# SS307-3.X – version 07.04.10

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Description

This criteria is used to draw cut and fill side slopes using Clear Zone Grading as defined in the Location & Design Manual, Volume 1, Roadway Design, Figure 307-3E. It will also draw the unpaved portion of the graded shoulder. An example of the side slope for a cut section is shown in Figure 1 below:

Figure 1
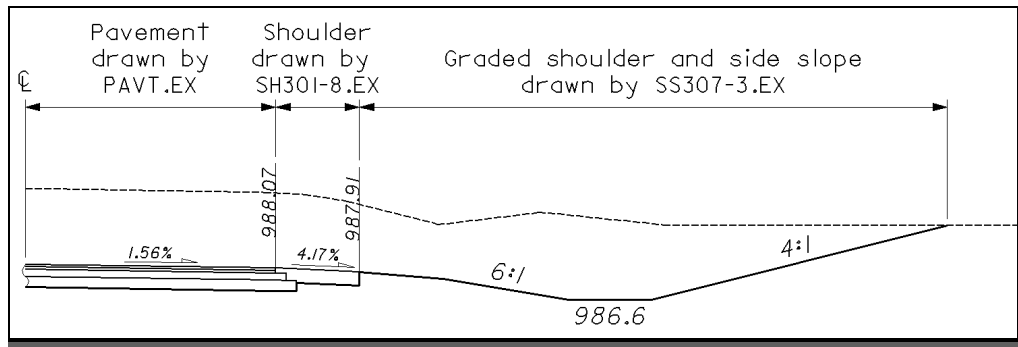
If the fill height is greater than the variable **"fill height"**, the criteria will draw fill side slopes using Barrier Grading as defined in Figure 307-4E.

Inclusion Sequence

ODOT's criteria files are written so that each individual file is responsible for drawing only a specific component of the proposed cross section design. This allows for greater flexibility when utilizing the criteria files to accommodate a wide variety of design scenarios. When a criteria run is processed, the user will specify the individual criteria files that will be used to draw each component. The order in which these components are specified is significant. Criteria files must be included in the order that they will process from the centerline out . For example, the pavement criteria must be included before the shoulder criteria which must be included before the side slope criteria. Each criteria file will start drawing where the previous criteria file ended.

The ODOT Standard criteria file **DEFINE.X** contains default definitions for some of the Define Variables used by ODOT's criteria files. **DEFINE.X** must always be included first in any criteria run.

In order to process **SS307-3.X**, a pavement and a shoulder criteria file must be included in the criteria run previous to **SS307-3.X**. The following ODOT standard pavement criteria files are available:

Pavement Criteria:	Documentation:
PAVT.X	http://www.dot.state.oh.us/prod/geopak/criteria/pavt.pdf
PAVT_OVERLAY1.X	http://www.dot.state.oh.us/prod/geopak/criteria/overlay1.pdf

SS307-3.X can included directly after any of the following ODOT standard shoulder criteria files:

Shoulder Criteria:	Documentation:
SH301-8.X	http://www.dot.state.oh.us/prod/geopak/criteria/sh301-8.pdf
SH301-8B.X	http://www.dot.state.oh.us/prod/geopak/criteria/sh301-8b.pdf
SH301-9.X	http://www.dot.state.oh.us/prod/geopak/criteria/sh301-9.pdf

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Initial Considerations

This criteria is used to draw cut and fill side slopes using Clear Zone Grading as defined in the Location & Design Manual, Volume 1, Roadway Design, Figure 307-3E. This criteria file will place Clear Zone Grading as detailed on Figure 307-3E and the following Figures 2, 3, and 4 of this documentation.

Clear Zone Grading is the shaping of the roadside using 4:1 or flatter foreslopes and traversable ditches within the clear zone area. Foreslopes of 3:1 may be used, but are not measured as part of the clear zone distances. Clear zone grading is recommended for undivided rural facilities where the design speed is 50 mph or greater, the design hourly volume is 100 or greater, and when at least one of the following conditions exist:

    A. The wider cross section is consistent with present or future planning for the facility.

    B. The project is new construction or major reconstruction involving significant length.

    C. The wider cross section can be provided at little or no additional cost.

When the fill height exceeds 16', the criteria file will place Barrier Grading. Barrier Grading is the shaping of the roadside when barrier is required for slope protection. Normally 2:1 foreslopes and normal ditch sections are used. Figure 307-4E of Volume 1 and Figure 5 on page 5 show examples of barrier grading.

Roadside ditches are generally categorized as traversable or non-traversable. Ditches that are traversable are preferred within the clear zone. This criteria file will place Traversable Ditch Sections as detailed on Figures 307-10E and 307-11E of Volume 1 and Figure 6 on page 6 for ditches located within the clear zone.

Ditches that fall outside of the clear zone are considered non-traversable. This criteria file will place Normal Ditch Sections as detailed on Figure 307-4E and Figure 7 on page 7 for ditches located outside of the clear zone.

Please see the Figures below and on the following pages for the sections (cut, shallow cut, low fill, medium fill or high fill) that this criteria file will place for the conditions encountered on the cross sections.

Figure 2: Figure 307-3E Cut Section
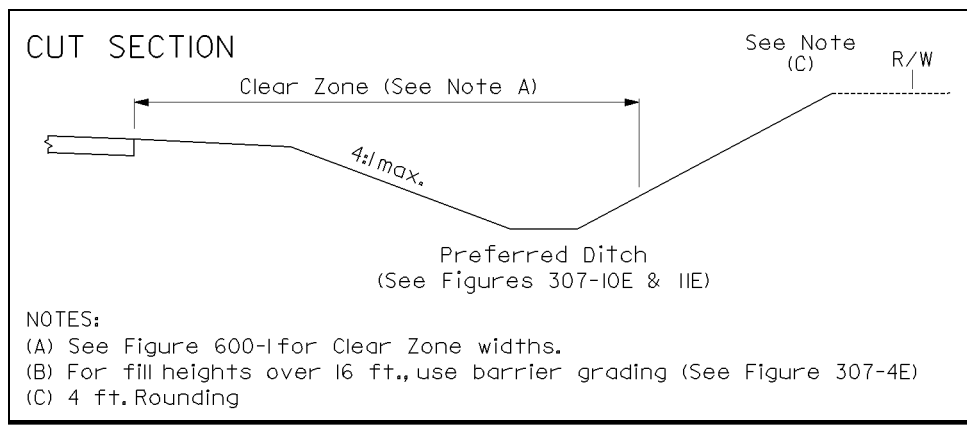
Figure 3: Figure 307-3E Fill Section

FILL SECTION (B)

Clear Zone (See Note A)

R/W

4:1 max.

See Note
(C)

Preferred Ditch
(See Figures 307-10E & 11E)

NOTES:
(A) See Figure 600-1 for Clear Zone widths.
(B) For fill heights over 16 ft., use barrier grading (See Figure 307-4E)
(C) 4 ft. Rounding
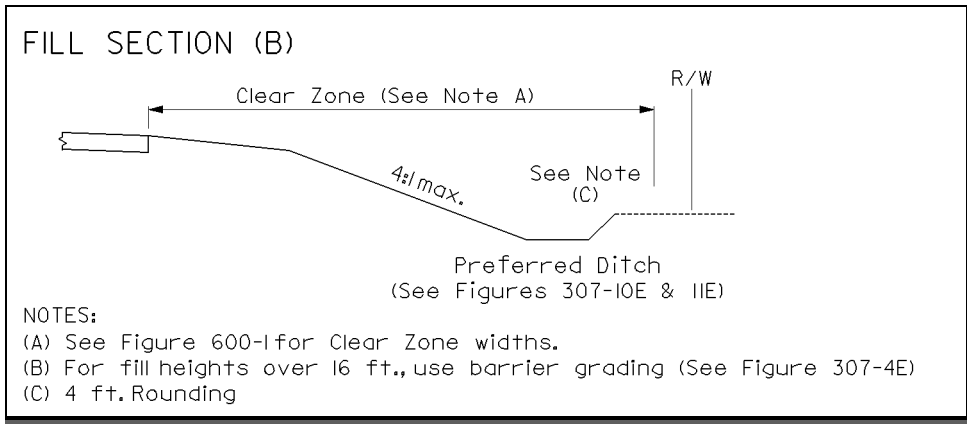
Figure 4: Figure 307-3E Medium Fill Section

MEDIUM FILL SECTION (B)

Clear Zone (See Note A)

4:1 max.

See Note
(C)

4:1

3:1 max.

See Note
(C)

R/W

Normal Ditch
(See Figures 307-4E)

NOTES:
(A) See Figure 600-1 for Clear Zone widths.
(B) For fill heights over 16 ft., use barrier grading (See Figure 307-4E)
(C) 4 ft. Rounding
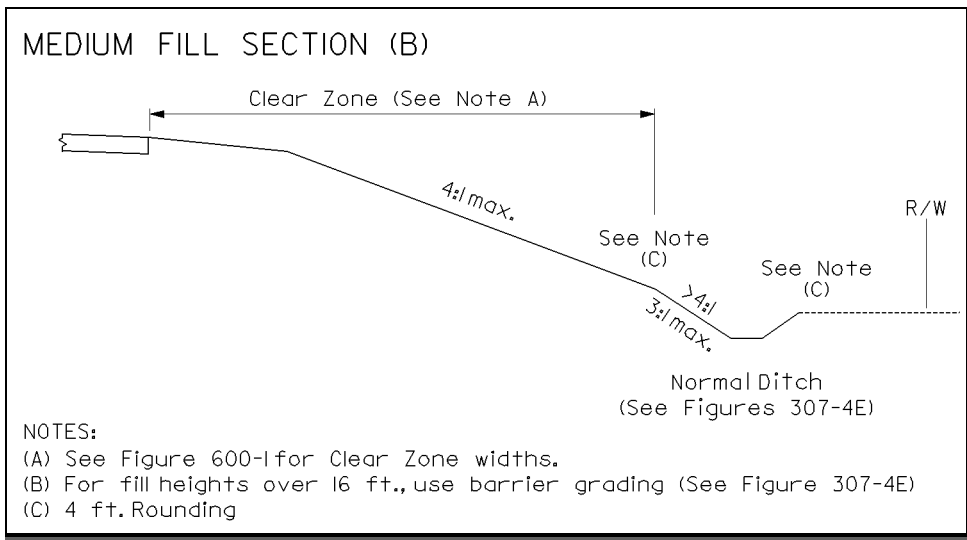
Figure 5: Figure 307-4E Barrier Grading Section

BARRIER GRADING

Steeper than
Normally 2:1

Exceeds 16'

(A)

(A)

See Note
(A)

Bench
Usually 10'

Normal Ditch

NOTES: (A) 4' Rounding
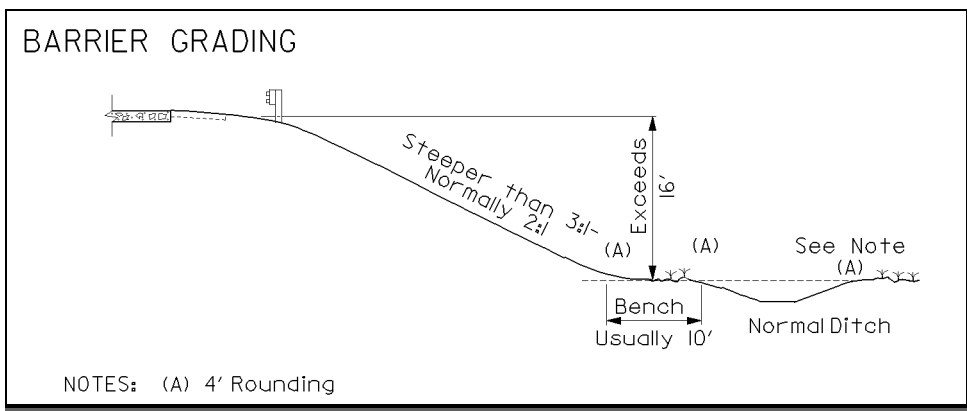
Figure 6: Traversable Ditch Sections

Figure 7: Figure 307-4E Normal Ditch Sections
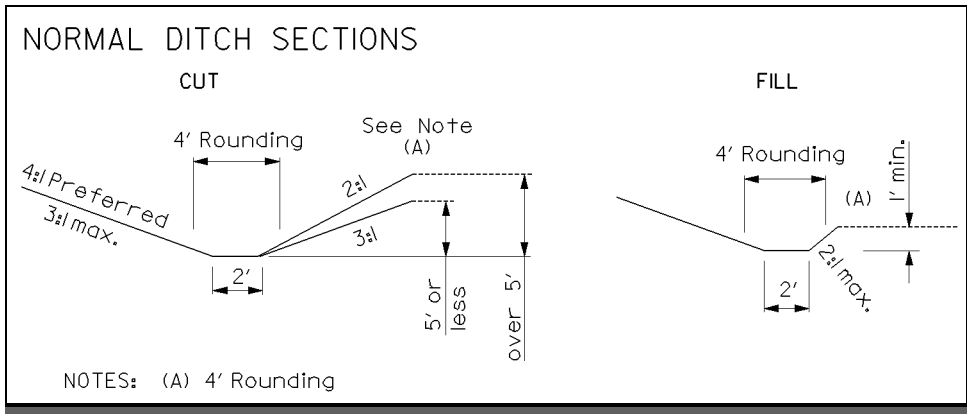
Establishing the Graded Shoulder Width

The criteria will start processing from the proposed edge of paved (treated) shoulder to draw the unpaved (untreated) portion of the graded shoulder. The width of the graded shoulder can be determined by two methods:

- Meet a graphic line representing the graded shoulder location. This method should be used if the graded shoulder width is variable.

