ODFW Guidance for Determining Instream Flow Needs

Introduction and Background

In 2015, the Oregon Water Resources Department (WRD) developed *Draft Guidelines: A Tool for Conducting Place-Based Integrated Water Resources Planning in Oregon* to direct the state's pilot program to advance place-based integrated water resources planning. The guidelines were drafted to ensure that the planning process supported Oregon's Integrated Water Resources Strategy (IWRS; adopted 2012, updated 2017), which serves as a blueprint for meeting the state's instream and out-of-stream water needs, now and in the future. The IWRS recognized that better understanding instream needs was a Critical Issue and directed the Oregon Department of Fish and Wildlife (ODFW) to determine flows to support instream needs (Action 3A). ODFW began ramping up efforts in 2016 to fulfill the directive, in parallel with the pilot place-based planning process, and our approach to instream flow methodologies has continued to advance as we learn more and refine techniques.

WRD's *Draft Guidelines* (2015) outlined a 5-step process in developing an integrated plan. Planning Step 2 (Characterize Water Resources, Water Quality, & Ecological Issues) and Planning Step 3 (Quantify Existing and Future Needs/Demands) provide the necessary foundation for collaborative groups to develop feasible solutions that can address identified issues and move forward successfully with implementation. Data gaps are expected, and Planning Steps 2 and 3 help identify where additional research is needed. While planning groups can indicate that data gaps preclude a complete understanding of various water resource issues, the Guiding Principles in Appendix A of the *Draft Guidelines* envision using "Science-Based, Flexible Approaches" throughout the planning process that can incorporate additional information to address the gaps as it becomes available (p. 18). This approach allows implementation strategies to be refined and adapted over time.

Several pilot groups used existing instream water rights to quantify instream needs given data limitations at the time the Step 2 and Step 3 reports were completed. However, it is important to note that using instream water rights as a proxy for instream need has limitations, including:

- The allowed methods in ODFW's instream rules (OAR 635-400; last modified in 1989) for determining instream flows dictate that instream water right application amounts must be based on habitat criteria. The limitations that exist in statute and rule effectively prohibit state agencies from applying for anything beyond the "minimum quantity of water necessary to

support the public use requested by an agency" (ORS 537.332(2)). It is important to note that minimum flows do not mean the absolute minimum flow that can sustain a population, but rather the minimum necessary to serve the management objective of the applicant agency. However, this has not been historically utilized to include the full range of flows needed for ecosystem health, and therefore, does not include protection for seasonally varying flows or temperature-based flows that provide important habitat formation and maintenance functions.

- WRD, through implementation of their rules, often reduces ODFW's biologically based instream water right application amounts to the 50th percentile flow, although the rule does indicate that there can be exceptions "where periodic flows that exceed the natural flow or level are significant for the applied public use" (OAR 690-077-0015(4)).
- Many important streams still do not have instream water rights, so an analysis based only on existing instream water rights will underestimate instream needs in the planning area.

Purpose

The purpose of this document is to provide focused guidance to planning groups as they determine or update instream needs estimates for:

1. Streams that have existing instream water rights; and
2. Streams where previous instream flow studies or other flow estimates are not available.

The goal of Steps 2 and 3 is to determine and use the best available datasets to estimate instream flow needs under natural flow conditions at a scale appropriate for understanding basin-wide needs. Natural flow conditions are defined as flow conditions that would exist in the absence of out-of-stream withdrawals and reservoir operations. The method outlined can easily be adjusted to incorporate other flow data, such as streamgage data, if available and representative of natural flow conditions. Groups are certainly encouraged to perform more in-depth analyses where high-quality, site-specific information is already available.

Streams that have existing instream water rights

For reasons indicated above, instream water rights often do not reflect the actual amount that ODFW requested in its applications; ODFW recommends that groups use amounts requested in its applications instead of certificated amounts to inform their Step 2 and 3 reports. In most instances,

ODFW encourages planning groups to consider existing instream water rights in conjunction with the amounts calculated using the modified presumptive standard method presented here to better characterize for the full suite of instream needs. Existing instream water rights do not fully reflect the natural flow regime of streams. Further, ~30% of instream water rights in Oregon are administratively set minimum perennial streamflows that were converted to instream water rights after the passage of the 1987 Instream Water Rights Act, and the amounts often do not reflect values needed for the conservation, maintenance, and enhancement of aquatic and fish life, wildlife, and habitat.

