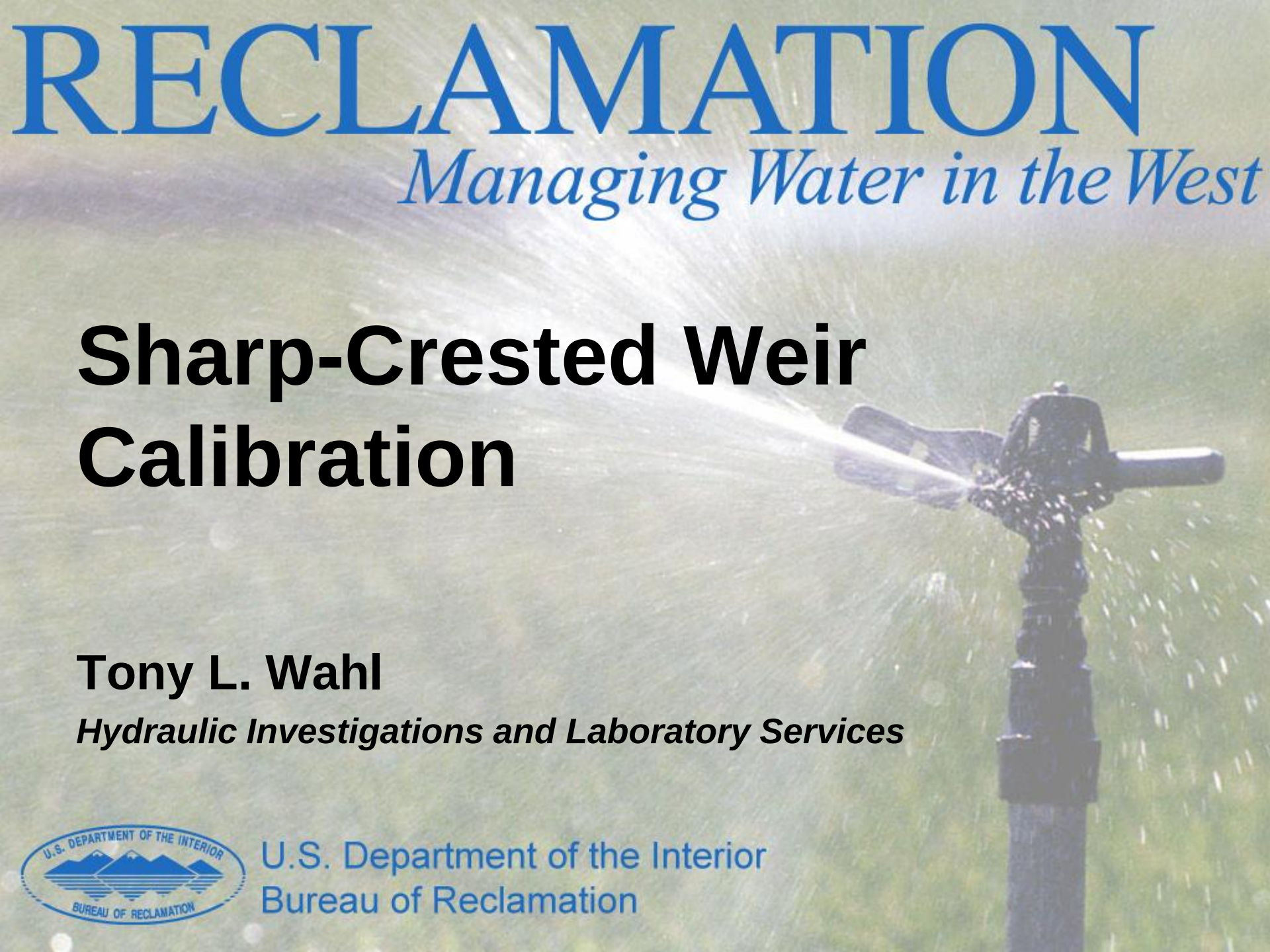
RECLAMATION

Managing Water in the West

Sharp-Crested Weir Calibration



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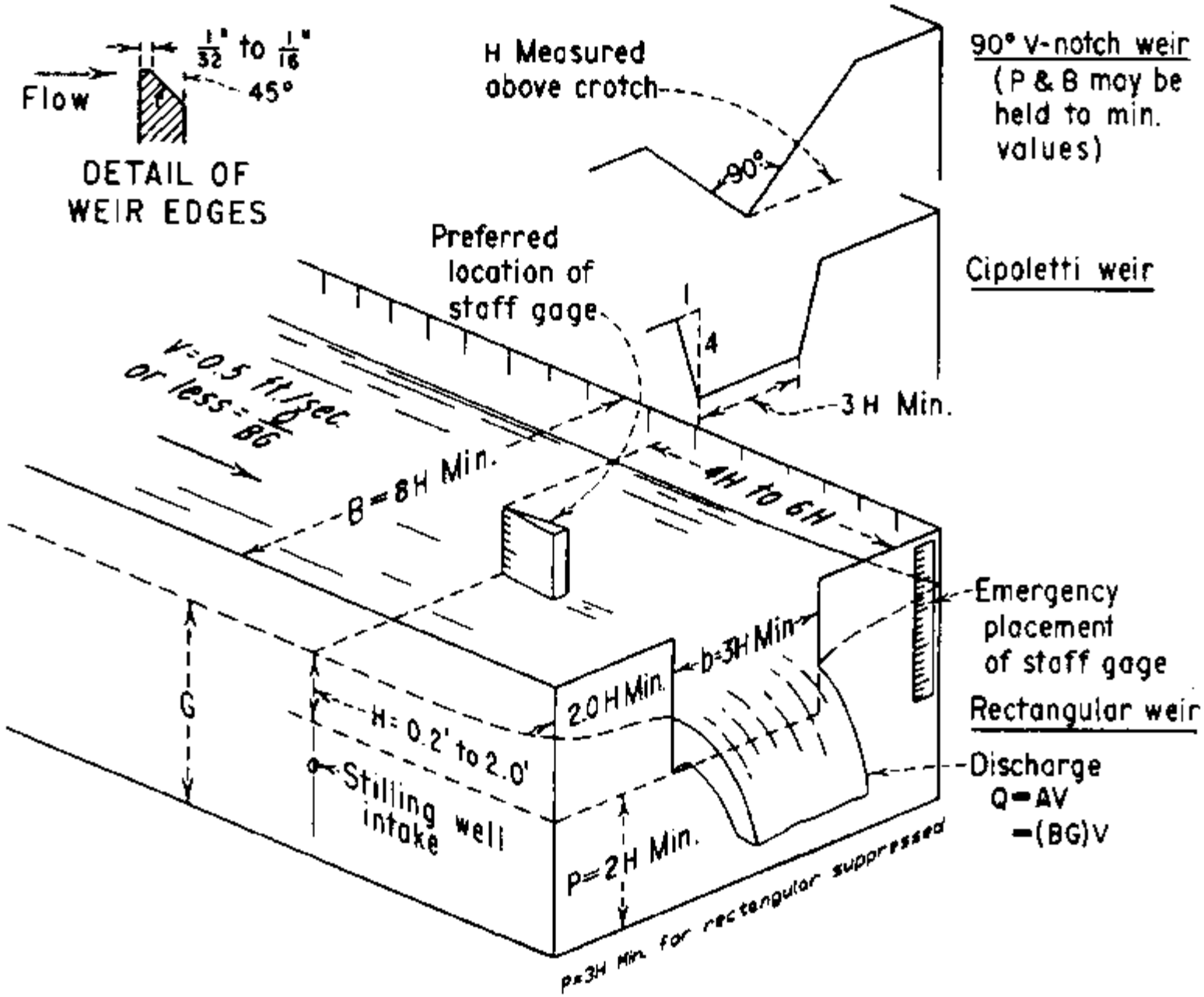
Bureau of Reclamation



WEIR PROPORTIONS

RECTANGULAR, CIPOLETTI AND 90° V-NOTCH

Fully Contracted Flow

- Weir box is large enough that flow through weir opening is unaffected by proximity of the sidewalls or floor
  - Weir box could be wider and/or deeper and it would not change the flow
- Standard equations apply
  - Easy to integrate into automated data collection network
  - One equation computes flow rate from measured head

Partially Contracted Flow

- Weir box is too small
  - too shallow or too narrow
- Flow does not contract fully as it passes through the opening
- Changes discharge vs. head rating of the structure
- Standard equations do not apply
- Difficult to integrate into data collection network

