



Designing a Pond

*This course is for the **2024 Release 2** version of:*

OpenSite Designer CONNECT Edition

OpenRoads Designer CONNECT Edition

OpenRail Designer CONNECT Edition

About this Practice Workbook...

- This workbook is designed for use in Live instructor-led training and for OnDemand self study. OnDemand videos for this course are available on the learning.bentley.com.
- This PDF file includes bookmarks providing an overview of the document. Click on a bookmark to quickly jump to any section in the file.
- Both Imperial and Metric files are included in the dataset. Throughout this practice workbook Imperial values are specified first and the metric values second with the metric values enclosed in square brackets. For example: **12.0'** [3.4m].
- This course workbook uses the *Training and Examples* WorkSpace and the *Training-Imperial* or *Training-Metric* WorkSet delivered with the software.
- The terms “Left-click”, “Click”, “Select” and “Data” are used interchangeably to represent pressing the left mouse button. The terms “Right-click” and “Reset” are also used interchangeably to represent pressing the right mouse button. If your mouse buttons are assigned differently, such as for left-handed use, you will need to adjust accordingly.

Have a Question? Need Help?

If you have questions while taking this course, you can submit questions to the [Civil Design Forum](#) on Bentley Communities where peers and Bentley subject matter experts are available to help.

Course Overview

This class will look at how to create a pond from a terrain model and to add attenuation to the drainage system.

OpenRoads Designer technology was used to build a pond and a terrain from that pond, so it is all fully parametric. The file has been referenced into the imported drainage network file.

If you do need to modify the volume and the terrain of this pond at any time you can come back to this file, change the values and of course the OpenRoads Designer model will automatically update and therefore you can use this for your pond hydraulics.

The class also covers how to place headwalls to outfall into the pond for the mainline drainage, create a Pond Outfall structure with vortex valve. We will also create pipes connecting all the structures, assess their invert levels to ensure that they have a reasonable gradient.

Finally, we will compute a scenario that will assess the whole network

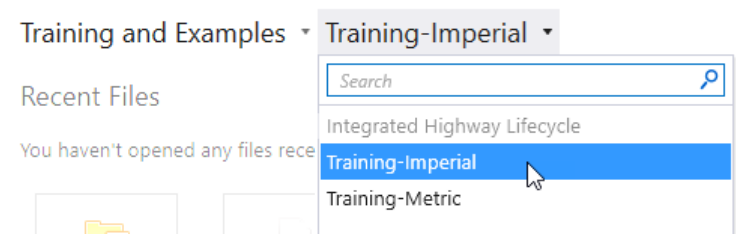
Getting Started

1. Start the software
2. Set the WorkSpace and WorkSet

The WorkSpace and WorkSet define standards that are used by the software, and the ones used for this training are installed during the software installation.

Typically, the WorkSpace contains organizational standards and the WorkSet contains project standards.

- a. Select **Training and Examples** from the *WorkSpace* drop-down menu
- b. Select **Training-Imperial** [*Training-Metric*] from the *WorkSet* drop-down menu



3. Open an existing file.



- a. Select **Browse**
- b. Browse to *C:\Bentley Training\Designing a Pond* or other folder where you unzipped the dataset files.
- c. Select the file **Mainline-Drainage-Imperial.dgn** [*Mainline-Drainage.dgn*] and click **Open**

Note: If you get a message stating “Incompatible Civil Data”, this is because the training files are “aligned” to OpenSite Designer. Clicking *Yes* will align the file to the software you are using (OpenRoads Designer or OpenRail Designer). This will have zero impact for the training courses. However, note that in production, upgrading the file will make the file read-only in OpenSite Designer. Full information is available at [Bentley Communities - Product Realignment](#).

Exercise 1: Completing the Imported Proposed Drainage Network

Description

In this exercise, you will add Inflow Headwalls, a Pond Outlet Structure to the pond, and then add an Outfall for the system and connect the nodes with pipes

Skills Taught

- Open a design file and check the references
- Place Nodes using AccuSnap
- Place Pipes
- Review and modify the inverts of the pipes

Checking Project Reference

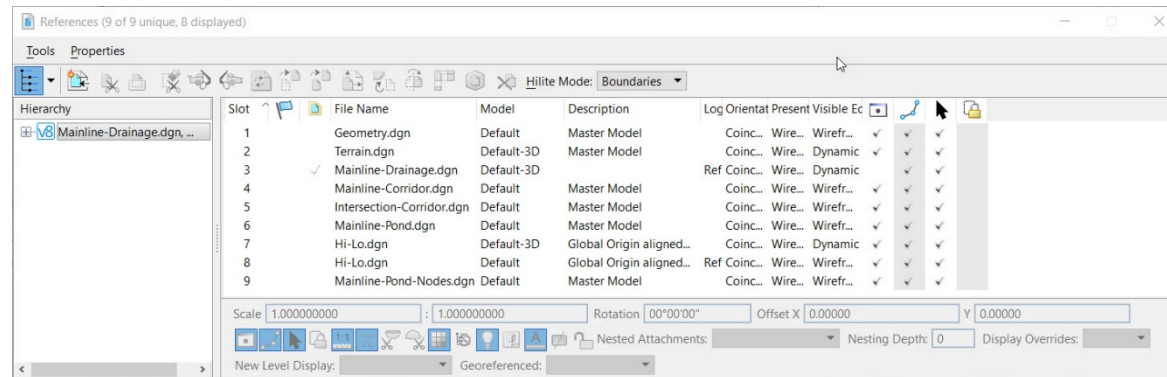
In this section you will assess the reference files that are attached.

1. On the *Home* ribbon, click *Attach Tools > References*

Note that References have already been attached and some have the *Display* icon clicked to turn off the *Default/ Default-3D* model.



- a. Check the Default-3D model References also
- b. Put focus back on to *View 1*, by clicking on its title bar
- c. The *Default* model References are shown below



The file has existing and design surface terrains, the mainline corridor, the high/low points of the design terrain and the pond terrain.

The *Mainline-Pond.dgn* contains the Geometry of the Layout of the Pond.

Note the *F7 shortcut* has been selected to *turn off* Construction Class elements. This is a toggle on/off and can be used as and when required.

Place Headwalls and Outfall

In this section you will place two Inflow Headwall will first be placed into the pond. Then we will place the Outfall Node.



1. Select **Drainage and Utilities** Workflow
2. On the **Layout** ribbon
 - a. Select, **Layout > Place Node**
 - b. In the **Place Node** dialog, check **Vertical Offset**, set value to **0, 0**
 - c. Set the **Feature Definition > Node > StormWaterNode > Headwalls > Sloped End Section, Concrete > Training Headwall**
 - d. In the **Name Prefix** type **IH_1**.

