Overview: Create a waterway surface model and compute earthwork volumes. A surface model covering the footprint of the proposed waterway is needed. Sizing of the water will be done externally, such as with NRCS EFT software. A constructed corridor surface is created by analyzing slices along an alignment based on a design profile, assemblies (templates), and the ground surface.

Software: AutoCAD Civil 3D, NRCS 2016 WW subassemblies, NRCS C3D 2016 template

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

Prerequisite
Import the NRCS waterway subassemblies into your Civil 3D setup.
Follow the instructions for creating Original Ground Contours.

Create the Alignment of the Proposed Waterway

Create the centerline of the waterway.
1) Tool Palette>NRCS 11x17B… Click Plan Commands… Waterway CL New
2) Draw a line that represents the centerline for the waterway.
3) Click Home… Create Design… Alignment… Create Alignment from Object
4) Select the Centerline of proposed waterway. Press Enter
5) If the direction of the alignment is correct, press Enter. ({R} Enter to reverse)
6) Set the Name to CL WW Main.
7) On the General Tab, set Site to None, checkmark Erase existing entities.
8) Uncheck Add curves between tangents. If used set the radius > ½ TW + daylighting.
9) Click OK

Create a Named View in order to find this Alignment easily later
10) Zoom to a full view of the alignment that you just created.
11) Click the View Controls… View Manager… New...
12) Input a View Name. E.g {CL WW Plan View}
13) On the View Properties tab Uncheckmark Save layer snapshot with view.
14) Click OK, Click OK.

Create the Profile of the Proposed Waterway

Extract a Profile of the Ground Surface to a profile view
15) Set the drawing annotation scale to match the desired horizontal profile scale.
16) Click Home… Create Design… Profile… Create Surface Profile
17) Pull down the alignment to CL WW Main.
18) The Station range To sample can be used to limit the length of the alignment profiled.
19) Use Ctrl + Click to select the multiple surfaces to be profiled. E.g. \{Ognd\}
20) The Sample offsets can be checkmarked to draw profiles parallel to the alignment.
   E.g. \{-20, 0, 20\}
21) Click Add>> to apply the process to the selected surfaces
22) In the Profile list pulldown the style to match the type of surface E.g. Original Ground. Use Bank – Right (Orange) for a right offset as an orange line & Bank–Left (Blue) for a left offset in blue.
23) Click Draw in Profile View
24) Set the Profile View style to the Horizontal/Vertical scaling desired. E.g. \{A100Hx5V\} Click Next
25) Select User Specified Range and input values for starting and stopping. Click Next
26) Select User Specified view height and input values for grid elevations. Click Next
27) Click Create Profile View
28) Click a location in the drawing for the profile to appear.

Create a Named View in order to find this Profile View easily later
29) Zoom to a full view of the profile view that you just created.
30) Click the View Controls… View Manager… New…
31) Input a View Name. E.g \{CL WW Main- Profile Layout\}
32) On the View Properties tab Uncheckmark Save layer snapshot with view.
33) Click OK, Click OK.

Create the planned profile of the waterway in the profile view
34) Click Home… Create Design… Profile… Profile Creation Tools

35) Select the Profile View of WW Main. A Profile View is the grid holding the profiles.
36) Alignment = CL WW Main
37) Input Name = \{Planned WW Main\}
38) General: Profile Style = Finished Ground
39) Click OK
40) From the Profile Layout Tools click Draw Tangents
41) Click the starting point and grade breaks of the Proposed WW profile from left to right. Use Shift + Right-Click to use Endpoint or other Osnaps. Or use: Transparent Commands
   • Only one transparent command can be active at a time.
   • To switch to a different one, press ESC to stop the active transparent command.
   • If a transparent profile command is running you will see “>>” at the left of the command line. E.g >>Specify Station
   • ESC out of the transparent commands first in order to quit out of the Draw Tangent command.
Four of the transparent commands that might be most useful.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile: Station &amp; Elevation</td>
<td>See ProfileView in Image 1.</td>
</tr>
<tr>
<td>Profile: *Grade &amp; Station</td>
<td>See ProfileView in Image 2.</td>
</tr>
<tr>
<td>Profile: *Grade &amp; Elevation</td>
<td>See ProfileView in Image 3.</td>
</tr>
<tr>
<td>Profile: *Grade &amp; Length</td>
<td>See ProfileView in Image 4.</td>
</tr>
</tbody>
</table>

*These can’t be used for the first point of a profile.