Kindsvater-Carter method, 1957

- Rectangular or V-notch weirs
- Generic discharge equation with coefficients that vary as a function of dimensionless ratios involving weir and weir box dimensions and head
- Tedious to apply using charts to look up coefficients
- Difficult to integrate resulting rating table into SCADA system

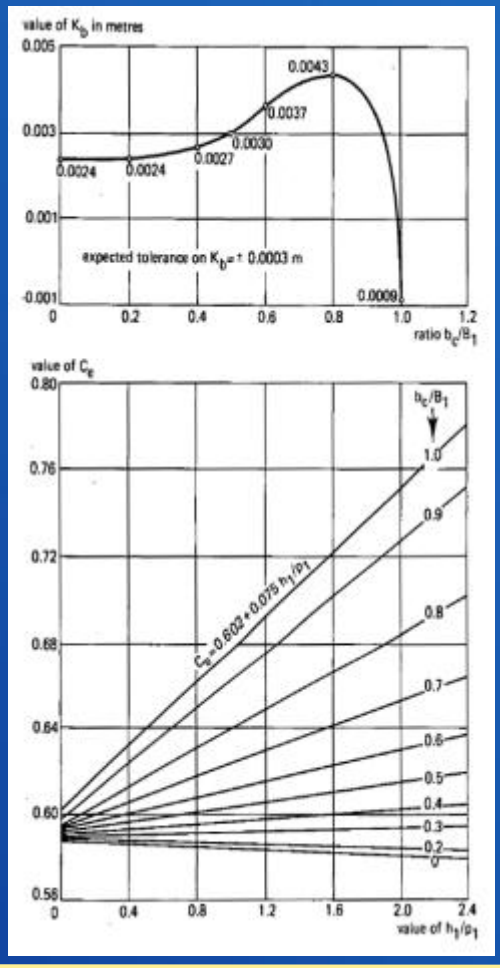
Application to Rectangular Weirs

$$Q = C_e \frac{2}{3} \sqrt{2g} b_e h_e^{1.5}$$

$$b_e = b_c + K_b$$

$$h_e = h_1 + K_h$$

$$(K_h = 0.001\,\text{m for all cases})$$



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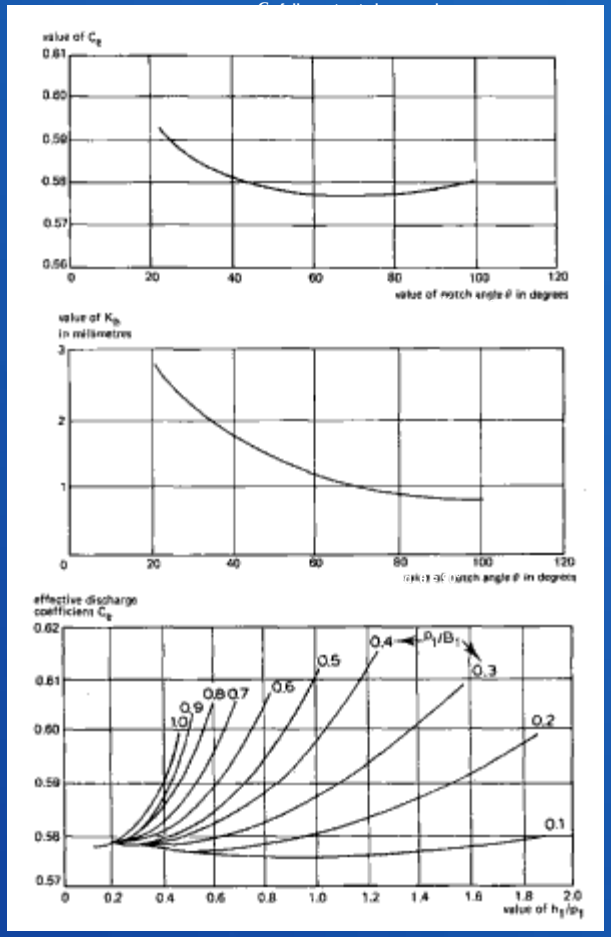
Application to V-Notch Weirs

