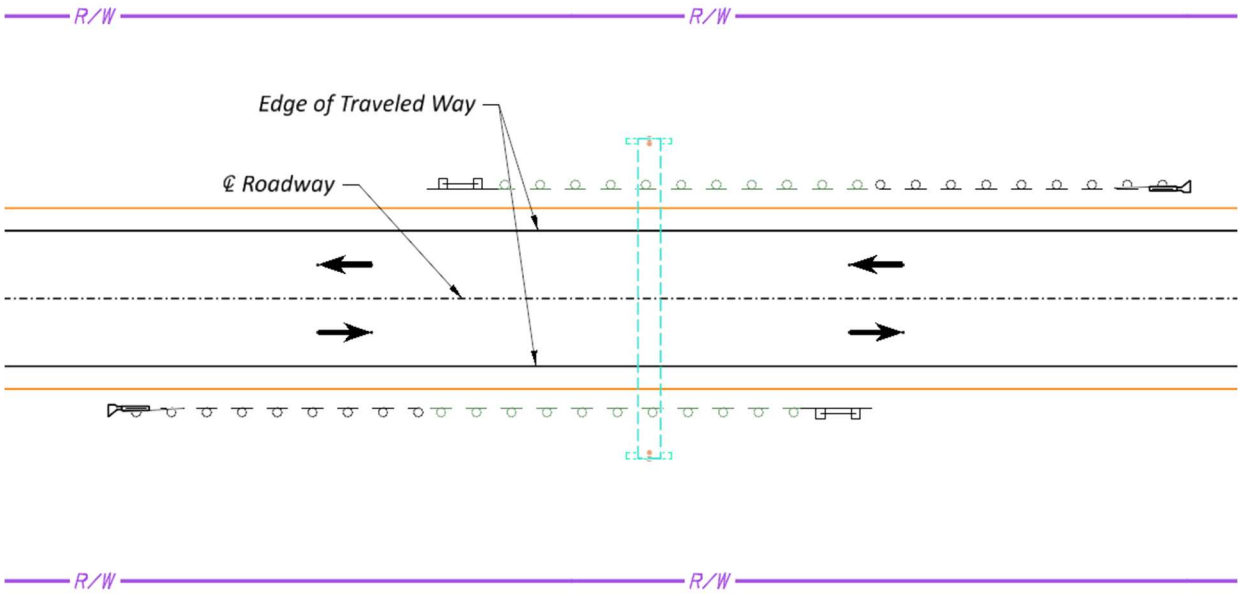
SAMPLE CALCULATIONS

Ex. 600-4

Clear Zone Grading to Eliminate Need for Barrier at a Fixed Object

Problem 4: Determine the required clear zone grading limits and additional pipe length required to extend a 48" culvert within existing right-of-way so that barrier protection can be eliminated. The project conditions are: a rural collector, tangent alignment, 100' of R/W, design speed of 55 mph, and 3200 ADT.



Solution 4: **Step 1** – Determine lateral clear zone grading limits and minimum culvert extension length. Refer to **Figure 600-1**, the clear zone is 21' when a 6:1 or flatter foreslope is provided, and 27' with a foreslope steeper than 6:1 to a maximum of 4:1. For this project a 6:1 foreslope is being used. The distance from the edge of traveled way to the back of headwall will need to meet or exceed the clear zone distance. Therefore, the 48" conduit will be extended so that the back of headwall is at least 21' from the edge of traveled way, and clear zone grading will be provided within that lateral zone.

Note: Although 6:1 is selected for this example, the determination of the foreslope grade will depend on available cover, right-of-way width, and other site & project specific conditions.

