DD-603 Federal-Aid Resurfacing Operational & Safety Checklist

DD-662 & Spec 607 Guardrail (Basics)

Wednesday, March 11, 2026

Jim Moore, DE9

Why are we talking about guardrail and grading?
Comments from FHWA:

- **FA-NHS Projects are looked at being '*only resurfacing projects'* with no safety or other enhancements being made.**
- **Safety field reviews are not being performed.**
- **Other departments are not being invited to the safety review for comments.**
- **Guardrail and guardrail end terminals are not being upgraded.**
- **Guardrail end terminals are being replaced at the same location without considering current length of need.**
- **Designers and Construction need to ensure that end terminals have the proper grading.**
- **Concrete barrier walls have become low due to several resurfacing projects, and they are not being upgraded.**
- **When FHWA makes recommendations, the district says it is outside the scope of the project.**

23 USC 106 – Project approval & oversight

United States Code (Law) Title 23 – Highways (Federal Highway Administration) contains those laws in effect on August 20, 2025

Chapter 1 – Federal-Aid Highways

Section 106 – Project approval and oversight

(a)(1) In General – "Submission of plans, specifications, and estimates. Except as otherwise provided in this section, each State transportation department shall submit to the Secretary for approval such plans, specifications, and estimates for each proposed project as the Secretary requires."

(c)(1) Assumption by States of Responsibilities of the Secretary – "NHS projects. For projects under this title that are on the National Highway System, including projects on the Interstate System, the State may assume the responsibilities of the Secretary under this title for design, plans, specifications, estimates, contract awards, and inspections with respect to the projects unless the Secretary determines that the assumption is not appropriate."

Stewardship and Oversight Agreement

Stewardship and Oversight Agreement on Project Assumption and Program Oversight By And Between The Federal Highway Administration, West Virginia Division Office, and the West Virginia Department of Transportation, Division of Highways (WVDOH)

Section 1. "In enacting section 106© of title 23, United States Code (U.S.C.)….

Design – PS&E – Contract Awards – Inspections – Real Property

The WVDOH is to exercise any and all assumptions of the FHWA's responsibilities in accordance with the Federal laws, regulations, policies, Executive Orders, and procedures that would apply if the responsibilities were carried out by FHWA

WVDOH Management Perspective

Jacob Bumgarner, State Highway Engineer sent out an email statewide on May 21, 2025, indicating that FHWA had reached out to inform him that we are not consistently following important Design Directive requirements, specifically DD-603 and DD-662. FHWA may delay project funding authorization if these requirements are not met, which may lead to a loss in federal funding.

Federal Aid Resurfacing Operational Safety Review Checklist and Safety Report

DD-603, Construction Projects on Existing Roads (CPER) Category

dated May 4, 2022 establishes WVDOH RRR policy.

The designer shall make all attempts to identify all safety and ADA requirements. The designer shall document all construction projects on existing roadway (CPER) resurfacing projects using the attached Federal-Aid Resurfacing Operational & Safety Review Checklist 2016 (Safety Checklist).

Safety! It's the right thing to do for our families and friends while we have federal funding, data and justification to do it.

Federal Aid Resurfacing Operational & Safety Review Checklist 2016

You will receive the following information from the Traffic Engineering Division. This information must be included in the review package before submitting for PS&E:

- [x] Include copy of crash data (generally excel spreadsheet-see attached example)
- [x] Include crash rate analysis (overall, wet, night as compared to statewide average-see attached example)
- [ ] *NOTE:* For non-expressway facilities, if no crash rates are above the statewide average (overall, wet, night) check here, attach the data and no further review is required.
- [x] Include the preliminary recommendation(s) for proposed improvements to address any identified rates above statewide average-see attached example)

The Operational Review & Safety Report prepared by District Design/District Traffic Engineering should include the following:

1. *Project Overview*
   - [x] Project Limits
   - [x] AADT
   - [x] Roadway classification (NHFC)
   - [x] ROW Width
   - [x] Location Map (WVDOH)/Google Map

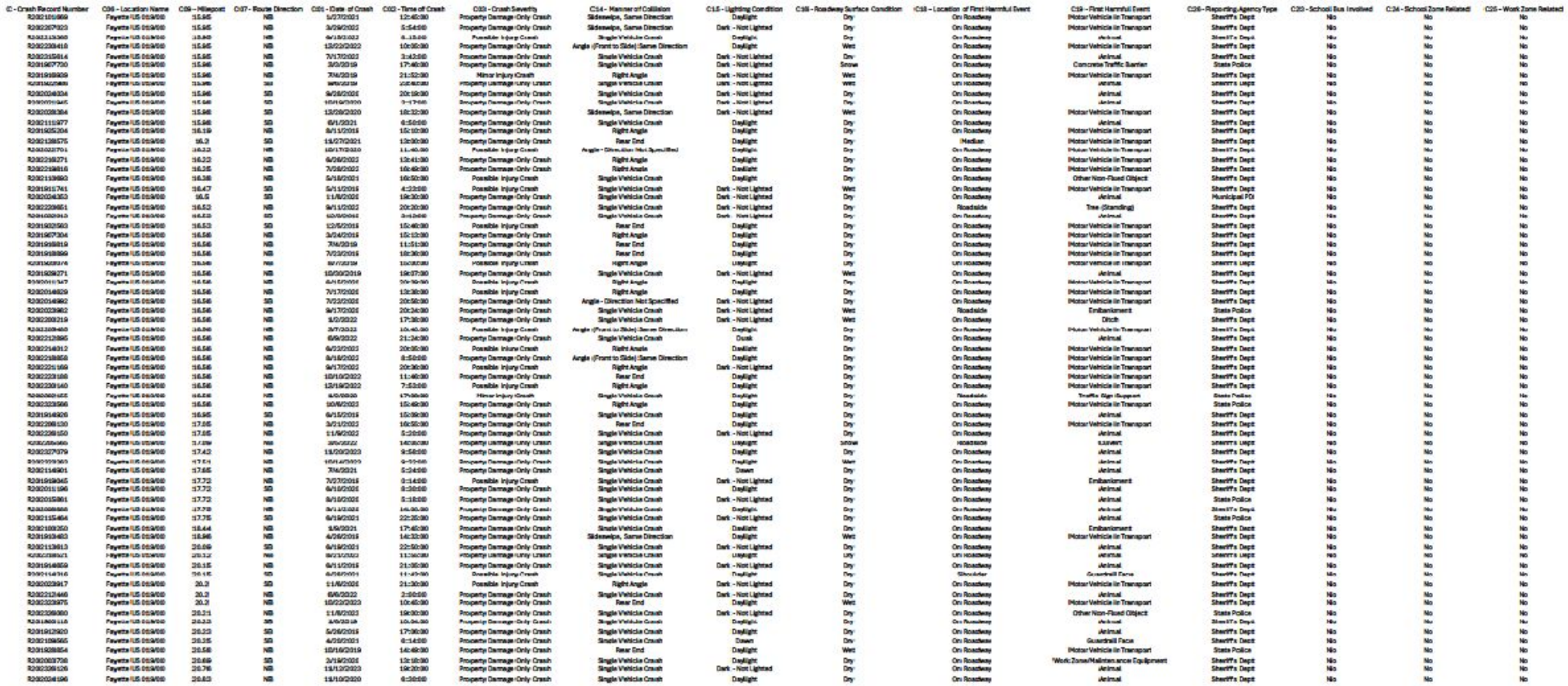
2. *Operational Experience*
   - [x] Using the crash data (excel spreadsheet) received from the Traffic Engineering Division match the mile points and the project stations included in the maintenance project construction documents. As an alternative location of crashes can be shown on Google map, Planning Straight Line or Cultural Straight Line
   - [ ] Summary of any fatal crashes (narrative only)
   - [ ] List any identified/recurring maintenance or operational concerns