- Use a variable to set the graded shoulder width. This method should be used if the graded shoulder is a constant width.

Figure 8: Graded shoulder width
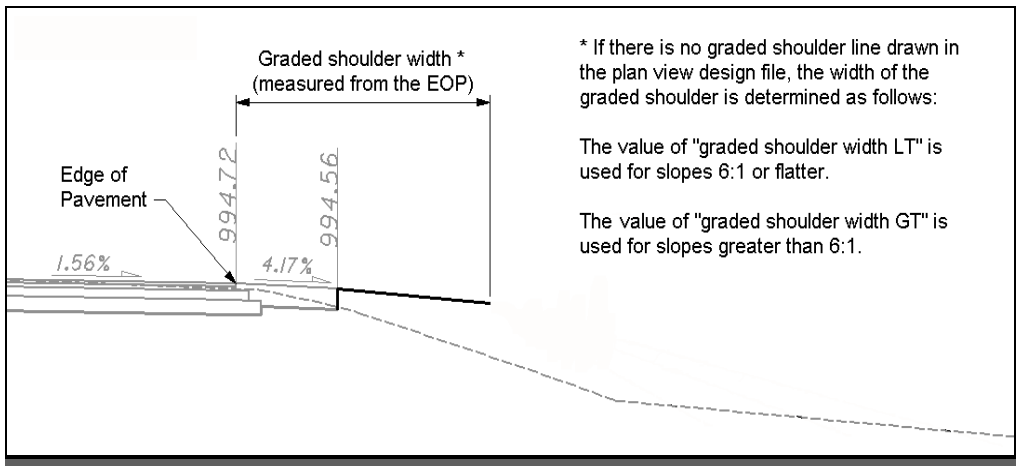
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The criteria will always look for a graphic representation of the graded shoulder first. The DGN Variable **"~proposed graded shoulder in dgn"** has been defined to establish the symbology for the graded shoulder line. The variable is defined as follows within the criteria:

```
define_dgn "~proposed graded shoulder in dgn" \
        dgn = "proposed dgn file name" \
        lvname = DT_P_Graded_Shoulder \
        wt = 1, byLevel \
        co = 9, byLevel
```

In order for the criteria to search for the graded shoulder line in the correct design file, the Define Variable **"proposed dgn file name"** is used to establish the name of the design file that contains the graded shoulder line. Please see page 28 for a detailed description of the **"proposed dgn file name"** variable.

If no graphics representing the graded shoulder are found, the criteria will set the width of the graded shoulder using the variables **"graded shoulder width lt"** (for sections where the foreslope is less than (lt) or equal to 6:1) or **"graded shoulder width gt"** (for sections where the foreslope is steeper than 6:1). See the Location & Design Manual, Volume 1, Figure 301-3E to determine the graded shoulder width.

The graded shoulder is drawn at a hardcoded slope of 8.0%.

Additional Processing Notes

No Graphic Ditch Line and COGO Profile
The criteria will first check whether the current section is in cut or fill by locating the **"depth of ditch flow"** as shown in Figure 9. The elevation at this point is compared to the elevation of the existing ground to determine whether the section is in cut or fill. Please see the **Drainage Considerations** section on page 22 for processing `SS307-3.x` with graphic ditch lines and/or COGO profile(s).

Figure 9: Locating the **"depth of ditch flow"**
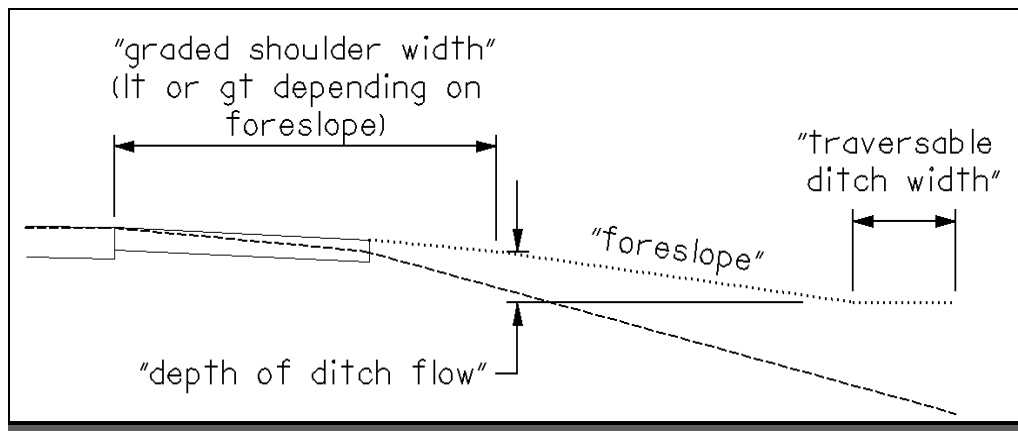
Cut Condition
If the criteria determines the section is in cut, the cut section is drawn as shown in Figure 10. The unpaved portion of the graded shoulder is drawn from the edge of the paved shoulder at a slope of 8.0%, to the width determined by either (1) the **"graded shoulder width gt"** or **"graded shoulder width lt"** variables depending on the **"foreslope"** defined or (2) the graphic representation of the graded shoulder. The back of the ditch is placed based on Figures 307-10E or 307-11E of Volume 1 and the defined variables detailed on the following pages.

Figure 10: Cut Section


```
"graded shoulder width"
(lt or gt depending on
    foreslope)

                                    "foreslope"        traversable ditch
                                                           backslope

    "depth of
    ditch flow"
                        "traversable
                        ditch width"
NOTE:
Backslope will be placed based on the user defined values for the
following variables:
   "foreslope"
   "preferred traversable ditch backslope *"
   "maximum traversable ditch backslope *"
   "reduce distance cut"

*: 307-10E or 307-11E.  The Figure used is determined by the
   "traversable ditch width" value.
```

Traversable Ditch Backslope Placement
The criteria file will determine which preferred and maximum ditch backslope variables to use based on the **"traversable ditch width"** value as shown in the table below.

Table 1	
"traversable ditch width"	Traversable Ditch Backslope Variables to be used
Less than 4'-0"	**"preferred traversable ditch backslope 307-10E"**
	"maximum traversable ditch backslope 307-10E"
Equal to or greater than 4'-0"	**"preferred traversable ditch backslope 307-11E"**
	"maximum traversable ditch backslope 307-11E"

Note: It is extremely important to make sure that the backslope values selected are acceptable as determined from either Figure 307-10E or 307-11E of Volume 1 using the user defined **"foreslope"** and **"traversable ditch width"** values.

The table below shows the acceptable backslopes this criteria file will test from flattest to steepest based on the **"foreslope"**, **"traversable ditch width"**, and preferred and maximum ditch backslope values.

Table 2											
"foreslope"	Acceptable Backslope Values										
	Figure 307-10E					Figure 307-11E					
10	10	8	6	5	4	10	8	6	5	4	3
8	10	8	6	5	4	10	8	6	5	4	3
6	10	8	6	5	4	10	8	6	5	4	3
5	10	8	6	5		10	8	6	5	4	
4	10	8				10	8	6	5	4	

After determining the appropriate preferred and maximum ditch backslope variables to be used, the criteria fill will first test the **"preferred traversable ditch backslope …"** (**…** is either 307-10E or 307-11E) placement**.**
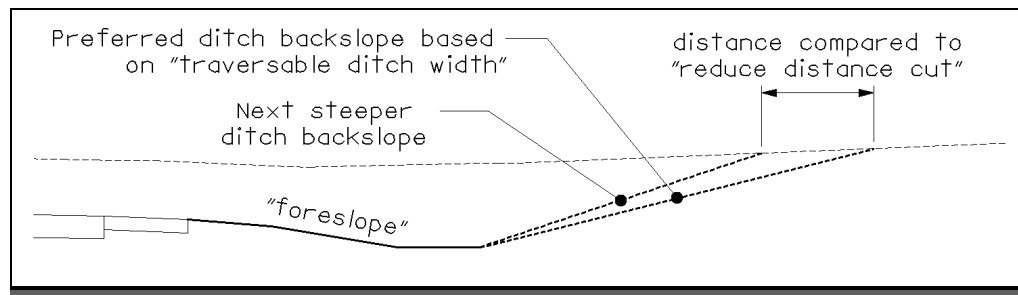
Prior to placing this **"preferred traversable ditch backslope …"**, the criteria will also test the next steeper acceptable backslope up to the **"maximum traversable ditch backslope …"** as shown below in Figure 11.

Figure 11: The use of **"reduce distance cut"** to determine ditch backslope placement

The criteria determines the distance between the flatter and steeper backslope placements. If this distance is less than or equal to the **"reduce distance cut"**, the criteria places the flatter ditch backslope. If this distance is greater than the **"reduce distance cut"** value, the criteria will place the steeper ditch backslope.

Important: The criteria file will continue to test the next acceptable steeper backslope up to the **"maximum traversable ditch backslope …"** value whether or not the previous backslope placement was greater then the **"reduce distance cut"** or not.

In the case where the **"preferred traversable ditch backslope …"** does not intersect existing ground, the criteria file will automatically try the next steeper backslope until one successfully intersects existing ground. As soon as this is achieved, the criteria will begin the comparison with the next steeper backslope up to the **"maximum traversable ditch backslope …"** value.

See the next page for an example of the criteria file processing a cut section.

Cut Section Processing Example

"preferred traversable ditch backslope 307-10E"	6	**"foreslope"**	8
"maximum traversable ditch backslope 307-10E"	4	**"reduce distance cut"**	4.0
"preferred traversable ditch backslope 307-11E"	8	**"traversable ditch width"**	4.0
"maximum traversable ditch backslope 307-11E"	3		

For the above example, the criteria file determines the **"traversable ditch width"** is 4.0. The criteria will select the **"preferred traversable ditch backslope 307-11E"** as the first backslope tested and in this example the slope 8:1 will be tested. The criteria will then test the placement of the next steeper ditch backslope, which in this example would be 6:1. The criteria will next determine the distance between these backslope placements as shown in Figure 11 on the previous page and as shown below in Figure 12.

If this distance was less than or equal to the **"reduce distance cut"** and the **"preferred traversable ditch backslope 307-11E"** intersects the existing ground, the criteria will internally mark the 8:1 backslope as acceptable. If this distance is greater than the **"reduce distance cut"** value, the criteria will internally mark the 6:1 backslope as acceptable. In our example, the criteria marks 6:1 acceptable and continues processing.

