Overview: Create the surface model and earthwork volumes for a pond embankment with a wave berm. A surveyed site with a surface model covering the footprint of the dam is needed. Final elevations of the normal pool, auxiliary spillway, and top of settled dam have already been computed.

Software: AutoCAD Civil 3D 2018, Civil 3D Workspace, NRCS C3D 2018 template

Notation: Button to Press *Displayed Text* **Icon** Action {Text to Enter} *Menu Item…*

Prerequisite

Follow the instructions for creating *Original Ground Contours.*

Embankment with a Berm

Placing the Centerline & Top of Dam

Create the centerline of the dam.

1. Tool Palette>NRCS 11x17B… Click *Plan Commands… Embankment CL New*
2. Draw a line that represents the centerline for the embankment, typically based on survey control points. This line needs to be longer than the actual embankment.
3. Click *Home… Create Design… Alignment… Create Alignment from Object*  …
4. Select the Centerline of dam. Press Enter
5. If the direction of the alignment is correct, press Enter. ({R} Enter to reverse)
6. Input the *Name* as {*CL Dam*}.
7. On the General Tab, set *Site* to *None*, checkmark *Erase existing entities.*
8. Uncheck *Add curves between tangents* if you want to keep the object as is.
9. Click OK

Create user defined contours to identify the limits of the dam.

10. Toolspace> Prospector… *Surfaces...* Right click *Ognd…* Click *Surface Properties…*
11. Click the *Information* tab and Set the *Surface Style* to *User Defined Contours*.
12. Click the *Analysis* tab and Set the *Analysis type* to *User Defined Contours*.
13. Set the *Ranges* to *3* and click the **down arrow**
14. Input the elevations of the normal pool {e.g. 1083.5}, auxiliary spillway {e.g. 1086.5}, and top of settled dam {e.g. 1088.5} into the *Range Details.*
15. Click OK
16. Toolspace> Prospector… *Surfaces... Ognd…* Click *Add Label…*
17. In the Add Labels box: Feature = *Surface*; Label Type = *Contour Single*: User = *Ognd Contour Elevations (Auto decimal)*
18. Click Add. Click on the Ognd surface.
19. Select the locations of the contours that you want labeled.
20. Press Enter to quit out of the contour labeling. Click Close

Create a feature line along the centerline of dam.

21. Click *Home… Create Design… Feature Line… Create Feature Line* …
22. In the dialog box set the *Site* to *Embankment,* and set *Style* to *Embankment Feature Line*. Click OK and the feature is created.
23. Press shift + right-click. Click *Apparent intersection*. Click on the intersection of the top of dam contour with the CL Dam alignment at the left end.
24. Input the elevation for the settled top of dam elevation. E.g.{*1088.5*} Press Enter.
25. Press shift + right-click. Click *Apparent intersection*. Click on the intersection of the top of dam contour with the CL Dam alignment at the right end.
26. Accept the grade. Press Enter. Press Enter.

Set the constructed elevations for the top of fill.

27. With the feature still selected right-click *Elevation Editor…*
28. In the Grading Elevation Editor panorama set the starting and ending elevations to the settle top of dam elevation. E.g.{*1088.5*}
29. Look at the length and determine the distance for 1/3 & 2/3 of the feature line.
30. Click **Insert Elevation Point**. Click into the drawing. Input the station of the first overfill grade break. E.g. {*89*} Press Enter.
31. Press Tab. Input the elevation of the constructed elevation of the dam. E.g. {*1089.5*} Click OK
32. Click **Insert Elevation Point**. Click into the drawing. Input the station of the second overfill grade break. E.g. {*178*} Press Enter.
33. Press Tab. Input the elevation of the constructed elevation of the dam. E.g. {*1089.5*} Click OK
34. Determine the constructed top of fill elevation for tie-in with a spillway dike. Click **Insert Elevation Point**. Move the cursor to the location of the Auxiliary Spillway contour along the CL of dam feature line and note the stationing. Move the cursor ~14' farther away from the end of the dam to the estimated downhill edge of the spillway dike and note the constructed top of fill elevation. E.g. {1088.8} Press ESC. You can use this for the construction top of spillway dike elevation later.
35. Click dismiss to close the Grading Elevation Editor Panorama. Press ESC.

Create the US & DS edge of the top of dam.

