

**Ecological Flows Science Advisory Board (EFSAB)**  
**Meeting Summary**                      **Oct, 22-23 2013**  
**Stan Adams Training Facility, Jordan Lake, Chapel Hill, NC**

**FINAL Approved for Distribution**

**Attendance (for both days unless otherwise noted)**

**Members**

Mark Cantrell, USFWS (10/22 only)  
Bob Christian, ECU (present 10/22; online 10/23))  
Tom Cuffney, US Geological Survey  
Linda Diebolt, NC League of Municipalities  
Chris Goudreau, NC Wildlife Resources Commission  
Jeff Hinshaw, North Carolina State University  
Amy Pickle, EMC, Duke (9/24 only))  
Sam Pearsall, Environmental Defense Fund  
Judy Ratcliffe, NC Natural Heritage Program (10/22 only)  
Jaime Robinson, CH2MHill  
Fred Tarver, NC Division of Water Resources

**Alternates**

Sarah McRae, US Fish & Wildlife (10/23)  
Vann Stancil, NC Wildlife Resources Commission  
Tom Thompson, Duke Energy  
David Williams, Div. SWC  
Tom Gerow, NC Forest Service

**Guests:**

Jennifer Phelan (10/22 only)

**NCSU Facilitation Team**

Mary Lou Addor, NC State University/NRLI  
Christy Perrin, NC State University/WECO  
Nancy Sharpless, NRLI

**Division of Water Resources**

Harold Brady

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**The purpose of the Ecological Flows Science Advisory Board:** The Ecological Flows Science Advisory Board (EFSAB) will advise NC Department Environment and Natural Resources (NCDENR) on an approach to characterize the aquatic ecology of different river basins and methods to determine the flows needed to maintain ecological integrity.

**Presentations, reports, and background information of the EFSAB** are available at: <http://ncwater.org/?page=366> (please note that this URL is new as of August 2013)

**Much of the discussion among the EFSAB at the October 22 and 23, 2013 meetings is captured in the [final report of the EFSAB](#) rather than in this meeting summary. The final report has been submitted to the Department of Environment and Natural Resources.**

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**October 22 & 23, 2013:**  
**Summary of Decisions, Recommendations and Proposed Actions**

**Decisions and Recommendations:**

1. The group reached consensus for including the RTI-USGS report as an Appendix for reference in the EFSAB Report.
2. The EFSAB agreed that in discussion of the 2 strategies, under #1 (line 632 of version 4.1), the first sentence should be revised to say: *The percentage of flow strategy using 80-90% flow-by combined with a critical low flow component as the ecological flow threshold.*
3. The writing group assigned to revise the language for addressing a critical low flow component of the statewide recommendation presented their revisions. The revisions were approved and incorporated into the Final Report on page 20, under Section 3.1.1 Percentage of Flow Strategy.
4. The EFSAB reached consensus on removing what had originally been #1 (then became new #4) in the section on “*Evaluating Potential for Ecological Impacts of Future Water Use*”, and then opted to remove the heading “*Evaluating Potential for Ecological Impacts of Future Water Use*”. See Final Report for the final language of this entire section on page 19, under Section 3.1.1 Percentage of Flow Strategy.
5. The group reached consensus on a revised Adaptive Management recommendation:

*There is uncertainty in the science and the existing models, thus a risk-averse strategy was used when devising recommendations. Changes in climate and land use are expected to have significant effects on patterns of temperature, precipitation, hydrology and ecology. Monitoring and predicting these changes will be critical for success in maintaining ecological integrity of North Carolina’s rivers and streams. An adaptive management approach is required to continually advance the science and reduce areas of uncertainty. Therefore, DENR should:*

1. *Emphasize new data (hydrologic and biological) collection and evaluation in headwaters, in the coastal plain, and in large rivers, recognizing that current biological models and assumptions may not address these systems.*
  2. *Adopt/design/develop strategies to:*
    - a. *Validate ecological thresholds (strategies should be informed by new data or research);*
    - b. *Track the impact of flow changes when they occur;*
    - c. *Modify characterizations, target flows, and thresholds based on new data, changing conditions (e.g., land cover, precipitation, hydrology) and lessons learned; and*
    - d. *Georeference nodes to facilitate analysis.*
6. The group finalized and reached consensus on the language for the section of the report addressing threatened and endangered species to:

“The flow requirements of listed species are often not fully understood. In order to conserve state and federally listed species, the EFSAB recommends that the flow needs of these species should be considered by the DENR in addition to the standard recommendations offered in this report. For planning purposes, portions of basins (e.g., nodes) that include listed species should be treated by DENR as

needing additional analysis in consultation with the WRC, NMFS and USFWS. When a decision moves beyond planning, then applicable environmental review documents will be sought from appropriate agencies. The EFSAB also encourages DENR and other appropriate agencies to support further research on the flow requirements of listed species.”

