



# MORRO BAY

## NATIONAL ESTUARY PROGRAM

### TECHNICAL MEMORANDUM

Subject: Stage-Discharge Relationship for Chorro Creek at Canet Road (San Luis Obispo County Station 753)

Date: August 30, 2024

### BACKGROUND

The County of San Luis Obispo established a stream gauge on Chorro Creek in 1978 at Canet Road (Station 753). The original gauging system was removed during the construction of a low-water vehicle crossing and a replacement gauge was installed in August 2003. In a partnership between the Estuary Program and San Luis Obispo County Public Works Department, the gauge was upgraded in December 2006 with an Automated Local Evaluation in Real-Time (ALERT) telemetry system, allowing for real-time stream stage data to be viewed or downloaded from the County's website:

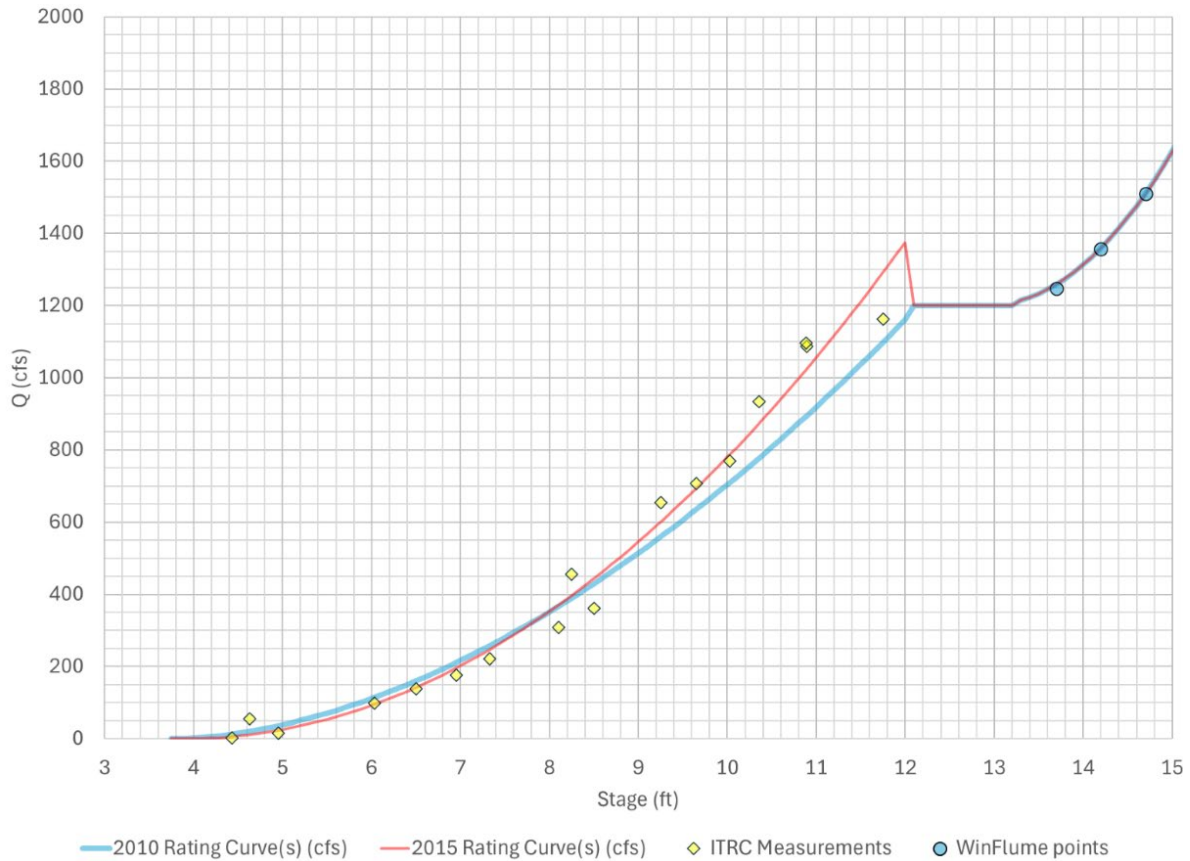
<https://wr.slocountywater.org/>.