$$Q = C_e \frac{8}{15} \sqrt{2g} \tan \frac{\theta}{2} h_e^{2.5}$$

$$h_e = h_1 + K_h$$



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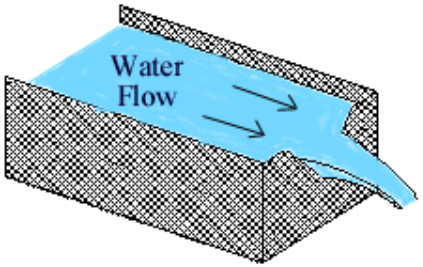
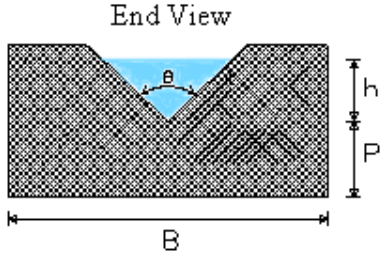
V-Notch (Triangular) Weir Calculator

Discharge and Head Calculations, Equations, and Guidelines for water flow measurement in streams and channels

To: LMNO Engineering home page (more calculations) Unit Conversions Trouble printing?
Weirs: Rectangular Cipoletti Weir End Depth: Circular Rectangular Triangular
Flumes: Parshall, Trapezoidal, Rectangular, and U shape Parshall (submerged)





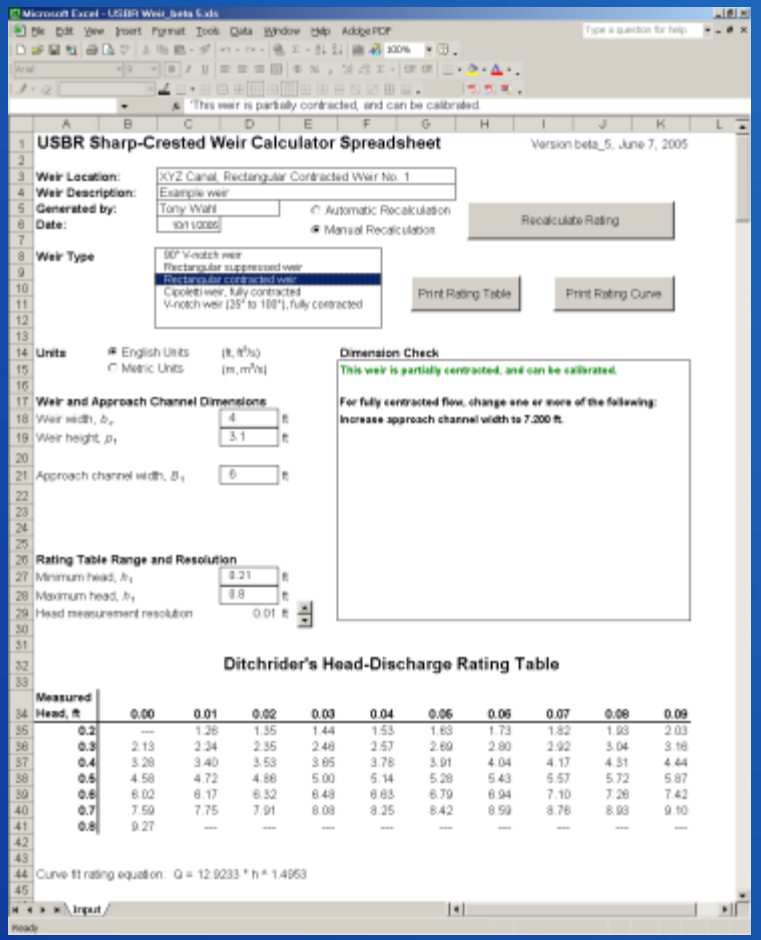
Solve for:	http://www.LMNOeng.com	**Click to Calculate**
Discharge	Discharge, Q (cfs, ft³/s):	Will be computed
	Head, h (ft):	1.0
Select Units:	Notch Angle, theta (degrees):	90.0
Discharge in ft³/s or cfs	Discharge Coefficient, C:	Will be computed
Head in feet	Head Correction Factor, k (ft):	Will be computed
Notch Angle in Degrees		

Introduction

Weirs are typically installed in open channels such as streams to determine discharge (flowrate). The basic principle is that discharge is directly related to the water

USBRWeir Spreadsheet

- Automates application of Kindsvater-Carter method
  - Rectangular weirs
  - V-notch weirs
  - Cipoletti weirs
- Produces rating tables and simplified rating equations for partially contracted weirs



