

**APPENDIX A**  
**GUIDELINES FOR THE USE OF BARRIER/CHANNELIZING**  
**DEVICES IN WORK ZONES**

**INTRODUCTION**

- A. The following safety guidelines have been developed to provide a methodical framework from which to assess every project as to the needs for appropriate techniques and devices to be employed during the construction phase. This covers a broad range of traffic conditions, vehicle speed, and duration of construction to insure that motorist and worker safety are addressed in a uniform manner throughout the Commonwealth.

Of particular note is the first strategy to use to avoid the use of barriers: Removal of the hazard or fixed object from the clear zone. If a hazard exists, remove the hazard or consider alternatives. The use of barriers to shield fixed objects should only be employed if it is not economically feasible to provide an alternate method of construction. Because barrier itself is a hazard; prior to including positive protection in a traffic control plan (TCP), careful consideration must be given to alternatives which would avoid or minimize exposure for workers and road users. Alternatives that are often considered include detouring traffic, minimizing exposure time, or maximizing the separation between traffic and workers. Strategies to avoid barrier use should be considered. These strategies include:

1. Removal of the hazard or fixed object from the clear zone or;
2. Encourage designers to eliminate the use of barrier during development of TCPs and Transportation Management Plans (TMPs) using the following techniques;
  - a. Through scheduling or sequencing phases of work (e.g., sequence to install permanent guardrail first when planned as part of project, accelerated construction techniques);
  - b. Designing a full road closure or ramp closure with traffic detoured offsite;
  - c. Designing a road or lane closure with onsite diversion (i.e., median crossover, temporary pavement, use of full depth shoulders; using ramps as a diversion around a work zones at an interchange);
  - d. Adding other options such as closing additional travel lanes to perform certain activities, performing work during non-peak travel periods; or using a slope wedge in lieu of open trenching.

- B. Projects that rarely require temporary barrier are listed below:

- Mobile, short duration, short term, and intermediate term work where typically the worker exposure for the installation and removal time for barrier offsets the safety benefits.
- Projects that involve only maintenance work such as asphalt overlays or surface treatment activities.
- Work zones with short activity areas with insufficient length of need for barriers.
- Work zones where use of barriers would reduce the acceleration/deceleration space required for the ingress and egress of construction vehicles.

- C. Projects that often require temporary barrier are listed below.

The following provides a list of areas where positive protection has been used in the past. However, this list is intended to provide guidance and should not be used in place of performing an engineering study.

- Objects that are within the clear zone such as:
  - Temporary shoring locations

- Bridge piers
- Overhead sign supports including foundations
- Staged pipe or culvert construction
- Stored construction material or equipment
- Pavement edge drop offs
- Non-traversable slope or steep/rough embankments within the clear zone
- Elevated drop inlet construction
- Staged bridge construction
- Worker or pedestrian safety is at risk due to the proximity of work to travel lanes
- Separation of opposing traffic

Positive protection is defined by the Federal Highway Administration (FHWA) as “*devices that contain and/or redirect vehicles and meet the crashworthiness evaluation criteria contained in NCHRP Report 350 and the Manual for Assessing Safety Hardware (MASH).*” By this definition, positive protection barriers should then also prevent intrusion into the work area.

Guidelines for using positive protection in a work zone are based on the premise that positive protection will reduce the severity of potential crashes. Positive protection in work zones is considered warranted when:

- Consequences of striking a fixed object or running off the road are believed to be more serious than striking the positive protection.
- Probabilities of striking a worker or pedestrian are believed to be greater than striking the positive protection.

These guidelines are to be used as a supplement to the 2009 Edition of the “Manual on Uniform Traffic Control Devices” (MUTCD).

D. The next sections include the following:

1. Channelizing Device/Barrier Selection Process
2. Checklist for Guidelines of Channelizing Device/Barrier Selection
3. Barrier Design Considerations
4. References and Other related materials

## **1. CHANNELIZING DEVICE/BARRIER SELECTION PROCESS**

This section describes how to use the information in this appendix. To facilitate the process, it is described in a step by step process below.

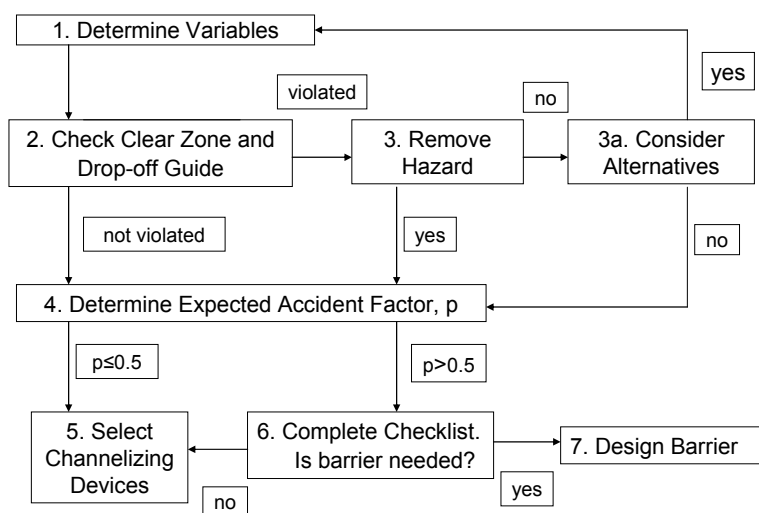
### **Step by Step Channelizing Device/Barrier Selection Process**

1. Determine variables:
  - a. Speed (pre-construction), S (mph)
  - b. Traffic Volume, V (vpd)
  - c. Construction Time, T (years)
  - d. Type of roadway (Limited Access, All Other Highways)
  - e. Run off the Road (ROR) Crashes Frequency Factor (Charts), f
  - f. Length of Work Area, L (miles)
2. Check the clear zone and drop-off charts to see if there is a hazard. Determine the location of all work crews and non-removable fixed objects that are close to the road:

