



Stream Flows for Steelhead: Methods to Identify Instream Flow Needs in the Ventura River Watershed



Danielle Ingrassia¹, Diane Haas¹, and Mary Larson²

¹ California Department of Fish and Wildlife, Water Branch, 830 S St., Sacramento, CA 95811

² California Department of Fish and Wildlife, South Coast Region, 4665 Lampson Ave. Suite C, Los Alamitos, CA 90720

Introduction

The Ventura River once hosted one of the largest runs of the Southern California Distinct Population Segment (DPS) of steelhead trout (steelhead; *Oncorhynchus mykiss*) on the southern California coast. Steelhead distribution and abundance have diminished substantially due to altered flow regimes, physical barriers to suitable coldwater habitat, insufficient habitat availability, and poor water quality. The Ventura River watershed may experience long periods of dry conditions, resulting in mainstem reaches becoming seasonally and annually intermittent. Unpredictability in the timing, magnitude, frequency, and duration of river flows limits the hydrologic connectivity of the riverine habitat. However, steelhead populations have the potential to recover through streamflow enhancement in the Ventura River and its tributaries.

As a trustee agency and in support of California Water Action Plan (CWAP), the California Department of Fish and Wildlife (Department) Instream Flow Program is evaluating instream flow needs for steelhead in the Ventura River watershed. The Department is conducting multiple activities in the mainstem Ventura River, lower Ventura River, and San Antonio Creek using a compilation of common and scientifically defensible methods. Study objectives and methods differ in each reach. We highlight the suite of methods that will be used in synchrony to produce instream flow criteria and identify important flow thresholds for fish and wildlife conservation, restoration, and protection of steelhead in the Ventura River watershed.

Mainstem Ventura River

Sections of the Ventura River watershed are characterized by intermittent flow due to underlying geology, seasonal rains, and anthropogenic factors. A six-mile intermittent reach spans the mainstem between the San Antonio Creek confluence and the Robles Diversion Dam. Several alluvial riffles were identified as potential passage impediments in the complex braided channel within the lower two miles of the intermittent reach. This area was selected for two-dimensional (2D) modeling, which allows for simultaneous evaluation of multiple critical riffle sites. The goal of this study is to evaluate flow regimes to support unimpeded adult steelhead migration through the Ventura River mainstem to upstream spawning and rearing habitat. This study will quantify stream flows associated with adequate water depths to ensure adult steelhead migration through the intermittent reach downstream of the Santa Ana bridge.



RTK topographic survey



Pressure transducer in channel

Study Objectives:

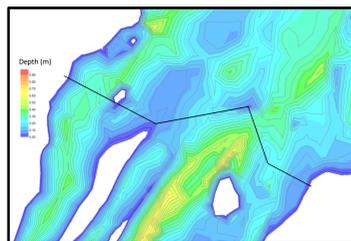
- Identification of the relationship between habitat and flows using hydraulic habitat modeling in the intermittent reach
- Identification of flows needed to protect adult steelhead passage

Methods:

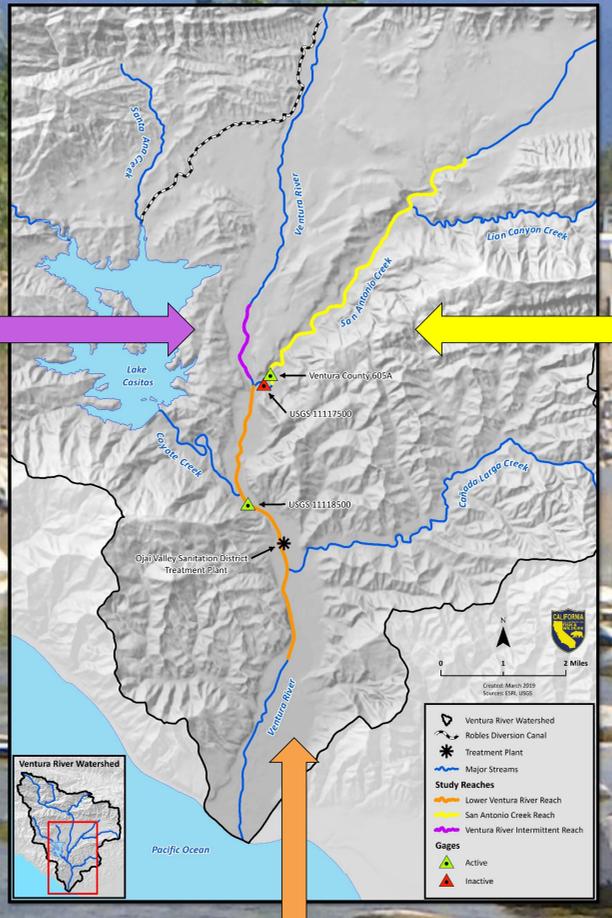
- Two-dimensional (2D) Hydraulic Habitat Model:
 - Topographic model development of the entire study reach using Total Station and Real-time kinematic (RTK) survey equipment
 - Predictive 2D hydraulic habitat model development using River2D and HEC-RAS to assess passage
- Critical Riffle Analysis (CRA):
 - Survey of critical riffles using 2D model simulation to estimate depth and width across the shallowest course from bank to bank
 - Comparison to target fish species passage criteria for minimum water depth and minimum proportion of passable riffle width
 - 2D models provide an innovative approach for analysis in a flashy river, where traditional CRA survey methods are not feasible