3. *Pavement Conditions*

	Existing	Proposed
Lane Width	12 L.F.	12 L.F.
Shoulder Width	4 L.F. Lt./10 L.F. Rt.	4 L.F. Lt./10 L.F. Rt.
Shoulder Material	Asphalt	Asphalt
Drop Off	None	None
Safety Edge Presence	None	Yes
Pavement Condition (IRI if available)	Poor	Good

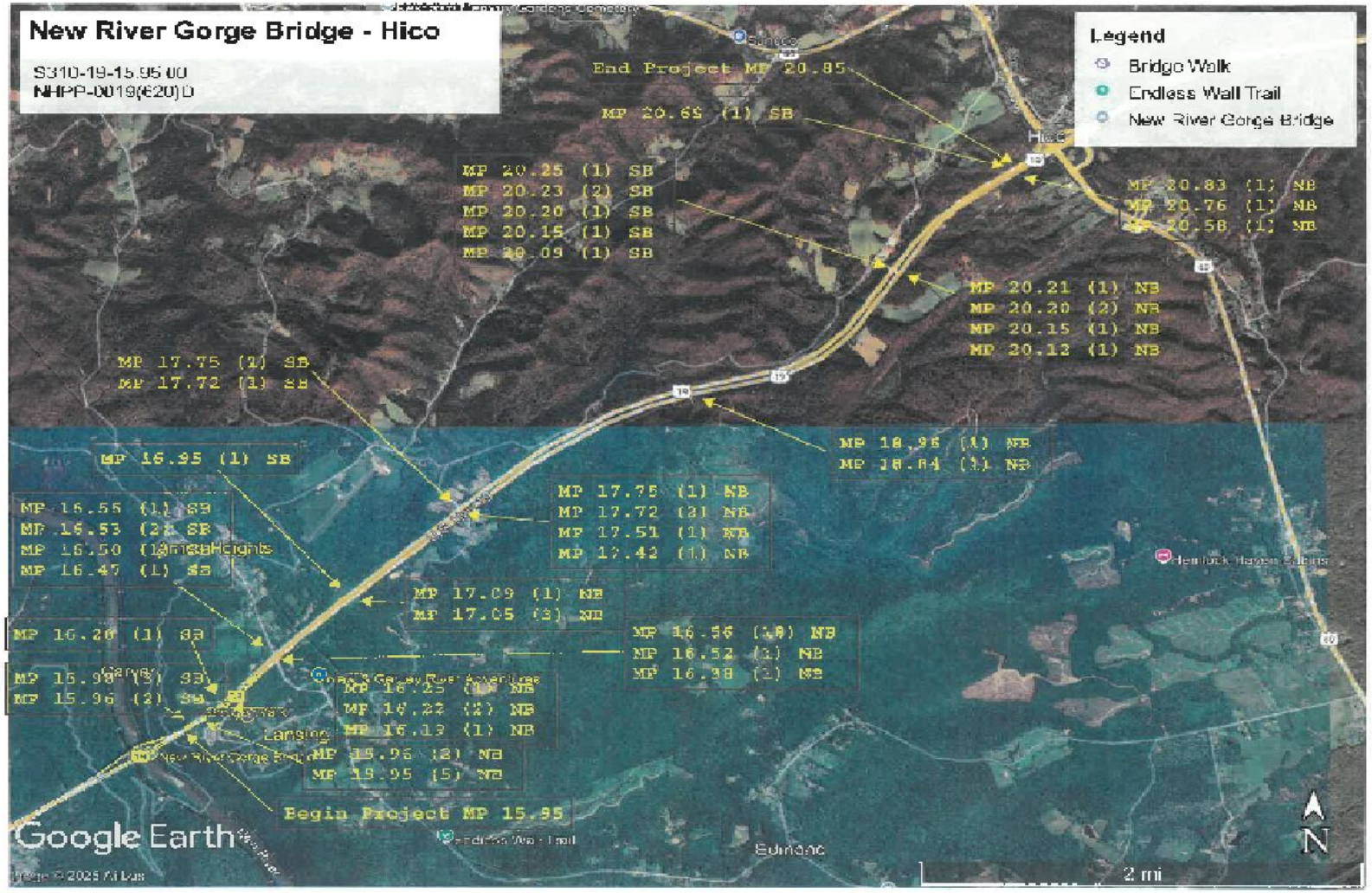
4. *Conclusions/Recommendations*
   - [x] Summary of any operational or safety enhancements included within project
   - [ ] Summary of how the initial recommendations for improvements were addressed
   - [ ] Any recommendations for improvements to be included in a separate project (send summary for all projects to Traffic Engineering Division for consideration in HSIP)

Federal Aid Resurfacing Operational and Safety Report



Federal Aid Resurfacing Operational and Safety Report

Google Earth Map of Crashes



Get other departments involved in helping identify safety or maintenance issues.

Ask the Interstate or APD Supervisor if they are aware of any issues that need addressed.

Ask Maintenance Engineer or Maintenance Assistants if they are aware of any issues.

Construction Engineer involved:

- Can your design be built.
  - Sequence of construction.
- Does the plans and specs cover installation, grading and other special details.

Traffic Engineer:

- What recurring issues impact traffic.
  - How can we lessen impacts to traffic.

DD-603, Construction Projects on Existing Roads (CPER) Category

Other Geometric and Cross-Sectional Element Criteria:

The designer **shall** determine the existing roadside departure accident rate for all construction projects on existing road projects. For projects that have above statewide average roadway departure rates, the designer **shall** investigate corrective measures for the corridor or spot corrections and document and implement actions. Projects on divided four lane routes that have above statewide average roadway departure accident rates within the project limits **shall** have median and outside side slopes graded to 6:1 and drainage adjusted. Types of corrective measures could include but are not limited to:

- Cross slope correction
- Superelevation correction
- Skid friction improvement
- Curve widening
- Shoulder paving
- Shoulder widening
- Lane departure warning devices
- Pavement marking and signing

Get your Traffic and Construction Engineers Involved.

DD-603, Construction Projects on Existing Roads (CPER) Category

Things To Improve Safety:

- Extend turn lanes for additional storage.
- Install Thrie Beam Bullnose Terminals around bridge piers and at bridges. Grade median to 10:1 or flatter as per Special Detail.
- Upgrade concrete median barrier if it doesn’t meet new height requirements.
- Upgrade traffic signals.
- Improve drainage.
- Replace damaged or missing right of way fence.
- Install delineator posts along travel lanes, at turn lanes, ramps, and on guardrail.

Get your Traffic and Construction Engineer Involved.