The Back-Of-Berm-Profiled **D-EWKS-Back of Bench** has an elevation of **36.75ft [11.2m]**

- e. At the **Select Reference Element for Elevation. <Reset> to Type Elevation** prompt, **Reset**, and type an elevation of **36.75ft [11.2m]**.
- f. In the Default view snap to the point in the top right of the pond.
- g. **Data point**
- h. **Rotation Mode > Absolute** and set the **Rotation** to around **200** degrees and **data point**

3. Place a second Headwall by snapping to the point below and left of the first Headwall.
 - a. In the **Name Prefix > IH_2**
 - b. At the **Select Reference Element for Elevation. <Reset > to Type Elevation** prompt, **Reset**, and type an elevation of **36.75ft [11.2m]**

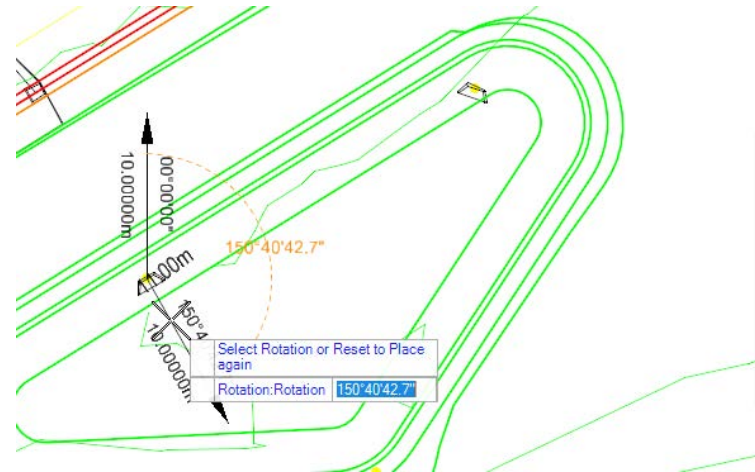
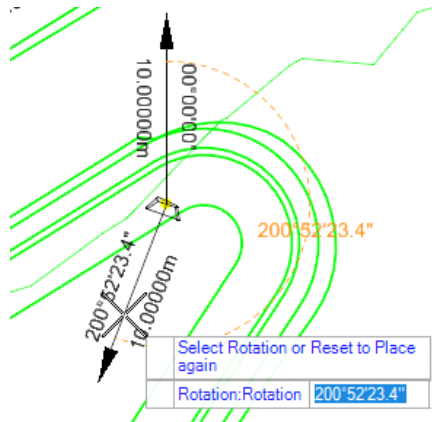
The screenshot shows the 'Place Node' dialog box with the following settings:

- Feature**
 - Feature Definition: Training Headwall
 - Name Prefix: IH-1
- Elevation**
 - Elevation is the Invert: ☐
 - ☐ Elevation: 36.750
- Baseline Reference**
 - Baseline Reference: ☐
- Rotation**
 - Rotation Mode: Absolute
 - ☒ Rotation: 200

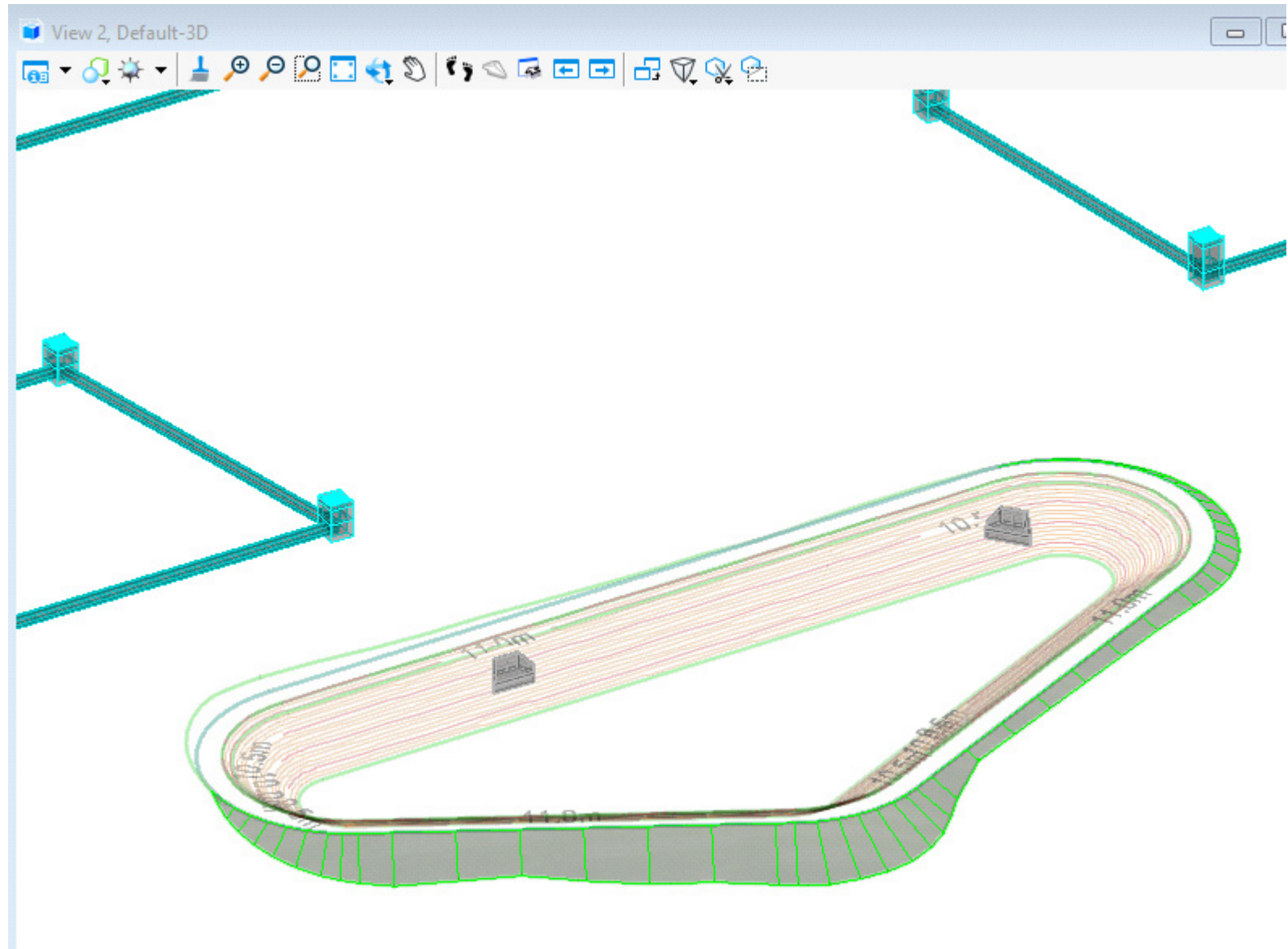
The screenshot shows the 'Place Node' dialog box with the following settings, overlaid on a map showing a pond and a headwall:

- Feature**
 - Feature Definition: Training Headwall
 - Name Prefix: IH_1
- Elevation**
 - Elevation is the Invert: ☐
 - ☒ Elevation: 36.750
- Baseline Reference**
 - Baseline Reference: ☐
- Rotation**
 - Rotation Mode: Absolute
 - ☒ Rotation: 200.00°

- c. In the Default view snap to the point in the top middle of the pond
- d. **Data point**
- e. *Rotation Mode* > **Absolute** set the **Rotation** to around **150** degrees and **data point**
- f. **Esc** to exit the command.



4. The *Default-3D* view displays the placed Inflow Headwalls.



An Outfall for the conveyance system is required.

