King County Normative Flows Project
Science Review Team meeting
Wednesday, November 13 and Thursday, November 14, 2002

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OVERVIEW

This report summarizes the discussions and recommendations of the Science Review Team (SRT) for the meeting November 13-14, 2002, at the Tacoma Meeting Room of the Mountaineers in Seattle. This and all other documents from the SRT are consensus reports of the team and represent its collective judgment and conclusions, including members absent from any given meeting.

The SRT believes that its recommendations following the first meeting in May 2002 bear repeating, because they continue to provide a relevant framework for team input.

1. **Work on a "conceptual framework" is valuable up to a point, but it can reach a point of diminishing returns rapidly.** In general, the revised document provided at the November meeting (the "Conceptual Framework") has reached that point. Work on at least two concrete case studies (one large system, one or more small systems) is no less timely now than it was in May 2002 when this recommendation was first made. The value of continuing with the literature review was not apparent to members of the SRT.
2. **A deterministic diagram linking "flows" to "fish" is simplistic. However, the recognition of "flow" as a critical parameter in maintaining healthy ecosystems is entirely appropriate.** As long as King County takes care *not* to represent the Normative Flow Project as a comprehensive solution to the region's loss of salmon, the decision to focus this project on flow alteration and rehabilitation is entirely appropriate and likely to result in concrete gains.
3. **The project scope should include mainstem rivers, regardless of jurisdictional authority.** Discussion during this meeting made more progress in identifying an appropriate mainstem river example (the Green) than in identifying suitable "small" systems. Options for selecting the small systems are more available and selection can be based on a number of system characteristics.
4. **Focus on Endangered Species Act issues and/or "salmon" is too limited; the scope must include the broader goal of ecological integrity**. Ranges of indicators, both hydrologic and biological, were explored with this recommendation in mind.

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW (summary of comments)

- The project should avoid emphasizing "100-year" time frames, ecologically relevant as they may be. There *are* long term issues—floods and droughts, for example—but many influences also occur in the near term and these should be the primary focus. Long-term ecological response is an outcome of the cumulative influence of short-term events, interacting with these infrequent events.
- Notwithstanding a focus on "near-term" phenomena, system-resetting events must not be forgotten—make them explicit in this framework. The ability of a system to return to its normal state following disturbance must also be considered. Management should focus on the near-term events over which it has most direct control, while remaining cognizant of how it influences the response of the system to infrequent or longer-term events.
- Flow is appropriate to identify as a major forcer, and in some settings *the* major forcer. It would be a mistake, however, not to acknowledge other forcing functions such as water quality, sedimentation, or temperature—do not oversell "flow" as the solution (just as "habitat restoration" has already been oversold). The project should state its implicit assumption that appropriate flows are *necessary* for salmon (and broader ecosystem) conservation. In addition, if human activity has not produced other effects on aquatic systems, then improvement in flows will be *sufficient* for conservation to occur.
- Some physical, biological, and cultural changes are exceedingly difficult or impossible to reverse. Certain of these changes in specific circumstances could render a return to an historical pattern of flow inadvisable, even impossible. For example, sustained increases in summer flow might favor proliferation and invasion of an introduced centrarchid that displaces native salmonids. The system is thus not necessarily "reversible." Therefore, the project goals should be based on an articulation of processes that are *easily reversible*, *less reversible*, and *irreversible*, and prioritize rehabilitation efforts accordingly.
- The documents must be careful of language: does the use of "ecological" indicators mean anything different from the use of "biological" indicators? Discussions should most clearly focus on the application of *physical*, *chemical*, and *biological* indicators.
- The use of reference conditions should articulate whether the yardstick for evaluating success is "best available conditions" or simply "a promising trajectory for change."
- Although the long-term *goal* of this project is salmon persistence, the *approach* is not simply to count fish—it is to use a greater variety of indicators to see if the underlying processes that we believe support those fish sustainably are improving (or can be improved).
- Work on the literature review has probably been overtaken by the schedule needs of the project; further searching or organizing of the literature is not likely to produce very much new information useful or relevant to guide the current phase of the project.

The main message from the discussion of these conceptual issues was that the Normative Flow Project should move as quickly as possible to on-the-ground testing of a credible group of indicators on a modest number of actual rivers and streams.

POTENTIAL INDICATORS

Potential indicators can be grouped into categories using the simple framework of "human activities," "hydrology," and "biology." There was no intention to make a definitive or exhaustive list of indicators at the meeting (insofar as these lists were developed without benefit of any on-hand reference material), but the examples should be illustrative. Overarching pitfalls to avoid include:

- Too much detail
- Losing a direct link to biological response
- Failing to meet the timeframe of the project

Sample Indicators of Human Activity

- Impervious density and/or "developed area"
- Road density
- Morphologic/hydraulic alteration of channel and floodplains in large rivers
- Length of active channel thread or of channel network (main channels + side channels)
- Channel sinuosity
- Ratio of historic to current floodplain area of inundation under average annual peak flow, or 5-year recurrence-interval peak flow.

