# Oklahoma Instream Flow Pilot Study Approach

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## Introduction

As part of the 2012 Oklahoma Comprehensive Water Plan (OCWP), the Oklahoma Water Resources Board (OWRB) convened an Instream Flow Advisory Group to discuss benefits and issues with a potential future Oklahoma instream flow program. This effort culminated in a report titled *Instream Flow Issues and Recommendations* (February 2011). The report outlined the issues associated with an instream flow program and recommended the following steps:

1. Address the legal and policy questions.
2. Study other mechanisms for protecting instream flows.
3. Develop a draft methodology for instream flow studies in Oklahoma.
4. Conduct a study on the economics of instream flows in Oklahoma.
5. Perform an instream flow pilot study in a scenic river.
6. Preserve the Instream Flow Advisory Group.

Furthermore, the *2012 OCWP Executive Report* identified eight priority recommendations including the following recommendation regarding Instream/Environmental Flows:

> The process developed by the OCWP Instream Flow Workgroup should be implemented and followed to ascertain the suitability and structure of an instream flow program for Oklahoma, with such process commencing in 2012 and concluding by 2015, as outlined by the Workgroup.

Consistent with these recommendations, the Instream Flow Advisory Group reconvened in 2013 to further define whether and how an instream flow (ISF) program might be implemented in Oklahoma. The ongoing Advisory Group has continued the dialogue about ISFs in Oklahoma per the recommendations in the 2011 report and the steps listed above. As part of the effort to address the institutional arrangements that govern what can or should be done with an ISF program in Oklahoma (Recommendations 1 and 2), a background report—*Instream Flow Advisory Group Support* (CH2M HILL and Carollo 2013)—investigated and summarized relevant Oklahoma water laws, existing programs and state and federal laws that may provide some level of ISFs and affect development of an ISF program in Oklahoma. The background report provided an initial overview on the ISF legal and policy framework, other states' ISF programs, and mechanisms for protecting ISFs to support the initial discussions with the Instream Flow Advisory Group.

## Background

To more fully understand the issues raised by the Advisory Group, the OWRB conducted a questionnaire/survey with open-ended questions in February 2013. Fifty-nine percent of the respondents replied to the questionnaire. In addition, the issues were the subject of significant dialogue by the entire group at each of the Advisory Group meetings.

The issues identified by the Advisory Group were summarized in May 2013. The detailed input was compiled as received and distributed to the Advisory Group. A synopsis of these issues is posted to OWRB's ISF webpage (http://www.owrb.ok.gov/supply/ocwp/instreamflow.php). It is recognized that the list does not represent consensus on the issues, but indicates the types of questions and concerns raised by members of the group. This preliminary input from the Advisory Group was used to guide the facilitated discussions during subsequent ISF Advisory Group workshops.

The prevailing theme of the Advisory Group responses concerned the institutional issues and potential economic impacts surrounding an ISF program, e.g., water law and permitting, and protecting existing and future consumptive water rights. The complexity of addressing the ISF program legal and policy issues in the abstract creates an immense challenge for the meaningful analysis of the voiced concerns. To make sound policy recommendations, the Group acknowledged that the basis, specifics and consequences of an ISF program must be known and understood.

The measures recommended in the ISF Advisory Group survey included the use of a pilot study to "measure, refine and adjust an ISF program process before finalizing or implementing any program," and one respondent noted that "scenic rivers are a logical starting point, especially considering that there is already precedence for regulations of flows." The recommendations provide a good starting point from which to address the institutional issues surrounding an ISF program with a reference to a specific instance.

Input received via the facilitated Instream Flow Advisory Group meetings and workshops was analyzed to further develop recommendations regarding an ISF program process. Four workshops were conducted (March 1, May 16, and October 7, 2013, and January 16, 2014). The detailed workshop agendas, summaries and presentations are found on OWRB's ISF website (http://www.owrb.ok.gov/supply/ocwp/instreamflow.php). The workshops were held to solicit the Advisory Group's expertise, to advance the dialogue on the ISF program in Oklahoma and to deepen their understanding of the different elements of existing ISF programs through technical presentations.

Most of the ISF Advisory Group workshop dialogue and subsequent output from workshops centered on legal and policy questions as well as effects on water users and economics, reflecting the comments received from the questionnaire. At the October 7, 2013 facilitated workshop, one opportunity discussed to advance the ISF perspectives and dialogue was to develop or consider an ISF study process similar to the Instream Flow Incremental Methodology (IFIM) process, rather than developing a specific ISF minimal flow. The IFIM is the most widely used method for assessing ISF needs and affords a systematic way to address outstanding concerns/issues, including potential economic benefits and impacts associated with establishing ISF goals or requirements in Oklahoma. That is, the results of the pilot study would provide tangible information that the Advisory Group could use as a basis for its final deliberations.