Streams where previous instream flow studies are not available

The modified presumptive standard presented here is a flexible technique that can provide a range of monthly flow target estimates for planning areas where previous instream flow studies are not available. This technique will aid planning groups in better understanding the current status of instream needs and potential future demands as completely as possible across the study area, an understanding that is necessary to determine what strategies/projects will best address top needs across all water-use sectors (i.e., agriculture, municipal and industry, and instream). Because many streams are already over-allocated, the ability to meet instream needs will often depend on voluntary and collaborative efforts. The process identified here is a key step to help planning groups determine where long-term basin planning and restoration efforts might be most effective and/or needed. **The approach presented should be regarded as a *starting point*** that serves as the foundation for additional studies that are needed to develop and implement actions identified by planning groups.

This document is *not* intended to replace ODFW's original 2018 document, *Step 3: Determining Instream Flow Ecological Needs,* which was provided to planning groups. That document provided a more extensive overview of the many tools/resources available for assessing current and future instream flow needs, and ODFW encourages groups to utilize that document to refine the development of instream flow targets beyond the method presented here. Both the 2018 document and this companion document are considered living documents in that they will be updated as environmental flow science continues to evolve and as technological and data innovations make more refined analyses possible.

Recommended method for foundational (Level 1) instream needs assessment

Commonly cited obstacles to inclusion of instream flows in water planning include the difficulty of selecting the appropriate flow methodology for a particular situation/scale, along with the cost and level of expertise needed to perform a holistic instream flow assessment (Kendy et al., 2012; Opperman et al., 2018). One route for overcoming these issues is to apply a hierarchical approach, using a desktop analysis that serves as the foundation for more complex, future flow assessments. Opperman et al. (2018) refer to the initial flow development phase that uses existing (measured or modeled) daily or monthly hydrologic data as a Level 1 approach, which is presented below. Although daily data is preferred, it is often not readily available, and the approach presented below is modified to use monthly (modeled or measured when appropriate) hydrologic data.

Hydrologic Index

The presumptive standard, proposed by Richter et al. (2011), is an approach that quantifies specific percentages of natural flow alteration and the resulting general ecological impacts (see Fig. 1). In general, Percent of Flow-based studies (POF) have identified that limiting daily extractions to between 10-20% of natural daily flows will maintain a moderate level of ecological function (Locke & Paul, 2011; Richter et al., 2011). Although originally intended to be used with daily measured discharge data, we have adapted the method to be used with monthly streamflow exceedance probability data (modeled or measured when appropriate). This adaptation is necessary due to the lack of real-time streamflow data across the state and because, in most situations, it is infeasible to have instream targets that fluctuate daily. In general, we are interested in target comparison to natural flows (i.e., representative of conditions prior to out-of-stream diversions), so under most circumstances, real-time measured flows are inappropriate for use in analysis because of water withdrawal influences. Monthly instream flow targets under this **modified presumptive standard** framework are defined as a range from 80% of the natural (pre-diversion) median/mean streamflow to the median flow to maintain a moderate – high level of function.

