SOUTH DAKOTA NRCS CIVIL 3D 2010 DRAFTING NOTE

WATERWAY EXAMPLE – CREATING A TRAPEZOIDAL CHANNEL USING A CORRIDOR

The design of a waterway using a Corridor is going to be demonstrated in AutoCAD Civil 3D 2010. The following design parameters for the waterway are going to be used. The bottom width of the channel is 30 feet with 10:1 sideslopes. The waterway will have 4 reaches. The first reach is Sta. 0+00 – 1+00 with a slope of 1.70% and a starting elevation of 102.7. The second reach is Sta. 1+00 – 3+00 with a slope of 1.25% and a starting elevation of 101.0. The third reach is Sta. 3+00 – 9+00 with a slope of 0.98% and a starting elevation of 98.5. The fourth reach is Sta. 9+00 – 11+47 with a slope of 0.53% and a starting elevation of 92.6. The ending elevation will be 91.30.

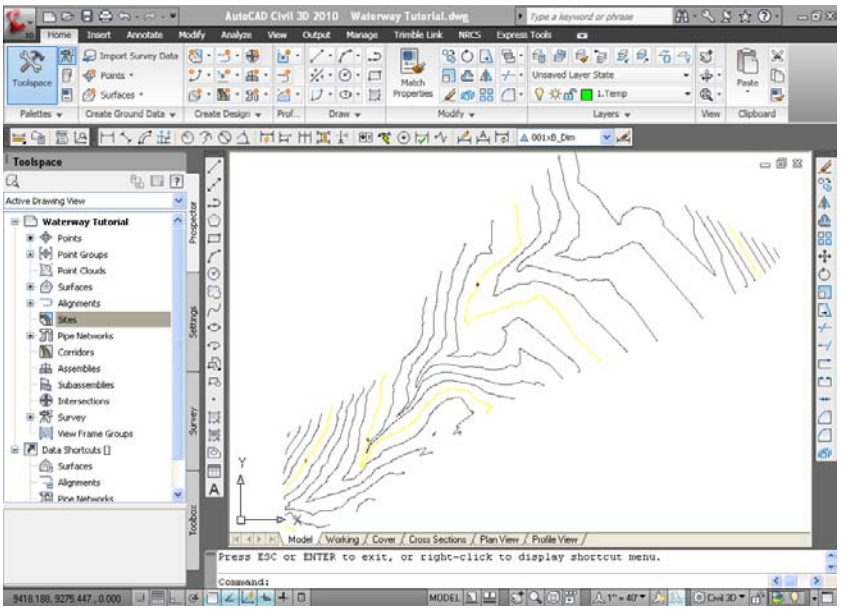
In this example, the channel will be created in the Site (on the Toolspace palette) called Waterway. It is also assumed that the user has access to the SD NRCS waterway template.

Add Alignment for the Waterway Centerline

An alignment is a line that is used for the centerline of a feature such as a waterway or a diversion. Alignments are connected with profiles and corridors to define a surface. In this example, a polyline is used to create the alignment.

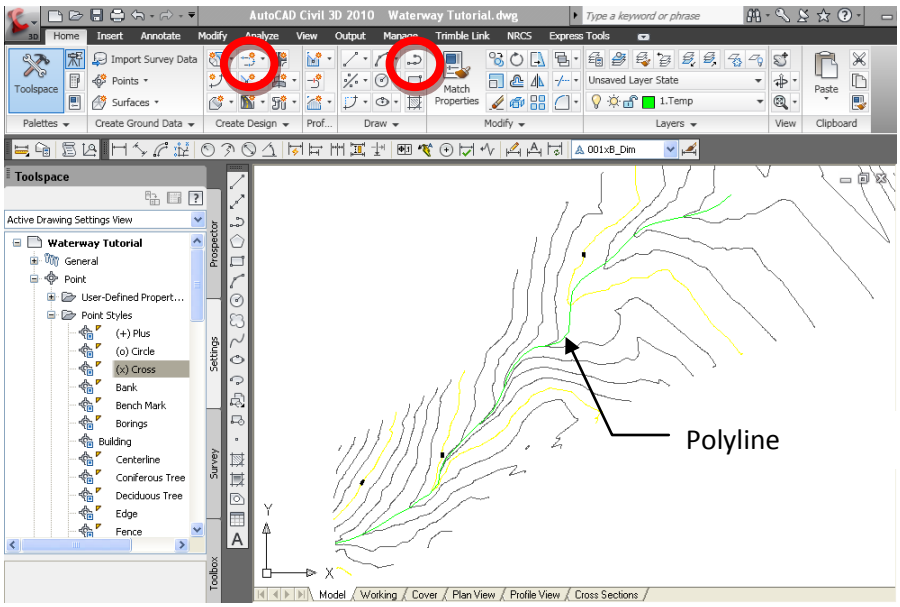
The first step is to start with a survey and have a ground surface developed and in this example is called Ognd (Refer to Dam - Points and Surfaces). Note that the intermediate contours (layer C.Topo.Ognd.Intr) have their color changed from the Red (20) to Gray (252) in the Layer Properties Manager for clarity in this example.

Figure 1: Screen view of the Civil 3D 2010 with the Toolspace on the left and the Ognd Surface displayed with contours with major interval at 5 feet and minor interval at 1 foot



A new Site will be created in the Toolspace under Sites. Right click on Sites and then select New and call the new Site Waterway. Next add a polyline to show the centerline of the waterway from start to finish. Add a Polyline found on the Home ribbon tab, starting at Sta. 0+00. At the end of the channel, hit Esc on the keyboard to exit the Polyline command (Figure 2). Click on the Alignment drop down menu on the Home ribbon. Choose Create Alignment from Objects Create Alignment from Objects . Select the polyline created for the waterway centerline and hit Enter twice.

Figure 2: Polyline added to represent centerline of waterway.



The Create Alignments from Objects dialog box (Figure 3) pops up. Type in the name of the alignment as Waterway. The Site should be changed to Waterway. The check box to Add Curves Between Tangents should be unchecked. All other settings on this dialog box should be left unchanged. Click on Ok and an alignment will replace the polyline (Figure 4). Double check the stationing to make sure it is in the right direction. To change the alignment stationing direction left click with the mouse on the alignment. A contextual ribbon appears specific to the Waterway alignment. Click on the Modify drop down Modify from the Alignment ribbon and select Reverse Direction Reverse Direction (do this step only if the alignment is in the wrong direction).

Create a Profile for the Waterway Centerline

A profile shows the vertical elevations of an alignment. The profile typically displays the elevations for the existing ground and a design surface. The profile will update automatically if the alignment is changed.

