



1.0 Introduction

Crushed aggregate shoulders are located beyond the pavement and any paved portion of shoulder, and are typically sloped at 4% (unless on the super-elevation of a curve). Shoulders are not on the in-slope, which is typically a steeper 6:1 or 4:1 slope. The crushed aggregate beyond 7 feet from the adjacent lane is not considered shoulder unless specified in the original typical section of that highway's plans. Many two-lane roadways have only a 6-foot total shoulder width. See *Table 4.10.01* at the end of this subject for typical shoulder widths. The Facilities Development Manual (FDM) Chapter 11-15 also describes shoulder widths and design of shoulders.

2.0 Materials

Crushed aggregate shoulders are made of limestone or other gravel consistent of a well graded granular surfacing material with ample fines and the right sized gradation to provide stability for vehicles that may have to use the area of the shoulder. Crushed aggregate shoulders need to be sloped to provide drainage and need to be compacted for strength.

3.0 Maintenance

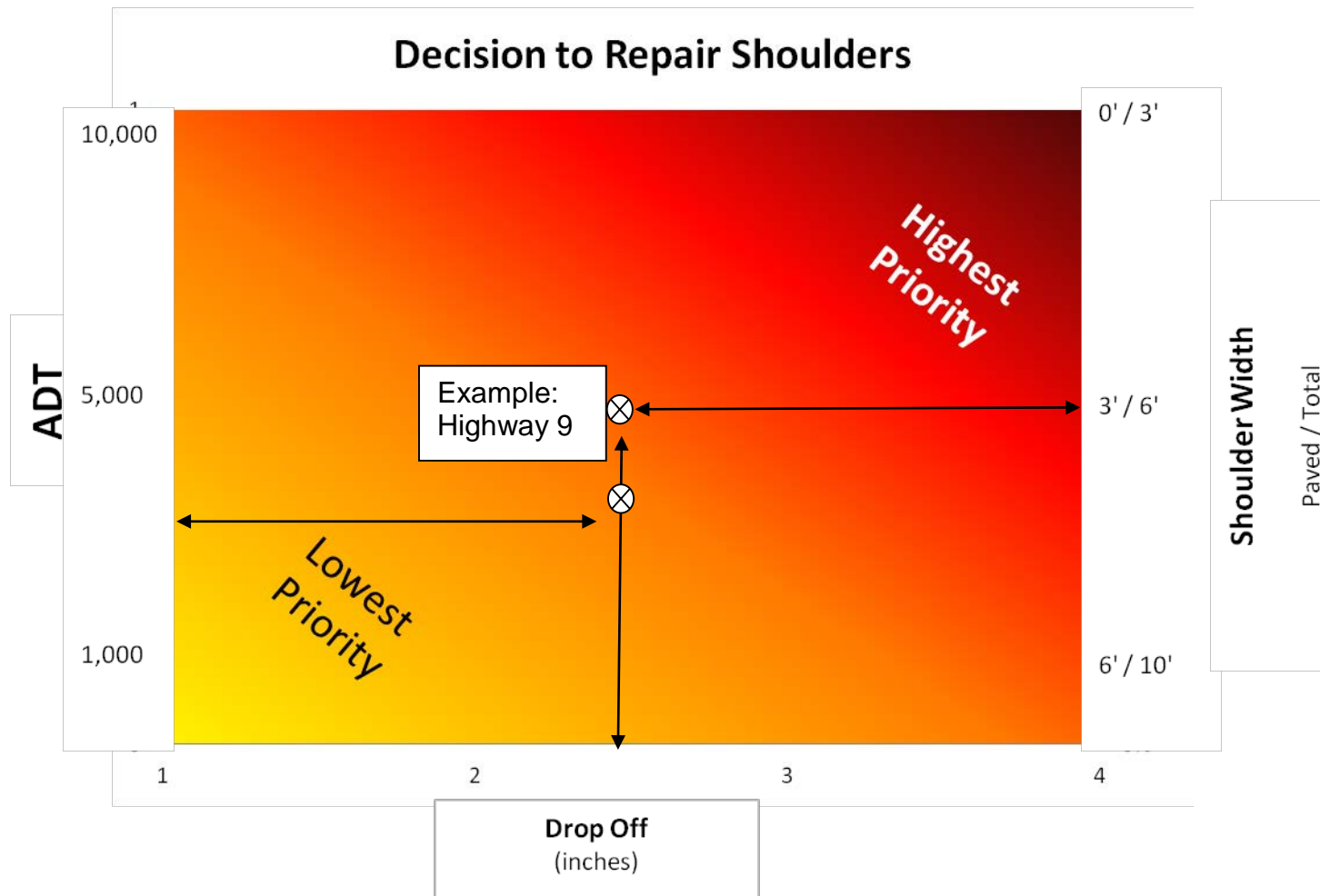
After the initial installation of a crushed aggregate shoulder, it may be necessary to make spot replacements of material from time to time. Water runoff from the pavement and vehicle use often causes some of the aggregate to settle, or to migrate onto the in-slope or into the ditch. When maintaining the crushed aggregate shoulder, the typical slope of 4% should be maintained unless it was designed otherwise as on the super-elevation of highway curves. Maintenance of the crushed aggregate shoulder includes grading, replacement of lost material and control of the erosion.

