

## TRAFFIC BARRIER INVENTORY AND ASSESSMENT

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A traffic barrier, such as a guide rail, cable rail, concrete barrier, or end treatment, helps to shield vehicles that run off the road from hitting natural or manmade obstructions and thus reduce the severity of crashes. On local roads, traffic barriers are part of a municipality's valuable road asset network, along with signs, pavement markings, ITS devices, traffic signals, pavements, and drainage features.

To effectively manage these assets, municipalities should know what traffic barrier systems exist along their roads and what is the condition of the guide rail and end treatments. Such data helps to ensure that the guide rail remains effective in keeping drivers safe and allows the municipality to plan for necessary repairs and replacements.

When conducting a traffic barrier inventory, municipalities should also be sure to document compliance with crash test criteria. Many existing barrier installations in Pennsylvania were designed to meet National Cooperative Highway Research Program (NCHRP) 350, NCHRP 230, and/or pre-NCHRP 230 criteria. However, the new standard for traffic barriers is the Manual for Assessing Safety Hardware (MASH) 2016, which was developed in consideration of new heavier vehicle population and higher speeds. Every effort should be made to replace pre-NCHRP 350 traffic barriers with MASH 2016 compliant barriers. In addition, all new installations must meet MASH 2016 criteria.



A guide rail helps to shield vehicles that run off the road from hitting natural or manmade obstructions.

### Inventory

Municipalities should start by establishing an inventory of guide rail and other traffic barriers in their roadway network. Information to gather would include the type of barrier, its exact location, and total length. The inventory should also identify the type of end treatment and include photographs of the barrier and end treatments on both the approach and trailing ends of the barrier. Be sure to note the date the photos were taken. A barrier mobile application (similar to the app that PennDOT uses) can be developed and used to document the guide rail, end treatment, cable barrier, and permanent concrete barrier inventory following any repair, replacement, installation, and removal/elimination activities.

The information gathered through this assessment can be easily tabulated in a spreadsheet or asset management or database program. To help identify the type of guide rail and end treatment, municipalities may want to review PennDOT Publication 33, *Shoulder and Guide Rail Condition Survey Field Manual*, April 2019, which has photos of many types of systems in use in Pennsylvania. In addition, the new Chapter 17 of PennDOT Publication 23, *Maintenance Manual*, provides department policy on timely maintenance and repair of traffic barriers. This chapter includes various levels of distress severity to help decide which damaged barrier should be fixed immediately and which can be repaired later.

### Assessment

The assessment of a guide rail and barrier should attempt to answer three questions:

- 1) What is its condition?
- 2) Is it still warranted?
- 3) If not, can it be removed?

Publication 33 is a valuable resource for assessing the condition of existing guide rail. In particular, the publication's Rail/Median Barrier Condition Identification Guide can be used to assess the post deflection, cable sag, deterioration, hardware, and height of the rail, all important components of the rail system.

Post Deflection	
Severity	Description
None	All posts are standing vertical, no deflection in any posts.
Low	The posts are standing at an angle $<15^\circ$ from the vertical.
Medium	The posts are standing at an angle $\geq 15^\circ$ and $\leq 30^\circ$ from the vertical.
High	The posts are standing at an angle $>30^\circ$ from the vertical.

Cable Sag	
Severity	Description
None	All cables are horizontal, little or no sag.
Low	The cables have sagged $<6$ inches.
Medium	The cables have sagged $\geq 6$ inches and $\leq 12$ inches.
High	The cables have either sagged $>12$ inches OR have become detached from the support posts.

Deterioration	
Severity	Description
None	No deterioration and barrier elements are like new.
Low	Surface rust or dents are apparent on any of the steel elements. Concrete barriers have spalled areas.
Medium	Structural rust with loss of section is apparent on steel elements. Wood posts are cracked. Concrete barriers are cracked.
High	Steel elements are rusted through. Wood posts are rotted. Portions are broken out of concrete barrier.



Low-severity post deflection



High-severity deterioration of the W-beam rail



Medium-severity cable sag

**Hardware** — For a guide rail to operate effectively, all support and fastening nuts and bolts, posts, cables, panels, and other necessary items must also be in place. Missing or defective hardware should be noted and repaired.



W-beam panel disconnected from the post

**Height of rail** — As municipalities place successive pavement overlays on their roads, the increased depth of the pavement may end up lowering the height of the rail and reducing the effectiveness of the W-beam guide rail, cable rail, or concrete barrier systems.

On strong-post W-beam systems, the height from the ground to the top of the rail should be 31 inches (but at least 26.5 inches). For an F-shape concrete barrier system, any of the 3 inches of vertical face of the base must be visible. Height of different strands of cable barrier must meet manufacturer guidance. In general, height of the lower cable from the ground must not exceed 20 inches whereas the height of top cable should be 30 inches.

### Other Considerations

**End treatments** — An end treatment helps to shield errant vehicles from penetrating or impaling the end of a guide rail or barrier system. It also acts as an anchor to provide strength in all cable and weak-post W-beam systems.