Left click with the mouse on the alignment. Select Surface Profile Surface Profile from the Alignment ribbon. The Create Profile from Surface dialog box appears. Under alignment pick Waterway, in select surfaces window choose Ognd and click the Add button. This is the original ground surface along the alignment. Under Profile List check to see if update mode is set to Dynamic and style is set to Ognd. Click on Draw in

Profile View. A Create Profile View dialog box appears (Figure 5). Select the Waterway alignment and in the Profile View Name box type in Waterway CL. Click Create Profile View. Pick a spot on your model space

Figure 3: Create Alignment from Objects dialog box

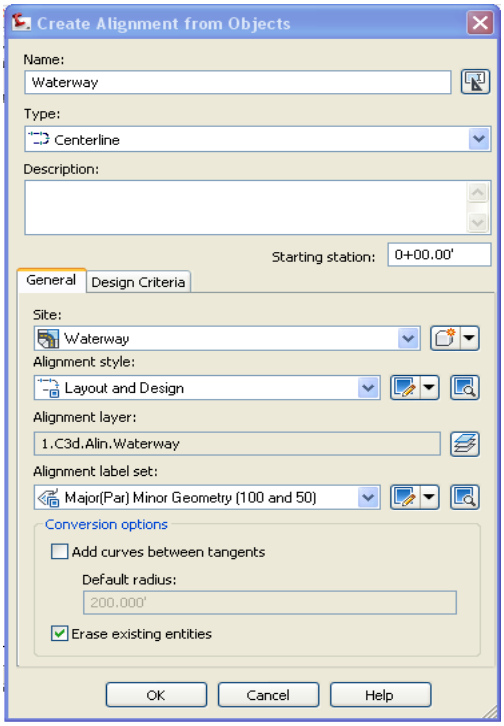
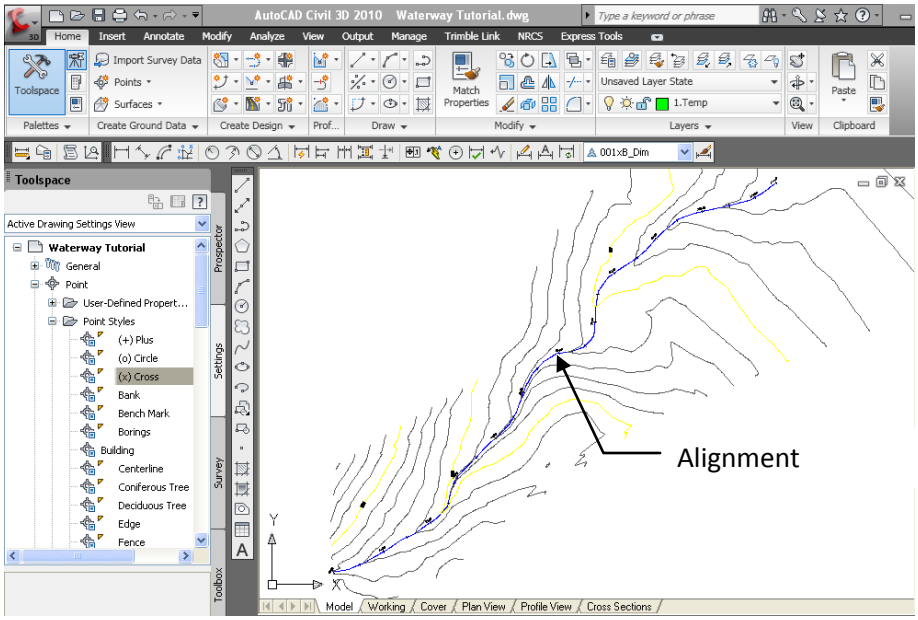


Figure 4: Alignment created



to place the profile. Left click with the mouse on the profile view. Select Profile Creation Tools

from the Profile View ribbon. The Create Profile – Draw New dialog box opens (Figure 6). Type Planned Waterway CL in the Name box. The Profile Style should be set to Fini. Click on the OK button. The Profile Layout Tools toolbar appears (Figure 7). Pick the Draw Tangents Without Curves and snap to the start

Figure 5: Profile View dialog box

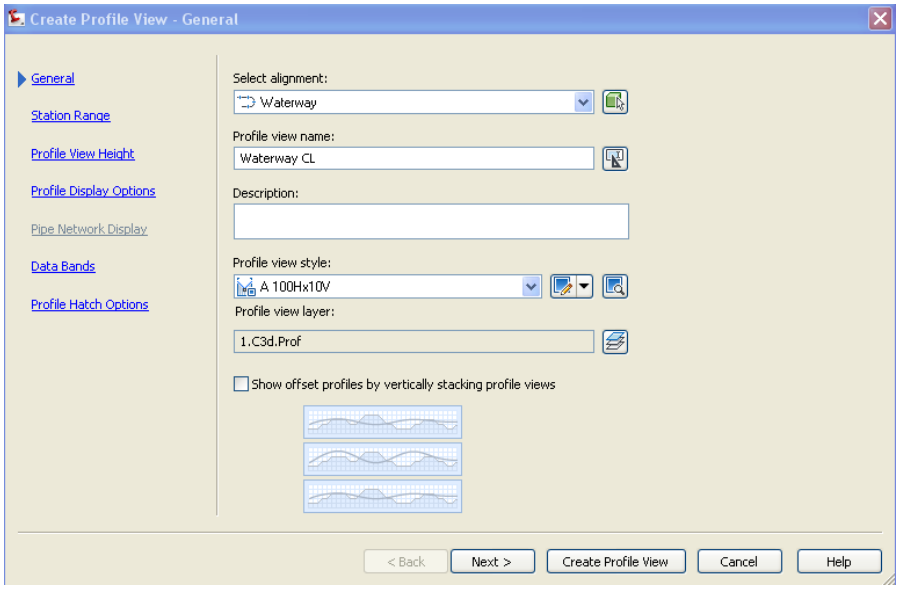


Figure 6: Create Profile – Draw New dialog box

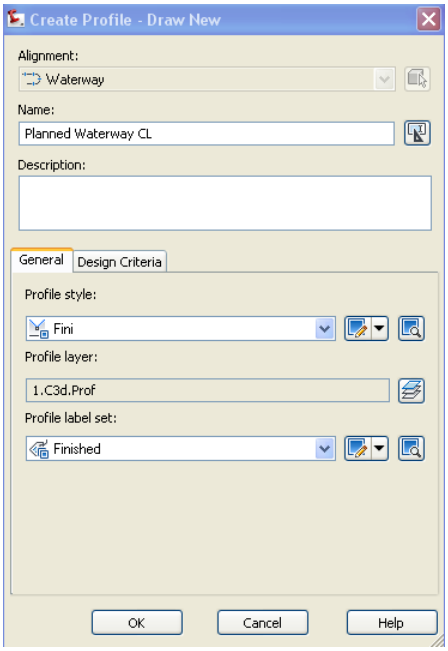
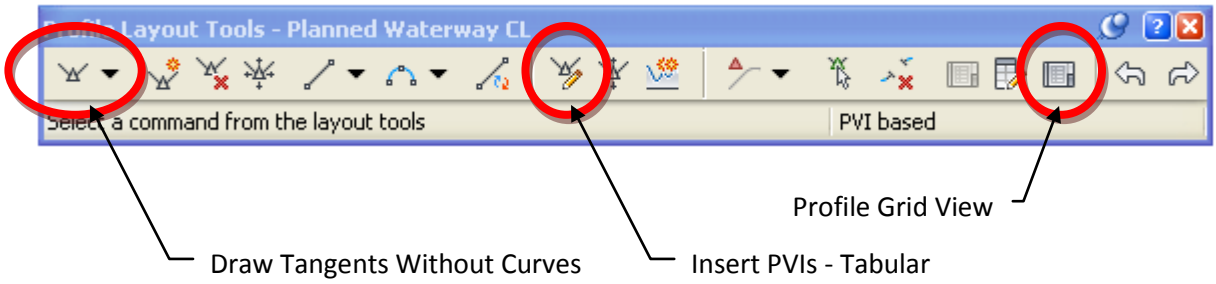
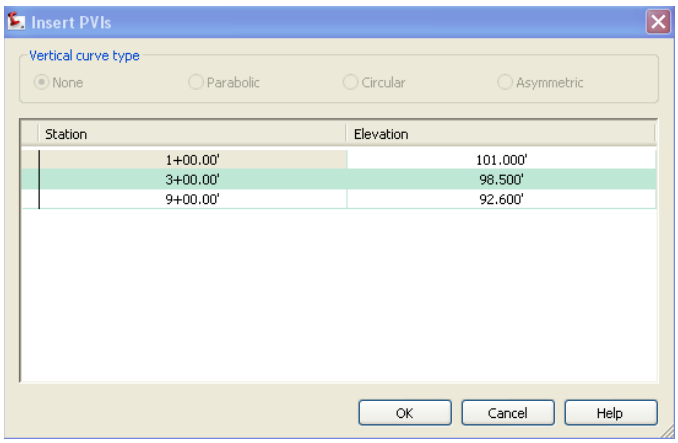