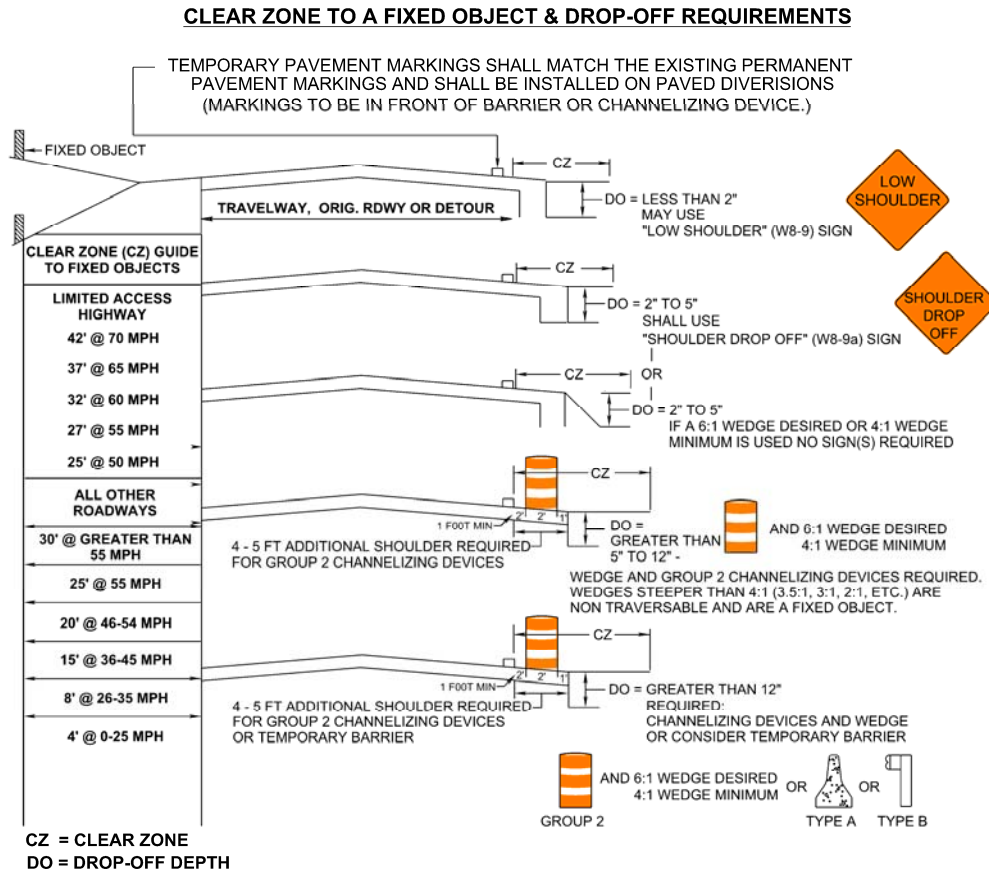
- a. Distance to fixed object, D in feet
  - b. Fixed Object Clearance Guide, CZ in feet (Figure 2)
  - c. Drop-off Guide, DO in inches (Figure 2)
- If workers are within the clear zone, then go to Step 3.
3. If a hazard exists, remove the hazard or consider alternatives then return to Step 1. Refer to Section B in the Introduction for examples of alternatives to consider. If a hazard exists, cannot be removed or there are no alternatives, go to Step 4.
  4. Determine the Expected Accident Factor, p, by finding the expected frequency of run-off-the-road (ROR) incidents near the fixed object or work crews based on the type of roadway determined in Step 1 and the Length of Construction Time the hazard exists:
    - a. ROR Frequency Factor Charts, f (Figure 3a Limited Access Highways or Figure 3b All Other Highways)
    - b. Fixed object length, L in miles (For singular type fixed objects such as headwalls, piers, and small work sites, use a minimum of 0.2 mi for length of construction zone.
    - c. Construction Time, T in years (use fraction of years if necessary, example 9 months = 0.75 year)
    - d. Expected Accident Factor,  $p = f \times L \times T$
  5. If  $p \leq 0.5$  or there is minimum work crew exposure with no violation of the CZ or DO, select a channelizing device from Figure 4.
  6. If  $p > 0.5$  or there are violations of the CZ or DO, complete the **Checklist for Guidelines of Channelizing Device/Barrier Selection**. If after completing the checklist, it is decided that barrier is not needed, select a channelizing device from Figure 4. If barrier is needed, then go to step 7.
  7. Design the barrier. Check for special situations and consider:
    - a. Barrier anchoring requirements and deflection information
    - b. Access openings and introduced barrier, Figure 5

The flow chart in Figure 1 graphically displays the seven steps process. **The engineer may review the checklist prior to starting the process.**

**Figure 1, Channelizing Device/Barrier Selection Process Flow Chart**



**Figure 2, Clear Zone and Drop-Off Requirements**



**Slopes steeper than 4:1 are considered a fixed object hazard.**

Example 1: Excavation on a non-limited access highway leaves a drop off depth of 8 inches during non working hours and it is located 4 feet from the edge line. The ADT is 5,300 and the speed limit is 35.

1. Determine the clear zone for 35 mph = 8 feet.
2. Protection needed: Figure 2 above, Group 2 channelizing devices shall delineate the work area and a 6:1 wedge desirable or a 4:1 wedge minimum shall be installed to eliminate the drop-off.

Example 2: A lane is being built parallel to traffic requiring excavation greater than 12 inches. The work is offset 10 feet from the existing traffic. The roadway is a non-limited access highway, ADT is 15,000 and the speed limit is 55.

1. Determine the clear zone for 55 mph = 25 feet.
2. Protection needed: From Figure 2 above,
  - A. Group 2 channelizing devices shall delineate the work area and a 6:1 wedge desirable or a 4:1 wedge minimum shall be installed to eliminate the drop-off or;
  - B. Table 1, Preliminary Channelizing Device, is used to determine a positive barrier, Type A, may be used but Figure 3b, ROR Frequency Factor Chart for All Other Highways, shall be used to determine barrier needs.