Steps for successful Interstate and APD Federal-Aid Projects:

- Complete traffic data for the project limits.
- Compare overall, wet, and night crashes to the statewide average.
- Get your Traffic Engineer involved for recommendations to lower the crash rate.
- Field review the project to look at where accidents frequently occur and decide if an improvement can be made.
- Check all signs and delineators to make sure that they are in good condition and reflective.
- Check all traffic signals. Do they have loops in the existing roadway surface. Upgrade signals as part of your project.

Federal Aid Resurfacing Operational and Safety Report

Project Information:

State Project Number S310-19-15.95 00

Federal Project Number NHPP-0019(620)D

Project Name NEW RIVER GORGE BRIDGE – HICO

County Fayette

Project Description:

Milling, Superpave Asphalt Skid Pavement, Type 9.5 @ 1.5 inches, Superpave Asphalt Base Course, Type 19 @ 2.5 inches, Milled in Rumble Strips, Aggregate Shoulders, Upgrade Guardrail to 31-inch MASH, Extend Three Turn Lanes, Pavement Markings, Raised Pavement Markers, and Traffic Control.

Federal Aid Resurfacing Operational and Safety Report

1. Project Overview

Project Limits

Begin Project: 0.27 miles South of CR 85/9 @ New River Gorge Bridge (MP 15.95)

End Project: 0.25 miles South of US 60 (MP 20.85)

AADT 16,000 (2023)

Roadway Classification

Functional System	Expressway
Federal Aid System	NHS
NHFC System	Principal Arterial – Other (Rural)
ROW Width	Varies throughout project

Federal Aid Resurfacing Operational and Safety Report

2. Operational Experience

Give a description of the accidents that occurred on this section of roadway (compared to statewide crash rate, what type of accidents, when did accidents occur, damages, summary of any fatal crashes, etc.

The crash data indicated that the overall crashes, wet crashes, and night crashes were all below the statewide crash rate. There were a total of seventy-one crashes that occurred throughout the project area. Out of the seventy-one accidents, forty-one were single vehicle crashes, thirteen were right angle crashes, eight were rear end collisions, four were sideswipe same direct crashes, three were angle front to side same direction crashes, and two were angle no direction specified crashes.

Federal Aid Resurfacing Operational and Safety Report

2. Operational Experience Continued

No crashes resulted in a fatality. Fifty-four crashes resulted in property damage only, fifteen crashes reported possible injuries, and two crashes reported minor injuries. Twenty-seven of the crashes occurred at night, forty-one during daylight hours, two at dawn, and one at dusk. Thirty-one accidents were motor vehicle in transport, twenty-seven involved a collision with an animal, three accidents resulted in a collision with the embankment, two accidents involved collisions with the guardrail, two accidents involved a collision with non-fixed object, one accident involved a collision with the concrete barrier, one involved a culvert, one involved the ditch, one was a collision a traffic support sign, and one was a collision with a tree. Most of the accidents occurred at or near the at grade intersections throughout this project.

Federal Aid Resurfacing Operational and Safety Report

3. Pavement Conditions

Pavement Conditions	Existing	Proposed
Lane Width	12 L.F.	12 L.F.
Shoulder Width	4 L.F. Lt./10 L.F. Rt.	4 L. F. Lt./10 L.F. Rt.
Shoulder Material	Asphalt	Asphalt
Drop Off	None	None
Safety Edge Presence	None	Yes
Pavement Condition	Poor	Good

Federal Aid Resurfacing Operational and Safety Report

4. Conclusion/Recommendations Continued

New raised pavement markers and all pavement markings shall be installed on this project for lane delineation.

This project will upgrade all the guardrail and end terminals to the new 31-inch height and MASH standard. Cut slope terminals have been installed to protect motorist from going over embankments. All cut slope terminals will have the bottom rail protecting motorists from sliding under the guardrail. Guardrail mounted delineator posts will be installed on all new guardrail in this project to help with lane delineation. The concrete barrier will be upgraded to the new height requirement.

All signs on this project will be upgraded on a future APD contract project.

Federal Aid Resurfacing Operational and Safety Report

Statewide Crash Rate vs Project Crash Rate

District: 9 County: Fayette

Functional Class: Principal Arterial – Other

Route: US 19

Begin MP: 15.95 End MP: 20.85

Rural/Urban: Rural

Total Crashes: 71 Crash Rate: 49.62

Statewide Crash Rate: 91.49 Difference: -45.76%

Wet Crashes: 14 Wet Crash Rate: 9.78

Statewide Wet Crash Rate: 37.00 Difference: -73.56%

Night Crashes: 30 Night Crash Rate: 20.97

Statewide Night Crash Rate: 41.00 Difference: -48.85%

Construction Plans, Federal-Aid Resurfacing Operational Safety Review Checklist, and Safety Report are complete now what?

DD-603, Construction Projects on Existing Roads Category

For Interstate and four-lane highways, the designer **will** contact FHWA to conduct a field review after receiving preliminary information required for completing the Federal-Aid Resurfacing Operational & Safety Review. Checklist 2016. Recommendations from the field review will be incorporated into the plans or noted as future projects or maintenance activities on the Federal-Aid Resurfacing Operational & Safety Checklist. The checklist, and any supporting documents, will be submitted with the PS&E package.

Contact FHWA to schedule Safety Review

Schedule
Safety Review
for
Project.

Who should I invite?

- Designer
- FHWA
- Development Engineer
- District Engineer/Manager
- Construction Engineer
- Assistant Construction Engineer
- Resurfacing Coordinator
- Regional Construction Engineer
- Traffic Engineer
- Maintenance Engineer
- Maintenance Assistant for the area
- Supervisor of roadway that the project is on

Meet at the closest DOH facility to the project

Make sure that all the people invited have a set of plans to review prior to the safety review meeting.

During Meeting:

Give an overview of the project (name, where is it located, what construction activities are planned).

Discuss the accident data, concerns, and solutions to correct the issues.

Let everyone provide feedback about their concerns. Try to come to an agreement about what needs to be done to improve safety and constructability.

Review the project site with FHWA and others once all discussions are final.

Use all feedback to make revisions to the plans and submit them to FHWA for their final approval.

Submit the approval email from FWHA and sign in sheet from safety review with your PS&E package in the Miscellaneous 19 Section.

If not, FHWA will delay project funding until a field review can be performed, and any findings found during the field review are incorporated into the project.

Improvements to all projects:

DD-662 - Guardrail

Approach End Terminals:

All end terminals on NHS projects to be let to construction after June 30, 2018, **shall** conform to the latest edition MASH.

On all Non-NHS 3R projects requiring Class 1 G/R at a minimum **shall** upgra all end terminals to MASH.

Improvements to all projects:

DD-662 - Guardrail

NHS Projects:

The standard approach end terminal is the Cut Slope Terminal (CST). If the use of the CST is not possible then the designer should use, in order of preference, a Flared End Terminal (FET) or Tangent End Terminal (TET).

Improvements to all projects:

DD-662 - Guardrail

<u>3R Projects:</u>

- The designer should not accept the location of the existing guardrail and en terminals as being correct and simply replace them with new material. The designer's goal should be improved safety. (Look at your length of need).
- This may require site grading, whic require a quantity of borrow excavation.