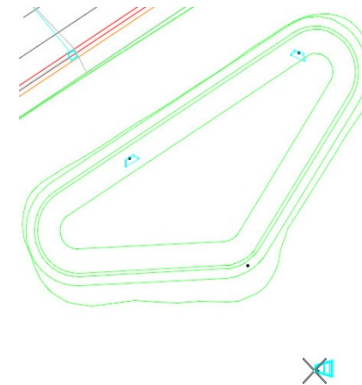
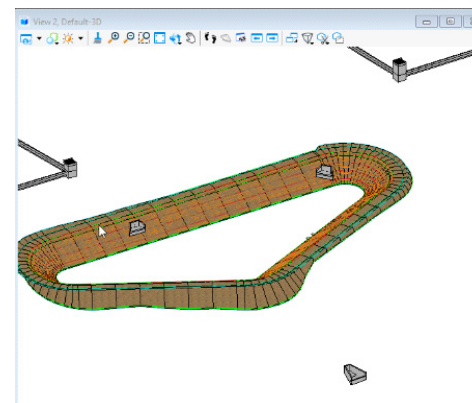
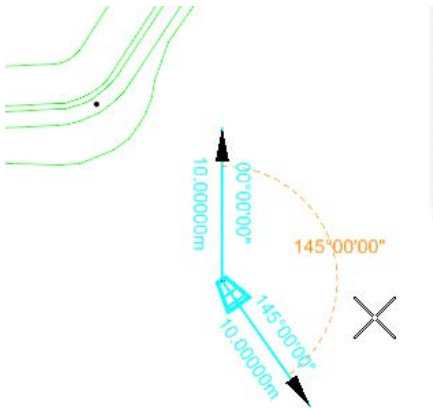


5. On the **Layout** ribbon
 - a. Select, **Layout > Place Node**
 - b. In the **Place Node** dialog, check **Vertical Offset**, set value to **0,[0]**
 - c. Set the **Feature Definition > Node > StormWaterNode > Outfalls > Training Outfall**
 - d. In the **Name Prefix > OF_1**.

- e. At the **Select Reference Element for Elevation. <Reset> to Type Elevation** prompt, **Reset**, and type an elevation of **24.5ft [7.5m]**

In the Default view snap to the point below the pond.

- f. **Data point**
- g. **Rotation Mode > Absolute** and set the **Rotation** to around **145** degrees and **data point**

A Pond Outlet Structure is required to control flow from the pond to the Outfall.

6. On the **Layout** ribbon

a. Select, **Layout > Place Node**

b. In the **Place Node** dialog, check **Vertical Offset**, set value to **0,[0]**

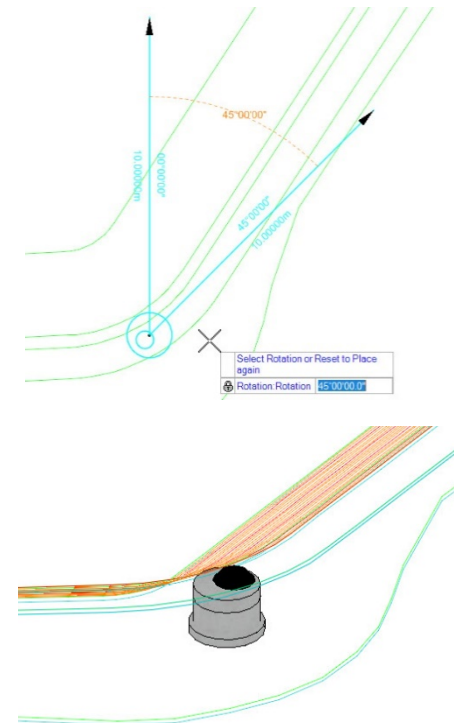
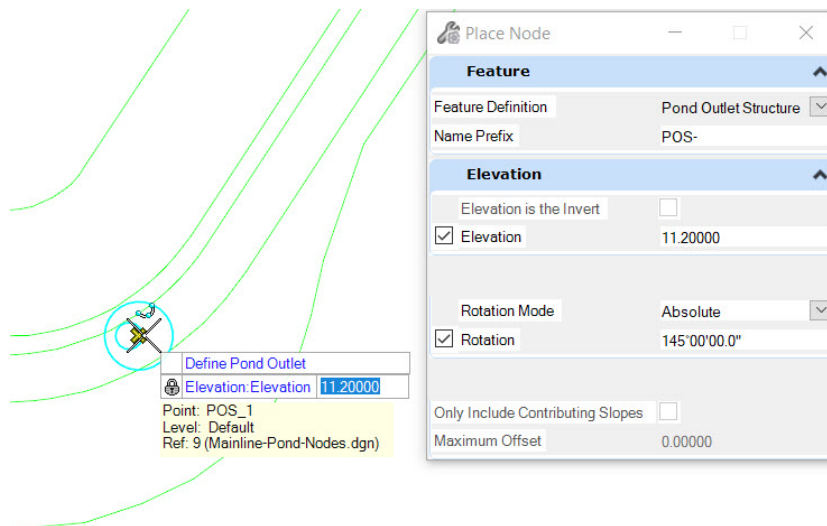
c. Set the **Feature Definition > Node > StormWaterNode > Pond Outlets > Pond Outlet Structure**

d. In the **Name Prefix > POS-1**

e. At the **Select Reference Element for Elevation. Reset to Type Elevation** prompt, **Reset**, and type an elevation of **36.75ft [11.2m]**

f. In the Default view **snap** to the point on the top of the pond bund

g. **Rotation Mode > Absolute** and set the rotation to around **45** degrees and **data point**



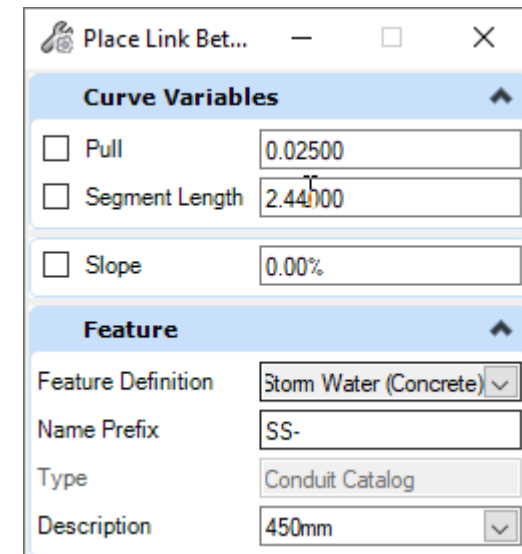
Place the Pipes

In this section you will now place the pipes connecting the Headwalls to the Drainage System and the Pound Outlet structure to the Outfall.

1. Select *Layout > Layout > Place Conduit*

a. In the *Place Link Between Nodes* dialog, set the *Feature Definition > Conduit > StormWater > Pipes > Circular > Storm Water (Concrete)*

b. Set the *Description > 18" [450mm]*, this is the Catalog Conduit Pipe Size Label



Curve Variables	
☐ Pull	0.02500
☐ Segment Length	2.44100
☐ Slope	0.00%

Feature	
Feature Definition	Storm Water (Concrete) ▼
Name Prefix	SS-
Type	Conduit Catalog
Description	450mm ▼

In the 2D **View 1** follow the prompts.

