The California Department of Fish and Wildlife

INSTREAM FLOW PROGRAM

Quality Assurance Plan

JULY 2023

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

PREFACE

This planning document is intended to describe California Department of Fish and Wildlife (CDFW) Instream Flow Program (IFP) quality assurance (QA) systems associated with:

- Project management
- Data generation and acquisition
- Assessment and oversight
- Data validation and usability

It follows the scope and format specified in the US Environmental Protection Agency (EPA) Region 9 document *EPA Region 9 Requirements for Quality Assurance Program Plans*. This promotes IFP comparability with other California agencies utilizing QA program plans (QAPrPs) and QA project plans.

Management of this QAPrP is detailed in A9: *Documents and Records*.

Group A:
Program Management

Figure 1. IFP staff performing a topographic survey of the Ventura River.

A1. TITLE AND APPROVAL SHEET

Document Summary

Table 1. Document summary.

Title	*Instream Flow Program Quality Assurance Plan*
Lead Organization	California Department of Fish and Wildlife Ecosystem Conservation Division Water Branch Instream Flow Program P.O. Box 944209 Sacramento, CA 94244 https://wildlife.ca.gov/conservation/watersheds/instream-flow
Primary Contact	Diane Haas Instream Flow Program Senior Environmental Scientist (Supervisor) diane.haas@wildlife.ca.gov
Effective Date	July 2023

Approval

Robert Holmes; Statewide Water Planning Program Manager
Water Branch; California Department of Fish and Wildlife

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Robert Holmes
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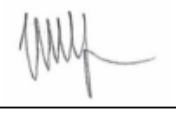
Signature

7/27/2023
Date

Will Hagan; Independent Quality Assurance Manager
Marine Pollution Studies Laboratory; Moss Landing Marine Laboratories


Signature

07/27/2023
Date

Recommended Citation

CDFW (2023). Instream Flow Program Quality Assurance Plan. California Department of Fish and Wildlife, Instream Flow Program (CDFW), West Sacramento, CA.

Abbreviations and Acronyms

Table 2. Abbreviations and acronyms.

Term	Definition
1D	One-dimensional
2D	Two-dimensional
ACS	American Chemical Society
CDFW	California Department of Fish and Wildlife
cfs	Cubic feet per second
CSDS	California Survey and Drafting Supply
CWAP	*California Water Action Plan*
DMP	Data management plan
EPA	US Environmental Protection Agency
FFC	*Functional Flow Calculator*
FN	Froude number
GPS	Global positioning system
HEC-RAS	*Hydrologic Engineering Center's River Analysis System*
IFP	Instream Flow Program
MPSL	Marine Pollution Studies Laboratory (Moss Landing Marine Laboratories)

Term	Definition
MQO	Measurement quality objective
NIST	National Institute of Standards and Technology
NWIS	*National Water Information System*
PHABSIM	*Physical Habitat Simulation*
QA	Quality assurance
QAPrP	Quality assurance program plan
QC	Quality control
RTK	Real-time kinematic
SEFA	*System for Environmental Flow Analysis*
SOP	Standard operating procedure
SWRCB	State Water Resources Control Board
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WCR	Watershed criteria report
WSEL	Water surface elevation
WUA	Weighted usable area

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Tables

Figures

A3. DISTRIBUTION LIST

This document will be electronically distributed to IFP staff and contractors appearing in Table 3. Additional document management details may be found in A9: *Documents and Records.*

Table 3. Distribution list.

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* Marine Pollution Studies Laboratory (Moss Landing Marine Laboratories)
** Statewide Water Planning Program

A4. PROGRAM ORGANIZATION

Roles and Responsibilities: Technical Staff

The IFP operates within the Water Branch of the CDFW Ecosystem Conservation Division. The program is implemented by technical staff members holding the following CDFW positions:

- *Environmental Program Manager 1 (Supervisor)*
- *Senior Environmental Scientist (Supervisor)*
- *Senior Environmental Scientist (Specialist)*
- *Environmental Scientist*
- *Fish and Wildlife Technician*
- *Senior Hydraulic Engineer*

These positions interact according to the following organizational chart (Figure 2).

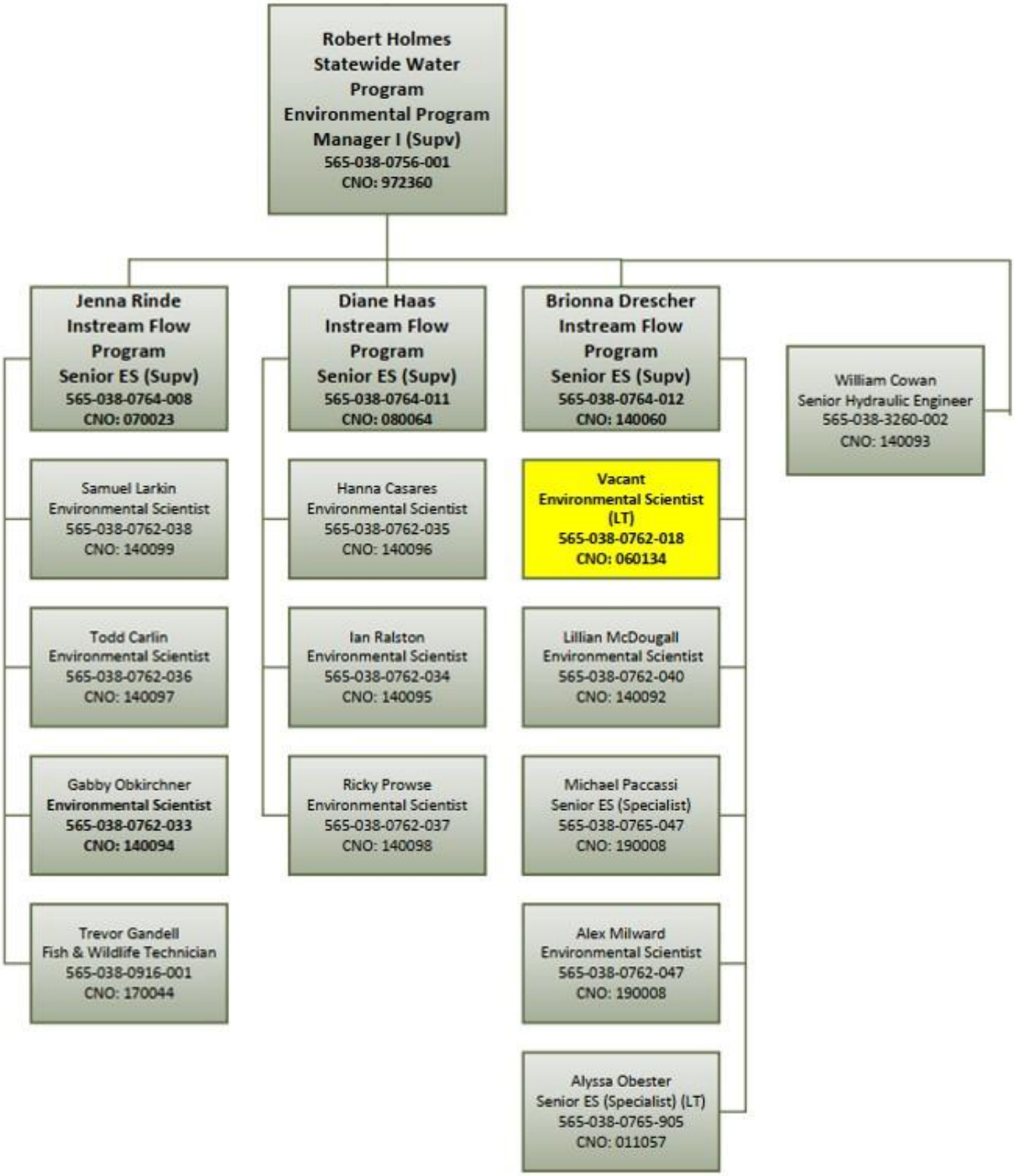

Figure 2. IFP organizational chart.