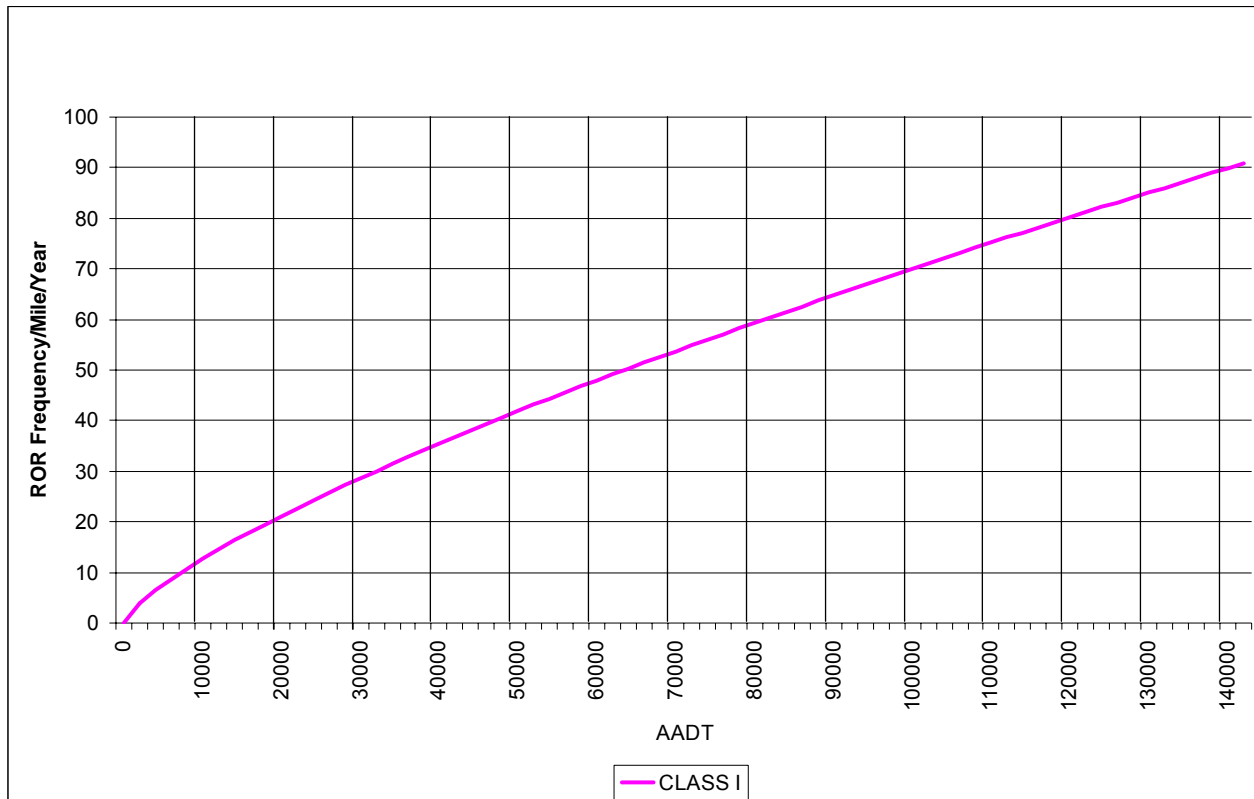
Example 3: A Limited Access highway is being built within 10 feet of an existing roadway with an ADT of 20,000 and the speed limit is 60. Fill areas are in excess of 9 feet throughout the work area.

1. Determine the clear zone for 60 mph = 32 ft.

2. Protection needed: Table 1, Preliminary Channelizing Device, is used to determine a positive barrier, Type A, may be used but Figure 3a<sup>1</sup>, ROR Frequency Factor Chart for Limited Access<sup>1</sup> Highways, shall be used to determine barrier needs.

**Figure 3a, ROR Frequency Factor Chart for Limited Access Highways**

Data presented is for 2 way ADT. When applying this chart to divided roadways, reduce ADT by one-half before entering chart.<sup>1</sup>



**Example:**

Interstate highway (2 lanes NB)  
 ADT= 34,000 (The ADT is for one direction only.)  
 Length Of Construction: 1 mile  
 Construction time: 0.5 yr  
 55 MPH Work Zone Speed Limit

- (1) From the Limited Access Highways ROR frequency factor chart, ADT of 34,000 indicates 30 ROR encroachments/mi/yr
- (2) Expected Accident Frequency Factor,  $p = f \times L \times T = 30 \times 1 \times 0.5 = 15$

Since the expected Accident Frequency factor is greater than 0.5, go to Checklist of Guidelines for Channelizing Device – Barrier Selection to determine if barrier is needed.

**Example for Night or Day only Work Zones:**

There are projects where lane closures are not continuous for several days. For example, if lane closures are limited to night only, then the traffic volume for the time period of the lane closure should be used instead of ADT. An example is provided below.

A bridge deck on an Interstate highway with 3 lanes in each direction will require patching, milling of the deck and placement of a Latex overlay.

ADT = 50,000 (the ADT is for one direction only). However, the volume required all work to be performed between 9:00 pm and 6:00 am each day. Therefore, the volume to be used will be between these hours, 6,000 vehicles for the 9-hour period.

Length of Construction = Bridge length is 550 feet; therefore, 0.2 mile will be used. Construction time = 9 hours. This is the actual time traffic is exposed to the hazard. {9 hrs ÷ (365d/yr x 24 hrs/d) = 0.001 yr}

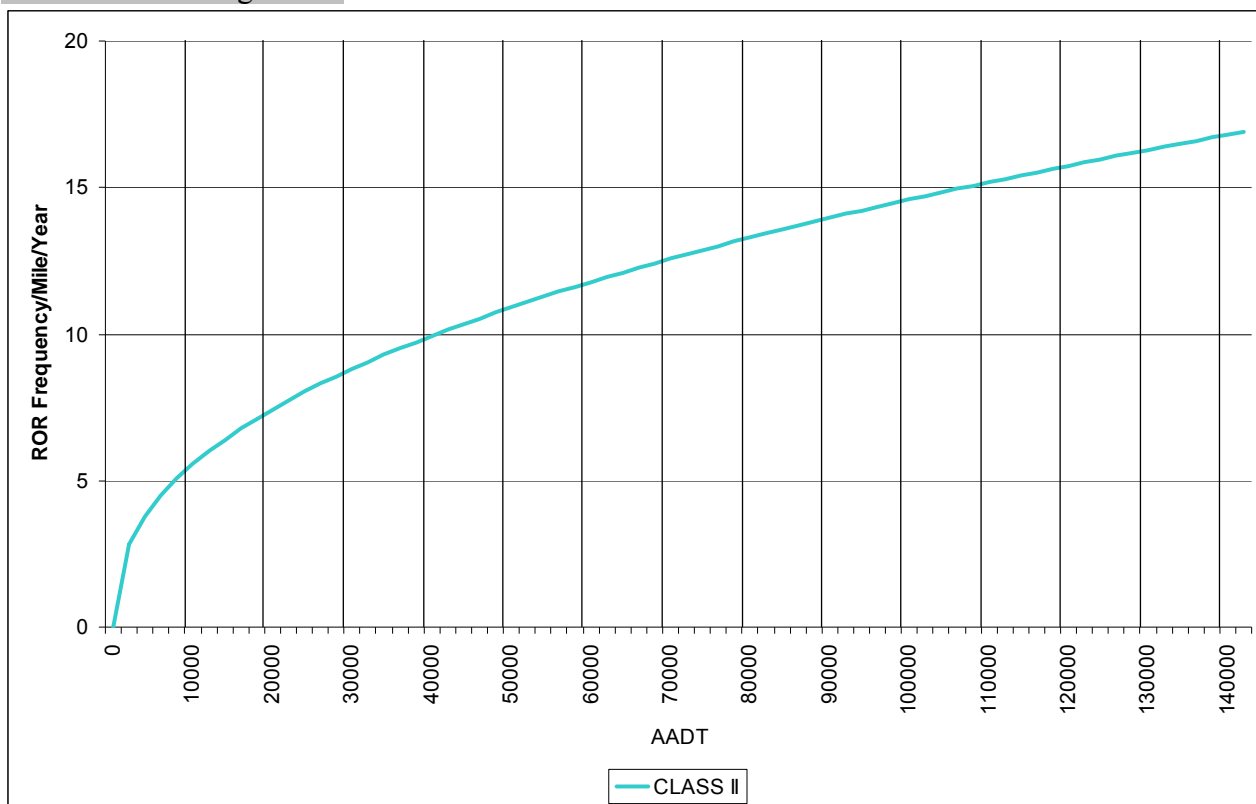
55 mph posted speed limit

Expected Accident Frequency Factor,  $p = f \times L \times T = 9 \times 0.2 \times 0.001 = 0.002$

Since the expected Accident Frequency Factor is well below 0.5, select a channelizing device from **Table 1**<sup>1</sup>.