c. Select, *Start Node > (Road Edge Channel Inlet) SO-2*

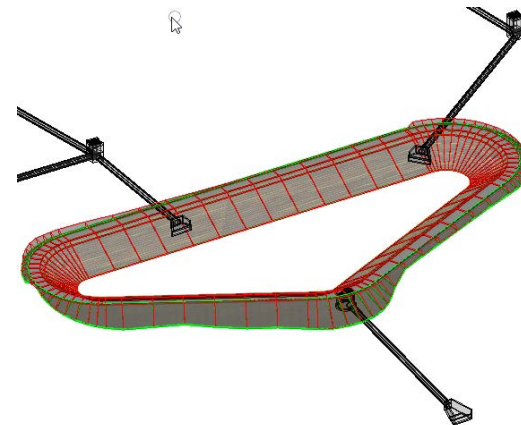
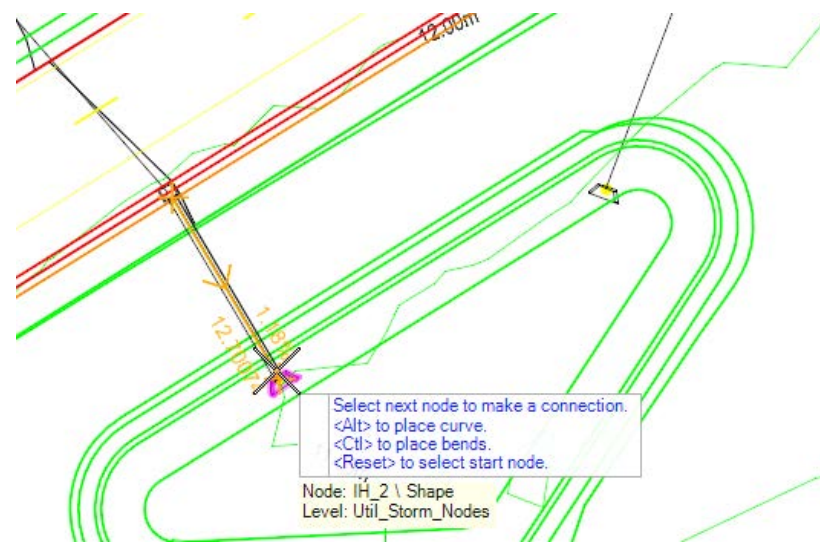
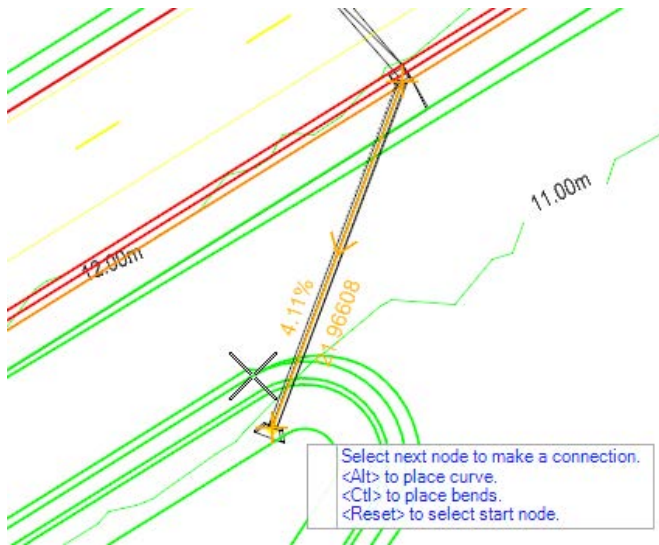
d. Select, *Next node to make a connection > (Headwall) IH_1*

e. Repeat for the *(Headwall) IH_2*, and the *(Pond Outlet Structure) POS-1* to the *(Outfall) OF-1*

f. **Esc** to exit the command.

The connections are displayed in both the 2D and 3D views. The connections can be modified later if the snaps to the **Connection Regions** are incorrect.

The placing of the pipes should resemble the layout in the following images.



The pipe from the Pond Outlet Structure requires an invert elevation just above the bottom of the pond so we can get water to the Outfall.

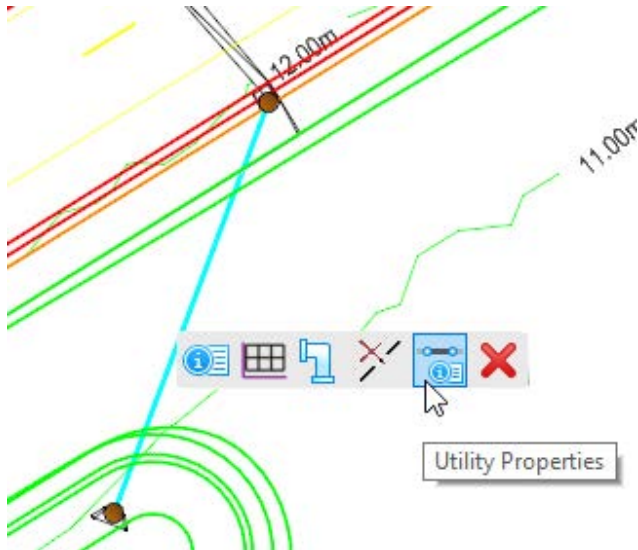
g. Select the pipe **SS-11** from the **SO-2** catch basin that connects to the Inflow Headwall **IH_1**

h. From the *Context Sensitive Toolbar* select > **Utility Properties**

From *Utility Properties* see the *Length (Scaled) (m)* is **72.730ft [22.168m]**

We need a reasonable slope from the Catch Basin **SO-2** to Headwall **IH_1**, so we are going to amend the IH_1 invert to **31.62ft [9.605m]**

Note: When *Set Invert to Stop?* Is set to *True* the Inflow Headwall Invert will control the incoming pipe invert.



Conduit Description	Circle - 450.0 mm
Set Invert to Start?	True
Invert (Start) (m)	9.655
Set Invert to Stop?	True
Invert (Stop) (m)	10.556
Has User Defined Length?	False
Length (Scaled) (m)	22.168
Length (Unified) (m)	22.168
Length (Construction) (m)	21.926
Slope (Calculated) (m/m)	-0.0406

2. Select > (*Headwall*) **IH_1**
 - a. From the *Context Sensitive Toolbar* select > **Properties**
 - b. Set the *Invert Elevation* > **31.62ft [9.605m]**.
3. Re-select the pipe **SS-11**
 - a. Check the *Invert (Stop)* from **Utility Properties**

Note: The Inflow Headwall invert was modified so this adjusted incoming pipe invert.

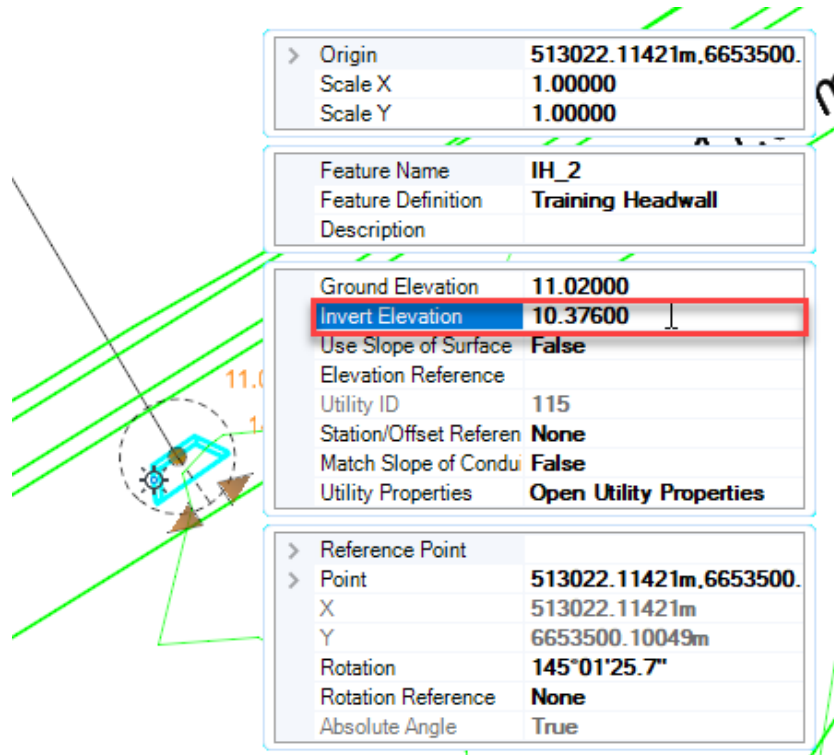
> Origin	513041.86906m,6653511.
Scale X	1.00000
Scale Y	1.00000