Specific roles and responsibilities of these technical staff members are detailed in the following sections.

ENVIRONMENTAL PROGRAM MANAGER 1 (SUPERVISOR)

The IFP is led by the *Environmental Program Manager 1 (Supervisor)*. Duties of this CDFW position include:

- Provide leadership to a team of scientific and engineering staff on statewide water planning issues to conserve aquatic and terrestrial ecosystems
- Coordinate and implement water planning programs focused on conservation and environmental protection
- Develop program policies, goals, and objectives
- Assist in formulating and finalizing instream-flow- and groundwater-related products
- Act as a representative in compliance negotiations, policy implementation, program budgeting, and strategic planning

SENIOR ENVIRONMENTAL SCIENTIST (SUPERVISOR)

Within the IFP, three *Senior Environmental Scientist (Supervisor)* staff lead a group of scientific personnel. Duties of this CDFW position include:

- Provide leadership to a multi-disciplinary team of environmental scientists and a fish and wildlife technician
- Plan, organize, and execute instream flow studies and manage contracted work
- Review technical data and complex hydraulic models
- Oversee the development of documents including study plans, technical reports, fact sheets, and guidance documents
- Be responsible for staff development, performance evaluation, program budgeting, and work force planning
- Collaborate with staff counterparts in the CDFW regions and other agencies

SENIOR ENVIRONMENTAL SCIENTIST (SPECIALIST)

The IFP currently includes multiple *Senior Environmental Scientist (Specialist)* staff. Duties of this CDFW position include:

- Provide internal and external coordination for implementation of instream flow studies
- Act as lead scientist and technical specialist in evaluating information to protect instream flow, groundwater, or aquatic habitat
- Develop and coordinate recommendations for data related to aquatic habitat and monitoring water use
- Prepare documents including study plans, technical reports, fact sheets, and guidance documents
- Plan and conduct flow studies
- Provide technical and procedural guidance to CDFW leadership and environmental scientists on aquatic habitat issues

ENVIRONMENTAL SCIENTIST

The IFP currently includes multiple *Environmental Scientist* staff. Duties of this CDFW position include:

- Develop and implement instream flow studies
- Collect streamflow and aquatic habitat data
- Analyze technical data to evaluate hydrology and monitor critical water quality components
- Prepare documents including study plans, technical reports, fact sheets, and guidance documents
- Provide presentations and participate in stakeholder outreach
- Develop technical information to support CDFW program and regional staff

FISH AND WILDLIFE TECHNICIAN

The IFP currently includes one *Fish and Wildlife Technician*. Under supervision, duties of this CDFW position include:

- Assist IFP staff with implementation of instream flow studies

- Conduct fieldwork relating to the collection of data for instream flow studies and related efforts
- Perform data entry and analysis on various computer systems
- Inventory, maintain, calibrate, and operate instream flow equipment

SENIOR HYDRAULIC ENGINEER

The IFP currently includes one *Senior Hydraulic Engineer.* Duties of this CDFW position include:

- Develop hydrologic and hydraulic engineering computer models
- Conduct hydrologic and engineering field studies for development of instream flow criteria
- Perform analyses, review hydrologic and engineering studies, prepare technical reports, and prepare legal exhibits
- Provide presentations and participate in stakeholder outreach

Roles and Responsibilities: Quality Assurance

The following project-specific IFP QA roles are filled by the above technical staff and a contractor from the Marine Pollution Studies Laboratory (MPSL) at Moss Landing Marine Laboratories.

- *Senior Project Lead/QA Officer*
- *Staff Project Lead*
- *Independent QA Manager*

Specific roles and responsibilities of these project-specific QA staff members are detailed in the following sections.

SENIOR PROJECT LEAD/QA OFFICER

The *Senior Environmental Scientist* (*Supervisory* or *Specialist*) oversees staff participating in projects and staff completing quality control (QC) tasks. The *Senior Project Lead* manages QA/QC processes as they are being performed and provides the final QA/QC review before project completion. The *Senior Project Lead* is responsible for ensuring that:

- Standard operating procedure (SOPs), field forms, and Microsoft Excel templates that may be used for the project are current
- Staff are adequately trained to perform project procedures
- Equipment is appropriate for the project and is properly calibrated
- Staff have enough time to complete project tasks

Oversight is provided by a *Senior Hydraulic Engineer* on the necessary steps to review data that may be used for hydraulic models and to validate modeling results.

STAFF PROJECT LEAD

The scientific staff (i.e., *Senior Environmental Scientist (Specialist)*, *Senior Hydraulic Engineer*, or Range C *Environmental Scientist*) is responsible for implementing the day-to-day tasks for a project with oversight from the *Senior Project Lead*. The *Staff Project Lead* is responsible for the following tasks:

- Creating and renaming the project's *QAQC_Log_Template.xlsx* file (e.g., *RedwoodCk_QAQC_Log.xlsx*)
- Setting up, maintaining, and organizing project files
- Establishing naming conventions at the beginning of a project and recording the conventions in the *QA/QC Log*
- Delegating QA/QC tasks
- Performing data omission tasks with *Senior Project Lead* approval.

When appropriate, the *Staff Project Lead* will check in with the *Senior Project Lead* for decisions that may require professional judgement, additional research, or discussion.

INDEPENDENT QA MANAGER

At the request of the IFP contract manager, duties of this position include:

- Creating, maintaining, and approving this QAPrP
- Performing audits of select *Instream Flow Evaluations*
- Performing audits of select watershed-wide instream flow criteria reports, or *Watershed Criteria Reports* (WCRs)

- Performing QA reviews of IFP procedural documents (e.g., SOPs, guidance documents) and fact sheets
- Maintaining all IFP staff training profiles

As a contractor with MPSL, this position is independent of all IFP data collection activities.

A5. PROBLEM DEFINITION/BACKGROUND

Program Purpose

The CDFW IFP develops instream flow criteria and recommendations to support and maintain healthy conditions for aquatic and riparian species. These instream flows are determined by investigating the relationships between flow and available stream habitat for waterways throughout California. Scientifically defensible instream flow criteria can be developed through site-specific studies and/or analyses based on modeled hydrologic data and may be transmitted to the State Water Resources Control Board (SWRCB) for consideration in water allocation and appropriation actions.

Instream flow is used to identify the rate of water flow, measured in cubic feet per second (cfs), required at different times of the year at a specific location in a waterway. Instream flow criteria and implementation of these flows are required to protect aquatic habitat, sustain wildlife, provide recreational opportunities, and support agriculture and domestic uses. While some watersheds have flowing water throughout the year, it is often the responsibility of water managers to distribute the water between uses. CDFW, a natural resource management agency, is faced with the complex task of identifying and recommending instream flows necessary for supporting natural resources. Instream flow determination is crucial so that aquatic, riparian, and terrestrial resources dependent on water will be considered and protected during water management activities.

Many of California's rivers and streams are known for the salmon and steelhead trout that begin and end their life cycles in them. To protect these anadromous fishes, and other aquatic and riparian species, studies are needed to better understand their habitat requirements. This is especially important in stream systems where conditions are altered from natural historic levels and where changes negatively affect the timing of flow distribution and temperature regimes. Instream flow studies are developed to assess the amount and timing of water flow, and study reports are generated that summarize the data collected in order to identify and recommend flow regimes required to maintain healthy aquatic resources.

Applicable Regulations

Programmatic activities are required by the *California Water Action Plan* (CWAP), Public Resources Code (§10000-10005), Fish and Game Code §5937 mandates, and the *Water Resilience Portfolio*. The IFP addresses objectives outlined in the applicable regulations described below by using rapid or site-specific flow assessment methodologies to develop instream flow criteria.

CALIFORNIA WATER ACTION PLAN

The California Natural Resources Agency, the California Environmental Protection Agency, and the California Department of Food and Agriculture developed the CWAP to meet three broad objectives:

1. More reliable water supplies
2. The restoration of important species and habitat
3. A more resilient, sustainably managed water resources system (water supply, water quality, flood protection, and environment) that can better withstand inevitable and unforeseen pressures in the coming decades

Action 4 of the CWAP, *Protect and Restore Important Ecosystems*, contains a sub-action that states the following:

The State Water Resources Control Board[a] and the Department of Fish and Wildlife[b] will implement a suite of individual and coordinated administrative efforts to enhance flows statewide in at least five stream systems that support critical habitat for anadromous fish.