It was agreed that OWRB and consultants would develop a suggested piloting approach/process plan for eview by the Advisory Group before the January 2014 Instream Flow Advisory Group meeting. The process would be geared toward assessing the list of issues and concerns identified in previous meetings by the Instream Flow Advisory Group. This would address Recommendation No. 5 from the February 2011 report: perform an ISF pilot study in a state-designated scenic river. The January 16, 2014 ISF Advisory Group meeting was utilized to discuss and refine the ISF pilot study approach.

The Advisory Group identified the upper Illinois River above Tenkiller Reservoir including Baron Fork and Flint Creeks as the best scenic-designated watershed to test the proposed ISF evaluation process. The Illinois was chosen because it has some discharges and has a broad existing dataset that should help reduce study costs. The group discussed the merits of conducting the pilot in a watershed that is more heavily used by consumptive users, or conducting pilot studies in more than one watershed. The group ultimately determined that an upper Illinois River study as the first watershed to be analyzed would be the best approach for initial testing of the proposed process.

Recognizing that the issues identified in Recommendations 1, 2, and 4 from the February 2011 report are abstract and statewide, the pilot study would focus on both policy and technical questions on a single stream/watershed so as to:

(1) better understand the benefits, costs, impacts, and other implications of a possible ISF program,

(2) identify additional questions and concerns,

(3) test and refine the process to better address the questions and issues raised by the ISF Advisory Group, and

(4) identify specific technical components of the approach that can be applied to ISF assessments in other watersheds.

The primary goal of the pilot study is to gain a better understanding of the implications of a process to assess ISF benefits and issues consistent with the overall goal of managing water resources in Oklahoma for multiple uses. This includes consideration of ISF needs, recreational uses of water, and consumptive uses of water in the watershed (e.g., public water supply, crop irrigation, power generation and industrial uses), drawing on significant involvement of stakeholders from all water interest groups in the watershed throughout the process.

## Study Purpose and Expected Outcomes

The purpose of a pilot study is to help define a study process that could be used for development of ISF recommendations for water resource planning purposes in other watersheds, if the state should move forward with an ISF program. The Illinois River system upstream of Tenkiller Reservoir is the suggested study area for piloting the IFIM process. This stream reach is mostly unregulated, i.e., it contains no major storage reservoirs or large diversions. However, the effects that streamflow alternatives might have on the downstream operational purposes of Tenkiller Reservoir would need to be assessed. Primary out-of-stream (consumptive) water uses include those for domestic and agriculture purposes. Instream water flow supports one of the state's most popular destinations for sport fishing, recreational boating, and scenic beauty. Also, this reach of the river and two of its tributaries, Baron Fork and Flint Creeks, are state-designated scenic rivers. An ISF study focused on fish has already been conducted on the Baron Fork.[1]

While the overall goal is to establish an ISF study process for potential application in other Oklahoma watersheds, it is important to recognize that each watershed will differ in terms of water supply, water use, future demand, and priorities. Flow recommendations and criteria that may be developed for the scenic – designated Illinois River would not be extrapolated to other stream systems. Again, the emphasis of this study is the process itself, not the specific flow recommendations that may be developed for the Illinois River system. Thus, the watershed-specific results of the pilot would only apply to the upper Illinois River watershed, but the same process (modified based on lessons learned in the pilot) could be applied to other watersheds in Oklahoma with different watershed-specific conditions and goals, and different watershed-specific findings. The pilot study should help identify concerns and needs associated with applying the approach elsewhere in the state.

The study approach outlined below would take approximately two years to complete. The initial information reviews, stakeholder outreach, and study planning would require 6 to 12 months. Implementing the field studies, which would include all field work and modeling, would require 6 months or more. Field work would occur primarily in the summer low flow period with additional measurements (flow related) during the spring and/or fall. Once the study results are completed, the analysis of alternatives and

[1] W. L. Fisher and W. J. Remshardt. 2000. Instream Flow Assessment of Baron Fork Creek, Oklahoma. Final Report, Oklahoma Water Resources Board, Oklahoma City, OK.

resolution of issues could be accomplished in about 6 months assuming that the parties to the study process are committed to its timely completion.

