personnel)
- Traffic (personnel)
- Public Affairs (personnel)
- Area Management (personnel)
- RTMC (personnel)
- Business Liaison, if assigned (personnel)
- Others??

TMP Scoping Worksheet

The TMP scoping worksheet includes the Work zone Mobility Impact Assessment Worksheet, Red Flag Checklist (including consideration of ABC techniques), and TMP Scoping Conclusions.

If TMP scoping worksheet was not completed during scoping, include the Work Zone Mobility Impact Assessment Worksheet and Red Flag Checklist.

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Insert TMP Scoping Worksheet

TMP worksheet

Insert TMP worksheets and comments.

Public Information Communications Plan

Insert communications plan from Public Affairs.

Traffic Analysis

Insert Traffic Analysis from Metro Traffic.

Traffic Control Plans and Construction Staging

Traffic control plans will be included in the Appendix. Insert table, figure, or description of approach to construction staging and general approach to develop temporary traffic control plans.

Time and Traffic Special Provisions

Time and traffic special provisions will be included in the Appendix. Include discussion of any significant items in the specifications.

TMP Modification Process

Following letting, the Construction Resident Engineer or one of his/her representatives if so designated will become the steward of the TMP document during construction administration. Before approving changes in traffic control, allowable lane or ramp closures, or other deviations from the TMP,

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Construction personnel will consult the TMP and appropriate Traffic, Area Management, Public Information, Design, RTMC, Business Liaison, or other parties as appropriate.

The following outlines the process for TMP modifications during construction:

1. If any significant changes as defined in Mn/DOT Metro TMP Process documentation are made during construction that conflict with provisions or commitments made in the TMP, the Project Engineer will document this as a "Change to the TMP". When practical, Construction personnel should discuss significant proposed changes with appropriate TMP Team members before approving.
2. If additional traffic mitigation measures are implemented during construction, these will also be documented as a "Change to the TMP" by Construction personnel.
3. If other functional areas have additional documentation (RTMC changes, monitoring, etc), they will add it to the document in ProjectWise.
4. The details regarding changes, and the reason for the change, will be documented and e-mailed to a list of TMP Modification Contacts, as detailed below:

TMP Modification Contacts

Insert names and contact information of those who are interested in being notified of TMP changes. Typically this list will include TMP Team members and FHWA area engineer if there is federal funding. Other interested parties can be included.

Appendices

Typically included in appendix:

Meeting Minutes from the following:

- Modeling output, if any
- Meeting Minutes from TMP team meetings, construction staging meetings, and others related to TMP
- Other records of correspondence
- Traffic Control Plans
- Time and Traffic special provisions
- Modifications to TMP, to be added by resident construction engineer

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7.1.5 Red Flag Checklist

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RED FLAG CHECKLIST

Complete this checklist for projects that do not go through the MnDOT scoping process or were scoped prior to March 2015. For projects currently being scoped, complete the TMP Scoping Worksheet, which includes the Red Flag Checklist, Work Zone Impact Assessment Worksheet, and TMP Scoping Conclusions).

Prepared By: Date:

Project Information:

SP:	TH:	Let Date:	Project Length:
Project Description (work type, area type, anticipated duration):			

	Yes	No	Needs further study	N/A	Comments
1. Is the existing shoulder in good enough condition to support traffic during construction?	☐	☐	☐	☐	
2. Could temporary structures and/or additional width be needed on culverts, bridges or shoulders to maintain traffic on the existing route or a detour route?	☐	☐	☐	☐	
3. Is there a pedestrian/bicycle path, trail, or access that needs to be maintained during construction?	☐	☐	☐	☐	
4. Will a Temporary Pedestrian Access Route (TPAR) be required (route meets ADA and PROWAG standards)?	☐	☐	☐	☐	
5. Are there critical features or services on the route that need to be considered (e.g. hospital, emergency services, transit, school buses)?	☐	☐	☐	☐	
6. Could crossovers be needed?	☐	☐	☐	☐	
7. Are there any issues regarding construction timeframes (e.g. time of day, time of year limits, major events, permits, bird nesting, fish spawning, high water)?	☐	☐	☐	☐	

Red Flag Checklist SP XXXX-XX

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	Yes	No	Needs further study	N/A	Comments
8. Could there be a need to maintain railroad traffic?	☐	☐	☐	☐	
9. Might temporary traffic signals be required?	☐	☐	☐	☐	
10. Does it appear that maintenance of traffic will require additional right-of-way?	☐	☐	☐	☐	
11. Will/Can the traffic be detoured? If yes, list proposed routes and answer the following:	☐	☐	☐	☐	
a. Is the local alternate detour route in good condition?	☐	☐	☐	☐	
b. Will the detour route have a detrimental impact on emergency vehicles, school buses, or other sensitive traffic?	☐	☐	☐	☐	
c. Are there bridge/culvert width or height restrictions on the detour?	☐	☐	☐	☐	
d. Are there issues regarding the suitability of the detour route (load limit restrictions, length, speed limit, travel time, etc)?	☐	☐	☐	☐	
e. Are modifications needed at intersections on detour/alternate routes?	☐	☐	☐	☐	
12. Could construction have business impacts that could affect project staging and/or require mitigation?	☐	☐	☐	☐	
13. Could Intelligent Work Zone (IWZ) devices be needed to mitigate traffic impacts?	☐	☐	☐	☐	

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	Yes	No	Needs further study	N/A	Comments
14. Could moveable barrier be needed/desirable to mitigate traffic impacts or for constructibility?	☐	☐	☐	☐	
15. Are there other projects in the area that should be coordinated or avoided?	☐	☐	☐	☐	
16. Are there geotechnical issues (poor soils, contaminated material, etc) that may affect construction?	☐	☐	☐	☐	
17. Are there utility issues that may affect construction staging?	☐	☐	☐	☐	
18. Is the delay to traffic anticipated to be greater than 10 minutes?	☐	☐	☐	☐	
19. Could the project benefit from innovative contracting (if Yes, contact OCIC to schedule a procurement method selection meeting)?	☐	☐	☐	☐	

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Consideration of Accelerated Bridge Construction (ABC) Techniques

Complete this section if project includes bridge construction (this checklist may need to be completed multiple times if multiple bridges with different staging complexity are included in project).

Bridge No.:	SP:	TH:	ADT On:	ADT Under:

Question/Issue	Yes	No	Needs further study	N/A	Comments
20. Is it likely that this project will include complex traffic control schemes, long detours, or significant user impacts due to bridge construction?	☐	☐	☐	☐	
21. Is it likely that this project will have an extended duration (more than one construction season, or extend into late fall) due to bridge construction?	☐	☐	☐	☐	
22. Is bridge construction on the critical path of this project?	☐	☐	☐	☐	
23. Does the existing bridge have features that make it difficult to accommodate staging (truss bridge, slab span, beam spacing issues, etc)?	☐	☐	☐	☐	
24. Are there significant risks or other factors (site complexity) that could be mitigated by accelerating bridge construction?	☐	☐	☐	☐	

ABC Consideration Conclusion:**

Based on the findings & comments above, further consideration of accelerated bridge construction is warranted:

☐ **YES** ☐ **NO** **Project Manager Name: _____ Date: _____**

If further consideration is warranted the Project Manager should contact the Bridge Office Preliminary Plans Unit and the Regional Bridge Construction Engineer for assistance in selecting appropriate ABC alternatives and techniques.

*****Please send a completed copy of this page to the Preliminary Plans Unit at MS 610.***

7.1.6 Work Zone Mobility Impact Assessment Worksheet

HANDOUT

WORK ZONE MOBILITY IMPACT ASSESSMENT WORKSHEET

Complete this worksheet for projects that do not go through the MnDOT scoping process or were scoped prior to March 2015. For projects currently being scoped, complete the TMP Scoping Worksheet, which includes the Red Flag Checklist, Work Zone Impact Assessment Worksheet, and TMP Scoping Conclusions).

Prepared By: Date:

Project Information:

SP:	TH:	Let Date:	Project Length:
Project Description (work type, area type, anticipated duration):			

1. Project has an effect on which type of roadway?
   ☐ Effect is on 2 lane – 2 way roadway – go to line 2
   ☐ Effect is on a multi-lane roadway – go to line 3
   ☐ Has no effect on roadway – **STOP; Red Flag Checklist, Transportation Management Plan or Basic Transportation Management Plan are not needed.**

2. Will traffic be delayed for greater than 15 minutes?
   ☐ Yes – go to line 6
   ☐ No – go to line 7

3. Is the project location included within the MnDOT Metro Lane Closure Manual (LCM)?
   ☐ Yes – go to line 4
   ☐ No – go to line 5

4. Is the work in accordance with the LCM?
   ☐ Yes – go to line 7
   ☐ No – go to line 6

5. Will demand be greater than 1800 veh/lane/hr for the open lanes?
   ☐ Yes – go to line 6
   ☐ No – go to line 7

6. Can the lane closure or traffic delay be re-staged or rescheduled to avoid the lane closure and/or delay restriction(s)?
   ☐ Yes – go to line 7
   ☐ **No – Continue to Red Flag Checklist and Prepare Transportation Management Plan with traffic analysis * during project development**

7. Is work planned to take more than 3 consecutive days at one location?
   ☐ **Yes – Continue to Red Flag Checklist and prepare Basic Transportation Management Plan during project development.**
   ☐ **No – STOP; Red Flag Checklist is not needed. Basic Transportation Management Plan can consist of 1404 special provisions and appropriate layouts in the Field Manual.**

*Coordinate with MnDOT Metro Traffic office regarding level of analysis for projects with Metro Trunk Highway impacts.

Work Zone Mobility Impact Assessment Worksheet SP XXXX-XX

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7.2 Design Scene Write-Ups and Sample News Letter

HANDOUT

CHAPTER 16: TRAFFIC

ADVANCE WARNING SIGN SPACING

The Advance Warning Sign Spacing for 0-30 mph has been reduced from 300 feet to 100 feet. This is more in line with the Federal MUTCD and accounts for more limited space in urban type jobs where the speed limit is 30 or less.

CENTERLINE MARKINGS

When paying for the double centerline yellow markings do not pay for them as two 4" solid line white but rather use the pay item…

2016 Spec…2582.502 4" DOUBLE SOLID LINE –*material* by LIN FT
2018 Spec…2582.503 4" DOUBLE SOLID LINE – *material* by LIN FT

INTERIM PAVEMENT MARKINGS – ITEM 2580

There has been confusion regarding the use of this pay item and the quantities to be included. A group has been reviewing the use of interim markings and several problems have been identified. This pay item should only be used for same day pavement markings to be placed on bituminous lifts and milled surfaces. Striping for detours or full striping of the project for suspensions should be paid for under pavement marking (2582) pay items. (Normally paint).

Interim markings do not include edge lines and the length of the skip will be 5 ft. with a 45 ft. gap. Quantities must include centerline marking for each lift including any milled surfaces. For two lane, two way roads, quantities for the no passing zones need to be included. These quantities are kept on record in the District Traffic Offices. When being paid for by the linear foot, the plan needs to indicate how many lifts were estimated, the amount of solid yellow line, yellow broken line (skip) and white broken line (skip).

If the interim markings are being paid for by the lump sum this information is not included in the plan but will be in the ProjectWise restricted file folder.

In either situation, the plan must contain the detail for the interim pavement markings.

INTERIM STRIPING TYPICAL

The interim striping typical can go in either the Traffic control section or the permanent pavement marking section. It should only be in one section and must be the typical as shown on the striping typical website. Make sure that the pay item is included in the Statement of Estimated Quantity.

HANDOUT

MULTI COMP VS EPOXY

The pay item for Epoxy has changed. MnDOT has maintained a Qualified Products List for Epoxy pavement markings; however, many of the products on this list are not 'true epoxies', one is a modified urethane and others are modified epoxies. In addition, there are other pavement marking materials for which a separate QPL was maintained (such as Polyurea). OTST decided to combine these into a Multi-Component list.

The new 2018 spec book has changed the 3590 specification to Multi-Component Liquid Pavement Markings and the pay item had to change as well.

Thus, when using the 2018 spec book, do not use EPOXY as the pay item – use MULTI COMP instead.

ONE DIRECTION LARGE ARROW

The Type III barricade with a One-Direction Large Arrow at the end of the merging taper and another identical assembly at the beginning of the taper (if a Flashing Arrow Board was not used) has essentially been what Minnesota has been using for lane closures since Appendix B was published.

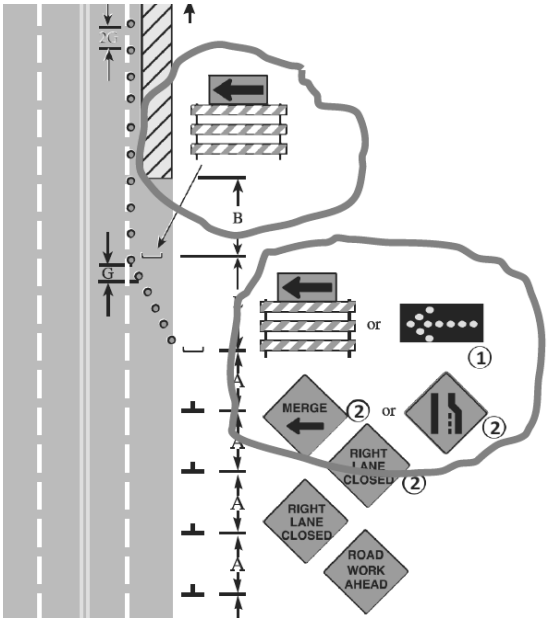
However, there was no language in TTC (Temporary Traffic Control) chapter of the MN MUTCD that allowed this use. The One-Direction Large Arrow is governed by language in Warning Signs Chapter 2C (2C.12) that limits its use to delineating a change in horizontal alignment for curves. Language was drafted for consideration by the Minnesota Committee on Uniform Traffic Control Devices, but it was found to not be in compliance with the Federal MUTCD.

Per a recent clarification from the FHWA, it cannot be used for merging tapers, though it will still be used for shifting tapers. **Therefore, for all projects submitted for the January 26, 2018 letting or later must following the new layout as described below.**

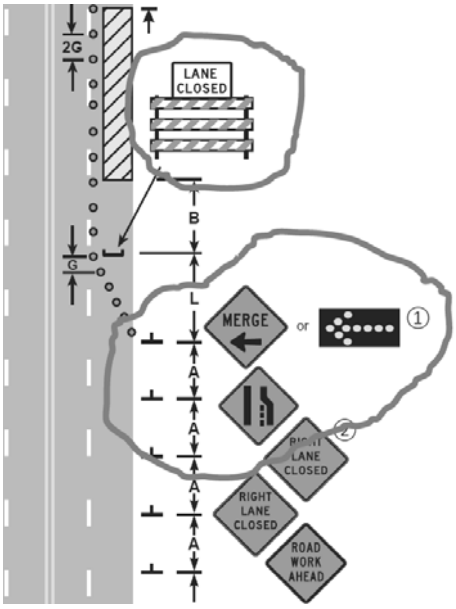
Due to this clarification, the Field Manual Committee has developed new layout, instead of the One Direction Large Arrow on the Type III barricade at the end of the taper, a LANE CLOSED (black on White) sign will be used (required when speed limit is 45 mph or greater). If the Flashing Arrow Board is not used (it is required when speed limit is 45 mph or greater), a MERGE with Arrow sign will be placed at the beginning of the taper.

HANDOUT

PREVIOUS METHOD-
NO LONGER ALLOWED



NEW METHOD



PAVEMENT MARKING TYPICALS

The Pavement Marking Typicals for projects follow a general style and format. The reference files are available in PDF and DGN formats to be imported in the pavement marking plans project border. They can be found at….

http://www.dot.state.mn.us/trafficeng/pavement/typicaldetail/index.html

The designer should be aware that when adding some of these typicals in the .DGN file it may look as though there is some overwriting occurring. It will self-correct when loaded into ProjectWise with MnDOT fonts. This will also self-correct when printed with MnDOT print cues so do not be concerned about it.

When the pavement marking typicals are placed on a sheet with a signature block, the signature is affirming the use of a specific pavement marking typical which follows MnDOT's Traffic Engineering Manual. The signature is not intended to imply that the Designer designed that specific pavement marking typical.

Design Notes

The Designer notes should be removed from the typicals prior to being placed in the plan. The designer notes and asterisk are on the "CAPT BLK" level. If they turn off that level all of that should disappear.

HANDOUT

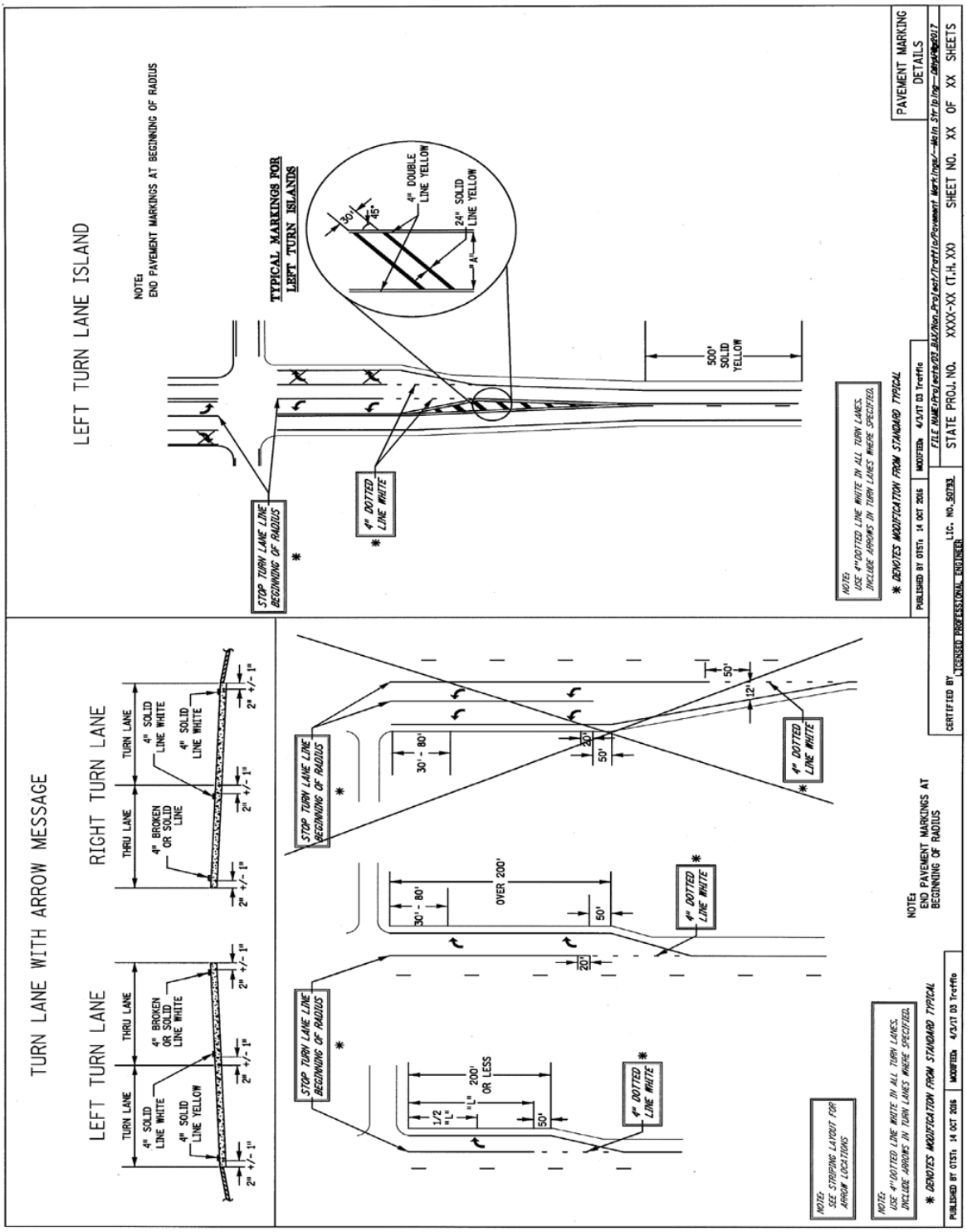
If revising the typical based on an option in the designer notes such as using a 6" marking instead of a 4" marking, a modification date and initial is not required. As this is allowed by MnDOT's Traffic Engineering Manual, this is not considered a modification and the revision can be made without following the modification guidelines below.

Modifying Typicals

Most of the typicals are used in the plans as is, but on occasion there is a need to change or modify a typical. The designer is allowed to make changes if allowed by the Minnesota Manual on Uniform Traffic Control Devises. If a typical is modified in a way that is not proved in the designer notes, follow the process below. If a typical contains information not associated with your project, it is optional for designers to cross out the undesired details/information, do NOT delete the undesired details/information from the typical.

- Fill in the modified date and designer initial in the bottom corner of the typical.
- Identify the changes made to the typicals
  - Label the changes using Italicized text and
  - Add a note to the typical above the PUBLISHED DATE: **DENOTES MODIFICATION FROM STANDARD TYPICAL*
  - Use the MicroStation custom line style StdsPlnMod to place a double line (thick/thin) box around the text to highlight/identify the modification(s).
  - See example below…

HANDOUT



HANDOUT

HANDOUT

PAVEMENT MESSAGES

Pavement messages are now paid for by the square foot. Individual messages (placing and removing) should be listed in a tab. The following chart shows square areas for both removal of messages, which includes a larger area around the marking, and installation, which only includes the area of material installed. The chart can be found at…

http://www.dot.state.mn.us/trafficeng/pavement/typicaldetail/index.html

The reason that the removal areas are larger than the placement areas is because the removal is a rectangular area.

- It is easier for the contractor to grind out a rectangle than the shape.
- If only the shape is removed, that removed shape may still be seen at night or in wet conditions.

Pavement Marking Character Areas
Areas are in square feet.
Pavement letters are 96" tall.

Character		Installed Area	Removal Area
A	=	5.27	10.67
B	=	7.19	10.67
C	=	4.79	10.67
D	=	6.26	10.67
E	=	5.84	10.67
F	=	4.61	10.67
G	=	5.89	10.67
H	=	5.94	10.67
I	=	2.56	2.67
J	=	3.76	10.67
K	=	5.71	10.67
L	=	3.79	10.67
M	=	8.13	10.67
N	=	7.07	10.67
O	=	6.04	10.67
P	=	5.35	10.67
Q	=	6.30	10.67
R	=	6.33	10.67
S	=	5.89	10.67
T	=	3.79	10.67
U	=	5.75	10.67
V	=	4.70	10.67
W	=	6.18	10.67
X	=	4.66	10.67
Y	=	3.86	10.67
Z	=	5.00	10.67
1	=	2.56	10.67
2	=	5.68	10.67
3	=	5.59	10.67
4	=	5.13	10.67
5	=	6.18	10.67
6	=	6.35	10.67
7	=	3.80	10.67
8	=	6.76	10.67
9	=	6.35	10.67
0	=	6.04	10.67

Message		Installed Area	Removal Area
AHEAD	=	28.58	64.99
BIKE	=	21.30	42.00
LANE	=	21.97	42.00

NOTE:
ALL REMOVAL AREAS ARE COMPUTED AS RECTANGLES AS REQUIRED BY SPEC. 2102

Message		Installed Area	Removal Area
ONLY	=	20.76	47.00
PED	=	17.45	37.00
SCHOOL	=	31.86	74.00
SIGNAL	=	29.84	67.20
STOP	=	20.44	50.00
XING	=	20.18	42.00
YIELD	=	22.31	54.27
	=	15.00	48.00
	=	12.01	35.00
	=	26.16	95.00
	=	25.87	88.00
	=	37.04	70.00
	=	42.55	44.00
	=	18.87	67.20
	=	25.10	93.39
	=	9.75	30.00
	=	0.75	1.50
	=	3.00	6.00
	=	5.79	8.00
	=	8.69	18.00
	=	11.58	32.00
	=	7.63	32.07
	=	3.53	14.12
	=	61.72	204.00

INSTALLATION AND REMOVAL OF HORIZONTAL BARS FOR RAILROAD CROSSING PAVEMENT MESSAGE PAID FOR AS 24" SOLID LINE WHITE.

PUBLISHED BY OTST: 19 JAN 2017 | MODIFIED:

HANDOUT

RADIUS CORNERS ON TYPE D SIGNS

Currently, there is a standard note that is placed on the Type D Sign Panel Layouts in the Signing Plan. It states: "Corners of the sign panels extending beyond the border shall not be trimmed."

The MNMUTCD allows for corners of sign panels to be trimmed. Please remove the above note from all future plans for Type D signs.

It is important to note that by removing the note in the construction signing plan, it does not mean that all MnDOT Type D signs are required to have the corners trimmed. It simply means that if Type D signs are manufactured with the corners trimmed MnDOT will accept them.

RAISED PAVEMENT MARKERS TEMPORARY

When including temporary raised pavement markers in the plan, show only one pay item. "Raised Pavement Markers Temporary" - and add footnote to the item indicating how many are one-way, two-way, and what color. We have a specification to attach to the proposal that only includes this pay item. (There is very little difference in cost for the different types.)

REMOVABLE PAVEMENT MESSAGES

The various message items 2581.602 PAVEMENT MESSAGE (_____) REMOVABLE POLY PREFORM by the EACH have been changed to one item 2581.618 REMOVABLE PREFORMED PAVEMENT MESSAGE TAPE by the SQ FT to match the permanent message items.

RUMBLE STRIPES

Any Wet Reflective pavement marking needs to be recessed somehow. This is due to the fact that the Wet Reflective markings utilize larger sized reflective media that will typically be scraped off in the winter months by plows – leading to little-to-no retroreflectivity after some snow plow operations. As a reminder, only liquid Wet Reflective pavement markings can be placed in a rumble.

This can become even more confusing when placed in a rumble. When a Wet Reflective marking is placed in a sinusoidal rumble (which is installed fully below the pavement surface) or placed in a centerline area that is recessed by installing a chip seal only in the travel lanes, it is already recesses and does NOT need to be ground in further. Therefore, the pay item for these pavement markings should just be (WR) not Ground In (WR).

The rectangular corrugated rumble is made by grinding out corrugations every 7 inches out of the pavement, which leaves the space in between the corrugations alone. If a Wet Reflective pavement marking is placed on a rectangular corrugated rumble, then the reflective media between the rumbles will be scraped off. Therefore, it is recommended that these Wet Reflective pavement markings also be ground in…Ground In (WR).

HANDOUT

ALTERNATE PEDESTRIAN ROUTE (APR)

A wide range of pedestrians can be expected at work sites, including the young, elderly, and people with disabilities such as hearing, visual, or mobility. These pedestrians need a clearly delineated and usable travel path.

If the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route. Layouts are available in the Minnesota Temporary Traffic Control Field Manual and Traffic Control Templates are available on MnDOT's Temporary Traffic Control Plan Template Sheets website – at http://www.dot.state.mn.us/trafficeng/workzone/ttctemplates.html .

Consideration should be made to separate pedestrian movements from both work site activity and motor vehicle traffic.

It is strongly encouraged to pay for this as…
2563.601 ALTERNATE PEDESTRIAN ROUTE by the LUMP SUM.

However, the ADA Office recommends making APR on mill and overlay projects incidental unless there are multiple curb line changes which require removal of large areas of pavement.

When APR is not practical pinch the staging timelines so that pedestrian facilities are interrupted for as little time as possible.

TRAFFIC CONTROL TABULATION

Traffic control items that are included with the lump sum should not show quantities on the tabulation. This information will be supplied in the current tabulated or listed format via a stand alone document to the Cost Estimating Engineer and the Project Design Services the Projectwise restricted file foder only, at the time of project submittal. The Preliminary Estimate and Data Base file (*.mdb) will be located in the specific projects ProjectWise location (a right protected folder), with AD group name of "DxEstimates" and a Folder name of "Estimates_Restricted" which restricts access for anyone except newly established AD group (Ex. Design Engineer, Lead Designer & District Cost Estimating Engineer).

Quantities can only be given in the plan for the items which are being paid for separately. However, the items which are paid for separately (not part of the lump sum) should be shown as a tabulation for traffic control and noted as being paid for separately. Items such as, but not limited to …

- 2533 PORTABLE PRECAST CONRETE BARRIER DES 8337
- 2554 IMPACT ATTENUATOR BARRELS
- 2554 IMPACT ATTENUATOR
- 2563 PORTABLE CHANGEABLE MESSAGE SIGN
- 2563 RAISED PAVEMENT MARKER TEMPORARY
- 2563 TUBE DELINEATOR
- 2582 TEMPORARY STRIPING

HANDOUT

WET REFLECTIVE MARKINGS

There has been a request to have specific pay items for the wet reflective pay items so that they can track where these items are used and to obtain historical price data on them.

Therefore, when the plan contains wet reflective pay items the following should be used on the Statement of Estimated Quantities….

Wet reflective items are required to be recessed per MnDOT Standard Specifications and MnDOT's Traffic Engineering Manual.

7.3 Sample Plan Sets

NOTES & GUIDELINES

GENERAL INFORMATION:

1. THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN THE DEVICES IN THIS TRAFFIC CONTROL PLAN UNLESS OTHERWISE NOTED.
2. FIELD CONDITIONS MAY REQUIRE MODIFICATIONS OF THIS LAYOUT AS DEEMED NECESSARY BY THE ENGINEER.
3. ALL DISTANCES ARE APPROXIMATE.
4. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ANY WORK AREAS NEAR TRAFFIC IN ACCORDANCE WITH THE MN MUTCD.
5. AN ANNUAL FALL REVIEW OF ALL TRAFFIC CONTROLS WILL BE MADE TO PREPARE FOR WINTER MAINTENANCE OF THE PROJECT. THIS MAY INCLUDE ADJUSTMENTS OR EXCHANGE OF ONE TRAFFIC CONTROL DEVICE FOR ANOTHER. READJUSTMENTS MAY AGAIN BE REQUIRED IN THE SPRING.
6. IF THE CONTRACTOR DECIDES TO PERFORM THE CONSTRUCTION WORK IN A SEQUENCE OTHER THAN SHOWN IN THIS TRAFFIC CONTROL PLAN THE CONTRACTOR SHALL PROVIDE COMPLETE REVISED TRAFFIC CONTROL PLANS TO BE APPROVED BY THE ENGINEER.

SIGNING:

1. ALL TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS, ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTENT WITH TRAFFIC OPERATION SHALL BE COVERED, REMOVED OR REVISED AS DIRECTED BY THE ENGINEER.
2. WHEN SIGNS ARE PLACED, THEY SHALL BE MOUNTED ON POSTS DRIVEN INTO THE GROUND AT THE PROPER HEIGHT AND LATERAL OFFSET AS SHOWN IN THE "TYPICAL TEMPORARY SIGN FRAMING & INSTALLATION DETAILS" IN THE PLAN. IF THIS IS NOT POSSIBLE, THEY WILL BE MOUNTED ON PORTABLE SUPPORTS AS APPROVED BY THE ENGINEER. WHEN THE SIGNS ARE REMOVED THE SIGN POSTS SHALL ALSO BE REMOVED AS SOON AS POSSIBLE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY EXTRA SIGNING NEEDED TO FACILITATE TRAFFIC SWITCHES OR FOR TRANSITIONING TRAFFIC FROM ONE STAGE TO ANOTHER.
4. ALL ORANGE WARNING AND ORANGE GUIDE SIGNS SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MnDOT APPROVED PRODUCT LIST FOR "SHEETING FOR RIGID TEMPORARY WORK ZONE SIGNS, DELINEATORS, AND MARKERS".
5. BARRICADES SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MnDOT APPROVED PRODUCT LIST FOR "BARRICADE SHEETING".
6. LONGITUDINAL DROPOFFS SHALL BE SIGNED AS SHOWN IN THE "TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS" FIELD MANUAL UNLESS OTHERWISE SPECIFIED IN THESE PLANS.
7. THE CONTRACTOR SHALL COORDINATE THE PLACEMENT OF THE FINAL SIGNS TO ASSURE THAT THE FINAL SIGNS ARE PLACED AS NEEDED, OR PROVIDE TEMPORARY SIGNING AT THEIR EXPENSE UNTIL THE FINAL SIGNING IS PLACED.