42) Press Enter when done creating the planned profile.

Review the Station/elevation data.

43) From the Profile Layout Tools click **Profile Grid View**

44) Edit any Stations and Elevations

45) Use the **Raiser/Lower** tool to change elevations of reaches of the proposed profile.

46) In the Grid View an individual point can be locked so that its location can’t be changed.

<table>
<thead>
<tr>
<th>No.</th>
<th>PVI Station</th>
<th>PVI Elevation</th>
<th>Grade In</th>
<th>Grade Out</th>
<th>Profile Curve Type</th>
<th>Lock</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2+21.75'</td>
<td>1082.350'</td>
<td>-10.25%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2+98.87'</td>
<td>1074.440'</td>
<td>-10.26%</td>
<td>2.50%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

47) Input these Grades into NRCS EFT Waterway Sizing Wizard to compute the size.

48) Close the Profile Layout tool

Label the profile view with the planned elevations and cut

49) Select the Profile View of the **WW Main**.

50) Right-click … click **Profile View Properties**…

51) In the Profile Views Properties box go to the **Bands** tab.

52) Click **Import Band Set**…

53) Select **Elev & Fill at Major Stations - in Grid**

54) Click **Ok** A Profile Bank is added to the List of bands.

55) Pulldown the column for Profile1 to the planned profile (e.g. Planned WW Main)

56) Pulldown Profile2 to the original ground surface profile (e.g. CL WW Main – Ognd)

57) Click **Ok** The elevation and cut will be added along the bottom of the profile view.

58) Save the drawing.
Create the Assembly/Template of the Proposed Waterway

Create an assembly for each Waterway shape & size used.

59) Click Home… Create Design… Assembly… Create Assembly

60) Input a Name describing the shape & size. E.g. \{P40x1.8\} for a Parabolic with a Top Width=40’and Depth = 1.8’ or \{T18x1.5\} for a Trapezoidal with Bottom width=18’ & Depth=1.5’.

61) Click Ok

62) Click a location in the drawing to create the assembly.

Build the assembly using the NRCS subassemblies.

63) Tool Palette>NRCS 11x17…My NRCS WW… click Parabolic WW wDaylight (or Trapezoidal WW wDaylight)

64) Click onto the circle on the Assembly marker to place the pre-built subassembly.

65) Press ESC.

66) Select the sub-assembly and set the size in Properties: Advanced Set Depth and Top Width of the waterway. Also adjust any of the other values as explained in the pdf help file. Press ESC.

Label the assembly with mtext

67) Tool Palette>NRCS 11x17…11x17 Text & Dims… click Notes (MS)

68) Click to place the text location and size.

69) In the context sensitive ribbon click Text Editor… Insert… Field …

70) Field Category = Objects, Field name = Object

71) At Object type click the Select Object button & Click on the Assembly vertical line.

72) Set Property = Name, click Ok

73) Press Ctrl + Enter to accept the input.

For additional Waterway sizes repeat the Create, Build and Label steps.

Create a Named View in order to find theses Assemblies later

74) Zoom to a full view of the assemblies that you just created.

75) Click the View Controls… View Manager… New…

76) Input a View Name. E.g \{ WW Assemblies\}

77) On the View Properties tab uncheck Save layer snapshot with view.

