FlowMaster

Bentley FlowMaster is an easy-to-use, Windows-based program that aids civil engineers with the design and analysis of pipes, ditches, open channels, weirs, and more.

Bentley FlowMaster computes flows, water velocities, depths and pressures based on several well-known formulas: Darcy-Weisbach, Manning's, Kutter's, and Hazen-Williams. It also utilizes the HEC-22 methodology to perform pavement drainage and inlet flow calculations.

Bentley FlowMaster lets you solve for a variable you select, computing the solution from the parameters you provide. The program will also calculate rating tables, and will plot curves and cross sections. These graphs and reports can then be viewed on the screen, copied to the Windows clipboard, saved to a file, or printed on any standard printer.

These tutorials provide step-by-step instructions for creating a project, entering data in a worksheet, and generating reports.

The purpose of this section is to provide step-by-step tutorials to get you familiar with some of the features and capabilities of Bentley FlowMaster. The tutorials serve as a means to get you started exploring and using the software.

Note: You should follow these tutorials in sequence.

If you need help within the program, press **F1** to access the context-sensitive online help.

Tutorial 1—Creating a New Project

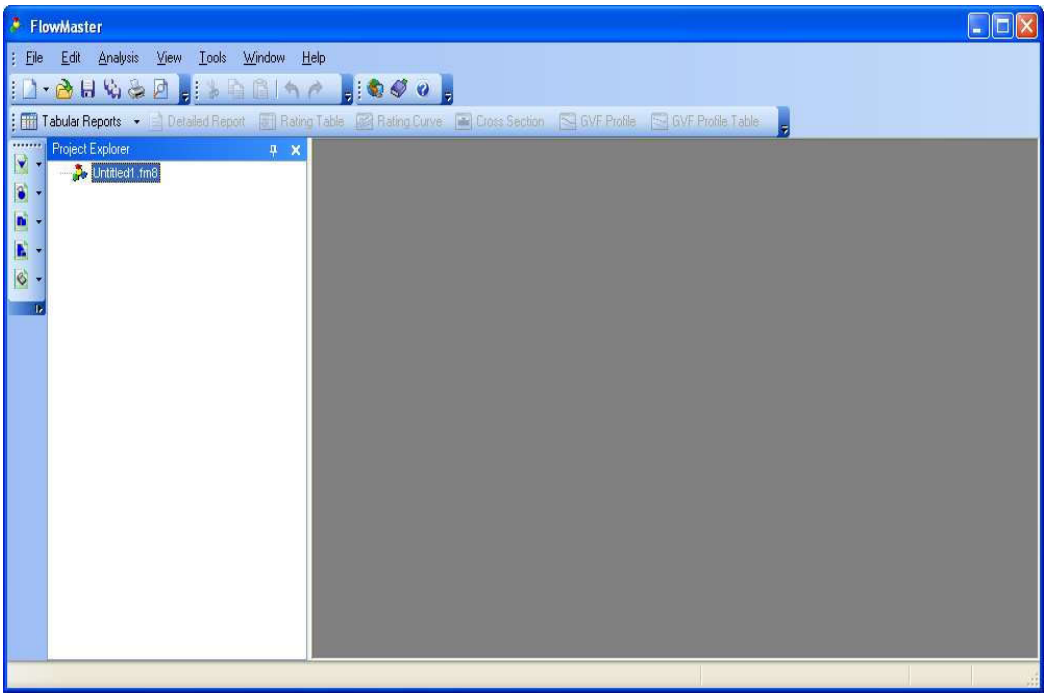
Data is entered and calculated in a worksheet. There are different worksheets for various structure types, because of the differing input and output data that is required for each.

Worksheets are contained within an Bentley FlowMaster project. A project holds global information such as Project Engineer, Project Date, Project Location (the location where the project files are stored on your computer), and any Notes that go along with the project.

The project is also associated with a unit system (FlexUnits). The unit system defines the units and display precision used in the project. Upon project creation, the default unit system is used, but this can be modified and saved for use on future projects.

1. Start Bentley FlowMaster by double-clicking the shortcut on your desktop or by clicking the Bentley FlowMaster command from the Start menu.
2. When Bentley FlowMaster opens, the welcome dialog box appears. Click the **Create New Project** button.

3. The main window opens, with the new project loaded.



4. Click **File** > **Save As**. The **Save As** dialog box opens.
5. Choose the directory to which the file will be saved and type **MyTutorial1** as the name for the project file.

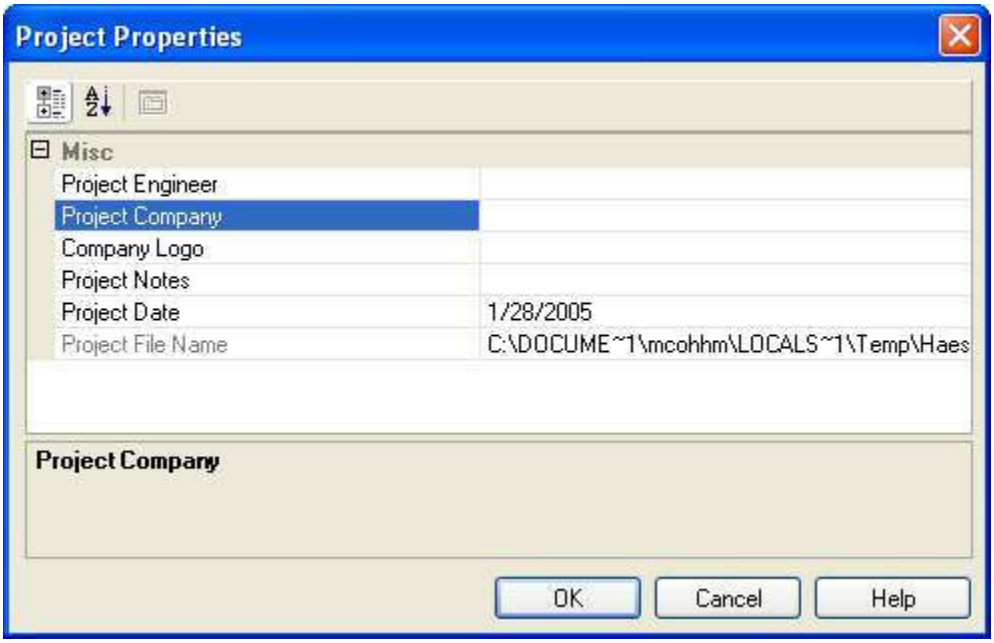
Note: We recommend you name the tutorial files you are using differently than any

other files in your program directory, so you don't overwrite pre-existing files.

