

Designing a Water Distribution System in a Site Development Project Using WaterGEMS

Workshop Overview

In this workshop, you will learn about the benefits of using the MicroStation platform in conjunction with WaterCAD or WaterGEMS. You will also learn about designing a water distribution system extension in a new site development project, and how to review a water system's fire flow capacity.

This course material has been developed for the WaterCAD or WaterGEMS V8i SELECTseries 5 Version 08.11.05.61 and MicroStation V8i SELECTseries 3 Version 08.11.09.459. (WaterCAD and WaterGEMS have also received limited testing on some prior versions of MicroStation V8i.)

Although you will use WaterCAD V8i on the MicroStation platform during this workshop, the interface and layout tools learned are equally applicable to WaterCAD, SewerCAD, SewerGEMS, StormCAD, CivilStorm, HAMMER, and PondPack.

Learning Objectives

After this course you will be able to:

- Apply the basic principles of water distribution modeling in the MicroStation V8i environment
- Open or create a new hydraulic model from with MicroStation
- Import a CAD file as a background and lay out new hydraulic model elements using AccuDraw and AccuSnap
- Set up levels for each hydraulic element type and have new elements automatically placed on the correct level

- Set up View Associations and Symbology Definitions
- Use the Print Preparation Tool
- Publish a 3D i-model of the hydraulic network

General Information on MicroStation Integration

In the MicroStation V8i environment you can create and model your network directly within your primary drafting environment. This gives you access to all of MicroStation's powerful drafting and presentation tools, while still enabling you to perform hydraulic modeling tasks like editing, solving, and data management. This relationship between the two applications enables extremely detailed and accurate mapping of model features, and provides the full array of output and presentation features available in MicroStation V8i. This facility provides the most flexibility and the highest degree of compatibility with other CAD-based applications and drawing data maintained at your organization.

Bentley WaterGEMS V8i features support for MicroStation V8i integration. You can run Bentley WaterGEMS V8i in both MicroStation and the stand-alone environment.

The MicroStation functionality has been implemented in a way that is the same as the Bentley WaterGEMS V8i base product. Once you become familiar with the stand-alone environment, you will not have any difficulty using the product in the MicroStation environment.

In the MicroStation V8i environment, you will have access to the full range of functionality available in the MicroStation design and drafting environment. The standard environment is extended and enhanced by using MicroStation's MDL (MicroStation Development Language) client layer that lets you create, view, and edit the native Bentley WaterGEMS V8i network model while in MicroStation.

MDL is a complete development environment that lets applications take full advantage of the power of MicroStation and MicroStation-based vertical applications. MDL can be used to develop simple utilities, customized commands or sophisticated commercial applications for vertical markets.

Some of the advantages of working in the MicroStation V8i environment include:

- Lay out network links and structures in fully-scaled environment in the same design and drafting environment that you use to develop your engineering plans.
- Have access to any other third party applications that you currently use, along with any custom MDL applications.

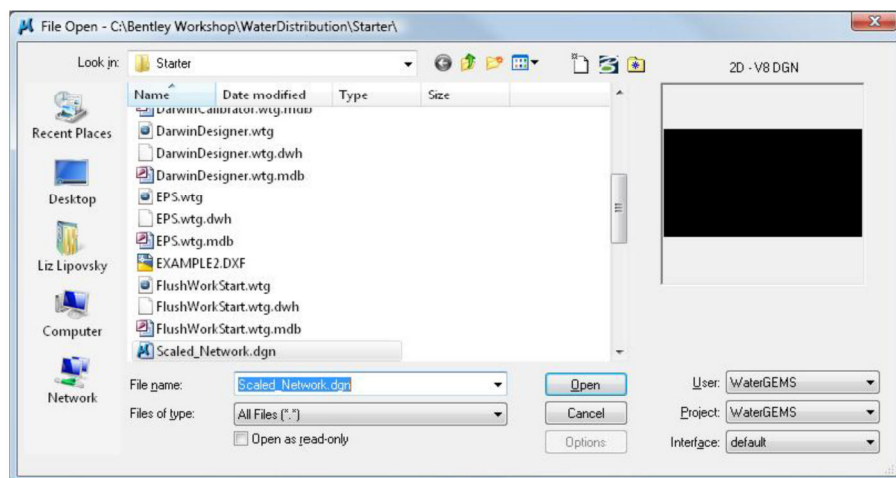
- Use native MicroStation insertion snaps to precisely position hydraulic network elements with respect to other entities in the MicroStation drawing.
- Use native MicroStation commands on hydraulic model entities with automatic update and synchronization with the model database.
- Control destination levels for model elements and associated label text and annotation, giving you control over styles, line types, and visibility of model elements.

Note: Bentley MicroStation V8i is the only MicroStation environment supported by WaterGEMS V8i.

A Bentley MicroStation WaterGEMS V8i project consists of:

- **Drawing File (.DGN)**—The MicroStation drawing file contains the elements that define the model, in addition to the planimetric base drawing information that serves as the model background.
- **Hydraulic Model File (e.g. .WTG)**—The model file contains model data specific to the hydraulic model, including project option settings, color-coding and annotation settings, etc. Note that the MicroStation .dgn that is associated with a particular hydraulic model may not necessarily have the same filename as the model's .wtg file.
- **Database File (.sqlite)**—The hydraulic model database file efficiently contains all of the input and output data for the hydraulic model in a small file. Note that the MicroStation .dgn that is associated with a particular model may not have the same file name as the model's database file. Recent version of WaterGEMS used (*.sqlite) files as a database storage.

When you start Bentley WaterGEMS V8i for MicroStation V8i, you will see the dialog below. You must identify a new or existing MicroStation dgn drawing file to be associated with the model before you can open a Bentley WaterGEMS V8i model.



From here you can either browse to an existing dgn file or create a new file using the *New* button on the top toolbar. Once you have selected a file, you can pick the *Open* button.

Once a drawing is open, you can use the WaterGEMS V8i Project drop down menu to create a new WaterGEMS V8i project, attach an existing project, import a project or open a project from ProjectWise.

There are a number of options for creating a model in the MicroStation client:

- **Create a model from scratch**—You can create a model in MicroStation. You'll first need to create a new MicroStation .dgn (refer to your MicroStation documentation to learn how to create a new .dgn). Start WaterGEMS V8i for MicroStation. In the first dialog, pick the *New* button and assign a name and path to the DGN file. Once the dgn is open, use the *New* command in the WaterGEMS V8i Project menu (Project > New). This will create a new WaterGEMS V8i project file and attach it to the Bentley MicroStation .dgn file. Once the file is created you can start creating WaterGEMS V8i elements that exist in both the WaterGEMS V8i database and in the .dgn drawing. See *Working with Elements* and *Working with Elements Using MicroStation Commands* for more details.
- **Open a previously created WaterGEMS V8i project**—You can open a previously created WaterGEMS V8i model and attach it to a .dgn file. To do this, start WaterGEMS V8i for MicroStation. Open or create a new MicroStation .dgn file (refer to your MicroStation documentation to learn how to create a new .dgn). Use the Project menu on the WaterGEMS V8i toolbar and click on the Project > "Attach Existing..." command, then select an existing WaterGEMS V8i.wtg file. The model will now be attached to the .dgn file and you can edit, delete, and modify the WaterGEMS V8i elements in the model. All MicroStation commands can be used on WaterGEMS V8i elements.
- **Import a model that was created in another modeling application**—There are four types of files that can be imported into WaterGEMS V8i:
 - WaterGEMS / HAMMER Database—this can either be a HAMMER V8i or V8, WaterGEMS V8i or V3, or WaterCAD V8i or V7 database. The model will be processed and imported into the active MicroStation .dgn drawing.
 - EPANET—You can import EPANET input (.inp) files. The file will be processed and the proper elements will be created and added to the MicroStation drawing.
 - Submodel—You can import a WaterGEMS V8i V8 subenvironment into the MicroStation drawing file.
 - Bentley Water model—You can import Bentley Water model data into your WaterGEMS V8i model in MicroStation.

If you want to trace the model on top of a dgn or other background file, you would load the background into the dgn first by using either File/Reference or File/Raster Manager. Then you start laying out elements over top of the background.

In this workshop you will be creating a hydraulic model from scratch with the aid of a background drawing that you will attach to your DGN.

Project Creation and Entering System Information

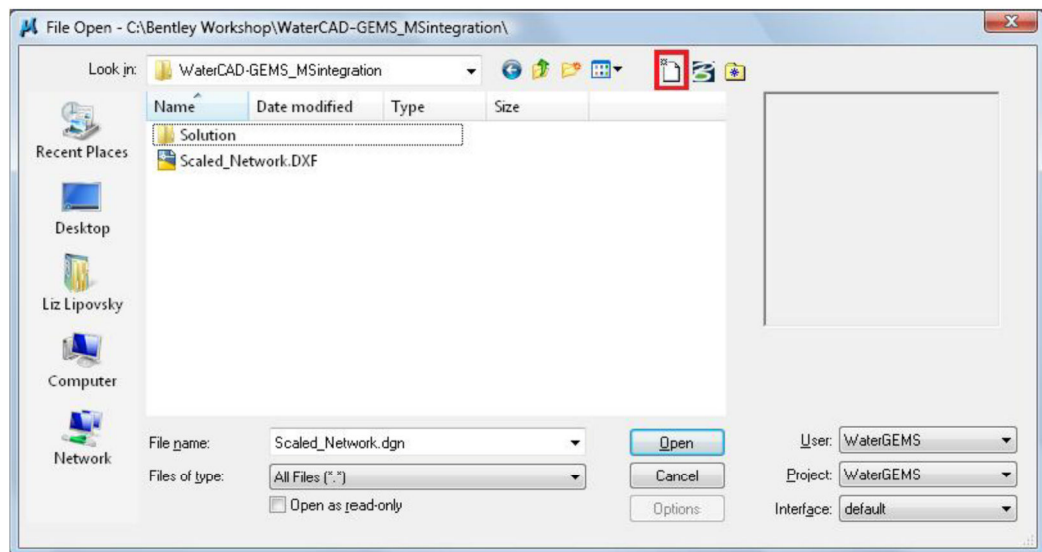
→ Exercise: Creating a new WaterGEMS Project in MicroStation

In this exercise you will create a new MicroStation DGN and WaterGEMS project file. You will then enter the project's properties and set up the element levels.

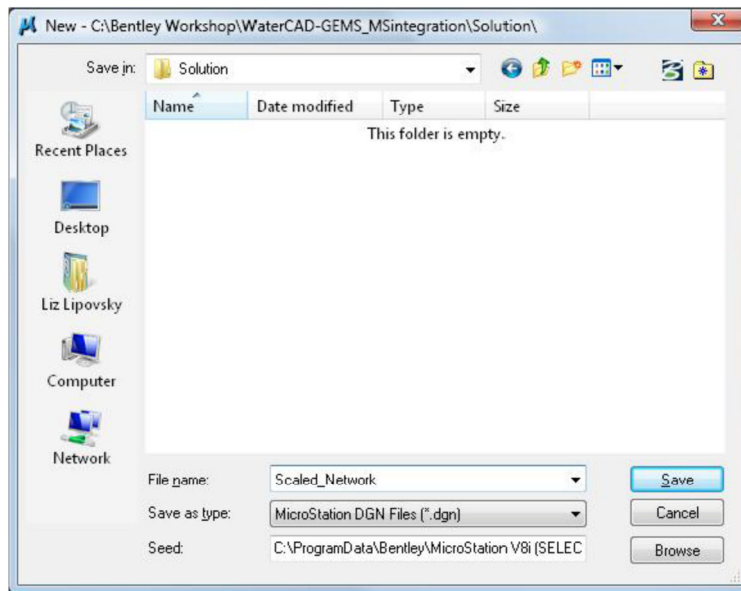
- 1 Start "WaterGEMS V8i for MicroStation V8i (SELECTseries 3)" from the start menu under *Bentley* or from the desktop icon.

You will be brought to the File Open dialog when WaterGEMS V8i for MicroStation V8i SELECTseries 3 opens. The primary function of this dialog is navigating to and opening design files.