Figure 7: Profile Layout Tools toolbar



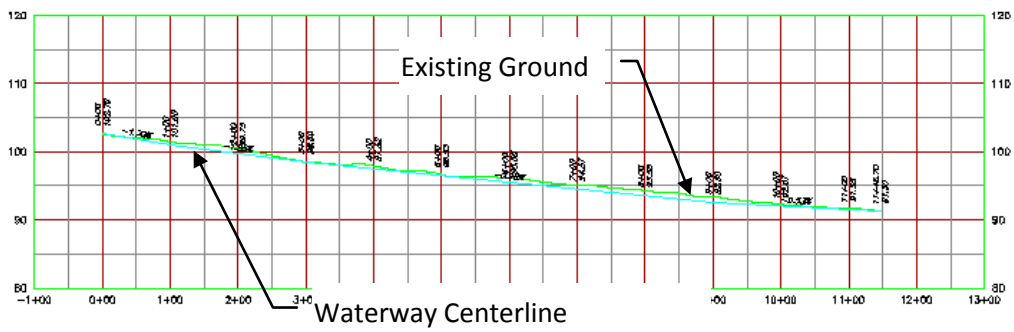
and endpoint of the original ground profile on the profile view (to help make sure your Object Snap has Endpoints selected; See MN Civil 3D Reference 211.0 Snap and Tracking. Click Insert PVIs – Tabular from the Profile Layout Tools. The Insert PVIs dialog pops up. Left click on the mouse in the box below Station. Type in 100 and hit the Enter key. Type in 101.0 and hit Enter. Repeat the Station and Elevation entry for the following in Figure 8.

Figure 8: Station and elevation data



Press the Ok button. Now select the Profile Grid View from the Profile Layout Tools. Change Sta. 0+00 elevation to 102.7' and the end station to 91.3'. The elevation cell can be modified by double clicking in the cell and typing in the new elevation. Close Profile Grid View. Close the Profile Layout Tools. The planned waterway centerline profile has been completed (Figure 9).

Figure 9: Finished waterway centerline profile with existing ground shown

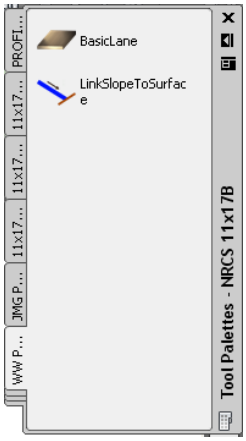


Create an Assembly

An assembly is an object that manages a group of subassemblies which visually represents a cross section. The assembly's mid point is where the assembly attaches to the alignment. Subassemblies are individual cross section components such as lanes or cut/fill slopes. The subassemblies can attach to the assembly or other subassemblies. After an assembly is created, it should resemble the cross section of the design surface.

Click on the Assembly drop down menu on the Home ribbon. Choose Create Assembly . A Create Assembly dialog box will pop up. Type Waterway for the name of the assembly and press Ok. Left click in the model space to place the assembly. Left click on the assembly. Click on the Tool Palettes icon Tool Palette from the Assembly ribbon. A Tool Palettes bar should appear. By moving the mouse arrow over the Tool Palettes will expand the palette and tabs will appear on the left hand side. Right click on a tab and select New Palette. A new tab will appear. Right click on the new tab and select Rename Palette. Type in a new name such as WW Palette and hit Enter (Figure 10).

Figure 10: Tool Palettes with Subassemblies added



Click on the Catalog icon Catalog from the Assembly ribbon. The Autodesk Catalog Library window pops up. Select Corridor Modeling Catalogs (Imperial) . Click on the Basic Subassemblies catalog. Right click on BasicLane and select Copy (The Link Width and Slope from the Generic Subassemblies catalog could also be used instead of BasicLane). Minimize the catalog window. Open the WW Palette on the Tool Palettes bar. Right click in the light gray area of the WW Palette and select Paste. The BasicLane icon now appears on the WW Palette. Click on Catalog icon from the Assembly ribbon. The Autodesk Catalog Library window pops up. Select Corridor Modeling Catalogs (Imperial). Click on the Generic Subassemblies catalog. Right click on Link Slope To Surface and select Copy. Close the catalog window. Open the WW Palette on the Tool Palettes bar. Right click in the light gray area of the WW Palette and select Paste. The Link Slope To Surface icon should appear in the tool palette. Left click on the

BasicLane icon and a Properties dialog box pops up. In the Properties box, under Advanced, the width should be set to 15' (half of the channel bottom width), the depth should be set to 0.0001', and the slope changed to 0.00% (Figure 11). Left click on the assembly and a subassembly will appear on the right hand side. In the Properties box, change the side to the Left, and left click on the assembly again. Another subassembly will appear and the entire channel bottom is shown. Now close the Properties dialog box and hit the Esc key. Open the Tool Palettes bar again and select the Link Slope To Surface icon. The Properties dialog box pops up and in the Advanced section change slope to 10:1 and change the Add Link in to Cut Only (Figure 12). Click on the left side of the BasicLane subassembly. A new subassembly is shown representing the side slope of the waterway channel. In the Properties box, change the side to the Right, and click on the right side of the BasicLane subassembly. The assembly should now look like a cross section of the waterway channel (Figure 13). Close the Properties dialog box and hit the Esc key.