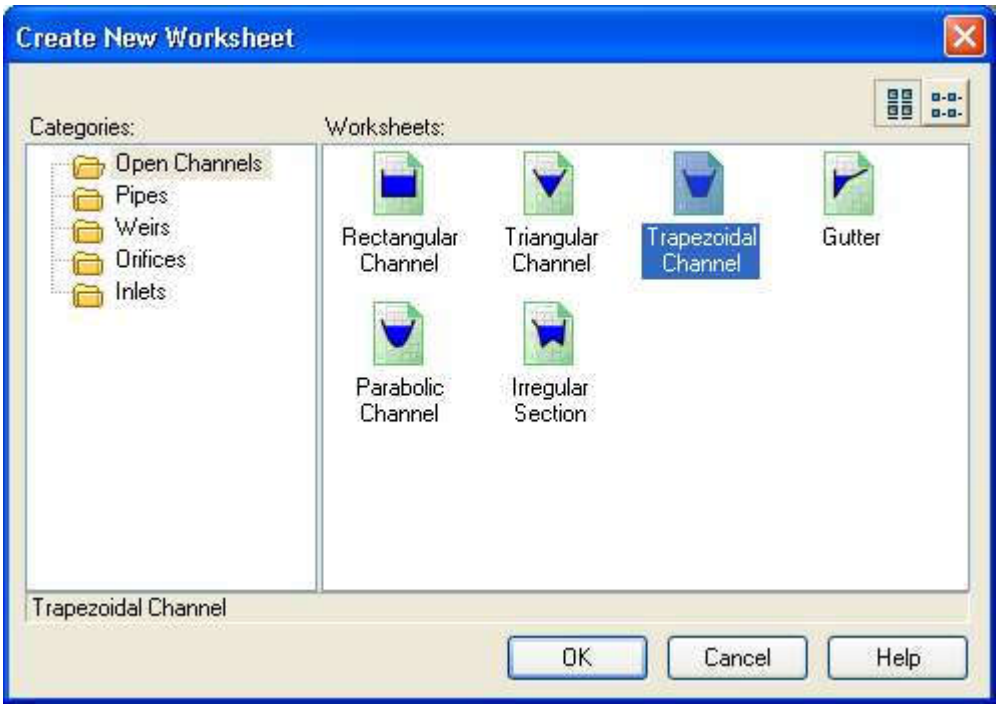
6. Now, enter some global project information. Click **File** > **Properties**.
7. In the **Project Properties** dialog box, note the types of information.

   The Project Date field should already contain today's date (this information is retrieved from the Windows system calendar and clock—click the down-arrow button to select a different date by using a calendar). Project File Name contains the path to the directory where the project is saved.

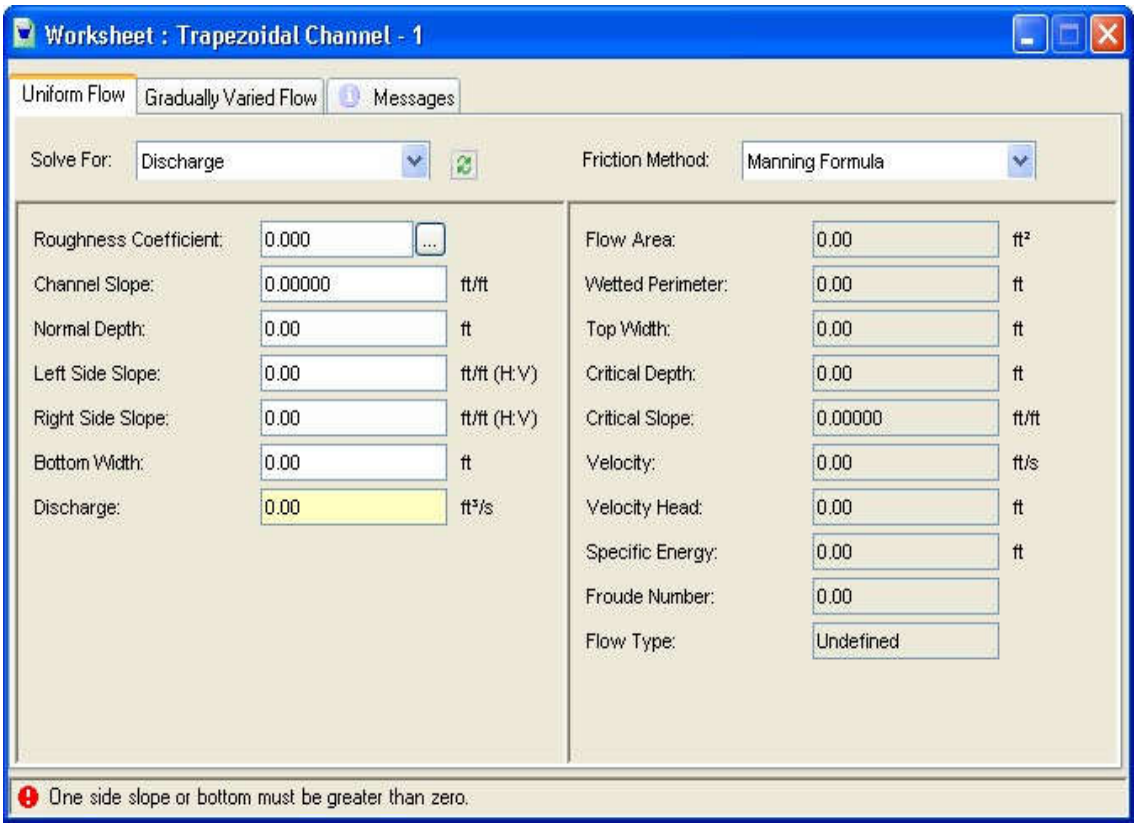
8. Enter the following information in the Project Properties dialog box:
   - Enter your name in the **Project Engineer** field.
   - Enter **Tutorial Project** in the **Project Notes** field.
   - If you want your company name to appear on the bottom of all reports associated with the project, enter the company name in the **Project Company** field.
   - If you want your company's logo to appear on the bottom of all reports associated with the project, click in the Company Logo field, then click the **Ellipses** button and select your company's logo image file.
   - Click **OK**.