The Estuary Program contracted with engineers at the Cal Poly Irrigation Training and Research Center (ITRC) to develop a stage-discharge relationship in 2008. ITRC measured discharge at flow rates ranging from 1.9 to 727 cubic feet per second (cfs). In 2010, ITRC developed three equations to represent discharge at Station 753. For stages below 12.2 feet, discharge was estimated as  $Q \text{ (cfs)} = 26Y^{1.8}$  where Y was the depth of water (in feet) minus channel bottom elevation (3.75 ft) above the reference datum. For stage values of 12.1 feet to 13.2 feet, discharge was estimated as  $Q \text{ (cfs)} \approx 1200$ . This was the case when the culverts were full, but water was not overtopping the bridge. For stage values greater than 13.2 feet, discharge was estimated as  $Q \text{ (cfs)} = 1200 + 88 [(H - 13.2) + 0.326]^{2.1}$  where H was the staff gauge reading without adjustment for the channel bottom elevation. This equation was developed for stages when water had overtopped the bridge. The water over the bridge was estimated using WinFlume software and a complex weir equation.

In 2015, the Estuary Program revised the stage-discharge relationship to better estimate discharge when stage values were below 12.1 feet. For stage values below 12.1 feet, the power function  $Q \text{ (cfs)} = 26Y^{1.8}$  was replaced with a polynomial function  $Q \text{ (cfs)} = 20.907Y^2 - 5.8341Y$ . While the updated equation was successful in approximating flows in the lower range, it created a discontinuity when the rating curve reached 12.1 feet. The resulting rating curve created two potential issues:

- The revised equation indicated that Chorro Creek's discharge increased to about 1,374 cfs at 12.0 feet, then fell to 1,200 cfs at 12.1 feet.
- The curve further indicated that flows did not rise back to 1,374 cfs until the stage reached about 14.3 feet (Figure 1). Although there are some circumstances where the discharge can

increase as the stage decreases<sup>1</sup>, the curve was intended to steadily increase without discontinuity.



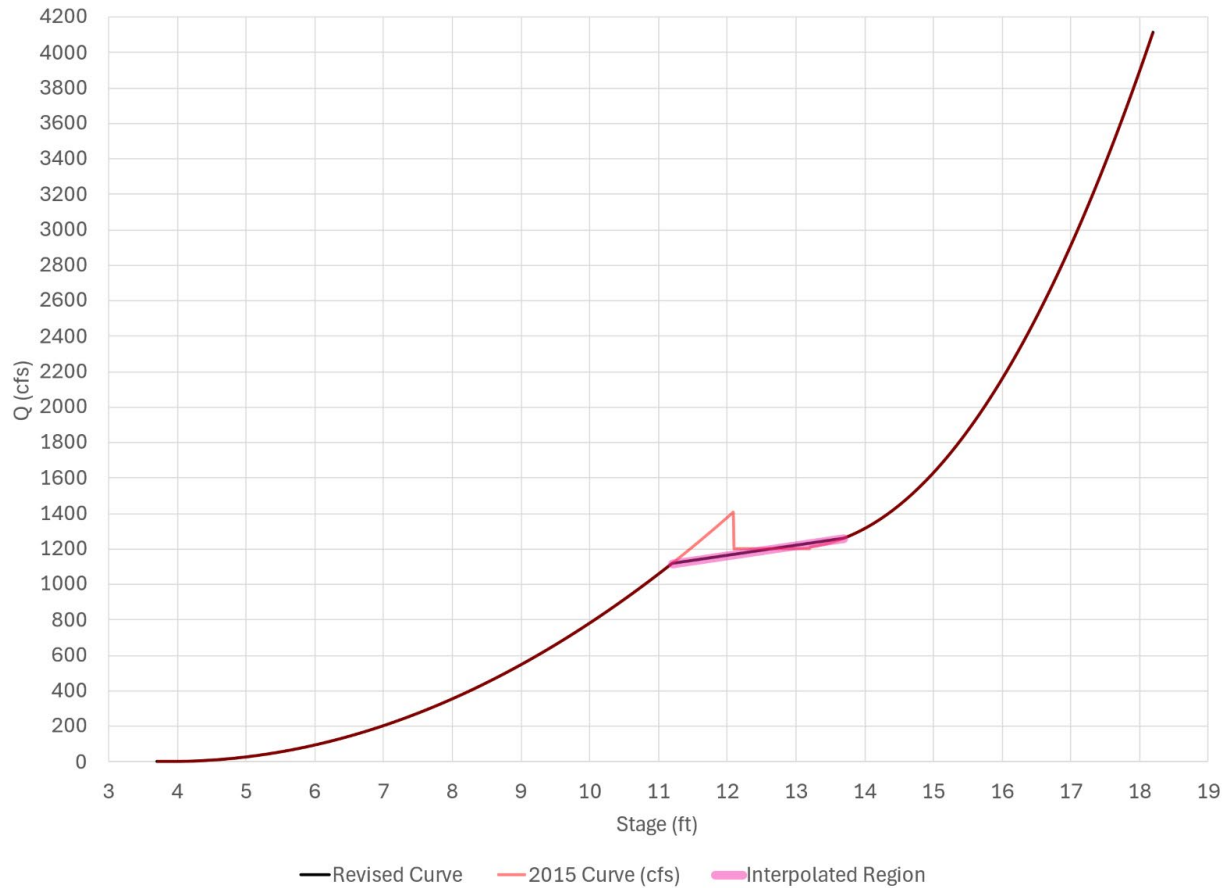
**Figure 1.** Comparison of the 2010 ITRC rating curve (blue) to the 2015 ITRC rating curve (red). The yellow points represent manual discharge measurements collected by ITRC, while the blue points represent anticipated discharge values generated by WinFlume.

