Go with the Flow:
Standard Procedures for Instream Flow Studies

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Introduction

Instream flow data collection in Californian streams and rivers is crucial to the protection of fish and wildlife. At any given time, instream flow studies may be conducted throughout the state by multiple agencies, consultants, or other organizations. To support the production of complete, consistent, and defensible data, the California Department of Fish and Wildlife (CDFW) Instream Flow Program (IFP) developed a Quality Assurance/Quality Control Program for instream flow assessments, in coordination with the Quality Assurance Research Group at Moss Landing Marine Laboratories. Through this partnership, peer-reviewed standardized operating procedures (SOPs) were developed to provide guidelines and enable consistent methods to be used throughout California. To date, five SOPs have been developed and are being applied in current Instream Flow Program studies. Each SOP is intended to be used in conjunction with other CDFW IFP SOPs and methods when more detailed information is needed to address questions of species- and lifestage-specific flow needs, river form, function or ecological processes, as relevant.

Critical Riffle Analysis for Fish Passage

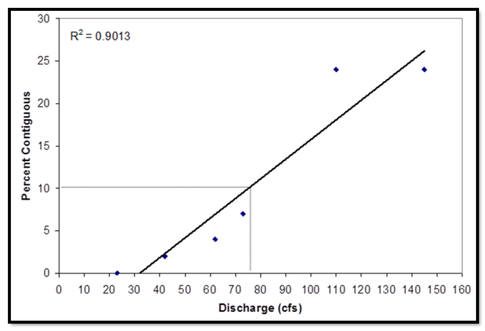
The critical riffle analysis (CRA) methodology is used to identify protective stream flow rates (a.k.a. passage flows) needed by salmon and trout to migrate over critical riffles. These are shallow riffles that are particularly sensitive to changes in stream flow due to diminished water depth, which may limit the hydrologic connectivity of river habitat and impede critical salmonid life history strategies. A series of depth measurements is made across the contours of a critical riffle along its shallowest course from bank to bank, and repeated over a range of flows to determine passage needs.

Instructions are provided for:

- Considerations for project timing and site selection
- Establishing the transect
- Data collection
- Tabular data entry
- Criteria for fish passage
- Considerations for application of passage flow rates

Critical riffle transect across the shallowest path

Over multiple flows, the total width and longest contiguous portion of the riffle transect meeting minimum depth criteria for salmonid passage are measured. Passage flows are identified through regression of discharge and percent of total or contiguous transect width. CRA is currently being applied to Deer and Mill Creeks (Tehama County), where low flow conditions and elevated water temperatures in the lower sections of each stream may be contributing to passage issues.



Example relationship between discharge and contiguous passable width

Wetted Perimeter Method

The wetted perimeter method (WPM) may be used to examine the low flow component of the hydrologic regime for ecological function and benthic macroinvertebrate production. The term wetted perimeter refers to the perimeter of a cross sectional area of a streambed from wetted edge to wetted edge, and is used as a measure of habitat availability over a range of discharges. This field-based method is used to determine the streamflow required for maintaining productive riffle habitats, typically during summer and/or fall low-flow months.

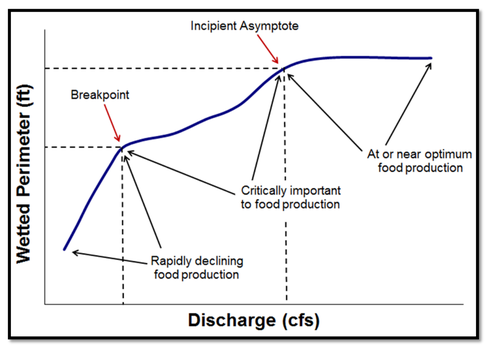
This SOP covers the following:

- WPM limitations and constraints
- Site selection and field procedures
- Data entry and analysis
- Developing the wetted perimeter-discharge curve
- Interpreting the curve and identifying breakpoints
- Considerations for determining flow recommendations

Wetted perimeter transect length, water depths, and discharge data are collected at a riffle site over different flow conditions to generate the wetted perimeter-discharge curve. Inflection points in the curve represent the thresholds for critically important food production. As the WPM is good for describing a minimum instream flow for low flow periods, it may be particularly useful for evaluating streams during drought years.