Feature Name	IH_1
Feature Definition	Training Headwall
Description	

Ground Elevation	10.24900
Invert Elevation	9.60500
Use Slope of Surface	False
Elevation Reference	
Utility ID	114
Station/Offset Referen	None
Match Slope of Condu	False
Utility Properties	Open Utility Properties

> Reference Point	
Point	513041.86906m,6653511.
X	513041.86906m
Y	6653511.53745m
Rotation	200°48'17.5"
Rotation Reference	None
Absolute Angle	True

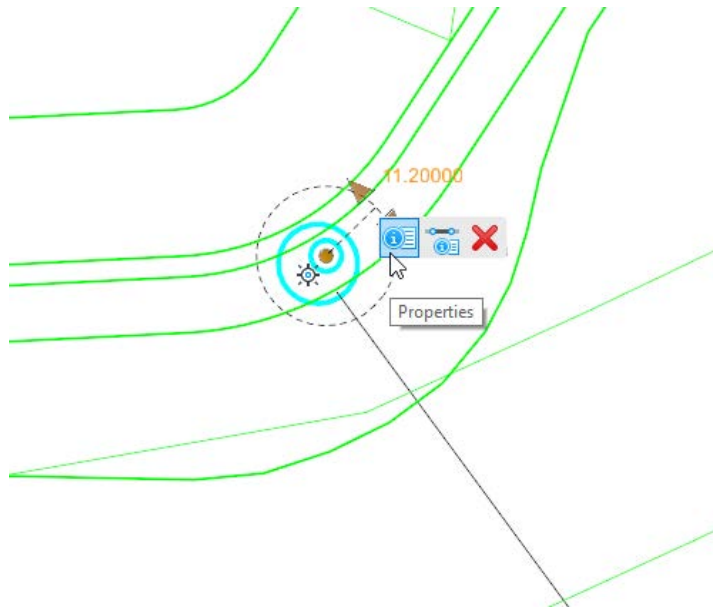
4. Select > (Headwall) **IH_2**
 - a. From the *Context Sensitive Toolbar* select > **Properties**
 - b. Set the *Invert Elevation* > **34.1ft [10.376m]**
5. Select the pipe **SS12**
 - a. Check the *Invert (Stop)* from **Utility Properties**



- b. Close the **Utility Properties** dialog

6. Select > (Pond Outlet Structure) **POS- 1**

a. Modify the *Invert* > **30.6ft** [9.300m], the bottom of the pond has an elevation of around **30.2ft** [9.200m]



Ground Elevation	11.20000m
Invert Elevation	9.300
Elevation Reference	
Use Slope of Surface	True
Baseline Reference	None
Baseline Station	0+000.000
Baseline Offset	0.00000m
Owner	
Operational Status	In Service
Quality Level	Undetermined
Utility ID	103
Utility Properties	Open Utility Properties

Feature Definition	Pond Outlet Structure
Feature Name	POS-1
Description	Pond Outlet Structure

> Point	513035.85598m,6653488.
X	513035.85598m
Y	6653488.45758m
Rotation	45°00'00.0"
Rotation Reference	None
Absolute Angle	True

Exercise 2: Place Pond

Description

This exercise will look at creating a pond to control flow rates by storing floodwater and releasing it slowly once the risk of flooding has passed.

Skills Taught

- Place Pond
- Review the Pond Hydraulics
- Review the Inflow Headwall Hydraulic properties
- Review the Pond Outlet Structure properties

Place the Pond

In this section you will now place the pond.

1. Set **View 2 Default 3D** as the active view. Turn off the *Level Display* of the Components in the **Mainline-Pond.dgn** reference.

This will help with the selection of the *Pond Terrain Model*

2. Select, *Home > Primary > Level Display*
 - a. Select *Reference > Mainline-Pond.dgn*
 - b. *Uncheck levels > D-Comp-EWKS-Fill* and *D-Comp-EWKS-Cut*

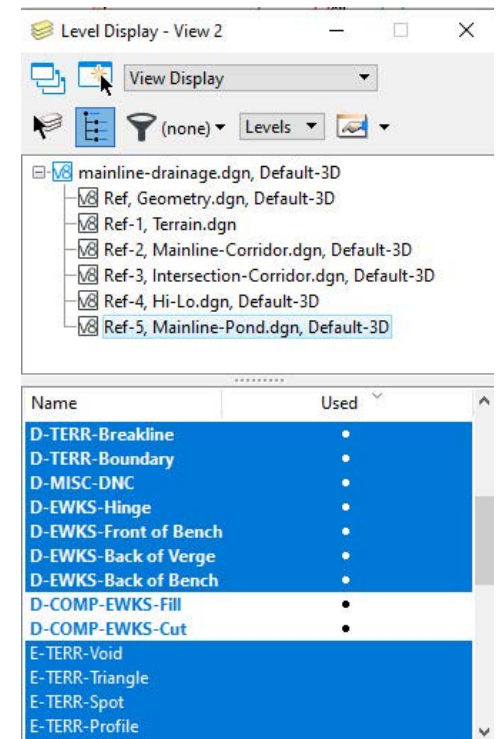
Note the top elevation of the pond is 36.75ft [11.200m]. This could be checked using *Analyze Point*.



3. Select *Layout > Layout > Place Pond*
 - a. Set the *Feature Definition > Drainage Area > Pond > Pond*
 - b. *Name Prefix > P-1.*
 - c. Set *Pond method > From Terrain Model*
 - d. **Data point** in the Default view to accept the *Pond method*.
 - e. Select the **Design-Contours-Pond** as the Terrain Model from the *Default-3D view*.

Move the cursor back into the Default view.

The prompt displays the *lowest* and *highest* elevation of the **Design-Contours-Pond** Terrain Model.



DataPoint to Accept Elevation. The lowest elevation found is 9.2 and the highest elevation is 11.2.		
	Parameters:Maximum Water Elevation	11.000

- f. *Type* > **36.000'** [**11.000m**] as the elevation, then **Data point** to accept the elevation.
- g. Set *View 1* Active, **Data point** anywhere within the bottom of the pond to *Select Point Within Pond Area*
- h. Select an *Inflow* for the pond, select > **(Inflow Headwall) IH_1**.
- i. Select an *Outflow* for the pond, select > **(Pond Outlet Structure) POS-1**
- j. **Data point** to *Accept the Boundary*



Place Pond	
Parameters	
Pond method	From Terrain Model
☒ Maximum Water Elevation	11.00000
Feature	
Feature Definition	Pond
Name Prefix	P-1

You can now see the **Pond Boundary** in the Default view.