Damaged turned-down end treatment and W-beam guide rail

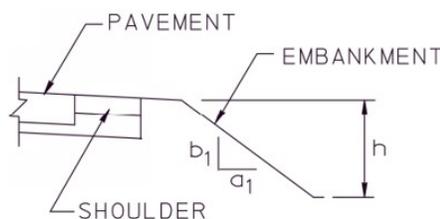
Municipalities should ensure repair or replacement of any end treatment that is deteriorated or damaged and can no longer serve its intended purpose. Nearly all end treatments are proprietary; therefore, it is important to follow the manufacturer's website for maintenance, repair, and replacement guidelines.

Transitions from a guide rail to bridge rail must have 1) a gradual stiffness and height transition between the bridge end and the approach guide rail, 2) an adequate attachment to the bridge barrier itself, and 3) the elimination of any potential snag points at the bridge end. If the existing bridge railings are not structurally adequate to support a connection, consider extending the traffic barrier across the structure.

**Warrants** — Keep in mind that traffic barriers should only be used if striking a hazard or leaving the road would cause more severe consequences than striking the barrier itself.

For roadside embankments, engineers use Table 12.6 of PennDOT's *Design Manual Part 2*, Publication 13M, to design new installations of guide rail. They rely on Table 12.7 in Publication 13M to determine the guide rail requirements for fixed objects within the clear zone of the roadway.

**TABLE 12.6  
BARRIER REQUIREMENTS FOR  
EMBANKMENT HEIGHTS**



EMBANKMENT SLOPE (S = b <sub>1</sub> : a <sub>1</sub> )	EMBANKMENT HEIGHT (h)			
	AVERAGE DAILY TRAFFIC (ADT)			
	> 5000	751 - 5000	401 - 750	≤ 400
1V:1.5H OR STEEPER	4.0 ft	6.0 ft	9.0 ft	17.0 ft
1V:2H	8.0 ft	10.0 ft	16.0 ft	31.0 ft
1V:2.5H	12.0 ft	16.0 ft	25.0 ft	49.0 ft
1V:3H OR FLATTER	GUIDE RAIL NOT REQUIRED			

PennDOT Pub 13M, *Design Manual Part 2*

**TABLE 12.7  
GUIDE RAIL REQUIREMENTS  
FOR FIXED OBJECTS  
WITHIN THE CLEAR ZONE**

FIXED OBJECTS WITHIN THE CLEAR ZONE	BARRIER REQUIRED	
	YES	NO
1. SIGN SUPPORT (GROUND MOUNTED): (A) POST OF BREAKAWAY DESIGN (B) SIGN BRIDGE SUPPORTS (C) CONCRETE BASE EXTENDING 4 in OR MORE ABOVE GROUND	X X X	X
2. LIGHTING POLES AND SUPPORTS OF BREAKAWAY DESIGN		X
3. BRIDGE PIERS AND ABUTMENTS AT UNDERPASSES	X	
4. CULVERT HEADWALLS 4 in OR MORE ABOVE GROUND	X	
5. TREES *		X
6. UTILITY POLES *		X
7. LIGHTING POLES WITH HIGH MAST LIGHTING	X	
8. RETAINING WALLS **		X

PennDOT Pub 13M, *Design Manual Part 2*

Both tables can also be used to decide if an existing guide rail is warranted. Consult a professional engineer to determine if an existing embankment or fixed object should be shielded with a traffic barrier. All these concepts are covered in more detail in the LTAP Roadside Safety Features class.

**Removal** — According to Publication 33, a guide rail section may be a candidate for removal if 1) the average daily traffic is greater than or equal to 2,000, the fill or embankment height is less than 10 feet, and

there are no fixed objects on the slope OR 2) if the average daily traffic is less than 2,000, the fill height is less than 20 feet, and there are no fixed objects on the slope.

In general, a guide rail section may be considered for removal if there are no fixed objects behind it and the slope behind the guide rail is relatively flat. Once guide rail is identified for removal, a municipality should be sure to remove it.

## Resources

- PennDOT Publication 33 can be accessed at [www.dot.state.pa.us/public/PubsForms/Publications/PUB%2033.pdf](http://www.dot.state.pa.us/public/PubsForms/Publications/PUB%2033.pdf)
- LTAP has developed a Guide Rail Evaluation Form (see example at right) to help in assessing existing guide rail. It requires the collection of traffic and roadway information and guide rail characteristics and can be used to justify the decision to remove an existing guide rail installation.
- LTAP covers guide rails in its Roadside Safety Features class.

### Guide Rail Evaluation Form

<b>Guide Rail Location:</b>	
<b>Traffic Characteristics</b>	
Posted Speed Limit	
85 <sup>th</sup> tile/design speed	
Volume	
Clear Zone from DMI	
Crash Data	
<b>Roadway Characteristics</b>	
Roadway surface	
Roadway width	
Horizontal Curves	
Shoulder	
<b>Guide rail Characteristics (Pub 33 Criteria)</b>	
Guide rail Type/Length	
Is the minimum deflection distance from DM-2, Table 12.4 and RC-54 provided?	
Guide rail Condition	
Deflection	
Cable Sag	
Deterioration	
Hardware	
Height	
End Treatments	
<b>Hazard Characteristics</b>	
Slope/Distance to hinge	
Fill Height	
Fixed Objects / Can they be mitigated?	
Candidate for Removal?	