**Figure 3b, ROR Frequency Factor Chart for All Other Highways**

Data presented is for 2 way ADT. When applying this chart to divided roadways, reduce ADT by one-half before entering chart.<sup>1</sup>



**Example:**

Rural primary highway (1 lane each direction)

ADT= 10,000 (ADT is for both directions.)

Length Of Construction: 0.5 mile

Construction time: 0.4 yr

55 MPH Work Zone Speed Limit

(1) From the all other highways ROR frequency factor chart, ADT of 10,000 indicates 5 ROR encroachments/mi/yr

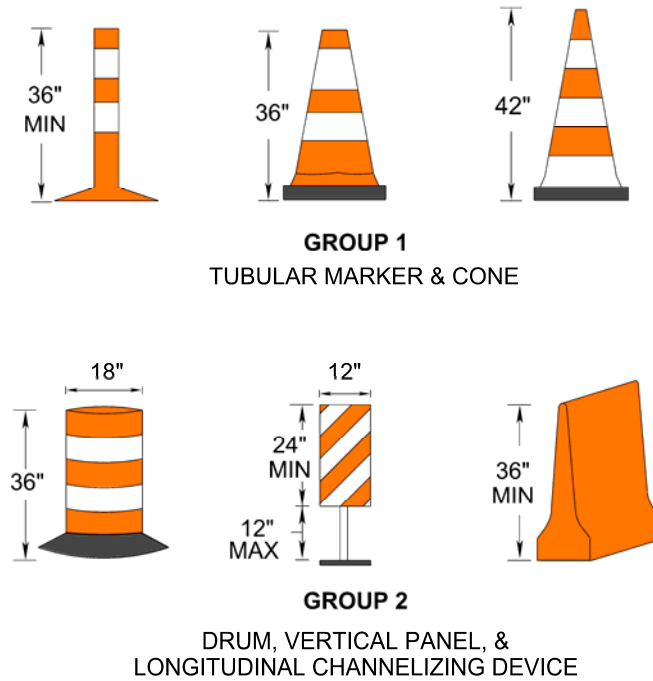
(2) Expected Accident Frequency Factor,  $p = f \times L \times T = 5 \times 0.5 \times 0.4 = 1.0$

If the expected Accident Frequency Factor is greater than 0.5, go to Table 1, Barrier-Channelizing Device Chart, to determine type needed.

**1: Revision 1 – 4/1/2015**

**Figure 4, Types of Barriers, Barricades and Channelizing Devices**

**Barricades and Channelizing Devices**

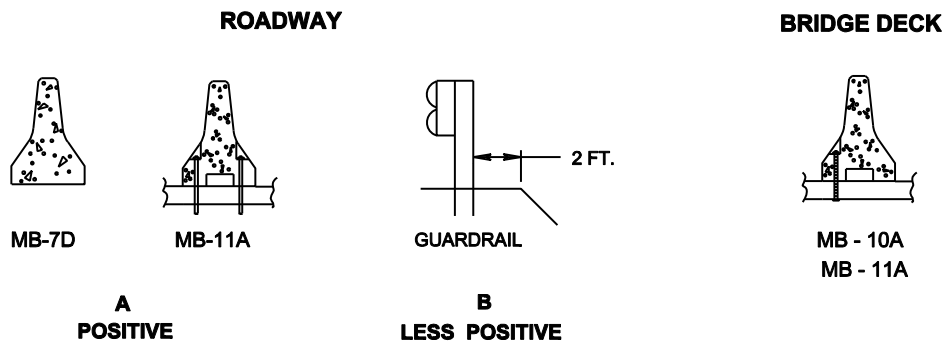


**SPACING GUIDE**

<b>Speed (mph)</b>	0 – 35	36 +
<b>Spacing (Feet)</b>	40	80

Channelizing device spacing along travelway is in feet. Spacing on curves 6° or greater (radii less than or equal to 955 feet), on transitions, or locations determined by the Regional Traffic Engineer to be ½ of the travelway spacing.

**Types of Barriers**

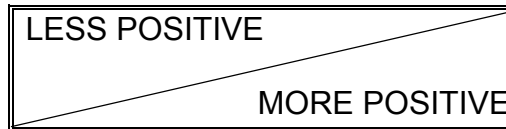


Barrier may require anchoring to the pavement or bolting to the bridge deck. Refer to Section 3, Barrier Design Considerations, for additional guidance. If anchoring/bolting is required it shall be on the traffic side(s) of the barrier. All barriers shall be installed in accordance with Section 500 of the current Road and Bridge Standards.

**Table 1, Preliminary Channelizing Device - Barrier Chart**

**Channelizing Device - Barrier Chart**

Existing Traffic ADT	Posted Speed Limit (mph)				
	0-25	26-35	36-45	46-54	55+
0-750	1,2	1,2	1,2	1,2	1,2 B
751-5500	1,2	1,2	1,2 B	B	B A
5501-15000	1,2	1,2 B	B	B A	A
Above 15000	1,2	1,2 B	A	A	A



**A more positive type of barrier can be substituted for values shown.**

For 1 and 2 designations, refer to Group 1 and 2 devices respectively in Figure 4.  
 For A and B designations, refer to Type A or B barriers respectively in Figure 4.

A temporary asphalt median is an alternative to temporary concrete traffic barriers for separation of traffic on two-lane, two-way roadways. See Page A-17 for additional guidance on the application of temporary asphalt medians.

**2. CHECKLIST FOR GUIDELINES OF CHANNELIZING DEVICE/BARRIER SELECTION**

The Checklist for Guidelines of Channelizing Device/Barrier Selection shall be used to assist the Designer/Traffic Engineer in determining and documenting the reason barriers are or are not required on a project or work zone operation. This documentation shall be signed and sealed by a registered professional engineer licensed to practice in the Commonwealth of Virginia. The completed Checklist for Guidelines of Channelizing Devices/Barrier Selection shall be filed in the project's preliminary engineering folder.