For both situations, the criteria file will test the next steeper backslope of 5:1. The criteria file will continue this process until all backslopes have been tested up to the **"maximum traversable ditch backslope 307-11E"** of 3. See below for a graphical representation of the criteria's internal processing.

Figure 12
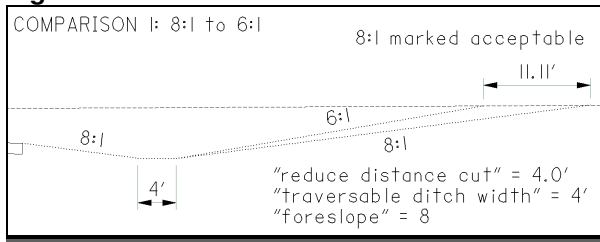
Figure 13
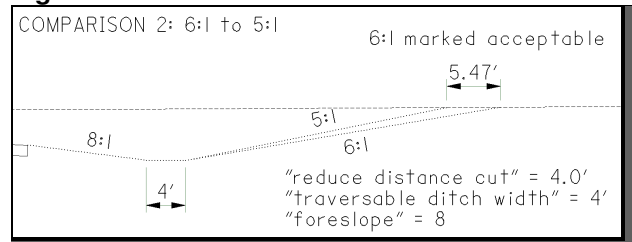
Figure 14
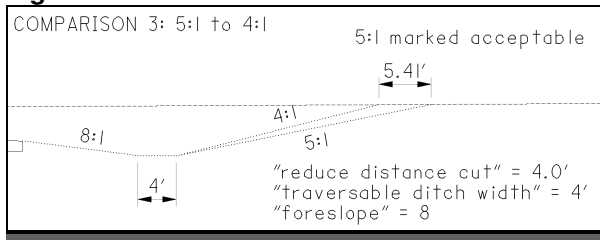
Figure 15
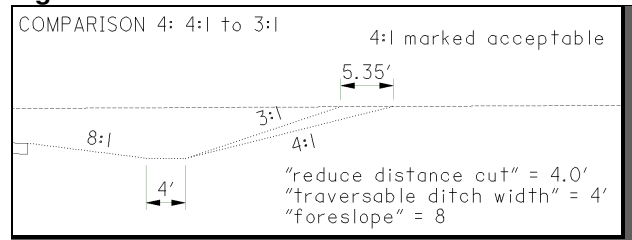
Figure 16
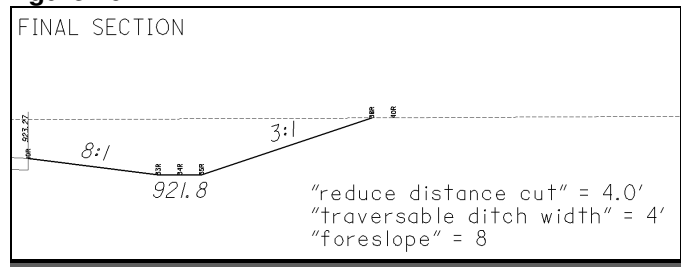
In cases where the section is in deep cut and the **"maximum traversable ditch backslope …"** does not intersect the existing ground, the section will be placed as shown below in Figure 17.

Figure 17

Clear Zone Offset
30.0

924.44

924.02

4.17%

8:1

Warning: Ditch Backslopes Do Not
Intersect Existing Ground For User
Defined Depth of Ditch Flow = 1.50'
And Maximum Traversable Ditch
Backslope of 4.00:1
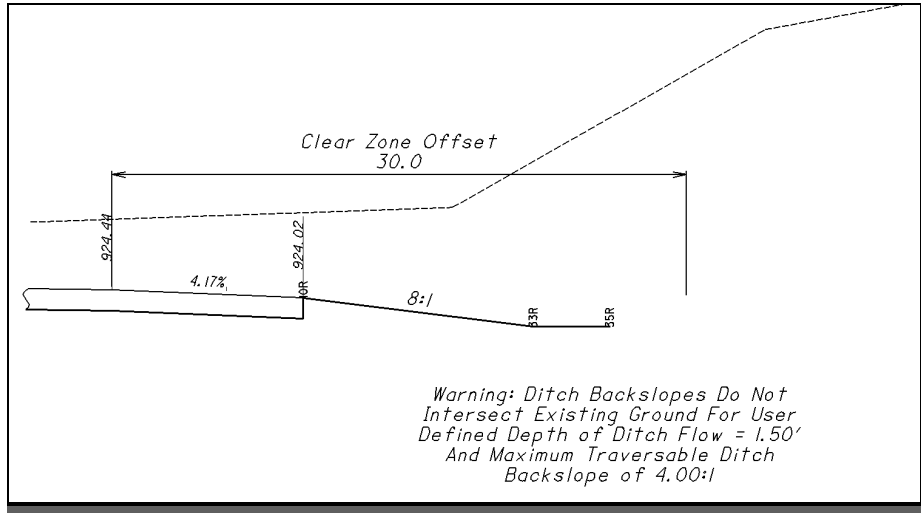
Shallow Cut or Low Fill Condition

If the criteria determines the section is in shallow cut or low fill, the criteria first draws the **"foreslope"** to the **"depth of ditch flow"** elevation. The criteria file then tests the existing ground slope to determine if a ditch can be placed meeting the minimum **"ditch depth cut"** requirement as shown in Figure 18.

If the **"ditch depth cut"** can be met, the section is considered to be in shallow cut. The criteria file will process the section using the acceptable ditch backslopes as detailed on the previous page until the ditch section is completed as shown in Figure 18 below.

Figure 18: Shallow Cut Processing

"traversable
ditch width"

depth >=
"ditch depth cut"

ditch
backslope

"foreslope"

Distance <= _d_cut_to_fill
where _d_cut_to_fill = 0.33*"clear zone distance"
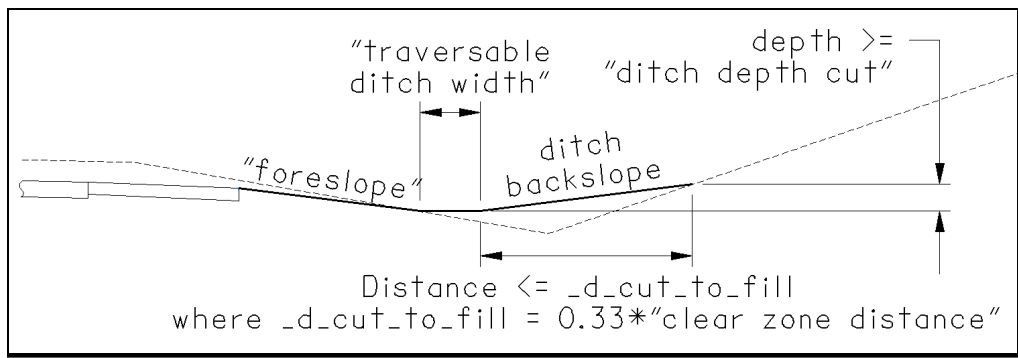
In the case where the **"maximum traversable ditch backslope …"** does not intersect the existing ground to meet the **"ditch depth cut"** requirement, the section will be placed using a variable slope as shown in Figure 19. The placed ditch backslope will be steeper than the **"maximum traversable ditch backslope …"** but will still be traversable and within the shaded portion of either Figure 307-10E or 307-11E of Volume 1.

Figure 19
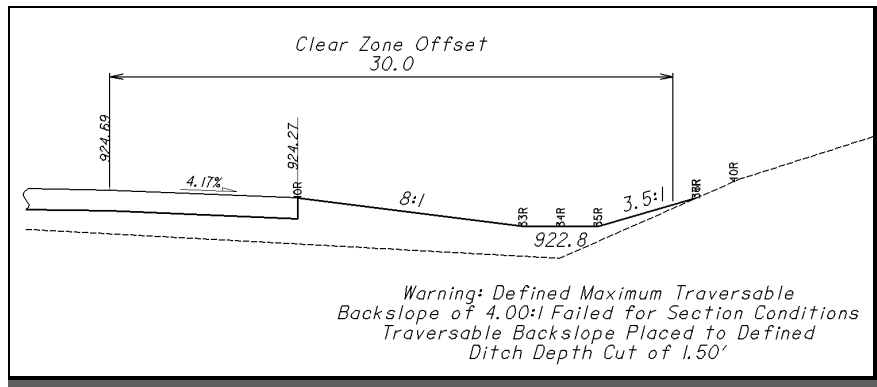
If the criteria file determines the existing ground is sloping down, the section is considered to be in low fill. The criteria file will draw the **"foreslope"** to the existing ground. Next, the criteria file determines where the **"foreslope"** intersects the existing ground compared with the **"clear zone distance"**. If it is within the **"clear zone distance"**, the criteria file tests the existing ground slope to determine if this slope is equal to or less than the **"foreslope"**. The criteria file also compares the existing ground slope with the **"terminate slope"** (see **Terminate Slope** section on). If the existing ground slope is equal to or less than the **"foreslope"** and no ditch is to be placed, the section is completed as shown in Figure 20.

Figure 20: Low fill (**"foreslope"** within the **"clear zone distance"**)
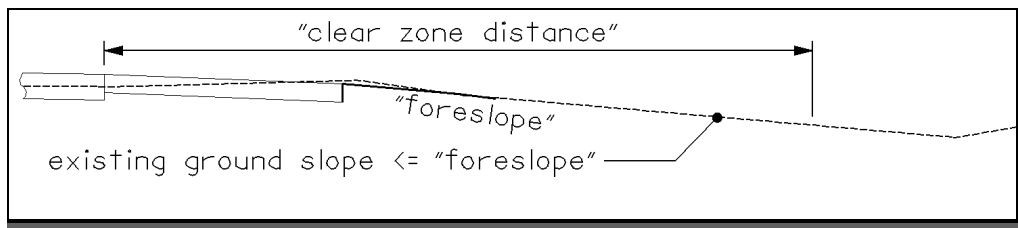
If it is at or outside the **"clear zone distance"**, the criteria file tests the existing ground slope to determine if this slope is equal to or less than the **"fill slope"**. If it is, the section is completed as shown in Figure 21.

Figure 21: Low fill (**"foreslope"** at or outside the **"clear zone distance"**)
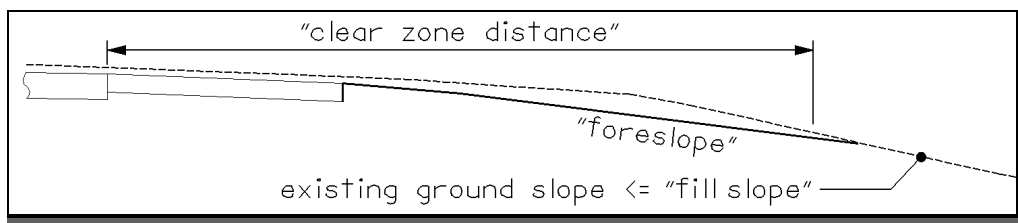
If the section is not placed in the **Low Fill Condition**, the criteria file proceeds to the **Fill Condition**.

Fill Condition

The criteria file draws the **"foreslope"** to the existing ground. The criteria file tests the existing ground slope at this location to determine the slope of the existing ground. If the existing ground slopes up or is less than the **"terminate slope"** a ditch section will be placed (see **Terminate Slope** section on page 15). The ditch section placed depends on the location of the **"clear zone distance"**. If the ditch bottom begins outside of the **"clear zone distance"** the criteria file places a Normal Ditch Section. On the other hand, if the ditch bottom begins within the **"clear zone distance"**, the criteria file places a Traversable Ditch Section as previously described in the **Cut Condition** on page 9.