78) Click Ok, Click Ok.
Create the Proposed Waterway Corridor & Surface

Create the Corridor
79) Click the View Controls… Custom Model Views. CL WW Main – Plan View to zoom to the Alignment.
80) Click Home… Create Design… Corridor
81) Input Name = {Waterway Main}
82) Set Alignment = CL WW Main
83) Set Profile (this is the “planned” profile) = Planned WW Main
84) Set Assembly = WW P40x1.8
85) Set Target Surfaces = Ognd.
86) Checkmark Set baseline and region parameters
87) Click Ok
88) If more than one Assembly template is needed
   a) Right click on the RG region and click Insert Region After.
   b) Select the assembly to use for the additional region. Click Ok
   c) Input the start and end stations for each region
89) Important: Be sure that the Regions (reaches) do not extend past the ends of the planned profile stationing. It will use Elevation = 0 where no planned profile exists.
90) Click Set all Targets…
91) Under the Object Name column set all to Ognd. Click Ok Click Ok
92) Click Set all Frequencies…
93) Under the Apply Assembly section pulldown the following:
   At Alignment Geometry Points= No
   At Profile Geometry Points= No
94) Click Ok Click Ok
95) Toolspace> Prospector…Corridors… Right click Waterway Main… Click Rebuild Automatic

96) If the Events Panorama appears, review errors and then close it.

Create a surface from the corridor.
97) Select the corridor that was created.
98) Corridor… Modify Corridor… Corridor Properties
99) On the surfaces tab click Create Corridor Surface
100) Edit the Name = Waterway Main.
101) Set Surface style = Grid Magenta 5x5
102) Specify code = Top, **Click Add Surface Item**

103) On the Boundaries tab, **right-click Waterway Main... Add Automatically > Daylight** (or Corridor Extents as Outer Boundary)

104) **Click Ok**

105) If the Events Panorama appears, review errors and then close it.

106) **Save the drawing.**

**Use Object Viewer** to preview the Waterway design
Select the Waterway surface. **Right-click, Click Object viewer.**
Rotate it around in 3D to make sure the start/end stations don’t drop to zero elevation.
**Press ESC** when done reviewing the surface.

**View the Corridor using Sections**

107) **Home... Profile & Section Views...Samples Lines**

108) **Press Enter**

109) **Select** the Waterway Alignment from the list (e.g. CL WW Main). **Click Ok**

110) **Input** a Name as WW Main Single Sample Line

111) **Set the data sources to sample. Checkmark the Ognd source. Checkmark the Waterway Main corridor, set Style to Waterway (Corridor Design). Click Ok.**

112) **Click** at a location along the alignment to temporarily create a sample line

113) **Input** the left width that you want to sample e.g. {100}. **Press Enter**

114) **Input** the right width e.g. {100}. **Press Enter.**

115) **Press ESC**.

116) **Home... Profile & Section Views...Section Views...Create Section View**

117) **Set the Section View Style** to your preferred scale (e.g. A 10Hx2V)

118) **Click Create SectionView**

119) **Pan** to a location for the Section View and click to place it.

120) **Use View...Model Viewports...Viewport Configuration... Three:Above** to switch to 3 views

121) **Arrange the views** so that you can see the Section View in one view, the Plan View in a view, and the Profile View in another. (Or setup a Layout Tab with 3 viewports.)

**The Station Tracker** tool helps the user to visually identify how profile views, section views, and alignments matches up with each other.

From the ribbon use **Analyze...Inquiry... Station Tracker... All Viewports...**
- When the cursor is near an alignment, a tracking line will show up at the same station in a profile view.
- When the cursor is in a profile view, a tracking line will show up at the same station along the base alignment.
- When the cursor is in a section view, a tracking line will show up in both the profile view and along the base alignment indicating what station the section view is located at.

122) **Use the center grip of the Sample Line to move it along the alignment. The Section View will update to the new sample line location.**
Edit the profile Station/elevation data.