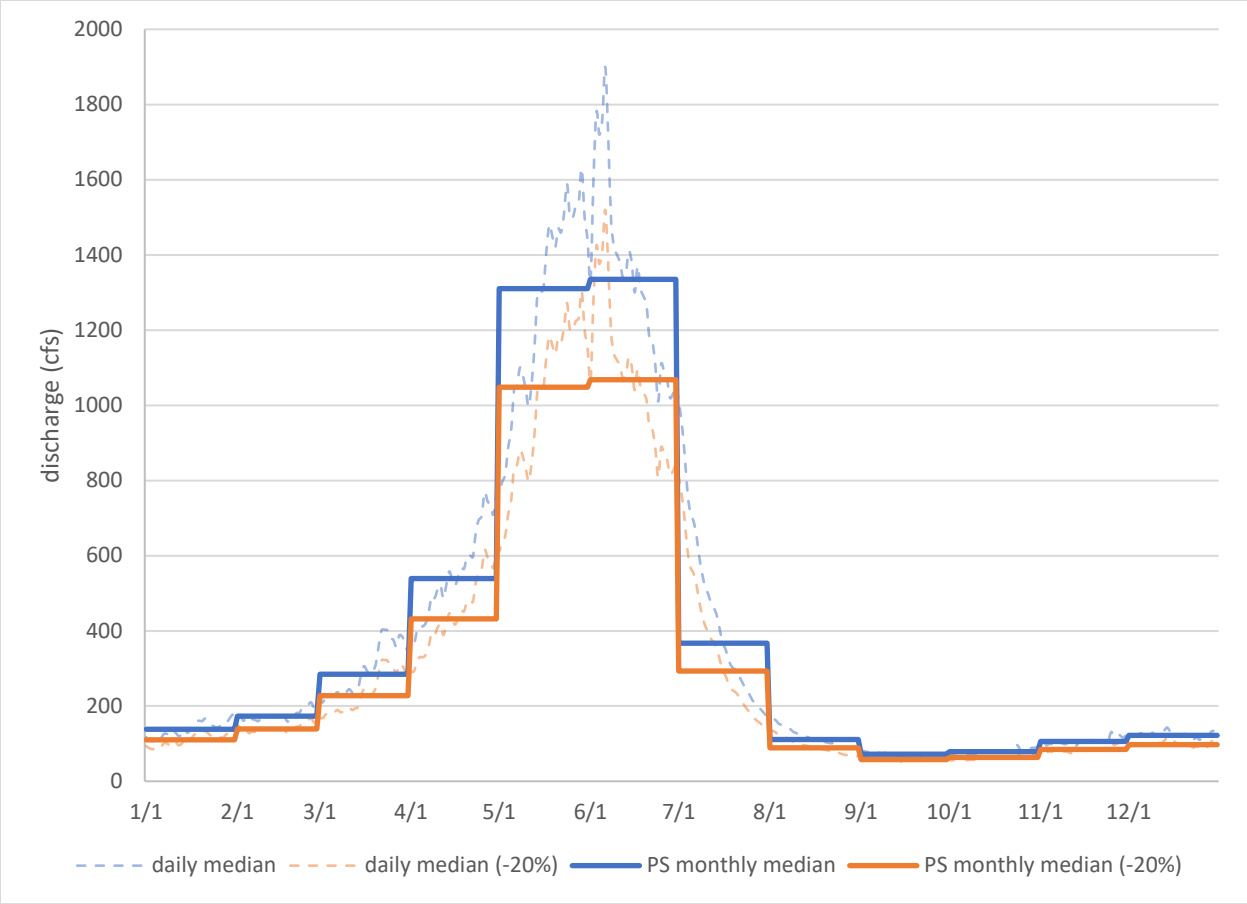

Figure 1. An example of the presumptive standard using daily data (dashed lines) versus the modified presumptive standard using monthly data (solid lines).

Data

ODFW recommends making use of all available streamflow data (modeled and appropriate gage data) for a given site that are representative of natural flow conditions. The intent is to make the best estimate possible of monthly pre-development streamflow through compilation of all available datasets. The following are commonly used data sources[1]:

1. WRD's Water Availability and Reporting System (WARS): The WARS dataset provides estimates of monthly 50% and 80% streamflow exceedance for outlets of Water Availability Basins (WABs) using regional regression equations (Cooper, 2002).

[1] Please see links and sources for additional information regarding model development assumptions and limitations.

2. United States Geological Survey (USGS) StreamStats: StreamStats produces monthly 5, 10, 25, 50, and 95 percent streamflow exceedances for nearly any stream reach in the state, using regional regression equations (Risley et al., 2008).
3. USGS/EPA National Hydrography natural flow database (medium resolution): the NHD dataset provides monthly mean flow estimates for most stream reaches (~0.01-3km) in the state.
4. University of Washington Variable Infiltration Capacity (VIC) model provides daily estimates of natural flows that can be used to determine reach-specific monthly exceedance probabilities (Hamman et al., 2018; Liang et al., 1994). Contact ODFW for processed datasets.

Planning groups should use these and other sources, when available, to obtain monthly datasets at the 50% exceedance (median) or mean flow. Once all datasets are compiled, monthly median values are calculated. When three or more datasets are available, an outlier removal process is recommended prior to calculating monthly median values. Additionally, resulting values should be evaluated against gage data where it exists.[2]

Scale

The scale of analysis is determined by the planning groups; however, the study area should not be analyzed at a scale coarser than the HUC 10 subwatershed. While it would be preferable to estimate instream needs for all current or historically fish-bearing streams in the planning area, the planning groups should use the following hierarchy to determine the scope of the instream needs assessment based on the time and resources available:

1. All HUCs containing streams that have sensitive, threatened, or endangered aquatic species (required);
2. All HUCs containing streams that have native aquatic species (highly recommended);
3. All other HUCs within the planning area (e.g., historical habitat that planning groups have identified as having high restoration/reintroduction potential).

Because a flow estimate is only valid for the reach where it is calculated, groups will need to perform additional analyses for identified high-priority reaches that are not located at a subwatershed outlet.