Figure 22: Fill condition (ditch section within the **"clear zone distance"**)
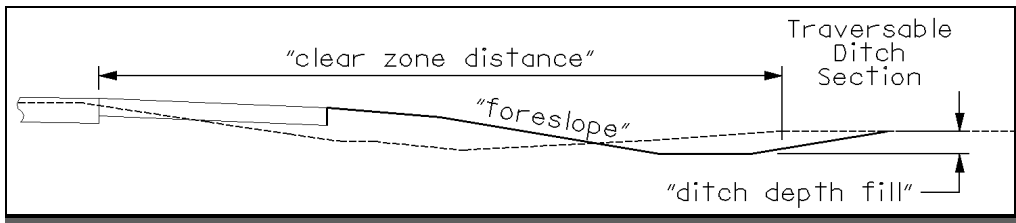
Figure 23: Fill condition (ditch section outside the **"clear zone distance"**)
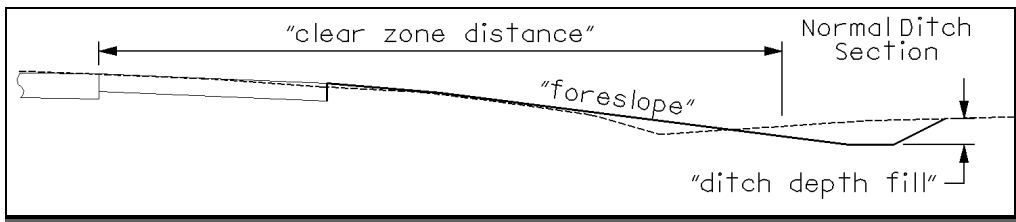
Medium Fill Condition

The criteria determines if the section is in medium fill by first drawing the **"foreslope"** to the **"clear zone distance"**. Next the criteria will draw test slopes, **"foreslope"** and **"fill slope,"** to intersect the existing ground as shown below in Figure 24.

Figure 24: The use of **"reduce distance medium fill"** to determine slope placement
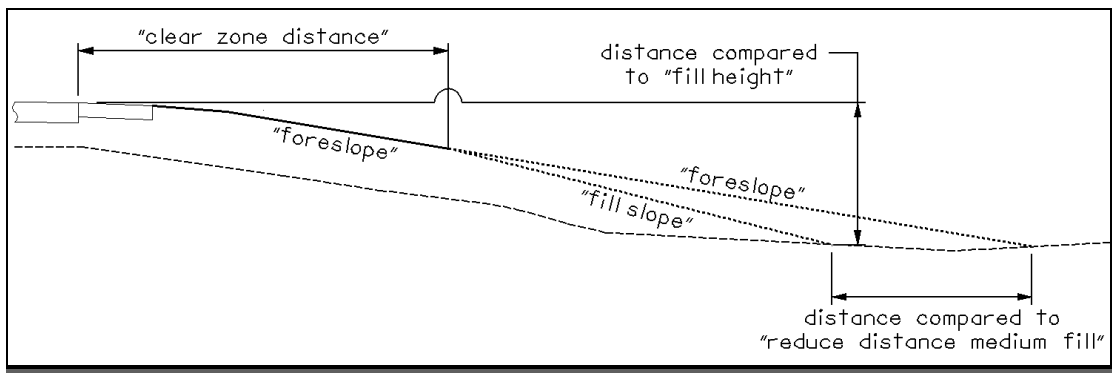
The criteria tests the distance between the **"foreslope"** and **"fill slope"** existing ground locations and if it is less than or equal to the **"reduce distance medium fill"** the criteria places the **"foreslope"** option. If this distance is greater than the **"reduce distance medium fill"** value, the criteria then tests the elevation difference at the **"fill slope"** location with the **"fill height"** value as shown on Figure 24 on page 14. If this difference is less than or equal to the **"fill height"**, the section is in medium fill. If it is greater than the **"fill height"** the criteria uses Barrier Grading.

After the existing ground slope is tested for ditch placement, the section will be completed based on the outcome. Two examples are shown in Figures 25 and 26 below.

Figure 25: Medium fill condition with ditch placed
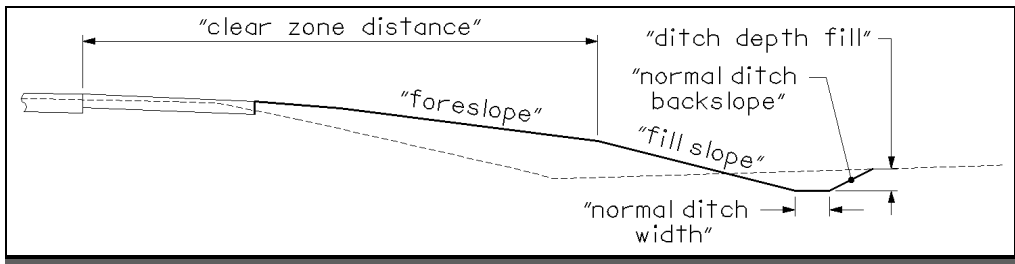
Figure 26: Medium fill condition with no ditch placed
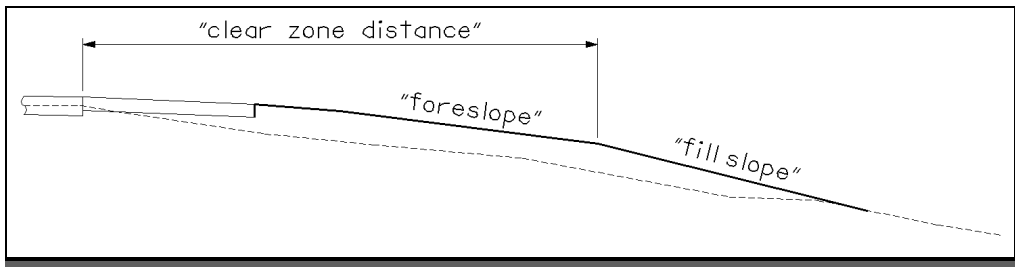
Fill Heights over "fill height" Condition
If the criteria determines the fill height is greater than 16 ft. (**"fill height"**), the criteria draws grading according to the Barrier Grading portion of Figure 307-4E. Before the grading will be placed, the criteria first tests to see if a bench will be placed for fill heights over 16 ft. as shown in Figure 27.

Figure 27: Checking fill height for bench placement
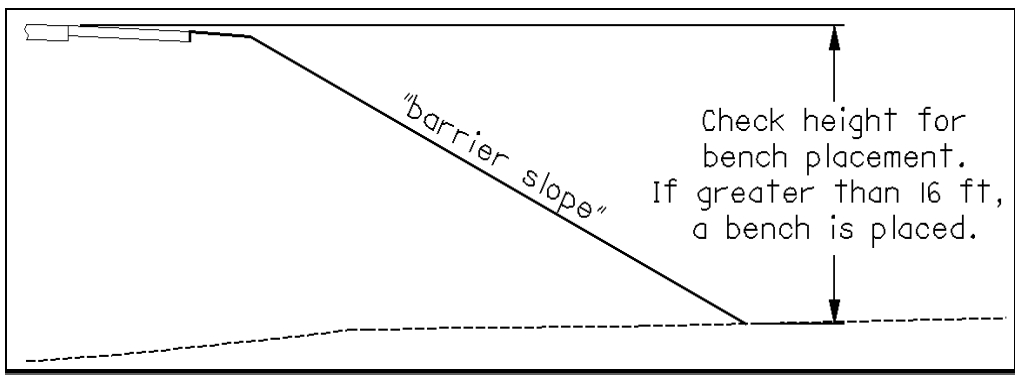
Next, the criteria tests the existing ground slope as shown in Figure 30 on page 17 to see if a ditch will be placed.

After the existing ground slope is tested for ditch placement, the section will be completed based on the outcome. If the fill height is over 16 ft., then a bench is placed as shown in Figures 28 or 29.

If the point where the barrier slope intersects the existing ground is higher than the ditch location, the criteria will use the existing ground as the bench as shown in Figure 28.

Figure 28: Existing ground used for the bench width
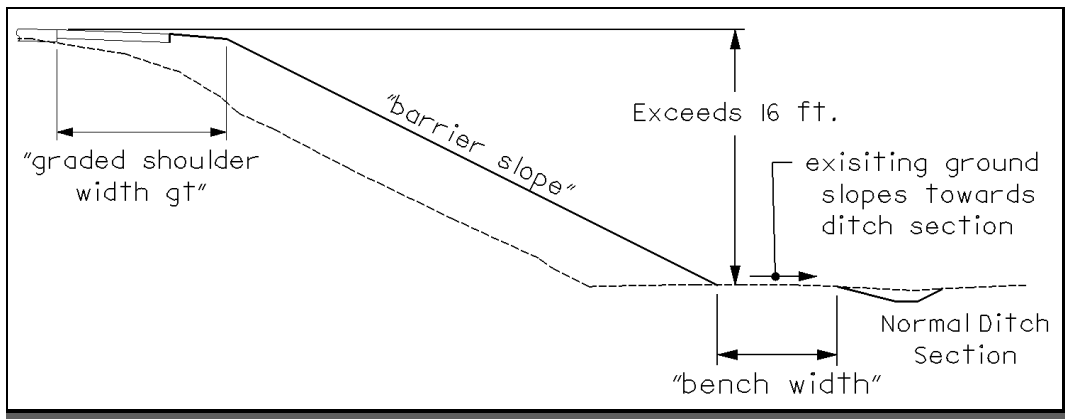
If the point where the barrier slope intersects the existing ground is lower than the ditch location, the criteria will draw the proposed grading to promote positive drainage using the **"bench width slope"**. The **"bench width slope"** is drawn from the **"barrier slope"** line to the ditch section as shown in Figure 29.

Figure 29: Proposed grading placed for bench width
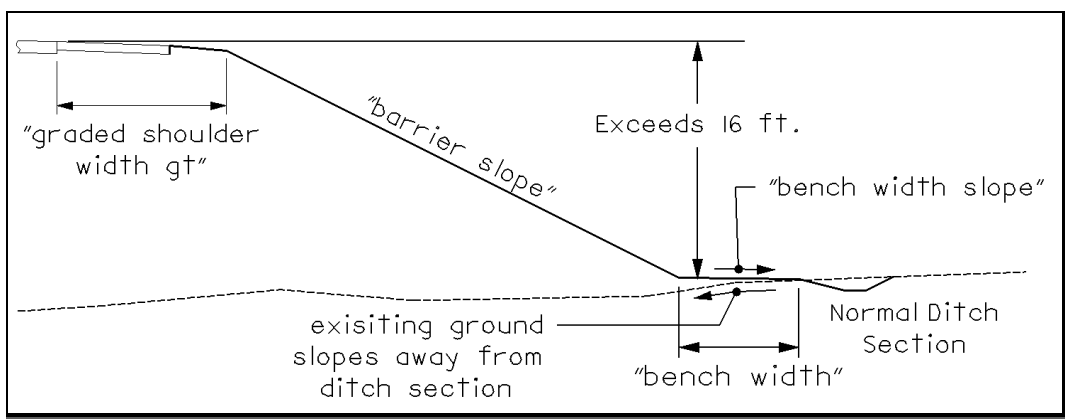
Terminate Slope
Before the grading will be placed, the criteria tests the existing ground slope as shown in Figure 30 to see if a ditch will be placed. The criteria will evaluate the slope of the existing ground at the point where the proposed side slope intersects the existing ground.

Figure 30: The use of **"terminate slope"**
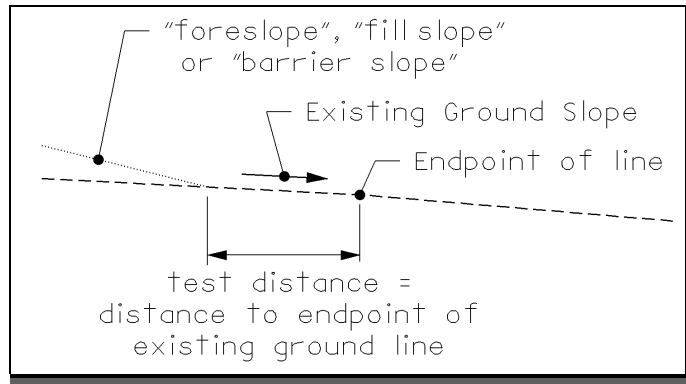
If the existing ground is sloping back towards the roadway, a ditch will be drawn as shown below left in Figure 31. If the existing ground is sloping away from the roadway, the criteria will not place a ditch unless the existing ground slope is steeper than the value of the variable **"terminate slope"** as shown below right in Figure 32.