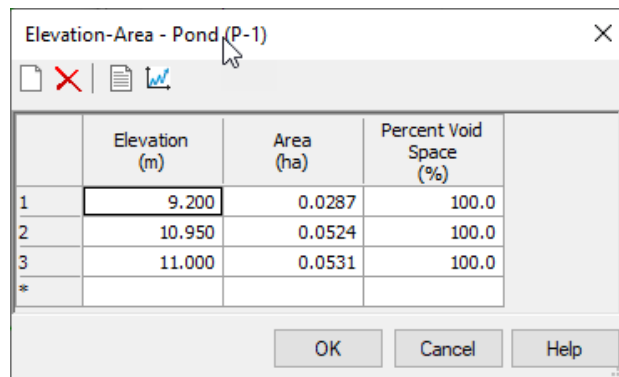
4. Select **Pond Boundary P-1** and from the *Context Sensitive toolbar*, Select > **Utility Properties**

You will see the Properties of the Pond

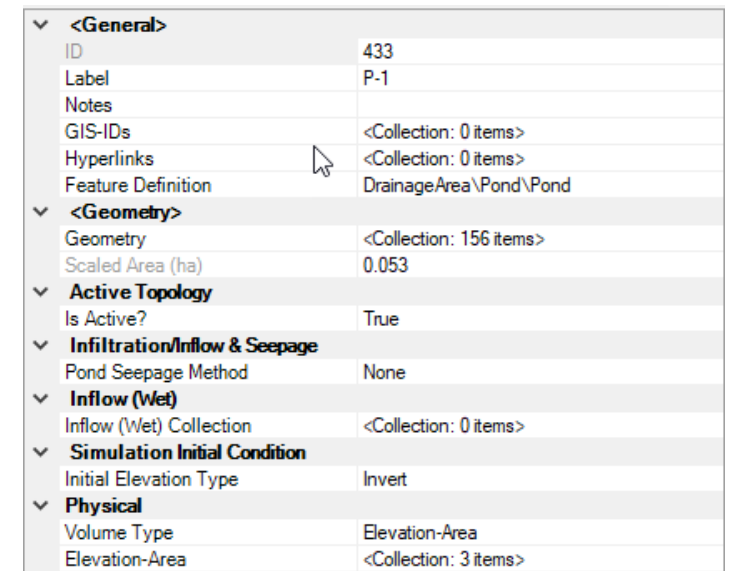
- a. Select **Physical** > **Elevation-Area** > **Collection of 3 items**.

- b. Select the **ellipse** to view the collection items.

The collection has been built by finding the surface area at every unique elevation in the *Pond Terrain Model*, so the collection correctly models every elevation at which the surface can change.



	Elevation (m)	Area (ha)	Percent Void Space (%)
1	9.200	0.0287	100.0
2	10.950	0.0524	100.0
3	11.000	0.0531	100.0
*			



<General>	
ID	433
Label	P-1
Notes	
GIS-IDs	<Collection: 0 items>
Hyperlinks	<Collection: 0 items>
Feature Definition	DrainageArea\Pond\Pond
<Geometry>	
Geometry	<Collection: 156 items>
Scaled Area (ha)	0.053
Active Topology	
Is Active?	True
Infiltration/Inflow & Seepage	
Pond Seepage Method	None
Inflow (Wet)	
Inflow (Wet) Collection	<Collection: 0 items>
Simulation Initial Condition	
Initial Elevation Type	Invert
Physical	
Volume Type	Elevation-Area
Elevation-Area	<Collection: 3 items>

The elevation of **35.925ft [10.95m]** comes from a feature in the pond that sits just below the top of the bund

If the value for Area on line 1 is set to 0.000, change it to read **0.0287**

- c. Select **OK** to close the dialog
- d. **Close** the *Properties* dialog

Check the Inflow Headwall Properties

In this section you will review and change the Inflow Headwall Properties

1. The *Inflow Headwall* properties will now have changed. The *Boundary Condition Type* was *Free Outfall*

2. Select > **(Inflow Headwall) IH_1**

a. From the *context sensitive toolbar* Select > **Utility Properties**

The *Boundary Condition Type* is now set to *Boundary Element*

The *Network Boundary Type* is *Discharge to Pond* and is now linked to the newly created **Pond P-1**

b. *De-select* > **(Inflow Headwall) IH_1**

3. Select > **(Inflow Headwall) IH_2**

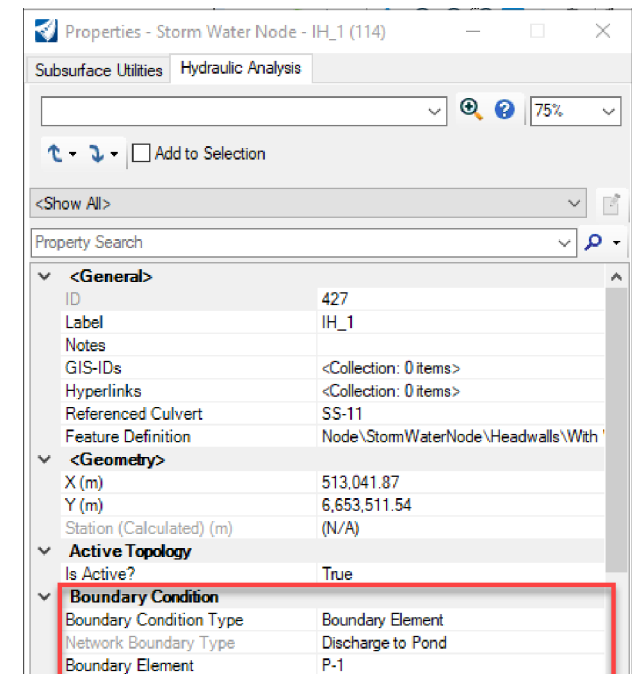
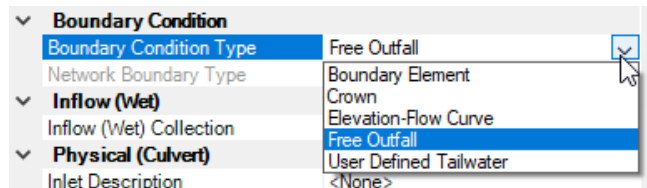
a. From the *context sensitive toolbar* Select > **Utility Properties**

The Inflow Headwall will discharge into the pond

Change the *Boundary Condition Type* > **Boundary Element**

b. From the drop down and Select > **Boundary Element**

c. Select > **P-1** as the *Boundary Element*



Check the Pond Outlet Structure Properties

In this section you will review the Pond Outlet Structure Properties

1. Select > **(Pond Outlet Structure) POS-1**
2. From the *context sensitive toolbar*, Select > **Utility Properties**

The *Upstream Pond* now shows the **P-1** feature

▼ Pond Outlet	
Upstream Pond	P-1
Has Control Structure?	Yes
Composite Outlet Structure	Composite Outlet Structure

3. Under the **Pond Outlet** Property
 - a. Set *Has Control Structure* > **Yes**
 - b. Click the **Ellipsis** in the *Composite Outlet Structure* property
 - c. Select *<Edit Composite Outlet Structure>*.

The *Composite Outlet Structure* dialog appears.

▼ Pond Outlet	
Upstream Pond	P-1
Has Control Structure?	Yes
Composite Outlet Structure	Composite Outlet Structure ▼
▼ Physical	<Edit Composite Outlet Structure>



- d. Select *New* > *Composite Outlet Structure*
- e. Rename > **Composite Outlet Structure**

f. Set the *Headwater Type* > **Use Pond for Headwater Range**

g. Set Pond to *< select from drawing >* and Select > **P-1**

h. Set the *Tailwater type* > **Free Outfall**

4. Right click on the *Composite Outlet Structure*, *Add* and Select > **Vortex Valve**

A Vortex Valve is required to control the discharge from the pond

a. Rename > **Vortex Valve**

b. Set the *Flow Direction* > **Forward Flow Only**

c. Set the *Elevation* > **30.5ft, [9.300m]**

(Remember the bottom of the pond is **@30.2ft, [9.200m]**)

5. Select **Category** for the *Vortex Valve*, select the drop down.

a. Select > **Edit**

b. Select > **Import from Library**

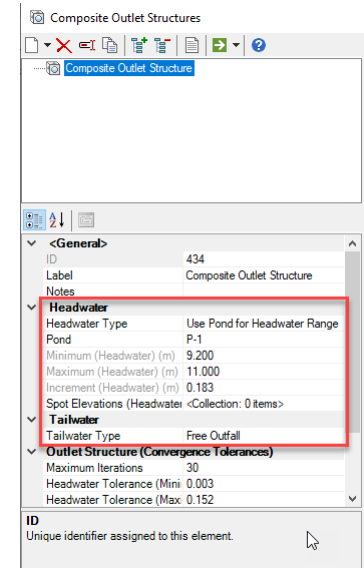
c. Select > *BE-SXH* > **BE-SXH-4"**, *[BE-SXH-102mm]*

The selected Vortex Valve does not have enough Head for the pond.