9. Click **File** > **New** > **Worksheet**.
10. In the Create New Worksheet dialog box, ensure that **Open Channels** is highlighted in the Categories pane, then click **Trapezoidal Channel**.



11. Click **OK**.
12. In the Trapezoidal Channel Worksheet dialog box, select **Discharge** in the Solve For drop-down list.
13. Select **Manning Formula** in the Friction Method drop-down list.



14. In the **Roughness Coefficient** field, click the **Ellipsis** (...) button to open the Materials library.
    a. Expand the tree containing all of the available material libraries.
    b. Expand the **HMI Material Library** item to see the available materials within the library.
    c. Click **Flood plain, cultivated** to highlight it.

       Note that the lower section of the Materials dialog box is updated with the data that is associated with this material.

    d. Click **OK**; the Materials dialog box closes and a roughness coefficient of **0.035** displays in the Roughness Coefficient field.

    Click each of the other input fields in turn and enter the data contained in the following table into the appropriate input fields:

Table 2-1: Input Data for Trapezoidal Worksheet (Tutorial 1)

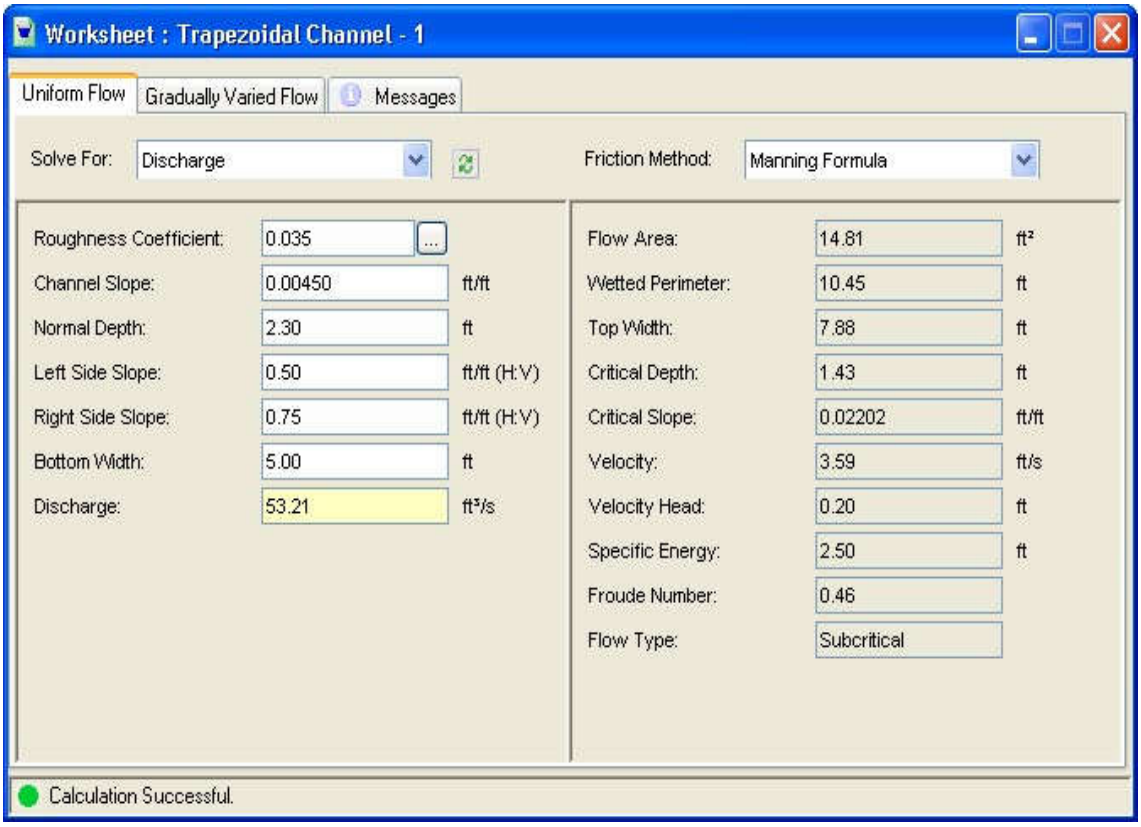
Attribute:	Value:
Channel Slope	0.004500 ft/ft
Normal Depth	2.30 ft
Left Side Slope	0.50 H:V
Right Side Slope	0.75 H:V

Bottom Width	5.00 ft

The calculated discharge should be 53.21 ft^3/sec.

Note: After you enter the last data into a field (Bottom Width, for example), you have to click in another field or click the Solve button to get the Discharge to refresh and update.

Save the project by clicking **File** > **Save As**.
Enter **MyTutorial2** in the File name field, then click **Save**.
If needed, close any open dialog boxes.