PAVEMENT MARKING:

1. THE ENGINEER'S INVOLVEMENT IN THE APPLICATION OF THE MATERIAL SHALL BE LIMITED TO FIELD CONSULTATION AND INSPECTION. THE CONTRACTOR WILL PLACE NECESSARY "SPOTTING" AT APPROPRIATE POINTS TO PROVIDE HORIZONTAL CONTROL FOR STRIPING AND TO DETERMINE NECESSARY STARTING AND CUTOFF POINTS. LONGITUDINAL JOINTS, PAVEMENT EDGES AND EXISTING MARKINGS MAY SERVE AS HORIZONTAL CONTROL WHEN SO DIRECTED.
2. OBLITERATE ANY CONFLICTING PAVEMENT MARKINGS AS DIRECTED BY THE ENGINEER.
3. TRANSITIONS AND TAPERS FOR TEMPORARY STRIPING SHALL BE WET REFLECTIVE OR SUPPLEMENTED WITH TEMPORARY RASIED PAVEMENT MARKERS AND SHOULD BE A MINIMUM OF 6" IN WIDTH.
4. INTERIM STRIPING SHALL CONSIST OF ALL CENTERLINE, NO PASSING ZONES, PAINTED ISLANDS, AND LANE LINES (INCLUDING TURN LANE LINES).
5. TRPM'S (TEMPORARY RAISED PAVEMENT MARKERS) SHOULD BE USED TO SUPPLEMENT THE LONG TERM (MORE THAN 3 DAYS) EDGELINES ON ALL TRANSITION AREAS.
6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION AND PLACEMENT OF TEMPORARY AND FINAL STRIPING. MnDOT TRAFFIC PERSONNEL WILL ASSIST IN THE SPOTTING OF TRANSITION AREAS, GORES AND TAPERS.

BARRIER & DELINEATION:

1. THE CONTRACTOR SHALL FURISH, INSTALL AND MAINTAIN TOP MOUNTED BARRIER DELINEATORS WITH A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 25' SPACES ON TOP OF THE BARRIER WHEN THE BARRIER IS WITHIN 10' OF TRAFFIC UNLESS OTHERWISE NOTED OR AS DIRECTED BY THE ENGINEER. IF THE TRAFFIC ENGINEER REQUIRES SIDE MOUNTED BARRIER DELINEATORS, THEY WILL HAVE A MINIMUM OF 12 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 12.5' SPACES. IF A SMALLER APPROVED BARRIER DELINEATOR IS USED IT SHALL BE AT ONE HALF THE SPACING AND ONE HALF THE BID PRICE.

CONSTRUCTION INFORMATION SIGNING:

1. THE CONTRACTOR SHALL USE CONSTRUCTION INFORMATION SIGNING AS SHOWN IN THE PLAN AND WHICH ARE TO BE USED AS FOLLOWS:
2. G20-X1 CLOSURE NOTICE SIGNS PAIRED WITH G20-X3 WORK ENDS SIGNS TO DISPLAY THE CORRECT START DATE AND AN ESTIMATED FINISH DATE AS APPROVED BY THE PROJECT ENGINEER.
3. G20-X2 WORK ZONE ADVANCE NOTICE SIGNS WITH THE CORRECT STARTING DATE DISPLAYED BEFORE WORK BEGINS. ONCE WORK BEGINS, THE START DATE LEGEND SHALL BE COVERED BY THE SUGGESTED PLAQUE CONTAINED IN THIS PLAN. IF NO ALTERNATE MESSAGE IS SUGGESTED OR IF DIRECTED BY THE PROJECT ENGINEER, THE CORRECT ESTIMATED FINISH DATE, MONTH, OR SEASON SHALL BE DISPLAYED.
4. CONSTRUCTION INFORMATION SIGNING NOT VISIBLE TO THE MOTORING PUBLIC ONCE WORK BEGINS WILL BE MOVED BY THE CONTRACTOR TO A SITE IN ADVANCE OF THE WORK ZONE OR CLOSURE AS DIRECTED BY THE PLAN OR PROJECT ENGINEER.

TRAFFIC CONTROL DEVICES & SYMBOLS LEGEND

SYMBOL	DESCRIPTION
	AREA CLOSED TO TRAFFIC / WORK AREA
	TRAFFIC CONTROL SIGN
	TYPE C BARRICADE =
	DRUM-LIKE CHANNELIZER (TYPE B) =
	TYPE A FLASHING WARNING LIGHT
	FLASHING ARROW BOARD TYPE C = (4' X 8' UNLESS OTHERWISE NOTED).
	SOLID LINE PAVEMENT MARKING WITH TEMPORARY RAISED PAVEMENT MARKERS AT 10' SPACES
	CONCRETE BARRIER WITH DELINEATORS AT 30' SPACES
	IMPACT ATTENUATOR
	PAVEMENT MESSAGE (LEFT ARROW SHOWN)

STRIPING KEY

CIRCLE - EPOXY

TRIANGLE - PAINT

PENTAGON - REMOVABLE PREFORMED PLASTIC MARKING

1ST DIGIT WIDTH	2ND DIGIT PATTERN	3RD DIGIT COLOR
4" OR 8"	S - SOLID B - BROKEN T - DOTTED D - DOUBLE K - DOUBLE BROKEN H - DOUBLE DOTTED	W - WHITE Y - YELLOW B - BLACK

EXAMPLE: (4SW) = 4" SOLID LINE WHITE - EPOXY

INDEX

TRAFFIC CONTROL SHEET NO.	DESCRIPTIONS
1	TITLE SHEET
2	PAY ITEM TABULATION SHEET
3	TRAFFIC CONTROL TABULATION SHEET
4	SPECIAL SIGN DETAILS
5	ADVANCED SIGNING
6	DETOURS
7	ALTERNATE PEDESTRIAN ROUTE
8	STAGING
9	TYPICALS

Sample Plan for TTC Design Course. This plan is to be used for example purposes only. Information in this plan may be out of date or practice. The designer must use most current standards and practices.

I HEREBY CERTIFY THAT SHEETS THROUGH OF THIS PLAN WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

DATE 5/31/2016 LIC. NO.

DESIGNER TECH NAME HERE

TITLE: TRAFFIC CONTROL TITLE SHEET

STATE PROJ. NO. 0000-000 (TH 000) SHEET NO OF SHEETS

PLOTTED/REVISED: 5/31/2016

DISTRICT #: METRO
IPLOT NAME: ttcsampleplan1
PATH & FILENAME: IP_PWPdll896\ttcsampleplan.dgn

TRAFFIC CONTROL TABULATION

ITEM	UNIT	STAGE ONE	STAGE TWO	STAGE THREE	STAGE FOUR	TOTAL
PORTABLE PRECAST CONC BARRIER DES 8337	LIN FT					
RELOCATE PORT PRECAST CONC BAR DES 8337	LIN FT					
IMPACT ATTENUATOR BARRELS	EACH					
RELOCATE IMPACT ATTENUATOR BARRELS	EACH					
IMPACT ATTENUATOR ASSEMBLY	AMBY					
RELOCATE IMPACT ATTENUATOR ASSEMBLY	AMBY					
TUBE DELINEATOR	EACH					
REPLACE TUBE DELINEATOR	EACH					
TRAFFIC CONTROL	LUMP SUM					
PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY					
MEDIAN BARRIER DELINEATOR	EACH					
RAISED PAVEMENT MARKER TEMP.	EACH					
4" SOLID LINE PAINT	LIN FT					
4" BROKEN LINE PAINT	LIN FT					
8" DOTTED LINE PAINT (WR)	LIN FT					
8" SOLID LINE PAINT (WR)	LIN FT					
PAVEMENT MARKING REMOVAL	SQ FT					
PAVEMENT MARKING REMOVAL	LIN FT					
POLICE OFFICER	HOUR					
PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY					
WORKERS PRESENT SPEED LIMIT	UNIT DAY					
DYNAMIC MERGE SYSTEM	UNIT DAY					
TRAFFIC CONTROL SUPERVISOR	HOUR					
TRAFFIC CONTROL SUPERVISOR	EACH					
TRAFFIC CONTROL SUPERVISOR	LUMP SUM					
REMOVABLE PREFORMED PAVEMENT MARKING TAPE	LIN FT					
REMOVABLE PREFORMED PLASTIC MASK (BLACK)	LIN FT					

TRAFFIC CONTROL TABULATION SHEET

"R" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
	R1-2	RED ON WHITE	36X36X36
	R2-1	BLACK ON WHITE	26X30
	R3-7L	BLACK ON WHITE	30X30
	R3-7R	BLACK ON WHITE	30X30
	R3-30AG	BLACK ON WHITE	36X30
TRAIL CLOSED	R9-9a	BLACK ON WHITE	24X18

DEVICES			
ITEM	SIGN NO.	COLOR	SIZE
	TYPE A		
	TYPE B		
	TYPE C		
	ARROW BOARD		96" X 48"
	AUDIBLE MESSAGE DEVICE		

"W" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
ROAD WORK AHEAD	W20-1	BLACK ON ORANGE	48" x 48"
SHOULDER WORK	W21-5	BLACK ON ORANGE	48" x 48"
RIGHT LANE CLOSED	W21-X5R	BLACK ON ORANGE	48" X 48"
	W4-2R	BLACK ON ORANGE	48" X 48"
MERGE	W20-X3	BLACK ON ORANGE	48" X 48"
	W1-4R	BLACK ON ORANGE	48" X 48"
	W1-6	BLACK ON ORANGE	48" X 24"

"G" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
END ROAD WORK	G20-2A	BLACK ON ORANGE	48" X 24"

"M" SERIES			

MISCELLANEOUS			

PLOTTED/REVISED: 2/3/2016

DISTRICT #: METRO
IPLOT NAME: ttcsampleplan3
PATH & FILENAME: IP_PWP-dl/8396/Vttcsampleplan.dgn

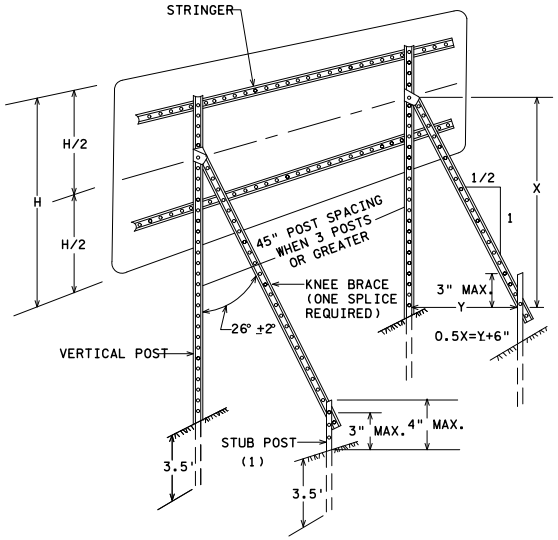
DRAWN BY:	CHECKED BY:	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. _____ DATE _____	TRAFFIC CONTROL TABULATION CHART STATE PROJ. NO. 0000-000 (TH 000) SHEET NO. OF SHEETS

SPECIAL SIGN DETAILS

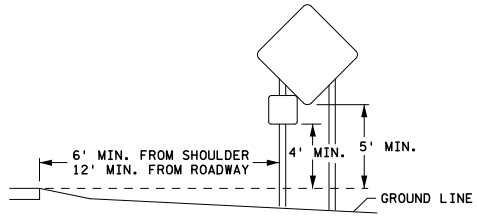
PLOTTED/REVISED: 2/3/2016

DISTRICT #: METRO
IPLOT NAME: ttcsampleplan4
PATH & FILENAME: IP_PWF-dl/8396/Vttcsampleplan.dgn

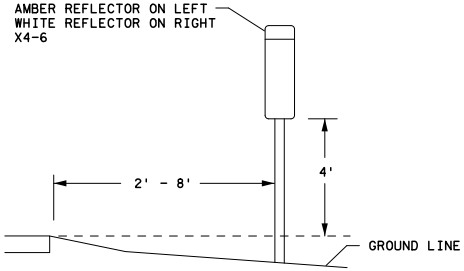
DRAWN BY:	CHECKED BY:	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. _____ DATE _____	SPECIAL SIGN DETAILS STATE PROJ. NO. 0000-000 (TH 000) SHEET NO. OF SHEETS



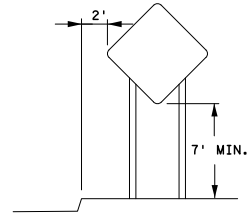
TYPICAL "A-FRAME" INSTALLATION
TYPE "D" SIGNS



TYPICAL RURAL DESIGN



DELINEATION MOUNTING



TYPICAL URBAN DESIGN

SIGN DATA

SIGNS TO BE PLACED ON DRIVEN U-POSTS, SHALL BE PLACED IN ACCORDANCE WITH TABLE 1 OR TABLE 2 BELOW. IF THE TTC PLAN PLACES TTC DEVICES ADJACENT TO EXISTING STRUCTURES, THEN THEY SHOULD BE PLACED SLIGHTLY BEYOND THAT STRUCTURE, SO AS TO NOT COMPROMISE THAT STRUCTURE AND THE NEW DEVICE'S CRASHWORTHINESS (NO MORE THAN TWO U-POSTS WITHIN 84 INCHES, ALIGNED IN THE SAME PLANE). SIGN PANELS SHALL BE PLACED ON SIGN STRUCTURES TO MEET THE 5' MIN DEPICTED ON THE TYPICAL RURAL DESIGN DETAIL, THE 7' MIN DEPICTED ON THE TYPICAL URBAN DESIGN DETAIL, OR 7' MIN AND 9' MIN DEPICTED ON THE TYPICAL MOUNTING DETAIL ON THIS SHEET.

TABLE 1

STANDARD CONSTRUCTION SIGNS IN MN/DOT STANDARD SIGNS AND MARKINGS MANUAL

PANEL SIZE (IN.)	POSTS			
	NO. & TYPE	SPACING (IN.)	KNEE BRACES QUANT.	LENGTH (FT.)
24 x 24	2-U	18		13
30 x 24	2-U	18		13
36 x 30	2-U	24		13
36 x 36	2-U	18		14
42 x 36	2-U	30		14
48 x 48	2-U	30		15
60 x 60	2-U	42	1	16
72 x 72	2-U	42	2	17
96 x 54	2-U	54	2	16
168 x 132	4-U	48	4	20

GENERAL NOTES:
1. POST LENGTHS ARE APPROXIMATE AND INCLUDE EMBEDMENT, BUT DO NOT INCLUDE ADDITIONAL LENGTH REQUIRED FOR SPLICE.
2. SEE MN/DOT STANDARD SIGNS AND MARKINGS MANUAL FOR PUNCHING HOLES.

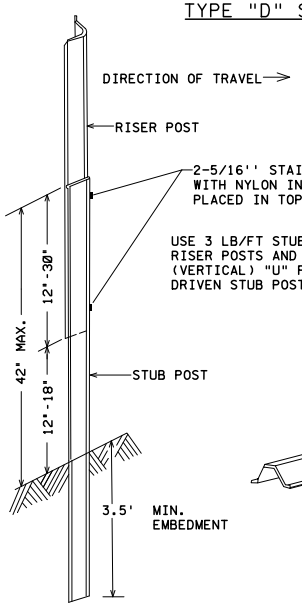
TABLE 2

SPECIAL DESIGN CONSTRUCTION SIGNS

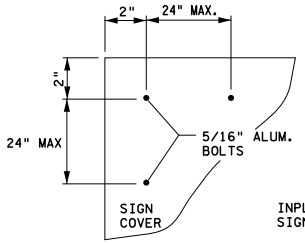
PANEL SIZE		POSTS			
LENGTH (IN.)	HEIGHT (IN.)	NO. & TYPE	SPACING (IN.)	KNEE BRACES QUANT.	LENGTH (FT.)
54 - 96	78	2-U	42	2	20
102 - 138	78	3-U	45	3	20
144 - 180	78	4-U	45	4	20

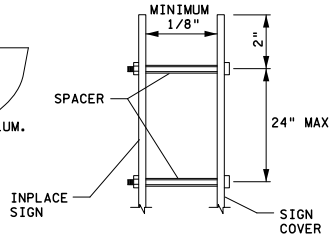
DESIGNER NOTE:

INCLUDE SPECIAL SIGN DETAILS IN THE TRAFFIC CONTROL PLAN IN TABLE TWO.



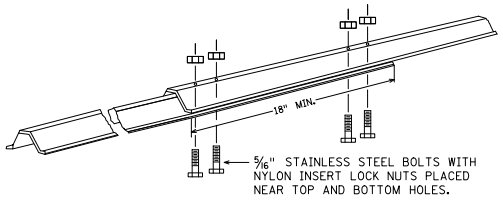
"U" POST BREAKAWAY SPLICE



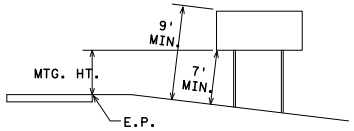


SPACER SHALL BE A MATERIAL THAT DOES NOT HARM THE SIGN SHEETING FACE (SUCH AS PLASTIC OR RUBBER).
REFER TO TRAFFIC ENGINEERING MANUAL CHAPTER 8 FOR MORE INFORMATION ON COVERING SIGNS

SIGN PANEL OVERLAY



KNEE BRACE STRUCTURAL SPLICE



TYPICAL MOUNTING

(1) OFFSET STUB POST 1' TOWARD ROADWAY RELATIVE TO VERTICAL POST.

NOTES:

FOR TEMPORARY CONSTRUCTION SIGN FRAMING, THE CONTRACTOR MAY USE GRADE 5 ZINC PLATED BOLTS FOR ALL BOLTED CONNECTIONS, EXCEPT FOR THE KNEE BRACE CONNECTION TO THE REAR STUB POST, WHICH SHALL UTILIZE A 5/16 INCH STAINLESS STEEL BOLT AND NYLON INSERT LOCK NUT. ADDITIONAL SIGN FRAMING DETAILS CAN BE FOUND IN THE TRAFFIC ENGINEERING MANUAL PART 6.

IF THE CONTRACTOR ELECTS TO USE SOME OTHER TYPE OF SIGN SUPPORT (OTHER THAN U-CHANNEL SIGN POSTS) FOR MOUNTING CONSTRUCTION SIGNS, DETAILS OF THE PROPOSED SIGN STRUCTURE SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO ORDERING THE SIGN STRUCTURE COMPONENTS. ANY SIGN STRUCTURE TO BE SUBMITTED TO THE ENGINEER SHALL BE AN FHWA ACCEPTED BREAKAWAY SIGN SUPPORT. SIGN STRUCTURE SHALL ALSO BE APPROVED FOR 90 MPH WIND LOAD.

GUIDE SIGNS SHOWN TO BE COVERED SHALL BE COVERED WITH THE SAME COLOR AS THE SIGN BACKGROUND. THE CONTRACTOR SHALL PLACE COVERS OR ADDITIONAL SIGNS USING A MINIMUM 1/8" PLASTIC SPACER BETWEEN THE INPLACE SIGN AND THE COVERING MATERIAL. HOLES WILL BE DRILLED IN THE COVER AND THE INPLACE SIGN AND SHALL BE PLACED IN ACCORDANCE TO THE SIGN PANEL DETAIL. SPACERS ARE REQUIRED. MID-PANEL SPACING SHALL BE NO GREATER THAN 24".

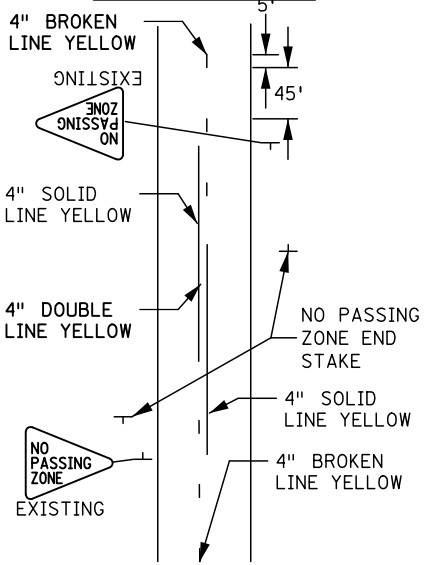
TYPICAL TEMPORARY SIGN FRAMING AND INSTALLATION DETAILS

REVISED: 2-3-16

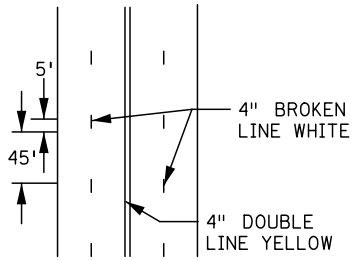
STATE PROJ. NO.	SHEET NO.	OF	SHEETS

PLOTTED/REVISED: 2/3/2016
DISTRICT #: METRO
IPLOT NAME: ttcsampleplan5
PATH & FILENAME: IP_PWFadl8396\Ttcsampleplan.dgn

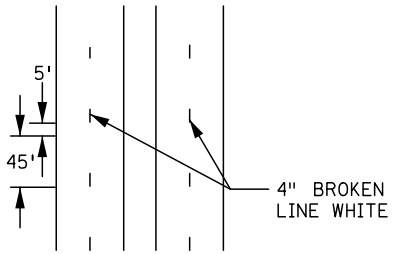
TWO LANE, TWO WAY



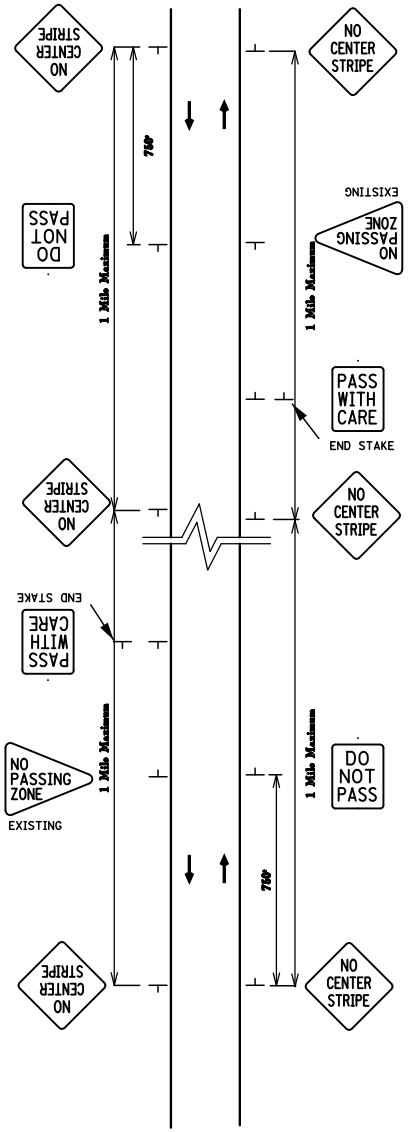
MULTI-LANE, UNDIVIDED



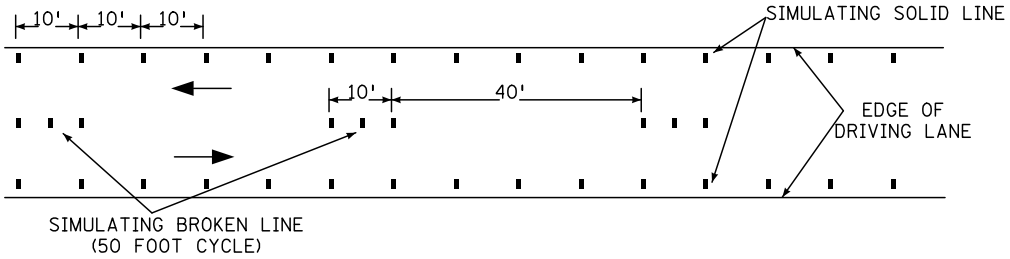
MULTI-LANE, DIVIDED



TWO LANE, TWO WAY WITHOUT MARKINGS LESS THAN 400 ADT



SIMULATING A SOLID LINE AND A BROKEN LINE (50 FOOT CYCLE) WITH TRPMS



USING TRPMS AS INTERIM PAVEMENT MARKING

WHEN TRPMS ARE USED TO SIMULATE A LINE THE FOLLOWING GUIDELINE APPLIES:

SKIP STRIPE - USES 3 TRPM's PER 10' SKIP STRIPE ON 5' CENTERS WITH A 40' GAP

SOLID LINE - USES TRPM'S ON 10' CENTERS ON TANGENTS, FLATTER GRADES AND CURVES UNDER 6 DEGREES. FOR CURVES OVER 6 DEGREES AND STEEP GRADES, THIS SPACING SHALL BE REDUCED TO 5' CENTERS.

GENERAL NOTES:

SEE SPECIAL PROVISIONS FOR INTERIM PAVEMENT MARKING GUIDELINES

THESE INTERIM PAVEMENT MARKING GUIDELINES APPLY TO ALL TEMPORARY TRAFFIC CONTROL ZONES OF AT LEAST 300' IN LENGTH ON TANGENT AND 50' ON CURVES OF 6 DEGREES OR GREATER.

1. FOR ALL PROJECTS GREATER THAN 1.25 MILES IN LENGTH, INTERIM SKIP STRIPE PAVEMENT MARKINGS SHALL USE THE SAME CYCLE LENGTH AS FINAL PAVEMENT MARKINGS (50') AND SHALL BE A MINIMUM OF 5' LENGTH.
2. ON PROJECTS GREATER THAN 300' IN LENGTH, BUT LESS THAN 1.25 MILES IN LENGTH, THE INTERIM MARKING SHALL MATCH THE CYCLE LENGTH AT EITHER END OF THE PROJECT. THE INTERIM STRIPE SHALL BE 5' IN LENGTH.
3. INTERIM STRIPING SHALL CONSIST OF ALL CENTERLINE, NO PASSING ZONES, PAINTED ISLANDS, AND LANE LINES (INCLUDING TURN LANE LINES).

ALL INTERIM MARKINGS SHALL BE PLACED PRIOR TO REMOVING LANE CLOSURE OR OPENING THE ROADWAY TO TRAFFIC.

FINAL MARKINGS AND ALL OTHER PAVEMENT MARKINGS INCLUDING EDGELINES, CHANNELIZING LINES, TURN LANE LINES, LANE REDUCTION TRANSITIONS, GORE MARKINGS AND OTHER LONGITUDINAL MARKINGS AND THE VARIOUS NON-LONGITUDINAL MARKINGS (STOP LINES, RAIL ROAD CROSSINGS, CROSSWALKS, WORDS, SYMBOLS, ETC) SHOULD BE PLACED WITHIN 14 CALENDAR DAYS OF OPENING ROAD TO TRAFFIC.

NOTE: WHEN FINAL MARKINGS ARE TO BE EPOXY AND PAINT IS USED FOR INTERIM SOLID LINES, A 10 MIL THICK LAYER APPLICATION OF A WATER-BASED TRAFFIC MARKING PAINT SHALL BE USED. WITH A 10 MIL LAYER OF PAINT APPLIED, BEADS SHOULD BE APPLIED AT A RATE OF 6 LBS/GAL. REMOVAL OF THE 10 MIL LAYER OF PAINT IS NOT REQUIRED PRIOR TO PLACING THE EPOXY.

USING SIGNING AS INTERIM PAVEMENT MARKING

ON LOW VOLUME ROADS WITH AN ADT (AVERAGE DAILY TRAFFIC) OF LESS THAN 400 VEHICLES, THE SIGNS MAY BE USED IN LIEU OF PAVEMENT MARKINGS FOR UP TO 14 CALENDAR DAYS (SEE SECTION 5A.1 OF THE MMUTCD) OR AS DIRECTED BY THE PROJECT ENGINEER.

1. IF NO INTERIM MARKINGS ARE USED A "NO CENTER STRIPE" SIGN (W8-12) SHALL BE USED FOR EACH DIRECTION OF TRAVEL. THIS SIGN SHALL BE REPEATED AT MAJOR INTERSECTIONS OR ONE MILE INTERVALS, WHICHEVER IS GREATER.
2. IF NOT ALREADY IN PLACE, A "DO NOT PASS" SIGN (R4-1) SHALL BE PLACED ON THE RIGHT SIDE OF THE ROAD AT THE BEGINNING OF THE ZONE OPPOSITE OF THE "NO PASSING ZONE" SIGN (W14-3)

PLOTTED/REVISED: 2/3/2016
DISTRICT #: METRO
IPLOT NAME: ttcsampleplan6
PATH & FILENAME: IP_PWP-dll8396\Vttcsampleplan.dgn

REVISED: 13-NOV-2015	CHECKED BY: XXX	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. _____ DATE 2/3/2016	INTERIM PAVEMENT MARKINGS STATE PROJ. NO. 0000-000 (TH 000) SHEET NO. 000 OF 000 SHEETS

NOTES & GUIDELINES

GENERAL INFORMATION:

1. THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN THE DEVICES IN THIS TRAFFIC CONTROL PLAN UNLESS OTHERWISE NOTED.
2. FIELD CONDITIONS MAY REQUIRE MODIFICATIONS OF THIS LAYOUT AS DEEMED NECESSARY BY THE ENGINEER.
3. ALL DISTANCES ARE APPROXIMATE.
4. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ANY WORK AREAS NEAR TRAFFIC IN ACCORDANCE WITH THE MNMUTCD.
5. AN ANNUAL FALL REVIEW OF ALL TRAFFIC CONTROLS WILL BE MADE TO PREPARE FOR WINTER MAINTENANCE OF THE PROJECT. THIS MAY INCLUDE ADJUSTMENTS OR EXCHANGE OF ONE TRAFFIC CONTROL DEVICE FOR ANOTHER. READJUSTMENTS MAY AGAIN BE REQUIRED IN THE SPRING.
6. IF THE CONTRACTOR DECIDES TO PERFORM THE CONSTRUCTION WORK IN A SEQUENCE OTHER THAN SHOWN IN THIS TRAFFIC CONTROL PLAN THE CONTRACTOR SHALL PROVIDE COMPLETE REVISED TRAFFIC CONTROL PLANS TO BE APPROVED BY THE ENGINEER.

SIGNING:

1. ALL TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTANT WITH TRAFFIC OPERATION SHALL BE COVERED, REMOVED OR REVISED AS DIRECTED BY THE ENGINEER.
2. WHEN SIGNS ARE INSTALLED, THEY SHALL BE MOUNTED ON POSTS DRIVEN INTO THE GROUND AT THE PROPER HEIGHT AND LATERAL OFFSET AS DETAILED IN THE MNMUTCD. IF THIS IS NOT POSSIBLE THEY WILL BE MOUNTED ON PORTABLE SUPPORTS AS APPROVED BY THE ENGINEER. WHEN THE SIGNS ARE REMOVED THE SIGN POSTS SHALL ALSO BE REMOVED AS SOON AS POSSIBLE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY EXTRA SIGNING NEEDED TO FACILITATE TRAFFIC SWITCHES OR FOR TRANSITIONING TRAFFIC FROM ONE STAGE TO ANOTHER.
4. ALL ORANGE WARNING AND ORANGE GUIDE SIGNS SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MN/DOT APPROVED PRODUCT LIST FOR "SHEETING FOR RIGID TEMPORARY WORK ZONE SIGNS".

   BARRICADES SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MN/DOT APPROVED PRODUCT LIST FOR BARRICADE SHEETING. NOTE THAT ASTM TYPE VII SHEETING IS NOT ALLOWED ON BARRICADES AFTER JANUARY 1, 2010.
5. LONGITUDINAL DROPOFFS SHALL BE SIGNED AS SHOWN IN THE "TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS" FIELD MANUAL UNLESS OTHERWISE SPECIFIED IN THESE PLANS.
6. THE CONTRACTOR SHALL COORDINATE THE INSTALLATION OF THE FINAL SIGNS TO ASSURE THAT THE FINAL SIGNS ARE INSTALLED AS NEEDED, OR PROVIDE TEMPORARY SIGNING AT THEIR EXPENSE UNTIL THE FINAL SIGNING IS INSTALLED.