123) **Select** the Planned Profile of the *WW Main*.
124) **Right Click… click** *Edit Profile Geometry*
125) From the Profile Layout Tools, **click** *Profile Grid View*
126) **Edit** any Stations and Elevations or grades
127) **Use** the *Raiser/Lower tool* to change the elevation of the profile.
128) In the Profile Entities Grid View, an individual profile point can be **locked** so that its location can’t be changed.
129) **Review** the changes to the surface and the sections
130) When done editing the profile, **close** the Profile Layout tool.
131) **Save** the drawing.

**Review the Proposed Waterway Surface & Volumes**

**Compute earthwork volume**

132) **Click** *Analyze… Volumes and Materials… Volumes Dashboard* 
133) In Panorama, **click** *Create new Volume Entry*
134) Input a Name E.g. *{V WW Main - Ognd}*
135) **Set the Style = _<off>_** *Click Ok*
136) **Set the Base Surface = Ognd. Set the Comparison Surface = Waterway Main**
137) *Click Ok*
138) A volume surface gets created. Cut and Fill volumes are displayed.

139) **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. A landscape layout might work better than portrait.
140) In Civil 3D, **click dismiss** to close the *Volumes Dashboard Panorama*.
141) **Save** the drawing.

**To track depths of the Waterway.**

142) **Use** *Home…Palettes▼… Coordinate Tracker on the V WW Main – Ognd surface* to see the Cut or Fill depths.

**To reset the model tab back to 1 View.**

143) **Use View Tools… Viewport Configuration… Single**

**Create Profiles and Cross Sections**

Create additional Profile Views that have user specified reaches

144) **Decide** on the horizontal scale that you want for the Profile Views and **set** the drawing annotation Scale.

Based on the horizontal scale, here is the reach length that fits into a viewport:

*700’ (1’=50’), 1400’ (1’=100’), 2800’ (1’=200’)*
Waterway Corridor Design

145) **Click Home... Profile & Section Views... Create Multiple Profile Views...**
146) **Select** the correct alignment.
147) **Set** the Profile View style to the Horizontal/Vertical scaling desired. E.g. `{A50Hx5V}` **Click Next**
148) **Select** Automatic and **input** the length of each view. E.g. `{700}` for a 1”=50’ scale. **Click Next**
150) **Select** Automatic. **Click Next**
151) In the Draw column checkmark the profiles that you want to have displayed. (E.g. *Planned WW Main & CL WW Main – Ognd.*) **Review** the Style column.
152) **Set** the Labels column for the planned waterway to *Finished Ground*.
153) **Click Next** **Click Next**
154) **Pull down** the Select Band Set to *Elev & Fill at Major Stations - in Grid*
155) **Pull down** the column for Profile1 to the planned profile (e.g. *Planned WW Main*)
156) **Pull down** Profile2 to the original ground profile (e.g. *CL WW Main – Ognd*)
157) **Click** Create Profile View
158) **Click** a location in the drawing for the profile to appear.
159) **Create** Named Views for each Profile View

Create an additional Sample Lines Group for section view creation.
160) **View ... Views... Views... CL WW Main – Plan View** to zoom to the Alignment.
161) **Decide** on the horizontal scale that you want for the Section Views and **set** the drawing annotation Scale.
   Based on the horizontal scale, here is the section width that fits a viewport.
   (1”=20’ @ 1 column: 280’; 2 columns: 130’) 
   (1”=10’ @ 1 column: 140’; 2 columns: 70’)
162) **Home... Profile & Section Views...Samples Lines ...**
163) **Press Enter**
164) **Select** the Waterway Alignment from the list (e.g. *CL WW Main*). **Click Ok**

165) **On** the Sample Line tools from the **Sample Line Group** pulldown **click** Create Sample Line Group

166) **Input** a Name as `{WW Main Sample Lines for Sections}`
167) **Set** the data sources to sample. **Checkmark** the *Ognd* source. **Checkmark** the Waterway Main corridor, **set** Style to Waterway (Sections with Labels). **Click Ok**
168) **Set** Sample line label style = Station at Both Ends of Sample Line
169) **Set** the data sources to sample. **Checkmark** the *Ognd* source and the WW Corridor Design. **Click Ok**
170) **Set** the **Creation Method** to *By Range of Stations* 
171) **Set** widths to 100’.
172) **Set** all Sampling Increments to 100’
173) Set Additional Sample: At Alignment Geometry to False.
174) Click Ok.
175) Press ESC.