## Proposed Study Approach

The proposed approach to the pilot study is modeled after the USGS IFIM process. Details of the methodology are available at the USGS website (http://www.fort.usgs.gov/products/software/ifim/). The IFIM is a decision-support process that provides a comprehensive technical framework for addressing streamflow needs for fish and other aquatic resources while incorporating consideration of the institutional environment (i.e., recreational interests and consumptive water uses such as public water supply, crop irrigation, power generation and industrial uses). It is the most commonly used methodology that includes institutional and stakeholder components. It employs a phased approach, putting the institutional tasks first, in accordance with the recommendations in the OCWP. The methodology typically is used for specific water project proposals (for example, a water diversion). However, the same steps can be applied to a stream- or basin-wide study considering future water use patterns. The methodology includes both an institutional analysis as well as the technical studies needed to identify and assess ISF alternatives. It includes deliberate engagement of all uses and users of water in the watershed in the decision-making process.

The proposed study would be completed by experts with experience in IFIM elements, with guidance provided by ISF Advisory Group. State and federal agency expertise would be drawn upon as well.

The IFIM process is implemented in five sequential phases:

1. Issue Identification
2. Study Planning
3. Study Implementation
4. Alternatives Analysis
5. Issue Resolution
6. Process Evaluation

The result is not based strictly on a calculated flow rate or flow regime for the watershed. Rather, it is the product of significant deliberation and input by all parties with water interests in the watershed. The intent of the pilot is to consider all water users and uses without bias, but with opportunities for each interest group to engage in the process. The process helps inform decision-making to reflect the competing needs of various water users and uses, and culminates in negotiations between various interests.

The steps above differ slightly from the published IFIM process in two regards. First, Phase 1 is defined as “Issues Identification” rather than “Problem Identification” because the study is not focused on a specific problem or proposed water development. This is not to say that some of the water issues in the Illinois River system are not viewed as problems by some stakeholders; however, the primary focus of the study is to evaluate the “process” of evaluating issues associated with ISFs. Second, we have added a sixth phase, which will evaluate the overall process itself in line with the overall goal of the study.

At this early stage, OWRB proposes to undertake only the first two phases because the last three cannot be clearly scoped until the earlier phases are completed, which could take 6 to 12 months.

### Phase 1. Issue Identification and Stakeholder Involvement

Phase 1 has two components: (1) address legal and policy questions; and (2) initial physical analysis. Phase 1 will result in a better understanding of the issues and objectives of the interested parties. Understanding the different objectives will set the stage for multi-objective planning. Collaboration at an early stage of the study will provide the foundation for a successful process.

The following tasks are to be completed for the legal/policy analysis:

- Identify stakeholders and affected parties from both within the watershed and from elsewhere where there is interest in the Illinois River (e.g., regional tourism).
- Conduct outreach to affected parties (stakeholder meetings).
- Identify and document concerns and issues of affected parties and provide responses to those issues.
- Outline a preliminary decision process to be used to recommend ISF criteria.

This first component of Phase 1 would address the following legal and policy issues in the context of the Illinois River study as those have been identified by the Instream Flow Advisory Group in the 2011 OWRB *Instream Flow Issues and Recommendations* report:

- Consideration of relevant legal, policy, and regulatory factors in the Illinois River study area
- Potential effect on current and future water right holders for municipal, industrial, agricultural, and other out-of-stream uses in the Illinois River study area
- Process for implementing flow recommendations in the Illinois River study area

While these issues were initially identified from an abstract, statewide perspective, the pilot study would address them in context specific to the Illinois River study area.

The Advisory Group also raised concerns about the economics of implementing an ISF program in Oklahoma both in terms of study costs and economic benefits/costs on developmental (out-of-stream water uses) and nondevelopmental (ISF-related) resources. These economic issues would be analyzed in specific context of the Illinois River study area.

The second component of Phase 1 includes the review and summary of information on the physical environment that would be subject to the ISF assessment:

- Summarize existing information on fish and other aquatic resources of concern.
- Determine the aquatic resource management goals for the streams or watershed.
- Summarize hydrologic information, including existing conditions and simulated natural (unimpaired) flows.
- Summarize all existing water rights by quantity and use categories.
- Summarize water quality information for the study streams.
- Describe landscape features and land use activities that affect hydrology, water quality, and stream sediment dynamics.

The final product of the review of existing information will be an identification of data gaps that can be addressed in the study planning and implementation phases discussed below.

## Phase 2. Study Planning

The emphasis of Phase 2 is to identify the information needed to address the concerns of each interest group. Proper planning will lead to the identification of:

- The temporal and spatial scale of the evaluations
- Important variables for which information is needed
- How information will be obtained if it is not available
- A schedule of when data must be collected in the field
- Coordination of data collection needed for model input, calibration, and testing
- Estimates of labor, equipment, travel, and other costs required to complete the studies by the agreed study deadline

The study tasks expected for Phase 3 of the overall Illinois River study include those associated with understanding the physical (including hydrologic), biological, and chemical processes that contribute to the stream ecosystem. These may include the following:

- Reanalysis of the hydrological data summarized in Phase 1, to potentially include use of Indicators of Hydrologic Alteration (IHA) or similar software
- Collection of fish and potentially other aquatic organisms if existing data are not sufficient to describe existing conditions
- Characterization of stream channels, including sediment and habitat typing
- Modeling of water temperature and perhaps other chemical constituents
- Development of physical habitat simulation models for representative stream reaches
- Development of habitat suitability criteria for key fish species and habitat guilds for inclusion in the physical habitat simulation models

Phase 2 includes only the study planning effort for the above processes. It should also identify the links among these processes in light of the natural, historical, existing, and anticipated future land use and water allocation practices in the Illinois River basin.