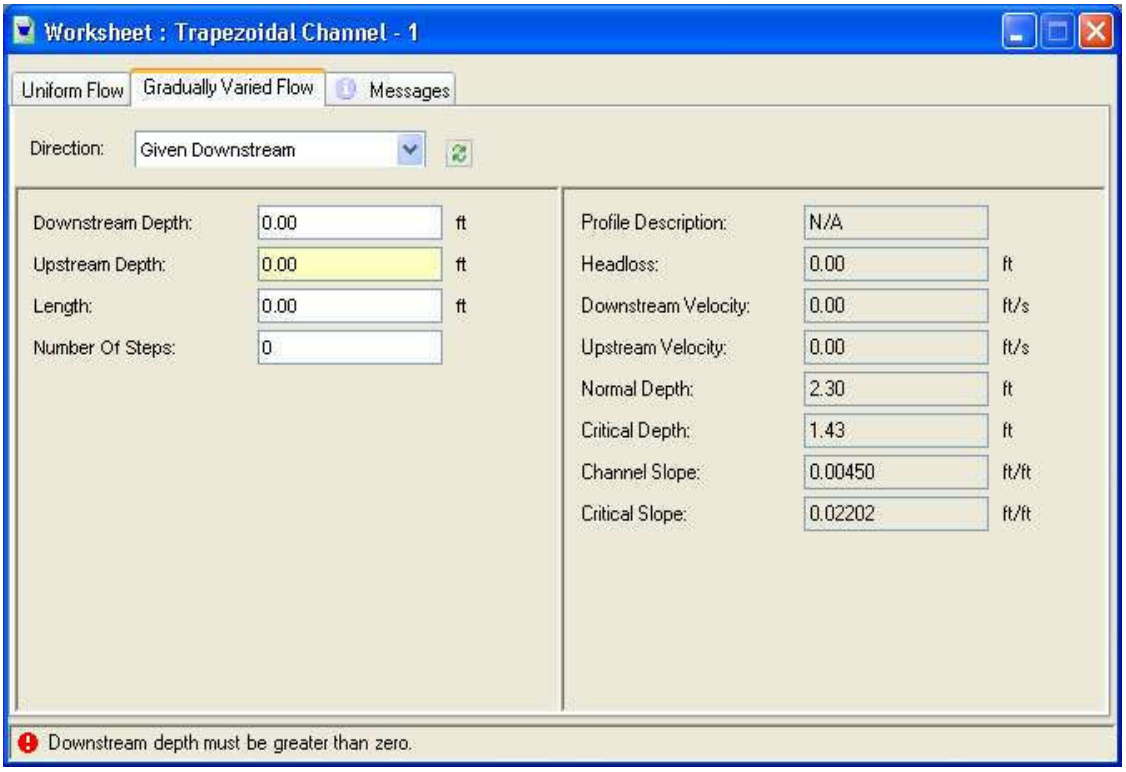


Class 2—Gradually Varied Flow Analysis

For free-surface flow, depth rarely remains the same throughout the length of a channel or pipe. Gradually varied flow analysis lets you calculate the downstream depth from the length of the channel and the upstream depth, or to calculate the upstream depth from the length of the channel and the downstream depth.

This tutorial is based on the project that was created in Tutorial 1—Creating a New Project.

1. If necessary, open the **MyTutorial2** project file that you saved at the end of Tutorial1, and, in the Project Explorer, double-click the **Trapezoidal Channel** item to open the worksheet containing the channel you defined in Tutorial 1.
2. In the Trapezoidal Channel Worksheet dialog box, click the **Gradually Varied Flow** tab.



   a. If needed, click the **Direction** drop-down list and select **Given Downstream**.

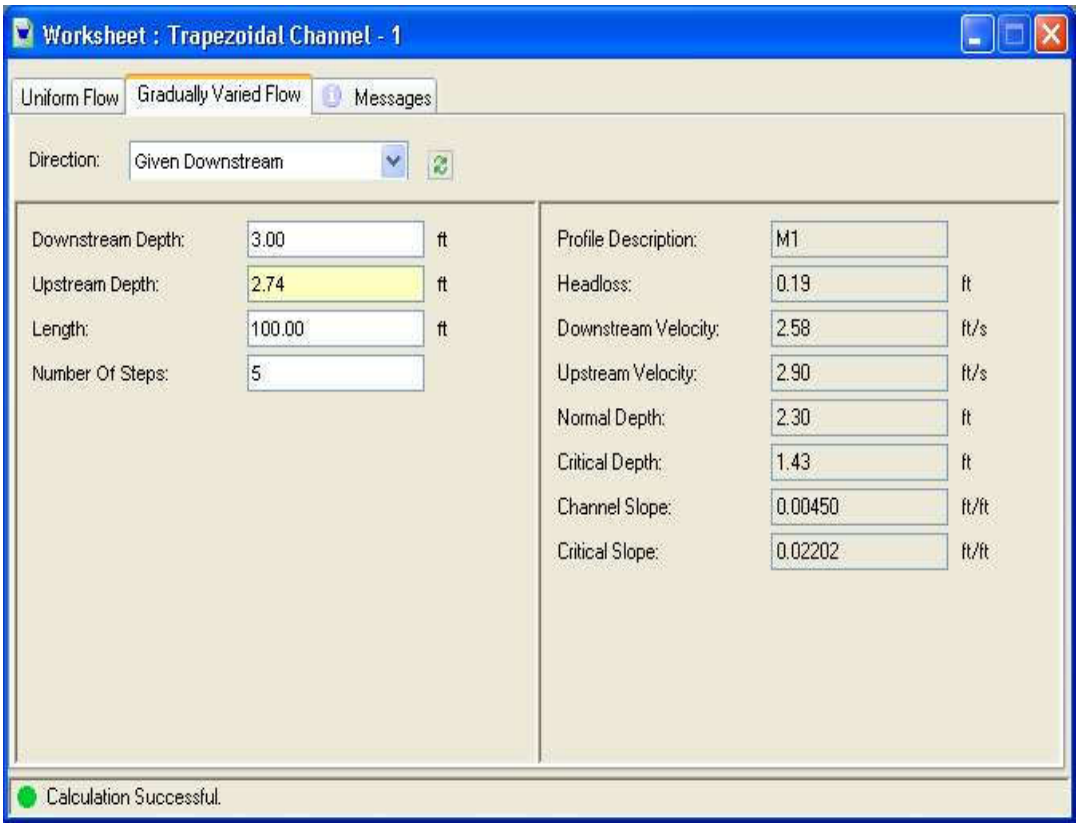
      This drop-down list lets you choose whether you are solving for upstream depth (when Given Downstream is selected) or downstream depth (when Given Upstream is selected).

   b. Click each of the other input fields in turn and enter the data contained in the following table into the appropriate input fields:

