RECLAMATION
Managing Water in the West

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Flow Calculator Simplifies Use of Sharp-Crested Weirs for Accurate Measurement of Water Deliveries

Easy to use software saves time and money and increases measurement accuracy

What Is The Problem?

Supervisory Control and Data Acquisition (SCADA) technology revolutionizes the operation of irrigation projects. It allows irrigation managers to monitor and operate their systems more efficiently from a centralized control center. Automated flow measurement is a key element of a successful irrigation SCADA system. Sharp-crested weirs are common water measurement structures used throughout the world and, when installed with a standard-sized approach channel or weir box, most have simple calibration equations that can be easily integrated into a SCADA system. Unfortunately, many sharp-crested weirs have a non-standard approach channel that is too narrow or too shallow. This changes the relationship between depth and flow rate, so that the flow no longer matches handbook values. In most cases, the weir will deliver more water than the standard handbook rating table would indicate.

Weirs with undersized approach channels can be calibrated with the Kindsvater-Carter method, published in 1957. The method is straightforward, but tedious. Existing computer programs can simplify the process but apply only to individual measurements. Developing a complete rating table and converting the rating table into a form that can be integrated into a SCADA system requires significant effort.

What Is The Solution?

The USBRWeir flow calculator simplifies the application of the Kindsvater-Carter method. The calculator computes complete rating tables and equations for:

- V-notch weirs of any angle between 25° and 100°
- Rectangular weirs (contracted and suppressed)
- Cipoletti weirs

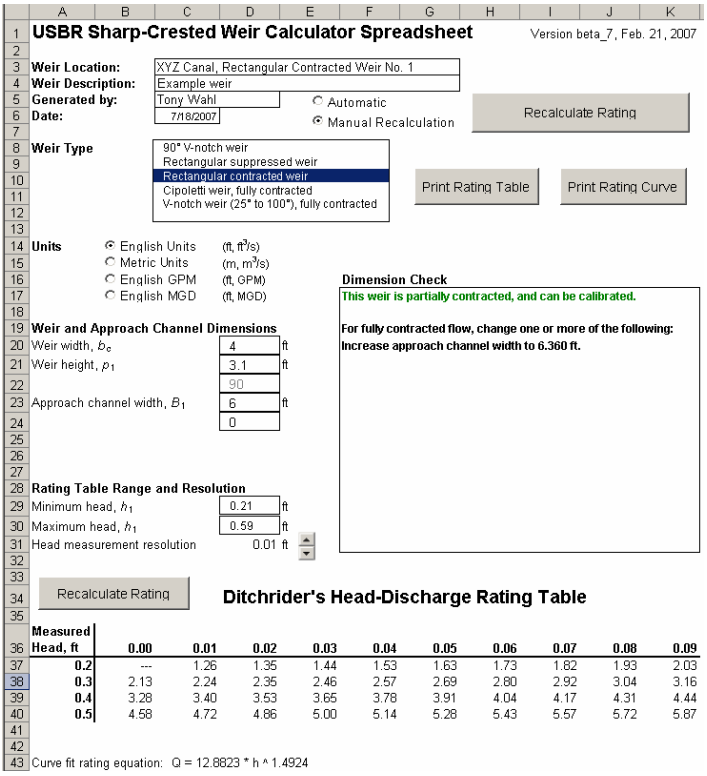
The primary benefit of using the flow calculator is improved flow measurement accuracy for non-standard weirs, which facilitates better water management. The calculator generates complete rating tables and rating equations in one step, saving time and money compared to previous means of applying the Kindsvater-Carter method.

Who Can Benefit?

All water managers whose systems include sharp-crested weirs with non-standard approach sections can benefit from the use of the flow calculator. The flow calculator will save time and money for users who might otherwise abandon non-standard sharp-crested weir installations because of the tedious process to generate more accurate flow measurements and construct new measurement structures or purchase alternative flow meters.

Where Have We Applied This Solution?

Since its release in 2006 for beta testing, the flow calculator has been applied by water managers and irrigators throughout the western U.S. The calculator has also been improved to support flow measurement units common in wastewater applications.



USBR Sharp-Crested Weir Calculator Spreadsheet — Version beta_7, Feb. 21, 2007

Weir Location:	XYZ Canal, Rectangular Contracted Weir No. 1
Weir Description:	Example weir
Generated by:	Tony Wahl
Date:	7/18/2007

○ Automatic ◉ Manual Recalculation — Recalculate Rating

Weir Type: 90° V-notch weir; Rectangular suppressed weir; **Rectangular contracted weir**; Cipoletti weir, fully contracted; V-notch weir (25° to 100°), fully contracted

Print Rating Table — Print Rating Curve

Units: ◉ English Units (ft, ft³/s); ○ Metric Units (m, m³/s); ○ English GPM (ft, GPM); ○ English MGD (ft, MGD)

Dimension Check
This weir is partially contracted, and can be calibrated.
For fully contracted flow, change one or more of the following:
Increase approach channel width to 6.360 ft.

Weir and Approach Channel Dimensions

Weir width, b_c	4	ft
Weir height, p_1	3.1	ft
	90	
Approach channel width, B_1	6	ft
	0	

Rating Table Range and Resolution

Minimum head, h_1	0.21	ft
Maximum head, h_1	0.59	ft
Head measurement resolution	0.01	ft

Recalculate Rating

Ditchrider's Head-Discharge Rating Table

Measured Head, ft	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.2	---	1.26	1.35	1.44	1.53	1.63	1.73	1.82	1.93	2.03
0.3	2.13	2.24	2.35	2.46	2.57	2.69	2.80	2.92	3.04	3.16
0.4	3.28	3.40	3.53	3.65	3.78	3.91	4.04	4.17	4.31	4.44
0.5	4.58	4.72	4.86	5.00	5.14	5.28	5.43	5.57	5.72	5.87

Curve fit rating equation: $Q = 12.8823 * h ^ 1.4924$

More Information

To download the flow calculator spreadsheet, please visit:
http://www.usbr.gov/pmts/hydraulics_lab/usbrweir/

Contact Information

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Collaborators

Reclamation's Science and Technology Program.