**ENGINEERING AND TRAFFIC INVESTIGATION  
WORK ZONE CHANNELIZATION/BARRIER ANALYSIS  
SECTION A**

Project No.:	Project's TMP Category:
Review Requested By:	Date of Request:
Project Scope:	Starting MP:
	Ending MP:
VDOT Project/Contract Manager:	Date of Review:

**SECTION B – ENGINEERING INVESTIGATION RESULTS**

<p><b>Reviewer(s):</b></p>    <p>Channelization/Barrier Device Selected (Check all that apply):</p> <p><input type="checkbox"/> Cones    <input type="checkbox"/> Drums    <input type="checkbox"/> Temporary Asphalt Median</p> <p><input type="checkbox"/> Guardrail    <input type="checkbox"/> Traffic Barrier Service Concrete</p>	
Decision Justification (What was decided and why):	
	(Office) (Office Location) (Title)

The related process is a guideline for aiding the engineer in the selection of barrier or channelizing devices.

## **Checklist for Guidelines of Channelizing Device/Barrier Selection**

<b>Information (Inputs)</b>	<b>Answers</b>
What type of work will be done?	
Will a hazard be located within the clear zone?	YES or NO
What is the speed limit to be used during construction?	mph
What is the design year traffic volume?	
What is the traffic mix for the roadway?	
What Work Zone Clear Zone is to be used?	
Will pedestrian traffic need to be maintained in the work area?	YES or NO
Can they be directed to another area?	YES or NO
What is the crash data for the area? (Attach HTRIS report if available.)	Rate: Frequency: Density: Prevalent Collision Type:
Can work be done when traffic volumes are lower?	YES or NO
Considering worker safety, how close will they be to traffic?	
How long will they be exposed to traffic?	___ hrs per day or ___ Days
How long will the barrier be in place? (If over three days consider the use of barriers.)	___ hrs per day or ___ Days

<b>Decision Process (channelizing devices vs barrier)</b>	<b>Answers</b>
What is the expected ROR frequency, $p$ ( $p=fxLxT$ )?	
If the expected ROR frequency is greater than 0.5, does Table 1, "Channelizing Device/Barrier Chart", indicate the use of barriers based on speed and volume?	YES or NO
Have other alternatives been considered other than the use of barriers? (Like a 6:1 wedge, detour, diversion, time restrictions for the work, elimination of the hazard, or to accelerate the work to reduce exposure time.)	
Consider that barriers may allow the contractor to work anytime, which may reduce construction time. However, use of Group II's or cones may limit his work to off-peak hours only.	
Generally, barriers cannot be placed around radii smaller than 100'. Do you have any small radii to protect?	YES or NO
Is the drop-off behind the barrier within 2' from the back of the barrier with a depth equal to or greater than 4'? If so, can a 6:1 wedge be used instead of the barrier?	YES or NO
What is the length of the barrier run? (Short barrier runs may not be a benefit, when considering the end protection.)	
What is the installation time? (in hours or days)	

<b><i>Decision Process (channelizing devices vs barrier)</i></b>	<b>Answers</b>
Will the traffic be exposed to the barriers when they are installed or removed?	YES or NO
Will barriers present any problem to accessing the work area?	YES or NO
Do workers have an escape route from an erratic vehicle?	YES or NO
Generally, traffic will shy away from barriers. Will this present any problems?	YES or NO
Will the barriers be used to separate traffic?	YES or NO
Has connections, crossovers, and entrances been considered?	YES or NO
Can a temporary asphalt median be used instead?	YES or NO
Will the barriers present a problem for either vertical or horizontal sight distance?	YES or NO
For barrier runs greater in length than 2 miles, have safety pull-off areas been provided?	YES or NO
After considering all of the above, is it practical to use barrier?	YES or NO

<b><i>Barrier Selection and Design (if applicable)</i></b>	<b>Answers</b>
How many lanes will be next to the barriers?	
And what is the offset from the edgeline to the face of the barrier?	
Where will the barriers be set? (In the lane or on the shoulder)	
If in the lane will the remaining lane width be acceptable?	YES or NO
What is the transition slope ratio?	
Will there be any problem installing the barrier with this ratio?	YES or NO
What type of barriers are to be used, single or double face?	
Can portable steel barriers be used?	YES or NO
What is the deflection of the barrier to be used? (If unknown use 6'.)	
Will the barriers need to be bolted down?	YES or NO
If so, does the entire run need to be bolted down?	YES or NO
What type of material will be under the barriers? (This may affect the stability and bolting, if required.)	
Will a lateral support be required?	YES or NO
If so, is there room to install it?	YES or NO or N/A
Would the barriers be placed on the outside of curves?	YES or NO
How will the barrier ends be protected? (If attenuators are to be used, consider the type, length of need/anchorage, and cost.)	
If the barrier ends are to be installed outside the clear zone, can a turned down end treatment be used?	YES or NO

### **3. BARRIER DESIGN CONSIDERATIONS**

Once it has been determined that a barrier is recommended, the next step is to determine the type of barrier and the barrier design.

The following three factors should be considered in the barrier design:

- a. Barrier anchoring requirements and deflection information
- b. Access openings, Figure 5
- c. Use of a temporary asphalt median/temporary raised island to separate opposing traffic.

#### **A. Barrier Anchoring Requirements and Deflection Information**

##### **Temporary Barrier Service Concrete Anchoring Requirements**

Traffic Barrier Service Concrete (TBSC) is designed to prevent an errant vehicle from entering a work zone. NCHRP 350 and the "Manual for Assessing Safety Hardware" (MASH) testing have provided lateral deflection distances for various barrier designs. The distances these barriers deflect may pose a hazard to workers and motorists in the work area if materials, equipment and workers are adjacent to and within the deflection area of the barrier. Additionally, TBSC placed on bridge structures are subject to movement caused by the vibration of vehicles, principally large trucks, when they traverse the structure. If TBSC is warranted based on the criteria for determining the application of barrier per the 2011 Virginia Work Area Protection Manual, the following guidelines should be used to determine if anchoring the TBSC is appropriate:

- If the barrier is placed within 2 ft of a trench/drop-off with a depth equal to or greater than 4 ft.
- On bridge decks.
- TBSC used as a bridge parapet.
- Equipment/materials are parked/stored within the TBSC deflection area.
- Site conditions that are deemed hazardous to workers.

An exception to the above guidelines for bridges may be permitted, with the approval of the Regional Traffic Engineer, provided the following conditions are met:

- No through openings in the bridge deck.
- TBSC is not used as a parapet.
- One open lane for traffic with a stop/yield condition or temporary traffic signal controlling traffic.
- Maximum lane width of 10 feet.
- Maximum posted speed of 25 mph.
- Maximum vehicle weight restriction of 22,000 pounds.