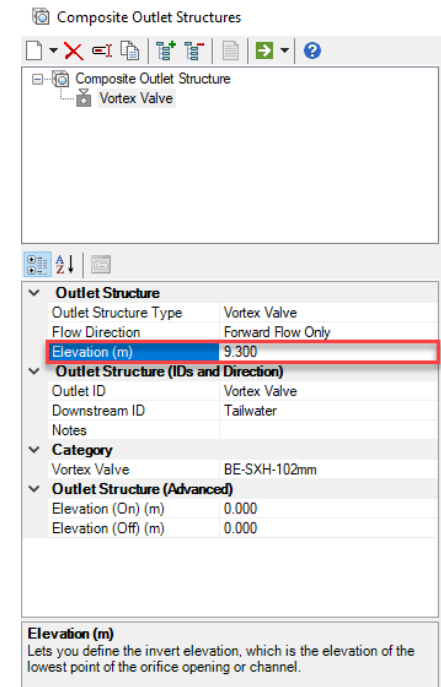
The *Maximum-Minimum(Headwater)* difference is **6ft, [1.8m]**

Note: For **Imperial** users there is no need to do step 6 below

d. **Select**

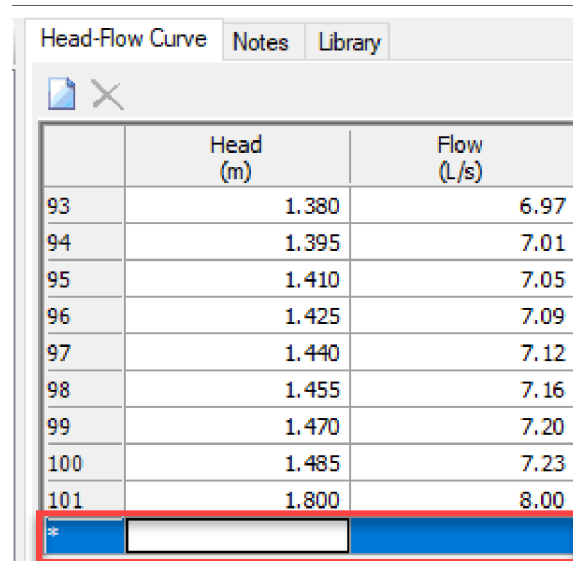


<General>	
ID	434
Label	Composite Outlet Structure
Notes	
Headwater	
Headwater Type	Use Pond for Headwater Range
Pond	P-1
Minimum (Headwater) (m)	9.200
Maximum (Headwater) (m)	11.000
Increment (Headwater) (m)	0.183
Spot Elevations (Headwater)	<Collection: 0 items>
Tailwater	
Tailwater Type	Free Outfall
Outlet Structure (Convergence Tolerances)	
Maximum Iterations	30
Headwater Tolerance (Mini)	0.003
Headwater Tolerance (Max)	0.152
ID Unique identifier assigned to this element.	



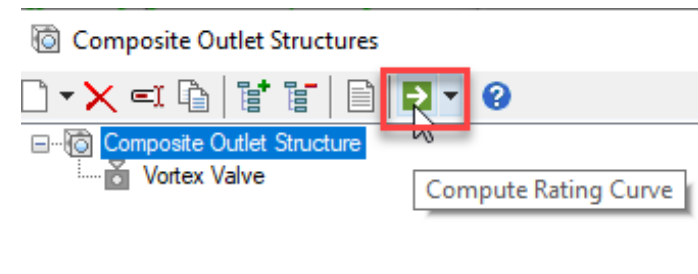
Composite Outlet Structures	
Composite Outlet Structure	
Vortex Valve	
Outlet Structure	
Outlet Structure Type	Vortex Valve
Flow Direction	Forward Flow Only
Elevation (m)	9.300
Outlet Structure (IDs and Direction)	
Outlet ID	Vortex Valve
Downstream ID	Tailwater
Notes	
Category	
Vortex Valve	BE-SXH-102mm
Outlet Structure (Advanced)	
Elevation (On) (m)	0.000
Elevation (Off) (m)	0.000
Elevation (m) Lets you define the invert elevation, which is the elevation of the lowest point of the orifice opening or channel.	

6. Click in the *Head (m)* blank cell next to the *asterisk*
 - a. Under the *Head Column > 1.8m*
 - b. *Tab* across, then type a *Flow (L/s) > 8*
 - c. *Tab* again.



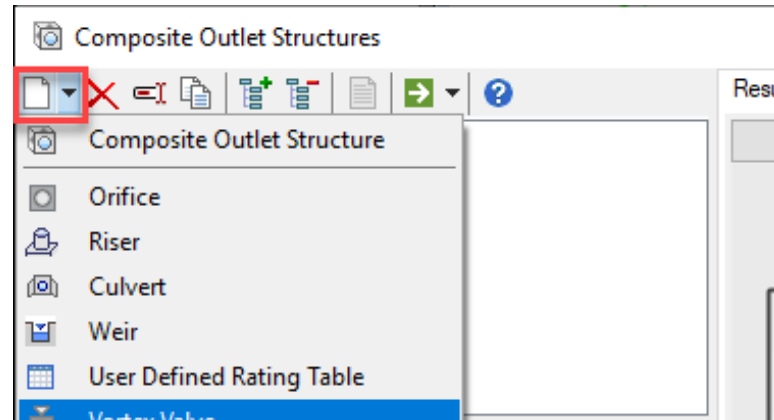
	Head (m)	Flow (L/s)
93	1.380	6.97
94	1.395	7.01
95	1.410	7.05
96	1.425	7.09
97	1.440	7.12
98	1.455	7.16
99	1.470	7.20
100	1.485	7.23
101	1.800	8.00
*		

7. **Close** the dialog
8. In the **Composite Outlet Structure** Dialog
 - a. Under *Category > Vortex Valve > BE-SXH-4", [BE-SXH-102mm]*
9. Select **Compute** from toolbar
This will update the *Rating Table*



10. Select **New > Composite Outlet Structures**

Other flow control structures such as Orifices, Weirs etc. are available to control the discharge from your pond.