PAVEMENT MARKING:

1. OBLITERATE ANY CONFLICTING PAVEMENT MARKINGS AS DIRECTED BY THE ENGINEER.
2. PAINT, POLYMER LANE TAPE AND/OR TRPM'S ARE ACCEPTABLE TEMPORARY STRIPING ALTERNATIVES ACCORDING TO ACTUAL CONDITIONS ENCOUNTERED AS DIRECTED BY THE ENGINEER. GENERALLY, ONLY PAINT WILL BE USED BEFORE MAY 1ST OR WHEN THE OTHER MANUFACTURERS' SPECIFICATIONS CAN NOT BE MET.
3. TRPM'S (TEMPORARY RAISED PAVEMENT MARKERS) SHOULD BE USED TO SUPPLEMENT THE LONG TERM (MORE THAN 3 DAYS) EDGELINES ON ALL TRANSITION AREAS WHEN THE CONDITIONS ARE WITHIN THE MANUFACTURERS' SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION AND INSTALLATION OF TEMPORARY AND FINAL STRIPING. MN/DOT TRAFFIC PERSONNEL WILL ASSIST IN THE SPOTTING OF TRANSITION AREAS, GORES AND TAPERS.

BARRIER & DELINEATION:

1. TOP MOUNTED BARRIER DELINEATORS WILL HAVE A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 30' SPACES ON TOP OF THE BARRIER WHEN THE BARRIER IS WITHIN 10' OF TRAFFIC UNLESS OTHERWISE NOTED OR AS DIRECTED BY THE ENGINEER. IF THE TRAFFIC ENGINEER REQUIRES SIDE MOUNTED BARRIER DELINEATORS, THEY WILL HAVE A MINIMUM OF 12 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 30' SPACES. IF A SMALLER APPROVED BARRIER DELINEATOR IS USED IT SHALL BE AT ONE HALF THE SPACING AND ONE HALF THE BID PRICE.

CONSTRUCTION INFORMATION SIGNING:

1. THE CONTRACTOR SHALL USE CONSTRUCTION INFORMATION SIGNING AS SHOWN IN THE PLAN AND WHICH ARE TO BE USED AS FOLLOWS:

   G20-X1 CLOSURE NOTICE SIGNS PAIRED WITH G20-X3 WORK ENDS SIGNS TO DISPLAY THE CORRECT START DATE AND AN ESTIMATED FINISH DATE AS APPROVED BY THE PROJECT ENGINEER.

   G20-X2 WORK ZONE ADVANCE NOTICE SIGNS WITH THE CORRECT STARTING DATE DISPLAYED BEFORE WORK BEGINS. ONCE WORK BEGINS, THE START DATE LEGEND SHALL BE COVERED BY THE SUGGESTED PLAQUE CONTAINED IN THIS PLAN. IF NO ALTERNATE MESSAGE IS SUGGESTED OR IF DIRECTED BY THE PROJECT ENGINEER, THE CORRECT ESTIMATED FINISH DATE, MONTH, OR SEASON SHALL BE DISPLAYED.

   CONSTRUCTION INFORMATION SIGNING NOT VISIBLE TO THE MOTORING PUBLIC ONCE WORK BEGINS WILL BE MOVED BY THE CONTRACTOR TO A SITE IN ADVANCE OF THE WORK ZONE OR CLOSURE AS DIRECTED BY THE PLAN OR PROJECT ENGINEER.

TRAFFIC CONTROL DEVICES & SYMBOLS LEGEND

SYMBOL	DESCRIPTION
	AREA CLOSED TO TRAFFIC / WORK AREA
	TRAFFIC CONTROL SIGN
	TYPE III BARRICADE =
	DRUM-LIKE CHANNELIZER =
	TYPE A FLASHING WARNING LIGHT
	FLASHING ARROW BOARD TYPE C = (4' X 8' UNLESS OTHERWISE NOTED).
	SOLID LINE PAVEMENT MARKING WITH TEMPORARY RAISED PAVEMENT MARKERS AT 10' SPACES
	CONCRETE BARRIER WITH DELINEATORS AT 30' SPACES
	IMPACT ATTENUATOR
	PAVEMENT MESSAGE (LEFT ARROW) EPOXY

STRIPING KEY

TRIANGLE - PAINT

PENTAGON - REMOVEABLE PREFORMED PLASTIC MARKING

1ST DIGIT WIDTH	2ND DIGIT PATTERN	3RD DIGIT COLOR
4" OR 8"	S - SOLID	W - WHITE
	B - BROKEN	Y - YELLOW
	D - DASH/DOUBLE	B - BLACK

EXAMPLE: (4SW) = 4" SOLID LINE WHITE - EPOXY

INDEX

TRAFFIC CONTROL SHEET NO.	DESCRIPTIONS
1	TITLE SHEET
2	PAY ITEM TABULATION SHEET
3	TRAFFIC CONTROL TABULATION SHEET

Example 1.
Need for TC Title Sheet -
The information found on it covers all of the TC sheets if they are numbered correctly. (See the sample plan for the website for additional pages included in the TC portion of the plan).

I HEREBY CERTIFY THAT SHEETS THROUGH OF THIS PLAN WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

DATE _____ LIC. NO. _____

DESIGNER TECH NAME HERE

TITLE: TRAFFIC CONTROL TITLE SHEET

STATE PROJ. NO. 0000-000 (TH 000) SHEET NO OF SHEETS

PLOTTED/REVISED: 11/17/2010

DISTRICT #: METRO
IPLOT NAME: t_typicals_title
PATH & FILENAME: IP_PWPd0796967\t_typicals_tc_tsh.dgn

LEGEND

- PERMANENT CONSTRUCTION
- TEMPORARY PAVEMENT CONSTRUCTION
- CONSTRUCT UNDER TRAFFIC
- REFLECTIVE PLASTIC DRUM (50' SPACING UNLESS NOTED OTHERWISE)
- TYPE "C" SIGN
- TYPE III BARRICADE
- LOW INTENSITY FLASHER, TYPE A
- DIRECTION OF TRAFFIC LANE
- PORTABLE CONCRETE MEDIAN BARRIER DESIGN 8337
- IMPACT ATTENUATOR
- TUBE DELINEATOR
- STORM DRAIN INLET PROTECTION
- RAPID STABILIZATION METHOD 3
- MS — SILT FENCE (MACHINE SLICED)
- BR — SEDIMENT CONTROL LOG TYPE STRAW
- DI — PROPOSED STORM SEWER CONSTRUCTED THIS STAGE
- DI — PROPOSED STORM SEWER CONSTRUCTED IN PREVIOUS STAGES
- DI — EXISTING STORM SEWER
- PROPOSED WATERMAIN CONSTRUCTED THIS STAGE
- PROPOSED WATERMAIN CONSTRUCTED IN PREVIOUS STAGES
- EXISTING WATERMAIN
- CP — CULVERT END CONTROLS
- EXISTING LIGHTING UNIT
- TEMPORARY LIGHTING UNIT
- TEMPORARY LIGHTING UNIT INSTALLED IN PREVIOUS STAGES
- TEMPORARY 50' WOOD POLE
- OHP — TEMPORARY OVERHEAD LIGHT CABLE 4 COND NO 4
- EXISTING DIRECT BURIED LIGHTING CABLE
- EXISTING CONDUIT
- DIRECT BURIED LIGHTING CABLE 4 COND NO 4 INSTALLED THIS STAGE
- DIRECT BURIED LIGHTING CABLE 4 COND NO 4 INSTALLED IN PREVIOUS STAGES
- 3" NON-METALLIC CONDUIT INSTALLED THIS STAGE
- 3" NON-METALLIC CONDUIT INSTALLED IN PREVIOUS STAGES

SYMBOLS & MATERIALS LEGEND

- CROSSWALK BLOCK
- PAVEMENT MESSAGE (LEFT ARROW)

STRIPING KEY

- CIRCLE-EPOXY
- PENTAGON-REMOVEABLE PREFORMED PLASTIC MARKING
- TRIANGLE-PAINT
- OCTAGON-PREF THERMO

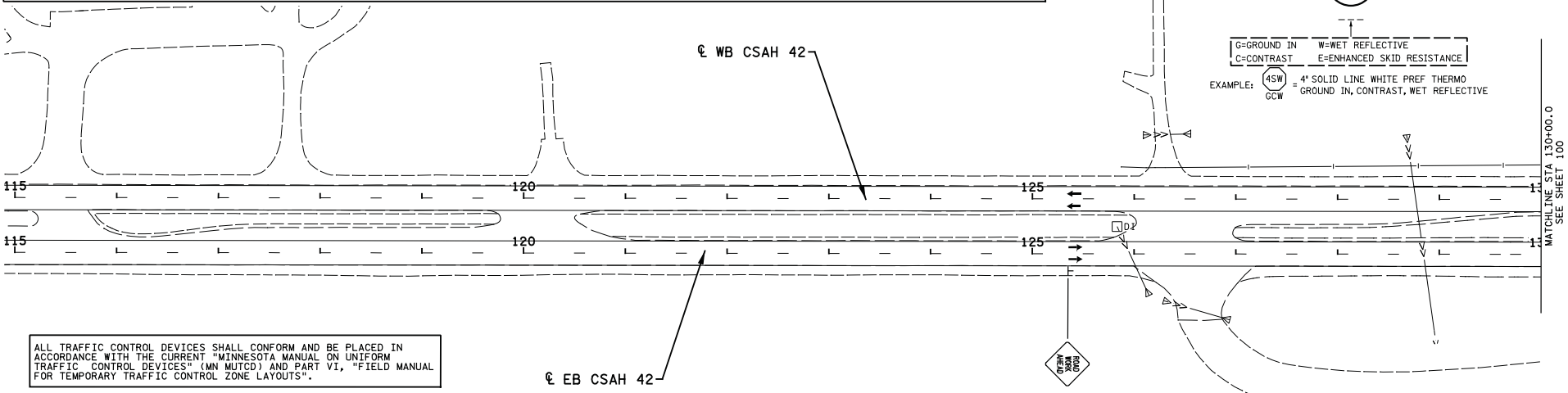
1ST DIGIT WIDTH: 4", 8", ETC.

2ND DIGIT PATTERN:
S - SOLID
B - BROKEN
T - DOTTED
D - DOUBLE
K - DOUBLE BROKEN
H - DOUBLE DOTTED

3RD DIGIT COLOR:
W - WHITE
Y - YELLOW
B - BLACK

G=GROUND IN W=WET REFLECTIVE
C=CONTRAST E=ENHANCED SKID RESISTANCE

EXAMPLE: 4SW GCW = 4" SOLID LINE WHITE PREF THERMO GROUND IN, CONTRAST, WET REFLECTIVE



ALL TRAFFIC CONTROL DEVICES SHALL CONFORM AND BE PLACED IN ACCORDANCE WITH THE CURRENT "MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MN MUTCD) AND PART VI, "FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS".

GENERAL NOTES:

PLACE PERMANENT TURF ESTABLISHMENT AND EROSION CONTROL MEASURES ALONG THE PERMANENT CONSTRUCTION. SEE EROSION CONTROL AND TURF ESTABLISHMENT PLANS.

CONTRACTOR SHALL COORDINATE ALL EXCAVATION AND GRADING OPERATIONS WITH UTILITY COMPANIES.

CENTERLINE ALIGNMENT NOT SHOWN FOR CLARITY.

RAPID STABILIZATION SHALL BE APPLIED IN AREAS NEEDED PER MNDOT SPEC. 2575.

SILT FENCE SHALL FOLLOW A SINGLE CONTOUR LINE AS CLOSE AS POSSIBLE WHEN PLACED.

ADDITIONAL EROSION CONTROL MEASURES MAY BE NEEDED AS CONDITIONS WARRANT. PLACE ADDITIONAL MEASURES AT THE DIRECTION OF THE ENGINEER.

THE CONTRACTOR SHALL MAINTAIN WATER SERVICE TO ALL ACTIVE SERVICES THROUGHOUT THE DURATION OF THE PROJECT. SEE SPECIAL PROVISIONS FOR DETAILS.

Example 2.
Need for TC Title Sheet -
This example is what is consistently seen. Since there is no title sheet usually all of the Legends are repeated on all of the TC sheets cluttering them up a bit. Also example 2 shows a sheet stating needed information so they are not saving any sheets/time by not having a title sheet.

0 50 100
scale in feet

NO	DATE	BY	CKD	APPR	REVISION

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DAKOTA COUNTY
STAGING AND TRAFFIC CONTROL PLANS
T.H. 52 / C.S.A.H. 42 INTERCHANGE
STAGE 1

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GENERAL TRAFFIC CONTROL AND STAGING NOTES

1. THE CONTRACTOR SHALL FURNISH, PLACE AND MAINTAIN THE DEVICES IN THIS TRAFFIC CONTROL PLAN UNLESS OTHERWISE NOTED.

2. ALL TRAFFIC CONTROL DEVICES, TEMPORARY LANE CLOSURE ARRANGEMENTS AND PROCEDURES, ETC., SHALL CONFORM WITH THE REQUIREMENTS OF THE CURRENT EDITION OF THE MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES INCLUDING THE FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS.

3. FIELD CONDITIONS MAY REQUIRE MODIFICATIONS OF THIS LAYOUT AS DEEMED NECESSARY BY THE ENGINEER.

4. IF THE CONTRACTOR DECIDES TO PERFORM THE CONSTRUCTION WORK IN A SEQUENCE OTHER THAN SHOWN IN THE TRAFFIC CONTROL PLAN, THE CONTRACTOR SHALL PROVIDE COMPLETE REVISED TRAFFIC CONTROL PLANS TO BE APPROVED BY THE ENGINEER.

5. ALL DISTANCES ARE APPROXIMATE.

6. ALL TEMPORARY TRAFFIC THRU LANES SHALL BE A MINIMUM OF 12 FEET IN WIDTH ON T.H. 52 MAINLINE AND RAMPS, AND A MINIMUM OF 11 FEET ON C.S.A.H. 42 UNLESS NOTED OTHERWISE.

7. REFLECTORIZED DRUMS USED FOR CHANNELIZATION SHALL HAVE 50 FOOT SPACING ALONG T.H. 52 AND 25 FOOT SPACING ALONG C.S.A.H. 42 AS SHOWN IN THE PLANS. DRUM LOCATIONS AND SPACINGS SHOWN ON THIS PLAN ARE APPROXIMATE AND ARE SUBJECT TO REVISION BY THE ENGINEER.

8. THE CONTRACTOR SHALL MAINTAIN A 2 FOOT MINIMUM CLEAR DISTANCE BETWEEN THE EDGE OF THE TRAVEL LANE AND THE NEAREST EDGE OF ANY ADJACENT TRAFFIC CONTROL DEVICES (DRUMS, BARRICADES, BARRIERS, ETC.) UNLESS OTHERWISE NOTED.

9. THE CONTRACTOR SHALL MAINTAIN ACCESS TO ALL DRIVEWAYS AND BUILDING ENTRANCES THAT ARE TO REMAIN OPEN AT ALL TIMES TO THE SATISFACTION OF THE ENGINEER (INCIDENTAL).

10. THE CONTRACTOR SHALL PROVIDE CERTIFIED FLAGGERS WITH TWO-WAY RADIOS AT ALL TIMES WHEN CONTRACTOR OPERATIONS REQUIRE ONE-LANE-TWO-WAY OPERATION OR WHEN, IN THE OPINION OF THE ENGINEER, ONE-LANE-TWO-WAY OPERATIONS ARE APPROPRIATE DUE TO SAFETY CONCERNS FROM OPEN EXCAVATIONS, ADJACENT EQUIPMENT, ETC. FLAGGERS AND FLAGGING OPERATIONS SHALL BE INCIDENTAL.

11. IN ALL WORK AREAS NOTED "CONSTRUCTION UNDER TRAFFIC" THE CONTRACTOR SHALL PROTECT THESE AREAS AT ALL TIMES TO PROVIDE FOR SAFE TRAFFIC MOVEMENT TO THE SATISFACTION OF THE ENGINEER.

12. THE ACTUAL NUMBER OF BARRICADES AT EACH LOCATION REQUIRED MAY VARY DEPENDING UPON THE SIZE OF BARRICADES USED, THE WIDTH OF THE ROAD CLOSURE AND THE MOVEMENT OF LOCAL CONSTRUCTION TRAFFIC.

13. BASED ON THIS TRAFFIC CONTROL PLAN, TRAFFIC WILL BE REQUIRED TO UTILIZE THE EXISTING SHOULDER PAVEMENT. IF THE EXISTING PAVEMENT BEGINS TO FAIL, THE CONTRACTOR SHALL IMMEDIATELY CLOSE THE LANE AND REPAIR THE PAVEMENT. PAYMENT WILL BE MADE UNDER THE APPROPRIATE ADDITIONAL TRAFFIC CONTROL ITEMS, REMOVAL, AND BITUMINOUS BID ITEMS.

BARRIER AND DELINEATION

1. TOP MOUNTED BARRIER DELINEATORS WILL HAVE A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 30 FT. SPACES ON TOP OF THE BARRIER WHEN THE BARRIER IS WITHIN 10 FT. OF TRAFFIC UNLESS OTHERWISE NOTED OR AS DEEMED UNECESSARY BY THE ENGINEER. IF THE TRAFFIC ENGINEER REQUIRES SIDE MOUNTED BARRIER DELINEATORS, THEY WILL HAVE A MINIMUM OF 12 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 30 FT SPACES. IF A SMALLER APPROVED BARRIER DELINEATOR IS USED IT SHALL BE AT ON HALF THE SPACING.

2. THE CONTRACTOR SHALL DETERMINE THE NEED FOR BARRIER BASED ON THEIR CONSTRUCTION MEANS AND METHODS. TEMPORARY BARRIER NOT SPECIFICALLY SHOWN IN THE PLANS, BUT DETERMINED AS NECESSARY FOR CONSTRUCTION BY THE CONTRACTOR AND ENGINEER SHALL BE PAID FOR UNDER THE PORTABLE PRECAST CONCRETE BARRIER AND RELOCATE PORTABLE PRECAST CONCRETE BARRIER BID ITEMS.

SIGNING

1. ALL TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTENT WITH TRAFFIC OPERATION SHALL BE COVERED, REMOVED OR REVISED AS DIRECTED BY THE ENGINEER. (INCIDENTAL)

2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY EXTRA SIGNING NEEDED TO FACILITATE TRAFFIC SWITCHES OR FOR TRANSITIONING TRAFFIC FROM ONE STAGE TO ANOTHER.

3. THE CONTRACTOR SHALL COORDINATE THE INSTALLATION OF THE PERMANENT SIGNS TO ASSURE THAT THE PERMANENT SIGNS ARE INSTALLED AS NEEDED, OR PROVIDE TEMPORARY SIGNING AT THEIR EXPENSE UNTIL THE PERMANENT SIGNING IS INSTALLED.

4. STREET IDENTIFICATION SIGNAGE SHALL BE MAINTAINED AT ALL TIMES. SIGNS LOCATED AT THE INTERSECTIONS SHALL BE MAINTAINED INPLACE OR BY TEMPORARY INSTALLATIONS (INCIDENTAL).

5. WHEN SIGNS ARE INSTALLED THEY SHALL BE MOUNTED ON POSTS DRIVEN INTO THE GROUND AT THE PROPER HEIGHT AND LATERAL OFFSET AS DETAILED IN THE MN MUTCD. IF THIS IS NOT POSSIBLE THEY WILL BE MOUNTED ON PORTABLE SUPPORTS AS APPROVED BY THE ENGINEER. WHEN THE SIGNS ARE REMOVED THE SIGN POSTS SHALL ALSO BE REMOVED AS SOON AS POSSIBLE.

6. ALL ORANGE SIGNS SHALL BE MADE OF "HIGH PERFORMANCE FLUORESCENT SIGN SHEETING."

7. LONGITUNAL DROPOFFS SHALL BE SIGNED AS SHOWN IN THE "TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS" FIELD MANUAL UNLESS OTHERWISE SPECIFIED IN THESE PLANS.(INCIDENTAL)

8. THE CONTRACTOR IS RESPONSIBLE FOR ANY PERMITS REQUIRED FOR TRAFFIC CONTROL SIGNING.

TEMPORARY PAVEMENT MARKING

1. THE CONTRACTOR SHALL REMOVE ALL EXISTING PAVEMENT MARKINGS WHICH CONFLICT WITH THESE TRAFFIC CONTROL PLANS TO THE SATISFACTION OF THE ENGINEER AND MUST NOTE THE ORIGINAL PLACEMENT. THE CONTRACTOR SHALL RESTORE ALL APPROPRIATE ORIGINAL PAVEMENT MARKINGS AFTER APPROVAL TO DO SO BY THE ENGINEER AND WILL SELF SPOT PLACEMENT BASED ON THEIR NOTES. REMOVAL OF TEMPORARY PAVEMENT MARKINGS, REMOVABLE PREFORMED PAVEMENT MARKINGS, AND CONFLICTING EXISTING PAVEMENT MARKINGS SHALL BE PAID FOR UNDER THE APPROPRIATE BID ITEM.

2. THE CONTRACTOR SHALL NOT PLACE PAINTED TEMPORARY PAVEMENT MARKINGS ON PERMANENT FINAL SURFACING (OR ON OTHER SURFACING WHICH WILL NOT ULTIMATELY BE REPLACED OR COVERED BY PLANNED CONSTRUCTION) UNLESS THE TEMPORARY MARKINGS ARE IN THE SAME LOCATION AS THE PERMANENT MARKINGS.

3. THE CONTRACTOR SHALL PLACE PERMANENT PAVEMENT MARKINGS AND COORDINATE INSTALLATION OF PERMANENT SIGNING (TYPES C, D, AND OH) DURING EACH STAGE OF CONSTRUCTION AS APPROPRIATE AND CONSISTENT WITH THE REQUIREMENTS OF THE TEMPORARY TRAFFIC CONTROL.

4. THE CONTRACTOR SHALL MATCH ALL TEMPORARY PAVEMENT MARKINGS TO EXISTING INPLACE STRIPING.

LIGHTING

1. EXISTING LIGHTING TO REMAIN SHALL BE OPERABLE DURING CONSTRUCTION. CUTOVER FROM TEMPORARY TO PERMANENT POWER AND CONTROL SHALL TAKE PLACE IN A SINGLE DAY.

2. CONSTRUCT PERMANENT LIGHTING, POWER AND CONTROL TO THE EXTENT POSSIBLE IN EACH STAGE. USE A COMBINATION OF PERMANENT AND TEMPORARY POWER AND CONTROL UNTIL PERMANENT POWER AND CONTROL IS COMPLETE. SEE LIGHTING PLANS AND DETAILS FOR FURTHER INFORMATION.

Example 2.
Need for TC Title Sheet -
This example is what is consistently seen. Since there is no title sheet usually all of the Legends are repeated on all of the TC sheets cluttering them up a bit. Also example 2 shows a sheet stating needed information so they are not saving any sheets/time by not having a title sheet.

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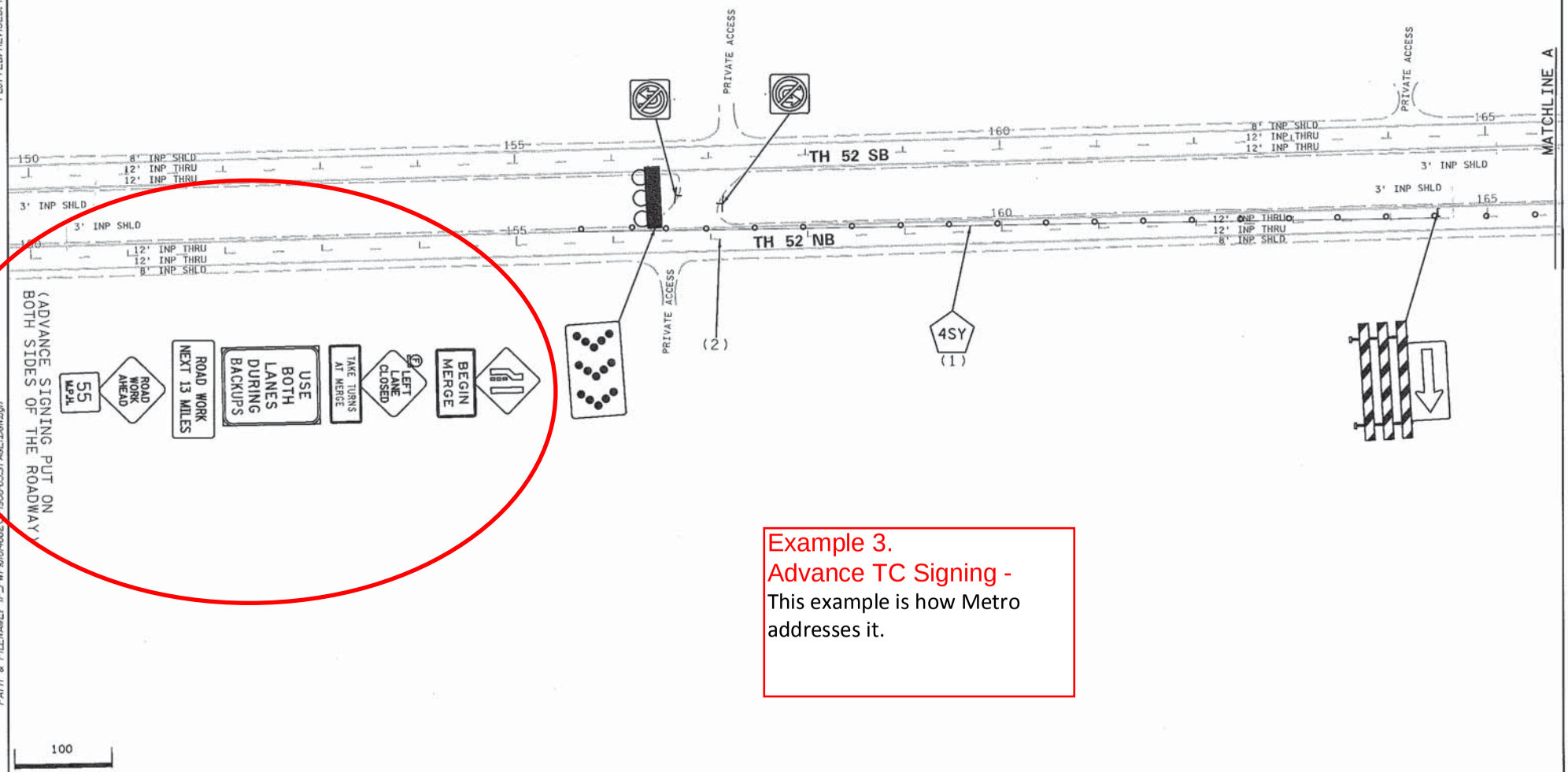
DAKOTA COUNTY
STAGING AND TRAFFIC CONTROL PLANS
T.H. 52 / C.S.A.H. 42 INTERCHANGE
GENERAL TRAFFIC CONTROL NOTES

SPECIFIC NOTES:

(1) 4" SOLID YELLOW REMOVABLE MARKING TAPE WITH TEMPORARY RAISED PAVEMENT MARKS AT 10' SPACES

(2) COVER CONFLICTING PAVEMENT MARKING



Example 3.
Advance TC Signing -
This example is how Metro addresses it.

100
SCALE IN FEET

STAGE 1

TRAFFIC CONTROL DETAILS

DRAWN BY: BT	CHECKED BY: SNM	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	STATE PROJ. NO. 1906-65 (TH 52) SHEET NO. TC8 OF TC44 SHEETS

PLOTTED/REVISED: 10/10/2016

DISTRICT *: METRO
IPLOT NAME: SP1906-65_STAGE1.DGN2
PATH & FILENAME: IP_PWP-d/814682/1906-65_STAGE1.DGN.dgn

LEGEND

- PERMANENT CONSTRUCTION
- TEMPORARY PAVEMENT CONSTRUCTION
- CONSTRUCT UNDER TRAFFIC
- REFLECTIVE PLASTIC DRUM (50' SPACING UNLESS NOTED OTHERWISE)
- TYPE "C" SIGN
- TYPE III BARRICADE
- LOW INTENSITY FLASHER, TYPE A
- DIRECTION OF TRAFFIC LANE
- PORTABLE CONCRETE MEDIAN BARRIER DESIGN 8337
- IMPACT ATTENUATOR
- TUBE DELINEATOR
- STORM DRAIN INLET PROTECTION
- RAPID STABILIZATION METHOD 3
- MS — SILT FENCE (MACHINE SLICED)
- BR — SEDIMENT CONTROL LOG TYPE STRAW
- DI — PROPOSED STORM SEWER CONSTRUCTED THIS STAGE
- DI — PROPOSED STORM SEWER CONSTRUCTED IN PREVIOUS STAGES
- DI — EXISTING STORM SEWER
- PROPOSED WATERMAIN CONSTRUCTED THIS STAGE
- PROPOSED WATERMAIN CONSTRUCTED IN PREVIOUS STAGES
- EXISTING WATERMAIN
- CP — CULVERT END CONTROLS
- EXISTING LIGHTING UNIT
- TEMPORARY LIGHTING UNIT
- TEMPORARY LIGHTING UNIT INSTALLED IN PREVIOUS STAGES
- TEMPORARY 50' WOOD POLE
- OHP — TEMPORARY OVERHEAD LIGHT CABLE 4 COND NO 4
- OHP — EXISTING DIRECT BURIED LIGHTING CABLE
- EXISTING CONDUIT
- DIRECT BURIED LIGHTING CABLE 4 COND NO 4 INSTALLED THIS STAGE
- DIRECT BURIED LIGHTING CABLE 4 COND NO 4 INSTALLED IN PREVIOUS STAGES
- 3" NON-METALLIC CONDUIT INSTALLED THIS STAGE
- 3" NON-METALLIC CONDUIT INSTALLED IN PREVIOUS STAGES

SYMBOLS & MATERIALS LEGEND

- CROSSWALK BLOCK
- PAVEMENT MESSAGE (LEFT ARROW)

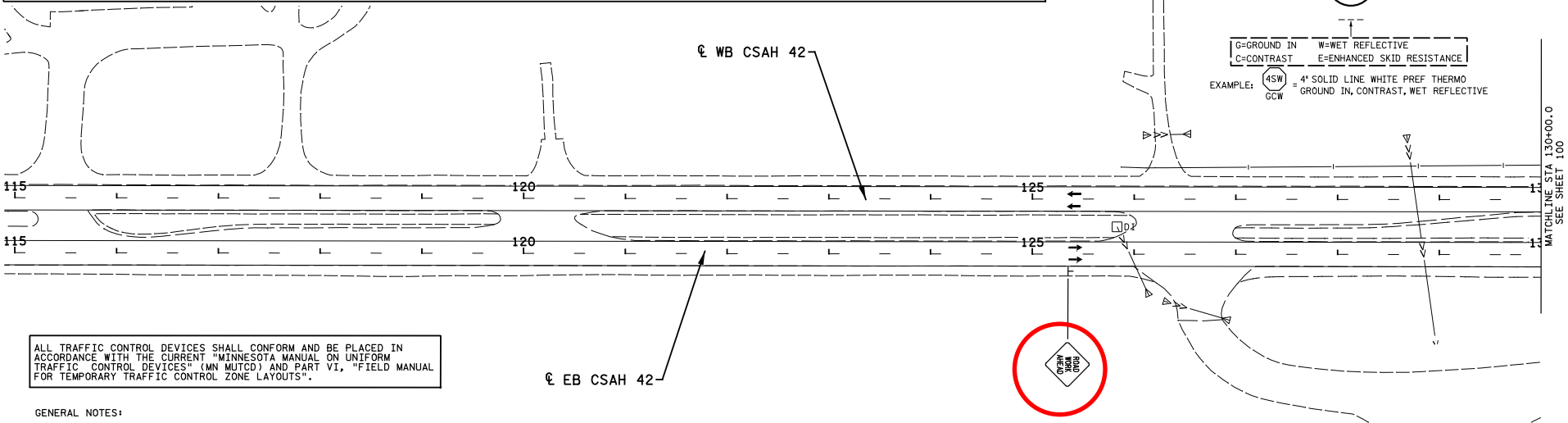
STRIPING KEY

- CIRCLE-EPOXY
- PENTAGON-REMOVEABLE PREFORMED PLASTIC MARKING
- TRIANGLE-PAINT
- OCTAGON-PREF THERMO

1ST DIGIT WIDTH	2ND DIGIT PATTERN	3RD DIGIT COLOR
4", 8", ETC.	S - SOLID B - BROKEN T - DOTTED D - DOUBLE K - DOUBLE BROKEN H - DOUBLE DOTTED	W - WHITE Y - YELLOW B - BLACK

G=GROUND IN W=WET REFLECTIVE
C=CONTRAST E=ENHANCED SKID RESISTANCE

EXAMPLE: 4SW GCW = 4" SOLID LINE WHITE PREF THERMO GROUND IN, CONTRAST, WET REFLECTIVE



ALL TRAFFIC CONTROL DEVICES SHALL CONFORM AND BE PLACED IN ACCORDANCE WITH THE CURRENT "MINNESOTA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MN MUTCD) AND PART VI, "FIELD MANUAL FOR TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS".