Through a coordinated effort between the SWRCB and CDFW, five priority stream systems (Figure 3) have been identified as a starting point for the CWAP effort:

1. Mark West Creek, tributary to the Russian River
2. Mill Creek, tributary to the Sacramento River

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[a] The State Water Resources Control Board operates under the authority of the California Environmental Protection Agency.
[b] The California Department of Fish and Wildlife operates under the authority of the California Natural Resources Agency.

3. Shasta River, tributary to the Klamath River
4. South Fork Eel River
5. Ventura River

Currently, SWRCB and CDFW are working to identify potential actions that may be taken to enhance and establish instream flow for anadromous fish in these five priority streams.

Source: https://www.waterboards.ca.gov/waterrights/water_issues/programs/instream_flows/cwap_enhancing

Figure 3. California Water Action Plan priority streams.

CALIFORNIA PUBLIC RESOURCES CODE (§10000-10005)

Division 10 (i.e., *Streamflow Protection Standards*) of California's Public Resources Code includes the following six sections relevant to IFP work.

Section 10000

The Legislature finds and declares as follows:

(a) A substantial increase has occurred in the number of requests to appropriate water from the various streams and watercourses of this state, especially for the purpose of generating electric energy.

(b) These requests, if approved without due regard for their cumulative effect on streamflows, could adversely affect, to a serious and significant degree, the fish and wildlife resources dependent on those streams and watercourses.

(c) These fish and wildlife resources are important for the entire state and are inextricably linked to the continued economic viability of industries, such as the fishing industry, which are desirable and important components of the state's economy.

Section 10001

The Director of Fish and Game shall identify and list those streams and watercourses throughout the state for which minimum flow levels need to be established in order to assure the continued viability of stream-related fish and wildlife resources. The director shall include in this identification list those streams and watercourses the director determines are significant, along with a statement of findings as to why that stream or watercourse was selected. The identification list required by this section shall rank the streams and watercourses beginning with those where the need for establishing minimum flow levels is the greatest. The director, at his discretion, may revise the list and may add or delete streams or watercourses as circumstances require. The initial identification list required by this section shall be completed no later than January 1, 1984.

Section 10002

The Director of Fish and Game shall prepare proposed streamflow requirements, which shall be specified in terms of cubic feet of water per second, for each stream or watercourse identified pursuant to Section 10001. In developing the requirements for each stream, the Director shall consult with the Director of Water Resources, the Director of Boating and Waterways, the Director of Parks

and Recreation and with all affected local governments. The Director of Fish and Game may also consult with any private individuals, groups, or organizations as the director deems advisable. Upon completion of the proposed streamflow requirements for any individual stream or watercourse, the Director of Fish and Game shall transmit these proposed requirements to the State Water Resources Control Board. The State Water Resources Control Board shall consider these requirements within a stream as set forth in Section 1257.5 of the Water Code. The Director of Fish and Game shall complete the preparation of proposed requirements for the initial streams not later than July 1, 1989. The Department of Fish and Game may contract for temporary services for purposes of preparing the proposed streamflow requirements.

Section 10003

The Director of Fish and Game, on his or her own motion or at the request of the State Water Resources Control Board, may review any streamflow requirement and may propose revision or modification thereof. The proposed revision or modification shall be transmitted to the State Water Resources Control Board.

Section 10004

The Department of Fish and Game shall initiate studies to develop proposed streamflow requirements for those streams or watercourses in each fiscal year for which funds are appropriated and shall complete studies on each stream or watercourse within three years. It is the intent of the Legislature that the department develop a program that will initiate studies on at least ten streams or watercourses in each fiscal year.

Section 10005

(a) The Department of Fish and Game shall impose and collect a filing fee of eight hundred fifty dollars ($850) to defray the costs of identifying streams and providing studies pursuant to Division 10 (commencing with Section 10000) of the Public Resources Code.

(b) The filing fee shall be proportional to the cost incurred by the Department of Fish and Game and shall be annually reviewed and adjustments recommended to the Legislature in an amount necessary to pay the costs of the Department of Fish and Game as specified in subdivision (a).

(c) Any user of water, including a person or entity holding riparian or appropriative rights, shall pay the filing fee to the Department of Fish and Game

upon application to the State Water Resources Control Board for any permit, transfer, extension, or change of point of diversion, place of use, or purpose of use, if there is a diversion of water from any waterway where fish reside. No permit, or other entitlement identified in this section is effective until the filing fee is paid. The State Water Resources Control Board shall, every six months, forward all fees collected to the department and provide the location for each entitlement for which a filing fee has been collected.

(d) The fee imposed by this section shall not be imposed on the following applications filed with the State Water Resources Control Board:

> *(1) Small domestic use registrations and livestock stockpond certificates submitted pursuant to Article 2.7 (commencing with Section 1228) of Chapter 2 of Division 2 of the Water Code.*
>
> *(2) The first application for an extension of time for an individual permit if no change in point of diversion, place of use, or purpose of use is included in the application.*
>
> *(3) Water applications which, in the opinion of the Department of Fish and Game, are filed for administrative and technical clarification purposes only.*
>
> *(4) Water applications or petitions, the primary purpose of which is to benefit fish and wildlife resources. The determination of the benefit to fish and wildlife shall be made, in writing, by the Department of Fish and Game in order to be exempt from the fee.*

(e) If an applicant or petitioner files multiple applications or petitions for the same appropriation, transfer, extension, or change, and the State Water Resources Control Board reviews and considers the applications or petitions together, only one filing fee is required for those applications or petitions.

CALIFORNIA FISH AND GAME CODE (FGC) §5937

Article 2 (i.e., Dams and Obstructions) of California's FGC is relevant to IFP work.

The owner of any dam shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam. During the minimum flow of water in any river or stream, permission may be granted by the department to the owner of any

dam to allow sufficient water to pass through a culvert, waste gate, or over or around the dam, to keep in good condition any fish that may be planted or exist below the dam, when, in the judgment of the department, it is impracticable or detrimental to the owner to pass the water through the fishway.

WATER RESILIENCE PORTFOLIO

Released in 2020, the *Water Resilience Portfolio* is California's blueprint for coping with more extreme droughts and floods and rising temperatures, while addressing long-standing challenges that include declining fish populations, over-reliance on groundwater, and lack of safe drinking water in many communities. The IFP has initiated the implementation of the objectives to protect and enhance natural systems described in Section 9 of the *Portfolio*.

Section 9

Help regions better protect fish and wildlife by quantifying the timing, quality, and volume of flows they need.

Section 9.1

Develop rapid methodologies to establish regional instream flow metrics through the multi-partner California Environmental Flow Framework. Provide regional training on the environmental flow methods and tools to support local and statewide resource managers. Develop a series of case studies around the state to refine the tools.

Section 9.2

Conduct and utilize instream flow analyses to further develop instream flow recommendations for ecologically important streams to protect public trust values.

Section 9.3

Bring together regulators, tribes, water users, public water agencies, non-governmental organizations, and other stakeholders to develop innovative, voluntary solutions to water supply, water quality, and ecosystem protection.

Section 9.4

Work with universities, tribes, public water agencies, and non-governmental organizations to develop new tools for identifying functional ecosystem flows.

Section 9.5

Develop analytical modeling tools that can be used to rapidly assess streamflow depletion tied to groundwater pumping.

Other Water Management Processes

In addition to meeting the objectives described by the applicable regulations above, the IFP participates in other water management and water allocation processes.

LAKE AND STREAMBED ALTERATION AGREEMENTS

CDFW requires a *Lake and Streambed Alteration Agreement* when a project activity may substantially adversely affect fish and wildlife resources within any river, stream, or lake. CDFW is the contact agency for reviewing permit applications and IFP staff provide input on base hydrology and flows to protect ecosystem needs.