- 2 Click the New File icon in the top right of the File Open dialog.



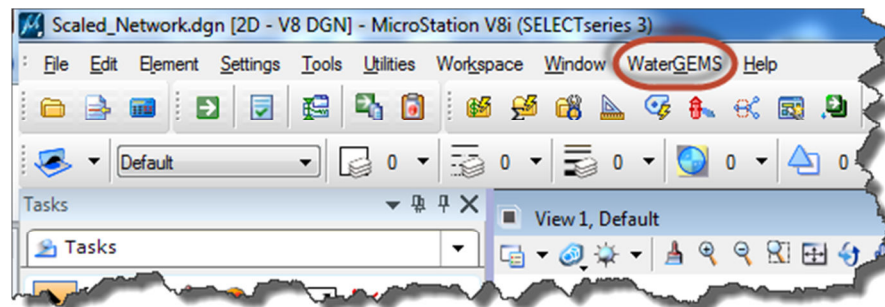
- 3 In the *New* dialog, browse to C:\Bentley Workshop\WaterCAD-GEMS_MSIntegration\
- 4 Enter a *File name* of **Scaled_Network** and click Save.



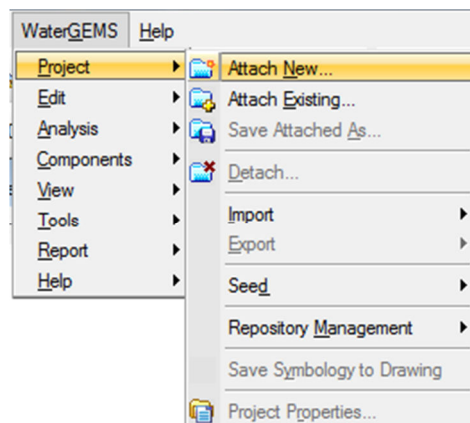
You will be brought back to the *File Open* dialog to open the file you just created.

5 Make sure **Scaled_Network.dgn** is selected, and click Open.

You are now in the MicroStation V8i interface. You should see a menu item at the top of the dialog that says *WaterGEMS*. This allows you to access the WaterGEMS menu items.



6 Select **WaterGEMS > Project > Attach New**.



This will bring up the *Save As* dialog so that you can save the WaterGEMS project.

7 Browse to C:\Bentley Workshop\WaterCAD-GEMS_MSintegration\Solution, enter a File name of **Scaled_Network**, and click Save. The WaterGEMS project will automatically be saved with a .WTG file extension.

8 Select **WaterGEMS > Project > Project Properties**.

9 Enter the following and then click OK.

Title: **Subdivision Workshop**

Engineer: **Enter your name**

Company: **Enter your company name**

Date: **Select today's date**

Click OK

➔ Exercise: Setting WaterGEMS elements to different levels

The Element Levels tool allows you to automatically put WaterGEMS elements onto different levels in a DGN. You can then have the ability to turn levels off or on, or lock them to prevent accidental movement of elements. This is a feature that you would set up prior to laying out any of your WaterGEMS network elements. We are going to set up layers for junctions, pipes, and tanks since those are the only elements we are using in this workshop.

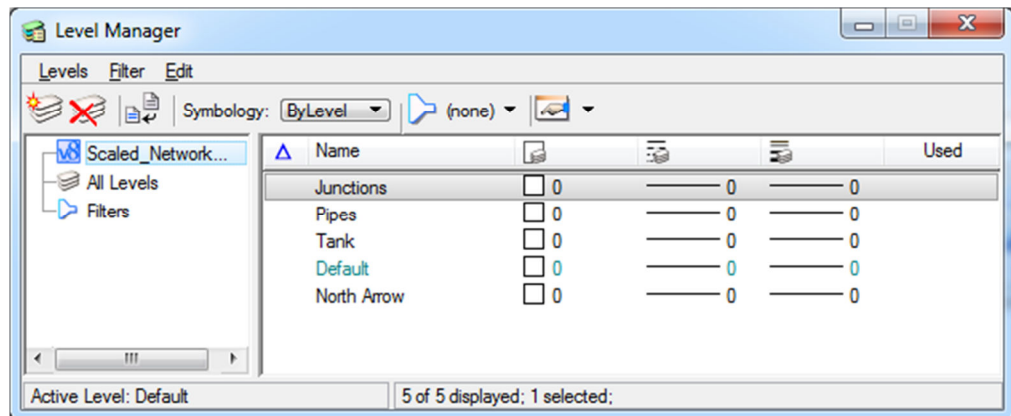
1 Open the Level Manager from the Primary Tools toolbar or by selecting **Tools > Levels > Level Manager**.



2 Click the *New Level* button.

3 Enter **Junctions** for the name.

4 Repeat that process and create new levels for both **Pipes** and **Tank**.



5 Close the Level Manager.

We now need to set the elements to their levels.

- 6 Select WaterGEMS > **View > Element Levels**.

This opens the Element Levels dialog.

- 7 For the *Pipe* row, select **Pipes** for both the Element Level and the Annotation Level columns.
- 8 Repeat this for **Junction** and **Tank**.

	Element Level	Annotation Level
Pipe	Pipes	Pipes
Junction	Junctions	Junctions
Hydrant	Active Level	Active Level
Tank	Tank	Tank
Reservoir	Active Level	Active Level
Customer Meter	Active Level	Active Level
SCADA Element	Active Level	Active Level
Pump	Active Level	Active Level
Variable Speed Pump Battery	Active Level	Active Level
PRV	Active Level	Active Level
PSV	Active Level	Active Level
PBV	Active Level	Active Level
FCV	Active Level	Active Level
TCV	Active Level	Active Level
GPV	Active Level	Active Level
Isolation Valve	Active Level	Active Level
Spot Elevation	Active Level	Active Level
Air Valve	Active Level	Active Level
Turbine	Active Level	Active Level
Periodic Head-Flow	Active Level	Active Level
Hydropneumatic Tank	Active Level	Active Level
Surge Valve	Active Level	Active Level
Discharge To Atmosphere	Active Level	Active Level
Rupture Disk	Active Level	Active Level
Orifice Between Pipes	Active Level	Active Level
Surge Tank	Active Level	Active Level
Check Valve	Active Level	Active Level
Valve With Linear Area Change	Active Level	Active Level
Pump Station	Active Level	Active Level

- 9 Click OK.

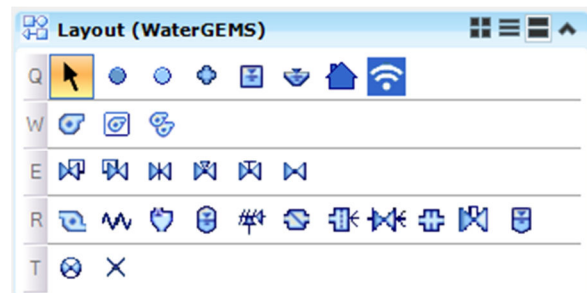
→ Exercise: Reviewing WaterGEMS Tasks

Now that we have the model set up to begin laying out our network, let's take a few moments to review the interface a little bit further.

The WaterGEMS tasks can be found in the Tasks dialog (default location is the left side of the MicroStation Interface) or under the WaterGEMS menu. You may need to scroll down the Tasks list



A task is simply a logical grouping of tools organized by use. For example, the Layout (WaterGEMS) task contains all of the elements that can be used in a WaterGEMS model.



- 1 Click on each WaterGEMS task group to view the options contained in each.
- 2 Use the buttons in the upper right corner of a task group to change the *Layout Mode* to the one you most prefer: Icon, List or Panel.



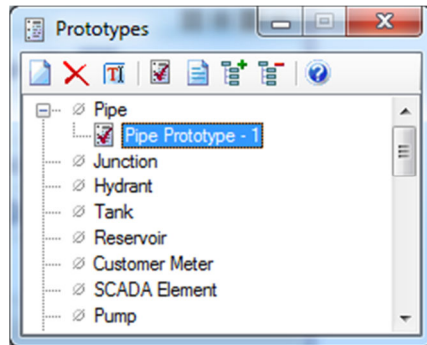
➔ Exercise: Creating pipe prototypes

Before you begin drawing the new water network, you will set up pipe prototypes. Prototypes contain the default values that will be assigned to new elements in your network.

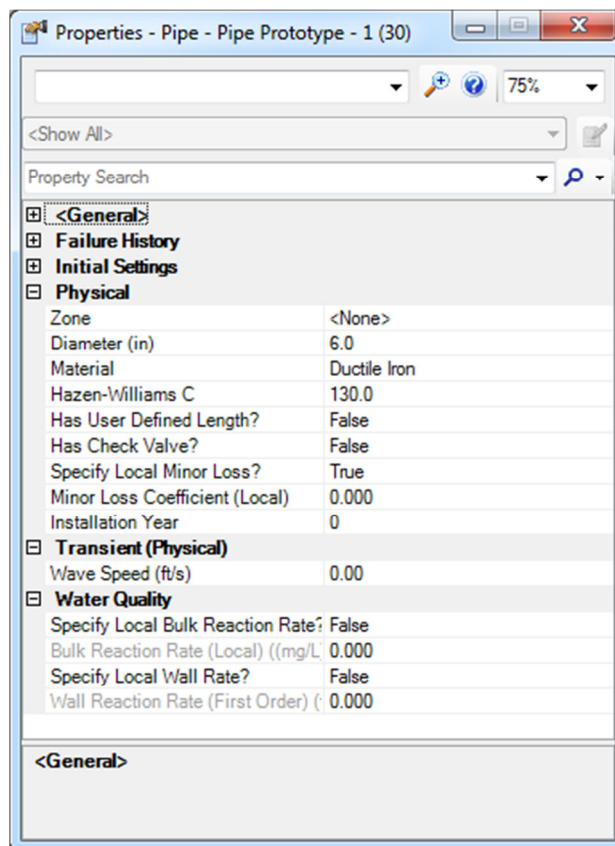
Prototypes can reduce data entry requirements dramatically if a group of network elements share common data. For example, if a section of the network contains all 12-inch pipes, use the Prototype manager to set the Pipe Diameter field to 12 inches. When you create a new pipe in your model, its diameter attribute will default to 12 inches.


In this workshop, the pipe prototype will be set to 6-inch diameter with PVC for material and a C-factor of 150.

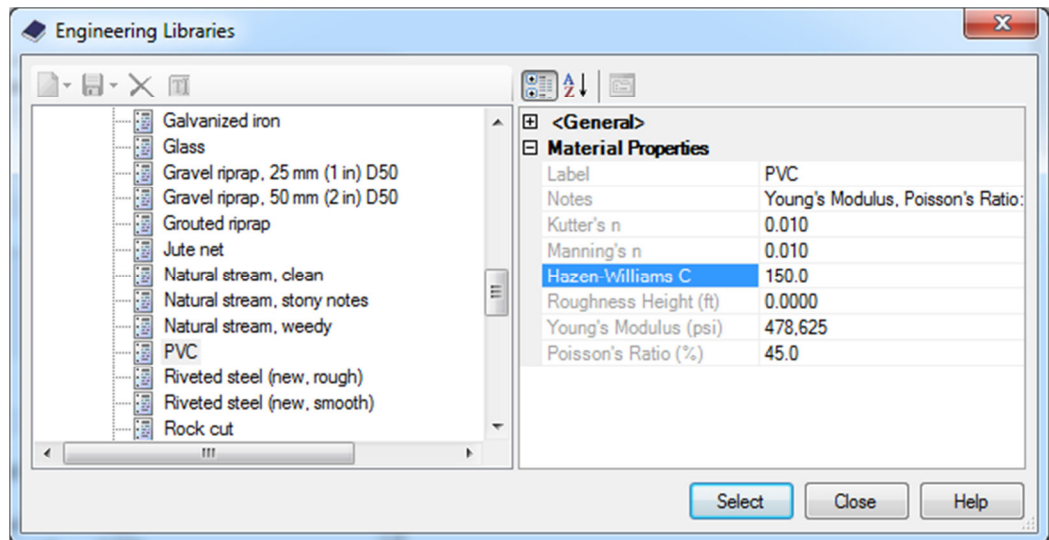
- 1 Select **WaterGEMS > View > Prototypes**.
- 2 Right click on *Pipe* and select **New**.