GENERAL NOTES:

PLACE PERMANENT TURF ESTABLISHMENT AND EROSION CONTROL MEASURES ALONG THE PERMANENT CONSTRUCTION. SEE EROSION CONTROL AND TURF ESTABLISHMENT PLANS.

CONTRACTOR SHALL COORDINATE ALL EXCAVATION AND GRADING OPERATIONS WITH UTILITY COMPANIES.

CENTERLINE ALIGNMENT NOT SHOWN FOR CLARITY.

RAPID STABILIZATION SHALL BE APPLIED IN AREAS NEEDED PER MNDOT SPEC. 2575.

SILT FENCE SHALL FOLLOW A SINGLE CONTOUR LINE AS CLOSE AS POSSIBLE WHEN PLACED.

ADDITIONAL EROSION CONTROL MEASURES MAY BE NEEDED AS CONDITIONS WARRANT. PLACE ADDITIONAL MEASURES AT THE DIRECTION OF THE ENGINEER.

THE CONTRACTOR SHALL MAINTAIN WATER SERVICE TO ALL ACTIVE SERVICES THROUGHOUT THE DURATION OF THE PROJECT. SEE SPECIAL PROVISIONS FOR DETAILS.

Example 4.
Advance TC Signing -
This is what we usually see and it ends up with more plan sheets needed.

0 50 100
scale in feet

NO	DATE	BY	CKD	APPR	REVISION

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DAKOTA COUNTY
STAGING AND TRAFFIC CONTROL PLANS
T.H. 52 / C.S.A.H. 42 INTERCHANGE
STAGE 1

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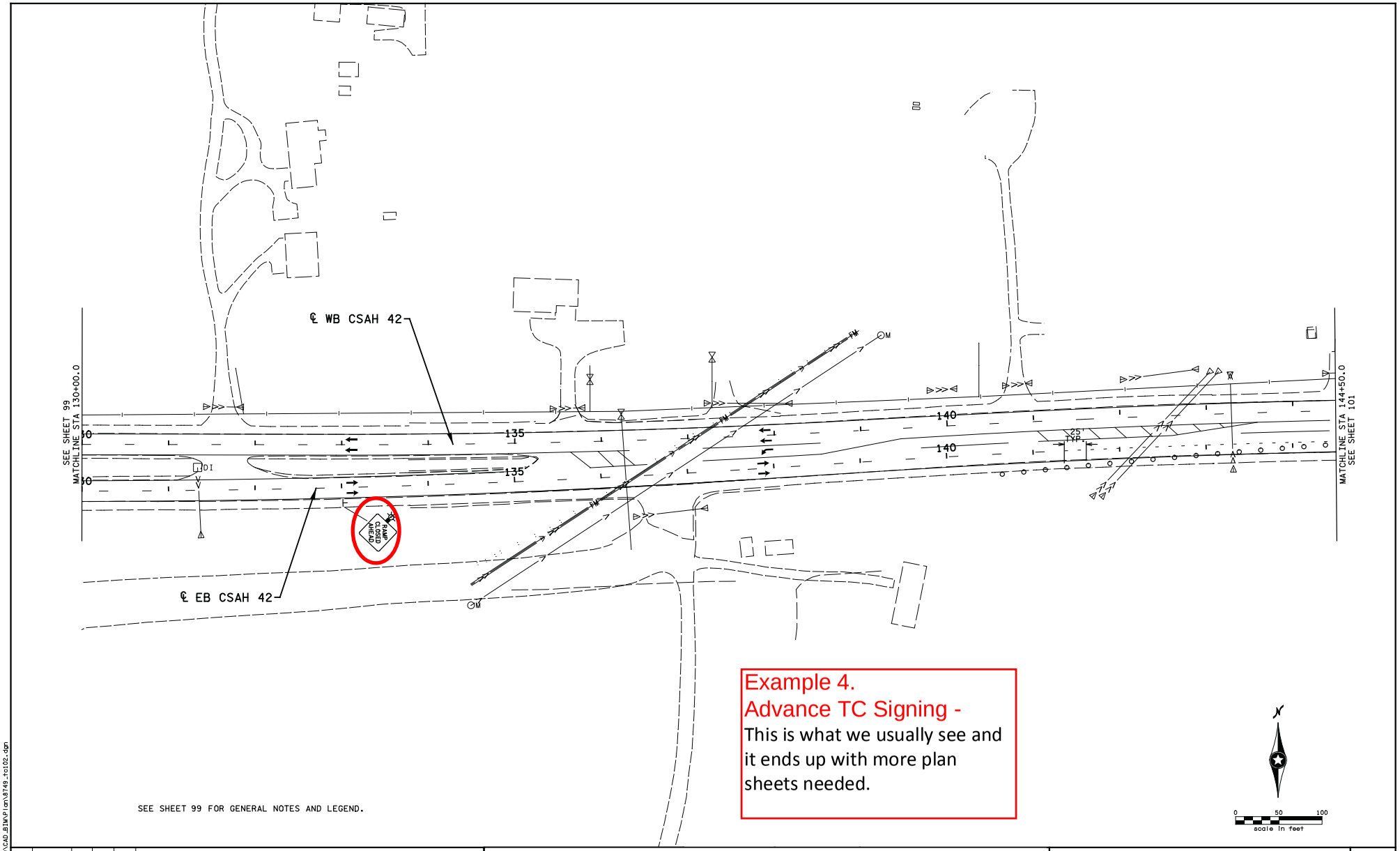

Example 4.
Advance TC Signing -
This is what we usually see and it ends up with more plan sheets needed.

SEE SHEET 99 FOR GENERAL NOTES AND LEGEND.

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DAKOTA COUNTY
STAGING AND TRAFFIC CONTROL PLANS
T.H. 52 / C.S.A.H. 42 INTERCHANGE
STAGE 1

SHEET 100 OF 406

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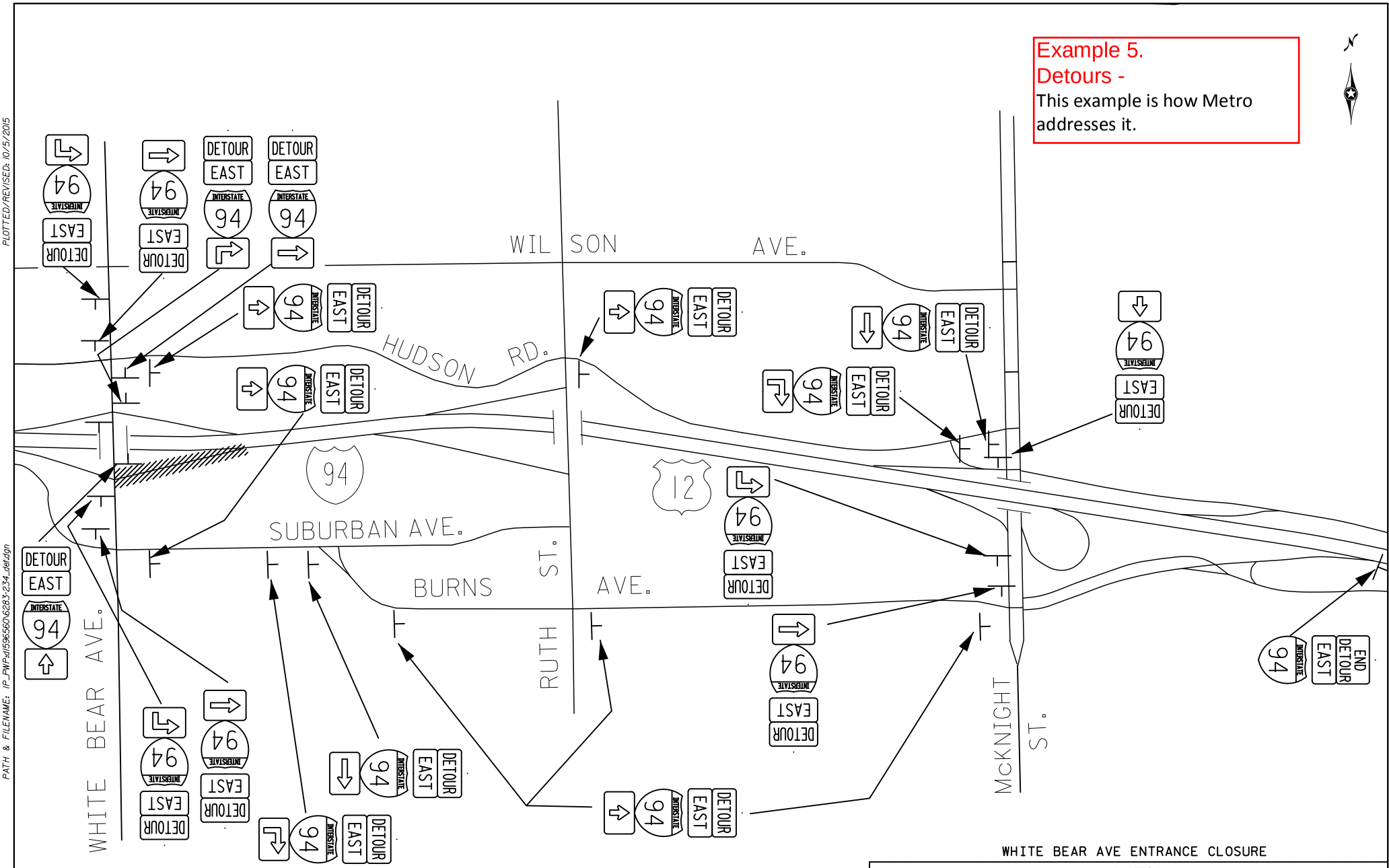
Example 5.
Detours -
This example is how Metro addresses it.



WHITE BEAR AVE ENTRANCE CLOSURE

DETOUR

DRAWN BY: JE	CHECKED BY: SM	CERTIFIED BY _	_ DATE 10/5/2015	STATE PROJ. NO. 6283-234 (TH 94) SHEET NO. TC20 OF TC132 SHEETS

PLOTTED/REVISED: 10/5/2015

DISTRICT #: METRO
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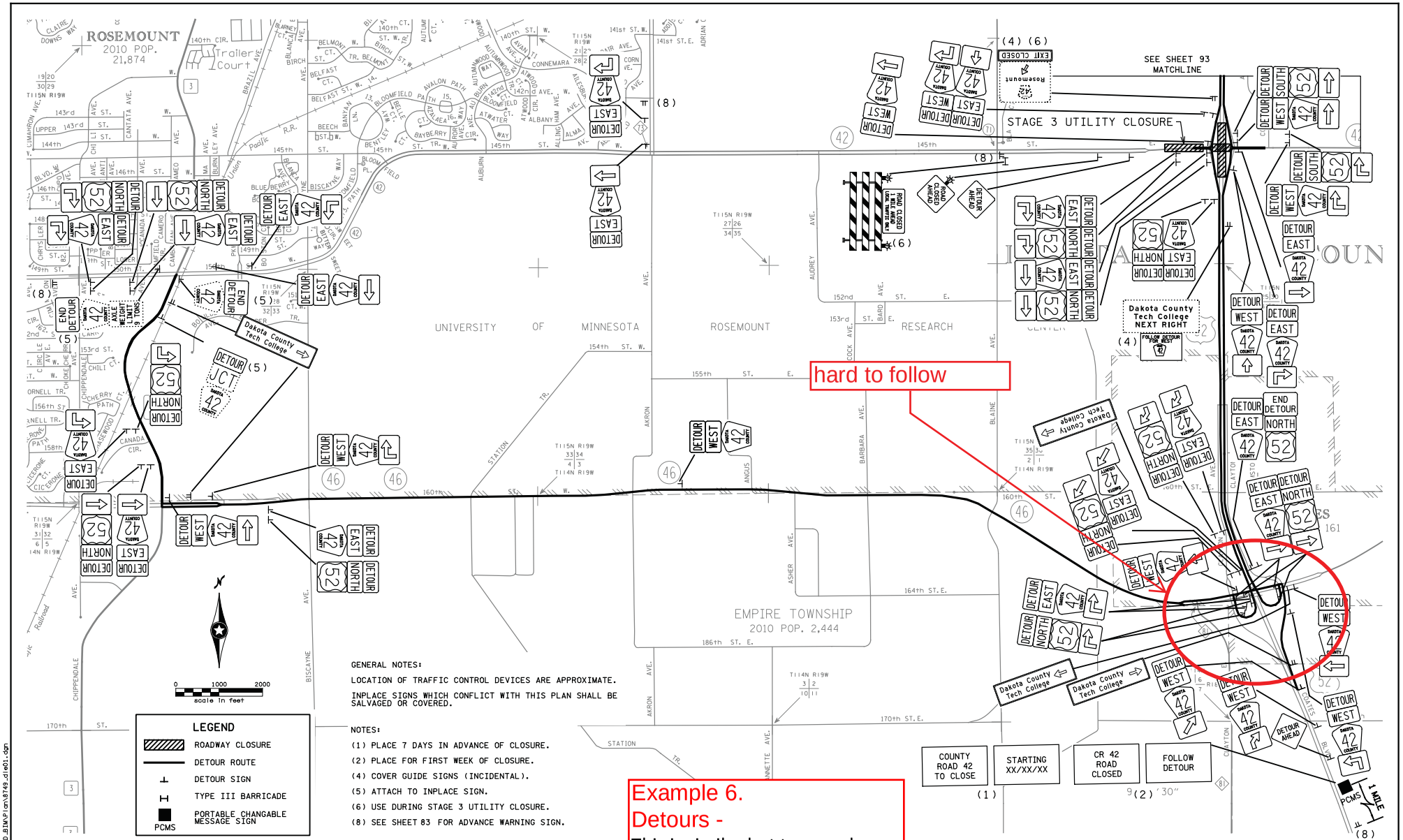

Example 6.
Detours -
This is similar but too much background is still left on.

NO	DATE	BY	CKD	APPR	REVISION

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DAKOTA COUNTY
DETOUR PLANS
T.H. 52 / C.S.A.H. 42 INTERCHANGE
CSAH 42 CLOSURE

SHEET 92 OF 406

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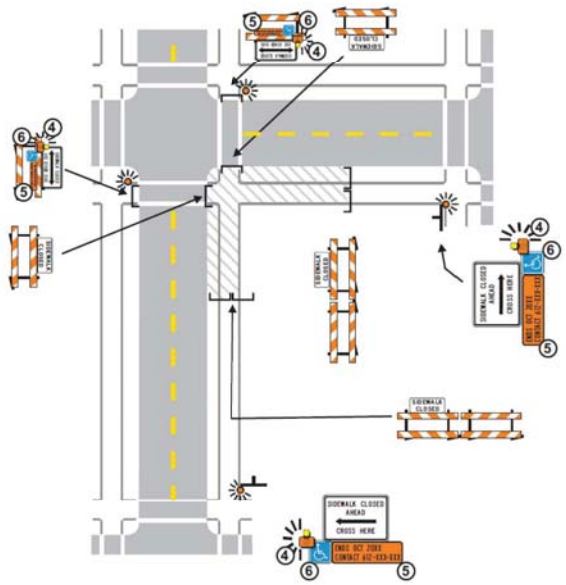
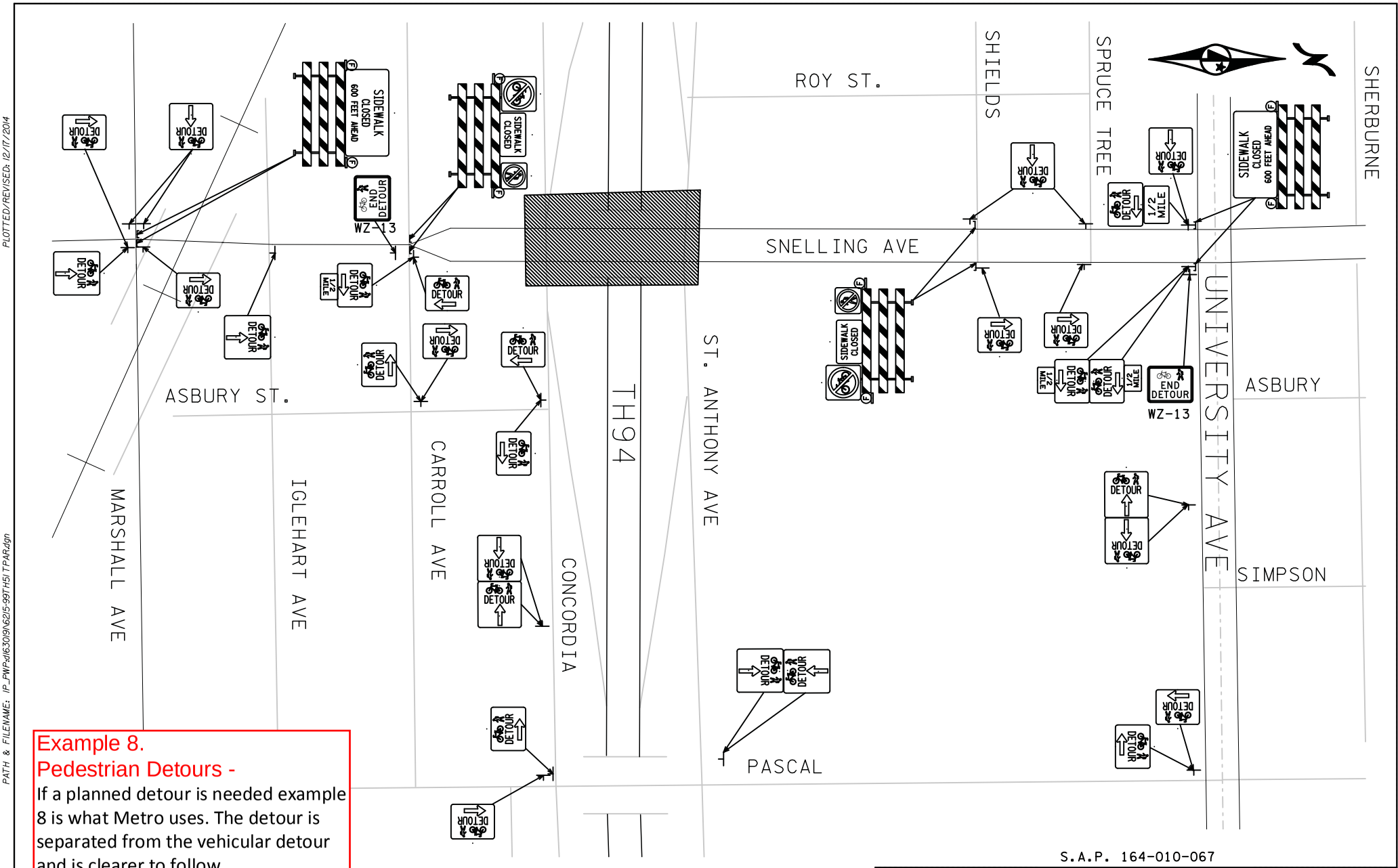
Example 7.
Pedestrian Detours -
For when you do not know how the contractor will exactly do the work, Metro has been relying on this example. This states the contractor needs to come up with a plan of attack and submit it to us for review. This is also repeated in the 1404.



NOTES:
1. When crosswalks, sidewalks or other pedestrian facilities are blocked, closed or relocated, temporary facilities shall include accessibility features consistent with the features present in the existing pedestrian facility.
2.. Refer to the Minnesota MUTCD Part 6D OR MN Traffic Control Field Manual for standards, guidance and options when blocking, closing, or relocating pedestrian facilities.
3. Where high speeds and/or high traffic volumes are anticipated, barrier should be used to separate the parallel temporary pedestrian walkway from vehicular traffic. Low speeds the appropriate approved Longitudinal Channelizing Devices shall be used to separate the parallel temporary pedestrian walkway from vehicular traffic or work area. When used, these devices shall be installed as detailed in the MN MUTCD Part 6F. Devices not on the MnDOT Approved Products List shall be submitted to the Project Engineer prior to the start of work for approval.
4. An approved audible message device or tactile message should be provided for Sight-impaired pedestrians if the detoured route currently contains one . When used, a message device should provide a complete physical description of the temporary pedestrian by-pass including duration, length of (and/or distance to) the bypass, any restrictions or hazards and project information as listed in note 7 below. The message device(s) may also describe an alternate route. The number and location of devices should be determined for each project prior to starting work. Devices may be placed prior to sidewalk work to warn regular users of the planned work.
5. Typical sign message for a temporary pedestrian bypass should include information such as the duration of the walkway restrictions (beginning and/orend dates) and a project contact number for 24/7 questions or reporting hazards.
6. The International Symbol of Accessibility should be displayed when any walkway through a work zone has been determined to be TPAR compliant. The Symbol of Accessibility shall not be displayed if persons with disabilities should not enter the temporary pedestrian by-pass. An alternate route should be posted when the temporary pedestrian bypass is non-complaint to TPAR standards.
7. Only traffic control devices controlling pedestrian flows are shown. Other devices may be needed to control traffic on the streets.
8. When both sides of a temporary pedestrian bypass require channelizing devices, then the devices should be a similar type (railing system, barricade, or fencing system), excluding when a barrier (such as concrete barrier) is used to protect pedestrians from an open traffic lane.
9. The International Symbol of Accessibility should be displayed when any walkway through a work zone has been determined to be TPAR compliant. The Symbol of Accessibility shall not be displayed if persons with disabilities should not enter the temporary pedestrian by-pass.
10. Conditions that are beyond recommended standards should be documented. A walkway is non-compliant if it is missing key ADA elements such as curb ramp(s), truncated domes, and detectable edging. Other restrictions or hazards may include insufficient width or pinch-point widths, traffic conflicts, steep grades, non-continuous railings, tripping hazards, or uneven/rough/soft surface conditions, etc.
11. When a sidewalk is closed but workers are present who will provide assistance or directions to pedestrians, then the devices as shown are not required
12. Pedestrian traffic signal displays controlling closed crosswalks shall be covered.
13. Pedestrian detour trailblazing signs should be used if the pedestrian detour is Located someplace other than across the street from the sidewalk closure.



Example 8.
Pedestrian Detours -
If a planned detour is needed example 8 is what Metro uses. The detour is separated from the vehicular detour and is clearer to follow.

S.A.P. 164-010-067

PEDESTRIAN DETOUR

DRAWN BY: BT	CHECKED BY: SNM	CERTIFIED BY _	DATE 12/17/2014	STATE PROJ. NO. 6215-99 (TH51)	SHEET NO. TC13	OF TC42 SHEETS

DISTRICT *: METRO
IPLOT NAME: 6215-99TH51 TPARI
PATH & FILENAME: IP_PWP-dl630\9\6215-99TH51 TPAR.dgn
PLOTTED/REVISED: 12/17/2014

NOTES & GUIDELINES

GENERAL INFORMATION:

1. THE CONTRACTOR SHALL FURNISH, INSTALL AND MAINTAIN THE DEVICES IN THIS TRAFFIC CONTROL PLAN UNLESS OTHERWISE NOTED.
2. FIELD CONDITIONS MAY REQUIRE MODIFICATIONS OF THIS LAYOUT AS DEEMED NECESSARY BY THE ENGINEER.
3. ALL DISTANCES ARE APPROXIMATE.
4. THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ANY WORK AREAS NEAR TRAFFIC IN ACCORDANCE WITH THE MNMUTCD.
5. AN ANNUAL FALL REVIEW OF ALL TRAFFIC CONTROLS WILL BE MADE TO PREPARE FOR WINTER MAINTENANCE OF THE PROJECT. THIS MAY INCLUDE ADJUSTMENTS OR EXCHANGE OF ONE TRAFFIC CONTROL DEVICE FOR ANOTHER. READJUSTMENTS MAY AGAIN BE REQUIRED IN THE SPRING.
6. IF THE CONTRACTOR DECIDES TO PERFORM THE CONSTRUCTION WORK IN A SEQUENCE OTHER THAN SHOWN IN THIS TRAFFIC CONTROL PLAN THE CONTRACTOR SHALL PROVIDE COMPLETE REVISED TRAFFIC CONTROL PLANS TO BE APPROVED BY THE ENGINEER.

SIGNING:

1. ALL TRAFFIC CONTROL DEVICES, INCLUDING OVERHEAD SIGNS ON ROADS OPEN TO TRAFFIC THAT ARE NOT CONSISTENT WITH TRAFFIC OPERATION SHALL BE COVERED, REMOVED OR REVISED AS DIRECTED BY THE ENGINEER.
2. WHEN SIGNS ARE PLACED, THEY SHALL BE MOUNTED ON POSTS DRIVEN INTO THE GROUND AT THE PROPER HEIGHT AND LATERAL OFFSET AS SHOWN IN THE TYPICAL TEMP SIGN FRAMING & INSTALLATION DETAILS IN THE PLAN. IF THIS IS NOT POSSIBLE THEY WILL BE MOUNTED ON PORTABLE SUPPORTS AS APPROVED BY THE ENGINEER. WHEN THE SIGNS ARE REMOVED THE SIGN POSTS SHALL ALSO BE REMOVED AS SOON AS POSSIBLE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY EXTRA SIGNING NEEDED TO FACILITATE TRAFFIC SWITCHES OR FOR TRANSITIONING TRAFFIC FROM ONE STAGE TO ANOTHER.
4. ALL ORANGE WARNING AND ORANGE GUIDE SIGNS SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MN/DOT APPROVED PRODUCT LIST FOR "SHEETING FOR RIGID TEMPORARY WORK ZONE SIGNS".

   BARRICADES SHALL BE FABRICATED WITH SIGN SHEETING MATERIAL AS LISTED ON THE MN/DOT APPROVED PRODUCT LIST FOR BARRICADE SHEETING. NOTE THAT ASTM TYPE VII SHEETING IS NOT ALLOWED ON BARRICADES AFTER JANUARY 1, 2010.
5. LONGITUDINAL DROPOFFS SHALL BE SIGNED AS SHOWN IN THE "TEMPORARY TRAFFIC CONTROL ZONE LAYOUTS" FIELD MANUAL UNLESS OTHERWISE SPECIFIED IN THESE PLANS.
6. THE CONTRACTOR SHALL COORDINATE THE INSTALLATION OF THE FINAL SIGNS TO ASSURE THAT THE FINAL SIGNS ARE PLACED AS NEEDED, OR PROVIDE TEMPORARY SIGNING AT THEIR EXPENSE UNTIL THE FINAL SIGNING IS PLACED.

PAVEMENT MARKING:

1. OBLITERATE ANY CONFLICTING PAVEMENT MARKINGS AS DIRECTED BY THE ENGINEER.
2. PAINT, POLYMER LANE TAPE AND/OR TRPM'S ARE ACCEPTABLE TEMPORARY STRIPING ALTERNATIVES ACCORDING TO ACTUAL CONDITIONS ENCOUNTERED AS DIRECTED BY THE ENGINEER. GENERALLY, ONLY PAINT WILL BE USED BEFORE MAY 1ST OR WHEN THE OTHER MANUFACTURERS' SPECIFICATIONS CAN NOT BE MET.
3. TRPM'S (TEMPORARY RAISED PAVEMENT MARKERS) SHOULD BE USED TO SUPPLEMENT THE LONG TERM (MORE THAN 3 DAYS) EDGELINES ON ALL TRANSITION AREAS WHEN THE CONDITIONS ARE WITHIN THE MANUFACTURERS' SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION AND PLACEMENT OF TEMPORARY AND FINAL STRIPING. MN/DOT TRAFFIC PERSONNEL WILL ASSIST IN THE SPOTTING OF TRANSITION AREAS, GORES AND TAPERS.

BARRIER & DELINEATION:

1. TOP MOUNTED BARRIER DELINEATORS WILL HAVE A MINIMUM OF 24 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 30' SPACES ON TOP OF THE BARRIER WHEN THE BARRIER IS WITHIN 10' OF TRAFFIC UNLESS OTHERWISE NOTED OR AS DIRECTED BY THE ENGINEER. IF THE TRAFFIC ENGINEER REQUIRES SIDE MOUNTED BARRIER DELINEATORS, THEY WILL HAVE A MINIMUM OF 12 SQ. IN. OF REFLECTIVE SURFACE AREA AND BE PLACED AT 30' SPACES. IF A SMALLER APPROVED BARRIER DELINEATOR IS USED IT SHALL BE AT ONE HALF THE SPACING AND ONE HALF THE BID PRICE.

CONSTRUCTION INFORMATION SIGNING:

1. THE CONTRACTOR SHALL USE CONSTRUCTION INFORMATION SIGNING AS SHOWN IN THE PLAN AND WHICH ARE TO BE USED AS FOLLOWS:

   G20-X1 CLOSURE NOTICE SIGNS PAIRED WITH G20-X3 WORK ENDS SIGNS TO DISPLAY THE CORRECT START DATE AND AN ESTIMATED FINISH DATE AS APPROVED BY THE PROJECT ENGINEER.

   G20-X2 WORK ZONE ADVANCE NOTICE SIGNS WITH THE CORRECT STARTING DATE DISPLAYED BEFORE WORK BEGINS. ONCE WORK BEGINS, THE START DATE LEGEND SHALL BE COVERED BY THE SUGGESTED PLAQUE CONTAINED IN THIS PLAN. IF NO ALTERNATE MESSAGE IS SUGGESTED OR IF DIRECTED BY THE PROJECT ENGINEER, THE CORRECT ESTIMATED FINISH DATE, MONTH, OR SEASON SHALL BE DISPLAYED.

   CONSTRUCTION INFORMATION SIGNING NOT VISIBLE TO THE MOTORING PUBLIC ONCE WORK BEGINS WILL BE MOVED BY THE CONTRACTOR TO A SITE IN ADVANCE OF THE WORK ZONE OR CLOSURE AS DIRECTED BY THE PLAN OR PROJECT ENGINEER.

TRAFFIC CONTROL DEVICES & SYMBOLS LEGEND

SYMBOL	DESCRIPTION
	AREA CLOSED TO TRAFFIC / WORK AREA
	TRAFFIC CONTROL SIGN
	TYPE III BARRICADE =
	DRUM-LIKE CHANNELIZER =
	TYPE A FLASHING WARNING LIGHT
	CONCRETE BARRIER WITH DELINEATORS AT 30' SPACES
	IMPACT ATTENUATOR
	FLASHING ARROW BOARD TYPE C = (4' X 8' UNLESS OTHERWISE NOTED).

STRIPING KEY

TRIANGLE - PAINT

1ST DIGIT WIDTH	2ND DIGIT PATTERN	3RD DIGIT COLOR
4" OR 8"	S - SOLID	W - WHITE
	B - BROKEN	Y - YELLOW
	D - DASH/DOUBLE	B - BLACK

EXAMPLE: (4SW) = 4" SOLID LINE WHITE - EPOXY

INDEX

TRAFFIC CONTROL SHEET NO.	DESCRIPTIONS
TC1	TITLE SHEET
TC2	PAY ITEM TABULATION SHEET
TC3	TRAFFIC CONTROL TABULATION SHEET
TC4	SPECIAL SIGNS
TC5	NARRATIVE
TC6-TC7	ADVANCED SIGNING
TC8-TC10	DETOURS
TC11-TC21	TRAFFIC CONTROL STAGE 1
TC22-TC32	TRAFFIC CONTROL STAGE 2
TC33	TYPICALS

Sample Plan for TTC Design Course. This plan is to be used for example purposes only. Information in this plan may be out of date or practice. The designer must use most current standards and practices.