11. **Close** the dialog

Ensure that the New **Composite Outlet Structure** is selected in the *Utility Properties* of the *Pond Outlet*

▼	Physical	
	Elevation (Ground) (m)	11.200
▼	Pond Outlet	
	Upstream Pond	P-1
	Has Control Structure?	Yes
	Composite Outlet Structure	Composite Outlet Structure

12. **Close** the *Utility Properties*

Exercise 3: Compute the System

Description

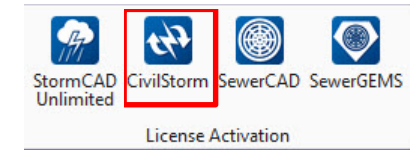
This exercise, you will activate CivilStorm, compute the scenario and review the results

Skills Taught

- License Activation
- Computing the Scenario
- Review the results of the Scenario

License Activation

1. From *Tools* > *License Activation* > **CivilStorm**

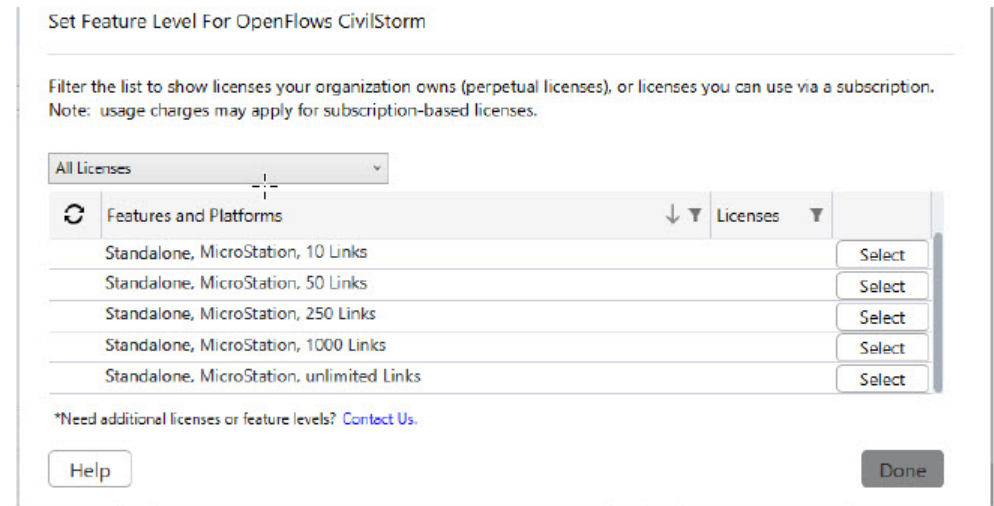


The software checks to see what **CivilStorm** licenses are available. If a license and feature level have not been previously selected, a dialog is displayed.

If your organization owns any licenses, they will be shown in **bold** text.

If you have a row that uses bold text:

2. Click the **Select** button for that row.
3. Click > **Done**.

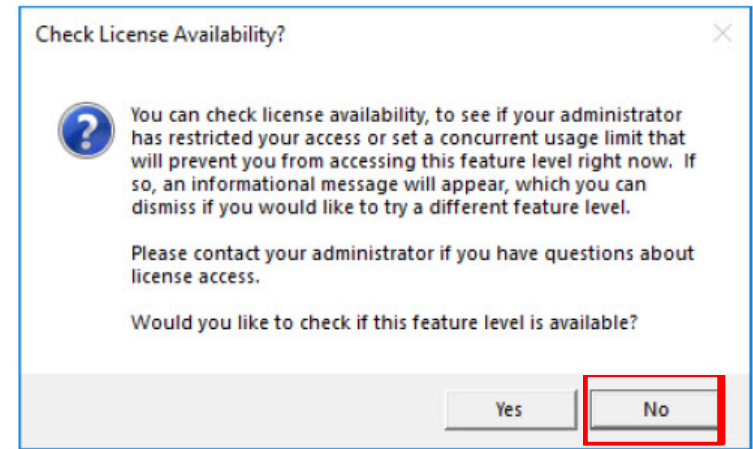


If you do not have a row that uses bold text:

4. Click the **Select** button for the *“Standalone, MicroStation, 250 Links”* row

A message asks whether you want to *Check License Availability*

- a. Click **No**



Computing the Scenario



1. From the **Analysis** ribbon, select **Analysis Tools** > **Compute Center**
 - a. Confirm that the **Scenario** is set to **Pond Design**

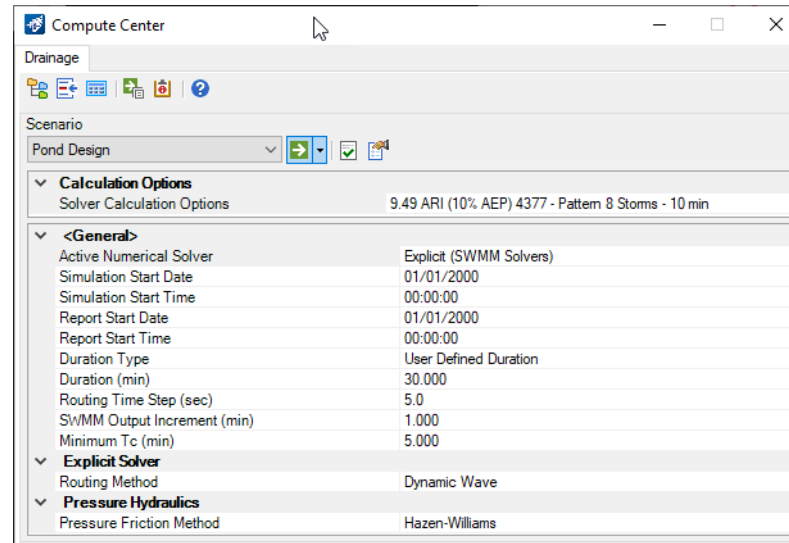
The **Compute Center** dialog always loads the current scenario.

Review the other settings in the **Compute Center** dialog.

Note: The setting for the **Active Numerical Solver**, is set to **Explicit (SWMM Solvers)**



2. Click **Compute**



After a few moments, the **SWMM Calculation Executive Summary** dialog is displayed.

- On the *SWMM Calculation Executive Summary* dialog select **Storage**

SWMM Calculation Executive Summary

Summary Nodes Links Catchments **Storage** Pumps Report

	ID	Label	Element Type	Volume (Average) (L)	Percent Full (Average) (%)	Evaporation Loss (%)	Exfiltration Loss (%)	Storage (Maximum) (L)	Percent Full (Maximum) (%)	Time to Maximum Storage (min)	Flow (Out to Links Maximum) (L/s)
P-1	536	P-1	Pond	275,240.5	56.8	0.0	0.0	477,118.1	98.4	30.000	44.95

☒ Show this dialog after Compute

Close Help

Note: the *Volume* and the *Storage Maximum* values.

- Close** the *SWMM Calculation Executive Summary* dialog
- Close** the *User Notifications* dialog.
- In *View 2* Select > **Pond Boundary**
 - From the *context sensitive toolbar* > **Utility Properties**
 - Scroll down and review the results. Particularly *Percentage Full Maximum*.
- Close** > **Utility Properties**
- Exit** the Software

Results

Calculation Messages	<Collection: 0 items>
Time to Maximum Depth (min)	30.000
Local Inflow (Total Volume) (L)	0.0
Depth (Maximum) (m)	1.785
Percent Full (Maximum) (%)	98.4
Local Inflow (Maximum) (L/s)	0.00
Evaporation Loss (%)	0.0
Time to Local Inflow (Maximum) (min)	0.000
Depth (Average) (m)	1.234
Percent Full (Average) (%)	56.8
Volume (Average) (L)	275,240.5

Summary

In this class we have looked at how to create a pond from a terrain model and to add attenuation to the drainage system.

We have also connected the drainage system to the pond by placing headwalls, a Pond Outfall structure with vortex valve. We also created the pipes connecting all the structures, assessed their invert levels to ensure that they have a reasonable gradient.

Finally, we will compute a scenario that assess the whole network.