- 3 Double click on **Pipe Prototype-1** to open the Properties manager if it is not open already, and enter **6** in the *Diameter (in)* field.

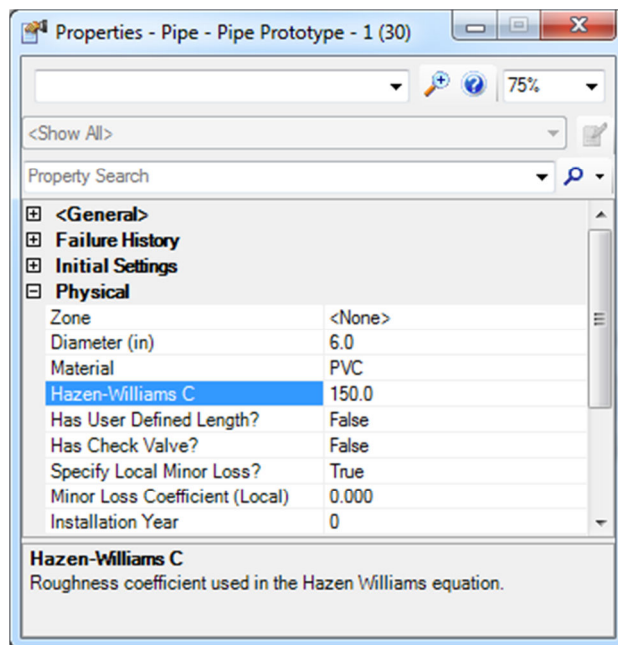


- 4  Click in the *Material* field, and then click the **ellipsis (...)** to open the Engineering Libraries manager.
- 5 Click the + next to *Material Libraries*, then select the + next to *MaterialLibrary.xml* and select **PVC**.
- 6 Confirm the *Hazen-Williams C Coefficient* is set at **150**.



7 Click *Select*.

Note: The *Hazen-Williams C* field automatically updates to 150 once PVC has been assigned as the *Material*.

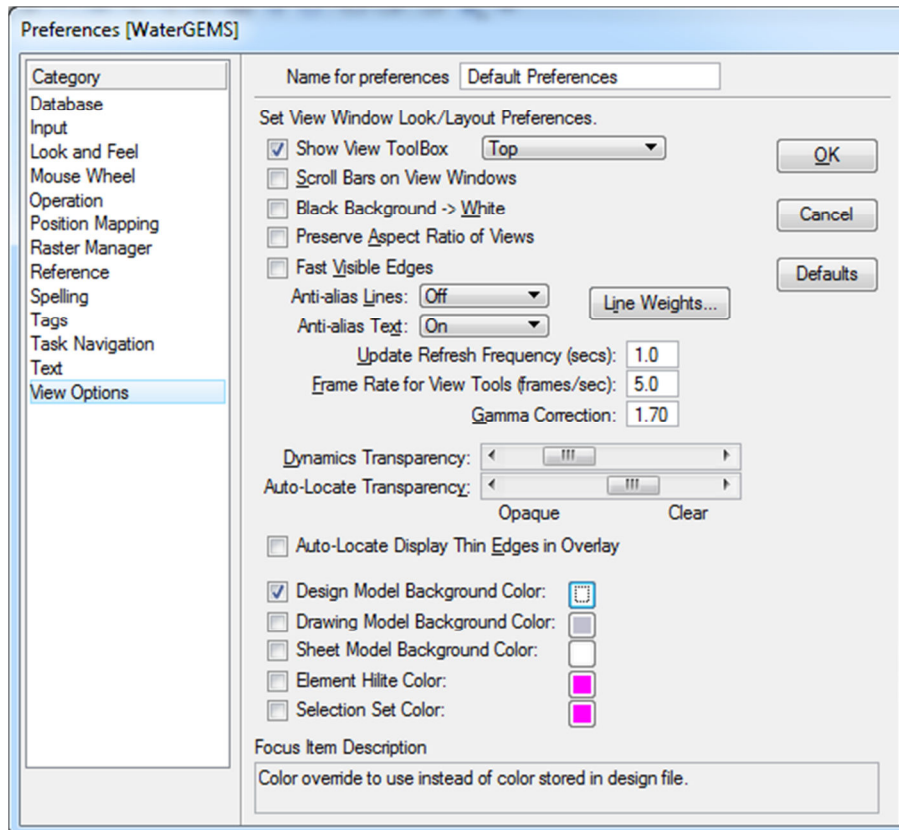
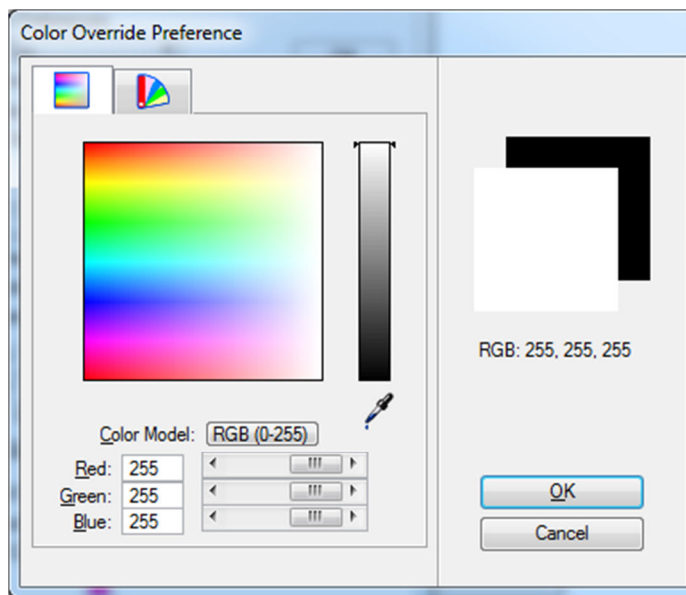


8 Close the Prototypes manager.


→ Exercise: Importing a CAD file to use in network layout

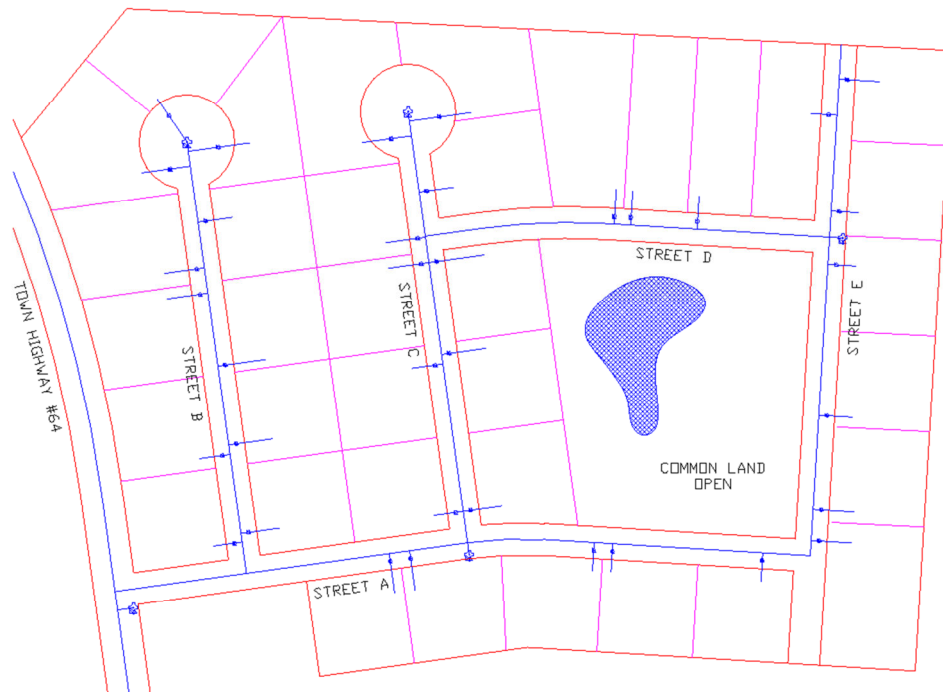
Before we begin, we want to change the background color to white.

- 1 Select **Workspace > Preferences**.
- 2 Select **View Options** and check the box for *Design Model Background Color*.
- 3 Click the color swatch and change the color from black to **white** and click OK.



- 4 Click OK again to exit the Preferences dialog.
- 5 Select **Settings > Design File** and select **Working Units**.
- 6 Change *Master Unit* to **Feet** and click OK.
- 7 Select **File > Import > CAD Files**.
- 8 Browse to C:\Bentley Workshop\WaterCAD-GEMS_MSintegration.
- 9 Select **Scaled_Network.dxf** and click Open.

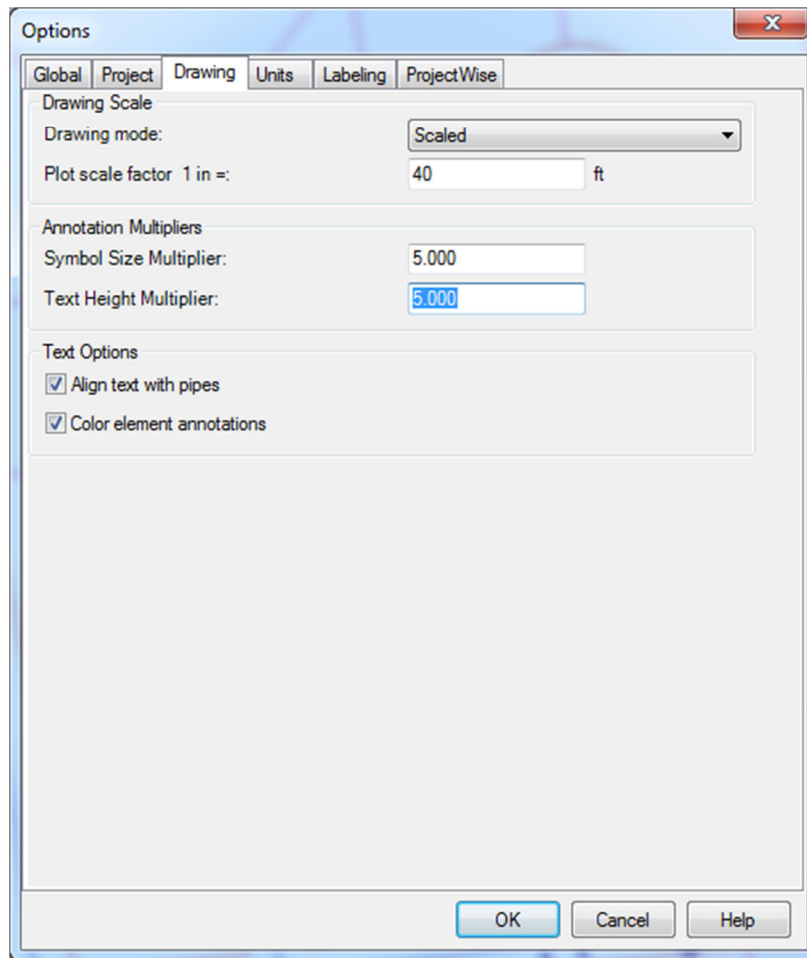
- 10  Click the *Fit View* button at the top of View 1 to view the map.




- 11 Select **File > Save**.