Figure 11: Basic Lane Properties dialog box

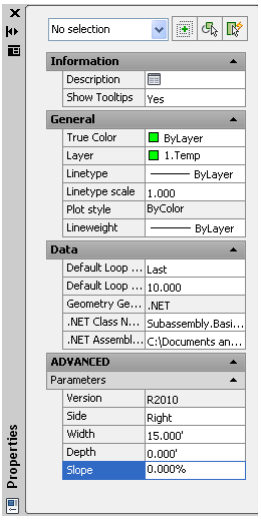


Figure 12: Link Slope to Surface dialog box

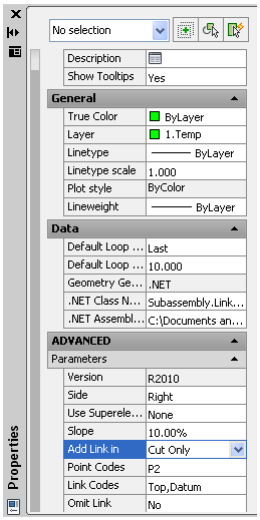
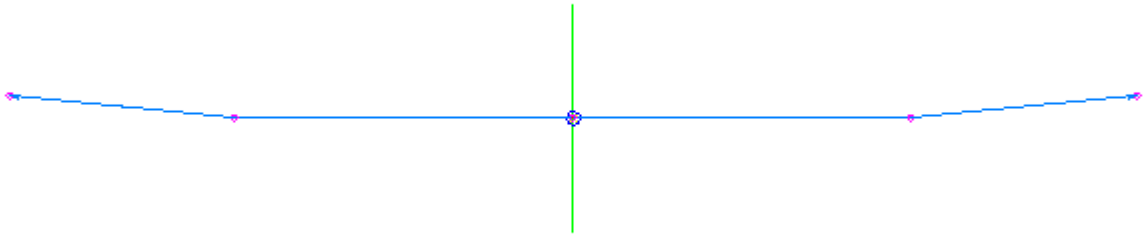


Figure 13: Waterway SubAssembly

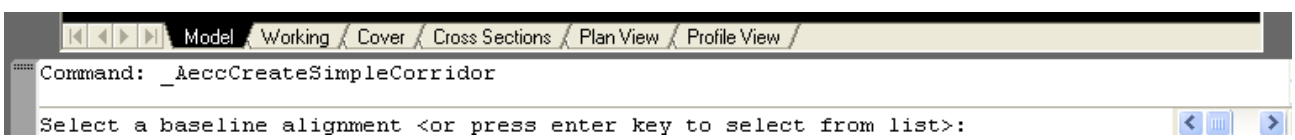


Create a Corridor

A corridor is a design model that use alignments, profiles, and assemblies. The corridor has feature lines which attach to the assembly points to form a 3D model. Multiple alignments, profiles, and assemblies can be used in a single corridor.

Click on the Corridor drop down menu on the Home ribbon. Choose Create Simple Corridor Create Simple Corridor. A Create Simple Corridor dialog box will pop up. Type Waterway for the name and hit Ok. In the Command Bar (Figure 14), Civil3D asks for a baseline alignment. Press the Enter key, select Waterway, and choose Ok.

Figure 14: Command Bar



The Command Bar asks for a profile. Press the Enter key and the Select a Profile dialog box appears. From the drop down menu select Planned Waterway CL and choose Ok. The Command Bar asks for an assembly. Press the Enter key and Select an Assembly dialog box appears. From the drop down menu select Waterway and choose Ok. A Target Mapping dialog box appears. In the Object Name column and the Surfaces row left click with the mouse on “Click here to set all”. The Pick a Surface dialog box appears. Select Ognd and choose Ok. Notice the Target Surfaces for both Link Slope to Surface subassemblies now target the Ognd (Figure 15). Choose Ok and pan over to the surface. The waterway corridor now appears on the original ground surface (Figure 16).

Figure 15: Target Mapping dialog box

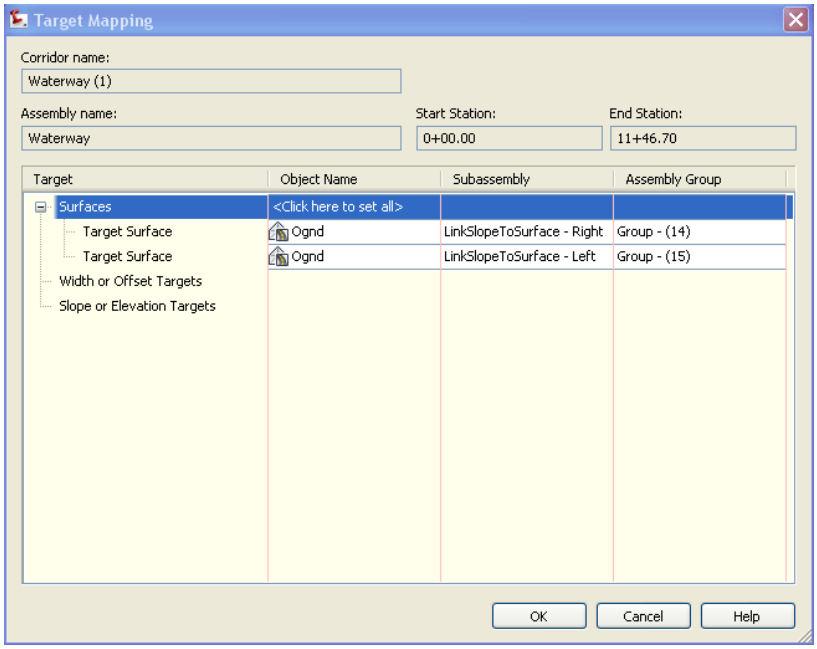
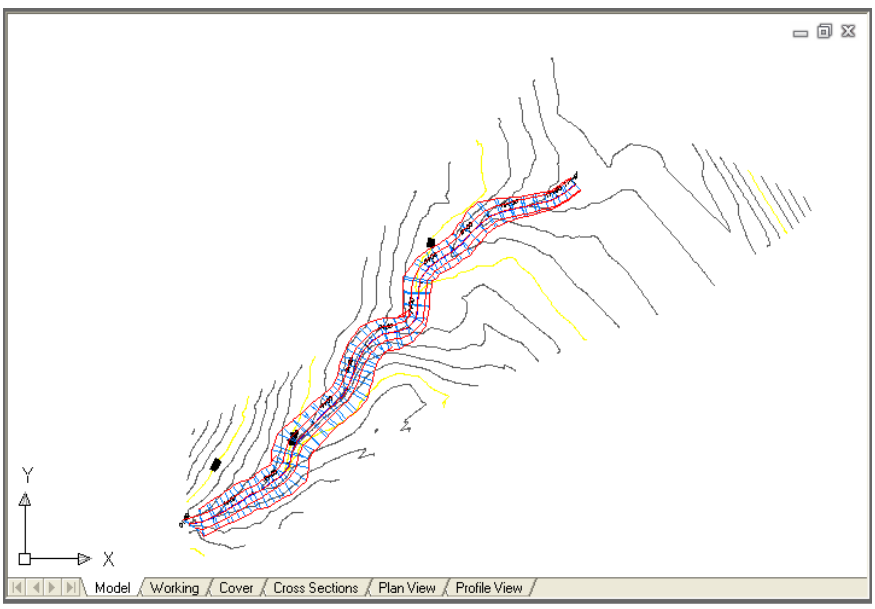


Figure 16: Screen shot of waterway corridor on the original ground surface



Create a Waterway Surface

A surface can be created from the 3D modeling of the corridor. The surface is needed to represent the waterway for the plans and to calculate volumes.

Left click on the waterway corridor. Select Corridor Properties from the Home ribbon. The Corridor Properties dialog box appears. On the Parameters tab, press the Set all Frequencies button. The Frequency to Apply Assemblies dialog box opens (Figure 17). Frequency is the distance between stations along the assembly. The default distance is 25' which we will leave as is. Change "At horizontal geometry points",

"At superelevation critical points", and "At Profile High/Low points" to No in the Value column using the drop down menu in each row. "At profile geometry points" should be set to Yes. Choose Ok. Click on the

Figure 17: Frequency to Apply Assemblies dialog box.