FEDERAL ENERGY REGULATORY COMMISSION

The Federal Energy Regulatory Commission is a nationwide, independent agency that regulates the interstate transmission of electricity, natural gas, and oil. Regional CDFW staff coordinate with outside companies operating hydroelectric projects under the jurisdiction of the Federal Energy Regulatory Commission. IFP staff provide technical guidance and expertise to regional CDFW staff on base hydrology and flows to protect ecosystem needs.

WATER RIGHTS

As trustee for California's fish and wildlife resources, CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species. The California Water Code requires that when considering the appropriation of water, the SWRCB consult with CDFW on the amounts of water needed for fish and wildlife. Regional CDFW staff engage in the water right process via review, analysis, and comment on new water rights applications, development of

conditions for water right permits and licenses, as well as any proposed changes to existing water rights. Water Rights Program staff within the IFP participate in the water rights permitting process by providing program technical support and coordination for regional CDFW staff to ensure statewide consistency. Additionally, IFP staff conduct water-right-related policy review, and coordinate with outside agencies and stakeholders regarding water right permitting and planning processes.

A6. PROGRAM DESCRIPTION

Tasks

To ensure high-quality science that is robust, credible, transparent, and relevant, the IFP:

- Conducts flow studies
- Collects field data
- Develops guidelines for QA
- Conducts outreach
- Coordinates with other agencies and interested parties on program-related activities

Instream flow studies should broadly consider the structure and function of the river system. Following the *Instream Flow Incremental Methodology*, five riverine components (i.e., biology, hydrology, geomorphology, water quality and connectivity) are reviewed when developing instream flow criteria. The development of instream flow criteria provides information on important factors in streams, such as:

- Relationships of flow to aquatic habitat
- Aquatic habitat suitability
- Stream water temperature
- Channel geomorphology
- Riparian habitat and restoration activities
- Temporal and spatial hydrologic characteristics of flow regimes
- Fish population abundance, distribution, and dynamics

Field Measurements

Each IFP study may utilize a combination of existing, empirical, and modeled data (see B9: *Non-Direct Measurements*) in addition to the discrete field measurements identified in Table 4.

Table 4. Field measurements.

Measurement	Unit
Depth	ft
Distance	ft
Dry/wetted bed profile elevation*	ft
Flow	ft^3/s
Stage of zero flow elevation*	ft
Velocity	ft/s
Water surface elevation*	ft

*If using Universal Transverse Mercator coordinates with a total station or real-time kinematic device, dry/wetted bed profile, stage of zero flow, and water surface elevations could be measured to 0.001 m.

Field measurements are made according to the IFP SOPs identified in B4: *Analytical Methods*. While these SOPs include comprehensive lists of required instruments and equipment, key IFP field measurement devices are described below. Management of these devices is detailed in B6: *Instrument/Equipment Testing, Inspection, and Maintenance* and B7: *Instrument/Equipment Calibration and Frequency*.

Field Measurement Devices

FLOW METERS

The IFP uses portable flow meters to collect velocity measurements that are used to calculate stream discharge. While the IFP's primary flow meter is the Hach FH950, the Marsh-McBirney Flo-Mate 2000 may also be used to collect data (Figure 4). Use of both meters follows the IFP's *Standard Operating Procedure for Discharge Measurements in Wadeable Streams in California*.

Figure 4. Hach FH950 (left) and Marsh-McBirney Flo-Mate 2000 (right).

AUTO LEVELS

The IFP's Nikon AE-7 automatic levels (i.e., auto levels – Figure 5) are used to perform the field surveys detailed in three IFP SOPs (i.e., *Standard Operating Procedure for Streambed and Water Surface Elevation Data Collection in California*, *Standard Operating Procedure for the Wetted Perimeter Method in California*, and *Standard Operating Procedure for the Habitat Retention Method in California*). Auto levels are used in conjunction with a stadia rod to collect dry/wetted bed elevations, stage of zero flow, and water surface elevations.

Figure 5. Nikon AE-7 auto level.

PRESSURE TRANSDUCER

For some studies, the IFP installs Solinst pressure transducers (PTs; Figure 6) at sites without stream gages to collect water depth measurements. These depth measurements are combined with water surface elevations to develop a rating curve and estimate flow time series data. The PTs are installed according to the State of Utah Division of Water Quality's *Standard Operating Procedure for Pressure Transducer Installation and Maintenance*.

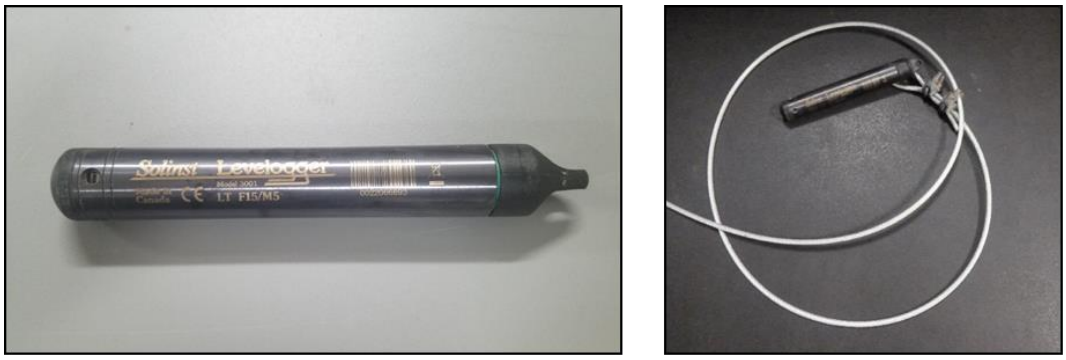

Figure 6. Solinst PT (left) with tether (right).

TOTAL STATION

The IFP uses the Trimble S6 total station and associated TSC2 field controller data collector (Figure 7) to measure two-dimensional (2D) bed topography attributes when a satellite signal is not available or sufficient to operate a real-time kinematic (RTK) global positioning system (GPS) device.

Figure 7. Trimble S6 (left) and Trimble TSC2 (right).

REAL-TIME KINEMATIC GLOBAL POSITIONING SYSTEM DEVICES

The Topcon FC 500 field controller and Topcon HiPer V receiver (Figure 8) are RTK positioning devices used by the IFP to measure 2D bed topography attributes when a GPS satellite signal is available.

Figure 8. Topcon HiPer V (left) and Topcon FC 500 (right).

Logistics

The IFP typically coordinates study design, field data collection, and study implementation with CDFW Regional staff, SWRCB, US Fish and Wildlife Service (USFWS), and non-governmental organizations. Programmatic studies may occur throughout California. While studies may be conducted throughout the year, field work is typically performed in flow conditions that are wadable but with measurable instream flow. Office-based work can be done at any time of the year and utilizes measured or modeled data.

A7. QUALITY OBJECTIVES AND CRITERIA

The IFP performs in situ field measurements that do not require the collection of physical samples. As a result, there are no QC samples or measurement quality objectives (MQOs) associated with IFP studies.

All IFP field devices must meet the performance requirements specified in B6: Instrument/Equipment Testing, Inspection, and Maintenance, B7: Instrument/ Equipment Calibration and Frequency, and Table 5.

Table 5. Field measurement criteria.

Measurement	Measurement Criterion
Depth	0.05 ft
Distance	0.10 ft
Dry/wetted bed profile elevation*	0.01 ft
Flow	0.01 ft^3/s
Stage of zero flow elevation*	0.01 ft
Velocity	0.01 ft/s
Water surface elevation*	0.01 ft

*If using Universal Transverse Mercator coordinates with a total station or RTK device, dry/wetted bed profile, stage of zero flow, and water surface elevations could be measured to 0.001 m.

All IFP modeling must meet the performance requirements specified in B9: *Non-Direct Measurements*.

Adherence to IFP performance requirements is assessed by the Independent QA Manager during WCR and *Instream Flow Evaluation* audits.