Improvements to all projects:

DD-662 - Guardrail

Guardrail Height:

In accordance with the revised standard details regarding guardrail height, all new guardrail shall be 31 inches to the top of rail. (All guardrail should be upgraded on Interstate and APD Projects).

Improvements to all projects:

DD-662 - Guardrail

Delineator Posts:

New guardrail delineators should also be replaced as part of the project since the removal of guardrail will also remove the existing delineator posts.

Improvements to all projects:

Guardrail

Grading Requirements for End Terminals:

FHWA will now start requiring plans to include a quantity of unclassified borrow excavation to properly grade under and around CST, FET, TET, and Bullnose Terminals.

Roadside Barrier Design

Deliverable of FAST Act, Pub. L. 114-94 $ 1418, '2016 Guardrail Training'

ROADSIDE BARRIER DESIGN

ORDER OF PREFERENCE

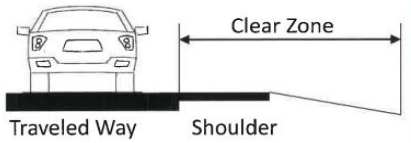
1. Remove the obstacle.
2. Redesign the obstacle so it can be safely traversed.
3. Relocate the obstacle to a point where it is less likely to be struck.
4. Reduce impact severity by using an appropriate breakaway design.
5. Shield the obstacle with a longitudinal traffic barrier designed for redirection or use a crash cushion
6. Delineate the obstacle if the previous alternatives are not appropriate.

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION, Pg 1-4

CLEAR ZONE DEFINITION

The unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles. The clear zone includes shoulders, bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes.

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION, Glossary



BARRIER WARRANTS

Obstacle	Guidelines
Bridge piers, abutments, and railing ends	Shielding generally needed.
Boulders	Judgment decision based on nature of fixed object and likelihood of impact.
Culverts, pipes, headwalls	Judgment decision based on size, shape and location of obstacle.
Foreslopes and backslopes (smooth)	Shielding not generally required.
Foreslopes and backslopes (rough)	Judgment decision based on likelihood of impact.
Ditches (parallel)	Refer to Figures 3-6 and 3-7 in Roadside Design Guide.
Ditches (transverse)	Shielding generally required if likelihood of head-on impact is high.
Embankment	Judgment decision based on fill height and slope (see Figure 5-1 in Roadside Design Guide).
Retaining Walls	Judgment decision based on relative smoothness of wall and anticipated maximum angle of impact.
Sign/Luminaire supports	Shielding generally required for non-breakaway supports.
Traffic signal supports	Isolated traffic signals within clear zone on high-speed rural facilities may need shielding.
Trees	Judgment decision based on site-specific circumstances
Utility poles	Shielding may be needed on a case by case basis.
Permanent bodies of water	Judgment decision based on location and depth of water and likelihood of encroachment.

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 5.2, Pg. 5-9

DESIGN CLEAR ZONE DISTANCE

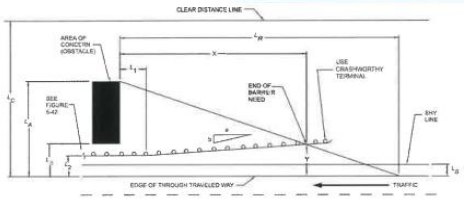
Design Speed (mph)	Design ADT	Foreslopes 1V:6H or flatter	Foreslopes 1V:5H to 1V:4H	Foreslopes 1V:3H	Backslopes 1V:3H	Backslopes 1V:5H to 1V:4H	Backslopes 1V:6H or flatter
≤40	UNDER 750[c]	7-10	7-10	b	7-10	7-10	7-10
	750-1500	10-12	12-14	b	10-12	10-12	10-12
	1500-6000	12-14	14-16	b	12-14	12-14	12-14
	OVER 6000	14-16	16-18	b	14-16	14-16	14-16
45-50	UNDER 750[c]	10-12	12-14	b	8-10	8-10	10-12
	750-1500	14-16	16-20	b	10-12	12-14	14-16
	1500-6000	16-18	20-26	b	12-14	14-16	16-18
	OVER 6000	20-22	24-28	b	14-16	18-20	20-22
55	UNDER 750[c]	12-14	14-18	b	8-10	10-12	10-12
	750-1500	16-18	20-24	b	10-12	14-16	16-18
	1500-6000	20-22	24-30	b	14-16	16-18	20-22
	OVER 6000	22-24	26-32[a]	b	16-18	20-22	22-24
60	UNDER 750[c]	16-18	20-24	b	10-12	12-14	14-16
	750-1500	20-24	26-32[a]	b	12-14	16-18	20-22
	1500-6000	26-30	32-40[a]	b	14-18	18-22	24-26
	OVER 6000	30-32[a]	36-44[a]	b	20-22	24-26	26-28
65-70[d]	UNDER 750[c]	18-20	20-26	b	10-12	14-16	14-16
	750-1500	24-26	28-36[a]	b	12-16	18-20	20-22
	1500-6000	28-32[a]	34-42[a]	b	16-20	22-24	26-28
	OVER 6000	30-34[a]	38-46[a]	b	22-24	26-30	28-30

See footnotes indicated in the Roadside Design Guide, 4th Edition, Pg. 3-3.
Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 3.1, Pg. 3-3

BARRIER DESIGN PRINCIPLES

1. **Deflection Distance** – The distance from the barrier to rigid obstacle when impacted; the working width is from the face to maximum lateral position of any part of system after impact. For the 31" high system (MGS) the working width was approximately 5' at TL-3. For High Tension Cable Barrier (HTCB) refer to Manufacturer.
2. **Slope in Front of Barrier** – The slope in front of w-beam guardrail shall be 10:1 or flatter. High tension cable barrier (HTCB) can be placed on 6:1 (or even 4:1) slopes with restrictions.
3. **Guardrail and Curbs** – The combination of curbs and guardrail on high speed roadways is not desirable. When necessary at high speed locations (45 mph or greater), WVDOH DD-663 provides for Type III 4" high sloped faced curb.
4. **Soil Backing** – A flat area (10:1) of 2.0 feet measured from the back of post is desirable but may vary depending on slope, soil type etc. DD-662 states that for new construction the face of Type III guardrail should be located 2' from the P.I. The 31" (MGS) guardrail with standard posts was successfully crash tested with post at breakpoint for 2:1 slope and also with 8' long steel post up to 18" beyond the breakpoint (to back of post).
5. **Flare rate** – Refer to Table below.

LENGTH OF NEED (LON) CALCULATION



For two way traffic use the centerline as edge of travelway for determining clear zone and length of need for the opposite direction.

Calculate the Length of Need (X) from the following equation:

$$X = \frac{L_A + (b/a)(L_1) - L_2}{(b/a) + (L_A/L_R)}$$

For parallel installations i.e. no flare, the equation becomes:

$$X = \frac{L_A - L_2}{L_A / L_R}$$

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION, Pg. 5-51

L_A = Back of Obstacle

L_c = Clear Zone Distance

b/a = Flare rate (see Table 5-9)

L_1 = Beginning of Flare

L_2 = Barrier Offset

L_3 = Distance to Obstacle

L_R = Runout Length (see Table 5-10)

Placing barrier on a flare can move the barrier and terminal away from the roadway and shorten the length of barrier. However the slope in front of barrier must be 10:1. Also, if used off of a transition, WVDOT requires an additional 12.5'of tangent guardrail before beginning the flare (DD-662).