Figure 31
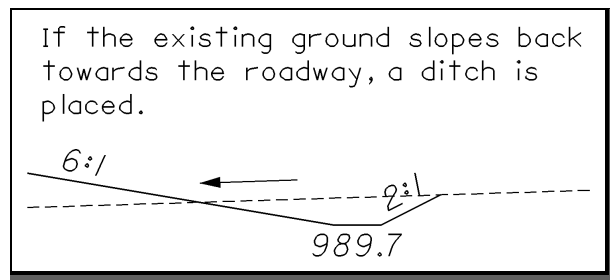
Figure 32
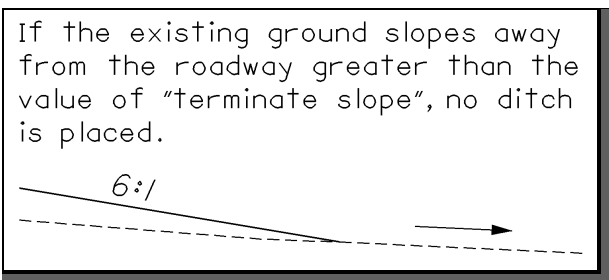
Changing the value of the variable **"terminate slope"** will control whether a ditch is placed. For example, if **"terminate slope"** is set to 1 and the existing ground slope is 0.5% (down), a ditch will be placed but if the existing ground slope was 1.2% (down) then no ditch will be placed.

Normal Ditch Backslope Placement
The define variables in Table 3 have been given the default values shown below. If you wish to change the default values, you will need to modify the value of the variable in the cross section run. The numeric variables _d_normal_cut_depth and _d_normal_fill_depth have been given the values shown in Table 4. These values are hardcoded in the criteria file. If you wish to modify this default value, you will need to modify the values in the criteria file itself.

Table 3		
Define Variable	Value	Backslope Placed
"normal ditch backslope1"	3	3:1
"normal ditch backslope2"	2	2:1

Table 4	
Numeric Variable	Feet
_d_normal_cut_depth	5
_d_normal_fill_depth	5

Figure 33: "normal ditch backslope1"
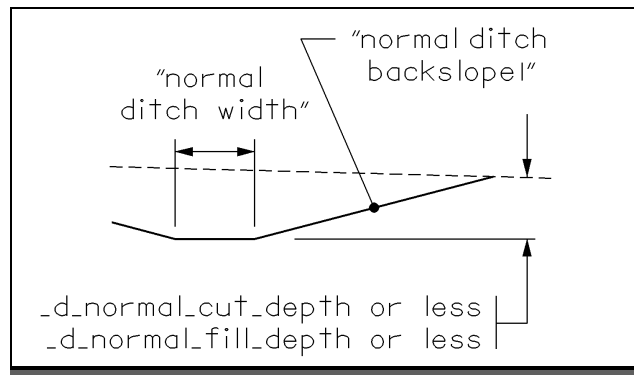
Figure 34: "normal ditch backslope2"
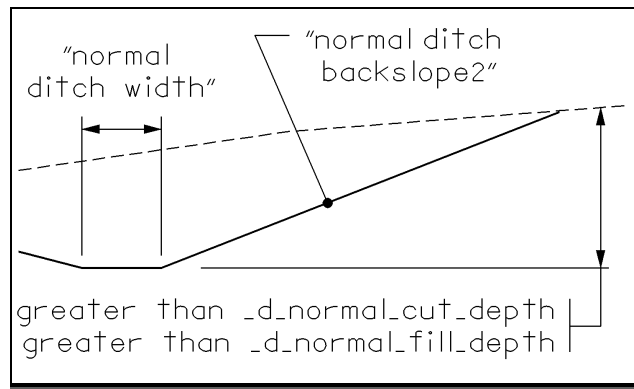
For sections in the **Low Fill Condition**, the criteria file will determine the ditch depth for the section on the ditch backslope side as shown in Figures 33 and 34. Based on this ditch depth, the criteria file will select the appropriate **"normal ditch backslope..."** to be placed using the tables and figures shown above.

For sections in the **Medium Fill Condition** or **Fill Heights over "fill height" Condition**, the criteria file will normally only place the **"normal ditch backslope1"** as shown on Figure 25 on page 15.

Horizontal Curve Correction Factor
For areas with a history of run-off-the-road accidents on the outside of curves with a Degree of Curvature (D_c) of 2°-00' or greater, Figure 600-1 provides a table of adjustment factors based on design speed that should be used to extend the clear zone. In these cases, the designer should ensure that the roadway has proper superelevation before evaluating the curve's effect on the clear zone.

When the potential for continuing accidents is high, the user has the option to extend the clear zone width on the outside of curves having a D_c of 2 degrees or sharper by multiplying the horizontal curve correction factor to the **"clear zone distance"**. If the criteria file determines the section is on a curve with a D_c of 2 degrees or sharper, whether the clear zone width is extended or not will be dependent on the value specified for the variable **"design speed"**.

To have the criteria file adjust the clear zone width by the factors shown in the Table on the bottom of Figure 600-1, set the **"design speed"** variable to the appropriate design speed for the roadway being designed. For example, the following conditions exist for a roadway with the following horizontal curves:

$$\textbf{"design speed"} \ = \ 55 \text{ mph}$$

$$\textbf{"clear zone distance"} \ = \ 21 \text{ ft}$$

$$\text{Curve 1 } D_c \ = \ 5°\text{-}00'$$

$$\text{Curve 2 } D_c \ = \ 3°\text{-}30'$$

First, setting the variable **"design speed"** to 55 will inform the criteria file to apply a horizontal curve correction factor to the outside of **EVERY** curve with a D_c of 2 degrees or sharper. In this example, both Curve 1 and Curve 2 will be affected. The criteria file will determine the factors to be 1.4 for Curve 1 and 1.3 for Curve 2 (factors obtained from Figure 600-1). The **"clear zone distance"** for both curves will be adjusted as shown in Table 5 below.

Table 5				
Curve	D_c	Curve Correction Factor	Calculation	Adjusted Clear Zone Width
1	5°-00'	1.4	21 x 1.4	29.4
2	3°-30'	1.3	21 x 1.3	27.3

Setting the **"design speed"** variable to zero (0) will set the criteria file to use the **"clear zone distance"** without adjusting the value on the outside of the curve(s).

Important: When the **"design speed"** is set to something other than zero (0), the criteria file will apply the appropriate horizontal curve correction factor to the outside of **EVERY** curve with a Dc of 2 degrees or sharper.

Proposed Grading
The final cross section cut and fill lines representing the proposed grading are drawn on various levels. The following levels should be shown on the final cross sections.

Table 6				
Level Name	**Purpose**	**Symbology**		
		Color	**Weight**	**Line Style**
XS_P_Finished_Grade	Proposed Ground Line	2	2	0
XS_P_Ditch_Bottom	Proposed Ditch Bottom	1	2	0
XS_P_Subgrade	Proposed Pavement Subgrade	7	2	0
XS_P_Subgrade	Proposed Finished Grade Line: under walls, headwalls, etc.	7	2	0

For a complete and current listing of the cross section levels refer to the CADD links accessed from the Department's CADD web site.   The web site can be accessed at the following URL address: http://www.dot.state.oh.us/cadd/

Text Labeling
The criteria will place several labels for the ditch elevation and the side slopes. The labels are placed on level XS_P_Annotation. The scale is determined by the define variable **"XS Annotation Scale"** from the criteria file **DEFINE.X**. The default value is 5.

The criteria file will also place Warning, Error and/or Designer Notes when processing. The Warning and Error messages are placed on level XS_P_Text_WarningMsg and the Designer Notes on level XS_P_Text_Info. Users should turn these levels off on the final plotting of the cross section sheets. If you don't want these messages to be drawn, you will need to modify the `_d_warning_message` value from 1 to 0 in the criteria file itself. The `_d_warning_message` value has been hardcoded in the criteria file.

Ditch Labeling
The criteria file provides two options for how the ditch labels will be placed. The variable **"ditch annotation style"** is used to select the desired label as shown in Figures 35, 36 and 37 below. The default value is 0.

Figure 35: "ditch annotation style" set to 0
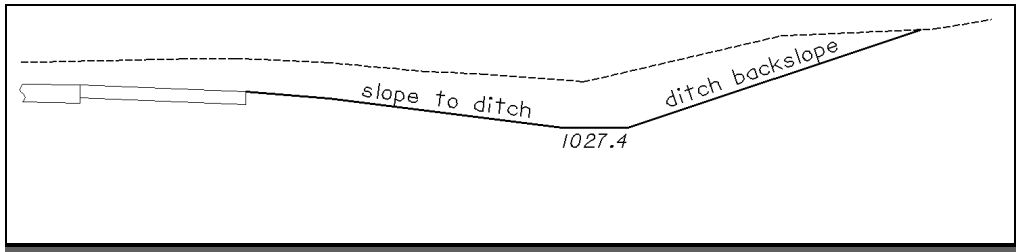
If **"ditch annotation style"** set to 1 for a ditch section:
When using this option, the user must set the COGO chain from which the offsets will be measured from under **"cl chain name"**. Please see the explanation of this variable **"cl chain name"** on page 30. See Figure 36 below for the usage of this variable.

Figure 36: "ditch annotation style" set to 1 for a ditch section
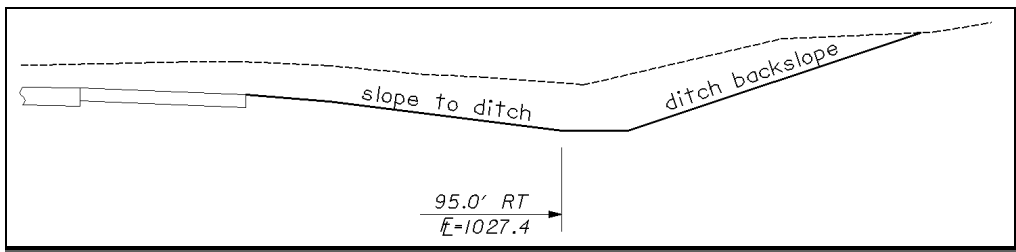
"ditch annotation style" set to 1 for a section containing a bench:
When using this option, the user must set the COGO chain from which the offsets will be measured from under **"cl chain name"**. Please see the explanation of this variable **"cl chain name"** on page 30. See Figure 37 below for the usage of this variable.

Figure 37: "ditch annotation style" set to 1 for a section containing a bench
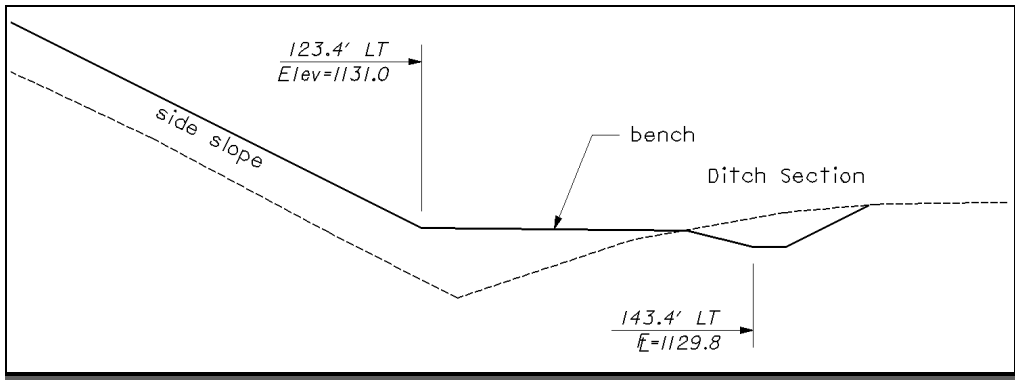
Drainage Considerations

After the side slope criteria has been processed for the first time, the designer must review the ditch elevations to ensure proper drainage. For sections in fill, the ditches are placed at the intersection of the side slope with the existing ground. This may not result in ditches that flow as the user desires. The designer has two options to correct the ditch elevations to ensure proper flow:

Manually edit the cross sections.
If only a few sections need modified it is easiest to manually edit the cross sections to make the necessary changes.