Example critical riffle survey site



Example 2D critical riffle transect



San Antonio Creek

Located seven miles above the Ventura River mouth, San Antonio Creek contributes a considerable amount of flow to the lower watershed. San Antonio Creek is extremely important to steelhead production and recovery as it is the only known tributary in the lower mainstem that supports significant spawning and rearing habitat. The goal of this study is to develop streamflow versus habitat relationships for multiple steelhead life stages and the habitats that support them in San Antonio Creek. Once quantified, these relationships will be used to support life history-based instream flow criteria to enhance flows in the Ventura River watershed.

Study Objectives:

- Identification of the relationship between streamflow and habitat using a combination of hydraulic modeling and empirical methods in San Antonio Creek
- Identification of flows to maintain steelhead passage
- Identification of steelhead spawning, rearing, and habitat maintenance flows
- Identification of productive riffle habitat flows



Survey transect

Methods:

- One-dimensional (1D) Hydraulic Habitat Model:
 - Hydraulic model development, in conjunction with depth, velocity, substrate, and cover criteria for target steelhead life stages, to determine the relationship between streamflow and suitable habitat using SEFA
 - Estimation of flows for spawning and rearing
- Habitat Retention Method:
 - Bed elevation surveys and rating curve development to identify flows to maintain minimum hydraulic criteria standards sufficient for movement and survival of aquatic biota
- Wetted Perimeter Method:
 - Bed elevation surveys and wetted perimeter-discharge curve development to identify flows to maintain benthic macroinvertebrate (BMI)/riffle productivity, and low flow thresholds

Lower Ventura River

The lower Ventura River study area is generally characterized by the occurrence of upwelling groundwater, providing a consistent source of cool water for aquatic habitat, and usually maintains a perennial flow. Also known as the "live reach", this area extends from below the Ojai Valley Sanitary District wastewater treatment plant to above the confluence with San Antonio Creek. This area is important for steelhead recovery because it provides overall ecological habitat to maintain the existing populations of steelhead within the lower watershed. The goal of this study is to evaluate flow regimes that will sustain aquatic life within the perennial reach of the lower Ventura River. This study will quantify stream flows required for habitat enhancement in the study area.

Study Objectives:

- Identification of ecological/benthic invertebrate production riffle flows
- Identification of movement and survival flows for steelhead life stages
- Identification of aquatic ecological habitat maintenance flows
- Identification of low flow cut-off threshold values

Methods:

- Habitat Retention Method:
 - Bed elevation surveys and rating curve development to identify flows to maintain minimum hydraulic criteria standards for movement and survival of aquatic biota
- Wetted Perimeter Method:
 - Bed elevation surveys and wetted perimeter-discharge curve development to identify flows to maintain BMI/riffle productivity, and low flow thresholds



Study site selection riffle survey



Survey transect

Next Steps

Data collection has been completed in all three study areas, and data analysis is underway. Technical reports for the mainstem Ventura River, lower Ventura River, and San Antonio Creek are being drafted and will be available online upon completion. The results from these studies may be used to assist with flow enhancement activities in the Ventura River watershed through the CWAP and other restoration and recovery efforts to support critical steelhead habitat. Department Instream Flow Program information and documents, including Standard Operating Procedures, can be found at <https://www.wildlife.ca.gov/Conservation/Watersheds/Instream-Flow>

Acknowledgements: Data collection was conducted by the Department Water Branch, South Coast Region, and US Fish and Wildlife Service staff.