RUNOUT LENGTHS

Design Speed (mph)	Runout Length (L_R) Given Traffic Volume (ADT) (ft) Over 10,000	5,000 to 10,000	1,000 to 5,000	Under 1,000
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 – TABLE 5.10

SUGGESTED FLARE RATES

Design Speed (mph)	Flare Rate for Barrier Inside the Shy Line	Flare Rate for Barrier at or Beyond Shy Line: Rigid Barrier	Flare Rate for Barrier at or Beyond Shy Line: Semi-Rigid Barrier
70	30:1	20:1	15:1
60	26:1	18:1	14:1
55	24:1	16:1	12:1
50	21:1	14:1	11:1
45	18:1	12:1	10:1
40	16:1	10:1	8:1
30	13:1	8:1	7:1

If the barrier can be flared – only over flat ground – see the AASHTO Roadside Design Guide section on Length of Need for the formula including a flared layout

REF: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 5.9

Clear Zone Concept
Roadside Design Guide – Chapter 3 Roadside Topography & Drainage Features

Clear Zone – The unobstructed, traversable area provided beyond the edge of the through traveled way for the recovery of errant vehicles.

'Traversable Foreslope' – Recoverable (4:1 or flatter, 6:1 preferred on high-speed roadways)

Non-recoverable (4:1 – 3:1) - you are going to the bottom

Critical (3:1 or steeper) - potential roll over.

Transverse slopes are more critical to errant vehicles so 10:1 preferred, but may cause drainage concerns.

6:1 or flatter may be acceptable.

Steeper slopes may result in the Dukes of Hazard jump.

Review the Tables, Charts and Examples for more details.

Design Clear Zone Distance Table 3-1

DESIGN CLEAR ZONE DISTANCE

Design Speed (mph)	Design ADT	Foreslopes			Backslopes		
		1V:6H or flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
≤40	UNDER 750[c]	7-10	7-10	b	7-10	7-10	7-10
	750-1500	10-12	12-14	b	10-12	10-12	10-12
	1500-6000	12-14	14-16	b	12-14	12-14	12-14
	OVER 6000	14-16	16-18	b	14-16	14-16	14-16
45-50	UNDER 750[c]	10-12	12-14	b	8-10	8-10	10-12
	750-1500	14-16	16-20	b	10-12	12-14	14-16
	1500-6000	16-18	20-26	b	12-14	14-16	16-18
	OVER 6000	20-22	24-28	b	14-16	18-20	20-22
55	UNDER 750[c]	12-14	14-18	b	8-10	10-12	10-12
	750-1500	16-18	20-24	b	10-12	14-16	16-18
	1500-6000	20-22	24-30	b	14-16	16-18	20-22
	OVER 6000	22-24	26-32[a]	b	16-18	20-22	22-24
60	UNDER 750[c]	16-18	20-24	b	10-12	12-14	14-16
	750-1500	20-24	26-32[a]	b	12-14	16-18	20-22
	1500-6000	26-30	32-40[a]	b	14-18	18-22	24-26
	OVER 6000	30-32[a]	36-44[a]	b	20-22	24-26	26-28
65-70[d]	UNDER 750[c]	18-20	20-26	b	10-12	14-16	14-16
	750-1500	24-26	28-36[a]	b	12-16	18-20	20-22
	1500-6000	28-32[a]	34-42[a]	b	16-20	22-24	26-28
	OVER 6000	30-34[a]	38-46[a]	b	22-24	26-30	28-30

See footnotes indicated in the Roadside Design Guide, 4th Edition, Pg. 3-3.
Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION – TABLE 3.1, Pg. 3-3

Consider:

- All of the notes associated with Table 3-1.
- Horizontal Curve Adjustment Factors Table 3-2 in accident prone locations.

Order of Preference (RDG p.1-4)

1. **Remove the obstacle.**
2. **Redesign the obstacle so it can be safely traversed.**
3. **Relocate the obstacle to a point where it is less likely to be struck.**
4. **Reduce impact severity by using appropriate breakaway design,**
5. **Shield the obstacle with a longitudinal traffic barrier designed for redirection or use a crash cushion.**
6. **Delineate the obstacle if the previous alternatives are not appropriate.**

Roadside Barriers – RDG Chapter 5

Longitudinal barrier used to shield motorists from natural and man-made obstacles located along either side of the traveled way.

Roadside Geometry and Terrain Features – Generally 3:1 foreslopes and 15’ fill heights warrant barrier consideration. (Figures 5-1, 5-2, 5-3.)

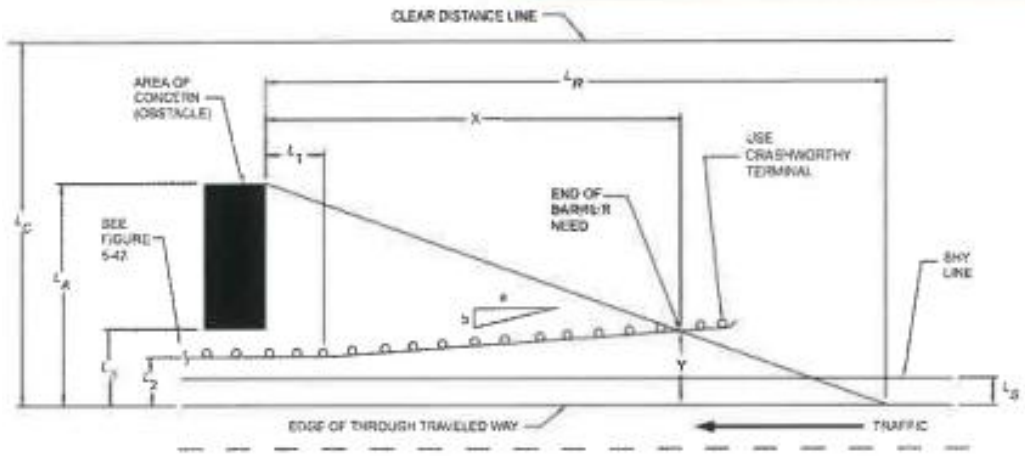
Barrier placement must account for dynamic displacement of 4’-5’.

Guardrail set 2’ from the embankment PI for adequate post support.

Suggested flare rates for barriers design (Table 5-9).

Length of Need to shield the obstruction

LENGTH OF NEED (LON) CALCULATION



For two way traffic use the centerline as edge of travelway for determining clear zone and length of need for the opposite direction.

Calculate the Length of Need (X) from the following equation:

$$X = \frac{L_A + (b/a)(L_1) - L_2}{(b/a) + (L_A/L_R)}$$

For parallel installations i.e. no flare, the equation becomes:

$$X = \frac{L_A - L_2}{L_A / L_R}$$

Ref: AASHTO ROADSIDE DESIGN GUIDE, 4th EDITION, Pg. 5-51

L_A = Back of Obstacle

L_c = Clear Zone Distance

b/a = Flare rate (see Table 5-9)

L_1 = Beginning of Flare

L_2 = Barrier Offset

L_3 = Distance to Obstacle

L_R = Runout Length (see Table 5-10)

Placing barrier on a flare can move the barrier and terminal away from the roadway and shorten the length of barrier. However the slope in front of barrier must be 10:1. Also, if used off of a transition, WVDOT requires an additional 12.5'of tangent guardrail before beginning the flare (DD-662).