### REVISED RATING CURVE: 2024

The Estuary Program contracted with Creek Lands Conservation (CLC) to develop a revised rating curve for Station 753 in July 2024. The discontinuity in the rating curve was replaced with a linear interpolation to create a smoother transition (Figure 2). Hydrologists at CLC evaluated two approaches to determine the best-fit curve: a linear interpolation and a monotonic spline. The straight-line interpolation method was selected as a preferable option because of its accessibility and replicability<sup>2</sup>.

<sup>1</sup> While the Canet Road stream gauge has not been evaluated for these conditions, many of the common predictable causes for this scenario appear to be absent from this site (e.g., downstream dams that cause back-watering at high flows, or large floodplain storage return flows).

<sup>2</sup> The largest absolute difference between the methods was approximately 1%, and the average difference was less than 1%.



**Figure 2.** Revised rating curve for Canet Road (black) compared to 2015 rating curve (red). The revised rating curve includes a linear interpolation for stage values of 11.2 to 13.7 feet (pink).

Four discharge equations were developed for the revised rating curve. For each of the following equations, **Q (cfs)** is the discharge of Chorro Creek at Canet Road, and **Y** is the stage value in feet as recorded by the SLO County stream gauge at Station 753. Note that the updated rating curve is only intended to estimate discharge when stage values are between 3.75 and 18.2 feet. The curve cannot accurately predict discharge when stage values are less than 3.75 feet or greater than 18.2 feet, as those values are outside of the known stage-discharge relationship.

1. For stage values between 3.75 feet and 4.02 feet, discharge is assumed to be zero: **Q (cfs) = 0.**
2. For stage values greater than 4.02 feet and less than or equal to 11.2 feet, estimate discharge with the equation: **Q (cfs) = 20.907\*(Y - 3.75)<sup>2</sup> - 5.8341\*(Y - 3.75).**
3. For stage values greater than 11.2 feet but less than 13.7 feet, use the linear interpolation: **Q (cfs) = 56.826\*Y + 480.48.**
4. For stage readings greater than 13.7 feet and less than or equal to 18.2 feet, use the equation: **Q (cfs) = 1200 + 88.02\*[(Y - 13.2) + 0.3259]<sup>2</sup>.**

## RESOURCES

For questions about the revised rating curve, please contact the Estuary Program. For more information about the stream gauge at Canet Road, please visit the [SLO County Public Works Department website](#).

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