➔ **Exercise: Laying out the network**

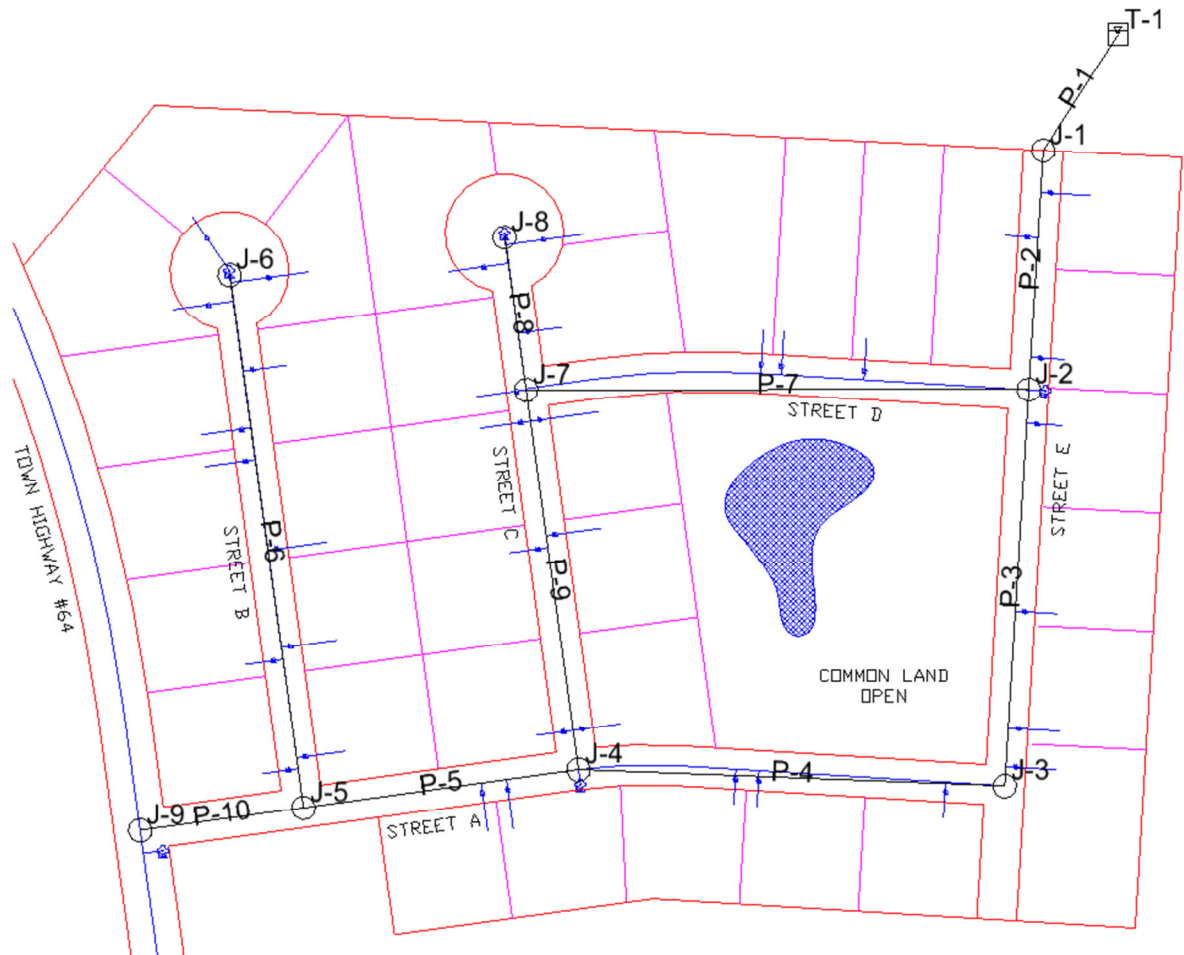
- 1 Select **WaterGEMS > Tools > Options** and click on the **Drawing** tab.
- 2 Change the following:
Symbol Size Multiplier: **5**
Text Height Multiplier: **5**




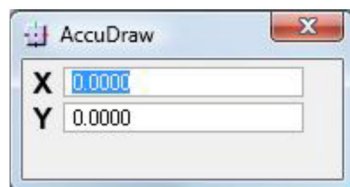
 **Note:** In the Element Symbology (**WaterGEMS > View > Element Symbology**) dialog click the *Drawing Style* button to choose between CAD or GIS style. If you want the CAD style change the multipliers as mentioned above; if you want the GIS style leave the multipliers set to 1.0.

- 3 Click OK and click Yes on the *Synchronization* message that comes up.

Follow the next set of instructions to layout the network as shown in the following picture:




- 4  Before you begin, make sure that AccuDraw is toggled on and you see the following dialog appear on your screen.

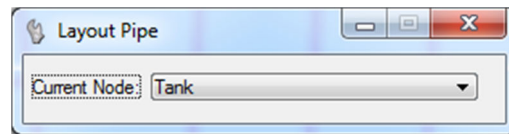


Note: You may see the AccuDraw dialog at the bottom of your screen:



- 5 Click the *Pipe Layout* tool  from the Layout (WaterGEMS) task group and move your cursor over to the drawing pane.

This will bring up the WaterGEMS Layout Pipe dialog. In this dialog you will choose the type of node you want to lay out at the beginning of the pipe.

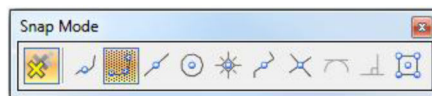


We will start by placing T-1, since P-1 is coming out of the tank.

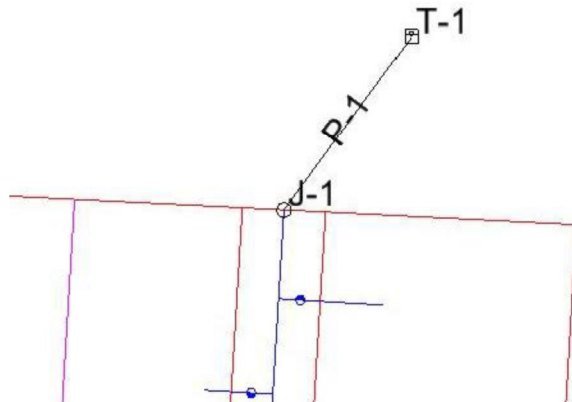
- 6 Select **Tank** from the *Current Node* menu item.
- 7 Zoom into the top right corner of the drawing.
- 8 Left click once on the drawing to place the tank in the desired position.

Hint: See the network drawing below for the tank location.

- 9 Select **Settings > Snaps > Button Bar** to show the Snap Mode toolbar.
- 10 Ensure the AccuSnap is toggled on, and the Snap Mode is set to **Keypoint Snap**.

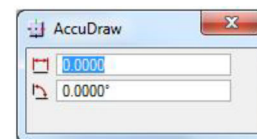


- 11 Select **Junction** from the Current Node dialog and left click once to place J-1 in its correct location and notice how P-1 has automatically been placed for you.



Note: If you have AccuSnap on, you can lay J-1 out right at the end of the blue water main.

- 12 To lay out P-2, move your mouse south to activate the AccuDraw dialog, then



press the Spacebar to switch to polar co-ordinates.

- 13 The distance field should be highlighted in black. Type **302.95** in this field and click the Enter key to lock the length.

Note: That will make the length of P-2 specifically 302.95 ft. If you move your mouse from left to right you will see that the length is fixed.

Advanced: You can also use Civil AccuDraw (Tools > Civil AccuDraw. Active toolbar) to help with layout. Civil AccuDraw gives you advanced functionality such as the

ability to specify a point by entering the Station and Offset from an existing alignment. If you have time, feel free to experiment with Civil AccuDraw.

14 Left click to place J-2 at the intersection shown in the network layout.

15 Continue laying out junctions J-3 through J-6 following the drawing until you reach J-6.

Note: You do not have to use AccuDraw for any of the other pipes. Steps 10 through 12 were just to show you how that feature works. The pipes will automatically pick up the pipe length when you lay them out, since this a scaled drawing.


16 After laying out J-6, right click to reset the active tool.

17 Click on J-2 and go across the diagram, click to layout J-7, then up to J-8, right click to reset.

18 Connect J-7 to J-4 and right click to reset.

19 Click on J-5 and move across and click to create J-9, right click to reset.

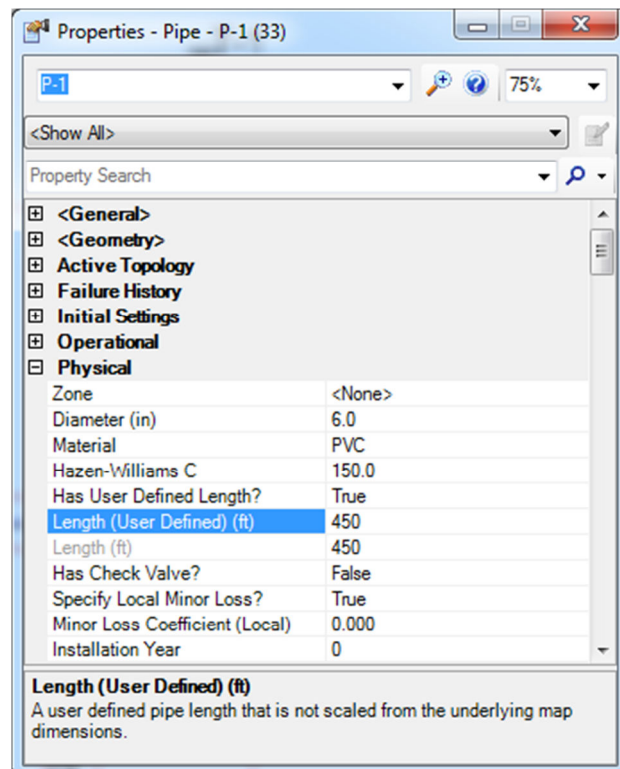
→ Exercise: Entering pipe data

1  Click the *Select* tool from the Layout task group, and click on P-1 to open the Properties manager.

2 Enter the following:

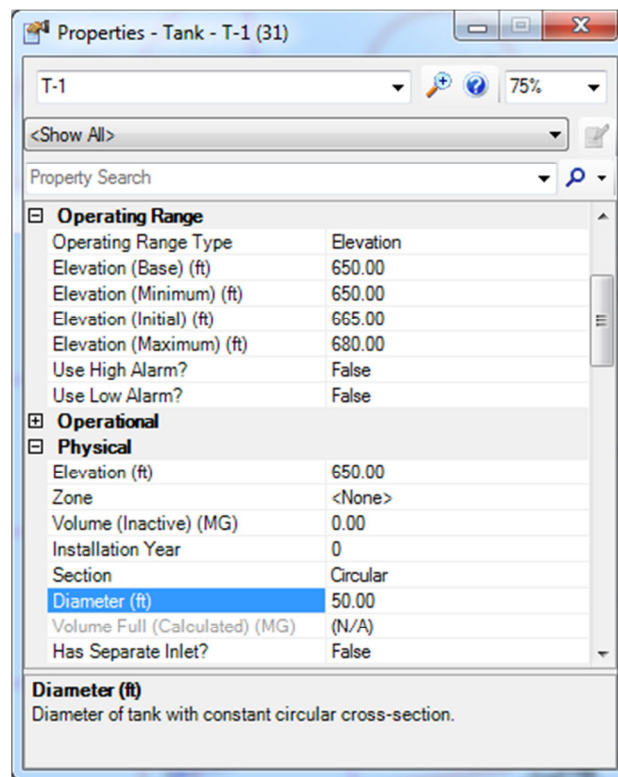
Has User Defined Length?: **True**

Length (User Defined) (ft): **450**




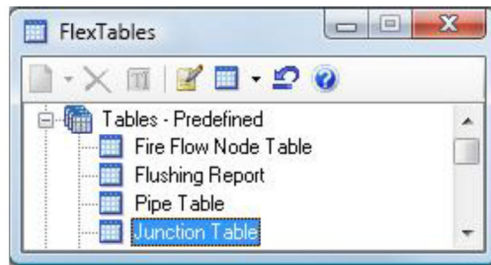
→ **Exercise: Entering tank data**

- 1 Click on T-1 in the drawing to change the open Properties manager to the tank properties.
- 2 Enter the following:
 - Elevation (Base) (ft): **650**
 - Elevation (Minimum) (ft): **650**
 - Elevation (Initial) (ft): **665**
 - Elevation (Maximum) (ft): **680**
 - Elevation (ft): 650
 - Diameter (ft): **50**



→ **Exercise: Entering junction data**

- 1  Select **WaterGEMS > View > FlexTables** or click the *FlexTables* button in the View task group.
- 2 Double click **Junction Table** under *Tables Predefined* to open the **Junction** FlexTable.