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Rating Table

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
0.6	6.02	6.17	6.32	6.48	6.63	6.79	6.94	7.10	7.26	7.42
0.7	7.59	7.75	7.91	8.08	8.25	8.42	8.59	8.76	8.93	9.10
0.8	9.27	---	---	---	---	---	---	---	---	---

Curve fit rating equation: Q = 12.9233 * h ^ 1.4953

Input

Ready

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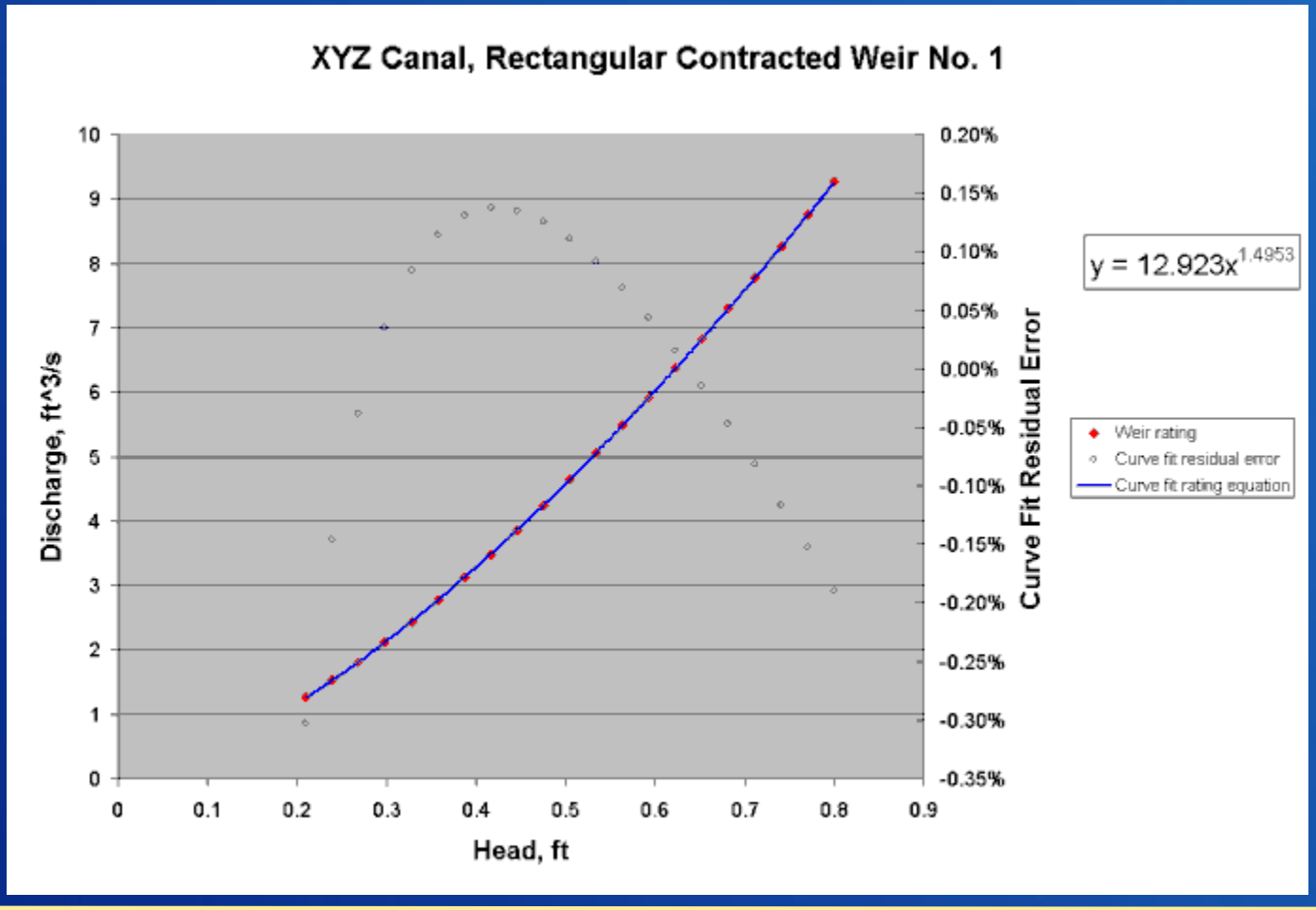
Rating Curve and Equation



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Obtaining USBRWeir.xls

- **www.usbr.gov/pmts/hydraulics_lab/usbrweir**