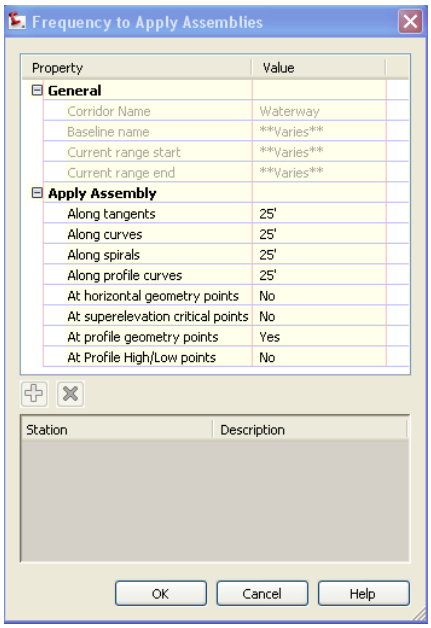
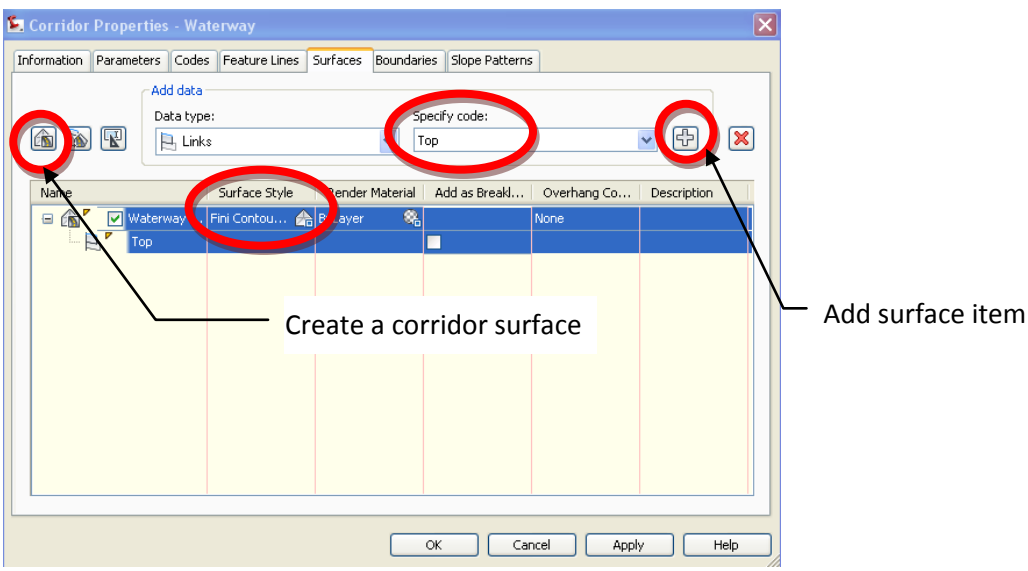


Figure 18: Surface tab in Corridor Properties dialog box.



Surfaces tab (Figure 18). Press the "Create a corridor surface" button . Select Top from the Specify code drop down menu and press the "Add surface item" button . Change the Surface Style to Fini Contours 1 and 5 by using the drop down menu and press Ok. Click on the Boundaries tab (Figure 19). Right click on Waterway in the Name column. Select P2 from the Add Automatically sidebar. Double check the Outer Boundary is selected from the Use Type column and press Ok. The surface has been added inside the corridor boundary (Figure 20). The waterway surface has been created, and edits to the waterway can be made by changing the alignment, profile, or corridor.

Figure 19: Boundaries tab in Corridor Properties dialog box.

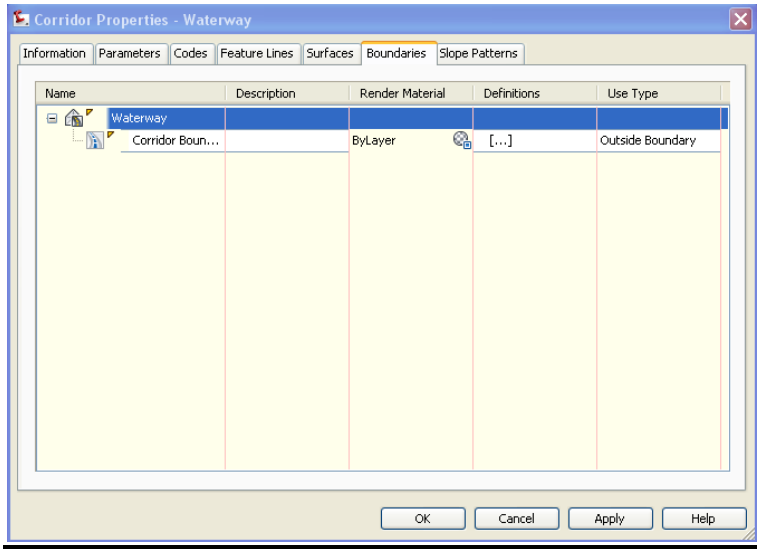
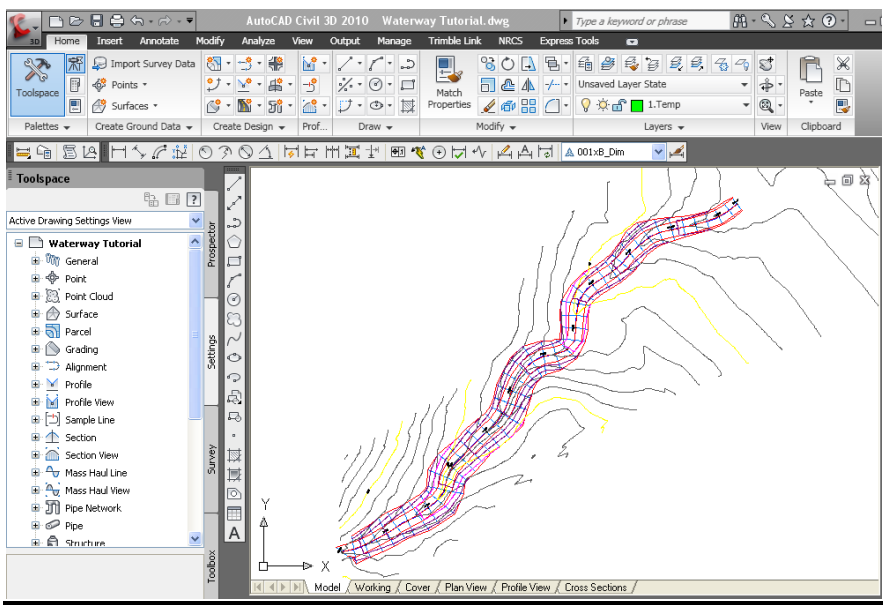


Figure 20: Screen shot of waterway surface.

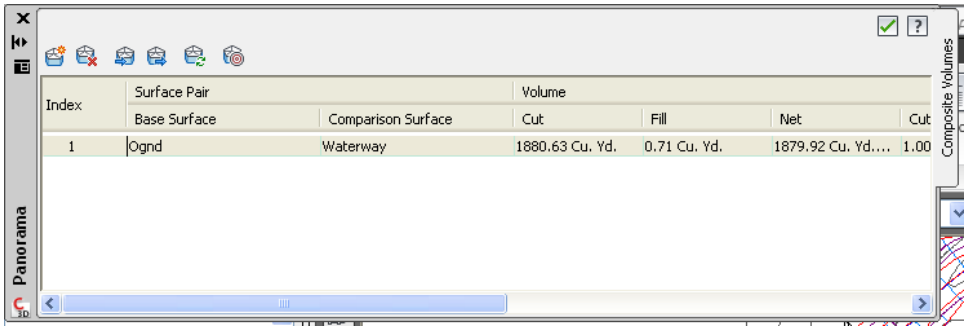


Compute the Earthwork Volumes

To compute the volumes between the Ognd surface and the Waterway surface go to the Analyze Ribbon Tab and click on Volumes

. This will open the Panorama Palette with the Compute Volumes window. Click on Create New Volume Entry and enter the two surfaces. Use the Ognd as the Base surface and Waterway as the Comparison surface. The waterway has an excavation of 1881 cubic yards and 1 cubic yard of fill.