I HEREBY CERTIFY THAT SHEETS TC1 THROUGH TC33 OF THIS PLAN WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA

DATE 11/29/2012 LIC. NO. _____

DESIGNER _____

TITLE: TRAFFIC CONTROL TITLE SHEET

STATE PROJ. NO. 2772-96 (TH 169)

SHEET NO TC1 OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: t_typicals_tc_tsh
PATH & FILENAME: IP_PWPdl492330\t_typicals_tc_tshdgn

TRAFFIC CONTROL TABULATION

TC

	PAY ITEM	UNIT	STAGE 1	STAGE 2	TOTAL
	PAVEMENT MARKING REMOVAL-PERMANENT	LIN FT	19841	11782	31623
	PORTABLE PRECAST CONC BARRIER DES 8337	LIN FT	9565		9565
	RELOCATE PORT PRECAST CONC BAR DES 8337	LIN FT		9170	9170
(2)	IMPACT ATTENUATOR	AMBY	6		6
	RELOCATE IMPACT ATTENUATOR	AMBY		6	6
(1)	MEDIAN BARRIER DELINEATOR	EACH	319	306	625
	REMOVABLE PREFORMED PLASTIC MASK (BLACK)	LIN FT	380	1123	1503
	TRAFFIC CONTROL	LUMP SUM	0.5	0.5	1
	4" SOLID LINE WHITE-PAINT	LIN FT	15017	15060	30077
	8" SOLID LINE WHITE-PAINT	LIN FT	1345	1746	3091
	4" BROKEN LINE WHITE-PAINT	LIN FT	1280		1280
	8" DOTTED LINE WHITE-PAINT	LIN FT	162		162
	4" SOLID LINE YELLOW-PAINT	LIN FT	16746	13657	30403
	PORTABLE CHANGEABLE MESSAGE SIGN	UNIT DAY	10		10
	DYNAMIC MERGE SYSTEM	UNIT DAY	14	14	28

NOTE: (1) 319 WHIE ONE WAY, 306 YELLOW ONE WAY
(2) 55 MPH NARROW PROFILE

Change "NOTE" to "SPECIFIC NOTE"

DISTRICT #:
IPLOT NAME:
PATH & FILENAME:

PAY ITEM TABULATION CHART

DRAWN BY: SNM | CHECKED BY: KF | CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. _____ DATE 11/29/2012

STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC2 OF TC33 SHEETS

TRAFFIC CONTROL TABULATION SHEET

"R" SERIES			
ROAD CLOSED	R11-2R	BLACK ON WHITE	48" X 30"
	R3-2	BLACK AND RED ON WHITE	24" X 24"
	R3-1	BLACK AND RED ON WHITE	24" X 24"
RIGHT LANE MUST EXIT	R16-X7R	BLACK ON WHITE	48" X 60"

"W" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
ROAD WORK AHEAD	W20-1	BLACK ON ORANGE	48" x 48"
	W1-X1R	BLACK ON ORANGE	48" x 48"
LEFT LANE CLOSED / RIGHT LANE CLOSED	W21-X5	BLACK ON ORANGE	48" X 48"
	W4-2R	BLACK ON ORANGE	48" X 48"
LEFT TWO LANES CLOSED / RIGHT TWO LANES CLOSED	W20-X13	BLACK ON ORANGE	48" X 48"
	W1-4	BLACK ON ORANGE	48" X 48"
	W1-6	BLACK ON ORANGE	48" X 24"
50 M.P.H.	W13-1	BLACK ON ORANGE	30" X 30"
	W4-1R	BLACK ON ORANGE	48" X 48"
RAMP CLOSED AHEAD	W20-X16	BLACK ON ORANGE	48" X 48"

"G" SERIES			
SIGN	SIGN NO.	COLOR	SIZE
END ROAD WORK	G20-2A	BLACK ON ORANGE	48" X 24"
RAMP CLOSED BEGINNING MONTH DY	G20-X1	BLACK ON ORANGE	54" X 48"
EXIT	G20-X7	BLACK ON ORANGE	48" X48"

"M" SERIES			
DETOUR	M4-9S	BLACK ON ORANGE	42" X 36"
DETOUR / DETOUR	M4-9M	BLACK ON ORANGE	42" X 36"
DETOUR / DETOUR	M4-9M	BLACK ON ORANGE	42" X 36"
DETOUR	M4-8	BLACK ON ORANGE	24" X 12"
SOUTH	M3-3m	BLACK ON WHITE	24" X 12"
NORTH	M3-1m	BLACK ON WHITE	24" X 12"
169	M1-4a	BLACK ON WHITE	30" X 24"
	M5-1	BLACK ON WHITE	21" X 15"
	M6-1	BLACK ON WHITE	21" X 15"
	M6-3	BLACK ON WHITE	21" X 15"

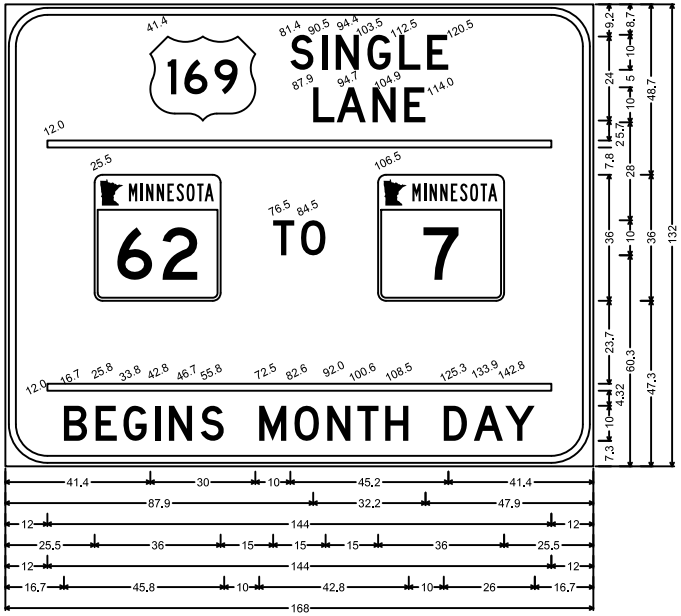
DRAWN BY: SNM | CHECKED BY: KF | CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER | LIC. NO. 40535 | DATE 11/29/2012

TRAFFIC CONTROL TABULATION CHART

STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC3 OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012
DISTRICT #: METRO
IPLOT NAME: T_typicals_tc_tsht2
PATH & FILENAME: IP_PWF:dl492330V_typicals_tc_tsht.dgn

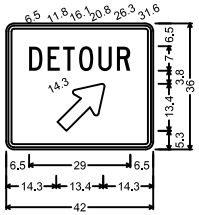
PLOTTED/REVISED: 11/29/2012
DISTRICT *: METRO
IPLOT NAME: t_typicals_tc_tsh3
PATH & FILENAME: IP_PWFdl492330V_typicals_tc_tsh.dgn



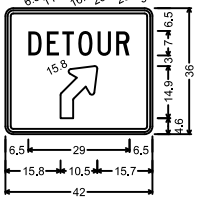
G20-X2: 12.0" Radius, 2.0" Border, 1.0" Indent, Black on Orange;
[SINGLE] D; [LANE] D; [TO] D; [BEGINS MONTH DAY] D;

WZ-1

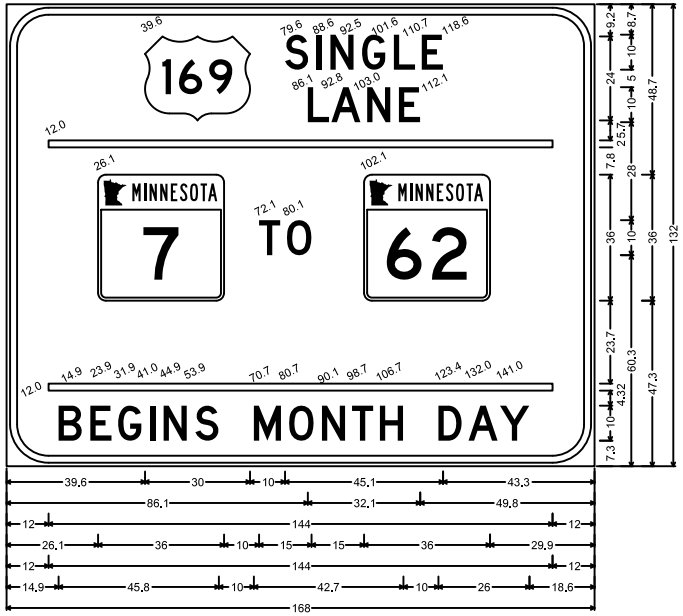
SPECIAL SIGN DETAILS



WZ-4
2.3" Radius, 0.9" Border, 0.6" Indent, Black on Orange;
[DETOUR] C;
Arrow Custom - 16.9" 135°;



WZ-5
2.3" Radius, 0.9" Border, 0.6" Indent, Black on Orange;
[DETOUR] C;
45 Deg Advanced Turn Arrow Custom 10.5" X 14.9";

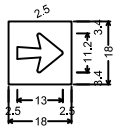


G20-X2: 12.0" Radius, 2.0" Border, 1.0" Indent, Black on Orange;
[SINGLE] D; [LANE] D; [TO] D; [BEGINS MONTH DAY] D;

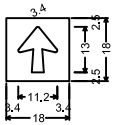
WZ-2

G20-X2 PANEL; 12.0" Radius, 2.0" Border, 1.0" Indent, Black on Orange;
[EXPECT DELAYS] D;

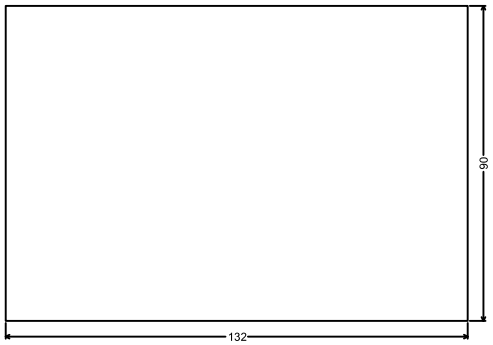
WZ-3



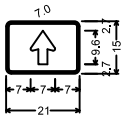
No border, Black on Orange;
Arrow 5 - 13.0" 0°;
WZ-6



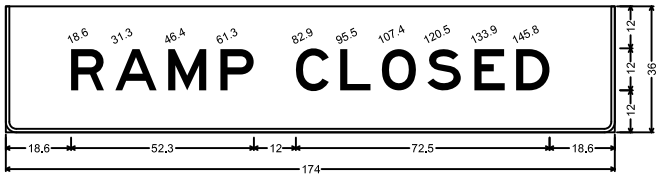
No border, Black on Orange;
Arrow 5 - 13.0" 90°;
WZ-7



No border, None on White;
WZ-10



90° ARROW Black 21X15;
1.5" Radius, 0.4" Border, 0.4" Indent, Black on Orange;
Arrow Custom - 9.6" 90°;
WZ-8



3.0" Radius, 1.0" Border, Black on Orange;
[RAMP CLOSED] E 125% spacing;

WZ-9

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	SPECIAL SIGN DETAILS STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC4 OF TC33 SHEETS

SP 2772-96

Traffic Control Narrative

Stage 1

Traffic:

NB and SB TH 169 - Left lane closure app. sta 179+00 to app. sta 328+00
Close ramp from Excelsior Blvd to SB TH 169

Construction:

Construct inside NB/SB TH 169 Bridge # 27568, # 27586 and # 27587

Stage 2

Traffic:

Shift NB and SB TH 169 to inside app. sta 179+00 to app. sta 328+00

Close ramp NB TH 169 to 7 th ST

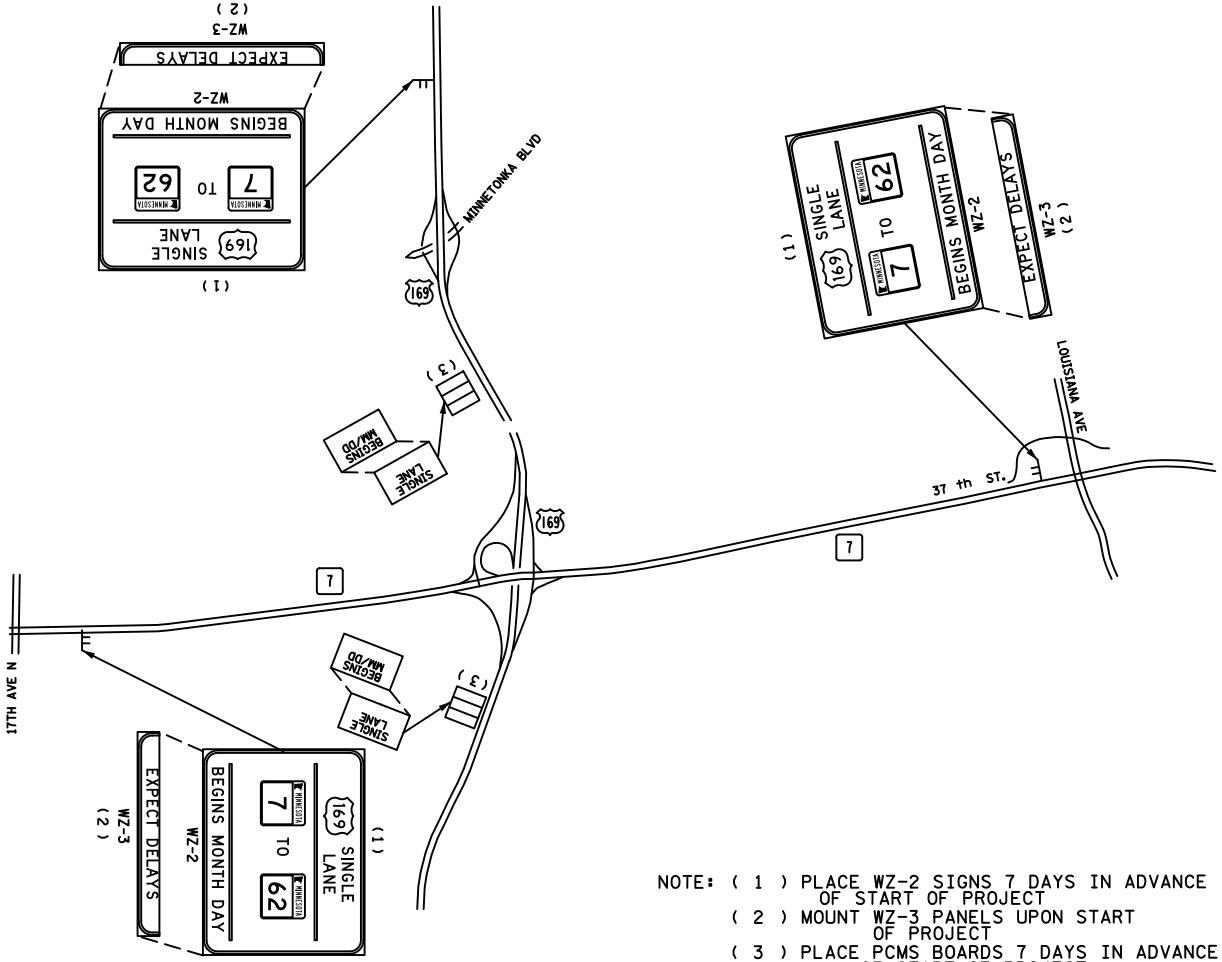
Close ramp from 7 th ST to SB TH 169

Close ramp from Excelsior Blvd to SB TH 169 (from stage 1)

Close ramp from Excelsior Blvd to NB TH 169
Close ramp from Bren Rd. to NB TH 169

Construct:

Outside NB/SB TH 169 Bridge # 27568, # 27586 and # 27587



NOTE: (1) PLACE WZ-2 SIGNS 7 DAYS IN ADVANCE OF START OF PROJECT
(2) MOUNT WZ-3 PANELS UPON START OF PROJECT
(3) PLACE PCMS BOARDS 7 DAYS IN ADVANCE OF START OF PROJECT

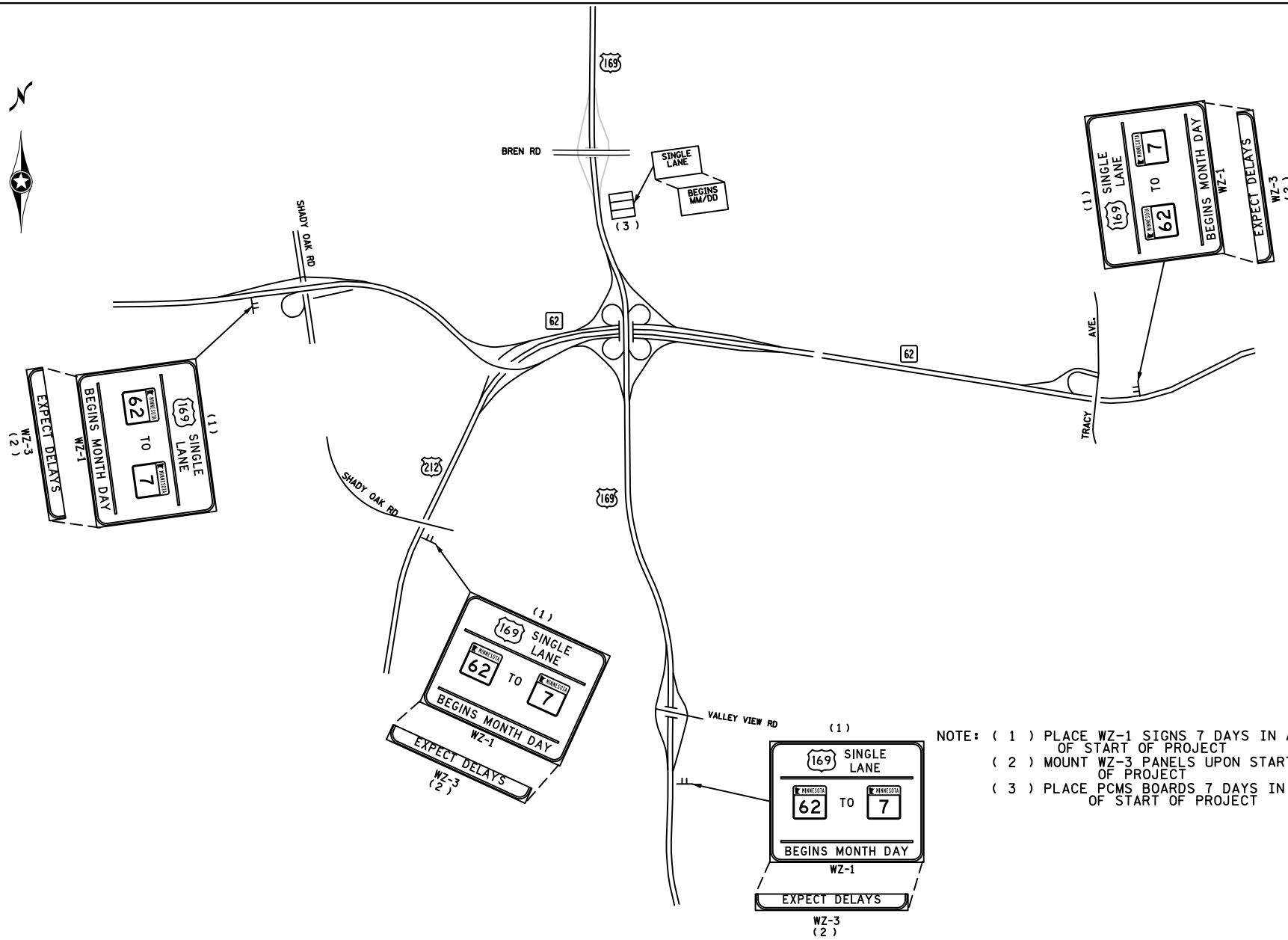
PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: DETOURS5
PATH & FILENAME: IP_PWFdl492330\DETOURS.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012

ADVANCED SIGNING

STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC6 OF TC33 SHEETS



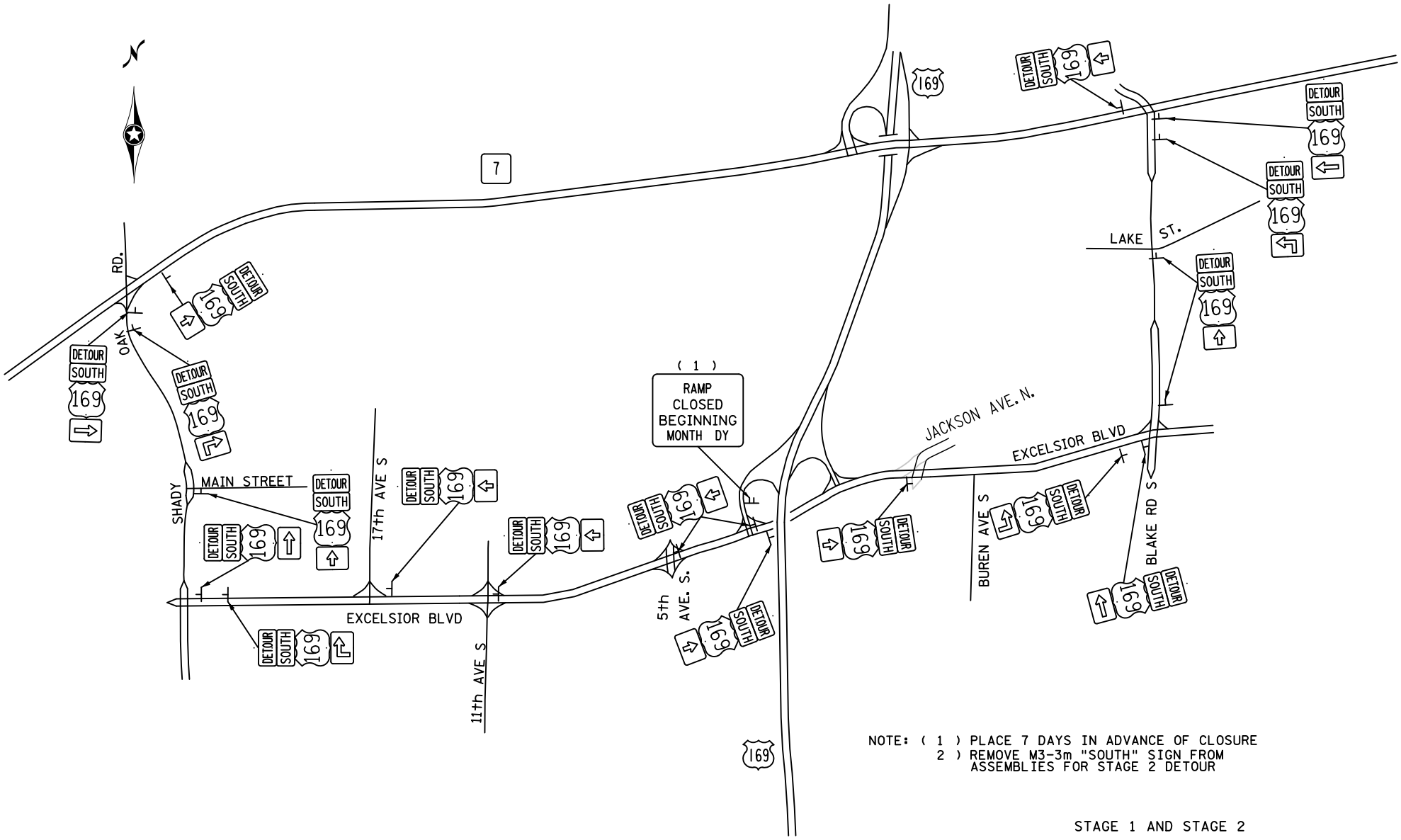
NOTE: (1) PLACE WZ-1 SIGNS 7 DAYS IN ADVANCE OF START OF PROJECT
(2) MOUNT WZ-3 PANELS UPON START OF PROJECT
(3) PLACE PCMS BOARDS 7 DAYS IN ADVANCE OF START OF PROJECT

ADVANCED SIGNING

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC7 OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: DETOURS6
PATH & FILENAME: IP_PWFdl492330\DETOURS.dgn



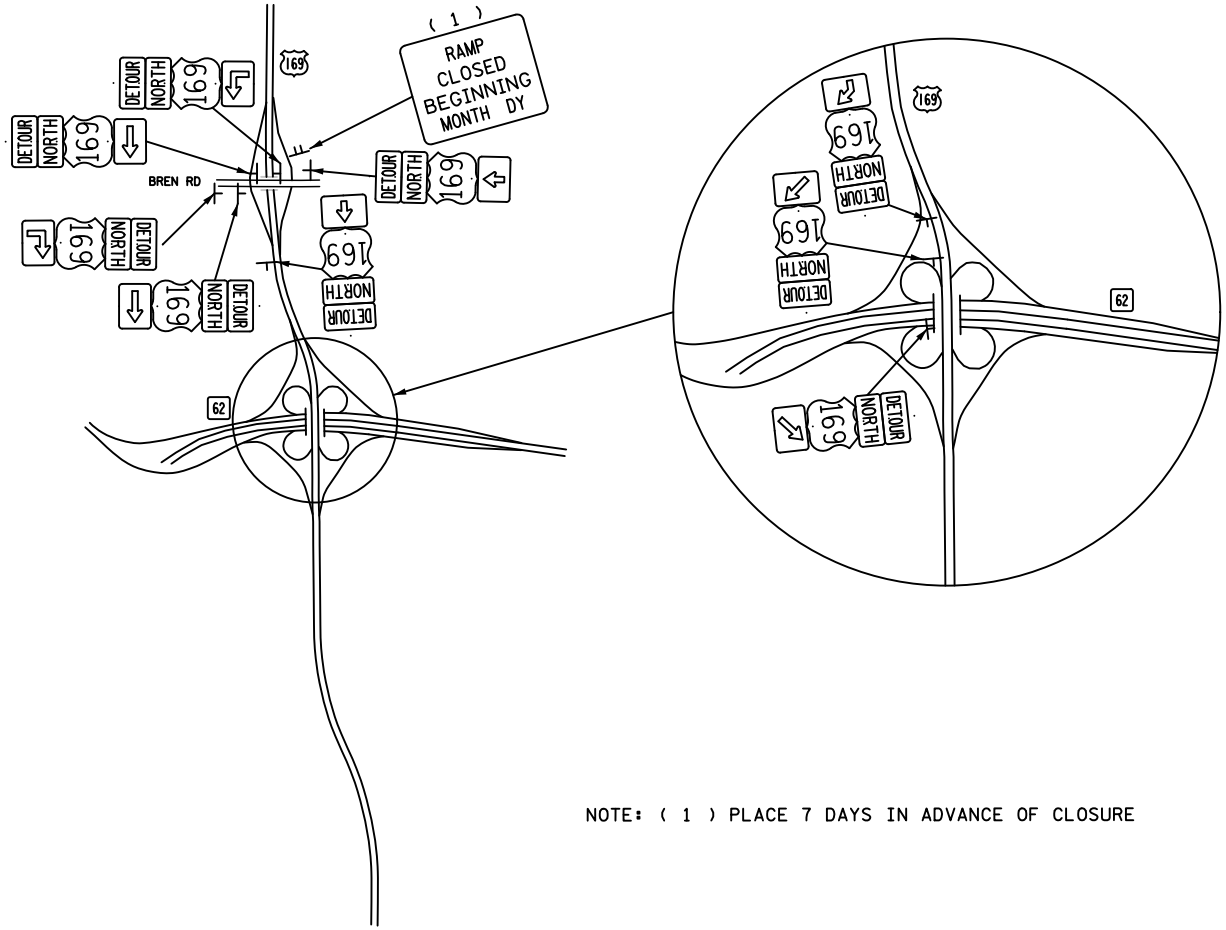
NOTE: (1) PLACE 7 DAYS IN ADVANCE OF CLOSURE
(2) REMOVE M3-3m "SOUTH" SIGN FROM ASSEMBLIES FOR STAGE 2 DETOUR

STAGE 1 AND STAGE 2

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY ___ LICENSED PROFESSIONAL ENGINEER ___ LIC. NO. 40535 DATE 11/29/2012	DETOURS STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC8 OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: DETOURS7
PATH & FILENAME: IP_PWF:dl49233\0\DETOURS.dgn



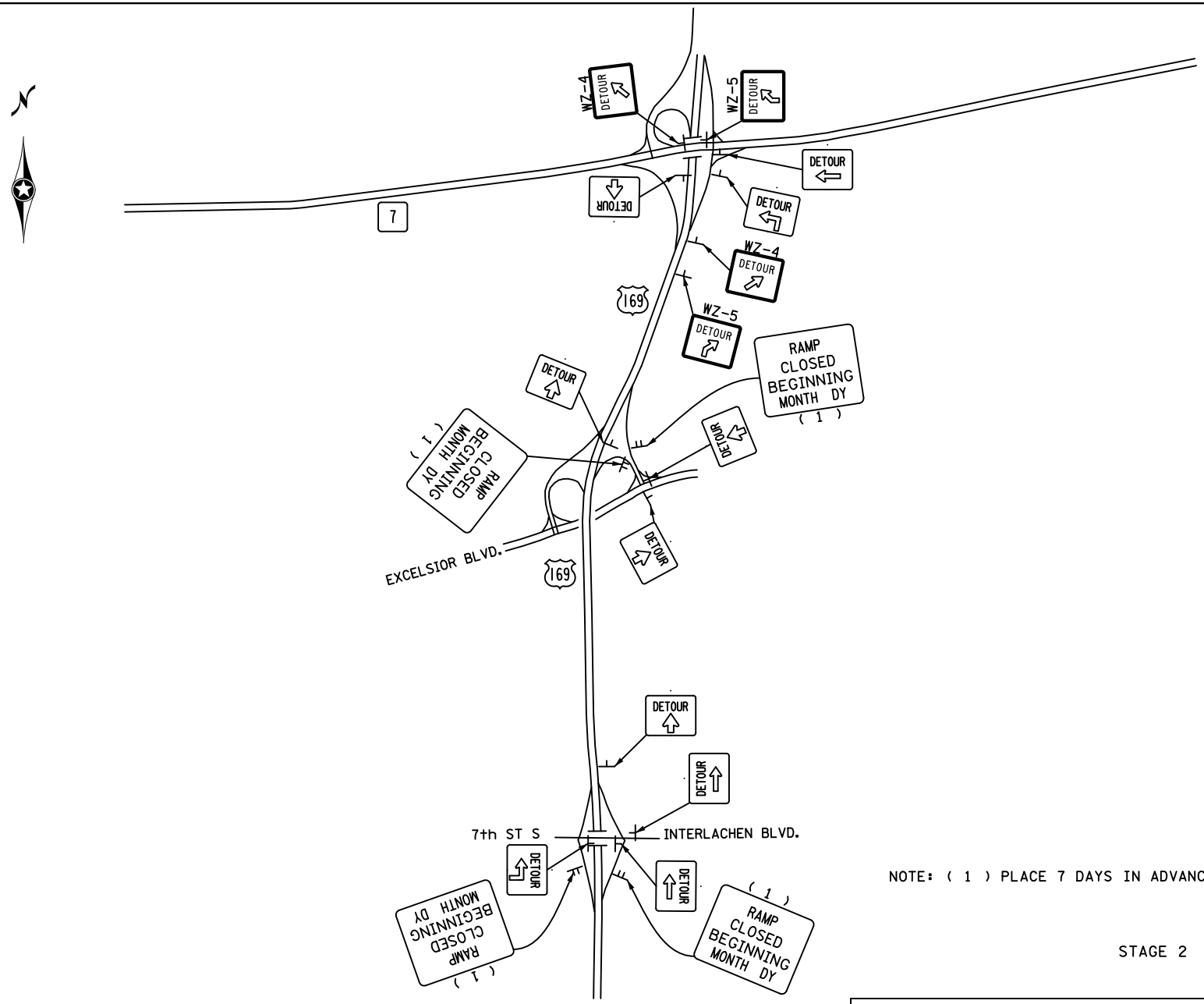
NOTE: (1) PLACE 7 DAYS IN ADVANCE OF CLOSURE

STAGE 2

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	DETOURS STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC9 OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: DETOURS9
PATH & FILENAME: IP_PWF:dl492330\DETOURS.dgn