Create section views.
176) Home... Profile & Section Views...Section Views...Create Multiple Views
177) Select the correct alignment and the Sample line group name that you just created.
178) Set the Section View Style to your preferred scale (e.g. A 20Hx2V)
179) Click Next
180) Select Production
   a) Browse to C:\ProgramData\CAD Std 2016\Templates\Iowa11x17EngSectionsTemplate(B).dwt
   b) Click Open
   c) Select the layout with the correct scale. (E.g. Sections 20 scale)
   d) Click Ok.
181) Set Group Plot Style = Waterway Array
182) Click Next
183) Select User specified. Input left and right distances that fit 1 column or 2 column.
   E.g. For 1’=20’ scale @ 1 column use Left = -140, Right = 140; for 2 use -60, 60
184) Click Next
185) Set Elevation range = User specified. Set at value of 2x or 3x the vertical scale.
186) Section Views height option= Follow a Section. Select section= Waterway Main.
187) Click Next
188) Verify the Sections that you want to Draw and the Style used.
189) Click Create Section Views
190) Pan to a location for the Section Views and click to place them.
191) Create a named view for this group of Section Views.
192) Save the drawing.

Create Reports
Civil 3D has multiple reports that might be useable for waterway projects.
Toolspace...Toolbox...
   Profile... Incremental Station Elevation Difference Report (e.g. WW cut sheet)
   Profile... PV1 Station (e.g WW Profile grade breaks)
   Profile... Profiles_in_CSV (e.g WW Profile grade breaks)

   Alignment... PI Station Report (e.g. Staking XYZ of alignments)

   Points...Points_List (e.g. Output of Control Points, Staking points, etc)
   Points... Points in CSV (e.g. Output of Control Points, Staking points, etc)

   Corridor...Sections Points Report (e.g. XYZ of points on planned Cross sections)
   Surface... Surface Report (e.g. Basic statics of Surfaces & Volume Surfaces)
Additional features

Zoom To is available by right-clicking on objects in Toolspace.. Prospector...

Additional editing options
Alignment: Steps to reverse the direction of an existing alignment:
   a. Select the alignment.
   b. From the activated Alignment ribbon use Modify\v.. Reverse Direction.

Alignment: Steps to apply curves to an existing alignment:
   a. Select the alignment.
   b. Right-click…. Click Edit Alignment Geometry
   c. The Alignment Layout Tools toolbar is activated for that alignment.
   d. From the Curves pulldown (6th column) use:
      e. Click on the incoming segment first.
      f. Click on the outgoing segment.
      g. Press Enter to accept Curve Angle as <Lessthan180>
      h. Input the radius (eg. 100) Press Enter
      i. Press ESC

Alignment: To remove a radius
   a. Select the alignment.
   b. Right-click…. Click Edit Alignment Geometry
   c. The Alignment Layout Tools toolbar is activated for that alignment.
   d. Click Delete sub-entity

Section View Groups: Updating the Vertical Scale
   a. Select one of the Section Views in the Group.
   b. Section View... Modify View... View Group Properties...
   c. On the Section Views tab you can change Style in the first row to update all of these section views to a different style. Click Ok
   d. Click Ok
   e. Section View... Modify View...Update Group Layout...

Section View Groups: Updating the Section Labeling
   a. Select one of the Section Views in the Group.
   b. Section View... Modify View... View Group Properties...
   c. On the Sections tab you can change Style of the Waterway to update all of the section views. [e.g. Waterway (Sections with Labels)] Click Ok
   d. Click Ok

To refresh the display type {rea} and Press Enter.

Refer to the documents: HowTo – Profiles & Sections and HowTo – Profile Creation & Editing for additional options.