As noted above, if equipment/materials are parked/stored or if workers' are completing work tasks within the TBSC deflection area the TBSC shall be anchored. Designers and engineers should use the VDOT pin and loop positive connection Precast Concrete Median Barrier (MB-INS) 6 ft dynamic deflection as the design criteria in determining anchoring TBSC during the development of the temporary traffic control plans. For field applications the TBSC Deflection Table should be used to determine anchoring requirements.

Designers and engineers should refer to the Road and Bridge Standards for additional guidance on the application of anchoring TBSC as well as specific details on anchoring various types of TBSC. **Designers and engineers should contact the Standards/Special Design section for additional guidance on the application of all longitudinal barriers.**

## Traffic Barrier Service Concrete (TBSC) Deflection

### Acceptance based on the following NCHRP 350 Test Criteria

Dynamic deflection is based on:

- ¾ Ton pick-up truck at 45 mph and 25° impact angle (TL-2).
- ¾ Ton pick-up truck at 62 mph and 25° impact angle (TL-3).
- 18,000 lb Single unit truck at 50 mph and 15° impact angle (TL-4).

For additional information on longitudinal barriers, length of need and impact attenuator application, please refer to IIM-LD-93, Construction Work Zone/ Safety Guidelines and Pay Items for Construction Work Zone: <http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM93.pdf>

**Table 2, Traffic Barrier Service Concrete Deflection Table**

Barrier types most likely to be used on VDOT projects are shown in **bold** and highlighted.

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage (a)
B112	Midwest Roadside Safety Facility	Steel strap tie-down system for PCB on bridge decks.	TL-3	3' - 2"	46'
B108	Barrier Systems, Inc.	Temporary steel barrier.	TL-2 TL-3	3'- 5" 6' - 4"	52' - 6" 105'
B-90	CalTrans	4 m (13') long single-slope barrier with double pin & loop connection.	TL-3	2' - 5"	85' - 4"
<b>B-86</b>	<b>Oregon DOT</b>	<b>42" Tall – 12.5'Lg. F-Shape precast concrete barrier w/pin &amp; loop connection.</b>	<b>TL-3 TL-4</b>	<b>2'- 9" 2'- 9"</b>	<b>125' 100'</b>
B-84	Indiana DOT	10' Long F-Shape barrier w/pin & loop connection.	TL-3	5'- 3"	36'
<b>B-79</b>	<b>Pennsylvania DOT</b>	<b>12.5' Long F-Shape temporary barrier w/plate connection.</b>	<b>TL-3</b>	<b>8'- 7"</b>	<b>80'</b>
B-69	Barrier Systems, Inc.	Steel Reactive Tension System (SRTS) Concrete Reactive Tension System (CRTS)	TL-3 TL-3	2'- 4" 2'- 0"	266' - 8"
<b>B-63</b>	<b>Barrier Systems, Inc.</b>	<b>Quickchange Moveable Barrier (QMB)</b>	<b>TL-3</b>	<b>4'- 6"</b>	<b>10'- 4"</b>
B-62	Gunnar Prefab AB	GPLINK precast temporary concrete barrier.	TL-3	5'- 10"	*
<b>B-54</b>	<b>Virginia DOT</b>	<b>20' Long F-Shape barrier w/pin &amp; loop connection.</b>	<b>TL-3</b>	<b>6'</b>	<b>60'</b>
<b>B-52</b>	<b>Easi-Set Industries</b>	<b>12' Lg. And 20' Lg. F Shape barrier w/J-J hook connection.</b>	<b>TL-3</b>	<b>4'- 4"</b>	<b>69' - 7"</b>
<b>B-42</b>	<b>Rockingham Precast</b>	<b>12' Long F-Shape w/T-Bar connection.</b>	<b>TL-3</b>	<b>3'- 10"</b>	<b>60'</b>

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage (a)
B-41	University of Nebraska - Lincoln	9'- 4" Long F-Shape barrier w/pin & loop connection.	TL-3	6'	11' - 5" Run-on 9' - 10" Run-off
B-40	Barrier Systems, Inc.	Narrow Quickchange Moveable Barrier.	TL-3	2'- 11"	(b)
B-36	Texas A&M (TTI)	Low-Profile Concrete Barrier for Work Zones	TL-2	5"	(c)

\* No published information is available.

- a – Anchorage is defined as the additional length of barrier needed, upstream and downstream of the work zone, to ensure the system does not exceed the maximum dynamic deflection noted in the adjacent column.
- b – System was anchored using two 6" steel tubes and two 1" by 4" steel straps w/turnbuckles. These were attached to two 3' diameter by 8' deep reinforced concrete anchors.
- c – System was anchored using a non-crashworthy end treatment. System must be terminated outside of clear zone or shielded with a crashworthy device.

### Temporary Longitudinal Steel Barriers<sup>1</sup>

#### Acceptance based on the following NCHRP 350/Mash08 Test Criteria

Dynamic deflection is based on:

- <sup>3</sup>/<sub>4</sub> Ton pick-up truck at 45 mph and 25° impact angle (TL-2).
- <sup>3</sup>/<sub>4</sub> Ton pick-up truck at 62 mph and 25° impact angle (TL-3).

For additional information on longitudinal steel barriers, length of need and impact attenuator application, please refer to IIM-LD-93, Construction Work Zone/ Safety Guidelines and Pay Items for Construction Work Zone: <http://www.extranet.vdot.state.va.us/locdes/electronic%20pubs/iim/IIM93.pdf>

**Table 3, Acceptable Longitudinal Steel Barriers**

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage
B134	Energy Absorption Systems, Inc.	Vulcan Barrier	TL-3	13'- 2"	302' Lg. (a)
B134	Energy Absorption Systems, Inc.	Vulcan Barrier with Anchoring System VAS	TL-3	6'- 11"	(b)
B-131	Highway Care, Inc.	Barrier Guard 800	TL-3	4'- 11"	(c)
B-158	Highway Care, Inc.	Barrier Guard 800 MDS	TL-3	0'- 3"	(d)
B-176A	Hill & Smith, Inc.	Zone Guard Standard	TL-3	6'- 4"	(e)
B-176A	Hill & Smith, Inc.	Zone Guard Minimum Deflection	TL-3	1'- 4"	(f)

- a – Freestanding barrier with no anchorage and is defined as the additional length of barrier needed, upstream and downstream of the work zone, to ensure the system does not exceed the maximum dynamic deflection noted in the adjacent column.
- b – System was anchored using a QuadGuard CZ<sup>®</sup>. This system is acceptable for uni-directional (run-on only) conditions. Refer to FHWA acceptance letter B-131 for additional guidance for this application.
- c – System was anchored each end with four anchors. System must be terminated outside of clear zone or shielded with a crashworthy device.
- d – System was anchored each end with four anchors. Each barrier of the system was also anchored every 20 feet with either joint anchors or intermediate anchors. System must be terminated outside of clear zone or shielded with a crashworthy device.
- e – System was anchored with four anchors at each end. System must be terminated outside of clear zone or shielded with a crashworthy device.
- f – System was anchored with four anchors at each end. The system was also anchored every 33'- 4" along the barrier. System must be terminated outside of clear zone or shielded with a crashworthy device.