[2] Groups may contact ODFW if they would like additional details regarding recommended methodology.

Step-by-step GIS method[3]

1. Add HUC-10 or HUC-12 watersheds included in the study area
2. Add ODFW Fish Habitat Distribution (FHD) data for:
    a. ALL sensitive, threatened, and endangered (STE) species in study area (groups are required to analyze these HUCs)
    b. All native species (it is recommended that groups analyze these HUCs)
3. Add other relevant ecological datasets that the group is aware of (e.g., other aquatic species' habitat, important cold-water habitat, springs, etc.) that will assist in project prioritization. (**Optional** here, but strongly recommended before proceeding to Planning Steps 4 (Develop Integrated Solutions for Meeting Long-Term Monitoring Needs) and 5 (Plan Adoption & Implementation)).
4. For each HUC outlet in the study area, compile values for the four modeled datasets (see above)
5. Remove any outliers and check against existing gage data (where appropriate)[4]; use the resulting monthly median value to determine a natural flow estimate for that point.
6. Calculate preliminary instream targets based on modified presumptive standard
7. Repeat the process for any identified key reaches/tributaries that are not located at the HUC outlet

Important caveats

It is important to note that although the use of monthly flows does preserve some aspects of the natural flow regime (seasonal flow magnitude and timing), the use of the monthly median does not fully capture shorter-duration disturbance flows and seasonal pulse flows that are important for maintaining the full range of flows needed to preserve ecological function (Kendy et al., 2012; Poff et al., 1997).

[3] The method presented as written requires use of GIS software. The method can be modified to do fully on a spreadsheet, although it is not as easy.

[4] Most gages are impacted by upstream withdrawals or flow regulation and therefore are not representative of natural flow conditions.

Modeled estimates of streamflow are typically based on regional regression relationships that incorporate a number of physical parameters (e.g., basin area, mean precipitation, etc.). There are certain settings where a natural flow estimate based on modeled datasets is less accurate or should be supplemented by additional data when available. For example, modeled streamflow estimates for intermittent streams or groundwater dominated systems with significant spring input can be inaccurate. Also, in areas where significant channel modification has occurred (e.g., channelization), the same flows will not provide the same habitat type and quality that existed in a natural channel. Previous work (e.g., watershed assessments) and enhanced local knowledge should be used to identify areas that might require further investigation. If modeled datasets are determined to be inaccurate for a location, the group should still calculate preliminary estimates and identify those reaches/areas as data gaps needing further study.

How to use the outputs

The modified presumptive standard technique, with the above-mentioned caveats considered, provides a high-level assessment of the range of monthly instream flows intended to maintain a moderate to high level of ecosystem function. Where appropriate, the instream need estimates can be compared to streamflow gage data or expected monthly flow estimates (OWRD Water Availability and Reporting System (WARS)) to evaluate the frequency of instream target achievement. Instream target achievement analysis results can be combined with existing regional or statewide prioritization efforts (e.g., earlier planning group results, ODFW's Aquatic Habitat Prioritization effort, Conservation Opportunity Areas, Oregon Connectivity and Mapping Project, etc.) to help classify streams as priorities for either voluntary instream flow restoration (existing low-moderate target achievement) or protection/conservation (existing high target achievement).

Even on well-studied river systems, there are uncertainties in understanding ecological response to changes in flow regime given the complexity of natural systems. Further, there are many other factors that affect the ecological integrity of a river system. Because perfect information is an impossible goal, a hierarchical and adaptive approach is recommended to restore degraded systems. Variable approaches that have been suggested, but a common theme is that a foundation based on the best available information – including an understanding of the river's past condition and its current potential for

restoration[5] – should inform next steps that are more tailored to the specific issues on high-priority streams (Kendy et al., 2012; Opperman et al., 2018; Poff et al., 2010; Wohl et al., 2015).

As planning groups move forward with implementation, ODFW recommends they perform more site-specific studies to further refine instream flow estimates (e.g., IFIM studies), determine other actions needed for improving ecosystem function, and perform long-term monitoring to determine if hypothesized improvements are being realized.

[5] A note on terminology: Because of human impacts, it is often not feasible to return a system to its natural pre-impact state (true restoration), and many efforts could more properly be described as rehabilitation. However, we retained the terminology restoration throughout this document because it is widely used in practice. This distinction highlights the need to understand the what the appropriate reference condition is when planning restoration approaches (see Stoddard et al., 2006 for additional information on the concept of reference condition).

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