Figure 21: The Panorama with the Volumes Between Surfaces.

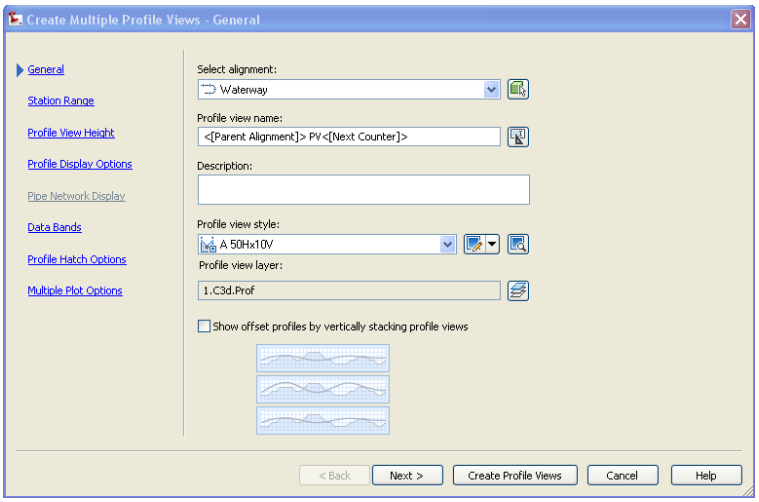


Create Multiple Profile Views for Plans

A profile view represents the vertical elevations from a horizontal alignment. Multiple profile views can be created so each profile has a consistent length and vertical scale. With waterways the profile view length will need to be adjusted so the profile views can fit on the fewest sheets possible, but still show detail in the vertical scale.

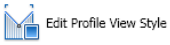
Click on the Profile View drop down menu on the Home ribbon. Choose Create Multiple Profile Views Create Multiple Profile Views . A Create Multiple Profiles dialog box opens (Figure 22). Choose Waterway from the Select Alignment drop down menu. Pick "A 50H x 10V" from the Profile View Style drop down and press the Next button.

Figure 22: The Create Multiple Profile Views – General dialog box



On the Station Range page, change the Length of Each View to 600'. Click Next. Select the User Specified button and enter 20'. Change the Profile View Datum By to Mean Elevation. On the Profile Display Options page, check that the Draw check box is checked for both profiles and click Create Profile Views. Pick a spot on your model space to place the profile. Two profiles are pasted into model space.

Left click on one of the multiple profile views. Select Profile View Properties Profile View Properties from the Profile View ribbon. Click on the Elevations tab and change the minimum elevation to a whole number that falls

below the lowest elevation on the profile. Change the maximum elevation to 20' higher than the minimum (Figure 23). Click Ok. Repeat this process for the other profile view. Left click on one of the multiple profile views. Select Edit Profile View Style 

from the Profile View Properties drop down

on the Profile View ribbon. A Profile View Style dialog box appears. Click on the Horizontal Axes tab. Change

Figure 23: The Profile View Properties – Elevations tab

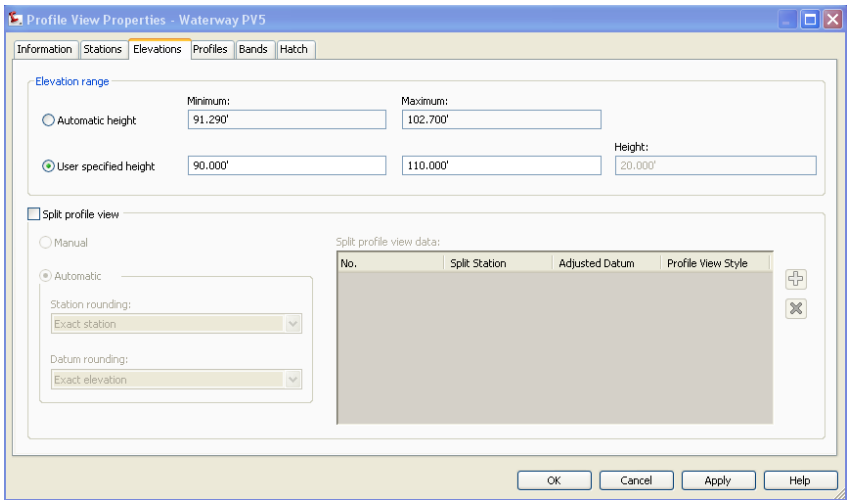
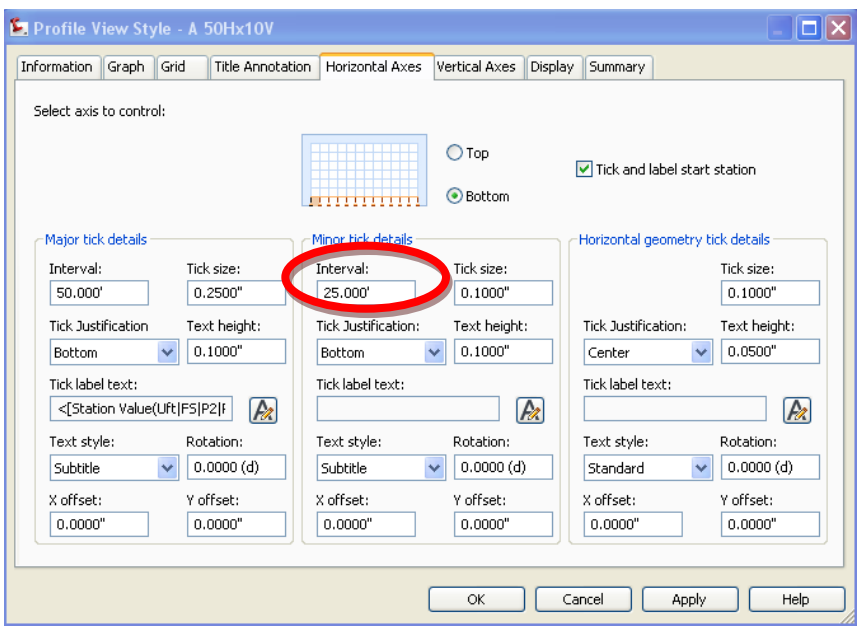


Figure 24: The Profile View Style – Horizontal Axes tab



the minor tick details interval to 25' for the Top and the Bottom axes (Figure 24). Click on the Vertical Axes tab. Change the major tick details interval to 5' for the Left and Right axes. Click Ok. These last steps were to clean up the profile views for easier viewing; they aren't required. Click on the Profile View tab (Figure 25). Open the View Ribbon. Choose New Viewport . The Viewports dialog box appears. On the New Viewports tab select Two: Horizontal and press Ok. With the Object Snap set to Endpoint select the upper left corner and the lower right corner of the inside box in the layout. Two viewports will show up with the

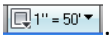
entire Model space shown in each viewport. Left click inside the top viewport and zoom in on the first multiple profile view. Change the viewport scale to 1”=50’  . Left click inside the bottom viewport and zoom in on the second multiple profile view. Change the viewport scale to 1”=50’.