NOTE: (1) PLACE 7 DAYS IN ADVANCE OF CLOSURE

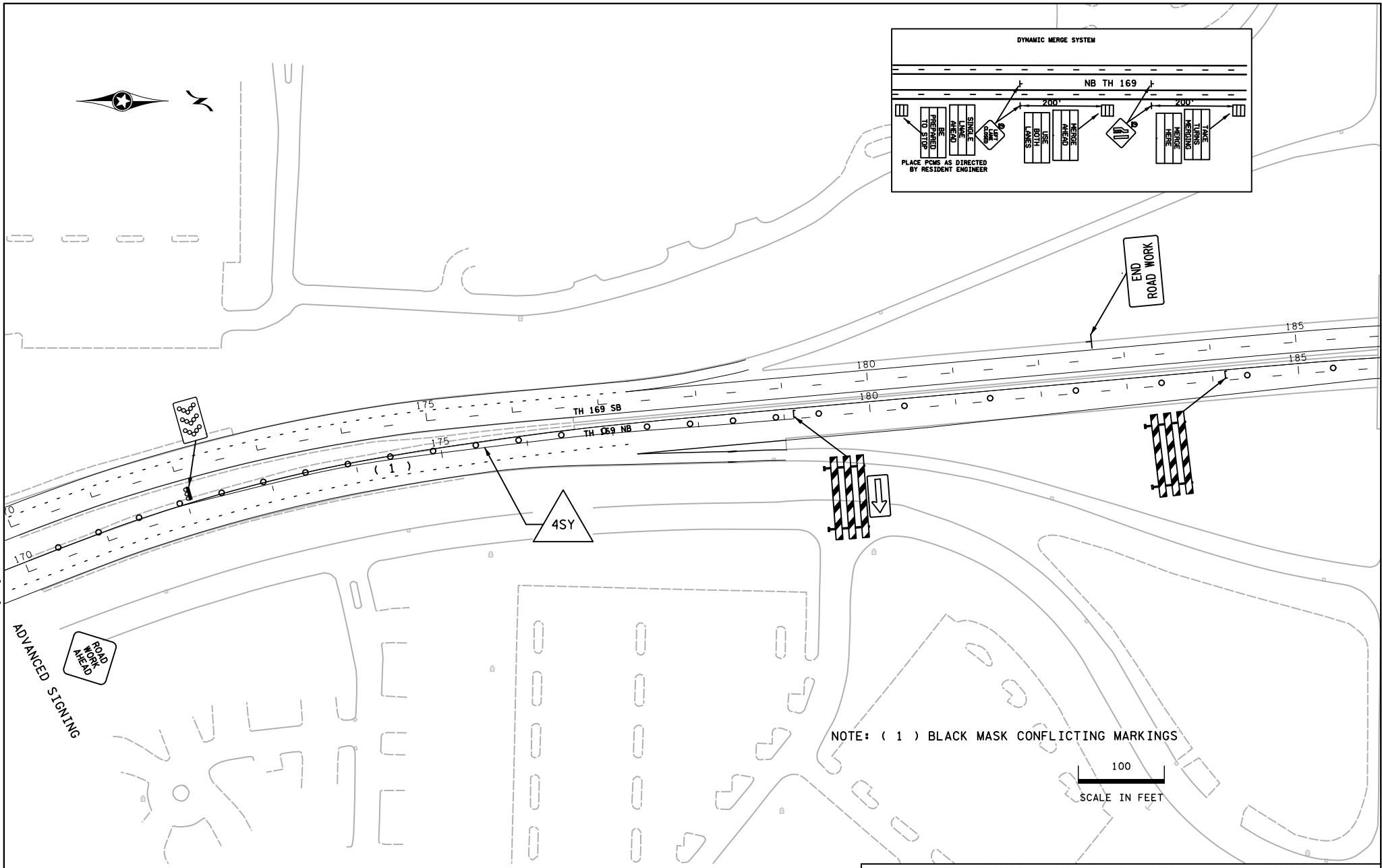
STAGE 2

DETOURS

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC10	OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012

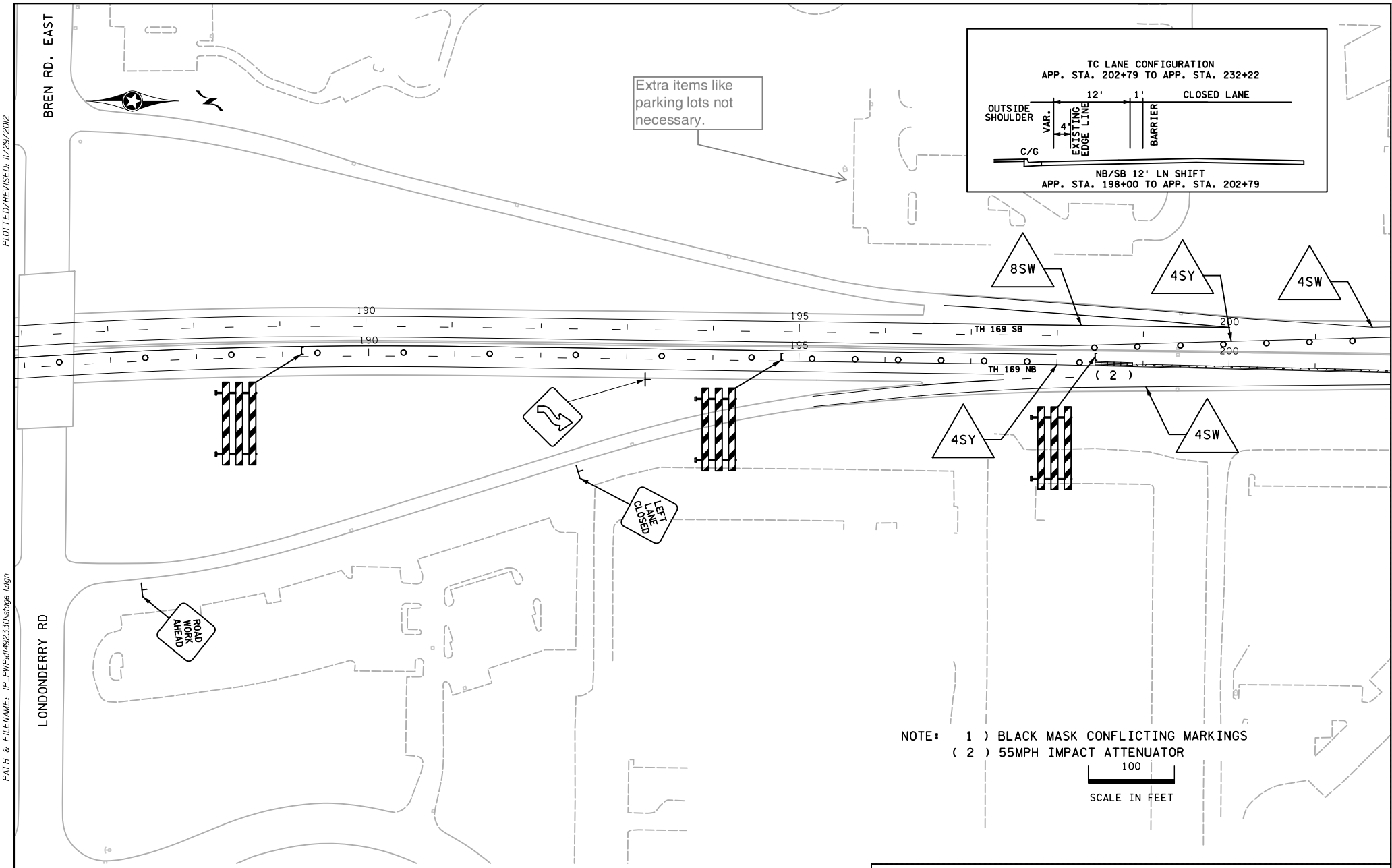
DISTRICT *: METRO
IPLOT NAME: DETOURS8
PATH & FILENAME: IP_PWF:dl492330\DETOURS.dgn



PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: stage 1\2
PATH & FILENAME: IP_PWFdl492330\stage 1.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	TRAFFIC CONTROL STAGE 1	
					STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC11 OF TC33 SHEETS

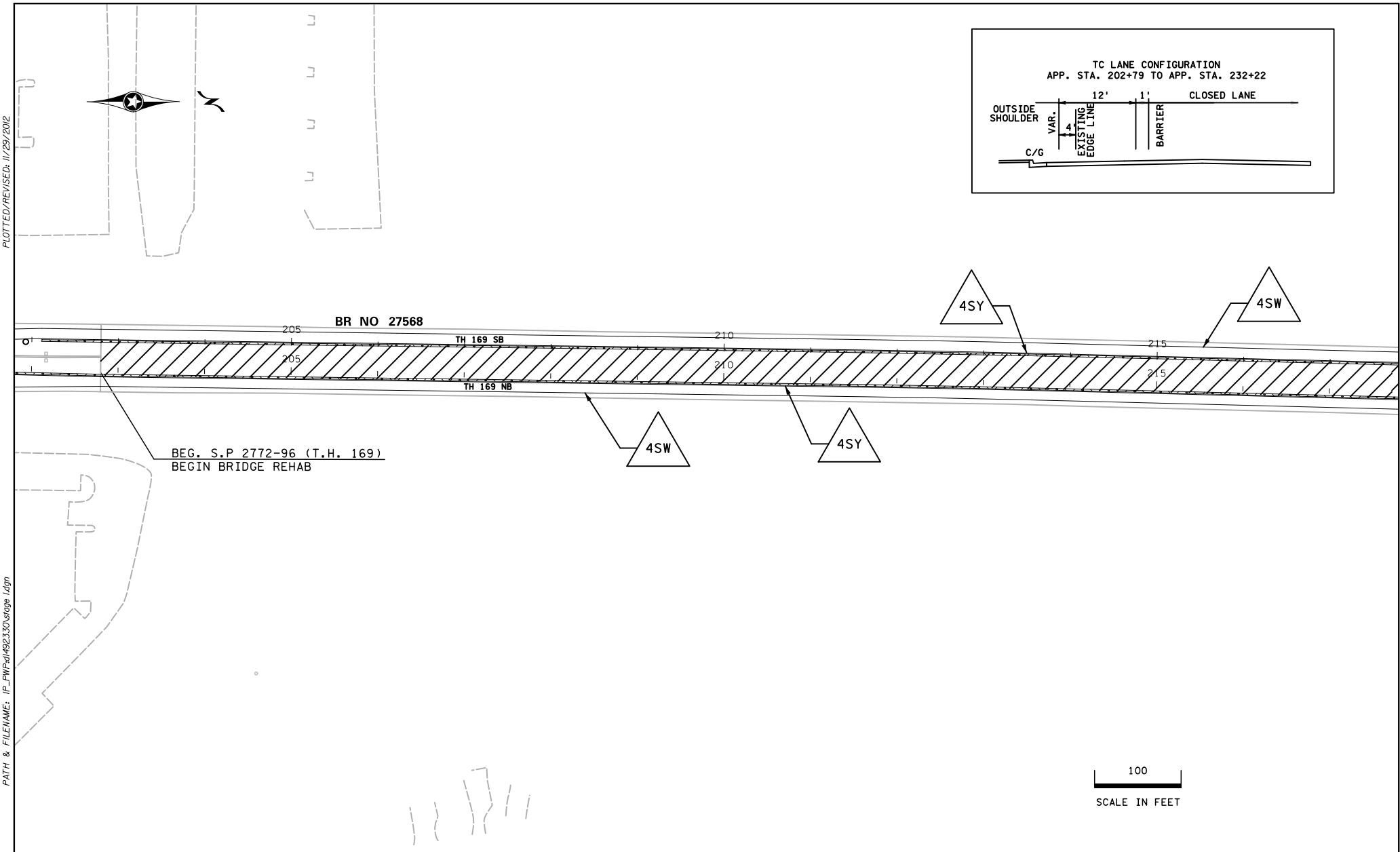


PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 1.l3
PATH & FILENAME: IP_PWF:dl492330\stage 1.dgn

TRAFFIC CONTROL STAGE 1

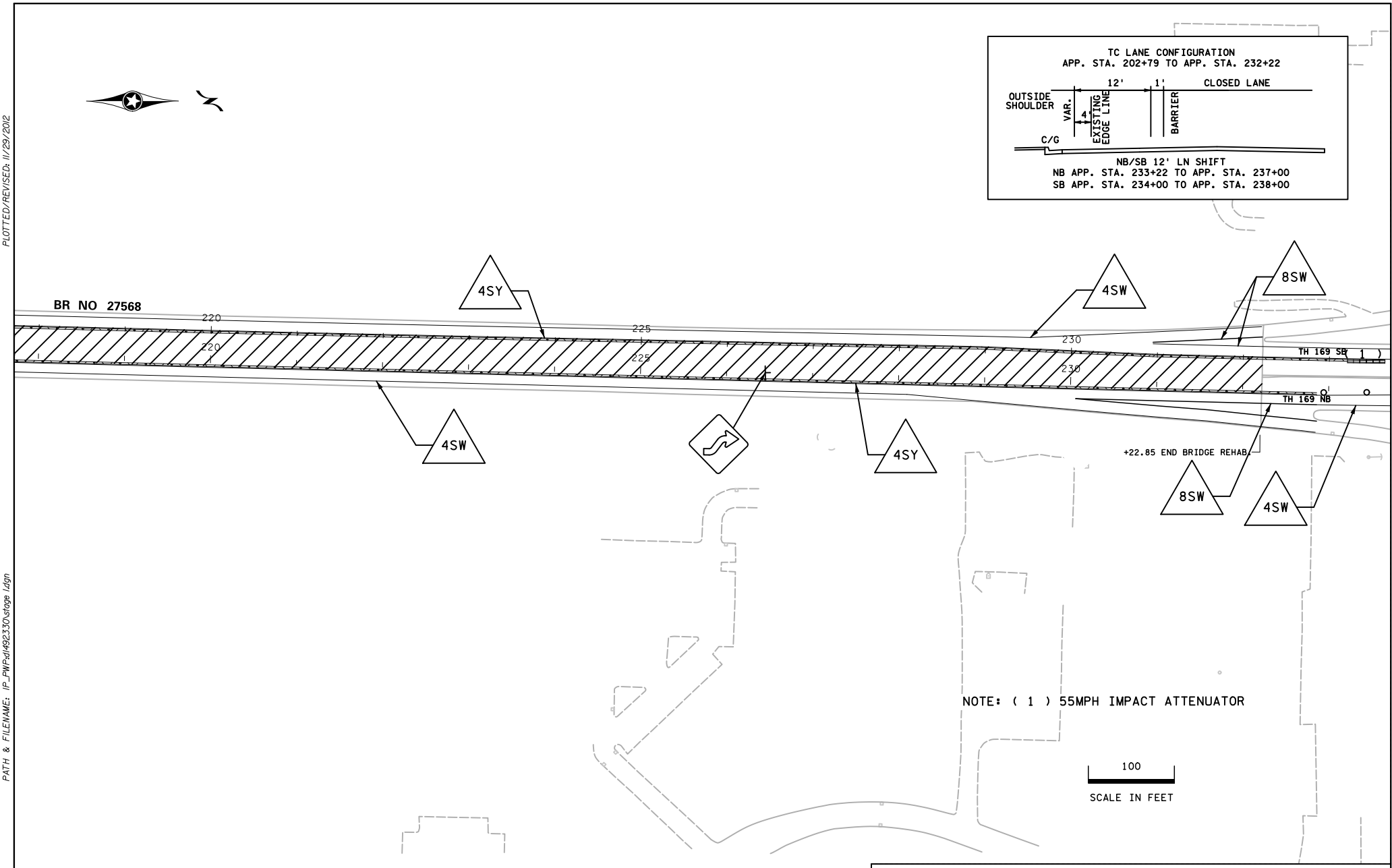
DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC12 OF TC33 SHEETS



PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 1i4
PATH & FILENAME: IP_PWF:dl492330\stage 1.dgn

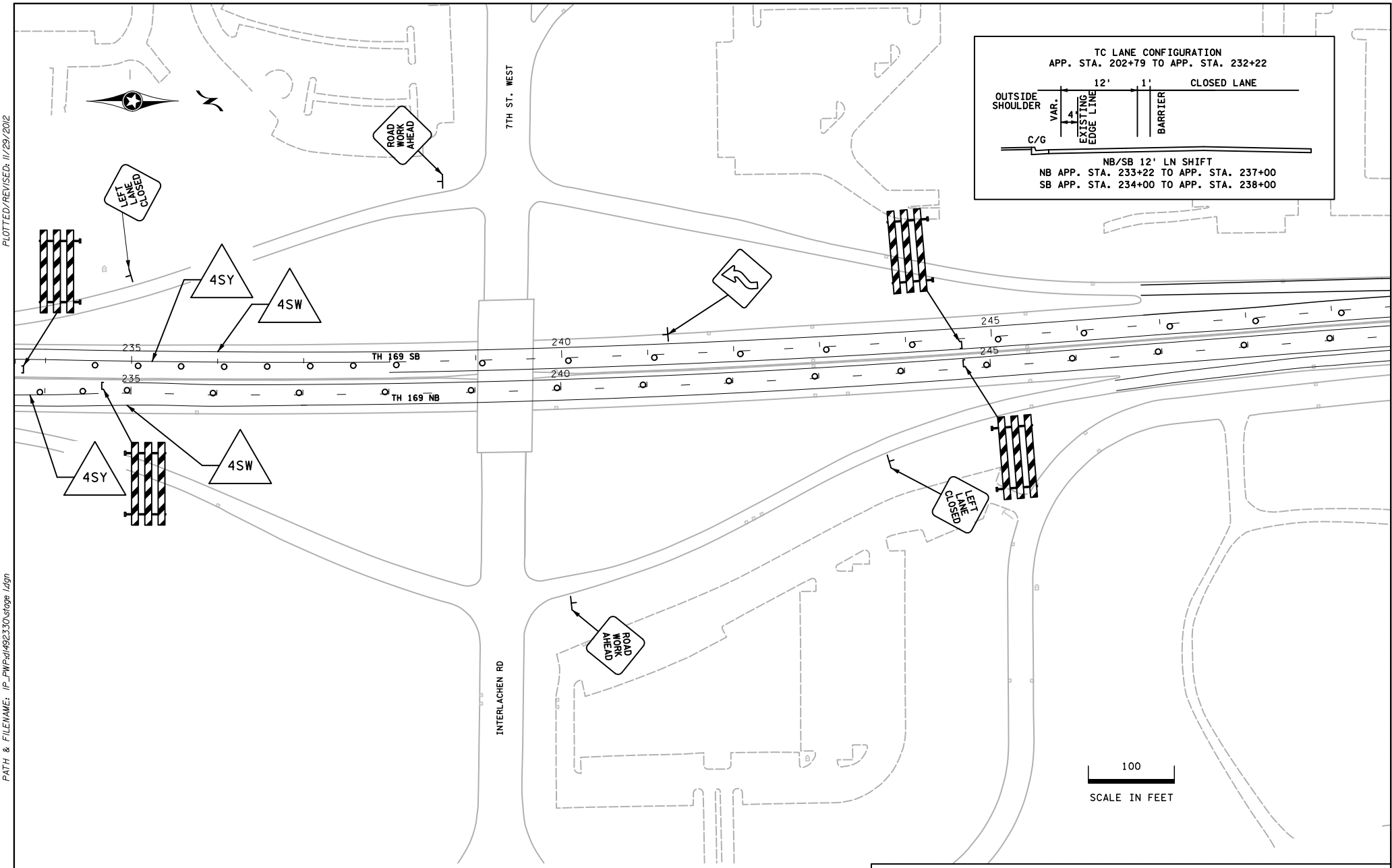
DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY ____ LICENSED PROFESSIONAL ENGINEER ____ LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 1
			STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC13 OF TC33 SHEETS



PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 115
PATH & FILENAME: IP_PWFdl492330\stage 1.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	TRAFFIC CONTROL STAGE 1	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC14	OF TC33 SHEETS



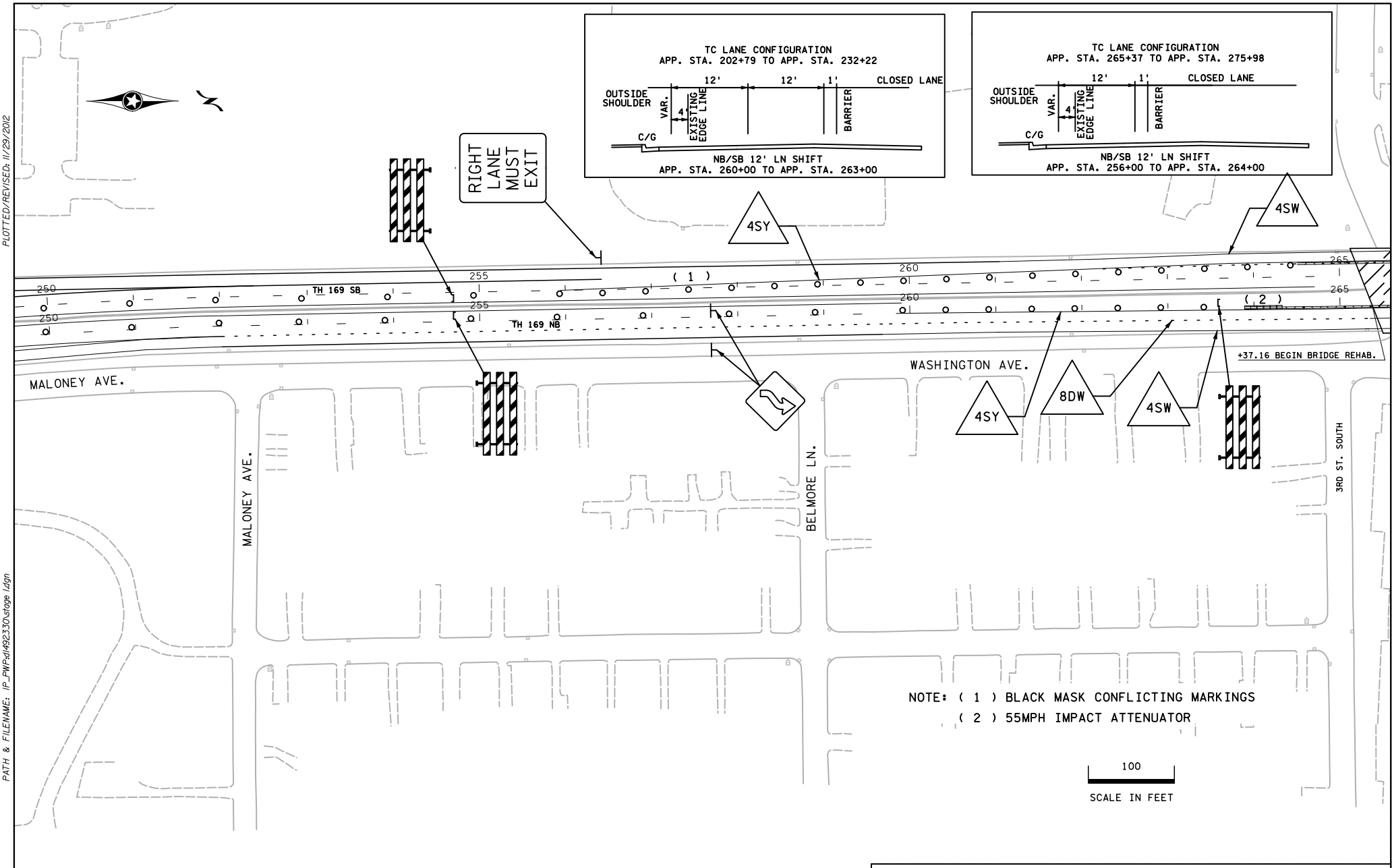
PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: stage 116
PATH & FILENAME: IP_PWF-dl492330\stage 1.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012

TRAFFIC CONTROL STAGE 1

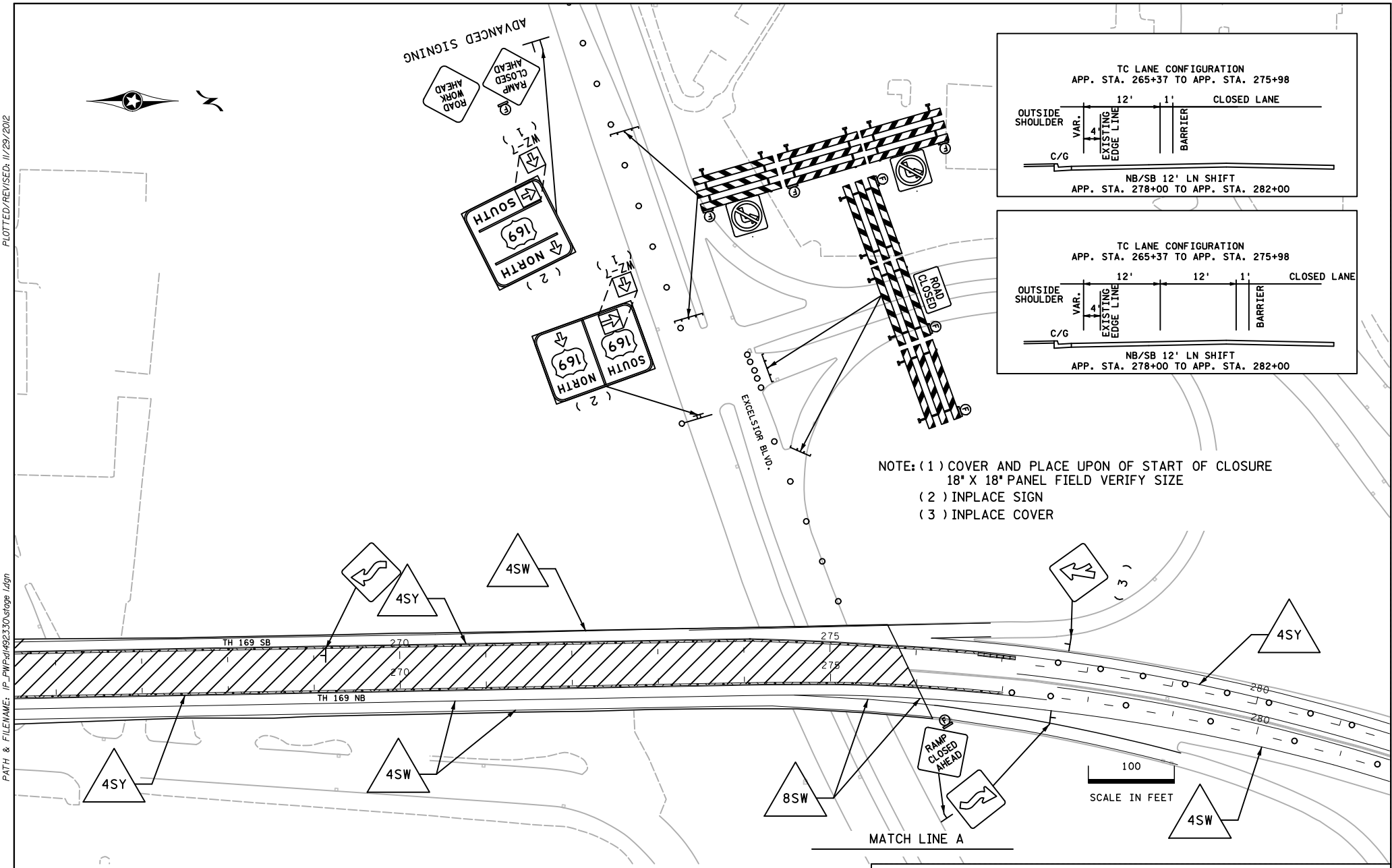
STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC15 OF TC33 SHEETS



PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 1l7
PATH & FILENAME: IP_PWFdl492330\stage 1.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 1 STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC16 OF TC33 SHEETS



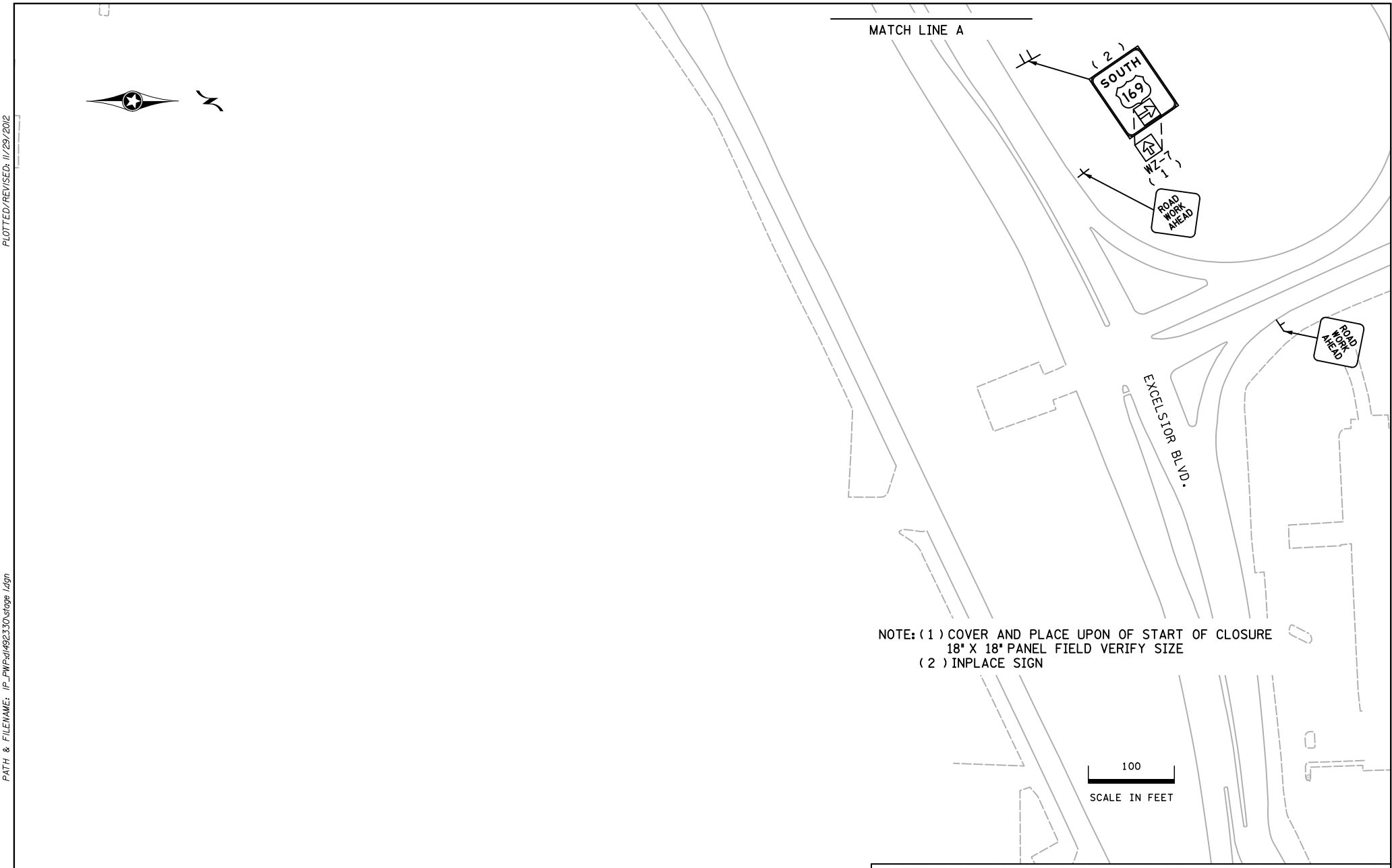
DISTRICT *: METRO
IPLOT NAME: stage 121
PATH & FILENAME: IP_PWFdl492330\stage 1.dgn