Sample Indicators of Hydrology

- Onset of autumn high flows
- False signals from aseasonal events (e.g., timing of first post-summer flow increase)
- Winter flow (mean, range of discharges, peak magnitude, rate of fluctuation)
- Number of days of floodplain inundation
- Magnitude and/or fluctuations in summertime baseflow
- Daily fluctuation rate of discharges
- T_{Qmean} (and/or other measures of hydrograph flashiness)
- Winter flows that exclude exotic species or that provide species access to headwaters
- Magnitude and stability of base flows—wash-out of fry/smolts, effect on non-natives (low-flow timing, fluctuations, and duration)

Many of these indicators are *not* equally applicable both to small streams undergoing urbanization or other human influences and to large rivers with or without dams. Many of them also are aggregates of multiple effects. So, for example, a characterization of "flashy discharge" will also correlate to large storm peaks, rapid recession, and low inter-storm baseflow. Thus

untangling the web of cause-and-effect (i.e. between the variety of hydrologic changes and the resulting biological response) is probably impossible. In consequence, using multiple hydrologic metrics is advisable (analogous to the approach taken for multimetric biological indicators). It also affirms the use of the "normative flow concept"—independent of our mechanistic understanding, the best match with predisturbance hydrologic conditions is most likely to yield improved biological conditions, barring novel circumstances (such as nonnative species) that are sometimes created.

Any hydrologic indicator poses a hypothesis that should be testable: the indicator will show a change from pre- to post-human disturbance. If it *does* show a change, it is a credible deterministic link to biological response (but of uncertain strength). If it does not, it should be abandoned. We should keep in mind that the hydrologic indicators for large streams my not also be the best indicators for small streams. There may be other hydrologic indicators than the ones enumerated here, but the search for an exhaustive list should *not* take precedence over applying the ones at hand. Case-study evaluation remains the most pressing task.

Sample Indicators of Biology

- Salmonid diversity (taxa richness)
- Spawning distribution by species
- Total fish density
- Total fish diversity
- Number of non-natives
- Sculpin species composition and diversity
- Amphibians
- Other fish metrics used in the Willamette River multimetric fish index

Specifically for small streams:

- B-IBI (see also the 10 primary metrics that encompass this index)
- Numbers and proportion of assemblage composed of coho salmon and cutthroat trout

Specifically for large rivers:

- Relative abundance of native salmonids in off-channel and floodplain habitats
- Floodplain vegetation (using parkland or sandbars as reference sites)

In general, any biological indicator for use in this project needs to have existing data from at least one system, and any data needing to be collected from other systems must be feasible *within the available timeframe*. This limitation suggests that the most useful biological indicators may be B-IBI for small streams and fish for large rivers.

SITE SELECTION

General guidelines for identifying the recommended method-testing sites (i.e. case studies) include:

- One large river and a selected set of small streams
- Systems with much pre- and post-disturbance data already existing

- Systems where comparisons can be readily made to show change that has occurred over time

A quick review of some factors important in the selection of case studies for King County's large rivers identified the Green as offering the best opportunity:

River	Intensity of Human Disturbance	Magnitude of Human Disturbance	Available Hydrologic Data	Available Biological Data
Green	H	H	H	M (L)
Cedar	H	M	L	M (L)
White	H	M	M	L
Snoqualmie	L	L	H	L

There was no equivalent list of small streams developed, in part because there are many more to select from. Criteria that the technical team might use to identify and select appropriate small streams include:

- Watersheds with a range of negative human influence
- Streams already covered by past B-IBI work
- Streams with some fish data.
- Streams with enough gauge data, or with strong confidence for synthesized data
- Streams with extensive information on human use across their landscapes, including current and historical information on channel and riparian condition

NEXT STEPS

The technical team appears to recognize what it needs to do next, and so the SRT made no concrete recommendations for the short-term actions of the project. The SRT recommended that the next meeting of the SRT should be scheduled summarily, as a way of helping the County make the best possible progress in study design and implementation over the next several months. However, for the SRT to have a productive next meeting the following should have already taken place:

- The indicators and metrics have been chosen;
- The initial study systems (both large and small) have been chosen;
- The data and information to be used on those systems have been assembled; and
- Some provisional testing of the indicators has occurred.

Mid-winter (February-March 2003) was recommended for the next SRT meeting. Achieving this schedule would require a significant, immediate realigning of project activities from conceptual model-building to actual data acquisition on real locales. The value to the project of making this change promptly cannot be overemphasized.