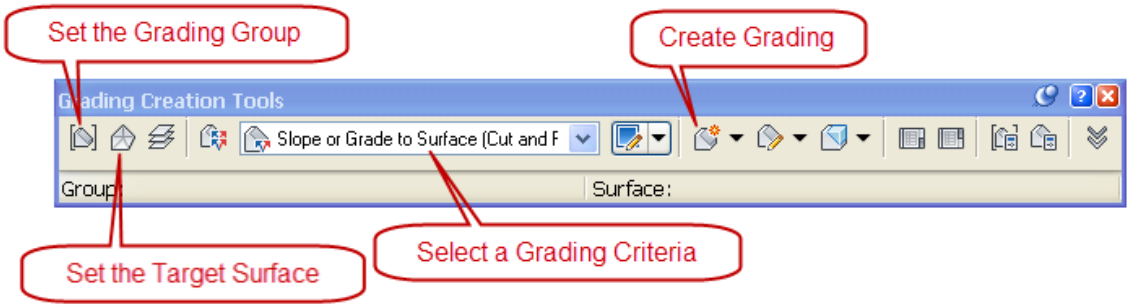
36. Click *Home… Create Design… Feature Line… Create Feature Line from Stepped Offset* …
37. Input the ½ topwidth distance to offset. E.g. {*6*} Press Enter.
38. Select the CL of Dam. Click upstream of the CL of Dam.
39. Input the relative elevation {0}. Press Enter.
40. Select the CL of Dam. Click downstream of the CL of Dam.
41. Input the relative elevation {0}. Press Enter. Press Enter.
42. Select the Upstream feature line. Right-Click *Feature Line Properties*
43. Checkmark *Name* and input *US edge TOF* Click OK
44. Select the Downstream feature line. Right-Click *Feature Line Properties*
45. Checkmark *Name* and input *DS edge TOF* Click OK
46. Save the drawing.

Note: If the embankment will include an Auxiliary Spillway go to the separate **HowTo- Auxiliary Spillway Layout C3D** document.

Placing the Toes and Wave Berm of the Dam

Note: If the embankment will use a blister berm go to the **HowTo- Pond Embankment Blister Berm C3D** document.

47. Click *Home… Create Design… Grading… Grading Creating Tools…*



48. Click **Set the Grading Group** .
49. Set the *Site* to *Embankment*. Click OK
50. Input a Grading Group *Name* as {*Embankment*} Click OK
51. Click **Set the Target Surface** . Select *Ognd*. Click OK

Downstream toe

52. Pulldown the **Select a Grading Criteria** Slope to *Slope or Grade to Surface (Fill)*
53. Click **Create Grading.**
54. Select the downstream edge of the dam. Click downstream of the dam.
55. Apply to entire length? Input *Y* Press Enter
56. Slope or grade? Input *S* Press Enter.
57. Fill Slope? Input *3.* Press Enter
58. Press ESC to exit the command

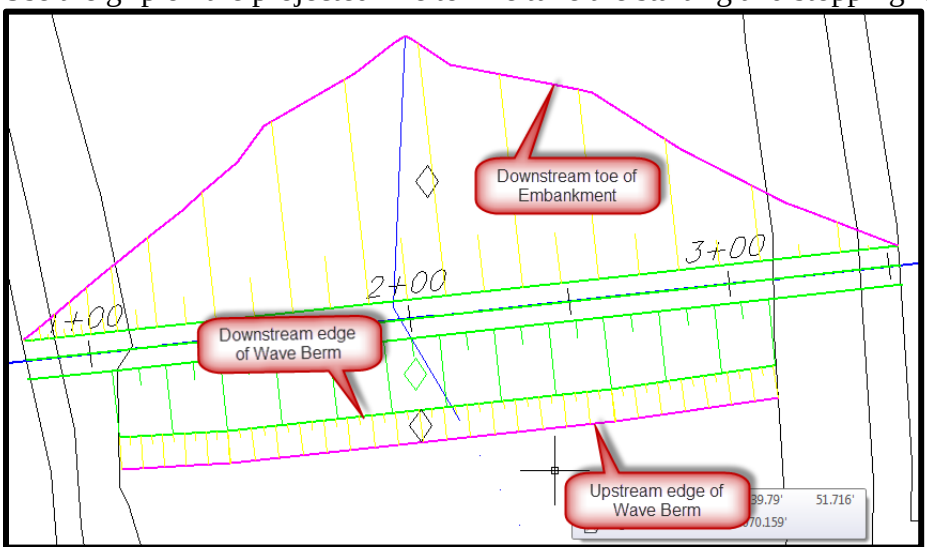
Note: If no wave berm is used, repeat steps 52-58, applying them to the **upstream** side of the dam. Then skip to step 104 for *"Create an alignment for the centerline of the pipe"*

Wave Berm

59. Pulldown the **Select a Grading Criteria** Slope to *Elevation Absolute & Slope*
60. Click **Create Grading.**
61. Select the upstream edge of the dam. Click upstream of the dam.
62. Apply to entire length? Input *N* Press Enter
63. Click near the contour line for the left end of the wave berm. Press Enter
64. Click near the contour line for the right end of the wave berm. Press Enter
65. Elevation? Input Elevation of wave berm. E.g. {*1083.5*} Press Enter.