**Longitudinal Channelizing Devices (Portable Water-Filled Devices)**

**Please Note:** Longitudinal channelizing devices (water-filled plastic devices) can only be used in lieu of Group 2 devices (Drums & Vertical Panels). Longitudinal channelizing devices shall not be substituted for Traffic Barrier Service Concrete (temporary concrete barriers) due to their severe dynamic deflections.

Anchorage is defined as the additional length of barrier needed, upstream and downstream of the work zone, to ensure the system does not exceed the maximum dynamic deflection noted in the adjacent column. All dynamic deflection distances are based on NCHRP 350 test with the barriers filled with fluid per the manufacturer’s installation instructions.

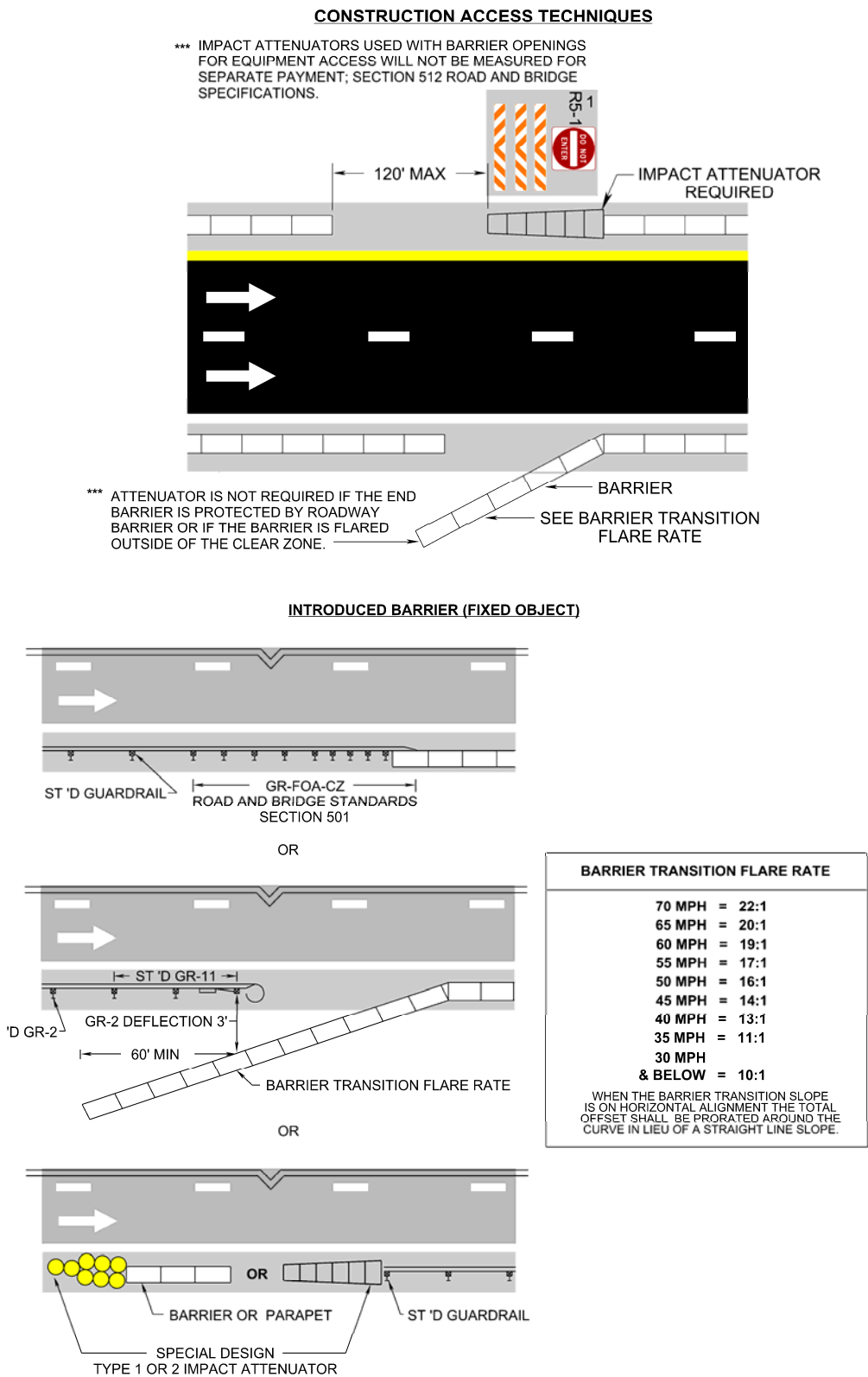
**Table 4, Acceptable Longitudinal Channelizing Devices<sup>1</sup>**

FHWA Code	Manufacturer	Device Description	Test Level	Dynamic Deflection	Anchorage
B111	Creative Building Products	Water Filled Plastic Barrier.	TL-2	10'- 4"	16' - 6" Lg. Segments (96')
B101	Rhino Safety Barrier LLC	Water-Filled Plastic Barrier.	TL-2	13'- 2"	59'
B-97	Yodock Wall Company, Inc.	Yodock Model 2001M/2001 Plastic Barriers w/ steel tubes.	TL-2 TL-3	12' 14'	46'
B-48	Energy Absorption Systems, Inc.	Triton water-filled temporary barrier.	TL-3	19'- 0" 22'- 8"	97' - 6" 65'
B-34 B-30	Armorcast Products Co.	Guardian Safety Barrier System	TL-3 TL-2	11'- 2" 6'- 6"	(a)

a - Please refer to FHWA acceptance letters for additional information. Manufacturer must supply anchorage information for the specific version to be installed.