Specify the ditch location with a COGO profile and/or graphic ditch line.
In cases where several cross sections need changed, the user has the option to define the ditch elevations by storing a COGO profile that represents the desired ditch profile. Additionally, the criteria provides the capability to specify the ditch offset by graphically drawing the ditch location in the plan view design file.

This criteria file is capable of determining the side slopes and the location of the drainage ditches by one of the following:

Table 7		
Graphic Ditch Line	**COGO Profile**	**Criteria Result**
Yes	No	Draws **"foreslope"**, **"fill slope"** (Medium Fill Condition), or **"barrier slope"** until the slope intersects the graphic ditch line.
Yes	Yes	The graphic ditch line is used to determine the offset for the ditch and the COGO profile is used to determine the elevation of the ditch. This may produce side slopes which vary from the standard.
No	Yes	Draws **"foreslope"**, **"fill slope"** (Medium Fill Condition), or **"barrier slope"** until the slope intersects the elevation obtained from the COGO profile.
No	No	Places **"foreslope"**, **"fill slope"** (Medium Fill Condition), or **"barrier slope"** and ditches, if applicable, based on the cross section and the criteria variables as previously described starting on .

The criteria will first search the MicroStation design file specified by the variable **"proposed dgn file name"**

for elements meeting the symbology specified by the variable **"~proposed ditch in DGN"**. If an element is encountered meeting the symbology, the criteria will next check to see if a COGO profile exists at this location. The COGO profile name is specified by the variables **"special ditch profiles lt"** (left side) or **"special ditch profiles rt"** (right side). If neither the graphic ditch line or COGO profile exist at the current location, the criteria file will process as described starting on . The graphic ditch line and COGO Profile options are detailed on the following pages.

Graphic Ditch Line or COGO Profile
In either of these cases, the criteria file will draw the **"foreslope"**, **"fill slope"** or the **"barrier slope"** to either:

- Graphic ditch line. The graphic ditch line will be used to determine the offset for the ditches.
- COGO profile. The COGO profile will be used to determine the elevation of the ditch.

Once the criteria file determines either the offset or elevation or both offset and elevation, it will place the ditch section as described on the following pages.

Setting the Ditch Elevation with a COGO Profile
The criteria will allow the designer to specify a COGO profile to define the ditch elevations independently for the left and right sides of the cross sections. The variables **"special ditch profiles lt"** and **"special ditch profiles rt"** are used to specify the names of the profiles for the left and right side ditches respectively. By default, these variables have been set to look for a profile named "none". If a profile named "none" is found in the COGO database, the elevations of the profile will be used for the cross sections that fall within the station limits of the profile.

Multiple profiles can be specified for each side of the cross sections. For example, a new ditch profile DITCHRT1 has been defined for stations 53+00 to 61+00 on the right side. A second ditch profile DITCHRT2 has been defined from station 66+00 to station 71+00, also on the right side. Both profiles can be specified by separating each profile name by a coma as shown in the example below:

Figure 38
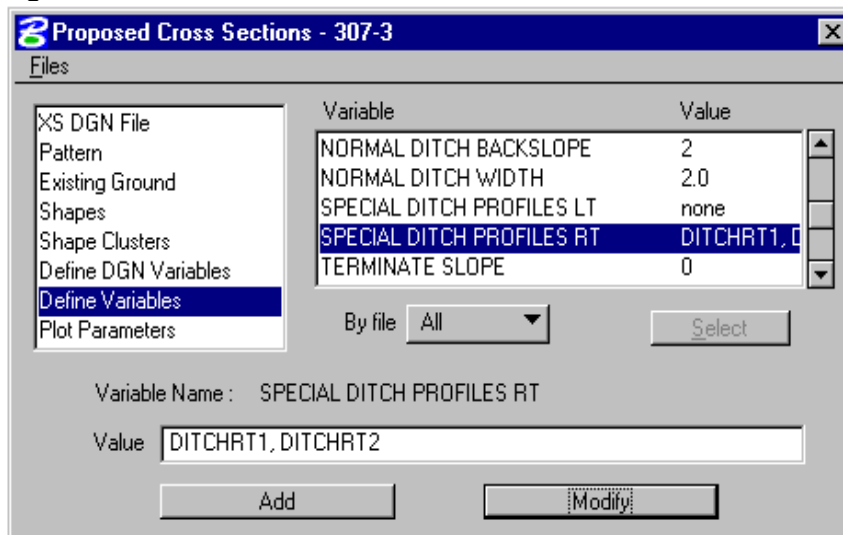
If a ditch profile has been specified, it does not matter whether the cross sections is in cut or fill. The side slope will be extended to meet the profile elevation as shown in the Figure 36 below.

Figure 39: COGO ditch profile example
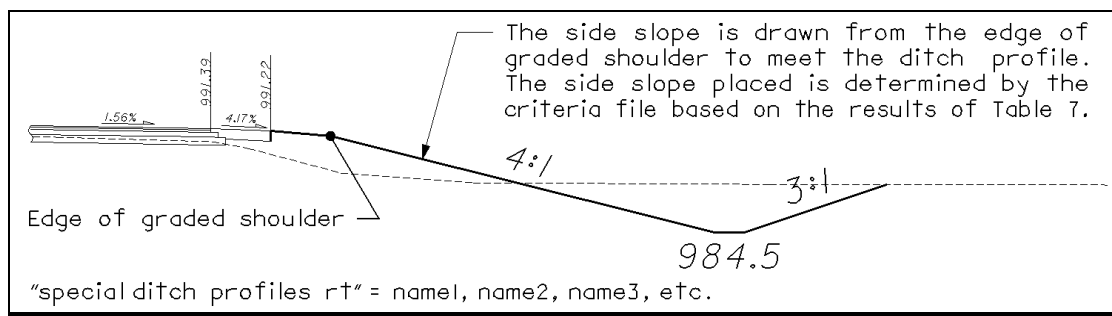
Setting the Ditch Offset with a Graphic Ditch Line

This option will allow the designer to specify the horizontal location of the ditch graphically in the plan view design file as shown in Figure 40 below. The ditch offset was established by extending the foreslope to meet the ditch line graphic.

The variable **"~proposed ditch in dgn"** is used to define the symbology for the graphic ditch line. The criteria will search the design file specified by the variable **"proposed dgn file name"** for the graphic ditch line. The variable is defined as follows within the criteria:

```
define_dgn "~proposed ditch in DGN" \
        dgn = "proposed dgn file name" \
        lvname = DR_P_Ditch_Intermittent \
        wt = 1,ByLevel \
        co = 11,ByLevel
```

If two ditch lines are drawn in the plan view, the criteria will draw the width of the ditch to match the plan view graphics.

If only one ditch line is encountered, it is assumed that this line is at the center of the ditch. The ditch width is determined by the location of the ditch and the **"clear zone distance"**. If the ditch section is within the **"clear zone distance"** the variable **"traversable ditch width"** will be used. If the ditch section is outside of the **"clear zone distance"** the variable **"normal ditch width"** will be used.

If the criteria finds a graphic ditch line, but no profile has been defined by the variables, **"special ditch profiles lt"** (left side) or **"special ditch profiles rt"** (right side), the graphic ditch line will be used for both the ditch offset and the elevation. If a graphic ditch line has been found, it does not matter whether the cross sections is in cut or fill. The side slope will be extended to meet the ditch offset whether or not the ditch elevation is above or below the existing ground.

Figure 40: Graphic ditch line example
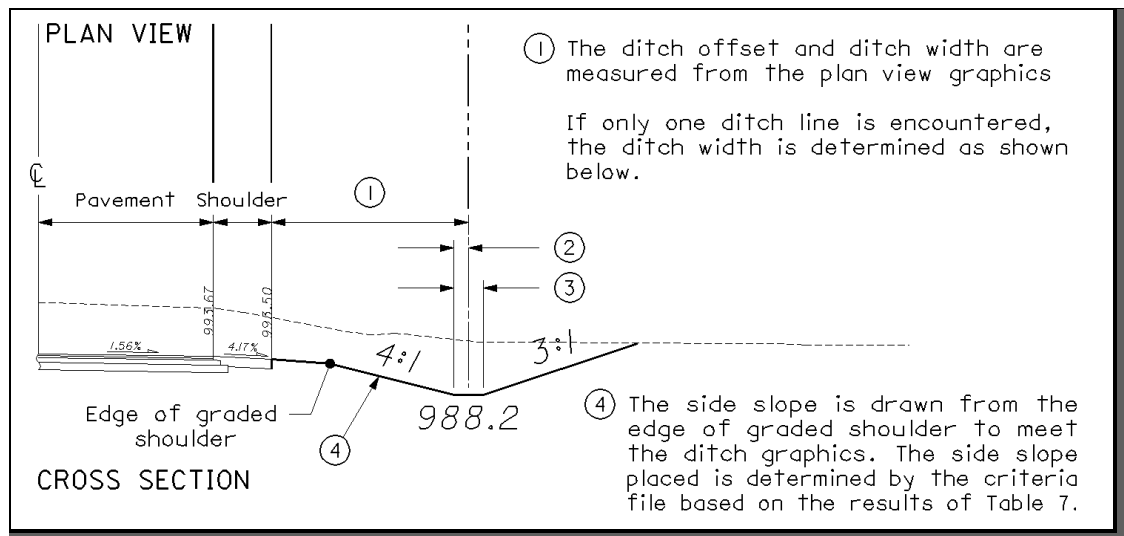
②   distance = "traversable ditch width" ÷ 2 for ditches within the **"clear zone distance"**.
    distance = "normal ditch width" ÷ 2 for ditches outside the **"clear zone distance"**.
③   distance = " traversable ditch width" for ditches within the **"clear zone distance"**.
    distance = "normal ditch width" for ditches outside the **"clear zone distance"**.

Cut Condition:
The criteria file will place the **"foreslope"** to whatever is present at the section, either the graphic ditch line or a COGO ditch profile.

Fill Condition:
Before the section is completed in the Fill Condition, the criteria will run the following tests shown in Table 8 before the ditch section is placed when a graphic ditch line or COGO ditch profile is present:

Table 8		
Criteria Test	**Criteria Result**	
Is the bottom of the ditch above existing ground using **"foreslope"**?	• Yes, Does the existing ground slope up allowing ditch section to be placed?	• Yes, ditch section is placed using existing ground as backslope.
		• No, proceed to **Medium Fill Condition**
	• No, Is the distance between **"foreslope"** and **"fill slope"** greater than the **"reduce distance medium fill"** value? (See Figure 24 for example of this comparison).	• Yes, determine the fill height of the ditch section placed with **"fill slope"**.
		• No, place completed ditch section using the **"foreslope"**.
Is the bottom of the ditch above existing ground using **"fill slope"** in the **Medium Fill Condition**?	• Yes, Does the existing ground slope up allowing ditch section to be placed?	• Yes, ditch section is placed using existing ground as backslope.
		• No, proceed to **Fill Heights over "fill height" Condition**.
	• No, place completed ditch section using the **Medium Fill Condition**.	
Is the fill height of the ditch section placed with **"fill slope"** greater than the user definable value **"fill height"**?	• Yes, proceed to **Fill Heights over "fill height" Condition**.	
	• No, place completed ditch section using either the **"foreslope"**, **"fill slope"**, or **barrier slope"**	

Graphic Ditch Line and COGO Profile
In this case, a graphic ditch line is used to determine the offset for the ditch and a COGO profile is used to determine the elevation of the ditch.