## Phase 3. Study Implementation

The technical studies identified during Phase 2 will be implemented in accordance with the schedules and budgets also identified in Phase 2. IFIM study implementation usually can be broken down into four fundamental steps:

1. Data collection/supplementation
2. Model calibration
3. Predictive simulation
4. Synthesis and integration of results

These steps assume that most of the studies, such as fish habitat, hydraulics, hydrology, sediment movement, and water temperature, will involve simulation modeling to some degree.

The general sequence of data collection activities can include the following:

1. Identify aquatic mesohabitats (riffle, runs, pools) within each key physiographic region.
2. Select transects in each mesohabitat and physiographic region.
3. Select IFIM-focus species of fish and macroinvertebrates, and compile habitat suitability criteria (HSC) for specific resident species and life stages of interest, as well as for recreation (e.g., canoeing/kayaking).
4. Collect field hydraulic and habitat data at selected transects at specific target flows.
5. Implement the Physical Habitat Simulation Model, which integrates stream hydraulic and physical characteristics with microhabitat requirements of key species and life stages. The output “Weighted Usable Area” (WUA) is a surrogate index for what is judged to be suitable habitat for each species under a range of flows.

## Phase 4. Alternatives Analysis

The final two phases of the traditional IFIM process involve alternatives analysis (Phase 4) and issues resolution (Phase 5). The alternatives analysis is important to the IFIM process because the IFIM process

generally does not result in a single "best" flow value. Rather, the IFIM generates WUA estimates over a range of flows (or for alternative flow time-series) for each target species. The WUA estimates form the basis of negotiations among interested parties, including the stakeholders identified in Phase 1.

Establishment of ISF or flow-regime alternatives for a particular stream reach can be formulated by any interested party after reviewing both the institutional analysis and the results of the technical studies from previous study phases. Alternatives are compared to an agreed-upon baseline condition to facilitate understanding of potential impacts and to begin negotiating and creating new alternatives that may be more compatible with the multiple objectives of the parties.

Each alternative will be evaluated by the following criteria and questions:

- Effectiveness—Are the objectives of each party sustainable? Is no net loss of habitat or biological function possible on a sustainable basis? What are the habitat costs and benefits of each alternative?
- Physical Feasibility—Are prior water rights and existing water uses maintained? Are reservoir purposes maintained? Is enough water available for instream resource values and potential future out-of-stream uses?
- Risk—How often does an alternative lead to a failure of the biological system? Is the failure reversible? Can contingency plans be developed?
- Economics—What are the costs and benefits of each alternative? Are existing water rights affected? Are values associated with reasonable future water uses accounted for?

## Phase 5. Issue Resolution

After several alternative flow regimes have been thoroughly evaluated by the teams that are party to the ISF resolution process (defined in Phase 1), the teams deliberate ISF criteria or standards that meet the overall watershed goals established in Phase 1. The teams must integrate their knowledge and understanding of the technical and social issues to reach an ultimate resolution. This process implies that the solution will entail some kind of a balance among conflicting social values.

The IFIM process rarely results in a single "best" flow value. Rather, the IFIM generates WUA habitat estimates over a range of flows (or for alternative flow time-series) for each target species and/or recreational requirement. It is important to understand that the maximum WUA values typically will occur at different flows and differing times of the year for the various target species, life stages, or other uses. In addition, the current and future needs for water for developmental purposes must be considered in the resolution process. Thus, selection of flow regimes suitable for protecting the aquatic community while recognizing the need to accommodate other beneficial uses of the water often requires balancing, tradeoffs, and seasonal variation that are the subject of negotiations and management decisions.

## Phase 6. Process Evaluation

Because the primary purpose of this pilot study is to define a conceptual framework and study process to be used for considering ISF needs for water resource planning purposes, it is important that the process itself be evaluated by the participating stakeholders. This will be accomplished with a questionnaire of the stakeholders that will solicit opinions as to strengths and weaknesses of the steps used in the pilot study and suggestions for improvement for future application to other watersheds. This phase may include workshops and other activities as identified in the stakeholder process.