SUGGESTED FLARE RATES

End Terminals – Chapter 8

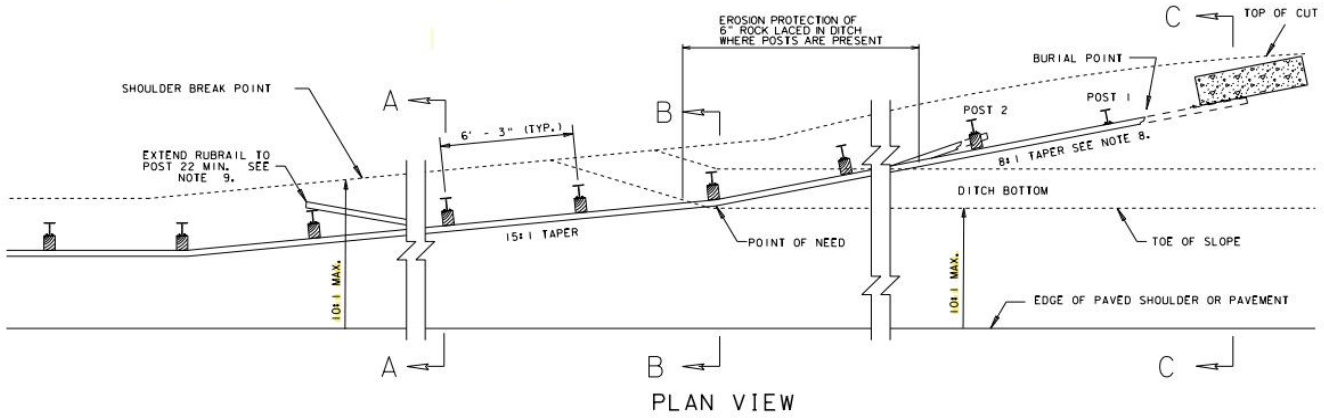
Often missed:

8.2 Anchorage Design Concepts

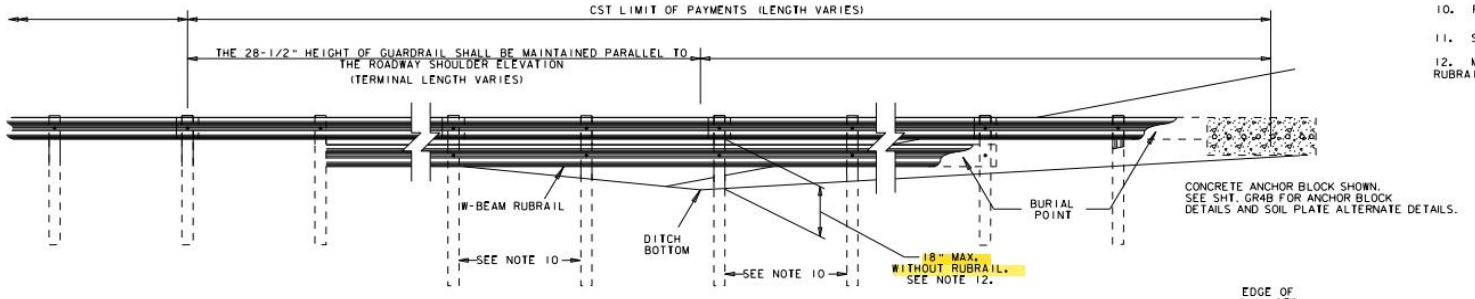
All flexible and semi-rigid barriers need to be terminated with an anchor system on both ends…..Anchorages at both ends transfer these tension forces to the ground….dynamic deflection is kept within acceptable levels.

Grading explanations.

Cut Slope Terminal



PLAN VIEW



ELEVATION VIEW

NOTES

1. FOR FILL TO CUT GUARDRAIL TERMINALS (TRAILING END, TWO LANE HIGHWAYS, AND ALL APPROACH END) WHERE ANCHORED ENDS ARE SPECIFIED, THE DETAILS AND REQUIREMENT HEREIN SHALL BE APPLICABLE.

2. PRIOR TO PLACING GUARDRAIL, A FINAL CHECK OF EXISTING CONDITIONS WILL BE MADE BY THE ENGINEER AND ANY ADJUSTMENT NECESSARY TO INSURE THE PROPER LOCATION AND FUNCTIONING OF THE GUARDRAIL FOR THE PURPOSE FOR WHICH IT IS INTENDED WILL BE MADE ACCORDINGLY.

3. POSTS, BLOCKS AND RAIL ELEMENTS SHALL BE THE SAME TYPES USED IN THE NORMAL GUARDRAIL INSTALLATION, UNLESS OTHERWISE NOTED. GUARDRAIL BLOCKS SHALL NOT BE USED ON ANY POSTS COMPLETELY UNDERGROUND.

4. THE FINAL DECISION AS TO THE TYPE OF CUT SLOPE TERMINAL INSTALLATION (TYPE A OR B) AT EACH LOCATION WILL ABE BASED ONTHE ACTUAL MATERIALS ENCOUNTERED DURING CONSTRUCTION.

5. CUT SLOPE TERMINAL INSTALLATION CAN INTERFERE WITH NORMAL DRAINAGE THROUGH A CUT SECTION. WHEN THIS OCCURS, DETAILS FOR MAINTAINING POSITIVE DRAINAGE WILL BE SHOWN ON THE PROJECT PLANS.

6. WHEN INSTALING CST TYING INTO 31" TOP OF RAIL HEIGHT GUARDRAIL. THE CST SHALL BE INSTALLED AT 28-1/2" HEIGHT. TAPER 31" GUARDRAIL DOWN VERTICALLY PRIOR TO CST INSTALLATION.

7. THE CST GUARDRAIL TERMINAL SHOULD BE USED ONLY WITH 2:1 OR STEEPER BACK SLOPE.

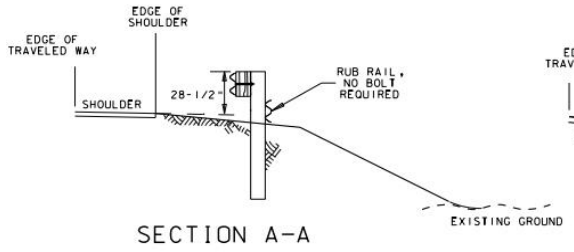
8. THE FLARE RATE OF THE GUARDRAIL MAY BE STEEPENED TO 8:1 AFTER CROSSING THE DITCH BOTTOM TO SHORTEN THE LENGTH OF THE TERMINAL.

9. RUBRAIL TO EXTEND FROM POST 2, THROUGH ENTIRETY OF DITCH, TO POST 22 AT A MINIMUM.

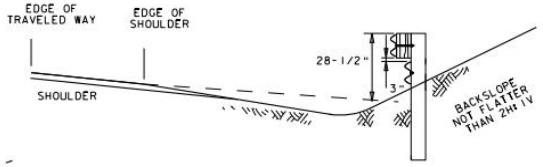
10. FOR THE RUB RAIL SECTION USE 8' LONG POSTS.