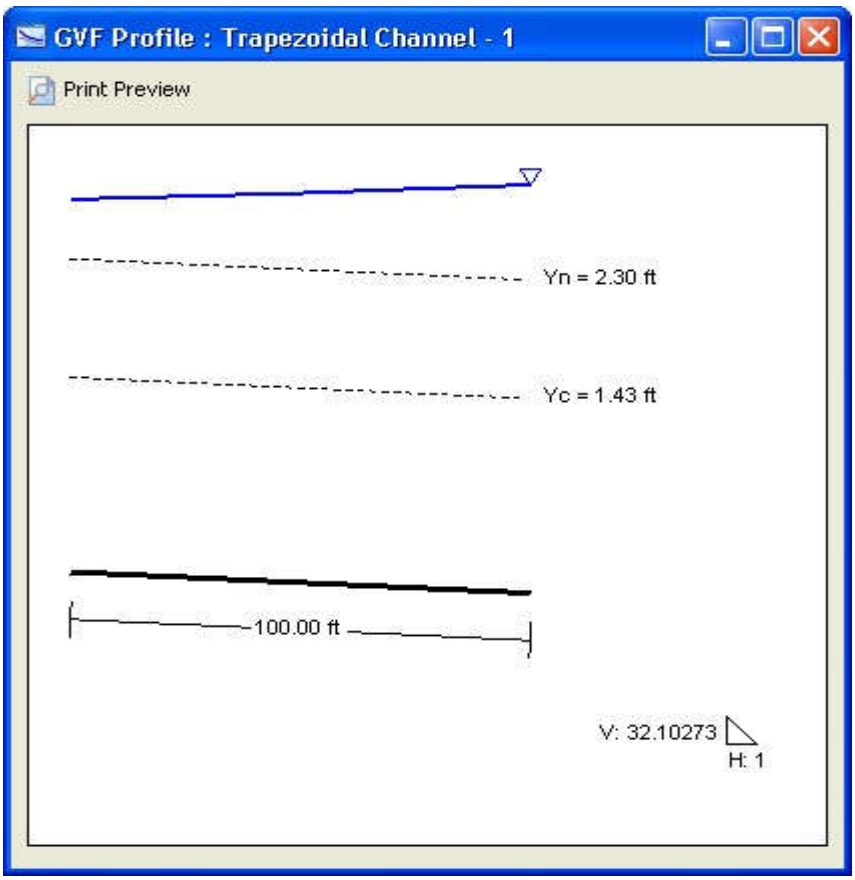
Table 2-2: Input Data for Gradually Varied Flow Analysis (Tutorial 2)

Attribute	Value
Downstream Depth	3.0 ft
Length	100 ft
Number of Steps	5

c. Click **Solve**. The calculated downstream depth should be **2.74 ft**. 



3. View the profile of the gradually varied flow analysis: Click **Analysis** > **GVF Profile**.



4. Save the project by clicking **File** > **Save As**.
5. Enter **MyTutorial3** in the File name field, and click **Save**.
6. If needed, close any open dialog boxes.

Class 3—Results Reporting

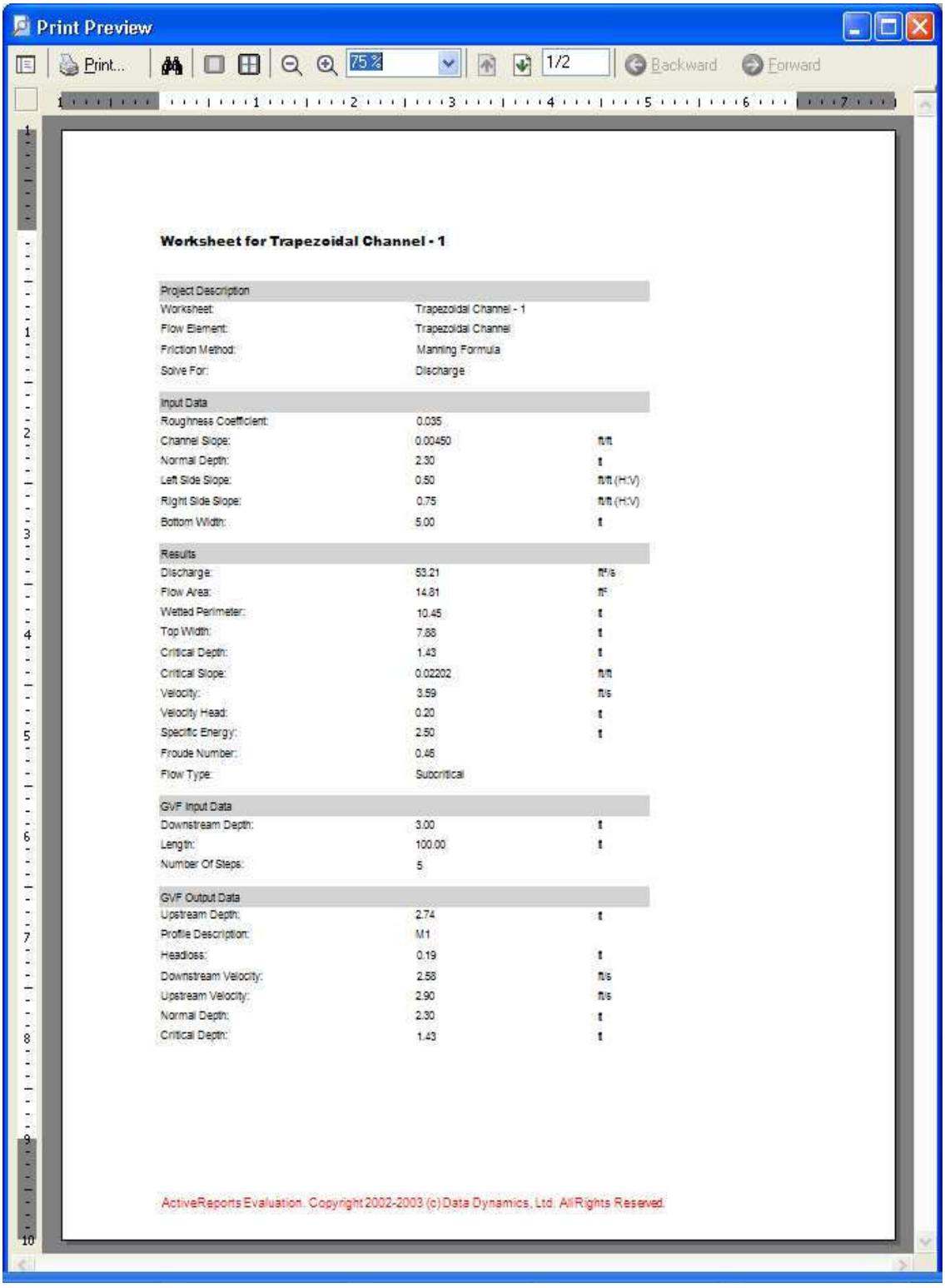
Bentley FlowMaster provides a number of methods of generating reports from your calculated results. This tutorial introduces you to these methods.