PLOTTED/REVISED: 11/29/2012

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012

TRAFFIC CONTROL STAGE 1

STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC17 OF TC33 SHEETS



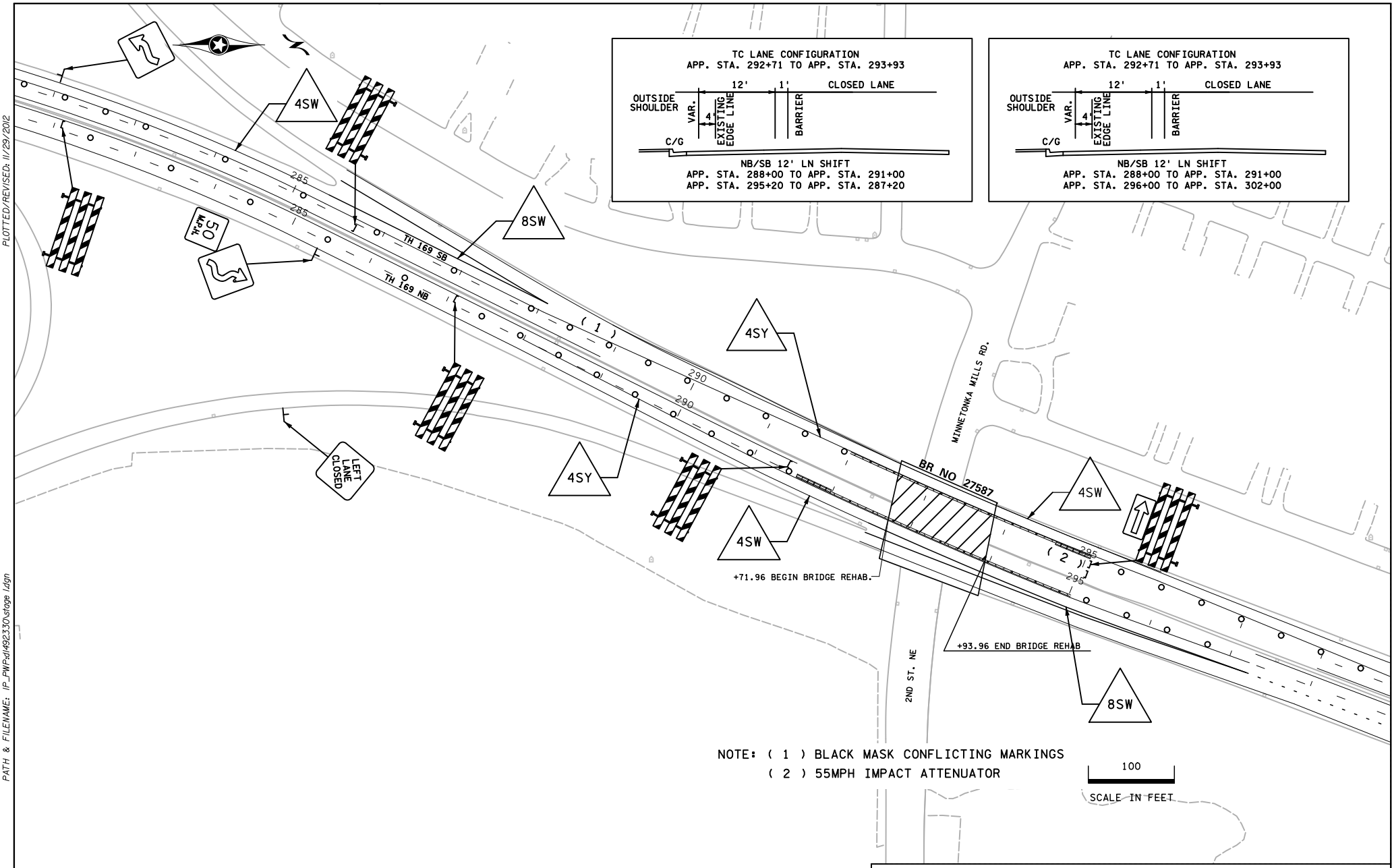
NOTE: (1) COVER AND PLACE UPON OF START OF CLOSURE
18" X 18" PANEL FIELD VERIFY SIZE
(2) INPLACE SIGN

PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 122
PATH & FILENAME: IP_PWF:d1492330\stage 1.dgn

TRAFFIC CONTROL STAGE 1

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER _____ LIC. NO. 40535 DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC18 OF TC33 SHEETS

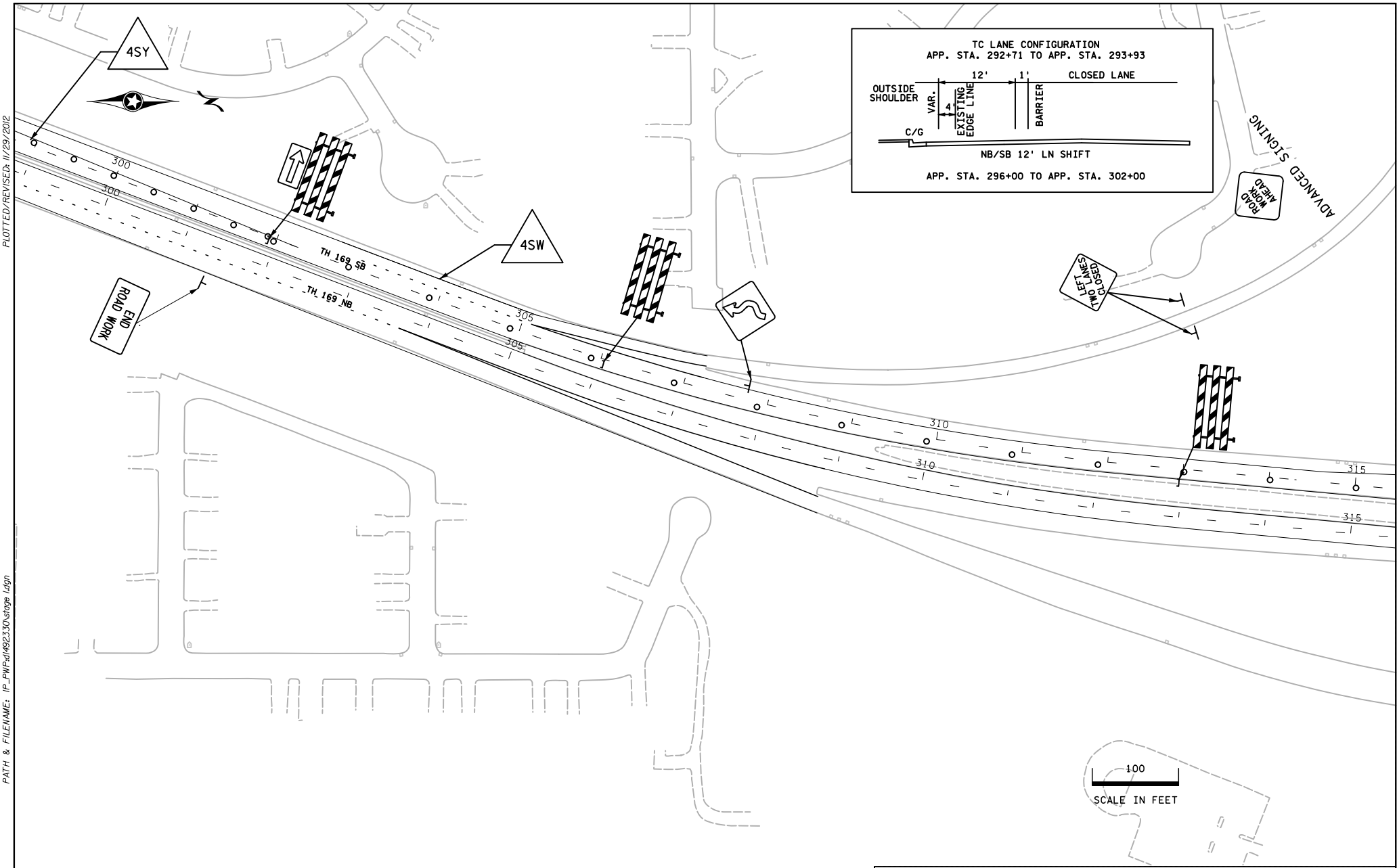


NOTE: (1) BLACK MASK CONFLICTING MARKINGS
(2) 55MPH IMPACT ATTENUATOR

PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: stage 1l8
PATH & FILENAME: IP_PWF:dl492330\stage 1.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER _____ LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 1
			STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC19 OF TC33 SHEETS

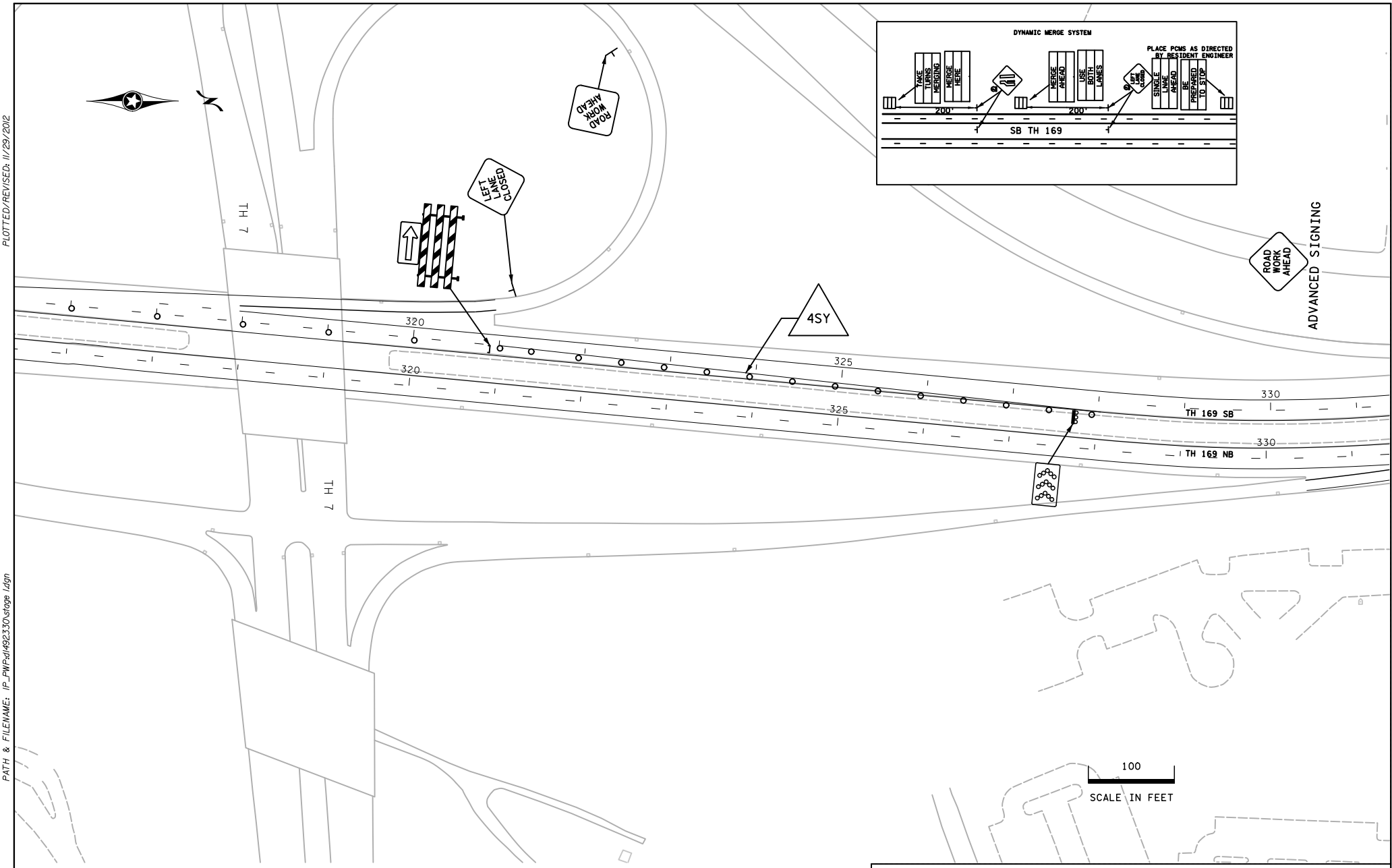


PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 119
PATH & FILENAME: IP_PWP-dl492330\stage 1.dgn

TRAFFIC CONTROL STAGE 1

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC20	OF TC33 SHEETS

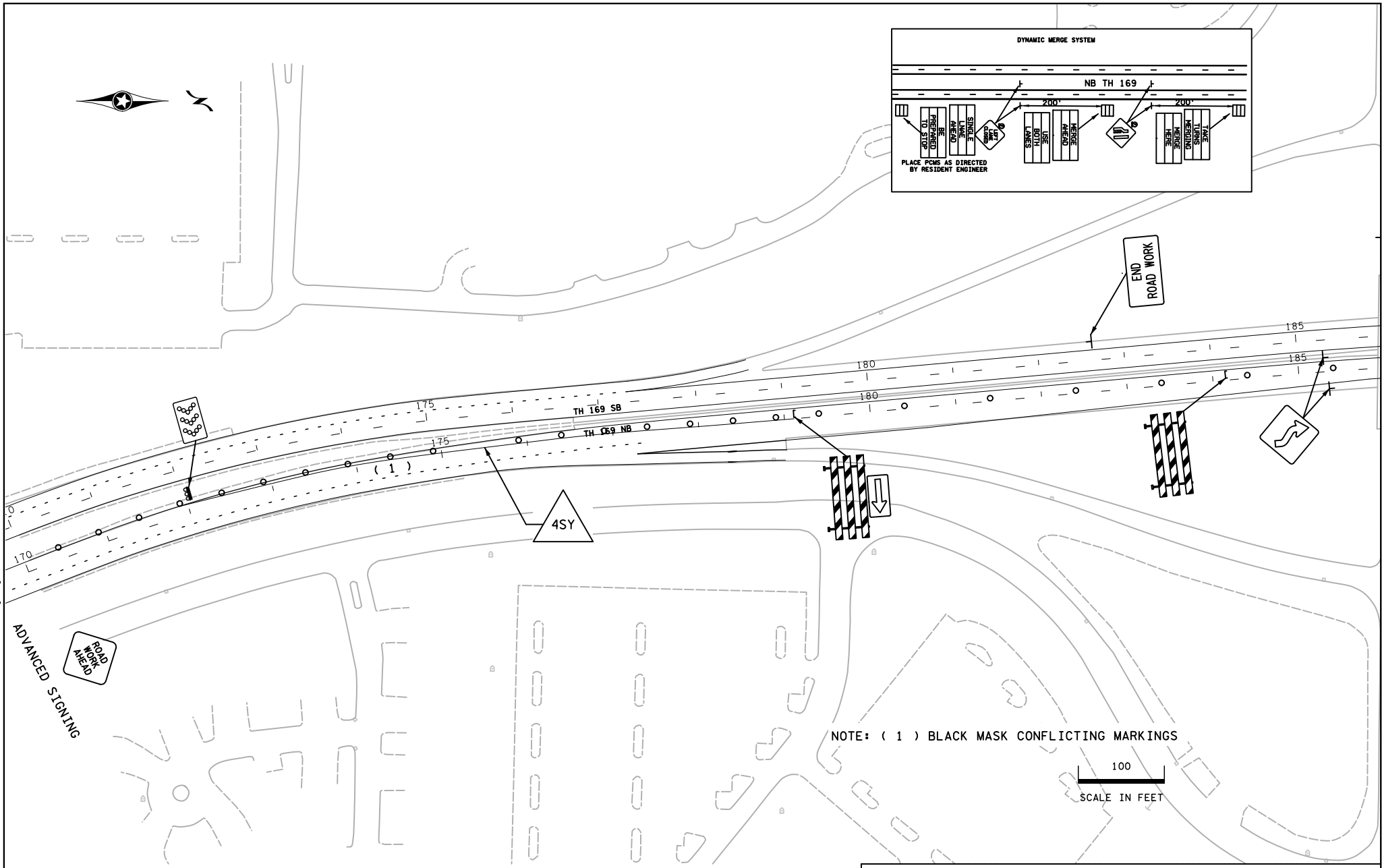


PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage 120
PATH & FILENAME: IP_PWF-dl492330\stage 1.dgn

TRAFFIC CONTROL STAGE 1

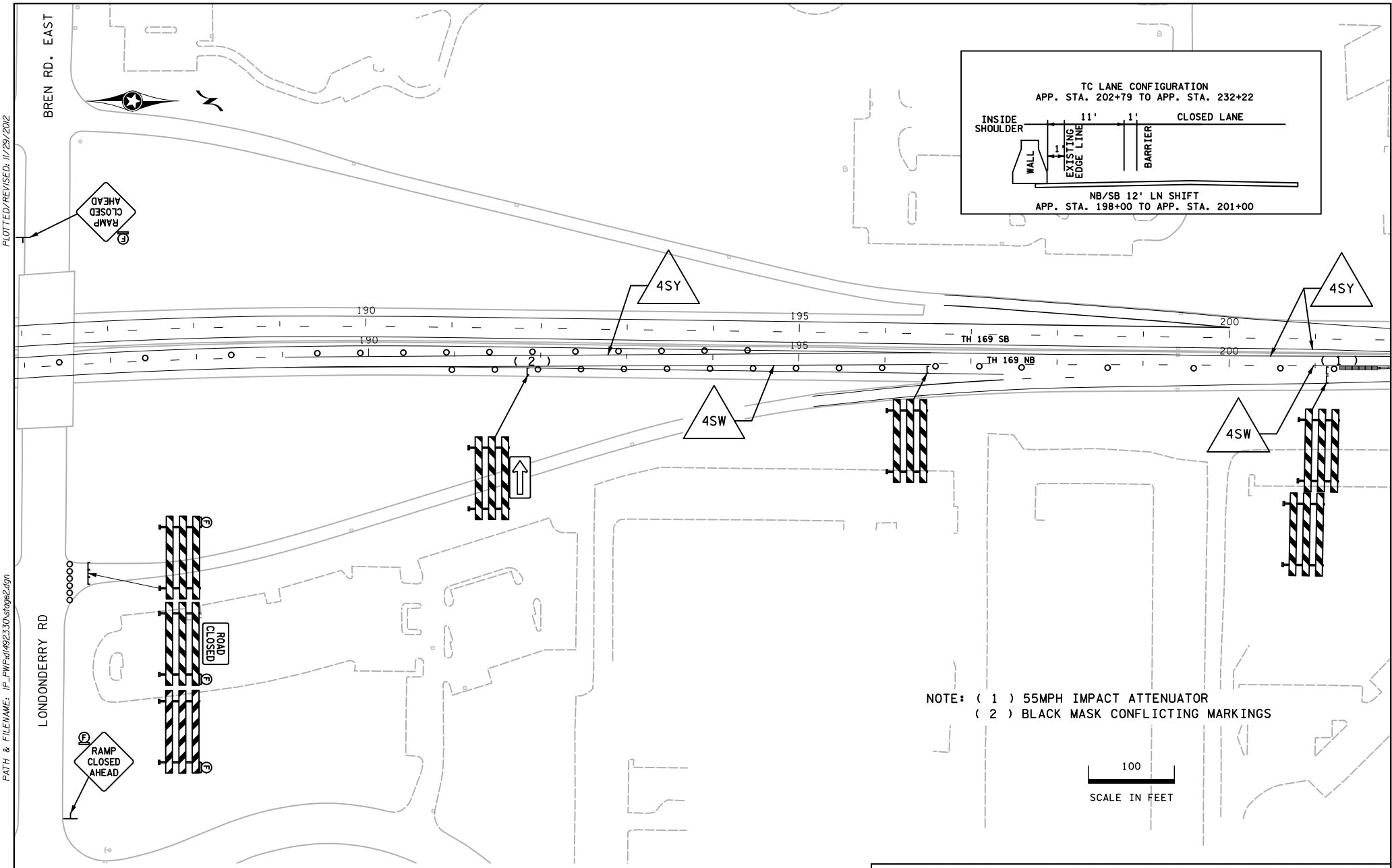
DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC21	OF TC33 SHEETS



PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: stage2I
PATH & FILENAME: IP_PWFdl492330\stage2.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	TRAFFIC CONTROL STAGE 2	
					STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC22 OF TC33 SHEETS

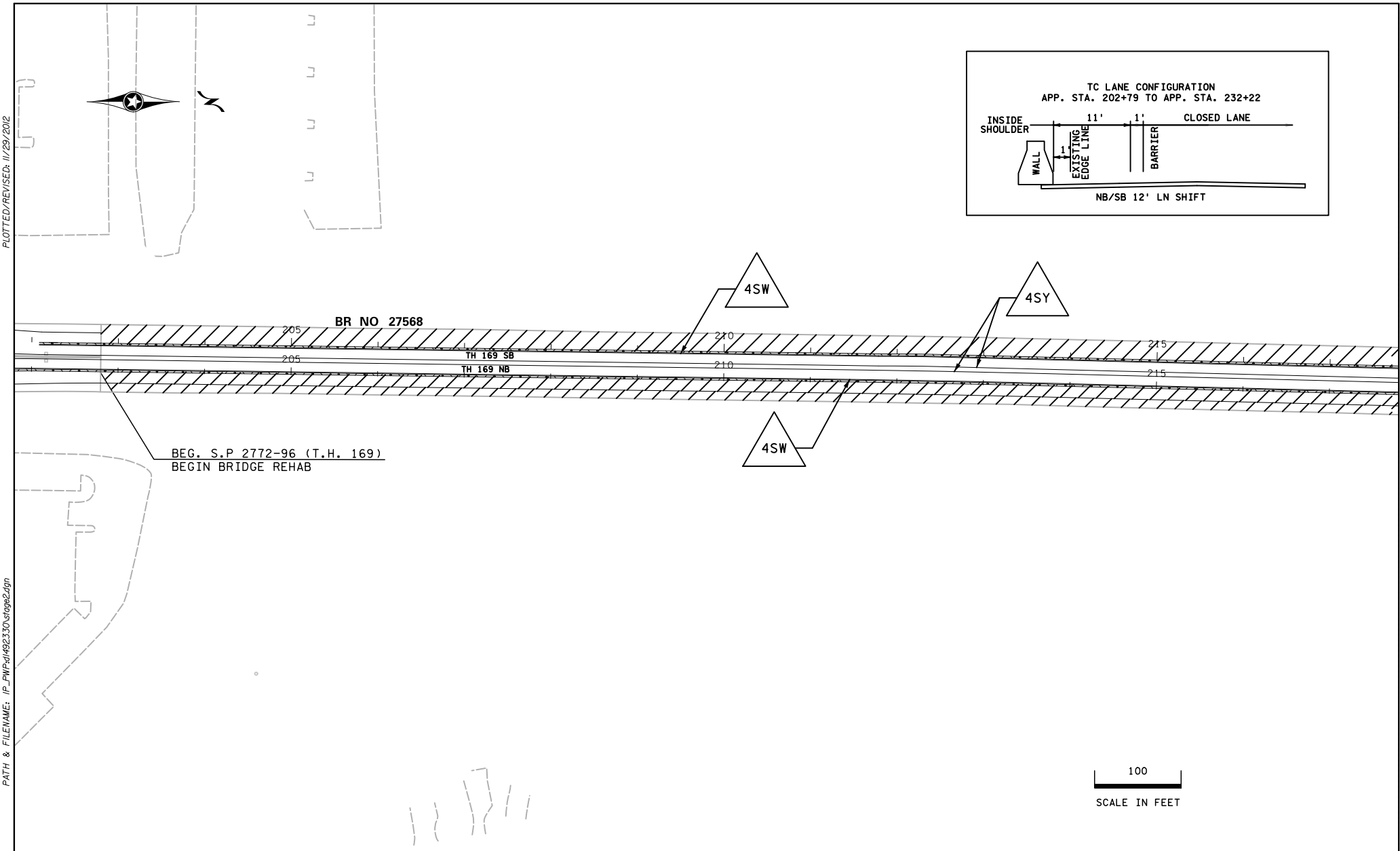


PLOTTED/REVISED: 11/29/2012

DISTRICT *: METRO
IPLOT NAME: stage22
PATH & FILENAME: IP_PWFdl492330\stage2.dgn

TRAFFIC CONTROL STAGE 2

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC23	OF TC33 SHEETS

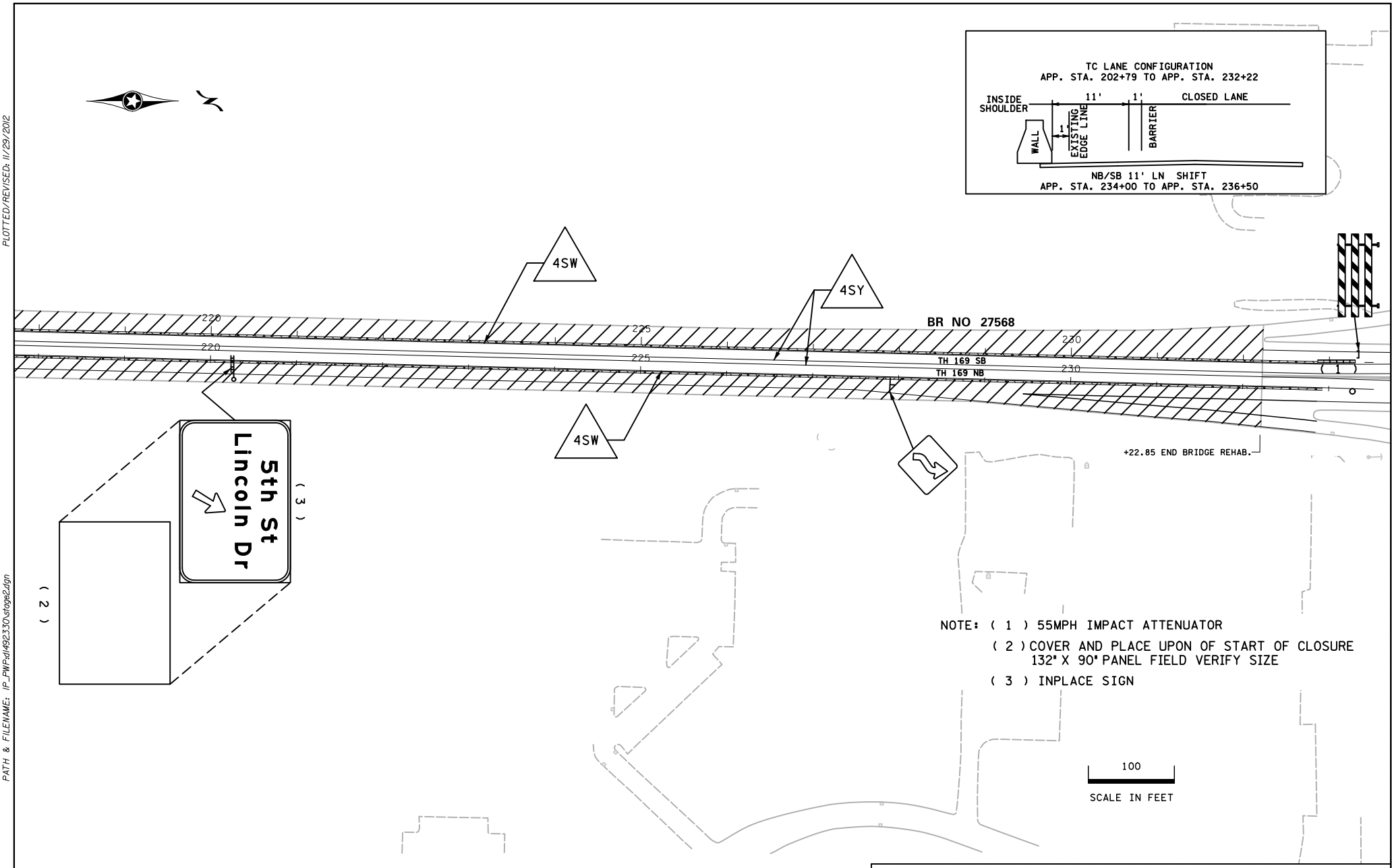


PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage23
PATH & FILENAME: IP_PWF:dl492330\stage2.dgn

TRAFFIC CONTROL STAGE 2

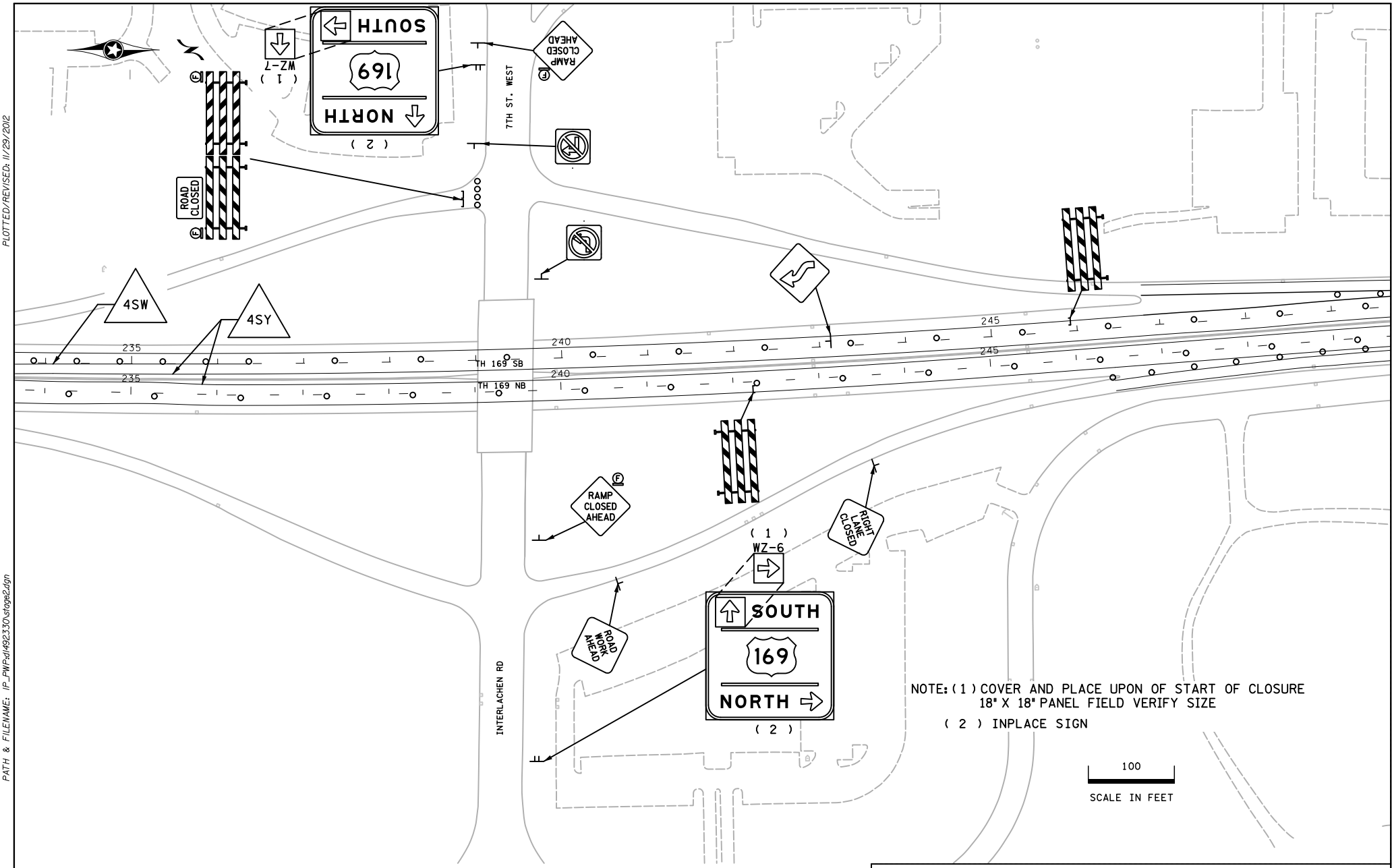
DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC24 OF TC33 SHEETS



PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage24
PATH & FILENAME: IP_PWF:d1492330\stage2.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 2
			STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC25 OF TC33 SHEETS