66. Cut Slope? Input *3*. Press Enter
67. Fill Slope? Input *3*. Press Enter . Press ESC
68. Use the grip on the projected line to fine tune the starting and stopping location so that the DS edge of the wave berm is very close to the contour line of the wave berm.
69. Pulldown the **Select a Grading Criteria** 

to *Distance and Elevation Relative*
70. Click **Create Grading.** 
71. Select the downstream edge of the wave berm.
72. Apply to entire length? Input *N* Press Enter
73. Select the start point: Input *0* Press Enter Press Enter
74. Click near the right end of the wave berm. Press Enter
75. Specify Distance: Input width of wave berm E.g. {12} Press Enter
76. Relative Elevation: If level Input *-0.0001*. Press Enter Press ESC
77. Use the grip on the projected line to fine tune the starting and stopping location.



78. Save the drawing.

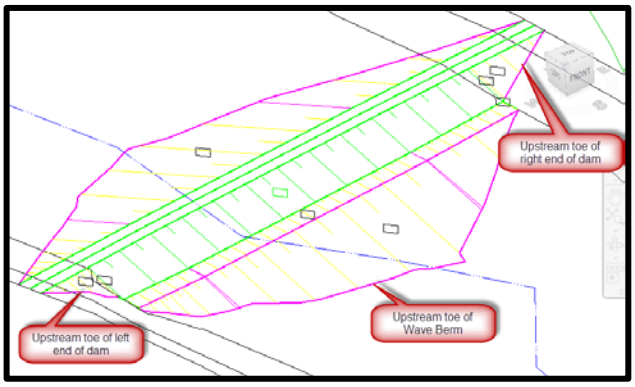
Upstream toes

79. Pulldown the **Select a Grading Criteria** 

to *Slope or Grade to Surface (Fill)*
80. Click **Create Grading.** 
81. Select the projected upstream edge of the wave berm.
82. Apply to entire length? Input *Y* Press Enter
83. Slope or grade? Input *S* Press Enter.
84. Fill Slope? Input *3*. Press Enter

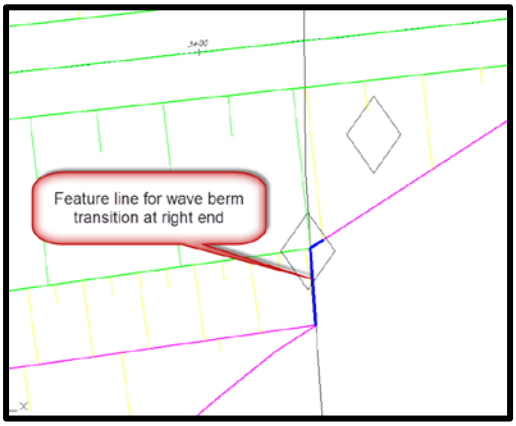
85. Select the left upstream edge of the dam. Click upstream of the dam.
86. Select the start point: Input *0* Press Enter Press Enter
87. Click ~5' short of the left end of the wave berm. Press Enter
88. Slope or grade? Input *S* Press Enter.
89. Fill Slope? Input *3*. Press Enter

90. Select the right upstream edge of the dam. Click upstream of the dam.
91. Click ~5' past the right end of the wave berm Press Enter
92. Click near the right end of the dam. Press Enter
93. Slope or grade? Input *S* Press Enter.
94. Fill Slope? Input *3*. Press Enter
95. Press ESC to exit the command. Close the Grading Creating tool.
96. Save the drawing.



Create feature lines for transition to wave berm.

97. Right Click the **Osnap Status.** Click *Settings…* and checkmark only *End Point* and *Object Snap On*. Click OK.
98. Click *Home… Create Design… Feature Line… Create Feature Line* …
99. In the dialog box set the *Site* to *Embankment*, and set *Style* to *Embankment Catch Line*. Click OK
100. Snap on the left end of the US edge of wave berm. Press Enter to accept the elevation.
101. Snap on the left end of the DS edge of wave berm. Press Enter.
102. Snap on the end of the grading to the left of the berm. Press Enter. Press Enter.



103. Repeat for the right edge of Wave Berm, Open end at Top of Fill, and for the Embankment to Spillway transitions.

Create an alignment for the centerline of the pipe.

104. Click *Home… Create Design…Alignment…Alignment creation tools…*
105. Input a *Name* e.g. {CL Pipe}
106. Set the Alignment Style = *Pipe*
107. Set the Alignment label set = *Major (perp) Minor Geometry (100 and 50)*
108. Click OK and the Alignment Layout Tools will appear.
109. In the 1st column click **Tangent- tangent (no curves)**
110. From the Transparent Command toolbar click the **Station Offset** command ; (or input {'SO} and Press Enter)
111. Select the *CL Dam* alignment and a tracking tool will appear.
Note: For each point created along the new alignment you will set a **station** along the *CL Dam* and then an **offset** relative to the *CL Dam*.
112. To set the station value for the starting point of *CL Pipe*, either input a station value "along the *CL Dam*" and press enter, or snap to the downstream toe of the dam where the pipe will outlet.