11. SEE GR-4A AND GR-4B FOR DETAILS OF TYPE A AND TYPE B TERMINALS.

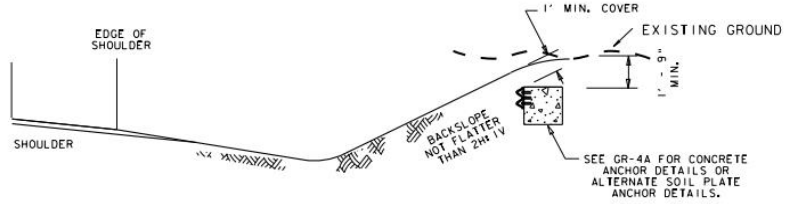
12. MAXIMUM CLEARANCE FROM BOTTOM OF W-BEAM TO GROUND LINE WITHOUT W-BEAM RUBRAIL IS 18".



SECTION A-A



SECTION B-B



SECTION C-C

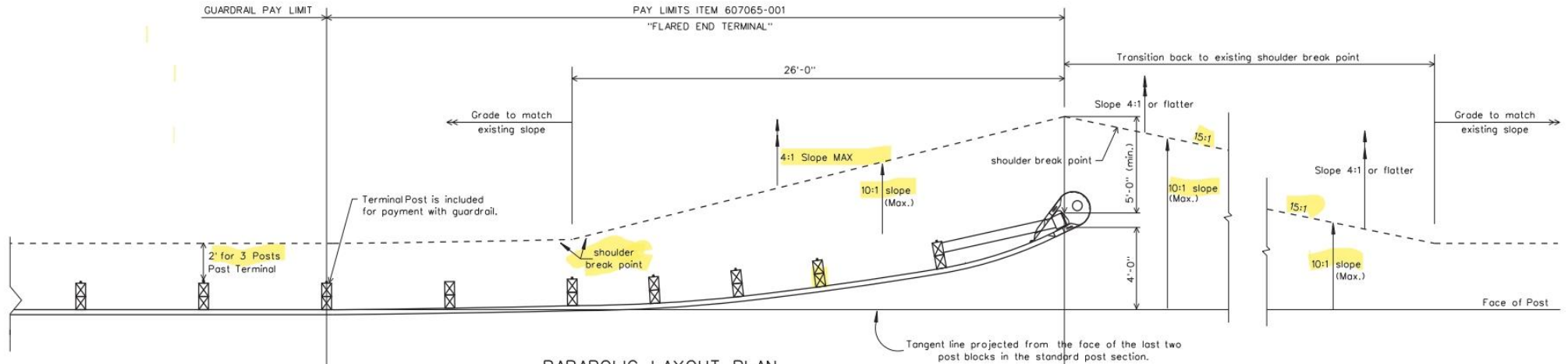
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED 7-1-99
REVISION DATE
4/22/15

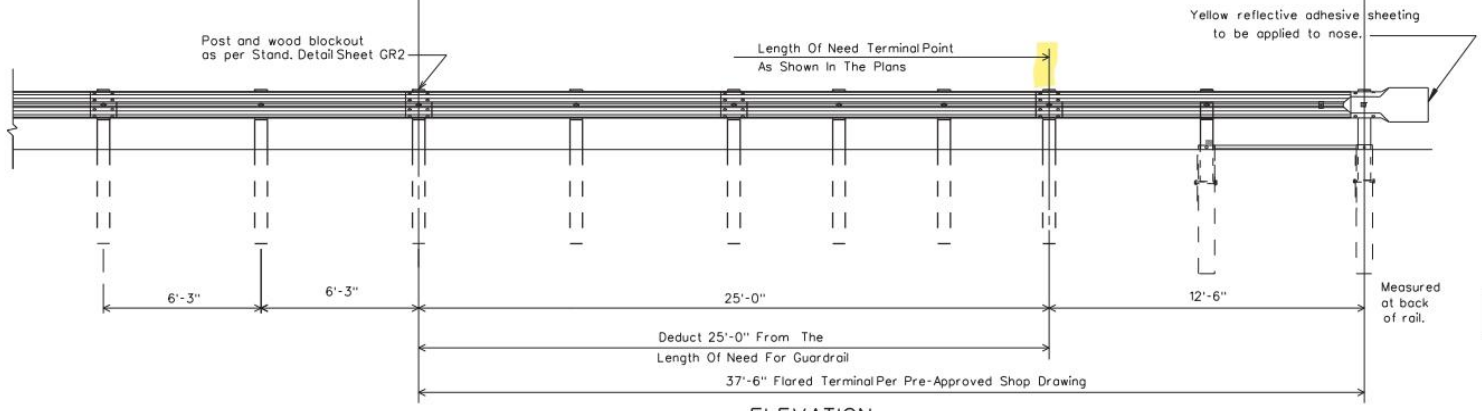
CUT SLOPE TERMINAL

STANDARD SHEET GR4

Flared End Terminal



PARABOLIC LAYOUT PLAN



ELEVATION

NOTES

For details of Flared End Terminal see pre approved shop drawings.

All materials used shall meet the applicable requirements of Section 607 of the Standard Specifications Road and Bridges.

The post offset dimensions are given to the center of the traffic face of the blockouts: except at the first post, where the dimension is to the center of the traffic face of the post. Offset points are to be located by measurements at the back of rail equal to the nominal post spacings shown on pre-approved shop drawings. Posts are to be set approximately radial to the railing at each location.

When a wood block is used adjacent to a wood post, the block shall be nailed to the post with a galvanized steel 10d common nail. The nail is to be driven into the center of the top or bottom of the block.

The cost of furnishing and installing the Flared End Terminal, complete with all miscellaneous hardware and parts as detailed on the pre-approved shop drawings , is to be included in the unit price bid for "Flared End Terminal".

Yellow reflective sheeting shall cover the entire nose of those terminals with a flat impact head. Those terminals with a rounded impact head shall be covered with a 1'-0" X 3'-0" yellow reflective sheet.