Figure 25: The Profile View tab

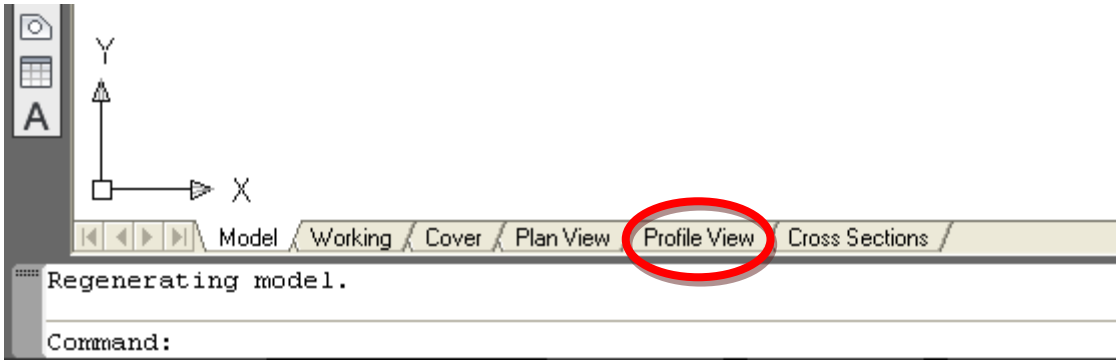
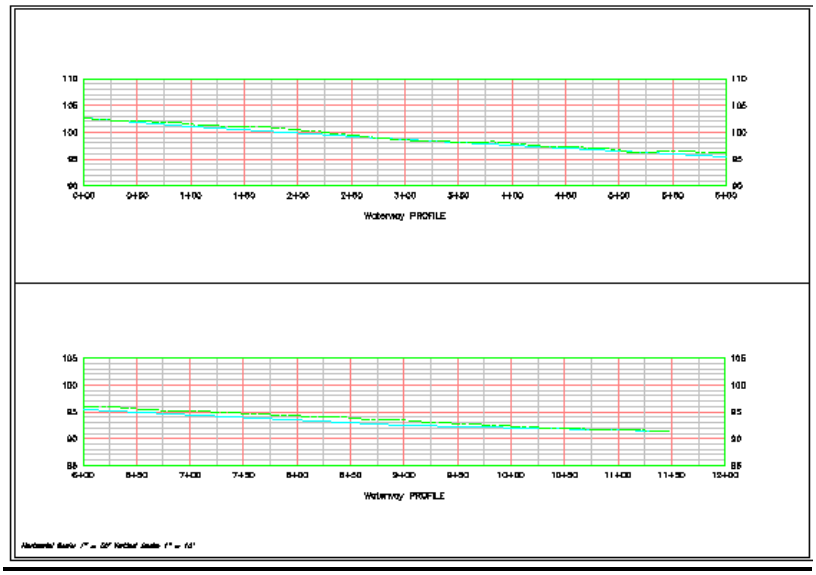


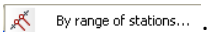
Figure 26: Screen shot of multiple profiles in Paper space



Create Sample Lines

Sample lines set the stations where the cross sections are taken from the surface. In this example, a sample line will be set at every 100’ station. The sample lines also define the width of the cross section.

Click on the Model tab . Select Sample Lines from the Home ribbon. Press the Enter key. The Select Alignment dialog box appears. Select the Waterway alignment and press Ok. The Create Sample Line Group dialog box appears. Under the Select Data Sources to Sample verify that only two Sample check boxes are selected. Ognd and the Waterway Surface (not the Corridor) should have a check mark in the Sample box. In the Style column for the Waterway Surface, click on the Ognd Style and change it to the Fini Style from the drop down and click Ok twice. The Sample Lines Toolbar appears. Click on the drop down

arrow for Sample Line Creation Methods and select By Range of Stations 

. The Create Sample Lines – By Station Range appears (Figure 27). Change the Left and Right Swath Widths to 50'. Scroll down to Sampling Increments. Use Sampling Increments should be set to True and the distances should be 100'. Additional Sample Controls should all be set to False. Click Ok. Sample lines appear at every 100' station along the waterway (Figure 28).

Figure 27: Create Sample Lines – By Station Range

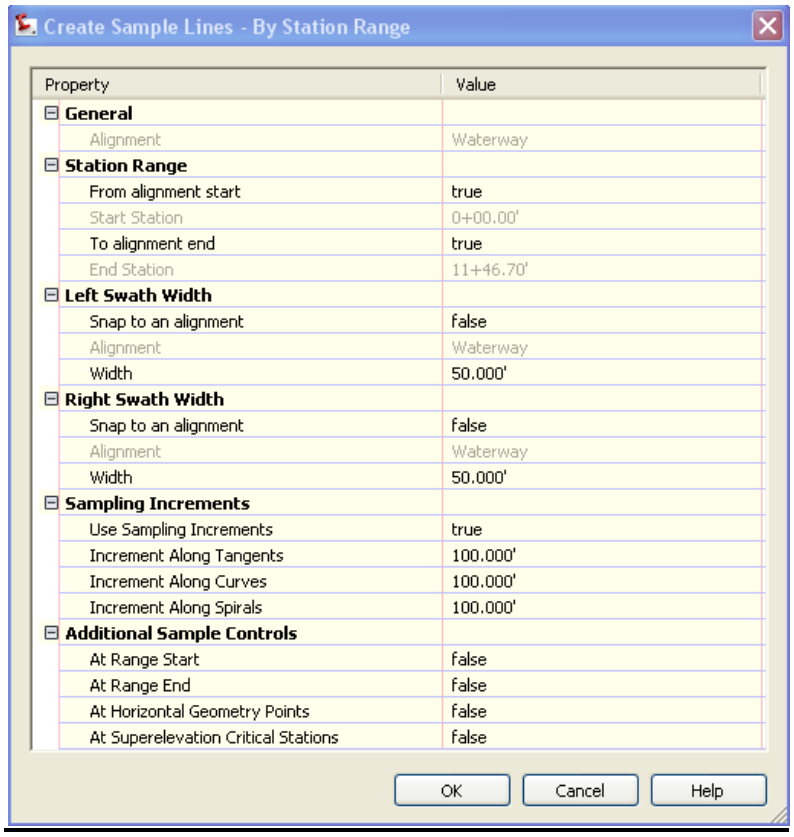
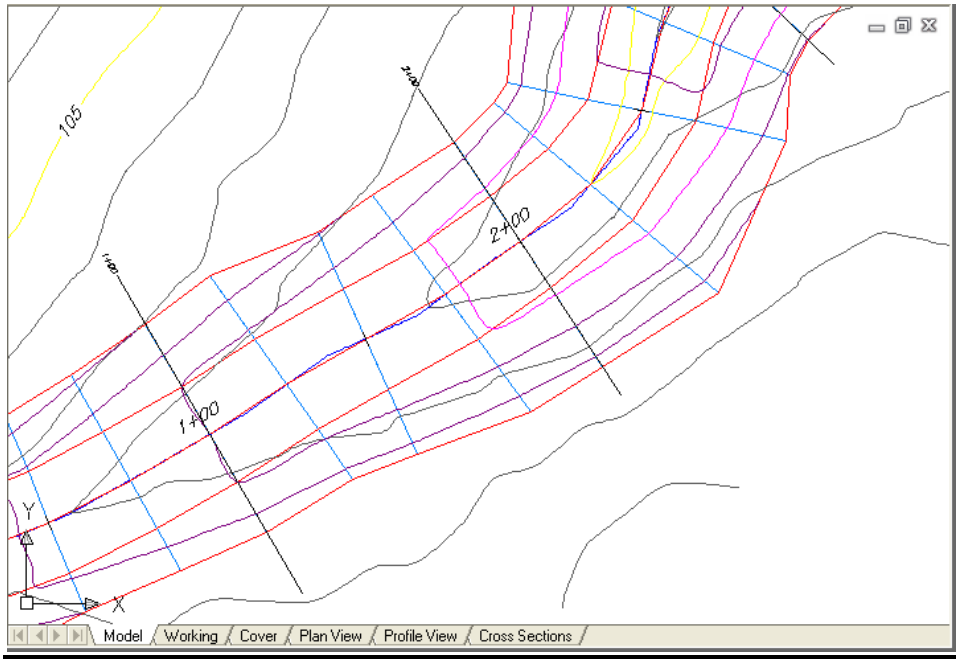