This tutorial is based on the project that was used in Tutorial 2—Gradually Varied Flow Analysis.

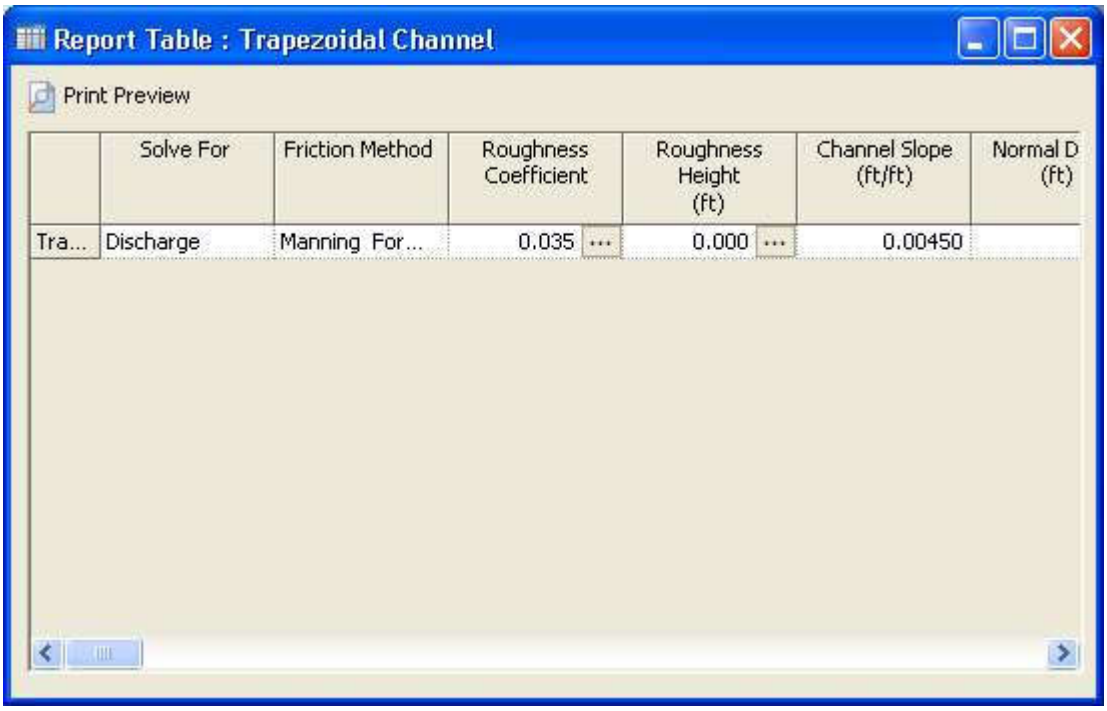
1. If necessary, open the **MyTutorial3** project file that you saved at the end of Tutorial 2, and, in the Project Explorer, double-click the **Trapezoidal Channel** item to open the worksheet containing the channel you defined in Tutorial 2.
2. Click **Analysis** > **Detailed Report**.
3. In the Generic Report Setup dialog box, change the default report title then click **OK**, or click **OK** to accept the default report title "Worksheet for Trapezoidal Channel."
4. The **Print Preview** dialog box opens, displaying the report as it would appear if printed.

Note the information supplied in the report: Project Information, Input Data, Results, GVF Input Data, and GVF Output Data.

5. Close the Print Preview dialog box.



6. Click **Analysis** > **Tabular Reports > Channels** > **Trapezoidal**.



7. The Report Table dialog box that opens presents all calculation messages, notes, input data, and results for all of the trapezoidal channel worksheets within the project; in this case, just one.

   This report is useful for comparing multiple worksheets of the same type. If you want to print this report, begin by clicking the **Print Preview** button.

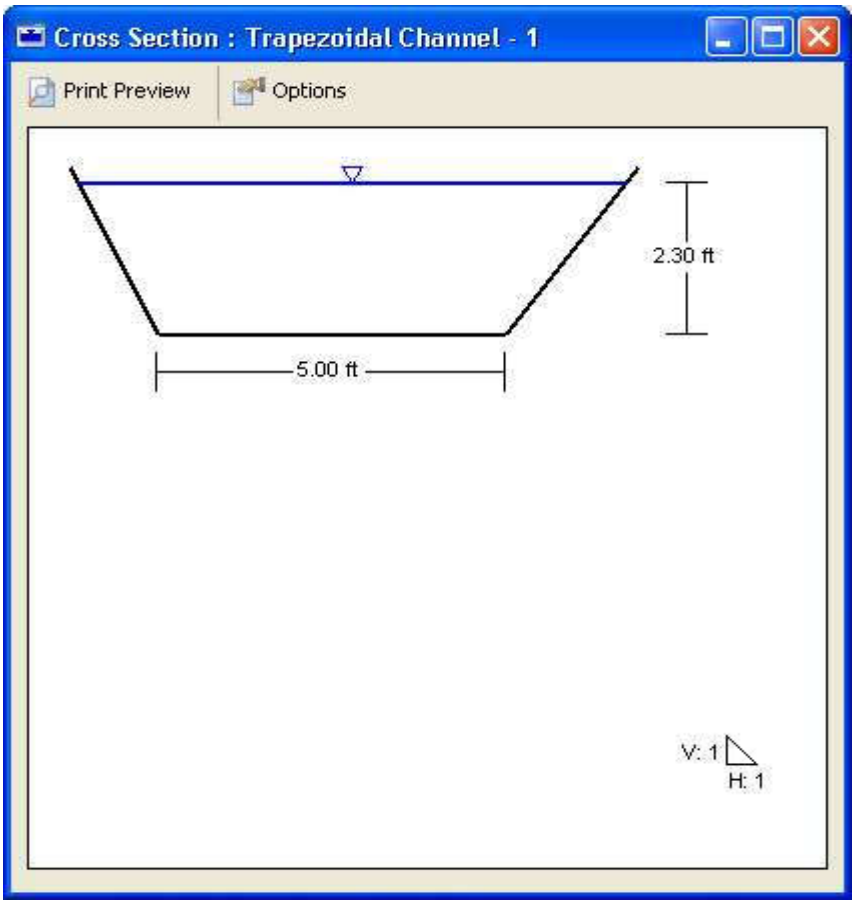
8. Close the Report Table dialog box.
9. Click **Analysis** > **Cross Section**.