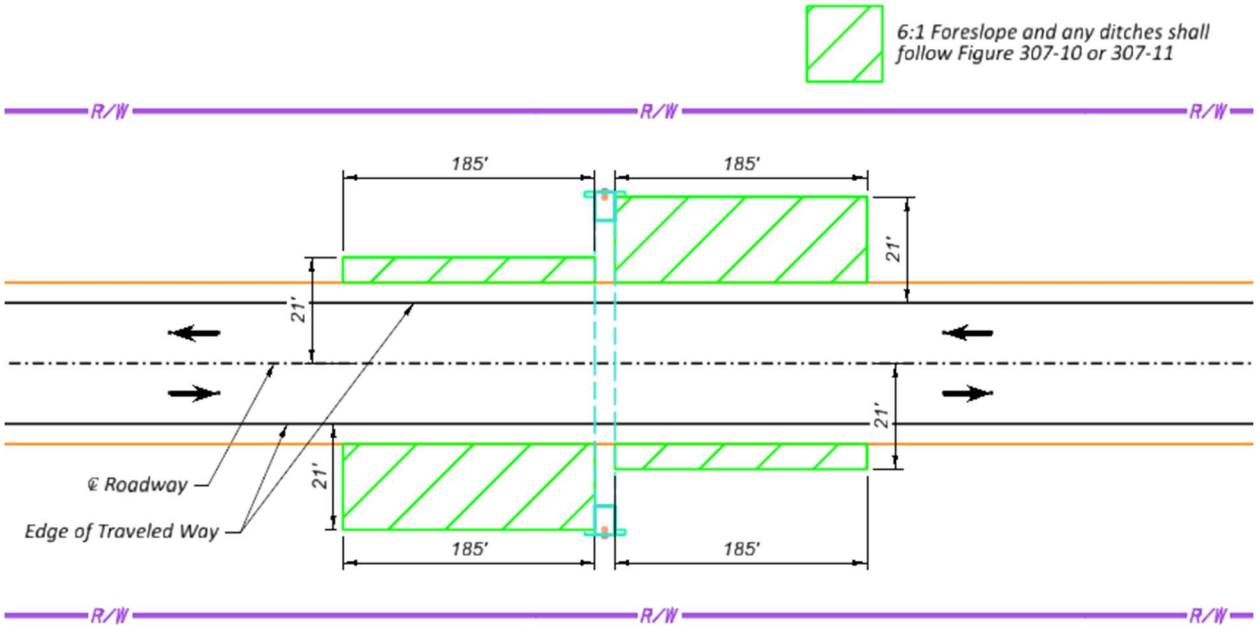
Step 2 – Determine the longitudinal limits of the clear zone grading. Refer to **Section 307.2.2**: clear zone grading is required for the runout length for the warranting feature (the 48" culvert). Refer to **Figure 602-1**, the Runout Length is 185' for a 55 mph roadway with 3200 ADT. Note that the clear zone length is measured from the center line for the Opposing Traffic side.

SAMPLE CALCULATIONS

Ex. 600-4

Clear Zone Grading to Eliminate Need for Barrier at a Fixed Object

(continued)



The foreslope grading shall be a minimum 6:1 for 185' on either side of the culvert and for 21' laterally measured from edge of traveled way. If there are roadside ditches being perpetuated through the hatched area, then they will need to follow **Figure 307-10 or 307-11** for the backslope tie-in.