Figure 28: Screen shot showing Sample Lines every 100' along waterway



Create Cross Sections

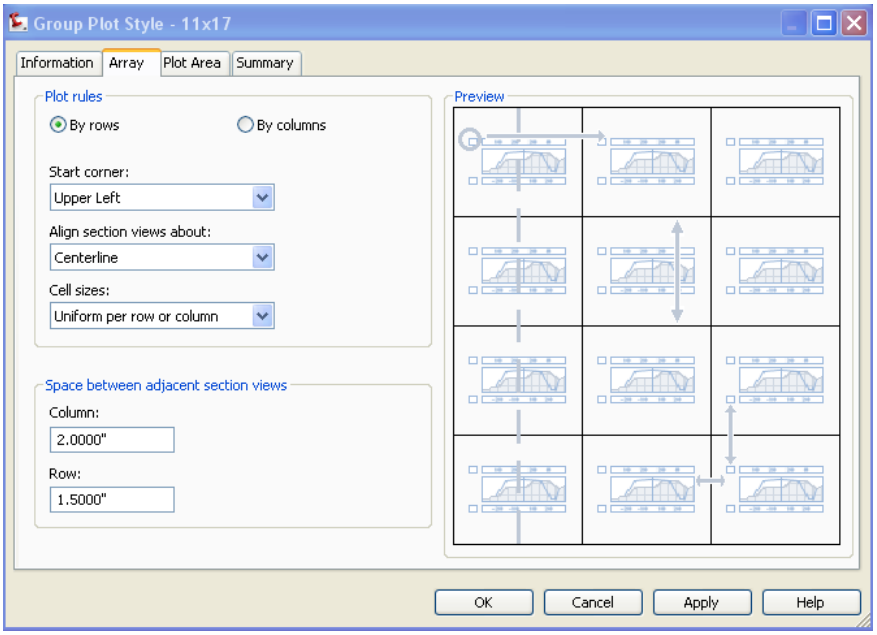
Cross sections are displayed in section views. The section view is similar to a profile view, and is updated automatically if a change to one of the surfaces is made. Multiple section views can be created to display all of the cross sections at once with the same scale.

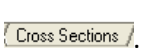
Left click on one of the newly created sample lines. Click on the Create Section View drop down

and select Create Multiple Section Views

. The Create Multiple Section Views - General dialog box opens. Change the Section View Style to "A 40H x 5V" (The Annotation Scale should be set to the same horizontal distance as your Section View Style e.g. 1"=40'). Change the Group Plot Style to "11 x 17". To the right of the Group Plot Style select the Edit Current Selection button. The Group Plot Styles dialog box appears. In the Array tab, click on the radial button in front of By Rows. Change start corner to Upper Left. The Space Between Adjacent Section Views should be 2.00" and 1.5" for Column and Row respectively (Figure 29).

Figure 29: Group Plot Style dialog box



Switch to the Plot Area tab. Click on the radial button in front of Plot By Page. The Sheet Style should be 11 x 17 and gaps between successive pages set at 2.0”. Press Ok. Press Next. In the Offset Range, change User Specified Left and Right to -50’ and 50’ respectively. Press Create Section Views button located at the bottom of the dialog box. Left click in an open spot in Model space. Multiple cross section views now appear in Model space. In Toolspace, on the Settings tab, expand the Section View, Sheet Styles. Select 11 x 17, right click, and select Edit. On the Display tab click off the light bulbs for Print Area and Sheet Border. Press Ok. Click on the Cross Sections tab  . Open the View Ribbon. Choose New Viewport . The Viewports dialog box appears. On the New Viewports tab select Single and press Ok. With the Object Snap set to Endpoint select the upper left corner and the lower right corner of the inside box. One viewport will show up with the entire Model space shown in the viewport. Left click inside viewport and zoom in on the multiple cross sections view (Figure 30). Change the viewport scale to 1”=40’ .

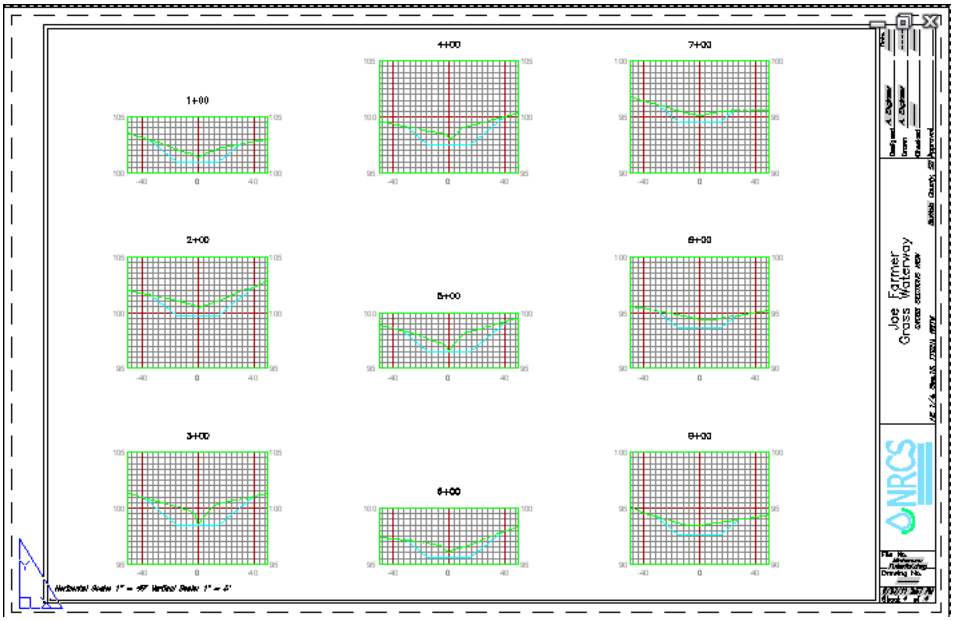



Figure 30: Screen shot of multiple cross section views in Paper space