Note: If Analysis > Cross Section is dimmed, click the Solve button, then try the menu item again.

10. In the Cross Section Setup dialog box, enter **Trapezoidal Channel** as the **Report Title**, and click **OK**.

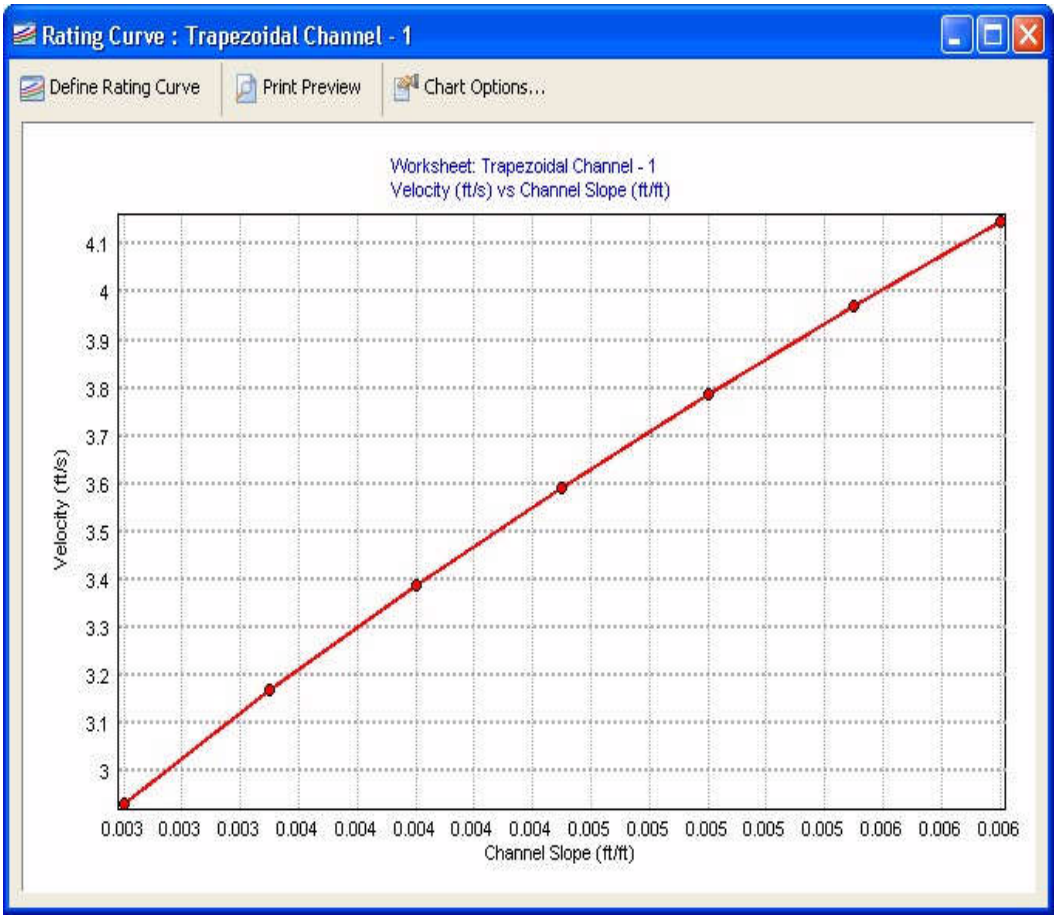
11. The Cross Section dialog box displays a cross section diagram defined by the trapezoidal channel worksheet.

    You can print the cross section by using the **Print Preview** button, then clicking the **Print** button in the Print Preview window.