3.1 Edge Drop / Drop Off

Identification of crushed aggregate shoulder needing repair is often identified by "drop off". Drop-off occurs when the material has settled or moved away from the pavement edge making a lip which can make it difficult for vehicles that have drifted from the through lane to safely return to the pavement, and often causing a potentially dangerous over-correction maneuver. For crushed aggregate shoulders, an average drop-off of 1 ½ inches on a highway segment of at least 100-feet long should be addressed within a reasonable time after the discovered drop-off – which is not usually longer than one season.

Figure 1 below should be used to help decide which crushed aggregate shoulders should be repaired first. Distance from the drop-off to the live traffic lane, ADT and the amount of drop-off are all significant factors in the decision to repair shoulder drop-off. When the drop-off is closer to the lane of travel, vehicles tend to more frequently go off this edge and therefore be of higher concern. Alternately, if the drop-off is 10 feet from the travelled lane, it is less likely a vehicle will drift that far away from the lane and therefore repairing the edge drop is of lesser concern. It also makes sense that a 4-inch drop-off in any circumstance, must be of high concern to all maintenance professionals.

FIGURE 1



Use either *Drop-off vs. Shoulder width*
 or use *Drop-off vs. ADT* (or consider both methods)
 to prioritize shouldering projects

Example: Highway 9 has an ADT of 3,500, a 3' paved / 6' total shoulder and the average drop off is 2.5". Using either method, the priority to repair this shoulder is moderate, but if there were no paved shoulder, the priority of this repair would be higher than moderate.

3.2 Repair Methods

Crushed aggregate shoulder repair is performed in different ways with different long-term results. The simplest repair is often call "pulling the shoulders", where a grader is used to bring back as much of the old material from the in-slope or the ditch and eliminate the drop off. Sometimes this is compacted afterward, but because the material is often blended with soil and there are varying depths of repair, the shoulder quickly returns to the condition with drop off. This option may also produce a shoulder slope steeper than our desired 4%.

A better method of repairing crushed aggregate shoulder is to scarify the existing shoulder causing a uniform, temporary drop off, compaction at this step may be necessary before additional material is added, graded and finally compacted. This method is proven to have longer lasting results, but traffic volumes and erosion can still cause the eventual return to a crushed aggregate shoulder with drop off. Chronic and frequent drop off problems on crushed aggregate shoulders can be solved by paving the shoulder as a last resort.

Typical Shoulder Standards

Roadway Design Class	Total Shoulder Width (paved and unpaved)	Paved Shoulder Width (resurface, restore, rehab)	Unpaved Shoulder Width (resurface, restore, rehab)	Paved Shoulder Width (reconstruct, new, replace)	Unpaved Shoulder Width (reconstruct, new, replace)
A1	6'	3'	3'	Concrete: 3' Asphalt: 5'	3' 1'
A2	8' min, 10' desired	3'	5'-7'	Concrete: 3' Asphalt: 5'	5'-7' 3'-5'
A3 (4 lane)	Left: 4' min, 6' desired Right: 10'	Left: 3'-4' Right: 8'-10'	Left: 0'-3' Right: 0'-2'	Left: 3'-4' Right: 8'-10'	Left: 0'-3' Right: 0'-2'
A3 (6 lane)	Left: 10' Right: 10'	Left: 8'-10' Right: 8'-10'	Left: 0'-2' Right: 0'-2'	Left: 8'-10' Right: 8'-10'	Left: 0'-2' Right: 0'-2'
C1	2'-4'	If AADT>750: 3'			
C2	5' min, 6' desired	If AADT>750: 3'		If ADT>750: 3'-5'	
C3	6'	3'	3'	Concrete: 3' Asphalt: 5'	3' 1'
C4	8'	3'	5'	Concrete: 3' Asphalt: 5'	5' 3'
L1	2'-4'	If AADT>750: 3'			
L2	2'-4'	If AADT>750: 3'			
L3	5' min, 6' desired	If AADT>750: 3'		If ADT>750: 3'-5'	
L4	6'	3'	3'	Concrete: 3' Asphalt: 5'	3' 1'
L5	8'	3'	5'	Concrete: 3' Asphalt: 5'	5' 3'

Note: The matrix summarizes the standards – please refer to the WisDOT Facilities Development Manual for a complete listing of shoulder standards and exceptions. “Unpaved Shoulder Width” (for resurfacing, restoration and rehabilitation projects) is the difference between “Total Shoulder Width” (second column) and “Paved Shoulder Width” (third column). “Unpaved Shoulder Width” (for reconstruction, new construction, or pavement replacement projects) is the difference between “Total Shoulder Width” (second column) and “Paved Shoulder Width” (fifth column).

Source: FDM 11-15, Attachments 1.1, 1.2 and 1.3 for total shoulder width standards (second column). FDM 11-15, Attachment 1.5 for paved shoulder width standards (third and fifth columns).

Table 4.10.01