A8. SPECIAL TRAINING/CERTIFICATION

Training

The IFP uses individualized staff training profiles (Figure 9) to record the reading of programmatic documents (e.g., SOPs, this QAPrP) and participation in IFP-hosted training events (Figure 10). Training profiles are updated when applicable documents are released or revised, or when applicable training events have concluded.

Training profiles are consolidated in a program-wide Microsoft *Excel* workbook. This workbook is maintained by the IFP's *Independent QA Manager* and assessed as part of *Instream Flow Evaluation* and WCR audits.

Name:	
Hire Date:	
Supervisor:	
Training Material	**Completion Date**
Standard Operating Procedures	
Critical Riffle Analysis for Fish Passage in California (CDFW-IFP-001; October 2012)	October 31, 2012
Discharge Measurements in Wadeable Streams in California (CDFW-IFP-002; August 2013)	August 31, 2013
Streambed and Water Surface Elevation Data Collection in California (CDFW-IFP-003; August 2013)	August 31, 2013
Wetted Perimeter Method in California (CDFW-IFP-004; August 2013)	August 31, 2013
Flow Duration Analysis in California (CDFW-IFP-005; August 2013)	August 31, 2013
Habitat Retention Method in California (CDFW-IFP-006; June 2016)	June 30, 2016
Critical Riffle Analysis for Fish Passage in California (CDFW-IFP-001v2; September 2017)	September 30, 2017
Habitat Retention Method in California (CDFW-IFP-006v2; December 2018)	December 31, 2018
Wetted Perimeter Method in California (CDFW-IFP-004v2; January 2020)	January 31, 2020
Discharge Measurements in Wadeable Streams in California (CDFW-IFP-002v2; February 2020)	February 28, 2020
Wetted Perimeter Method in California (CDFW-IFP-004v3; July 2020)	July 31, 2020

Figure 9. Example IFP training profile.

Department-wide safety trainings hosted by CDFW are included in the project-specific IFP health and safety plan.

Figure 10. IFP field training.

A9. DOCUMENTS AND RECORDS

Quality Assurance Documents

The IFP maintains and implements a variety of planning and procedural QA documents. As applicable, their management and implementation are assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

These internal, dated documents will be updated as needed to ensure current, consistent use. When revisions are issued, document recipients will be instructed to retire all previous versions and discontinue all references to them.

INSTREAM FLOW PROGRAM QUALITY ASSURANCE PLAN

The planning, implementation, and assessment of the IFP's QA system is detailed in this document. According to EPA Region 9, the purpose of a QAPrP is to document planning for environmental data generation and to provide a program-specific "blueprint" for obtaining the type and quality of environmental data needed for the range of decisions or uses reflected by program activities. A QAPrP should document how QA and QC are applied to ensure that the results obtained are of the type and quality needed and expected.

The IFP's *Independent QA Manager* is responsible for the creation, maintenance, approval, and electronic distribution (i.e., emailing) of this document and its revisions according to A3: *Distribution List*. To ensure that it remains current, this document will be reviewed annually and revised at a minimum of every three years.

INSTREAM FLOW PROGRAM QUALITY ASSURANCE AND QUALITY CONTROL GUIDELINES

Procedural details associated with many of the IFP's data management systems are centralized in the document *Instream Flow Program Quality Assurance and Quality Control Guidelines*, whose scope includes:

- QA roles and responsibilities
- *QA/QC Log* template
- Calibration and validation

- File data verification
- Office data entry verification
- Document management

INSTREAM FLOW PROGRAM EQUIPMENT PERFORMANCE EVALUATION GUIDANCE

Procedural details associated with many of the IFP's equipment management systems are centralized in the internal programmatic document *Instream Flow Program Equipment Performance Evaluation Guidelines*, whose scope includes:

- Calibration test instructions
- Maintenance contracts
- Tracking

Quality Assurance/Quality Control Log

For each IFP study, a Microsoft *Excel* workbook called a *QA/QC Log* is initiated. Throughout the study, individual worksheets are populated with applicable study information, including:

- Administration
- Project personnel
- File naming conventions
- Scanned data
- Equipment downloads
- External data
- Data entry verification
- Data omission
- R scripts
- Data analyses
- Data reporting

If required for a study, additional worksheets may be added. The *QA/QC Log* allows the IFP to be transparent and accountable in its data management and decision-making processes. Specific procedures associated with this system are

detailed in the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines*. Implementation of the *QA/QC Log* is assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

Additional Quality Assurance Coverage

While the IFP's *Study Plans*, *Instream Flow Evaluations*, and WCRs do not include detailed QA coverage, they will each reference this QAPrP and other applicable IFP QA documents.

Scientific Data Governance Policy

When a project includes scientific data collection, the Department requires that a *Data Management Plan* (DMP) and all associated scientific data collected by Department staff be submitted for compliance with the Department's *Scientific Data Governance Policy*. The purpose of the DMP is to improve accessibility and sharing of data by helping inventory, centralize, and secure data. DMPs only contain data that the Department generated and not data from external parties. Data that is well-organized and well-documented with metadata will support the sharing of scientific data and will help facilitate development of future DMPs and data uploads.

A DMP includes metadata, a data dictionary, and collected data that were used to generate a report in its original or analyzed format. Importantly, the metadata of a DMP outlines the project's name, contact persons, description, data format, quality assurance, timeline, status, and sharing restrictions. Additionally, the data dictionary defines data terms, abbreviations, and units that may have been used on datasheets or in workbooks during analysis. A DMP can begin prior to data collection but should be maintained during the length of a project and ultimately completed once the project is finished or a report is generated.

Data Retention Policy

ELECTRONIC DATA

Old or archived data not relevant to a finalized project may be deleted after project completion if approved by the *Senior Project Lead*. All files relevant to the final report, including omitted data referenced in the report, must be retained.

HARDCOPY DATA

Physical datasheet destruction is done to reduce material storage. Electronic datasheets must be maintained indefinitely. Projects are eligible for datasheet destruction if they:

- Have created and maintained electronic files
- Have been completed for five years or more
- Have no past, current, or anticipated litigation and are not subject to a litigation hold
- Are not subject to any past, current, or anticipated *Public Records Act* requests
- Are not subject to any other past, current, or anticipated legal obligations (e.g., adjudications)

If the above criteria are met, the following documents may be destroyed following approval by the *Senior Project Lead*:

- Field datasheets
- Field notebooks
- Other physical documents used to record field activities

The *Admin* tab of the project *QA/QC Log* is updated to include the destruction date, approving party, and approval email file path.

LITIGATION HOLDS

Consult with the Office of General Council for guidance on datasheet destruction if a study may be subject to, is undergoing, or was under a litigation hold. Even if litigation is over for a project, there may still be legal obligations to retain records.

Records that can be requested under a litigation hold can include any and all of the following that are relevant or potentially relevant to a project:

- Hardcopies of documents
- Electronic information:
    - Email and email attachments
    - Voicemail messages
    - Word processing documents
    - Calendars and planners
    - Spreadsheets and databases
    - Instant messages
    - Network logs
    - Presentations
    - Graphics files and computer-aided design files
    - Other (e.g., any information that is digitally created, stored, and transferred)
- Any information recorded by handwriting, typewriting, printing, photographing, photocopying, tape recording, video recording, and any other means of recording information
- Documents found on:
    - Desktop and laptop computers
    - Network and email servers
    - Personal digital assistants such as smartphones, permanent or portable storage devices (e.g., backup tapes, ZIP drives, flash drives, offsite storage, home-based computer devices, vehicle "Black Boxes", phone company voicemail records)

Group B:
Data Generation and Acquisition

Figure 11. Trimble S6 total station on Silver King Creek.

B1. SAMPLING PROCESS DESIGN
B2. SAMPLING METHODS
B3. SAMPLE HANDLING AND CUSTODY

The IFP performs in situ field measurements that do not require the collection of physical samples. Consequently, content associated with these QAPrP sections are not relevant to IFP studies.

B4. ANALYTICAL METHODS

The IFP supports the use of a variety of defensible methods to quantify flow regimes for fish, wildlife, and their habitats. The program recognizes that there are a large number of proven, acceptable, and defensible procedures available for quantifying flow needs. The challenge is selecting a suite of tools that provides the necessary flow regime information. There are four key considerations:

1. Riverine processes are dynamic and complex, and thus require flexibility in method selection.
2. The use of multiple methods can help address the complex ecological relationships of a riverine ecosystem.
3. The vast majority of instream flow quantification methods are based on some aspect of biology.
4. There is no single best method. The five core riverine components (i.e., hydrology, geomorphology, biology, water quality, and connectivity) must be considered.

Depending on their scope, IFP studies may include some or all of the SOPs appearing in Table 6. In addition, these SOPs are available on the IFP website as an informational resource for other state and federal agencies, non-governmental organizations, private contractors, and other organizations throughout California.

Table 6. IFP SOPs.

ID	Name	Effective Date
IFP-001	*Standard Operating Procedure for Critical Riffle Analysis for Fish Passage in California*	September 2017
IFP-002	*Standard Operating Procedure for Discharge Measurements in Wadeable Streams in California*	February 2020
IFP-003	*Standard Operating Procedure for Streambed and Water Surface Elevation Data Collection in California*	August 2013
IFP-004	*Standard Operating Procedure for the Wetted Perimeter Method in California*	July 2020

ID	Name	Effective Date
IFP-005	*Standard Operating Procedure for Flow Duration Analysis in California*	August 2013
IFP-006	*Standard Operating Procedure for the Habitat Retention Method in California*	December 2018

Prior to use, all SOPs are written and reviewed by IFP scientists and/or engineers and approved by the *Statewide Water Planning Program Manager* and IFP's *Independent QA Manager.* Maintenance and implementation of these SOPs is assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

Additionally, the IFP uses the *Guidelines to the Application and Use of the Physical Habitat Simulation System* (CDFG 2008) which provides guidelines for conducting 1D and 2D hydraulic habitat modeling studies. These internal, dated documents will be updated as needed to ensure current, consistent use. When revisions are issued, document recipients will be instructed to retire all previous versions saved locally and discontinue all references to them. When SOPs are revised mid-study, data will be re-collected or re-analyzed following the updated and cited SOP.

Staff training associated with these analytical methods is detailed in A8: *Special Training/Certification*. Quality control and instrument/equipment management associated with these analytical methods may be found in the next three sections of this document.

Figure 12. IFP scientists perform a field survey of Butte Creek.

B5. QUALITY CONTROL

At this time, the IFP neither performs nor subcontracts sampling. As a result, there are no QC samples or MQOs associated with IFP studies.

All IFP field devices must meet the performance requirements specified in B6: *Instrument/Equipment Testing, Inspection, and Maintenance* and B7: *Instrument/ Equipment Calibration and Frequency*. All IFP modeling must meet the performance requirements specified in B9: *Non-Direct Measurements*. Adherence to these requirements is assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

B6. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Implementation of IFP studies and SOPs requires a variety of instruments and equipment (see A6: *Program Description*). These devices, as well as associated spare parts and consumables, are stored in the IFP's West Sacramento headquarters.

Programmatic devices requiring specialized management are identified in Table 7.

Table 7. Device testing, inspection, and maintenance.

Device	Responsible Party	Documentation
Hach FH950 Flow Meter	IFP, Hach	Equipment Performance Tracking Log; Hach Open-Channel Calibration Certificate
Marsh-McBirney Model 2000 Flow Meter	IFP, Hach	Equipment Performance Tracking Log; Hach Open-Channel Calibration Certificate
Nikon AE-7 Auto Level	IFP, CSDS	CSDS Calibration Report; Equipment Performance Tracking Log
Solinst Levelogger 3001 Pressure Transducer	IFP, Solinst	Equipment Performance Tracking Log
Trimble S6 Total Station	California Surveying and Drafting Supply (CSDS)	CSDS Calibration Report; Equipment Performance Tracking Log
Topcon FC 500 Field Controller	Topcon Vendor	Equipment Performance Tracking Log
Topcon HiPer V Receiver	Topcon Vendor	Equipment Performance Tracking Log

These and other devices (e.g., stadia rods, measuring tapes) must be inspected by IFP staff prior to use. Additional management may be carried out by IFP staff, the device manufacturer, and/or CSDS. These activities are documented in the IFP's *Equipment Performance Tracking Log* and elsewhere as noted.

Additional procedural details associated with these devices may be found in the internal IFP document *Instream Flow Program Equipment Performance Evaluation Guidance* (see A9: *Documents and Records*). Device testing, inspection, and maintenance systems are assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

Flow Meters

Prior to each use, flow meters are calibrated by IFP staff according to B7: *Instrument/Equipment Calibration and Frequency.* Meters failing calibration are sent to Hach for maintenance. Following this maintenance, meters requiring sensor bulb calibration will be issued an *Open Channel Calibration Certificate*.

Auto Levels

At least annually, IFP staff perform the "two-peg test" detailed in the internal IFP document *Instream Flow Program Equipment Performance Evaluation Guidance* (see A9: *Documents and Records*). The records of this test are kept in an internal shared drive. Devices failing this test receive manufacturer-recommended, National Institute of Standards and Technology (NIST) traceable testing, inspection, and maintenance by CSDS.

Pressure Transducer

Before each deployment, IFP staff confirm the PT's ambient barometric pressure measurement against an independent device. Devices failing this test receive manufacturer or manufacturer-authorized service.

Total Station

The total station receives annual, manufacturer-recommended, NIST-traceable testing, inspection, and maintenance by CSDS. The oscillator offset is checked and adjusted approximately every three years.

Real-Time Kinematic Global Positioning System Devices

All RTK-GPS devices receive manufacturer-recommended firmware/software updates as needed.

B7. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

While all devices identified in B6: *Instrument/Equipment Testing, Inspection, and Maintenance* require routine service and/or repair, the IFP's flow meters (i.e., Hach FH950, Marsh-McBirney Flo-Mate 2000) require calibration immediately before each use. This calibration is performed according to the IFP's *Standard Operating Procedure for Discharge Measurements in Wadeable Streams in California* and the internal IFP document *Instream Flow Program Equipment Performance Evaluation Guidance* (see A9: *Documents and Records*).

Meter calibration is documented in the applicable study's *Discharge Data Sheet* or *Stage/Discharge Worksheet*. Calibration systems are assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

B8. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Programmatic SOPs (see B4: *Analytical Methods*) include a variety of instruments and equipment that are detailed in a dedicated section within each document. These instruments and equipment, as well as associated spare parts and consumables, are inspected by IFP staff for proper function, as well as consistency within and among programmatic studies.

Routine inspections associated with specialized IFP devices are described in B6: *Instrument/Equipment Testing, Inspection, and Maintenance*.

B9. NON-DIRECT MEASUREMENTS

In addition to direct field measurements (see A6: *Program Description*), IFP studies utilize a variety of models as well as data from sources such as the US Geological Survey's (USGS's) *National Water Information System* (NWIS). Use of these non-direct measurements is assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

Models

Instream flow criteria are developed using field measurements and modeling. Model selection, software, and performance are described below.

MODEL SELECTION

The use of multiple models can help address the complex ecological relationships of a riverine ecosystem. When deciding which model, or suite of models, is appropriate for an intended use, the user must take into consideration limitations and constraints. For example:

- Models manage uncertainty, they do not eliminate it.
- The relationship between flow and habitat is not linear and may differ between streams.
- A flow that is beneficial for one species may be detrimental to other species. For example, higher flow is not always better (and may actually be worse).
- Model accuracy depends on the accuracy of the data input. Models have specified limits. Due to interactions not fully accounted for or understood, models only address a portion of a system, and may not be able to predict the precise behaviors or relationships of a whole system.

MODEL SOFTWARE

Currently, the IFP uses a variety of commercial and open-source modeling software.

Functional Flow Calculator

Using daily streamflow time series data, the eFlows *Functional Flow Calculator* (FFC) quantifies key hydrologic aspects of the annual flow regime. The FFC produces dimensionless reference hydrographs and a suite of functional flow metrics that quantify functional flow components. Results are presented visually, and data can be directly downloaded. The hydrographs and metrics enable comparisons of streamflow patterns across regions, stream classes, and various forms and magnitudes of flow alteration. The FFC generates 24 core metrics describing aspects of streamflow timing, magnitude, duration, frequency, and rate of change, organized into five functional flow components:

1. Fall pulse flow
2. Wet-season baseflow
3. Peak flows
4. Spring recession flow
5. Dry-season baseflow

Hydraulic Engineering Center River Analysis System

The US Army Corps of Engineers' *Hydraulic Engineering Center River Analysis System* (HEC-RAS) contains several river analysis components for:

- One-dimensional (1D) steady flow water surface profile computations
- 1D and 2D unsteady flow calculations
- Sediment transport/mobile bed computations
- Water temperature/water quality modeling

All four components use a common geometric data representation and common geometric and hydraulic computation routines. In addition to these river analysis components, the system contains several hydraulic design features that can be used once the basic water surface profiles are computed.

HydroCalc

Developed by Northwest Hydraulic Consultants, *HydroCalc* software is based on Manning's equation and can be used to develop rating curves for discharge and hydraulic parameters. *HydroCalc* includes the following computational capabilities and modules:

1. Open channel/uniform flow module
2. Pipe flow module
3. Sediment yield module
4. Manifold/diffuser module
5. Riverine cross section geometry module

Physical Habitat Simulation System

The purpose of the USGS *Physical Habitat Simulation System* (PHABSIM) is to simulate a relationship between streamflow and physical habitat for various life stages of a species of fish. The two basic components of PHABSIM are the hydraulic and habitat simulations of a stream reach using defined hydraulic parameters and habitat suitability criteria. Hydraulic simulation is used to describe the area of a stream having various combinations of depth, velocity, and channel index as a function of flow. This information is used to calculate a weighted usable area (WUA) for the steam segment from suitability information based on field sampling of the various species of interest.

River 2D

The University of Alberta's *River 2D* is a 2D, depth-averaged finite element hydrodynamic modeling suite that has been customized for fish habitat evaluation studies. The *River2D* model simulates hydraulic conditions in natural rivers from IFP topographic data input and uses the habitat suitability curves containing known biological preference data to calculate the potential habitat for specific species life-history stages by obtaining the WUA. The modeling suite consists of four programs:

1. *River 2D*
2. *River 2D - Bed*
3. *River 2D - Ice*
4. *River 2D - Mesh*

System for Environmental Flows Analysis

The *System for Environmental Flow Analysis* (SEFA) is a software program that provides a set of tools for quantifying effects of flow variation on aquatic habitat. Data collection and analysis using SEFA can be performed in numerous

ways depending on river morphology, structural alterations, and management objectives.

The IFP has used SEFA for:

- 1D habitat hydraulics analysis
- Habitat suitability criteria development
- Hydrologic and habitat time series analysis

Additionally, SEFA has the ability to apply multivariate habitat models as well as standard habitat suitability criteria.

MODEL PERFORMANCE

Model calibration flows will be selected such that:

1. The lowest simulated flow is no less than 0.4 times the lowest measured flow used in the rating curve
2. The highest simulated flow is at most 2.5 times the highest measured flow used in the rating curve

For 2D hydraulic habitat models, the IFP adheres to *Sacramento Fish and Wildlife Office Standards for Physical Habitat Simulation Studies* prepared by the Restoration and Monitoring Program of the USFWS. These include:

- *Accuracy:* the accuracy of the 2D bed topography elevations collected should be 0.1 ft and the horizontal accuracy should be at least 1.0 ft.
- *Mesh Quality:* the quality of the fit between the final bed profile and the computational mesh, as measured by the Quality Index value, should be at least 0.2.
- *Solution Change/Net Flow:* when the model is run to steady state at the highest flow simulated, the solution change should be less than 0.00001 and the net flow should be less than one percent.
- *Froude Number (FN):* the maximum FN for low gradient streams should be less than one.
- *Water Surface Elevation (WSEL)*: if developing a 2D model, WSELs predicted at the upstream transect should be within 0.1 foot of the WSEL predicted by PHABSIM for the highest simulated flow (or observed at the highest measured flow).

- *Velocity Validation*: the target correlation between at least 50 spatially distributed measured and simulated velocities is greater than 0.6.

US Geological Survey National Water Information System

Many IFP studies rely on discharge, level, and/or stage data from USGS gaging stations. These data are made available through the USGS NWIS. Associated procedures and performance criteria are described below.

PROCEDURES

Procedures associated with USGS gaging stations are identified in Table 8.

Table 8. USGS gaging station procedures.

Document Title	Details
Stage Measurement at Gaging Stations (Book 3, Chapter 7, Section A)	Techniques and Methods 3–A7; 2010
Discharge Measurements at Gaging Stations (Book 3, Chapter 8, Section A)	Techniques and Methods 3–A8; 2010
Levels at Gaging Stations (Book 3, Chapter 19, Section A)	Techniques and Methods 3–A19; 2010
Quality Assurance Plan for Discharge Measurements Using Acoustic Doppler Current Profilers	Scientific Investigations Report 2005-5183; 2005

MEASUREMENT CRITERIA

The USGS gaging stations identified in Table 8 are subject to the performance requirements specified in Table 9.

Table 9. USGS gaging station measurement criteria.

Parameter	Measurement Criterion
Discharge	See below
Stage	0.01 foot or 0.2 percent of the effective stage, whichever is greater

The following sections detail additional considerations associated with each of the three above parameters.

Discharge Measurements

The accuracy of a discharge measurement is dependent on many factors, including the:

- Equipment used
- Location and characteristics of the measuring section
- Number and spacing of measurement verticals
- Rate of change in stage
- Measurement of depth and velocity
- Presence of ice or debris in the measuring section
- Wind
- Experience of the hydrographer

The evaluation of the accuracy of a measurement is a qualitative assessment that takes some, or all, of these factors into account. A quantitative measure of the accuracy for some discharge measurements can also be made.

Stage Measurements

The primary use of stage data by the USGS is for computation of streamflow records. Consequently, stage accuracy requirements are stringent. In accordance with this primary use, and because the use of stage data cannot be predicted, the overall accuracy of stage data established for USGS gaging stations is either 0.01 ft or 0.2 percent of the effective stage, whichever is greater.

B10. DATA MANAGEMENT

IFP data management includes field (i.e., hardcopy) and office (i.e., electronic) records and a variety of commercial and open-source software. Programmatic data management is assessed by the *Independent QA Manager* during WCR and *Instream Flow Evaluation* audits.

Field Data Management

Prior to field data collection, the *Staff Project Lead* ensures that the latest applicable field datasheet templates are printed and available. Completed datasheets are then verified according to D2: *Verification and Validation Methods* and the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines* (see A9: *Documents and Records*). To ensure a permanent record, original data may not be modified after leaving the field site. Hardcopy records are retained and retired according to A9: *Documents and Records*.

Office Data Management

Before hardcopies are transcribed into electronic files, the *Staff Project Lead* ensures that the latest applicable entry workbook templates are available. Populated electronic files are then verified according to D2: *Verification and Validation Methods* and the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines* (see A9: *Documents and Records*).

Each workbook has a single (i.e., non-duplicated) working copy. Working electronic files for a project should be kept on a shared electronic drive accessible to all IFP project participants. Once the project has been completed and all non-essential files have been deleted, the folder will be transferred to the *U:* drive for long-term storage. The IFP's *U:* drive is currently backed up twice a day for 30 days on a primary backup server, and then archived to another server and held for a period of 12 months.

IFP files associated with *R Studio* software are managed using the Water Branch repository of *GitHub* cloud-based storage service.

Additional office data management information may be found in D1: *Data Review, Verification, and Validation* and D2: *Verification and Validation Methods*. Procedural details may be found in the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines* (see A9: *Documents and Records*).

Software

Current IFP studies may include a variety of computer software (Table 10).

Table 10. IFP software.

Software	Developer
ArcGIS Pro	Esri
E-flows Functional Flows Calculator	University of California at Davis
EndNote	Clarivate
HEC-RAS	U.S. Army Corps of Engineers
HydroCalc	Northwest Hydraulic Consultants
Inkscape	Open Source
Office Suite (i.e., *Excel*, *Publisher*, *Word*)	Microsoft
PHABSIM	US Geological Survey
R Studio	Open Source
River 2D	University of Alberta
SEFA	I. Jowett, R. Milhous, and T. Payne

Because this software is commercial or open-source, IFP performs none of the QC processes associated with in-house, custom software. To ensure that the latest software is utilized for programmatic studies, the IFP installs updates when feasible or recommended by the developer.

Modeling Software is further discussed in B9: *Non-Direct Measurements*.

Scientific Data Governance Policy

When a project includes scientific data collection, the Department requires that a DMP and all associated scientific data collected by Department staff be submitted for compliance with the Department's *Scientific Data Governance Policy* (see A9: *Documents and Records*). Data that is well-organized and well-documented with metadata will support the sharing of scientific data and will help facilitate development of future DMPs and data uploads.

Group C:
Assessment and Oversight

Figure 4. Hollow Tree Creek.

C1. ASSESSMENTS AND RESPONSE ACTIONS

The EPA defines an audit as: a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

At the request of the IFP, the program's *Independent QA Manager* may perform audits of:

- *Instream Flow Evaluations* and any supplementary technical reports (e.g., calibration, habitat-suitability criteria)
- WCRs

In both types of audits, results may be defined as follows:

- *Finding*: an absence or failure of a system
- *Observation*: an isolated failure in an otherwise functional system
- *Recommendation*: a suggested improvement to an existing system or its implementation

Instream Flow Evaluation Audits

Typically, the *Independent QA Manager* reviews the *Study Plan* associated with the selected *Instream Flow Evaluation*. Based on *Study Plan* details, the *Independent QA Manager* requests IFP study information and a variety of scanned and electronic files for assessment. Audits performed while the applicable *Instream Flow Evaluation* is being drafted also include:

- Subject-matter review against a standardized review checklist customized for IFP studies
- Editorial review against the American Chemical Society's (ACS's) *ACS Style Guide: A Manual for Authors and Editors*
- Data verification of all applicable report tables against their electronic source file(s)

Upon audit completion, the *Independent QA Manager* submits to the IFP an *Instream Flow Evaluation Quality Assurance Report* and explanatory cover letter. The scope of this audit report includes:

- Document review
- Data verification
- Methods
- Instrumentation
- Staff

Watershed Criteria Report Audits

Typically, the *Independent QA Manager* requests from IFP study information and a variety of scanned and electronic files for assessment. Audits performed while the applicable WCR is being drafted also include:

- Subject-matter review against a standardized review checklist customized for IFP studies
- Editorial review against the ACS's *ACS Style Guide: A Manual for Authors and Editors*
- Data verification of all applicable report tables against their electronic source file(s)

Upon audit completion, the Independent QA Manager submits to the IFP a *Desktop Audit Report* and explanatory cover letter. The scope of this audit report includes:

- Document review
- Data verification
- Personnel
- Software
- Methods
- File Management

C2. REPORTS TO MANAGEMENT

Year in Review Report

Each year's IFP activities, including QA, are summarized in a publicly available *Year in Review* report. This annual report's scope includes:

- Regulatory updates
- Watershed-specific updates
- QA/training
- Publications/presentations
- Programmatic objectives

The report's *Quality Assurance/Training* section provides information on completed and planned trainings, QA tasks, and products.

Audit Reports

The WCR and Instream Flow Evaluation audits detailed in C1: *Assessments and Response Actions* generate Desktop Audit Reports and Instream Flow Evaluation Quality Assurance Reports, respectively. Following each audit, these audit reports are submitted to an IFP Senior Environmental Scientist (Supervisor). As applicable, audit report follow-up may include IFP staff and/or the Independent QA Manager.

QA/QC Log

While use of the *QA/QC Log* (detailed in A9: *Documents and Records*) is not limited to management, it is the primary basis for routine, ongoing QA-related communication and transparency for all IFP studies.

Group D:
Data Validation and Usability

Figure 5. An IFP scientist performing a field survey of the Navarro River.

D1. DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

IFP field measurements are used as inputs to a variety of modeling applications (see B9: *Non-Direct Measurements*). However, the measurements themselves are not an end product for the IFP, nor are they made available to others for unrelated end uses (e.g., via databases). Consequently, the communication to end users afforded by data validation and assessment are not applicable to IFP data.

Data verification is an important aspect of the IFP data review process. According to EPA, data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. In the context of IFP studies, data verification ensures the complete and accurate transposition of field measurements between measurement devices, hardcopy field records, electronic records, and reports. All IFP data are verified according to D2: *Approaches to Verification, Validation, and Assessment*, and the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines* (see A9: *Documents and Records*).

D2. APPROACHES TO VERIFICATION, VALIDATION, AND ASSESSMENT

Verification

The IFP performs verification on its field (i.e., hardcopy) and office (i.e., electronic) data. Details of these processes (e.g., responsible parties, dates) are recorded in the *QA/QC Log* accompanying each program study.

FIELD DATA VERIFICATION

Before leaving the field, populated datasheets are verified to ensure:

- Complete, clear, and accurate use
- Clear error correction (if applicable)
- Consistent date usage and formatting
- Adherence to appropriate IFP standards (e.g., numerals, blank spaces)
- Adherence to applicable SOP-specific requirements

Datasheets must be verified by a different staff member than the one who recorded the information. To ensure a permanent record, original data may not be modified after leaving the field site. Additional data management details may be found in B10: *Data Management*. Additional field data verification information may be found in D1: *Data Review, Verification, and Validation*. Procedural details may be found in the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines* (see A9: *Documents and Records*).

OFFICE DATA VERIFICATION

Once field records are transposed into electronic files, populated electronic files are verified to ensure:

- Complete and accurate transcription (including notes)
- Inclusion of all applicable data modifications and omissions in the project *QA/QC Log*

- Confirmation of data modifications and omissions with appropriate IFP staff
- Adherence to appropriate IFP standards (e.g., rounding, blank spaces)
- Application of worksheet protections
- Adherence to file naming conventions
- Traceability of photos
- Adherence to applicable SOP-specific requirements
- Inclusion of tables and figures within their source workbook

Staff members may not verify data that they entered. Additional data management details may be found in B10: *Data Management.* Additional data verification information may be found in D1: *Data Review, Verification, and Validation*. Procedural details may be found in the internal IFP document *Instream Flow Program Quality Assurance and Quality Control Guidelines* (see A9: *Documents and Records*).

AUDIT-RELATED DATA VERIFICATION

The WCR and *Instream Flow Evaluation* audits detailed in C1: *Assessments and Response Actions* both include a transposition verification of all report tables against their source Microsoft *Excel* workbook(s). Deviations are immediately reported to the IFP by the *Independent QA Manager* so that necessary table revisions may be made prior to report finalization.

Validation and Assessment

As described in D1: *Data Review, Validation, and Verification Requirements*, IFP field measurements are used as inputs to a variety of modeling applications (see B9: *Non-Direct Measurements*). However, the measurements themselves are not an end product for the IFP, nor are they made available to others for unrelated end uses (e.g., via databases). Consequently, the communication to end users afforded by data validation and assessment are not applicable to IFP data.

D3. RECONCILIATION WITH DATA QUALITY OBJECTIVES

Field measurements collected by the IFP are used as inputs to a variety of modeling applications (see B9: *Non-Direct Measurements*). However, the measurements themselves are not an end product for the IFP, nor are they made available to others for unrelated end uses (e.g., via databases).

While the IFP does not employ EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process*, it may coordinate study design, field data collection, and study implementation with CDFW Regional staff, SWRCB, USFWS, other agencies, and non-governmental organizations to ensure that end-user needs are met.

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