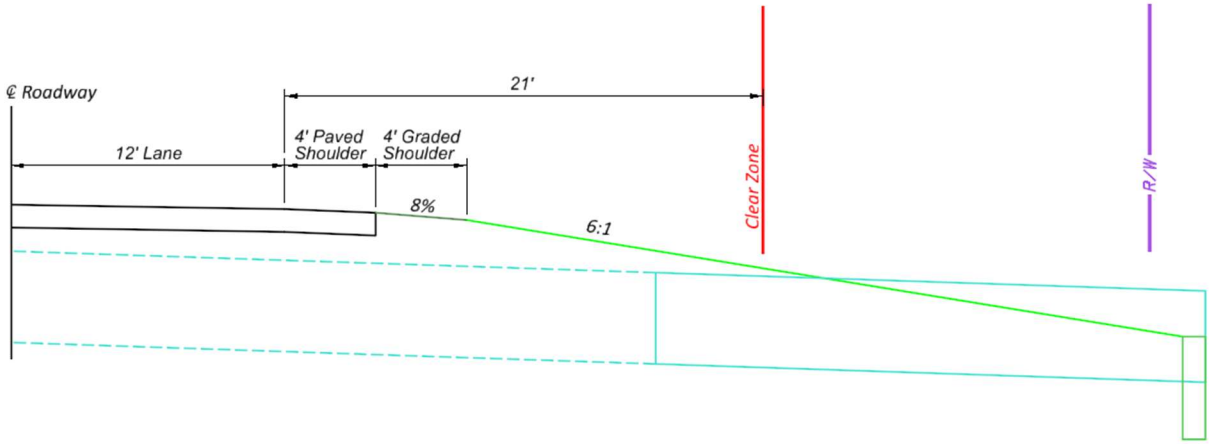
Step 3 – It needs to be confirmed that the extension of the culvert at the applicable grade will intercept the 6:1 foreslope and remain within the right-of-way to ensure the design is in accordance with the project's constraints.

SAMPLE CALCULATIONS

Ex. 600-4

Clear Zone Grading to Eliminate Need for Barrier at a Fixed Object

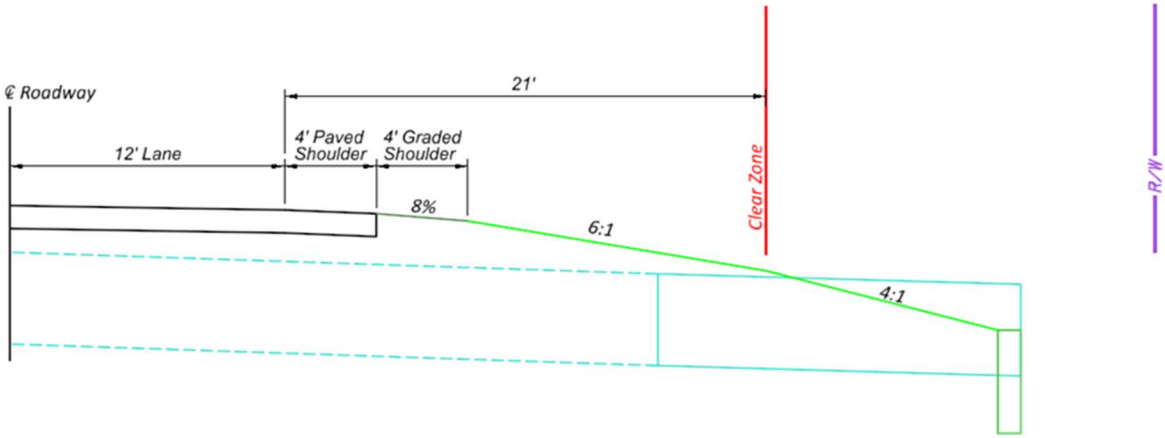
(continued)



It is apparent from the cross section that the culvert extension cannot be completed with a 6:1 foreslope as it would have to be extended outside of the existing right-of-way, which is not an option for this project. Therefore, there are two options to consider before purchasing additional right-of-way:

1. Return to Step 1 and change the foreslope to a value steeper than 6:1 to 4:1 maximum, which would cause the clear zone to increase to 27' (and would affect the graded shoulder width per **Figure 301-3**).
2. Utilize the bottom option on **Figure 307-3** which allows the foreslope grade to have a break at the clear zone boundary to steeper than 4:1 to 3:1 maximum.

Option 2 has been selected for this example:



SAMPLE CALCULATIONS	
Ex. 600-4	**Clear Zone Grading to Eliminate Need for Barrier at a Fixed Object**

(continued)

Breaking the foreslope at the clear zone boundary to a 4:1 results in the foreslope grade intercepting the top of headwall within the right-of-way. Therefore, a pipe extension of 16’ will meet the project constraints and eliminate the need for barrier when the proper grading is provided. The final step is to update the plan view: