Instream Flow Study Methods Used in Washington State

Washington state law requires that instream resources and values, including fish (see sidebar), are protected and preserved with adequate stream flows. One of the most important water management tools we have to protect stream flows is to set stream flow levels by regulation, called "instream flows."

To determine stream flow numbers, a lot of discussion centers on fish needs. This is because fish are considered an "indicator species" – if the fish are doing well, then generally other instream resources are too. And fish needs can be more easily quantified by existing methods than other instream values. This is why fish studies are often the basis for determining instream flow numbers.

Data from the fish studies are integrated with an understanding of the stream flow needs of the fish and other instream values and balanced with the water needs of people to determine the final instream flow numbers.

The term "instream flow" identifies a specific stream flow level (measured in cubic feet per second, cfs) at a specific location on a given stream. The weather causes natural flow variations throughout the year, so an instream flow is a range (a "regime"), usually changing month-to-month, instead of a single number.

In Washington, the four most commonly used stream flow study methods are:

- Instream Flow Incremental Methodology (IFIM)
- Toe-width
- Wetted width (wetted perimeter)
- Hatfield and Bruce

Refer to the table on page 4 for a brief side-by-side comparison.

Instream Flow Incremental Methodology (IFIM)

IFIM is used nationwide and is accepted by most water resource managers as the best available tool for determining the relationship between stream flows and fish habitat. The method is relatively time-consuming and expensive, and is therefore best used for rivers where there is a lot of water and therefore a lot of controversy.

WHY IT MATTERS

The Legislature has instructed Ecology to set instream flows to protect and preserve instream resources. Watershed planning and other groups around the state are examining local water resources and many are choosing to work with Ecology to establish or revise instream flows in their watersheds.

The intent is to set instream flows throughout the state. Washington residents will find it helpful to understand the science behind instream flows.

Definitions

Instream flow: A stream flow regime established in an administrative rule (WAC). An instream flow is a water right for a stream, which protects instream resources from future withdrawals.

Instream resources and values: As defined in state law, these include fish and wildlife, aesthetics, water quality, navigation, livestock watering and recreation, all of which depend on adequate amounts of water in our rivers.

Stream flow: The amount of water flowing in a stream or river.

IFIM is a series of computer-based models which calculate how much fish habitat you gain or lose as you increase or decrease stream flow. It is based on the understanding that fish prefer water with a certain depth and velocity (how fast the water is flowing). These preferences vary for different species of fish, and for each of their life stages.

Experts collect data on the river at specific representative sites and this in turn is put into a group of models called RHABSIM (**R**iverine **HAB**itat **SIM**ulation), a part of IFIM. Data on fish habitat preferences are then entered, and the final calculation results in "Weighted Usable Area" (WUA), the stream flows specific fish species at specific life stages prefer, based on the depths and velocities they prefer.

For a more detailed explanation of IFIM, refer to Ecology publication #Q-WR-95-104.

Toe-width

Toe-width is a simple measurement and calculation. Based on the width of the stream, it provides a stream flow number useful for protecting salmon and steelhead spawning and rearing. The "toe" of the stream refers to the point in a stream where the side of the stream meets the bottom. The toe-width measurement is the distance from the toe of one streambank to the toe of the bank across the stream channel. In this approach, the toe-width of a stream is measured and put into an equation to yield a reasonable stream flow number for protecting fish.

Most of the over 250 instream flows set by rule in Washington State were done with Toe-width. Quick Toe-width estimates may be adequate for management purposes and results compare favorably with those from IFIM.

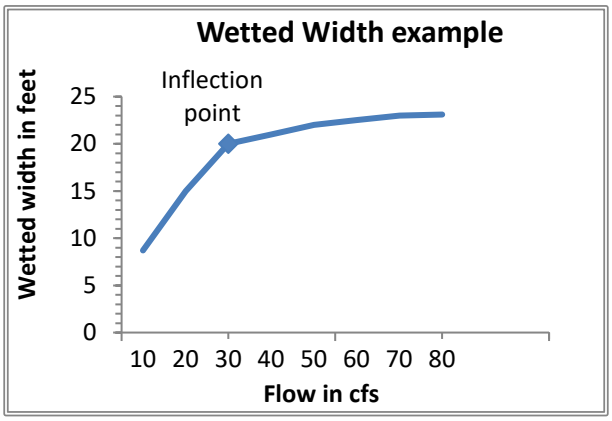
Wetted Width (Wetted Perimeter)

This method is used to help determine a stream flow recommendation for low flow periods, based on adequate fish rearing and migration flows. The wetted perimeter is the portion of the channel that is "wet." The method assumes a connection between reducing wetted width and the loss of fish habitat. It involves measuring from water's edge to water's edge over a number of site visits.

Graphs are developed to show the relationship between actual stream flow and wetted width. There can be a clear point where the graph levels out – when you're no longer rapidly gaining width with increases in flow. This point is referred to as the breakpoint or "inflection point." It

indicates the stream flow level at which habitat is stable, and therefore where sufficient food is protected to maintain the existing fish population at an acceptable level. This point becomes the stream flow recommendation.

The technique was modified by Dr. Hal Beecher (Washington Department of Fish & Wildlife) who added a measurement of width where depth is at least 6 inches. This would indicate where the width was adequate for fish passage and rearing habitat. Young salmon are seldom found in water shallower than 6 inches.



Hatfield and Bruce

Hatfield and Bruce developed a series of equations to estimate the stream flow that maximizes the weighted usable area (WUA) based on previous IFIM studies, for up to four life stages of certain salmonids (such as salmon and trout). This method can be done entirely from the office; no field work is required. The user looks up the yearly average stream flow, longitude and latitude for the river, and enters these into equations on a calculator or computer.

This method is a quick, high-level technique using IFIM study results. It does not replace a detailed analysis of a watershed and river.

For more information

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Ecology's instream flow web page: https://ecology.wa.gov/Water-Shorelines/Water-supply/Protecting-stream-flows/Instream-flow-implementation.

If you need this publication in an alternate format, please call the Water Resources Program at 360-407-6872. Persons with hearing loss, call 711 for Washington Relay Service. Persons with a speech disability, call 877-833-6341.

Quick Overview of Instream Flow Methods Used in Washington State

Method	Purpose & typical use	Constraints	Advantages	Cost	Time	Equipment needed
IFIM	• Describes the full fish habitat versus stream flow relationship for all fish species and lifestages. • Provides data on fish habitat at various stream flows, based on depth, velocity, substrate and cover.	• Relatively date intensive (have to visit each site at least 3 times at the appropriate stream flow). • Takes a while (typically, because of the need for several measurements, it takes a week of field work spread over 3-4 months). • Specialized training needed. • Timeliness is crucial—when measurements have to be taken is highly contingent on how fast stream flows are falling.	Generally recognized as "state of the art"—*i.e.*, it is generally an accepted method of determining stream flows needed for fish.	Relatively much more time intensive (more site visits; longer time to take measurements, run the computer model and write up the results).	Can take from six months to a year (flow measurements are needed for least 3 various stages of stream flow).	Relative to Toe-width, much needed. Rod, velocity meter, tape measure, surveying level and tripod, survey rod; personal computer and IFIM program, boat and associated measuring equipment (if working in unwadeable streams or rivers).
Toe-width	• Describes "peak habitat" for salmonids rather than the full range of habitat versus flow. • A quick method for obtaining data to look at spawning and rearing flows.	Yields a single number for spawning and rearing flows (which makes it hard to balance between species and lifestages because it does not show the relationship between fish habitat and stream flow).	• Quick: many streams can be measured in one day. • Easy: the method can be learned in an hour or so.	• Low cost per site (maybe an hour or two per site). • Most of the cost is the driving time to and between sites.	Can take as little as a week from data collection through write-up.	Minimal (measuring tape and a calculator).
Wetted width	Identifies how the width of the stream changes with stream flow.	• Used to determine an "inflection point" which may not be apparent on some streams. • Provides a very minimal level of protection.	Easy: the method can be learned in an hour or so.	Less costly than Toe-width but may be costly since as many as 10 field visits at different stream flows is often needed to determine an "inflection point."	Will take months of field work since several visits to the site at different stream flows is needed (10 or more). Field time more than for IFIM.	Minimal (measuring tape and a calculator).
Hatfield and Bruce	Uses an equation based on existing IFIM study results to estimate stream flow that maximizes fish habitat (WUA) by species and lifestage.	A reconnaissance level office tool; not a substitute for detailed analysis of watershed and reach.	Quick, but need hydrological data. No field work required.	Low: some office time for the calculation.	Short amount of office time only.	Minimal (a computer or calculator).