- Right click on the *Label* column and select **Sort > Sort Ascending**.

	ID	Label	Elevation (ft)	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
32: J-1	32	J-1	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
34: J-2	34	J-2	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
36: J-3	36	J-3	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
38: J-4	38	J-4	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
40: J-5	40	J-5	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
42: J-6	42	J-6	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
44: J-7	44	J-7	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
46: J-8	46	J-8	0.00	<Collecti...	(N/A)	(N/A)	(N/A)
49: J-9	49	J-9	0.00	<Collecti...	(N/A)	(N/A)	(N/A)

9 of 9 elements displayed SORTED

- Enter the elevations from the table below for each node:

Junction	Elevation (ft)
J-1	620
J-2	605
J-3	580
J-4	545
J-5	510
J-6	580
J-7	580
J-8	600
J-9	490

Your FlexTable should look similar to the following:

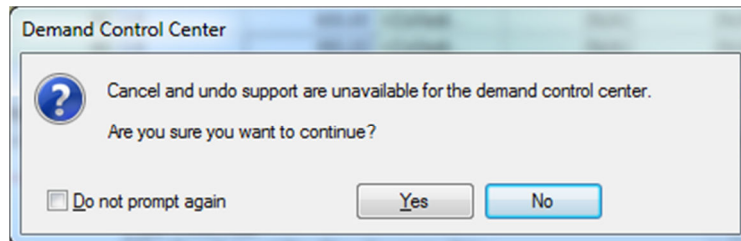
	ID	Label	Elevation (ft)	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
32: J-1	32	J-1	620.00	<Collected...	(N/A)	(N/A)	(N/A)
34: J-2	34	J-2	605.00	<Collected...	(N/A)	(N/A)	(N/A)
36: J-3	36	J-3	580.00	<Collected...	(N/A)	(N/A)	(N/A)
38: J-4	38	J-4	545.00	<Collected...	(N/A)	(N/A)	(N/A)
40: J-5	40	J-5	510.00	<Collected...	(N/A)	(N/A)	(N/A)
42: J-6	42	J-6	580.00	<Collected...	(N/A)	(N/A)	(N/A)
44: J-7	44	J-7	580.00	<Collected...	(N/A)	(N/A)	(N/A)
46: J-8	46	J-8	600.00	<Collected...	(N/A)	(N/A)	(N/A)
49: J-9	49	J-9	490.00	<Collected...	(N/A)	(N/A)	(N/A)

- 5 Close the FlexTable: Junction Table and the FlexTables manager.
- 6 Save your file.

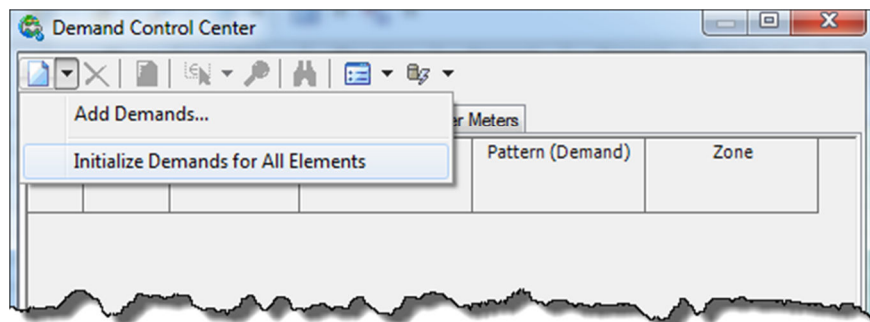
→ Exercise: Using the Demand Control Center

- 1 Select **WaterGEMS > Tools > Demand Control Center**.

The message below will come up on your screen:



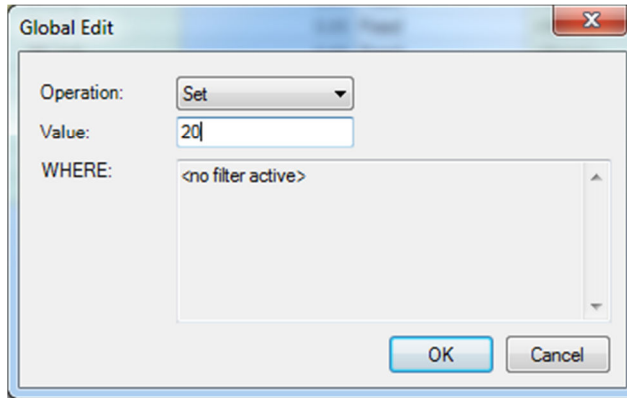
- 2 Click **Yes** to continue to the Demand Control Center.
- 3 Click the **New** button and select **Initialize Demands for All Elements**.



This will add all of the junctions in the model to the table so that flows and patterns can be entered for them.

- 4 Right click the *Demand (Base) (gpm)* column header and select **Global Edit**.

- 5 Enter **20** as the *Value* and then click OK.



- 6 This will set the demands for all the junctions to 20.


The Demand Control Center dialog box displays a table with the following data:

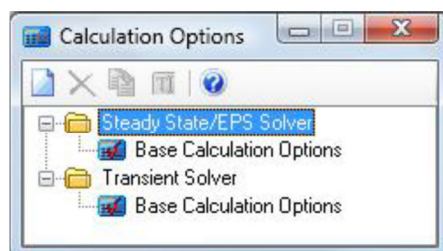
	ID	Label	Demand (Base) (gpm)	Pattern (Demand)	Zone
1	32	J-1	20.00	Fixed	<None>
2	34	J-2	20.00	Fixed	<None>
3	36	J-3	20.00	Fixed	<None>
4	38	J-4	20.00	Fixed	<None>
5	40	J-5	20.00	Fixed	<None>
6	42	J-6	20.00	Fixed	<None>
7	44	J-7	20.00	Fixed	<None>
8	46	J-8	20.00	Fixed	<None>
9	49	J-9	20.00	Fixed	<None>

Buttons: Close and Help

- 7 Click *Close* on the Demand Control Center dialog.

➔ Exercise: Reviewing Calculation Options

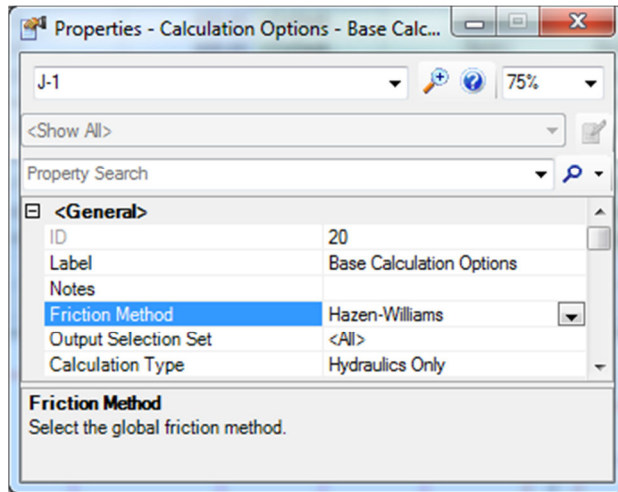
- 1  Select **WaterGEMS > Analysis > Calculation Options** or click the *Calculation Options* button in the Analysis task group.



- 2 Double click **Base Calculation Options** under *Steady State/EPS Solver* to open the Properties manager.

Note: You may dock the Properties dialog if it is more convenient.

- 3 Make sure the *Friction Method* is set to **Hazen-Williams**.



- 4 Close the Calculation Options manager by clicking the X.

→ Exercise: Computing the model and reviewing results

- 1  Select **WaterGEMS > Analysis > Validate** or click the *Validate* button in the Analysis task group.

The validate command verifies that there are no problems with the model.

- 2  Select **WaterGEMS > Analysis > Compute** or click the *Compute* button.

When the run has completed, the Calculation Summary dialog opens.

The screenshot shows a dialog box titled "Calculation Summary (1: Base)". It contains a table with the following data:

Time (hours)	Balanced?	Trials	Relative Flow Change	Flow Supplied (gpm)	Flow Demanded (gpm)	Flow Stored (gpm)
All Time Steps(1)	True	3	0.0000062	0	180	-180
0.00	True	3	0.0000062	0	180	-180

Below the table, there are tabs for "Information", "Status Messages", "Trials", "Intra-Trial Status Messages", and "Run Statistics". The "Information" tab is selected, showing a table with columns "Time Step", "Element ID", and "Message".

- 3 Review the Calculation Summary, and then close it.
- 4 Go to the FlexTables manager and open the **Junction Table** under *Tables-Predefined*.
- 5 Review the *Pressure* and *Hydraulic Grade* columns.

	ID	Label	Elevation (ft)	Demand Collection	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
32: J-1	32	J-1	620.00	<Collected...	20	663.93	19.0
34: J-2	34	J-2	605.00	<Collected...	20	663.35	25.2
36: J-3	36	J-3	580.00	<Collected...	20	663.15	36.0
38: J-4	38	J-4	545.00	<Collected...	20	663.04	51.1
40: J-5	40	J-5	510.00	<Collected...	20	662.93	66.2
42: J-6	42	J-6	580.00	<Collected...	20	662.90	35.9
44: J-7	44	J-7	580.00	<Collected...	20	663.08	35.9
46: J-8	46	J-8	600.00	<Collected...	20	663.07	27.3
49: J-9	49	J-9	490.00	<Collected...	20	662.92	74.8

Note: if you do not see the Hydraulic Grade or Pressure column, click the Edit button, select the field from the left side, then click the single arrow button to add it as a displayed field on the right side.


- 6 Keeping the Junction FlexTable open, go back to the FlexTables manager and open the **Pipe FlexTable** to review those results.
- 7 Complete the Results Table at the end of the workshop and answer the questions about Run 1.

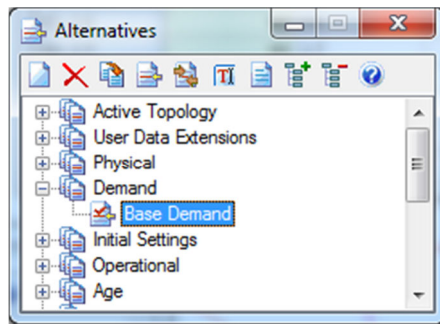
Warning: Make sure the units are consistent with those on the answer table. If they are not, modify the units on the reports. Right click the column heading and select **Units and Formatting**. Make the necessary changes. You also may decrease the *Display Precision* to round your values to whole numbers. Click OK to apply any changes you make.

Fire Flow Simulation and Pipe Resizing

In this section you will walk through the steps to simulate a fire flow at J-6 using the Demand Alternative.

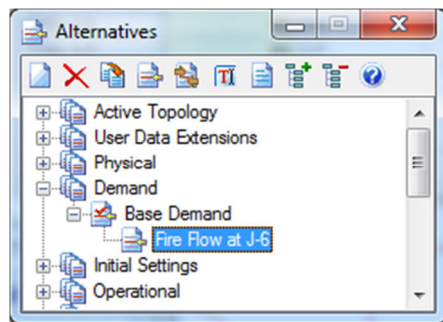
➔ **Exercise: Creating the fire flow demand alternative**

- 1  Select **WaterGEMS > Analysis > Alternatives** or click the *Alternatives* button in the Analysis task group.
- 2 Expand the *Demand* alternative.



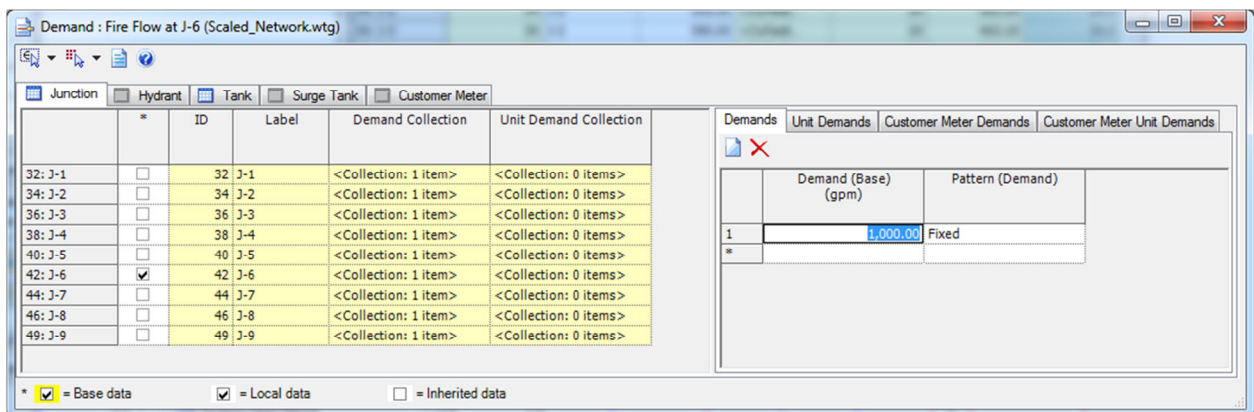
- Right click *Base Demand* and select **New > Child Alternative** from the context menu that comes up.

- Click the *Rename* button to rename the new child alternative **Fire Flow at J-6**



Hint: You can also rename the alternative by right clicking the alternative to be renamed and selecting **Rename** from the context menu.

- Double click the **Fire Flow at J-6** alternative to open it.
- On the Junction tab, click the row for junction J-6. With this row selected, change the *Demand (Base) (gpm)* on the right side to to **1000 gpm**.

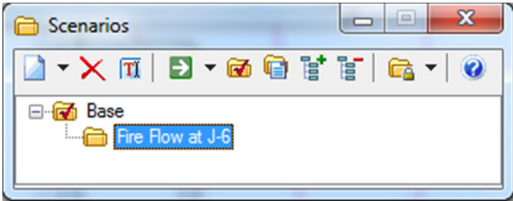


- Close the dialog when you are done.

➔ Exercise: Creating the fire flow scenario

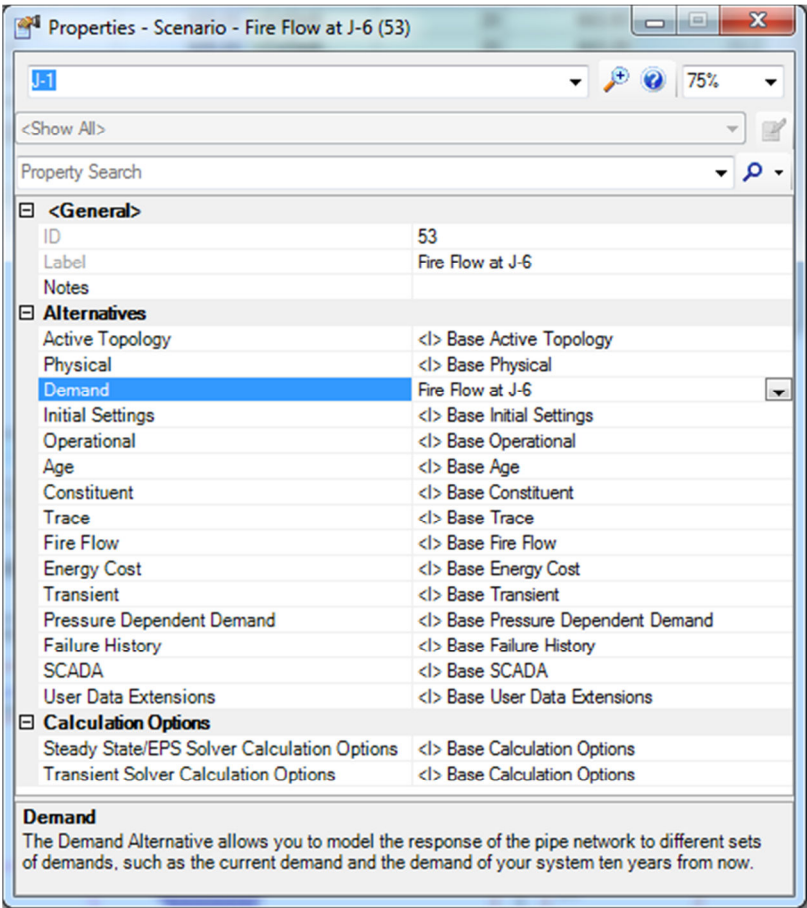
- Open the Scenarios manager (**WaterGEMS > Analysis > Scenarios**).
- Right click the Base scenario and select **New > Child Scenario**.


3 Enter the scenario name as **Fire Flow at J-6**.



4 Double click **Fire Flow at J-6** to open the Properties manager.

5 Select **Fire Flow at J-6** as the *Demand* alternative.



6  Back in the Scenarios manager, select **Fire Flow at J-6** and select the *Make Current* button.

Note: Note that the Fire Flow at J-6 scenario icon now has a red check mark on it. That indicates which scenario is the current scenario.

7  Click the *Compute* button in the Scenarios manager or on the main toolbar.

8 Review the results and complete the Results Table at the end of the workshop and answer the questions about Run 2.

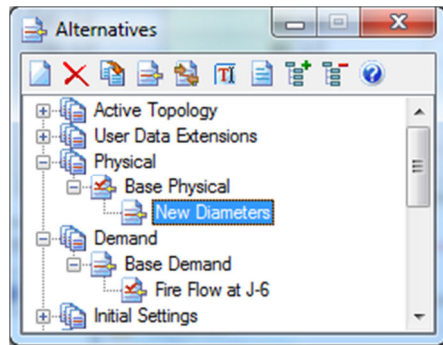
Note: A network of 6 inch pipes will not work well in this situation. The problem areas are most likely those pipes with the highest velocities and/or friction slopes. Review the

pipes with the highest velocities and hydraulic gradients in the pipe table. These pipes will need to be upsized.

In this scenario we are going to try to fix the problem areas from the previous fire flow run by upsizing the pipes with the highest velocities and friction slopes.

➔ **Exercise: Creating a new physical alternative**

- 1 Open the Alternatives manager (**WaterGEMS > Analysis > Alternatives**).
- 2 Expand **Physical** to view the Base Physical alternative.
- 3 Right click the *Base Physical* alternative and select **New > Child Alternative**.
- 4 Click the *Rename* button to rename the new child alternative **New Diameters**.



- 5 Double click **New Diameters** to edit it.
- 6 Change the diameters to the following:

Pipe	Diameter (in)
P-1	10
P-2	10
P-3	8
P-4	8
P-5	8
P-6	8

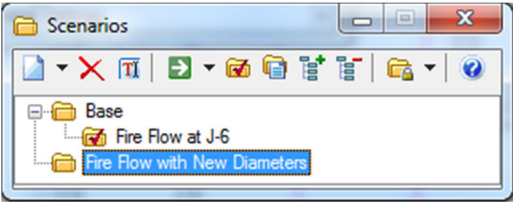
	*	ID	Label	Zone	Material	Diameter (in)
33: P-1	<input checked="" type="checkbox"/>	33	P-1	<None>	PVC	10.0
35: P-2	<input checked="" type="checkbox"/>	35	P-2	<None>	PVC	10.0
37: P-3	<input checked="" type="checkbox"/>	37	P-3	<None>	PVC	8.0
39: P-4	<input checked="" type="checkbox"/>	39	P-4	<None>	PVC	8.0
41: P-5	<input checked="" type="checkbox"/>	41	P-5	<None>	PVC	8.0
43: P-6	<input checked="" type="checkbox"/>	43	P-6	<None>	PVC	3.0
45: P-7	<input type="checkbox"/>	45	P-7	<None>	PVC	6.0
47: P-8	<input type="checkbox"/>	47	P-8	<None>	PVC	6.0
48: P-9	<input type="checkbox"/>	48	P-9	<None>	PVC	6.0
50: P-10	<input type="checkbox"/>	50	P-10	<None>	PVC	6.0

* = Base data = Local data = Inherited data

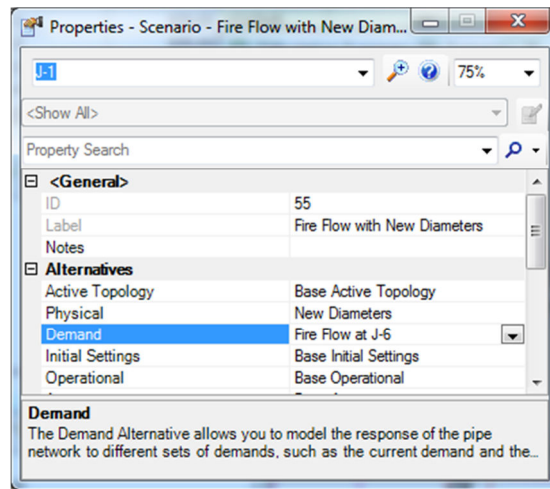
7 Close the “Physical: New Diameters (Scaled_Network)” dialog when you are done.

➔ **Exercise: Creating the new fire flow scenario for new diameters**

- 1 Open the Scenarios manager (**WaterGEMS > Analysis > Scenarios**).
- 2 Select **Base**, click the *New* button, and select **Base Scenario**.
- 3 Enter the scenario name as **Fire Flow with New Diameters**.



- 4 Double click **Fire Flow with New Diameters** to open the Properties manager.
- 5 Select **New Diameters** as the *Physical* alternative and **Fire Flow at J-6** as the *Demand* alternative.



- 6 Close the Properties manager.
- 7 Select **Fire Flow with New Diameters** and click the *Make Current* button or right click it and select **Make Current**.
- 8 Click the *Compute* button.
- 9 Close the Calculation Summary and review the results.
- 10 Complete the table at the end of the workshop and answer the first remaining questions about Run 3.

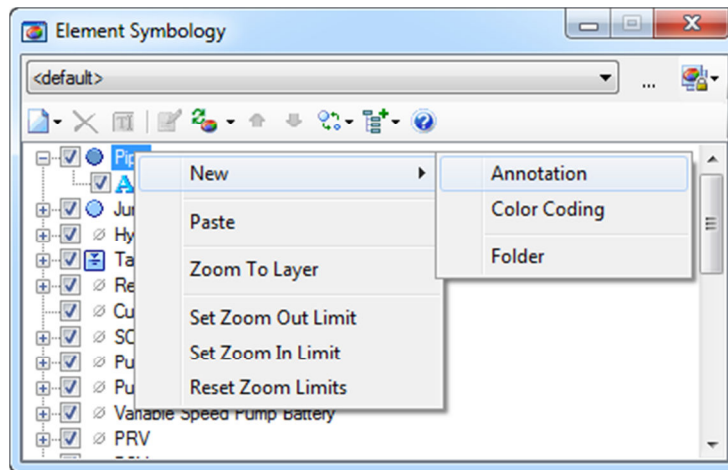
Results and Output

In this section you will learn how to annotate and color code your network elements with system results, set up Symbology Definitions, use View Associations, set up a sheet model and use the print preparation tool for printing your design.

➔ Exercise: Setting up Annotation

You will annotate the pipes by velocity and the junctions by pressure to make it easy for you to view the results and graphically see how the results change for each scenario.

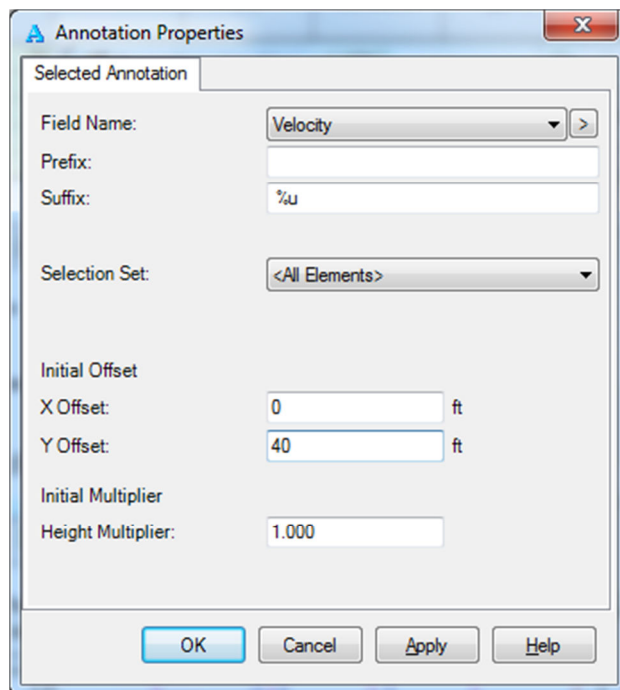
- 1 Go to the Element Symbology manager by selecting **WaterGEMS > View > Element Symbology**.
- 2 Right click on **Pipe**, and select **New > Annotation** to open the Annotation Properties dialog.



- 3 On the Annotations Properties manager enter the following:

Field Name: **Velocity**

Initial Y Offset: **40**



- 4 Click OK.

In the plan view, you can now see the placement of *Velocity* for each pipe.

- 5 Follow the same procedure to annotate the *Pipes* by **Diameter** (Initial Y Offset **80**) and the *Junctions* by **Pressure** (Initial Y Offset **-20**). You may vary the X and Y Offsets so the plan view has the look you prefer.

Note: You can also drag the annotations around on the drawing so that they are not blocking any other annotation.

- 6 When you have annotated the Pipes and Junctions, change the current scenario, using the Scenarios manager, to view how the annotations update as the scenarios are changed.

➔ **Exercise: Setting up color coding for pipes and junctions**


Another way to view element results is with color coding. In this section we will set up color coding for pipes by diameter and junctions by pressure.

- 1 In the Element Symbology manager, right click Pipe and select **New Color Coding**.

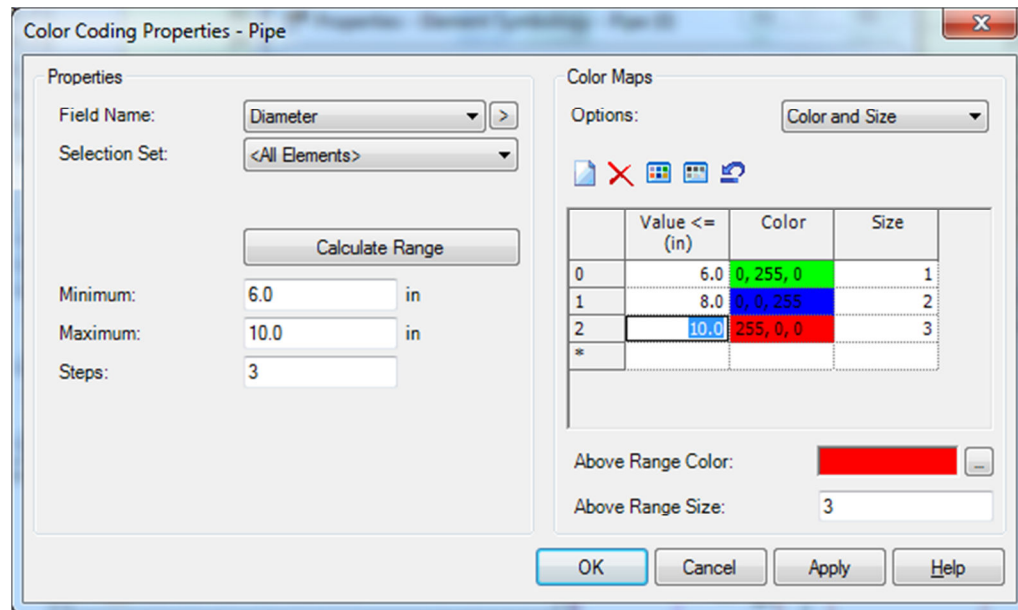
This will bring up the Color Coding Properties - Pipe dialog.

- 2 Select **Diameter** for *Field Name*.
- 3 Click the *Calculate Range* button and select **Full Range**.

If the Fire Flow with New Diameter Scenario is current, you will see that this populates the Minimum and Maximum fields with 6 in and 10 in pipes. If you see 6 in for the Maximum, change it to 10.

- 4 Change *Steps* to **3** since we only have 3 different diameters used in the model, 6, 8, and 10.
- 5 Set *Options* to **Color and Size**.
- 6  Click the *Initialize* button.
- 7 Set the *Value*, *Color*, and *Size* to the following:

Value <= (in)	Color	Size
6	Green	1
8	Blue	2
10	Red	3

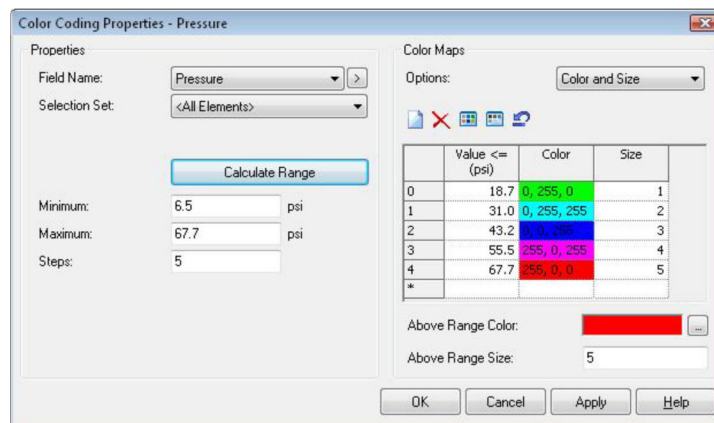


8 Click Apply and OK.

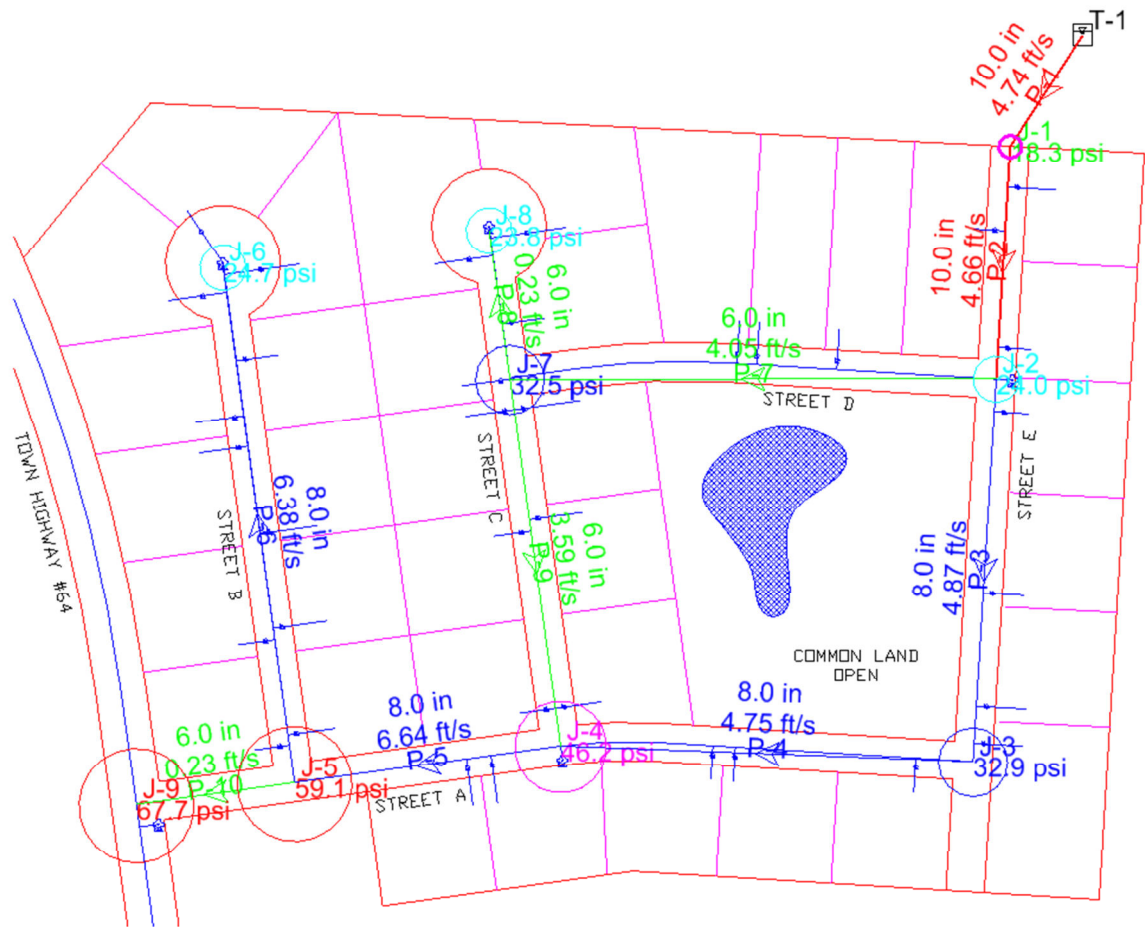
You will see that the pipes and their associated annotations are now color coded according to their diameter.

9 Set up the Junction color coding for **Pressure** using **Color and Size**.

10 The default values that you get for the Minimum, Maximum, Steps, Value, Color, and Size are fine so leave them as they come up.



11 Click Apply and OK. Your network drawing should look similar to the following:

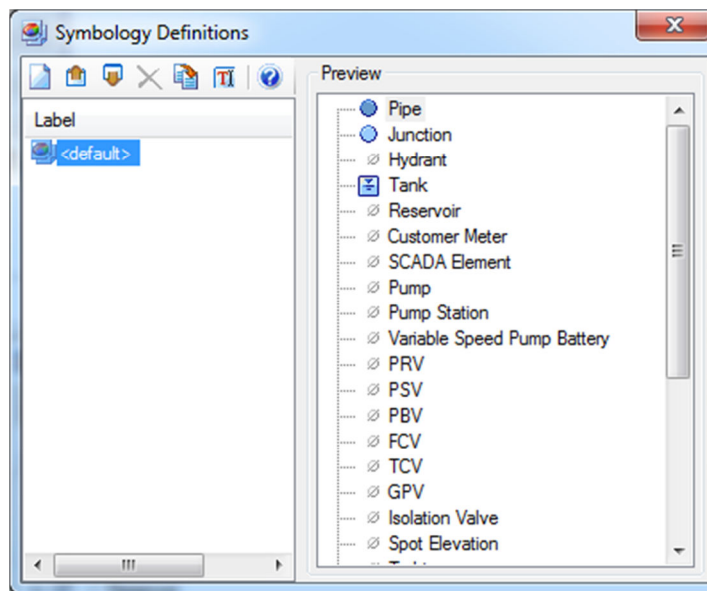


12 Save your file.

➔ Exercise: Setting up Symbology Definitions

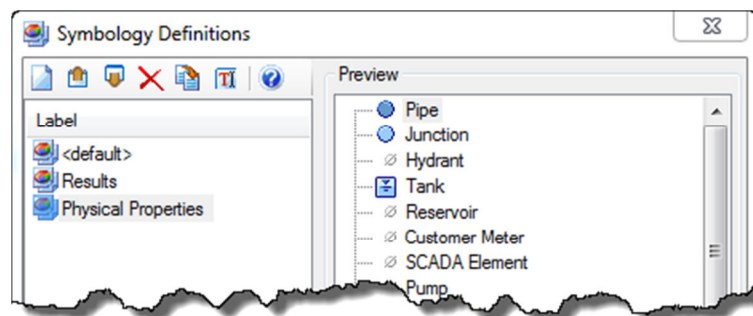
In this section, you will set up the Symbology Definitions for pipes and junctions that you will use to set up the View Associations in the next exercise.

- 1 Go to the Element Symbology manager by selecting **WaterGEMS > View > Element Symbology** if it is not already open.
- 2 Click the *ellipsis* button next to the drop down menu at the top of the dialog. This opens the Symbology Definitions dialog.

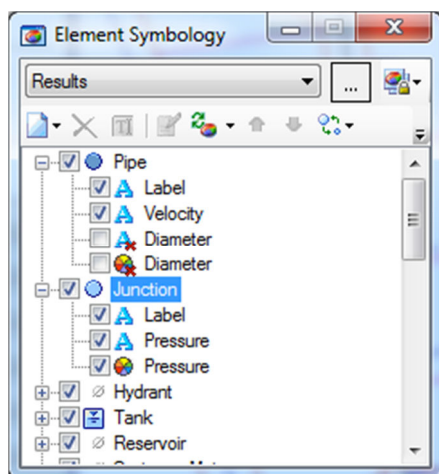


This is where we will create and name our symbology groups. We want to have two groups. One group will be for the annotations and color coding to show our results. The other group will be for the annotations and color coding to show the physical properties of the pipes.

- 3 Click the *New* button to create a new definition.
- 4 Click the new symbology definition, click the *Rename* button and name the new definition **Results**.
- 5 Repeat steps 3 and 4, but name the second definition **Physical Properties**.



- 6 Close out of the dialog when you are done to return to the Element Symbology manager.
- 7 Using the drop down menu at the top of the Element Symbology manager, select **Results**.
- 8 Expand Pipe and Junction symbology sections.
- 9 Select **Label** and **Velocity** for *Pipe*, and select **Label**, **Pressure** annotation, and **Pressure** color coding for *Junctions*.




10 Select **Physical Properties** from the drop down menu.

11 Expand Pipe and select **Label**, **Diameter** annotation, and **Diameter** color coding.

➔ Exercise: Setting up View Associations

Now that we have the annotations, color coding, and symbology definitions set up we can set up the view associations.

View associations allow you to define the Element Symbology Definition and the Scenario that is displayed for each MicroStation view.

 There is a *View Associations Scenario Mode* button in the Scenarios Manager and the Element Symbology Manager. This button allows you to toggle between Independent and Synchronized view modes.

When **Independent** is selected, you can change the active scenario (or element symbology) for the current view without changing the active scenario (or element symbology) displayed in the other views.

When **Synchronized** is selected, changing the active scenario (or element symbology) in the current view will also change the active scenario (or element symbology) in all of the other views.


Multi-view Synchronized Mode:

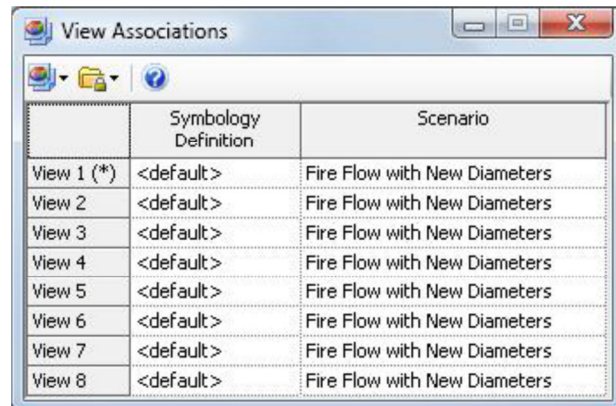
- When the user is in multi-view synchronized mode, a change of the active scenario and/or symbology definition will cause all view windows to update to have that scenario and/or symbology definition to be used.

Multi-view Independent Mode:



- A user can only have one view window active (in focus) at any given time. When the user changes a symbology definition, that newly active symbology definition will now be used whenever that view window is active (or until the user changes the active symbology definition again).

- Likewise, when the user changes the current scenario, that newly active scenario will now be used whenever that view window is active (or until the user changes the current scenario again).

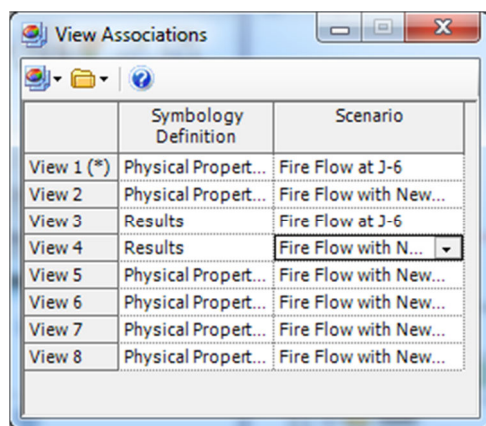
- 1  Select **WaterGEMS > View > View Associations** or click the *View Associations* button in the View task group.



We are going to use 4 different views in this workshop to review the network.

- 2  Click the *Scenario Mode* button and select **Independent Mode**.
- 3  Click the *Symbology Definition Mode* button and select **Independent Mode**.
- 4 Set the View Associations dialog up as follows using the drop down menus:

View	Symbology Definition	Scenario
View 1	Physical Properties	Fire Flow at J-6
View 2	Physical Properties	Fire Flow with New Diameters
View 3	Results	Fire Flow at J-6
View 4	Results	Fire Flow with New Diameters





5 Close the View Associations dialog when you are done.

→ Exercise: Setting up different views

Having WaterGEMS V8i integrated with MicroStation V8i allows you to take advantage of the MicroStations 8 available views. You can set up each view to show a different part of your water system, so that you do not have to keep zooming and/or panning to get to a certain part of the system. You can also use of the View Associations tool and set up different symbology displays for each view.

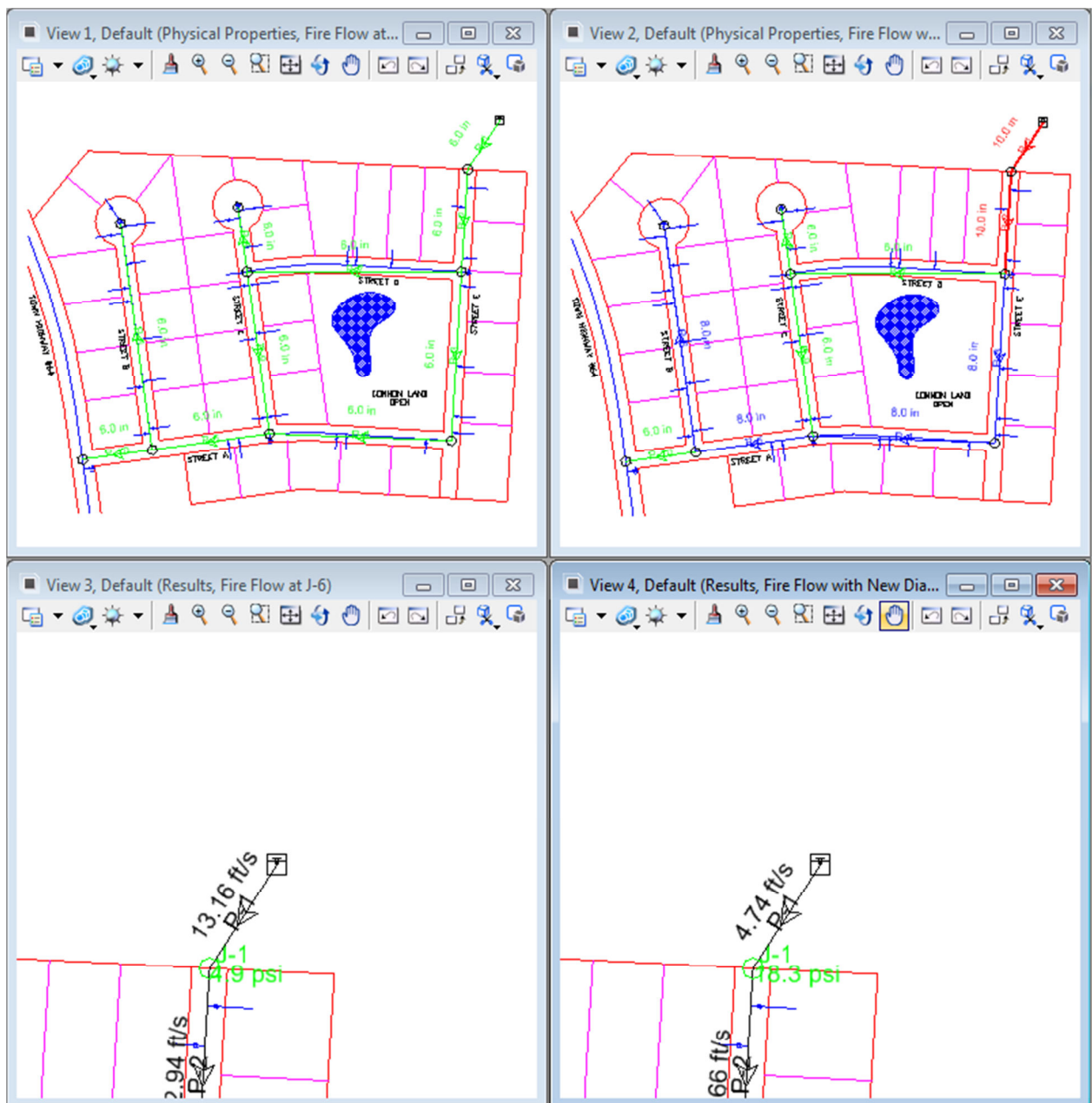


- 1 Turn on views 1 through 4 by selecting them in the status bar.
- 2 Select **Window > Tile** to arrange all four views equally in the MicroStation interface.
- 3  Click in View 1 and select **Fit View**.
- 4 Click in View 2 and do the same, then issue a reset (right click in the drawing pane).
- 5 Click in View 3 and in the Properties manager type **T-1** in the search field, set the

zoom level to 100%,  and then click the Find button to zoom in on the tank.



- 6 Repeat step 5 for View 4. Your view should look like the following:



Note: Note that in each view you are viewing different scenarios, color coding, annotations, results, and physical properties of one model. The title of each view shows the Symbology Definition being used along with which scenario is being shown.

In this example you can clearly see the change in velocity in pipe P-1 as a result of using larger diameters in the Fire Flow with New Diameters scenario.

This brings us to the end of the workshop. The majority of the features shown in this workshop are only available when using the MicroStation platform in conjunction with one of the hydraulics and hydrology applications. Users can enjoy significant productivity benefits by utilizing both applications together.

Assessment

Now that you have completed this workshop, let's measure what you have learned.

Use the results sections in this workshop to complete the table:

	Base	Fire Flow	Fire Flow New Diameters
Pressure at J-1 (psi)			
Pressure at J-6 (psi)			
Pressure at J-9 (psi)			
HGL at J-5 (ft)			
Velocity in P-1 (ft/s)			
Velocity in P-6 (ft/s)			
Flow in P-3 (gpm)			
Flow in P-7 (gpm)			
Pipe with highest Headloss Gradient			
Headloss Gradient in that pipe (ft/1000ft)			

Questions

- 1 Why is the pressure so high at J-9 even though it is far from the source?
- 2 Why must you rely so heavily on pipes greater than 6 inch in this fairly small subdivision?

Answer Key

	Base	Fire Flow	Fire Flow New Diameters
Pressure at J-1 (psi)	19	4.9	18
Pressure at J-6 (psi)	36	-22	25
Pressure at J-9 (psi)	75	34	68
HGL at J-5 (ft)	663	568	646
Velocity in P-1 (ft/s)	2	13	5
Velocity in P-6 (ft/s)	0.2	11	6
Flow in P-3 (gpm)	69	568	764
Flow in P-7 (gpm)	71	552	356
Pipe with highest Headloss Gradient	P-1	P-1	P-5
Headloss Gradient in that pipe (ft/1000ft)	2.4	75	15

* Some answers may vary between users due to the nature of this scaled model

- 1 Why is the pressure so high at J-9 even though it is far from the source?

It is located at the lowest elevation in the system.

- 2 Why must you rely so heavily on pipes greater than 6 inch in this fairly small subdivision?

Streets are not laid out with water distribution in mind. More loops would result in smaller pipes/greater reliability.

- 3 What would really happen if you used the system from run 2 and had a fire at J-6 that needed 1000 gpm?

You would not be able to get 1000 gpm. You would have lower flow with higher pressures.

- 4 How does the split in flow between pipes P-3 and P-7 change as you change pipe diameters? Why?

Initially they are the same but there is more flow through P-3 as it is increased.

- 5 If another source of water were available along the highway at J-9, how might that source affect the design?

You might need to make P-10 larger so it would not be a bottleneck for the future source.

6 What else could you do to help the pressures during normal demand periods?

If possible:

- **Put the tank at a higher elevation (higher static head)**
- **Operate the tank with more water in the tank (higher static head).**
- **Increase the system looping**
- **Add a fire pump to maintain adequate flow/pressure**