Figure 41: Example of the ditch drawn by intersecting a graphic ditch line and a COGO profile
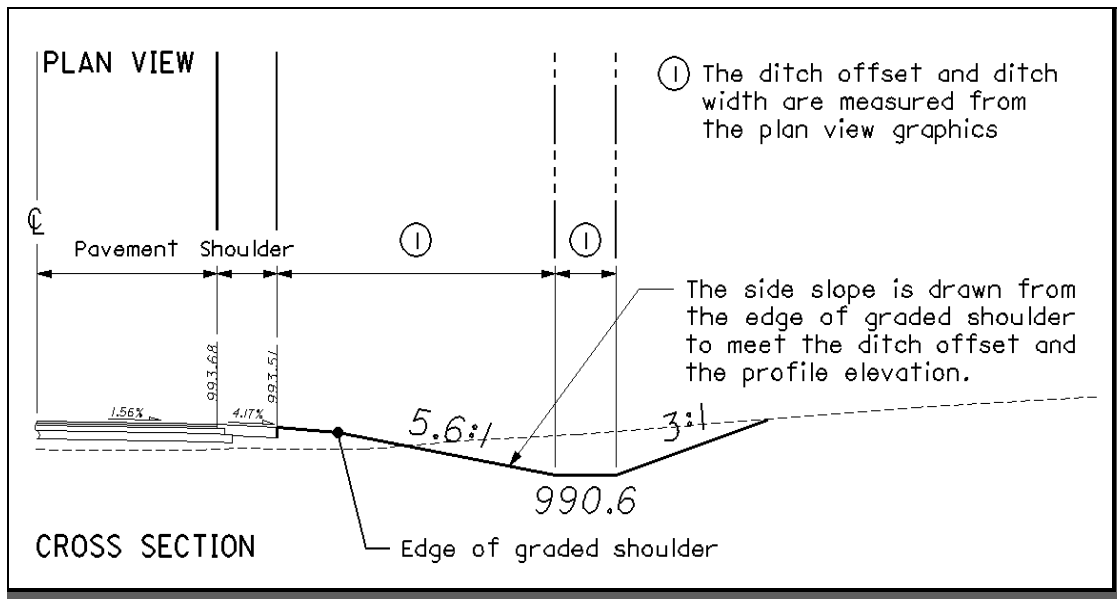
Please note that the side slopes are determined by the ditch offset and the profile elevation. This can result in variable slopes as shown in the figure above.

If two ditch lines are drawn in the plan view, the criteria will draw the width of the ditch to match the plan view graphics.

If only one ditch line is encountered, it is assumed that this line is at the center of the ditch. The ditch width is determined by the location of the ditch and the **"clear zone distance"**. If the ditch section is within the **"clear zone distance"** the variable **"traversable ditch width"** will be used. If the ditch section is outside of the **"clear zone distance"** the variable **"normal ditch width"** will be used.

This method can be used for sections in cut or fill. In either case, the offset and the elevation of the ditch is determined by the plan view graphics and the COGO profile.

SS307-3.X – version 07.04.10

Summary of Variables

A summary of the variables defined in `SS307-3.x` is included below. Most of the **Define Variables** have been assigned a default value within the criteria. The user should review the variables below to ensure that the default values are acceptable for the project. The value of each variable can be changed by the user before processing the criteria, as needed. See the ODOT GEOPAK Road Training Guide, Part 2, Chapter 5 for more information on modifying the default value of the **Define Variables**.

DEFINE VARIABLES

Variables defined by the user:

The following variables must be defined by the user before processing.

> **"clear zone distance"**
> This variable defines the distance from the edge of pavement to the clear zone. See the following figures and sections of the Location and Design Manual for more information:

Table 9		Table 10	
Figure	**Title**	**Section**	**Title**
307-3E	Clear Zone Grading Sections	307.2	Slopes
600-1	Clear Zone Widths	600.2	Clear Zone
600-2	Clear Zone Measurements		

> **"fill slope"**
> This variable defines the slope used for the medium fill condition. The define variable **"foreslope"** is drawn to clear zone and then **"fill slope"** is placed. See Figures 307-3E and 600-2 of the L&D Manual for the usage of this variable. Entered as single number. For example, if you require a slope of 4:1 keyin 4, 3 for 3:1, etc.

> **"foreslope"**
> This variable defines the foreslope used for cut or fill condition placed from the edge of graded shoulder. Entered as single number. For example, if you require a slope of 4:1 key in 4, 6 for 6:1, etc.

> **"graded shoulder width lt"**
> This variable defines the graded shoulder width to be used without barrier or foreslope is less than (lt) or equal to 6:1. See Figure 301-7 Graded and Treated Shoulder Widths for the usage of this variable. For recommended dimensions for this variable, see Figure 301-3 under the Graded Width Without Barrier, 6:1 or Flatter Foreslope column.

> **"graded shoulder width gt"**
> This variable defines the graded shoulder width to be used with barrier or foreslope is greater than (gt) 6:1. See Figure 301-7 Graded and Treated Shoulder Widths for the usage of this variable. For recommended dimensions for this variable, see Figure 301-3 under the Graded Width With Barrier or Foreslope Steeper Than 6:1 column.

"maximum traversable ditch backslope 307-10E"

This variable defines the maximum ditch backslope that would be the maximum placed on the cross section for "traversable ditch width" values that are less than 4'-0". The backslope is placed based on Figure 307-3E Preferred Ditch and Figure 307-10E. See page 9 for the usage of this variable. Entered as single number. For example, if you require a slope of 8:1 keyin 8, 6 for 6:1, etc.

"maximum traversable ditch backslope 307-11E"

This variable defines the maximum ditch backslope that would be the maximum placed on the cross section for "traversable ditch width" values that are equal to or greater than 4'-0". The backslope is placed based on Figure 307-3E Preferred Ditch and Figure 307-11E. See page 9 for the usage of this variable. Entered as single number. For example, if you require a slope of 8:1 keyin 8, 6 for 6:1, etc.

"preferred traversable ditch backslope 307-10E"

This variable defines the preferred ditch backslope that will be attempted first on the cross section for "traversable ditch width" values that are less than 4'-0". The backslope is placed based on Figure 307-3E Preferred Ditch and Figure 307-10E. See page 9 for the usage of this variable. Entered as single number. For example, if you require a slope of 8:1 keyin 8, 6 for 6:1, etc.

"preferred traversable ditch backslope 307-11E"

This variable defines the preferred ditch backslope that will be attempted first on the cross section for "traversable ditch width" values that are equal to or greater than 4'-0". The backslope is placed based on Figure 307-3E Preferred Ditch and Figure 307-11E. See page 9 for the usage of this variable. Entered as single number. For example, if you require a slope of 8:1 keyin 8, 6 for 6:1, etc.

VARIABLES ASSIGNED A DEFAULT VALUE:

The following variables have been assigned default values as noted below. If you wish to change the default values, you will need to modify the value of the variable in the cross section run.

Design File Variables

"PROPOSED DGN FILE NAME"
"XS DGN FILE NAME"

These variables are used by the DEFINE_DGN variables to identify the base map MicroStation design file that contains the existing, proposed, and cross section graphics. The default value for each variable has been defined using a relative path as follows:

```
define "PROPOSED DGN FILE NAME" ..\roadway\basemaps\nnnnnBP###.dgn
define "XS DGN FILE NAME" ..\roadway\basemaps\nnnnnXC###.dgn
```

By default GEOPAK will look for design files in the Working Directory assigned for the project. Using the directory structure defined in the **ODOT CADD Engineering Standards Manual**, Section 302, Project Directory Structure, the GEOPAK Working Directory should be defined as the `geopak` folder.

The "`..`" syntax will instruct GEOPAK to look for the proposed design file by starting in the Working Directory, and then go up the project folder path one directory. From there, go into the `\roadway\basemaps` folder to find the file.

"design speed"
This variable sets whether the criteria file will extend the clear zone width on the outside of curves having a D_c of 2 degrees or sharper by multiplying the horizontal curve correction factor to the **"clear zone distance"**.

If this variable is set to 0, it will not extend the clear zone width. If the variable is set to one of the following design speeds (mph) 40, 45, 50, 55, 60, 65, or 70, the criteria file will extend the clear zone width on the outside of curves having a D_c of 2 degrees or sharper. The criteria file will determine the appropriate horizontal curve correction factor based on the **"design speed"** entered and the degree of curvature for every horizontal curve it encounters during processing.

See **Horizontal Curve Correction Factor** section on for the usage of this variable. The default value is 0.

Variables specific to cut conditions:

"reduce distance cut"
This variable is used only on cut sections. The variable defines a distance measured between the flatter traversable ditch backslope and the next available steeper traversable ditch backslope at the existing ground intersection. This value allows the designer the option of placing the steeper ditch backslope instead of the flatter ditch backslope if the distance between the two is larger than the **"reduce distance cut"**. See Figure 11 for the usage of this variable. The default value is 4 ft.

Variables specific to fill conditions:

"barrier slope"
This variable defines the foreslope used for barrier grading. **"Barrier slope"** is drawn from the edge of graded shoulder to the existing ground, bench or ditch. Entered as a single number. For example, if you require a slope of 2:1 keyin 2. The default value is 2.

"bench width"
For fill sections greater than 16 ft, a bench is placed with this width using either existing ground as shown in Figure 28 or drawn at the bottom of the fill before the ditch as shown in Figure 29. The default value is 10 ft.

"bench width slope"
This variable sets the bench width slope. This is the slope the bench is placed with if proposed grading is placed instead of using an existing ground bench. See Figure 29 for the usage of this slope. Given in positive percent, i.e., 2 for 2%. The default value is 1.

"fill height"
This variable is the value for fill height where the fill section uses barrier grading instead of clear zone grading (see Figure 307-4E). See Figure 24 for the usage of this variable. The default value is 16 ft as stated in Note B on Figure 307-3E.

"reduce distance fill"
This variable is used only on fill sections. The variable defines a distance measured between the flatter traversable ditch backslope and the next available steeper traversable ditch backslope at the existing ground intersection.   This value allows the designer the option of placing the steeper ditch backslope instead of the flatter ditch backslope if the distance between the two is larger than the **"reduce distance fill".** See Figure 11 for the usage of the similar variable **"reduce distance cut"**. The default value is 4 ft.

"reduce distance medium fill"
This variable is used only on medium fill sections. The variable defines a distance measured between **"foreslope"** and **"fill slope"** at the existing ground intersection.   This value allows the designer the option of placing the **"fill slope"** instead of the **"foreslope"** if the distance between the two is larger than the **"reduce distance medium fill".** See Figure 24 for the usage of this variable. The default value is 4 ft.

"terminate slope"
This variable defines the maximum slope of the existing ground (in the down direction) at which the proposed foreslope in a section terminates and no ditch is placed. See **Terminate Slope** section and Figure 30 on page 17 for the usage of this variable. Given in positive percent, i.e., 2 for 2%. The default is set at 0.

Labeling Variables:

"cl chain name"
This variable identifies the name of the COGO chain to be used for any criteria function which measures offsets from a chain. This function is used in labeling ditch offsets and bench offsets (please see "**ditch annotation style**" below and the **Ditch Labeling** section on page 21 for more information on the usage of this variable). The default value is `none`.

"ditch annotation style"
This variable sets the ditch annotation style for the labeling of the ditch section. If this variable is set to 1, it will also place offsets with sections containing benches. The two styles are shown in the Figures 35 and 36 on page 21. The default value is 0.

"offset for construction limits"
This variable defines the distance from the edge of proposed grading to the construction limits. This sets and places a marked point 40. The default value is 2 ft.

Variables for the ditches:

"depth of ditch flow"
This variable sets the minimum depth of ditch flow below the edge of graded shoulder. The default value is 1.5 ft (18 in.) for no underdrains. If the project contains underdrains, the depth is determined by the underdrain depth + outfall of the underdrain outlet to ditch. See Figures 9 and 10 for the usage of this variable in the criteria file processing. The default value is 1.5 ft.

"ditch depth cut"
This variable sets the minimum depth of ditch below existing ground on the ditch backslope side for sections in cut (see Figure 307-3E Preferred Ditch Section). See Figure 18 for the usage of this variable. The default value is 1.5 ft.

"ditch depth fill"
This variable sets the minimum depth of ditch below existing ground on the ditch backslope side for sections in fill (see Figure 307-3E Preferred Ditch Section and Figure 307-4E Normal Ditch Sections - Fill). See Figures 22, 23, 25 and 42 for the usage of this variable. The default value is 1 ft.