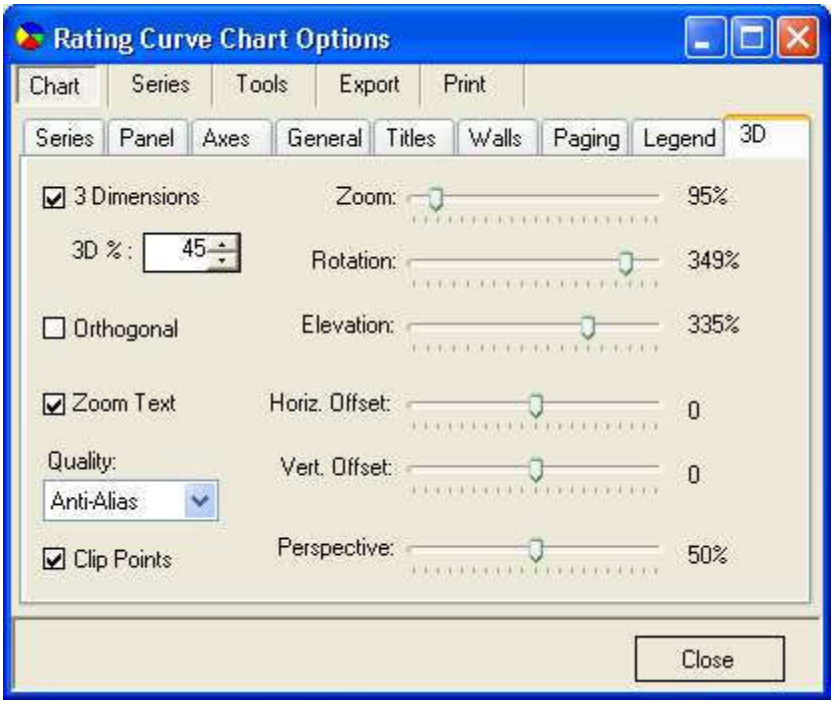


12. To change the size of the diagram:
    a. Click the **Options** button.
    b. Select the **Manual Scale** check box.
    c. Enter new value in the **Aspect Ratio** field, such as **3**, and click OK. The diagram changes to reflect the aspect ration you entered.
    d. Change the Aspect Ratio back to **1**.
    e. Close the Cross Section dialog box.
13. Bentley FlowMaster also lets you graph a range of results that are calculated from a range of values for a specified variable via the rating curves feature.
    a. If necessary, close any open Print and Print Preview dialog boxes and open the Trapezoidal Channel Worksheet dialog box.
    b. Click **Analysis** > **Rating Curve**.
    c. In the Rating Curve Setup dialog box, select **Velocity** in the **Plot** drop-down list. This is the attribute for which a range of values will be calculated.

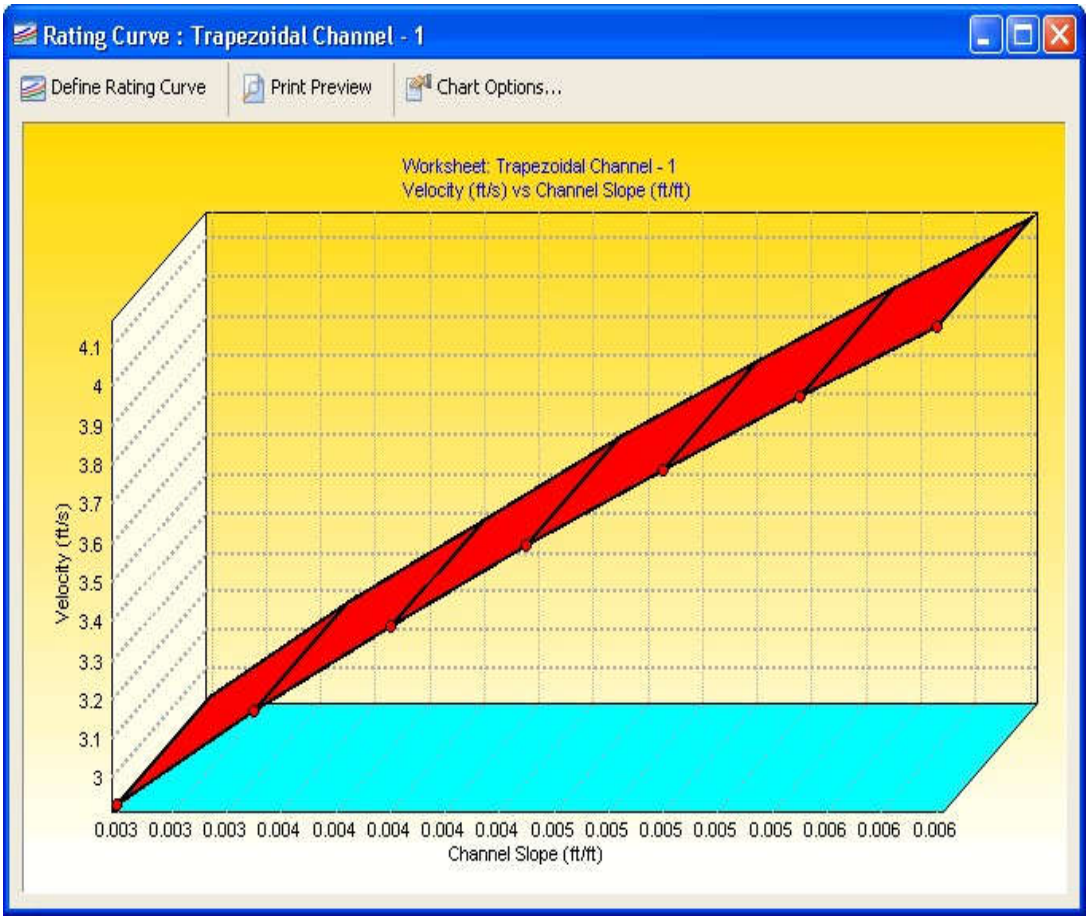
d. Select **Channel Slope** in the **Vs**. drop-down list; this sets the attribute against which the **Plot** attribute is calculated.
e. Enter the information contained in the following table for the other fields in the Rating Curve Setup dialog box:
    - Minimum: 0.0030 ft/ft
    - Maximum: 0.0060 ft/ft
    - Increment: 0.0005 ft/ft
f. Click **OK**. The Rating Curve dialog box opens, showing a graph of the velocity at each of the slopes in the range that is specified by the values you entered.



14. You can change practically any aspect of the graph's appearance by clicking the **Chart Options** button.



a. Experiment with the various settings available to you. To create the 3D chart shown here:



b. Click **Chart Options** > **3D**.
c. Select the **3 Dimensions** check box.
d. Set the 3D % to **90**.
e. Click the **Walls** tab.
f. Click the **Bottom** tab, then click **Color**.
g. Set the bottom color (in the example it has an Red, Green, Blue (RGB) value of **0**, **255**, **255**).
h. Click the **Panel**, then **Background** tabs.
i. Click the **Pattern**, **Gradient**, then **Format** tabs.
j. Select **Vertical** from the Direction drop-down list.
k. Click the **Colors** tab.
l. Click **Start**.
m. Click **Custom** and set an RGB value of **255**, **215**, **0**.
n. Click **OK** > **OK** to close the color dialog boxes.
o. Click **End**.
p. Select white from the Color Editor dialog box (RGB of 255, 255, 255).
q. Click **OK**.
r. In the Hatch Brush Editor dialog box, select the **No Middle Color** check box.
s. Click **OK**, then **Close**.

15. You can print the chart by clicking the **Print Preview** button, then clicking the **Print** button in the Print Preview window, or redefine the rating curve settings by clicking the **Define Rating Curve** button.
16. Save the project, then close all the open windows.