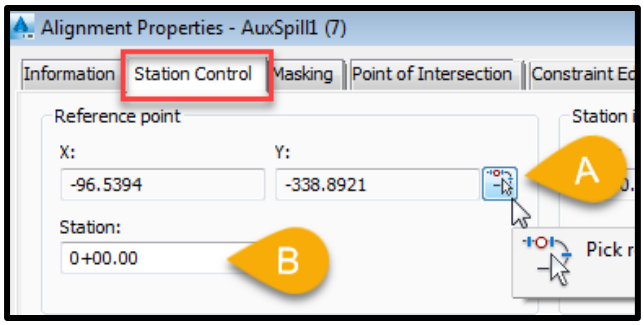
113. Input an offset distance from the *CL Dam* alignment past the upstream toe. (Positive is normally upstream. Watch the tracking tool for values.) E.g. {150} Press Enter.
114. Set the station value for the ending point of pipe alignment, using the same method as you did for the starting point. (Input a value or Snap to toe)
115. Input an offset distance from the *CL Dam* alignment past the downstream toe. (Negative is normally downstream) E.g. {-200} Press Enter.
116. Press ESC to exit the Station Offset transparent command
117. Press ESC to stop adding to the alignment
118. Close the Alignment Layout tool.

Editing the alignment direction and stationing.

119. If the new alignment is backwards, select the alignment. On the context sensitive ribbon use *Alignment…Modify▼… Reverse Direction*. Then click OK.

120. To the set a specific stationing value for a location along the alignment. (Eg. Set the stationing for the CL pipe at the CL of dam to 10+00.)

a. Select the alignment
b. Right-Click *Alignment Properties…*
c. *Station Control* Tab
d. Click **Pick reference point** (See A)
e. Click OK at the warning message.
f. Snap to a location in the drawing. E.g. Intersection of CL Pipe w/ Dam.
g. Set the station value of the reference point. E.g {*1000*} (See B)
h. Click OK. Click OK at the warning message. Click OK.



Creating a Surface Model for the Embankment

Convert gradings to become the embankment surface model.

121. Toolspace> Prospector… *Sites...Embankment…Grading Groups…* Right click *Embankment...* Click *Properties*
122. Click the *Information* tab and Checkmark the *Automatic Surface Creation*
123. In Create Surface, pulldown the *Style* to *_Contours (1 and 5) and Triangles* Click OK . (*Grid Magenta 5x5* can be useful too.)
124. Click OK . Click OK .
125. Select the "ungraded" Spillway and wave berm feature lines & embankment end feature lines for adding to Embankment
126. Right-Click *Feature Line… Add to Surface As Breakline…*
127. In Select Surface, pulldown to the *Embankment* surface. Click OK .
128. *Set Description = {Dam}, Checkmark Supplementing factors: Distance = {2}*
129. Click OK Press ESC.

Fill in void areas within the embankment surface model.

130. Click *Home… Create Design… Grading… Create Grading Infill* …
131. Click into the surface voids inside of the added feature lines. Press Enter.

Remove exterior triangles that are not wanted.

132. Select the *Embankment* surface
133. *Tin Surface… Modify Surface…Edit Surface… Delete lines…*
134. Click on the exterior triangles to be removed. Press Enter.
135. Save the drawing.

Verify the surface & lock it

136. Select the Embankment surface. Right-Click, Click *Object Viewer*.
137. Press ESC when done visually reviewing the surface.
138. Use *Home…Palettes▼… Coordinate Tracker* to inspect the elevations of the *Embankment* surface.
139. Toolspace> Prospector… *Surfaces…* Right-Click *Embankment…* Click *Lock…*

Computing the Earthfill Volume for the Embankment & Stripping

Compute earthfill volume

140. Click *Analyze… Volumes and Materials… Volumes Dashboard*
141. In Panorama click **Create new Volume Entry**
142. Input a Name E.g. {V Embankment - Ogrnd}
143. Set the Style = _<*off*> Click Ok
144. Set the Base Surface = *Ogrnd.* Set the Comparison Surface = *Embankment*
145. Click Ok
146. In Panorama click **Create new Volume Entry**
147. Input a Name E.g. {V Embankment - Strip}
148. Set the Style = _<*off*> Click Ok
149. Set the Base Surface = *Strip.* Set the Comparison Surface = *Embankment*
150. Click Ok
151. Two volume surface gets created and the Fill column will show the volume.
152. Save the drawing.

153. Use **Generate Cut/Fill Report** to create a report. It can be saved or information can be copied from the report into Word or Excel Document
154. In Civil 3D click dismiss to close the **Volumes Dashboard** Panorama.