WPM transect across a riffle hydraulic control

Riffle during summer low flow



Example wetted perimeter-discharge curve

Streambed and Water Surface Elevation Data Collection

Streambed and water surface elevations (WSELs) are key components of habitat-based hydraulic models and other analyses used to develop flow vs. habitat relationships in instream flow studies for fish and wildlife resources.

The following procedures are discussed:

- Considerations for site selection
- Establishing a vertical benchmark
- Tripod and auto level set up
- Site set up
- Differential leveling techniques
- Collecting WSELs
- Collecting bed elevations
- Measuring stage of zero flow (SZF) elevation
- Turning points and closing the level loop

Measuring water surface elevation with a stadia rod

Bed profiles and WSELs are used to enable stream width/flow relationships to be predicted over a simulated range of flows and validate temperature models for current stream temperature studies on Mill and Deer Creeks.

Discharge Measurements in Wadeable Streams

Reliable discharge measurements are essential to determining relationships between stream hydrology and variables affecting fish populations. This basic measurement is the amount of water flowing in a stream, usually expressed in cubic feet per section (cfs), and is a critical component of every stream flow study. This SOP uses the Marsh-McBirney Flo-Mate Model 2000 portable velocity flow meter (Model 2000), which works well around vegetation, with larger substrate sizes, and for shallow depths.

Instructions are provided for:

- Site selection guidelines for discharge transects
- Equipment care and calibration
- Use of the Model 2000 with the USGS top-setting wading rod
- Data collection
- Qualitative evaluation of discharge measurements
- Calculating discharge

Measuring discharge with the Model 2000 flow meter and top-setting wading rod

Current studies use multiple discharge measurements as components of critical riffle analysis, wetted perimeter method, and streambed and water surface elevation data collection. Collecting discharge is particularly valuable in areas where stream gaging station data is not available.

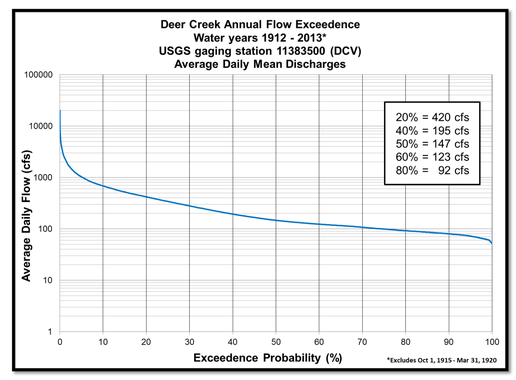
Flow Duration Analysis

Flow duration analysis (FDA) is commonly used to describe flow characteristics of a stream and determine flow recommendations for fish and aquatic ecosystem health. Many hydraulic habitat flow models require sampling at a representative range of flows. FDA may be used to identify flows of interest, and design a sampling schedule for an instream flow study. A flow exceedence probability curve is developed using existing hydrologic data from a specified time period, and reflects average flow characteristics of a stream throughout the range of discharge. The curve indicates the probability a particular flow will be exceeded considering the flows recorded during the specified time period.

The following processes are discussed:

- Considerations for obtaining flow data
- Procedures for compiling annual flow data
- Creating annual and monthly exceedence graphs
- Interpretation of curve results

Resulting curves are useful to compare, predict, and recommend stream flows. Study planning for Deer and Mill Creeks included FDA to determine target flows for sampling critical riffles.



Annual flow exceedence curve

CDFW Instream Flow Program documents and information can be found at **http://www.dfg.ca.gov/water/instream_flow.html**

Acknowledgements

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