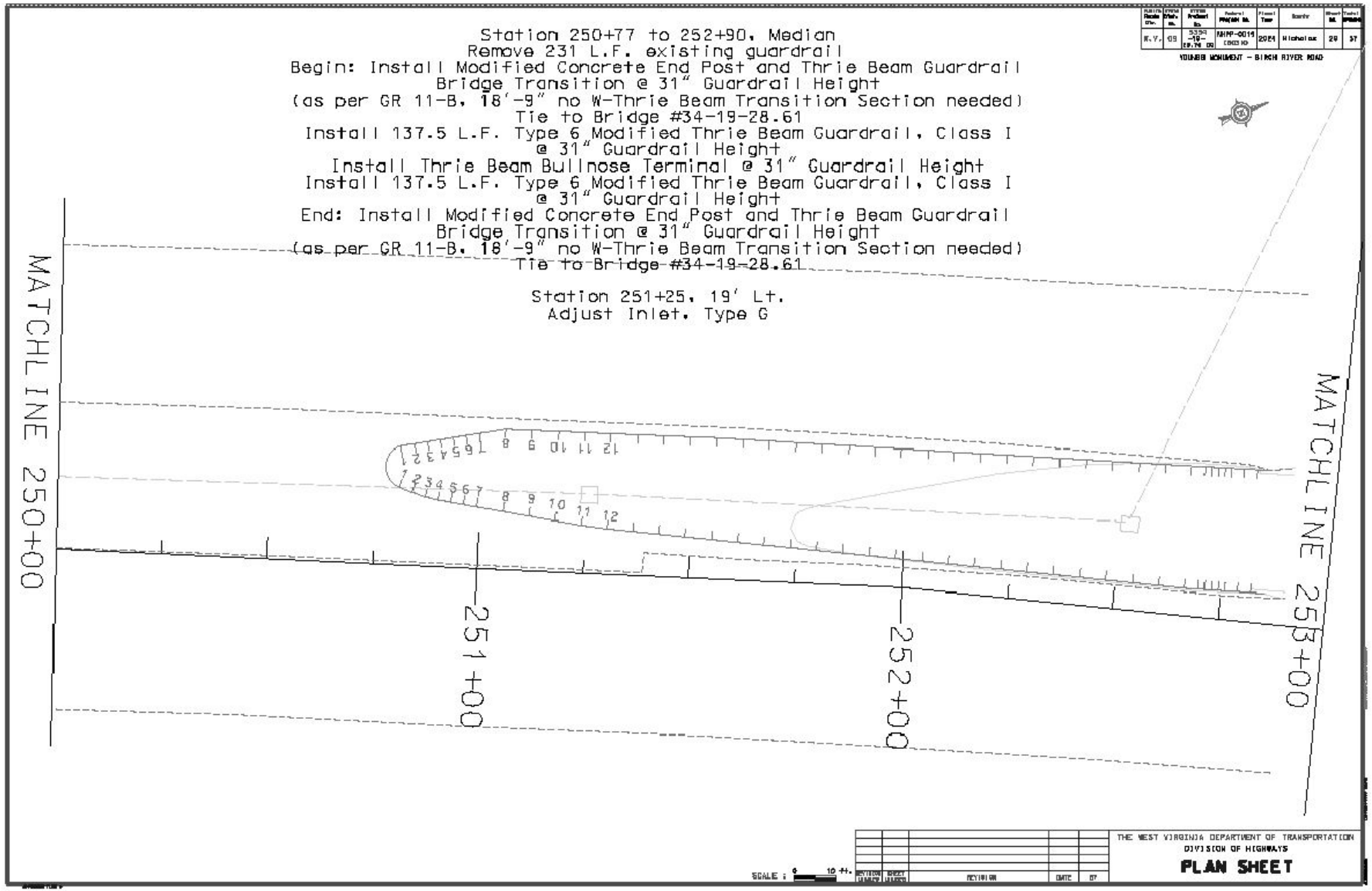
As of 11-13-12 revision date, this detail is obsolete and no longer used for new construction.

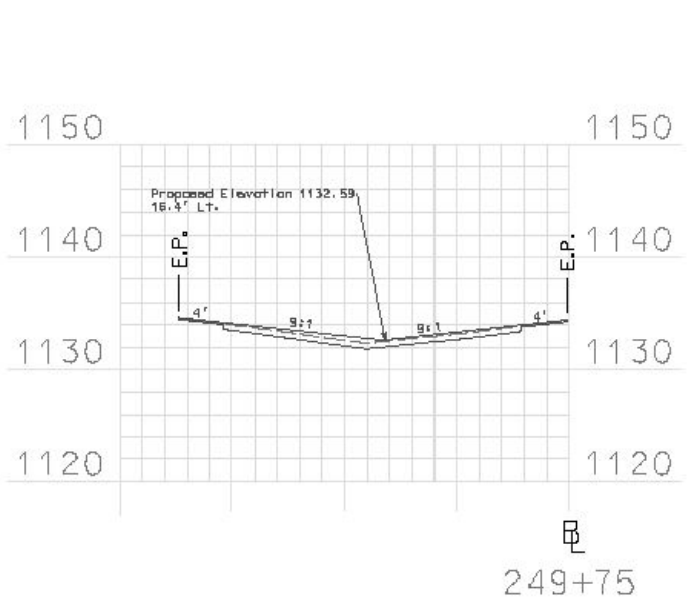
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

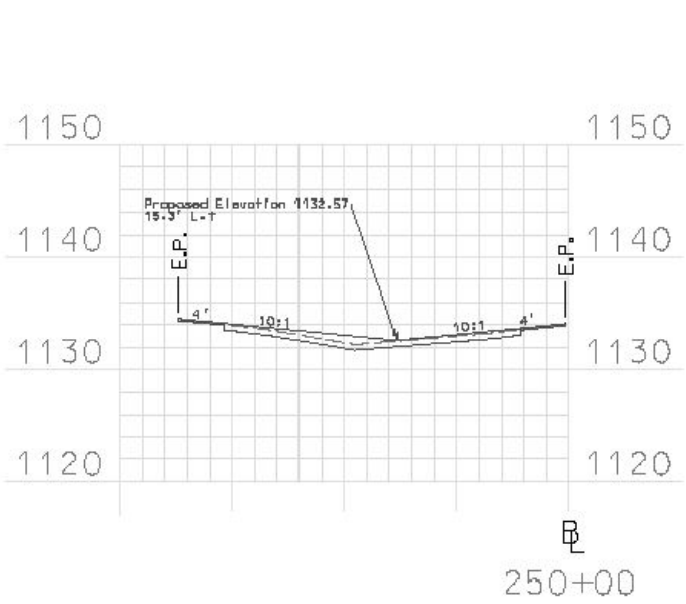
PREPARED 7-1-99
REVISION DATE
11-13-12

FLARED END TERMINAL
PARABOLIC LAYOUT
(SHEET 1 OF 2)

STANDARD SHEET GR5


Station 250+77 to 252+90, Median
Remove 231 L.F. existing guardrail
Begin: Install Modified Concrete End Post and Thrie Beam Guardrail Bridge Transition @ 31" Guardrail Height
(as per GR 11-B, 18'-9" no W-Thrie Beam Transition Section needed)
Tie to Bridge #34-19-28.61
Install 137.5 L.F. Type 6 Modified Thrie Beam Guardrail, Class I @ 31" Guardrail Height
Install Thrie Beam Bullnose Terminal @ 31" Guardrail Height
Install 137.5 L.F. Type 6 Modified Thrie Beam Guardrail, Class I @ 31" Guardrail Height
End: Install Modified Concrete End Post and Thrie Beam Guardrail Bridge Transition @ 31" Guardrail Height
(as per GR 11-B, 18'-9" no W-Thrie Beam Transition Section needed)
Tie to Bridge #34-19-28.61
Station 251+25, 19' Lt.
Adjust Inlet, Type G
MATCHLINE 250+00
MATCHLINE 253+00
251+00
252+00
YOUNGS MONUMENT - BIRCH RIVER ROAD
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET





YOUNGS MONUMENT - BIRCH RIVER ROAD

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CROSS SECTIONS

Conclusions

- Renew our focus on guardrail and other safety improvements based on data and site knowledge to fulfill our FHWA obligations.
- Learn where to find the information, and how to apply it.
- Let’s do our best to provide safe roadways for our family and friends.

Thank you for showing up every day and fighting the good fight to build high quality and safe roads.

Jim Moore, DE-9

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Email: james.f.moore@wv.gov