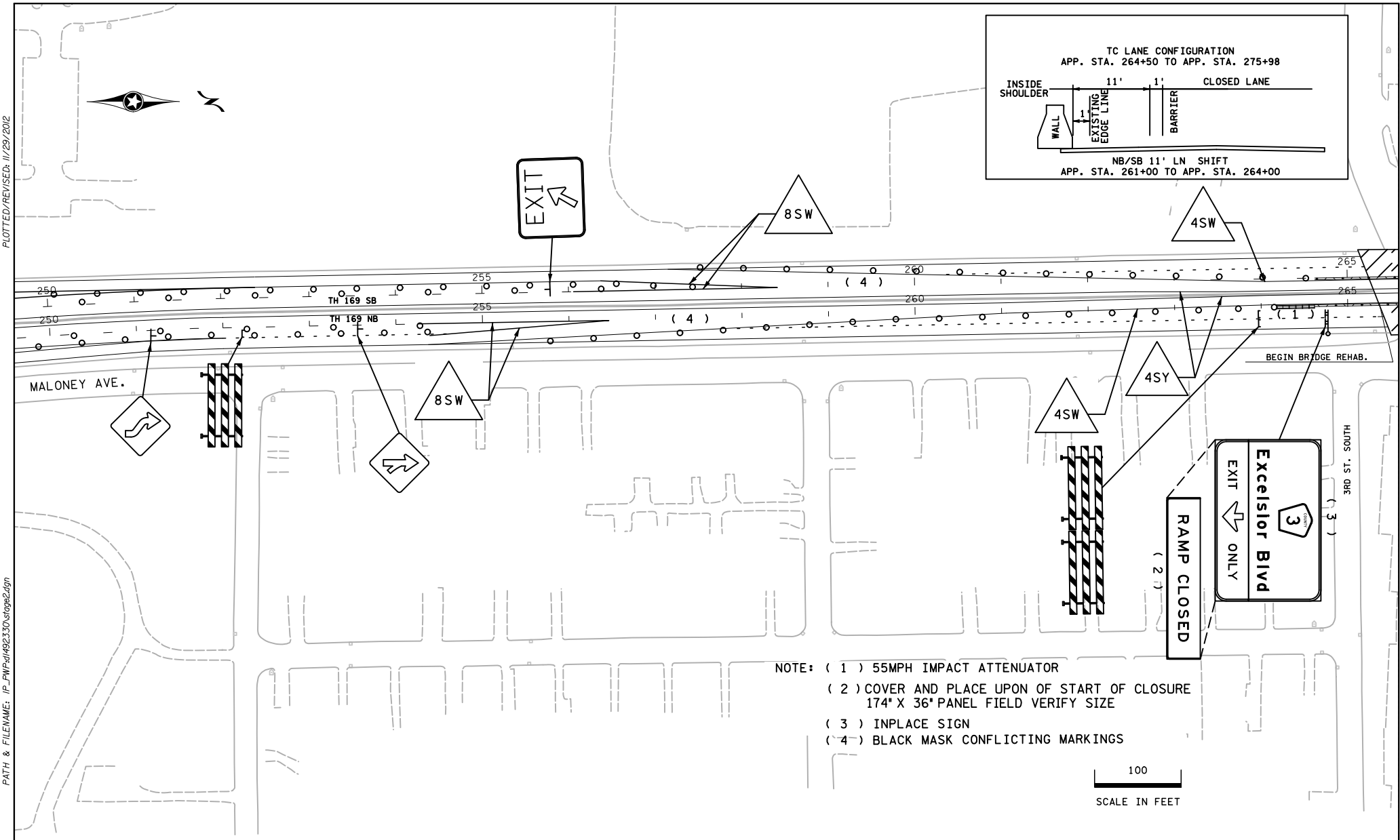


PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage25
PATH & FILENAME: IP_PWFdl492330\stage2.dgn

TRAFFIC CONTROL STAGE 2

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC26 OF TC33 SHEETS

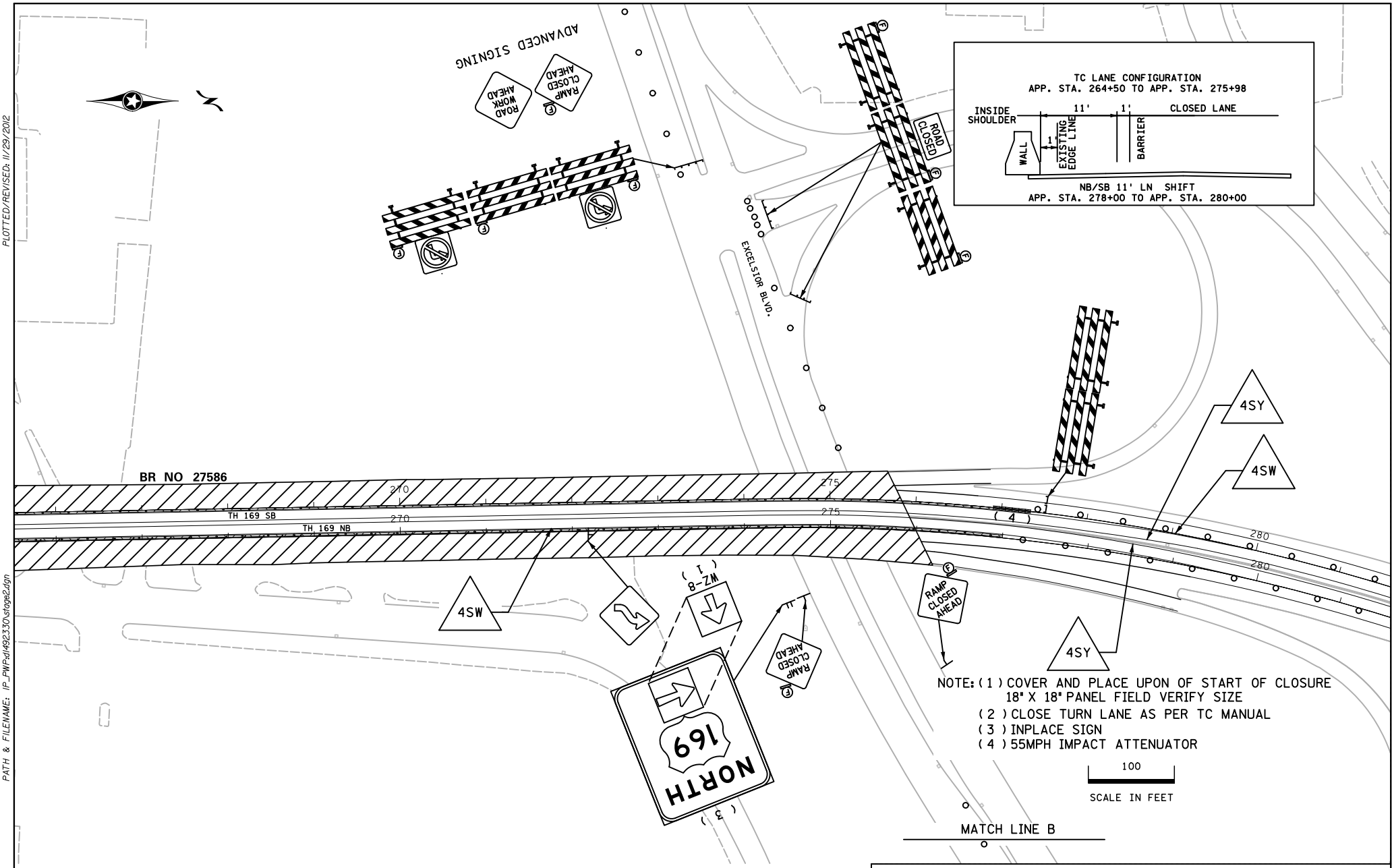


PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage26
PATH & FILENAME: I:\P_PWF\d1492330\stage2.dgn

TRAFFIC CONTROL STAGE 2

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC27	OF TC33 HEETS

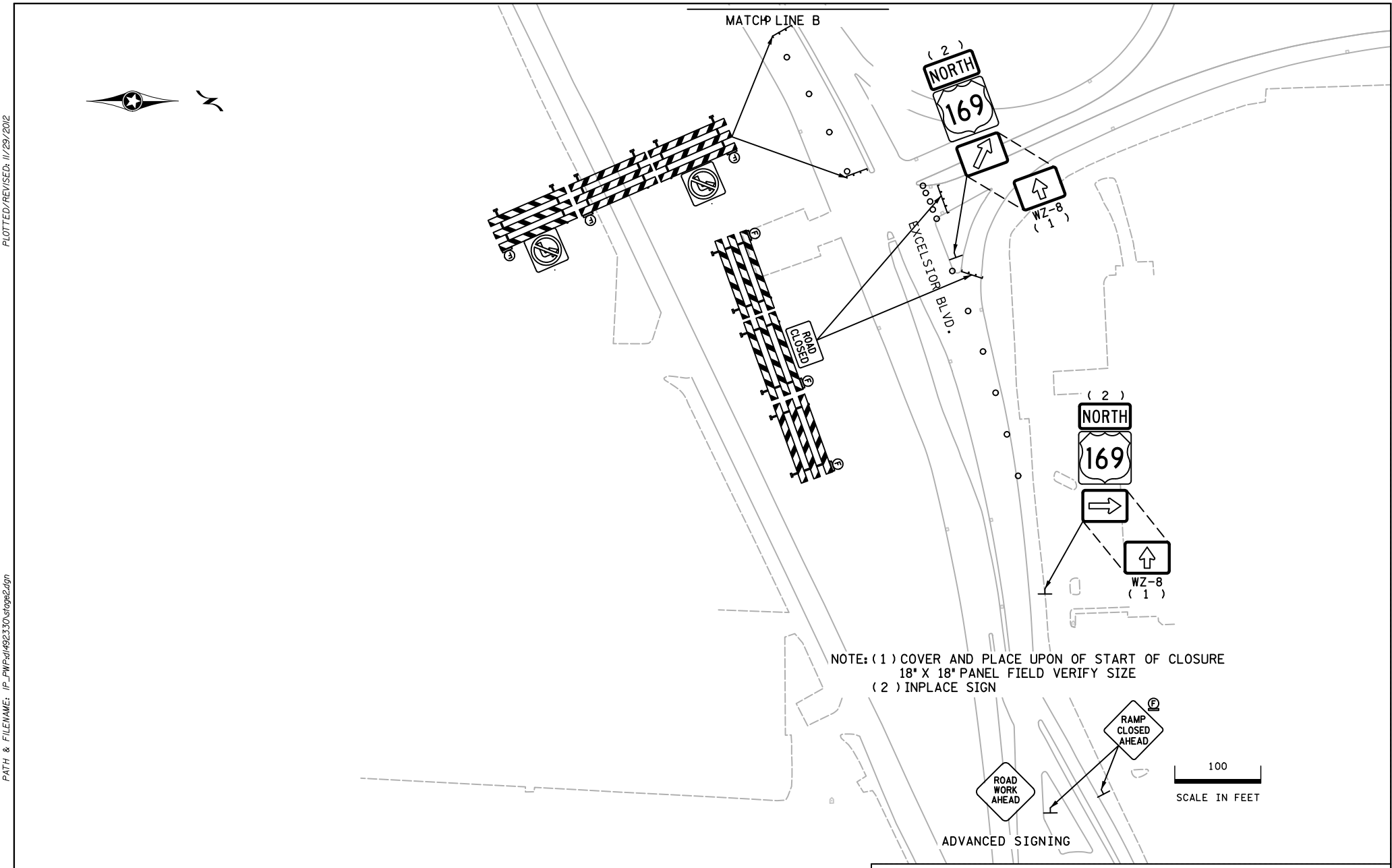


NOTE: (1) COVER AND PLACE UPON OF START OF CLOSURE 18" X 18" PANEL FIELD VERIFY SIZE
(2) CLOSE TURN LANE AS PER TC MANUAL
(3) INPLACE SIGN
(4) 55MPH IMPACT ATTENUATOR

TRAFFIC CONTROL STAGE 2

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012	STATE PROJ. NO. 2772-96 (TH 169)	SHEET NO. TC28	OF TC33 SHEETS

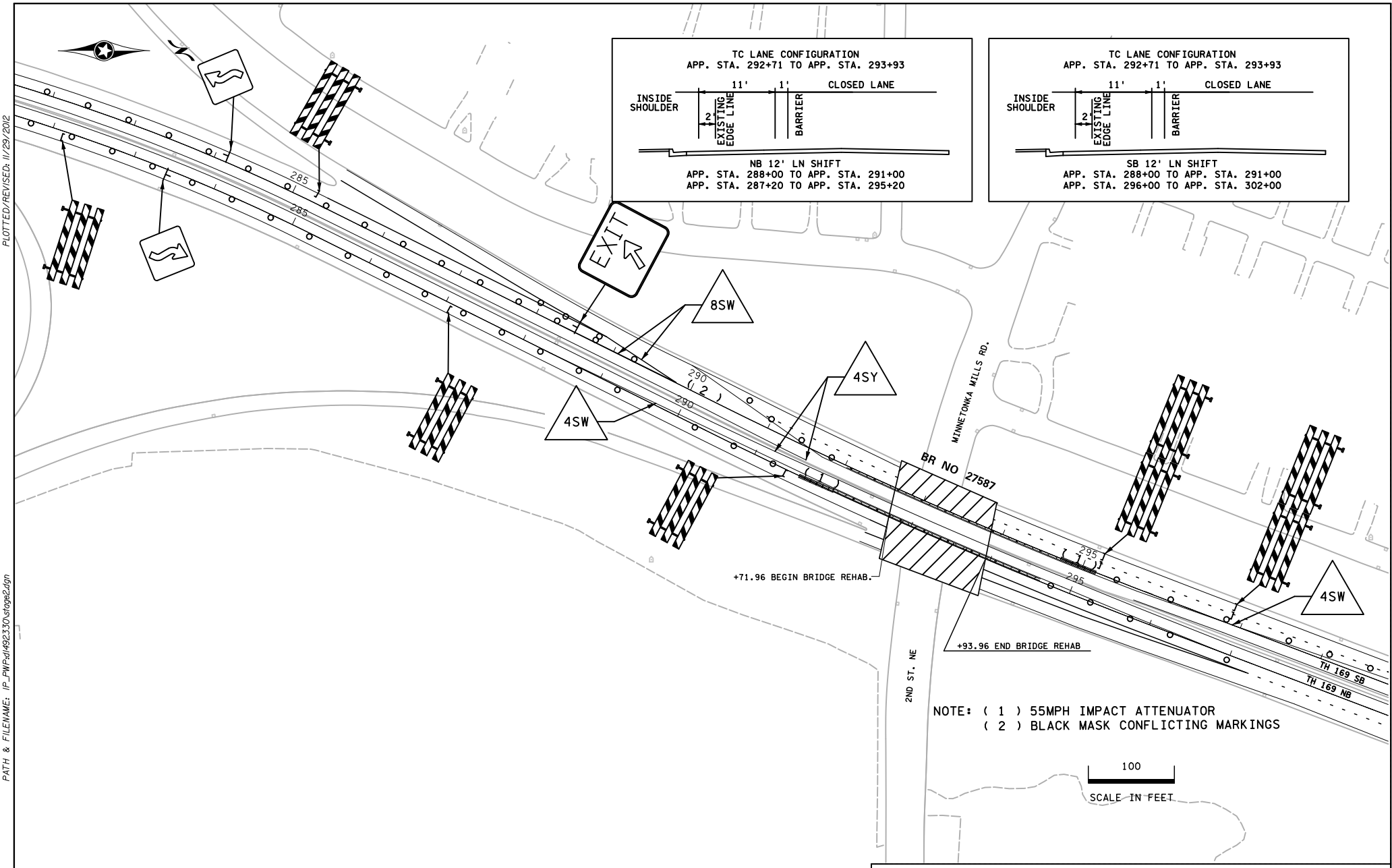
PLOTTED/REVISED: 11/29/2012
DISTRICT #: METRO
IPLOT NAME: stage2/0
PATH & FILENAME: IP_PWFdl492330\stage2.dgn



DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 2
			STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC29 OF TC33 SHEETS

PLOTTED/REVISED: 11/29/2012

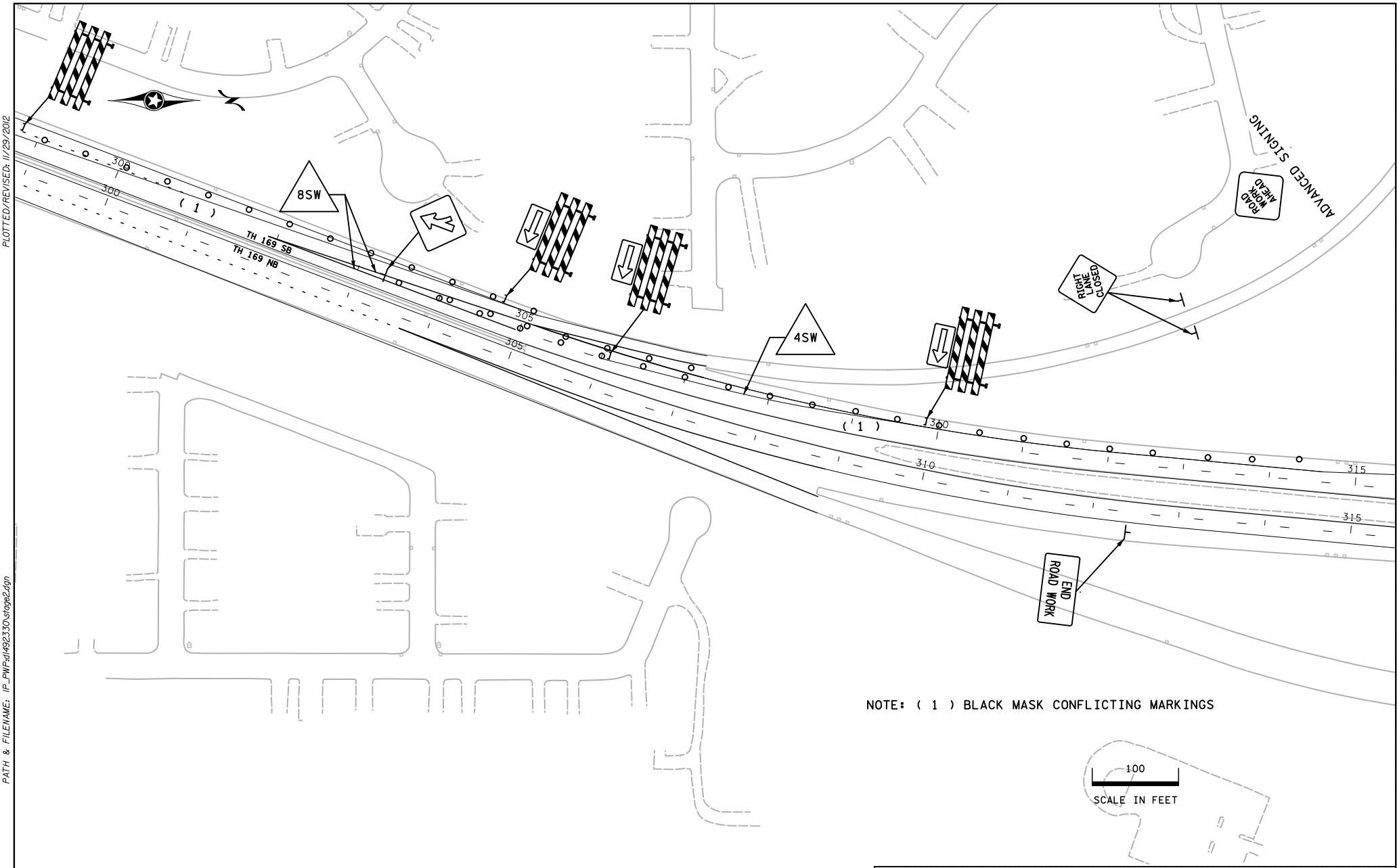
DISTRICT #: METRO
IPLOT NAME: stage2II
PATH & FILENAME: IP_PWF:dl492330\stage2.dgn



PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage27
PATH & FILENAME: IP_PWFdl492330\stage2.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 2
			STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC30 OF TC33 SHEETS

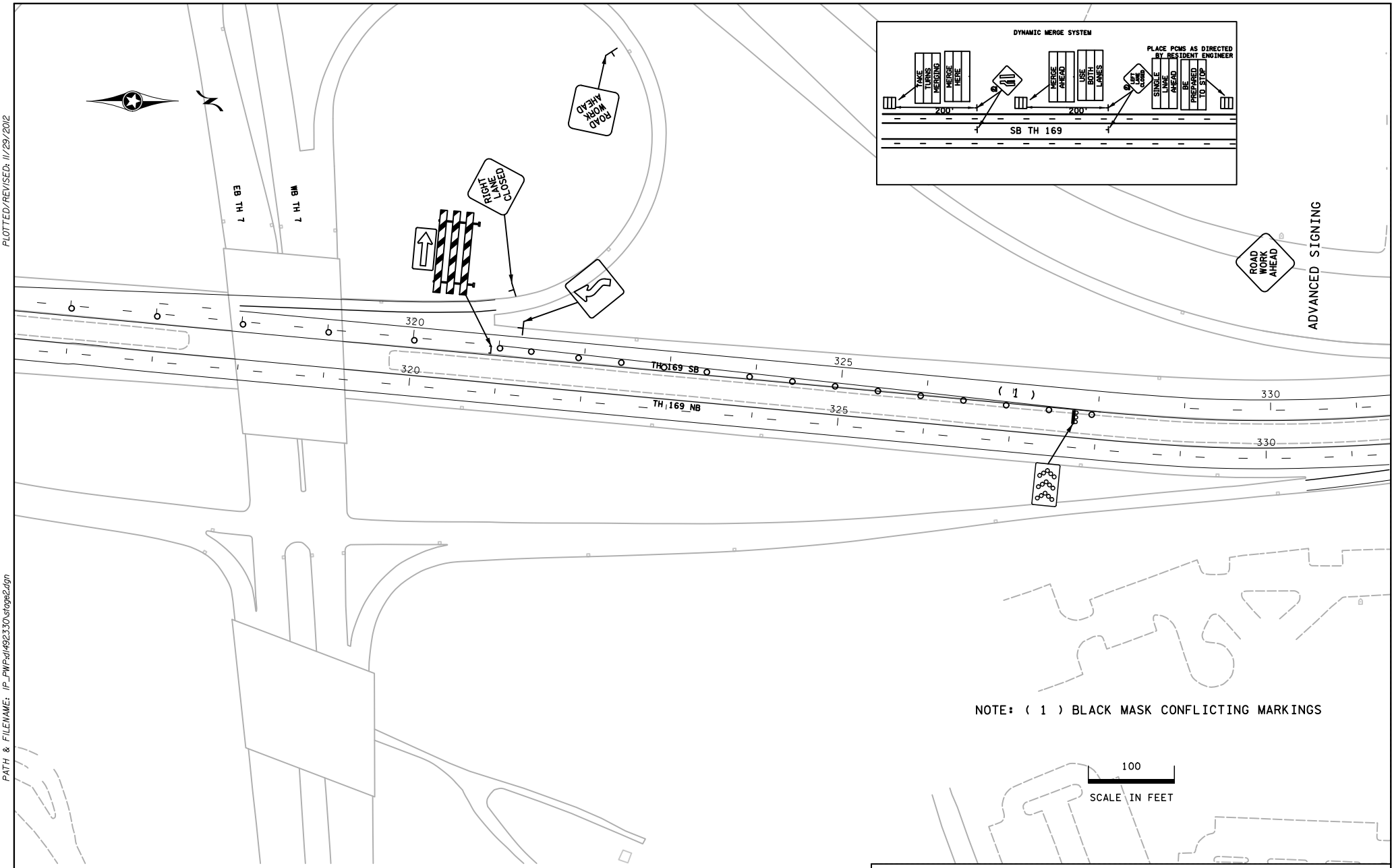


NOTE: (1) BLACK MASK CONFLICTING MARKINGS

PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage28
PATH & FILENAME: IP_PWF:dl492330\stage2.dgn

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY ____ LICENSED PROFESSIONAL ENGINEER ____ LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL STAGE 2 STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC31 OF TC33 SHEETS



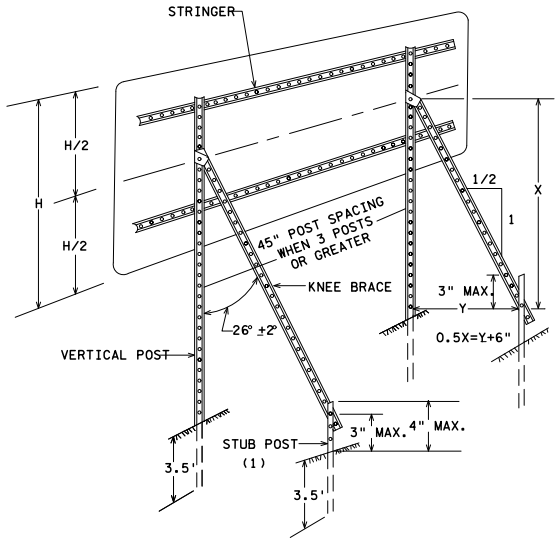
PLOTTED/REVISED: 11/29/2012

DISTRICT #: METRO
IPLOT NAME: stage29
PATH & FILENAME: IP_PWFdl492330\stage2.dgn

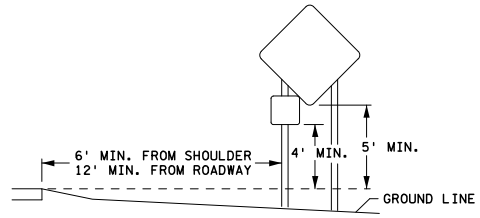
DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER	LIC. NO. 40535	DATE 11/29/2012

TRAFFIC CONTROL STAGE 2

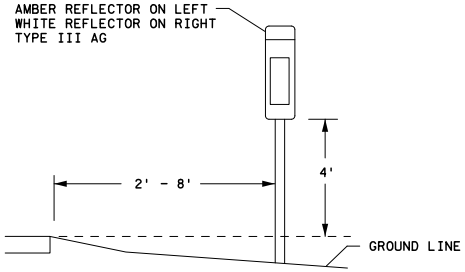
STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC32 OF TC33 SHEETS



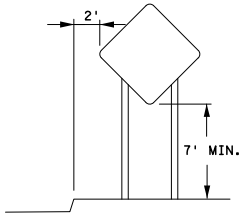
TYPICAL "A-FRAME" INSTALLATION
TYPE "D" SIGNS



TYPICAL RURAL DESIGN



DELINEATION MOUNTING



TYPICAL URBAN DESIGN

SIGN DATA

SIGNS TO BE INSTALLED ON DRIVEN U-POSTS SHALL BE INSTALLED IN ACCORDANCE WITH TABLE 1 OR TABLE 2 BELOW. SIGN PANELS SHALL BE INSTALLED ON SIGN STRUCTURES TO MEET THE MINIMUM 5 FEET DEPICTED ON THE TYPICAL RURAL DESIGN DETAIL, THE 7 FEET DEPICTED ON THE TYPICAL URBAN DESIGN DETAIL, OR MINIMUM 7 AND 9 FEET DEPICTED ON THE TYPICAL MOUNTING DETAIL ON THIS SHEET.

TABLE 1

STANDARD CONSTRUCTION SIGNS IN MN/DOT STANDARD SIGNS MANUAL

PANEL SIZE (IN.)	POSTS			
	NO. & TYPE	SPACING (IN.)	KNEE BRACES QUANT.	LENGTH (FT.)
24 x 24	2-U	18		13
30 x 24	2-U	18		13
36 x 30	2-U	24		13
36 x 36	2-U	18		14
42 x 36	2-U	30		14
48 x 48	2-U	30		15
60 x 60	2-U	42	1	16
72 x 72	2-U	42	2	17
96 x 54	2-U	54	2	16
168 x 132	4-U	48	4	20

GENERAL NOTES:
1. POST LENGTHS ARE APPROXIMATE AND INCLUDE EMBEDMENT, BUT DO NOT INCLUDE ADDITIONAL LENGTH REQUIRED FOR SPLICE.
2. SEE STANDARD SIGNS MANUAL FOR PUNCHING HOLES.

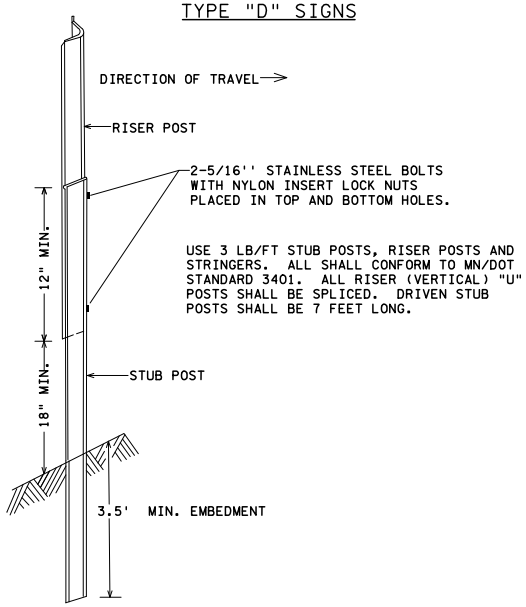
TABLE 2

SPECIAL DESIGN CONSTRUCTION SIGNS

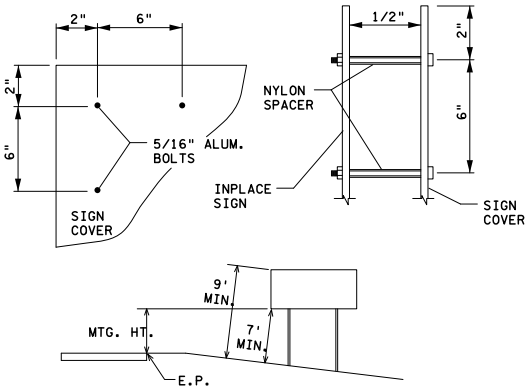
PANEL SIZE		POSTS			
LENGTH (IN.)	HEIGHT (IN.)	NO. & TYPE	SPACING (IN.)	KNEE BRACES QUANT.	LENGTH (FT.)
54 - 96	78	2-U	42	2	20
102 - 138	78	3-U	45	3	20
144 - 180	78	4-U	45	4	20

DESIGNER NOTE:

INCLUDE SPECIAL SIGN DETAILS IN THE TRAFFIC CONTROL PLAN IN TABLE TWO.



"U" POST SPLICE



TYPICAL MOUNTING

(1) OFFSET STUB POST 1' TOWARD ROADWAY RELATIVE TO VERTICAL POST.

NOTES:

FOR TEMPORARY CONSTRUCTION SIGN FRAMING, THE CONTRACTOR MAY USE GRADE 5 ZINC PLATED BOLTS FOR ALL BOLTED CONNECTIONS, EXCEPT FOR THE KNEE BRACE CONNECTION TO THE REAR STUB POST, WHICH SHALL UTILIZE A 5/16 INCH STAINLESS STEEL BOLT AND NYLON INSERT LOCK NUT. ADDITIONAL SIGN FRAMING DETAILS CAN BE FOUND IN THE TRAFFIC ENGINEERING MANUAL PART 6.

IF THE CONTRACTOR ELECTS TO USE SOME OTHER TYPE OF SIGN SUPPORT (OTHER THAN U-CHANNEL SIGN POSTS) FOR MOUNTING CONSTRUCTION SIGNS, DETAILS OF THE PROPOSED SIGN STRUCTURE SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO ORDERING THE SIGN STRUCTURE COMPONENTS. ANY SIGN STRUCTURE TO BE SUBMITTED TO THE ENGINEER SHALL BE AN FHWA ACCEPTED BREAKAWAY SIGN SUPPORT. SIGN STRUCTURE SHALL ALSO BE APPROVED FOR 90 MPH WIND LOAD.

SIGNS SHOWN TO BE COVERED SHALL BE COVERED WITH THE SAME COLOR AS THE SIGN BACKGROUND. THE CONTRACTOR SHALL PLACE COVERS OR ADDITIONAL SIGNS USING A MINIMUM 1/2" NYLON SPACER BETWEEN THE INPLACE SIGN AND THE COVERING MATERIAL. HOLES WILL BE DRILLED IN THE COVER AND THE INPLACE SIGN AND SHALL BE PLACED IN ACCORDANCE TO THE SIGN PANEL DETAIL. SPACERS ARE REQUIRED. MID-PANEL SPACING SHALL BE NO GREATER THAN 24".

TYPICAL TEMPORARY SIGN FRAMING AND INSTALLATION DETAILS

PLOTTED/REVISED: 11/29/2012
DISTRICT *: METRO
IPLOT NAME: t_typicals_tc_tsh4
PATH & FILENAME: IP_PWFdl492330V_typicals_tc_tsh.dgn
4/28/06 LAYOUT 20.DGN

DRAWN BY: SNM	CHECKED BY: KF	CERTIFIED BY _____ LICENSED PROFESSIONAL ENGINEER LIC. NO. 40535 DATE 11/29/2012	TRAFFIC CONTROL
			STATE PROJ. NO. 2772-96 (TH 169) SHEET NO. TC33 OF TC33 SHEETS

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