## B. Construction Access Technique and Introduced Barrier

Figure 5, Construction Access Technique and Introduced Barrier





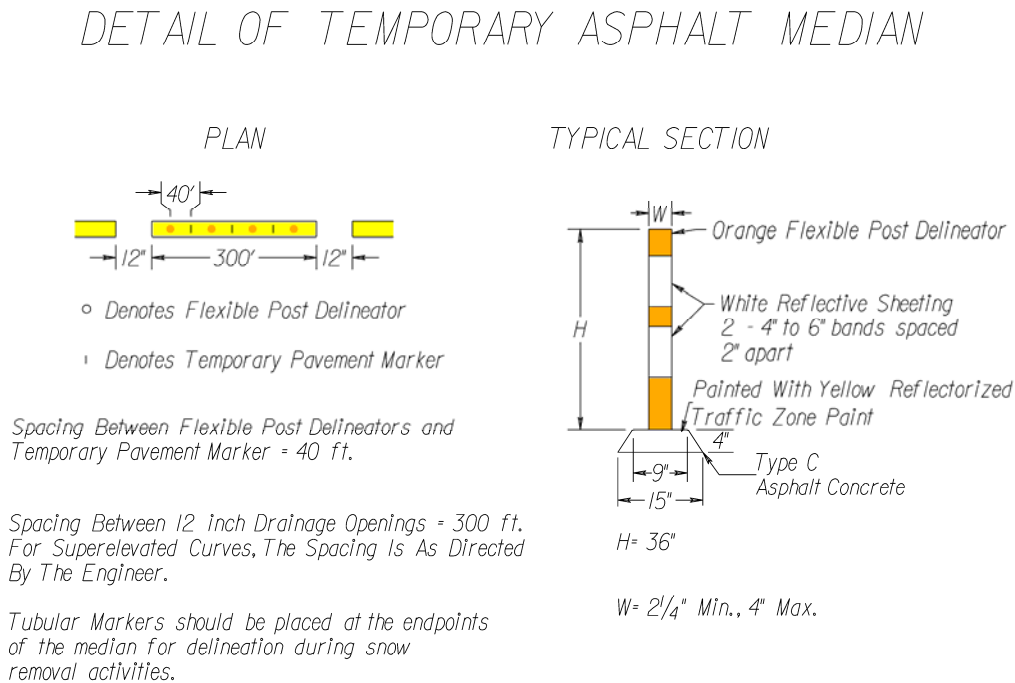
### C. Use of Temporary Asphalt Median/Temporary Raised Island

Temporary asphalt medians may be considered as an alternative to temporary concrete traffic barriers for separation of traffic on two-lane, two-way temporary detours on roadways with posted speed limits of 45 mph or less and a vehicular traffic volume range of 4,000 to 15,000 average daily traffic (ADT). Temporary asphalt medians may be used in other two-lane, two-way operations where physical separation of vehicular traffic from the TTC zone is not required. All recommendations for the use of temporary asphalt medians must have the written approval of the Regional Traffic Engineer.

In addition to the information listed in the Checklist for Guidelines of Barrier/Channelizing Devices Selection engineering study, each location for the application of the temporary asphalt median should be reviewed to ensure that the existing roadway’s geometrics provide an operating speed equal to or within 10 mph of the existing roadway’s posted speed limit. Also, when an intersection is within the two-way, two-lane operation, attention should be given to temporary traffic control at the intersection, especially the side street approaches. This attention may include, but is not limited to, additional advance warning signing and supplemental pavement markings at the approaches to as well as at the intersection.

The Temporary Traffic Control Plan (Maintenance of Traffic/Sequence of Construction Plan) shall include the required temporary asphalt median layout details along with the “Detail of Temporary Asphalt Median”, available from the Location and Design Division.

**Figure 6, Temporary Asphalt Median Detail**



#### **4. REFERENCES AND OTHER RELATED MATERIALS**

##### **VDOT Memorandums:**

IIM-LD-93, Construction Work Zone/ Safety Guidelines and Pay Items for Construction Work Zone  
[http://www.extranet.vdot.state.va.us/locdes/electronic\\_pubs/iim/IIM93.pdf](http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/IIM93.pdf)

IIM-LD-184, Concrete Median Barrier/Traffic Barrier Service  
[http://www.extranet.vdot.state.va.us/locdes/electronic\\_pubs/iim/IIM184.pdf](http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/IIM184.pdf)

IIM-LD-222/TE-358, Roadway Safety Features/NCHRP 350 Test Requirements  
[http://www.extranet.vdot.state.va.us/locdes/electronic\\_pubs/iim/IIM222.pdf](http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/IIM222.pdf)

IIM-LD-241/TE-351, Work Zone Safety and Mobility/Transportation Management Plan Requirements  
[http://www.extranet.vdot.state.va.us/locdes/electronic\\_pubs/iim/IIM241.pdf](http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/iim/IIM241.pdf)

TE-342, Work Zone/Lane Encroachment and Center Lane Closure Policy for Work Zones on Limited Access Highways  
[http://www.virginiadot.org/business/resources/traffic\\_engineering/memos2/TE-342\\_Lane\\_Encroachment\\_and\\_Center\\_Lane\\_Closure\\_Policy\\_for\\_Work\\_Zone\\_on\\_Limited\\_Access\\_Highways.pdf](http://www.virginiadot.org/business/resources/traffic_engineering/memos2/TE-342_Lane_Encroachment_and_Center_Lane_Closure_Policy_for_Work_Zone_on_Limited_Access_Highways.pdf)

TE-350, Work Zone Safety/Work Zone Speed Analysis  
[http://www.virginiadot.org/business/resources/traffic\\_engineering/memos2/TE-350\\_1\\_Work\\_Zone\\_Speed\\_Analysis.pdf](http://www.virginiadot.org/business/resources/traffic_engineering/memos2/TE-350_1_Work_Zone_Speed_Analysis.pdf)

TE-352, Work Zone Safety/Slow Roll Temporary Traffic Control (Slow Roll TTC)  
[http://www.virginiadot.org/business/resources/traffic\\_engineering/memos2/TE-352\\_Slow\\_Roll\\_Temp\\_Traffic\\_Control.pdf](http://www.virginiadot.org/business/resources/traffic_engineering/memos2/TE-352_Slow_Roll_Temp_Traffic_Control.pdf)

##### **VDOT Manuals:**

Virginia Road and Bridge Specifications  
<http://www.virginiadot.org/business/const/spec-default.asp>

Virginia Road and Bridge Standards  
[http://www.virginiadot.org/business/locdes/2008\\_standards\\_complete\\_sections.asp](http://www.virginiadot.org/business/locdes/2008_standards_complete_sections.asp)

Virginia Road Design Manual (Index)  
<http://www.virginiadot.org/business/locdes/rdmanual-index.asp>

##### **National Manuals and Web Sites:**

2009 Manual on Uniform Traffic Control Devices  
[http://mutcd.fhwa.dot.gov/kno\\_2009.htm](http://mutcd.fhwa.dot.gov/kno_2009.htm)

FHWA Safety (Work Zones)  
<http://safety.fhwa.dot.gov/wz>

The National Work Zone Safety Information Clearinghouse  
<http://www.workzonesafety.org>