

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: <u>Button to Press</u> <i>Displayed Text</i> Icon <u>Action</u> {Text to Enter} <u>Menu Item</u> ...
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Prerequisite



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

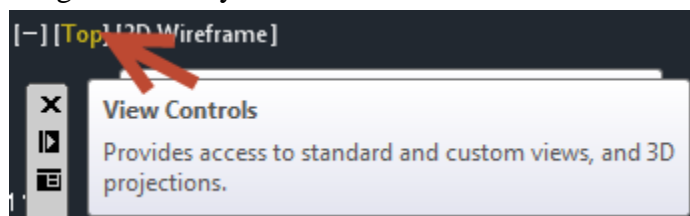
Create the Alignment of the Proposed Waterway

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 

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 . Click .



Create the Profile of the Proposed Waterway



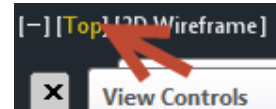
Extract a Profile of the Ground Surface to a profile view

- 15) Set the drawing annotation scale to match the desired horizontal profile scale.
- 16) Click *Home... Create Design... Profile... Create Surface Profile*  ...
- 17) Pulldown 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 pull-down 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.

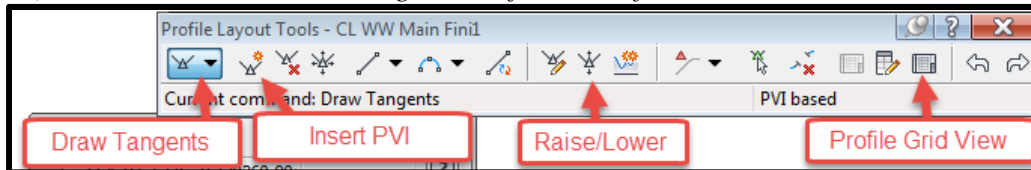
Create a Named View in order to find this Profile View easily later


- 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.



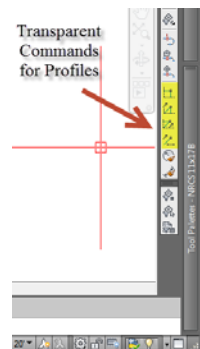
Create the planned profile of the waterway in the profile view

- 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.

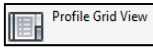
Four of the transparent commands that might be most useful.

-  **Profile: Station & Elevation**
-  **Profile: *Grade & Station**
-  **Profile: *Grade & Elevation**
-  **Profile: *Grade & Length**


*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.

No.	PVI Station	PVI Elevation	Grade In	Grade Out	Profile Curve Type	Lock
1	2+21.75'	1082.350'		-10.26%		
2	2+98.87'	1074.440'	-10.26%	2.50%		

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*)

List of bands								
Location: Bottom of profile view								
w La...	Major Int...	Minor Int...	Geometry ...	Label Sta...	Label En...	Alignment	Profile1	Profile2
<input checked="" type="checkbox"/>	100.000'	10.000'	...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CL WW M...	Planned WW Main	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.

Waterway Corridor Design

Create the Assembly/Template of the Proposed Waterway


Create an assembly for each Waterway shape & size used.

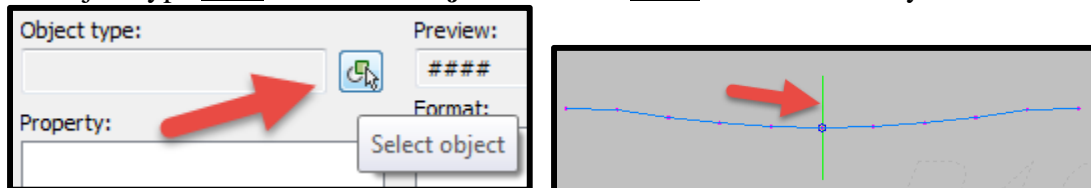
- 59) Click *Home... Create Design... Assembly... Create Assembly* ...
- 60) Input a Name describing the shape & size. E.g. {P40x1.8} for a Parabolic with a Top Width=40' and Depth = 1.8' or {T18x1.5} for a Trapezoidal with Bottom width=18' & Depth=1.5'.
- 61) Click **Ok**
- 62) Click a location in the drawing to create the assembly.