"normal ditch backslope1"
This variable defines the ditch backslope placed based on Figure 307-4E Normal Ditch Sections. This variable is used only during normal ditch placement where the depth for the section on the ditch backslope side is less then or equal to 5 ft (_d_normal_fill_depth = 5, _d_normal_cut_depth = 5).

See Figure 33 on page 18 and Figure 42 below for the usage of this variable. Entered as single number. For example, if you require a slope of 2:1 keyin 2, 3 for 3:1, etc. The default value is 3 (for 3:1).

"normal ditch backslope2"
This variable defines the ditch backslope placed based on Figure 307-4E Normal Ditch Sections. This variable is used only during normal ditch placement where the depth for the section on the ditch backslope side is greater than 5 ft (_d_normal_fill_depth = 5, _d_normal_cut_depth = 5).

See Figure 34 on page 18 for the usage of this variable. Entered as single number. For example, if you require a slope of 2:1 keyin 2, 3 for 3:1, etc. The default value is 2 (for 2:1).

"normal ditch width"
This variable defines the ditch width based on Figure 307-4E Normal Ditch Sections. See Figure 42 below for the usage of this variable. The default value is a width of 2 ft.

Figure 42: Normal Ditch Section
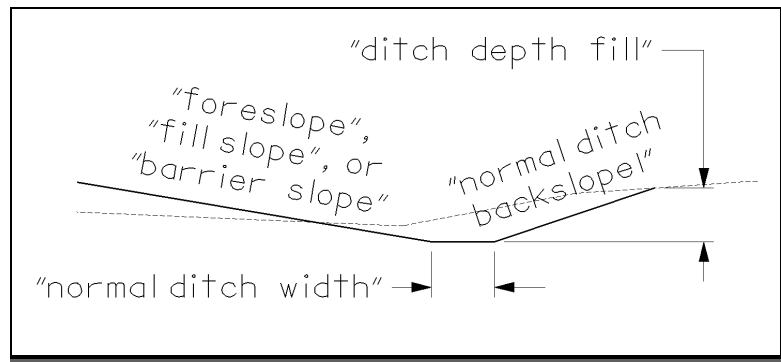
"special ditch profiles lt"
This variable identifies the name of the COGO profile to be used on the left side of the pavement for the ditch. If the ditch profile is found at the station being processed, the **"foreslope"**, **"fill slope"**, **"barrier slope"** or a variable slope will be drawn to intersect the profile elevation. See the **Drainage Considerations** section starting on page 22. The default value is `none`.

"special ditch profiles rt"
This variable identifies the name of the COGO profile to be used on the right side of the pavement for the ditch. If the ditch profile is found at the station being processed, the **"foreslope"**, **"fill slope"** , **"barrier slope"** or a variable slope will be drawn to intersect the profile elevation. See the **Drainage Considerations** section starting on page 22. The default value is `none`.

"traversable ditch width"
This variable defines the ditch width based on a preferred ditch section as shown in Figures 307-3E, 307-10E, and 307-11E. See Figures 10 and 18 for the usage of this variable. The default value is 4 ft.

Define DGN Variables

The following DEFINE_DGN variables are used by the criteria to locate the MicroStation elements that **SS307-3.x** will search for in order to draw the side slopes.

These variables have been defined with the values listed below in accordance with ODOT standards and should never be redefined by the user.

Additionally, these variables have been defined as "hidden" variables and will not show up in the DEFINE_DGN Variables portion of the Proposed Cross Sections dialog box when preparing a criteria run.

"~existing ground"
The criteria has the capability of determining the existing ground slope at the location where proposed grading intersects the existing in the cross section MicroStation design file. This variable is used to define the symbology for the existing ground line. The variable has been defined as follows:

```
define_dgn "~existing ground" \
        dgn = "xs dgn file name" \
        lvname = XS_X_Ground_line \
        co = 0,2,ByLevel\
        wt = 1,ByLevel\
        lc = 3,ByLevel
```

"~proposed ditch in DGN"
The criteria has the capability of placing the proposed drainage ditches at the location of a ditch line placed in the plan view MicroStation design file. This variable is used to define the symbology for the proposed ditch line. The variable has been defined as follows:

```
define_dgn "~proposed ditch in DGN" \
        dgn = "proposed dgn file name" \
        lvname = DR_P_Ditch \
        wt = 1,ByLevel \
        co = 11,ByLevel
```

"~**proposed graded shoulder in dgn**"
The criteria will set the graded shoulder width automatically using the variables **"graded shoulder width lt"** or **"graded shoulder width gt"**. Occasionally, the graded shoulder will have a variable width. In this case, the designer has the option to draw the graded shoulder in the plan view design file. The criteria will look for a graphic graded shoulder line matching the symbology listed below. If a graded shoulder line is encountered, the criteria will ignore the value of the variables **"graded shoulder width lt"** and **"graded shoulder width gt"**.

```
define_dgn "~proposed graded shoulder in dgn" \
          dgn = "proposed dgn file name" \
          lvname = DT_P_Graded_Shoulder \
          wt = 1,ByLevel \
          co = 9,ByLevel
```

Marked Points

GEOPAK has a simple, yet very important way of "remembering" where the location of various points are during the drawing process. This is accomplished with marked points.

Some marked points are stored during the criteria processing that are only used temporarily and do not need to be "remembered" as processing continues. These points can be subsequently redefined by another criteria file. There are, however, certain key locations that are referred to by subsequent criteria files. The following marked points must be previously defined by the pavement and shoulder criteria files in order for **SS307-3.x** to process correctly:

Edge of pavement	x1 y1
Edge of paved shoulder	x5 y5
Outside bottom of shoulder	x14 y14

S307-3.x will store the following marked points during processing that should never be redefined by another criteria file:

Edge of graded shoulder	x10 y10
Inside edge of ditch	x33 y33
Flowline of Ditch	x34 y34
Outside edge of ditch	x35 y35
Ditch backslope to existing ground	x36 y36
Proposed to existing ground	x37 y37
Construction limits	x40 y40
Depth of ditch flow	x525 y525

This criteria file will place a piece of text on the cross section at the location of the marked point. On the left side of the cross section, the text is placed using the marked point number and is appended with the letter "L". On the right side, the letter "R" is appended to the marked point number. This text is placed on level XS_P_Text_MarkedPoint.

The figures shown on the following pages display the marked points which are labeled for use in preparing grading plans or creating profiles.

The GEOPAK Profile Grade Report can be used to search for the marked point text and store a COGO chain and/or profile. For example, the Profile Grade Report can be run to search each cross section for the text "40R" in order to store a COGO chain by measuring the offset from the centerline to the text origin. Once the chain is stored, it can be plotted as a construction limit line in the plan view design file using the Design and Computation Manager. For more information on the Profile Grade Report tool, see the GEOPAK online help.

The marked point text can also be used for preliminary evaluation of drainage ditches. For example, the criteria can be run without a ditch profile or a graphic ditch line. In this case, the criteria will place the ditch using the values of the define variables. After this initial processing of the cross sections, the Profile Grade Report can be used to connect all the 33L or 33R points as a separate COGO ditch profile. The ditch profile can be edited using the Vertical Alignment Generator, and then a second criteria run can be processed using the variables **"special ditch profiles lt"** or **"special ditch profiles rt"** to force the criteria to draw the ditches at the elevation set with the new profile.

Cut or Shallow Fill section
    Ditch:
        foreslope to ditch   x33 y33   backslope to ground   x36 y36
        back of ditch   x35 y35   proposed to existing ground x37 y37

Figure 43

Cut or Shallow Fill section
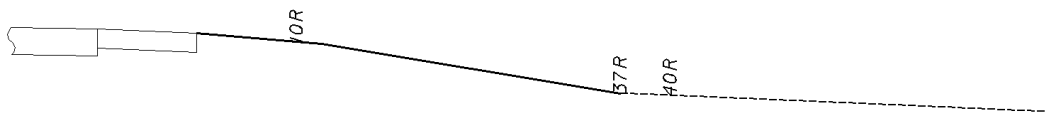   No ditch (fill condition):
        proposed to existing ground x37 y37

Figure 44

Medium Fill section
      Ditch:
            foreslope to clear zone x30 y30   backslope to ground   x36 y36
            fill slope to ditch   x33 y33   proposed to existing ground x37 y37
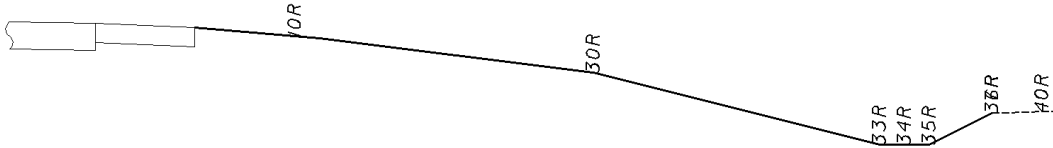   back of ditch   x35 y35

Figure 45

Medium Fill section
      No ditch:
            foreslope to clear zone   x30 y30
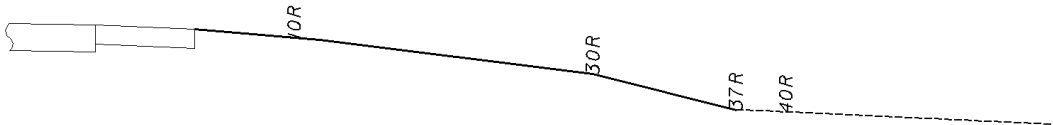   proposed to existing ground x37 y37

Figure 46

Barrier section
      Ditch with bench:
            barrier slope to ground   x31 y31   back of ditch   x35 y35
            bench width to ditch   x32 y32   backslope to ground   x36 y36
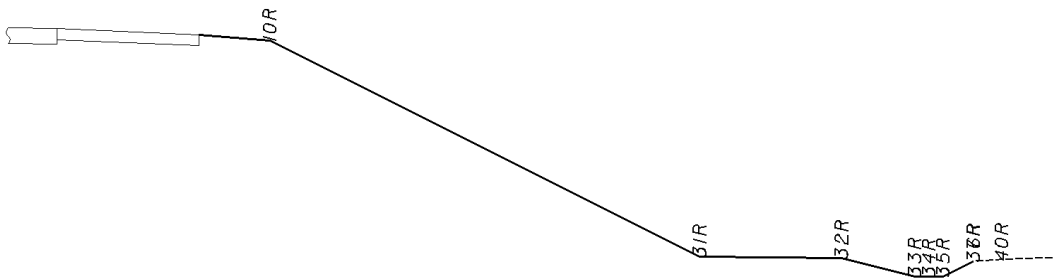   ditch foreslope to bottom x33 y33   proposed to existing ground x37 y37

Figure 47

Barrier section
       Ditch with no bench:
              foreslope to ditch   x33 y33   backslope to ground   x36 y36
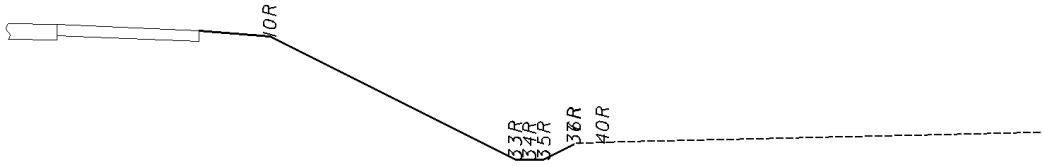   back of ditch   x35 y35   proposed to existing ground x37 y37

Figure 48

Barrier section
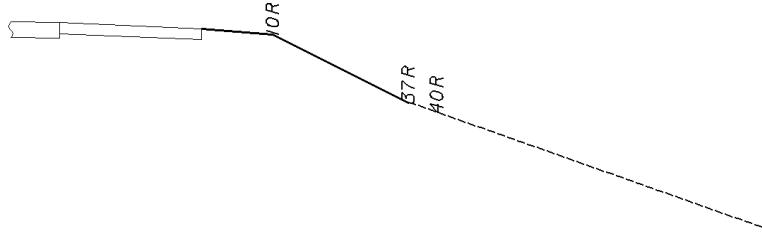   No ditch:
              proposed to existing ground x37 y37

Figure 49