Build the assembly using the NRCS subassemblies.

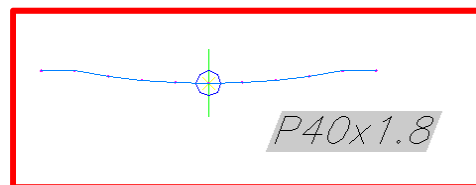
- 63) Tool Palette>NRCS 11x17...My NRCS WW... click *Parabolic WW wDaylight* (or *Trapezoidal WW wDaylight*)
- 64) Click onto the circle on the Assembly marker to place the pre-built subassembly.
- 65) Press ESC.
- 66) Select the sub-assembly and set the size in *Properties: Advanced* Set *Depth* and *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.



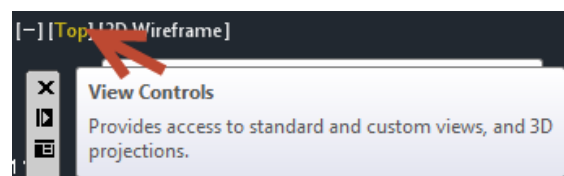
- 72) Set Property = *Name*, click **Ok**
- 73) Press **Ctrl + Enter** to accept the input.



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

Create a Named View in order to find these 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

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

c) Input the start and end stations for each region

Name	Alignment	Profile	Assembly	Start Stati...	End Station	Frequ...	Target	Over
<input checked="" type="checkbox"/> BL - CL WW Main - (4)	CL WW Main	Planned WW Main		0+00.00'	11+29.07'
<input checked="" type="checkbox"/> RG - P40x1.8			P40x1.8	0+00.00'	4+50.00'	25'
<input checked="" type="checkbox"/> RG - P30x1.6 - (2)			P30x1.6	4+50.00'	11+25.00'	25'

The alignment (CL WW Main) goes from 0+00 to 11+29. The 1st reach use a 40x1.8 parabolic ww from 0+00 to 4+50, and the 2nd reach uses a 30x1.6 parabolic ww from 4+50 to 11+25.

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

91) Under the Object Name column set all to *Ognd.* Click Click

92) Click

93) Under the Apply Assembly section pull down the following:

At Alignment Geometry Points= *No*

At Profile Geometry Points= *No*

94) Click Click

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*

Waterway Corridor Design

- 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.

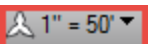
- 142) Use *Home... Palettes* ▼.. *Coordinate Tracker*  on the *V WW Main – Ognd* surface to see the Cut or Fill depths.


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')

- 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
- 148) Select Automatic and input the length of each view. E.g {700} for a 1"=50' scale.
- 149) Click
- 150) Select Automatic. Click
- 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 Click
- 154) Pulldown the *Select Band Set to Elev & Fill at Major Stations - in Grid*
- 155) Pulldown the column for Profile1 to the planned profile (e.g. *Planned WW Main*)
- 156) Pulldown Profile2 to the original ground profile (e.g. *CL WW Main – Ognd*)
- 157) Click
- 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')

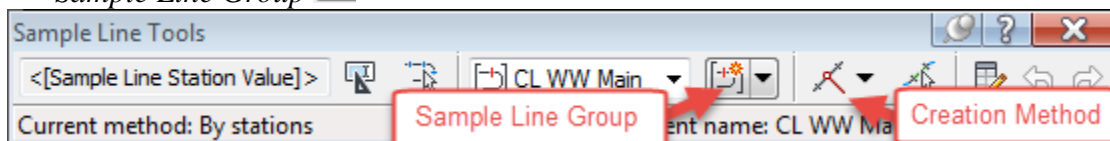
(1"=10' @ 1 column: 140'; 2 columns: 70')

- 162) Home... Profile & Section Views... Samples Lines ...

- 163) Press Enter

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

- 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 .

- 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 .


- 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... PVI_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*▼.. *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:
 **Free Curve Fillet (Between two entities, radius)**
- 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.