7. Chris, Fred, and Linda will revise the Flow-Habitat section and submit it for the EFSAB’s review by 10/31/13.
8. With the understanding that there was additional work to be done on the glossary, acronyms and reference sections, labeling all figures and tables correctly, putting the report into consistent outline format, searching for terms to be corrected [historic versus historical, for example], re-writing the flow-habitat relationships section, and making the use of articles consistent, the EFSAB reached full consensus on moving the document forward and submitting it to DENR. The EFSAB would receive the finalized document for final review before submission.

**Proposed Actions:**

1. The RTI/USGS team will recalculate P-value for the non-scaled intercept (table 16, 17).

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**I. Executive Summary**

**TITLE: Overview of the RTI- USGS Report**

Presenter: Jennifer Phelan, RTI International

**Major Discussion items/concerns/questions:**

- If you are an expert witness trying to tear this apart, what are the chinks in the armor?

- Biggest problem is the data are over such a large time period- DENR monitoring occurs only every 5 years in a basin. Though getting the type of relationships we're getting with such broad data tells me we're picking up a pretty good signal.
- Are there ways going forward to validate the approach, in a standardized or supplemental data collection, to do a number of stratified sites on an annual basis, looking at some of the outliers?
- Kim Meitzen's work found that the same site over time was very messy from one day to the other. A better strategy would be to wait 5-10 years, and then repeat this process. Routine, annual sampling at same site would probably not lend clarity.
- It should be in your report that this is not a predictive model. If you have flow changes, what is likely to happen to the biology in the state? It's not an estimate of what will happen on a specific creek.
- If somebody were to suggest another option besides the selection of the 80th percentile, the 90th shows the same strength.

**Decisions Made:** The group tested consensus for including the RTI-USGS report as an Appendix for reference in the EFSAB Report – the group was at full consensus with all 1's.

**Proposed Actions or Identified Decisions to be made:**

- The RTI/USGS team will recalculate P-value for the non-scaled intercept (table 16, 17)

## **Continued Review and Development of EFSAB Recommendations**

**TITLE: Discussion: Critical Low Flow**

**Major Discussion Items/Concerns/Questions:**

- Critical low flow is important for maintaining ecological integrity.
- We have not had adequate time to determine a specific number.
- Asking DENR to identify a critical low flow is important.
- It is not just the number; it is how you react.
- The important point is to avoid a scenario where the 80% flow-by goes below the critical low-flow. The critical low flow becomes the flag.
- You will sometimes hit the critical low flow without withdrawals during drought.
- I think it is the duration that we are concerned about. With a withdrawal scenario, the duration of the low flow will be extended; we want it closer to the natural duration.
- I would hope it would identify not necessarily where the threshold was reached, but would stimulate DENR to evaluate whether they have plans to react to droughts. I'm trying to think of how this would work so just reaching the threshold under normal conditions wouldn't cause them to always do additional work. We want to link it in their planning tool to a duration; we're not saying what the duration or threshold is.
- The language in bold does not suggest the Board is recommending Alberta; it just uses Alberta as an example.
- The Alberta paper cites a lot of different approaches. Many use 7Q10, which we do not want to recommend.
- Should we refer to the paper as a review of methods and a proposed method?
- I don't think that discussion of the Alberta paper belongs in the recommendations section
- How can we refer them to an undefined low-flow threshold?
- We encourage DENR to look at it and figure it out.

## Decisions Made:

1. The EFSAB agreed that in discussion of the 2 strategies, under #1 (line 632 of version 4.1), the first sentence should be revised to say: *The percentage of flow strategy using 80-90% flow-by combined with a critical low flow component as the ecological flow threshold.*
2. The writing group assigned to revise the language for addressing a critical low flow component of the statewide recommendation presented their revisions. The revisions were approved and incorporated into the Final Report on page 20, under Section 3.1.1 Percentage of Flow Strategy.

## TITLE: Discussion: Evaluating Potential for Ecological Impacts of Future Water Use (Flag-raising)

In addition to editorial changes, discussion included:

- The permitted flows (in #1 in version 4.2) are grandfathered, not ecological flows.
- **We should move #1 down to be # 4 (with new language), as an exception to the others. (all yes)**
- I agree. That's how we did coastal and headwaters.
- Doesn't it get included in prevailing conditions?
- Yes, but it isn't attributing it directly to that. It gets blurred.
- Fransen isn't going to put 80% flow-by in those nodes. He still wants to know, when looking at the entire basin, what is going on that now cause that node to fail, using a different set of criteria.
- **Rewrite the section on the permitted flows. (Chris, Tom T., Jeff)**
- The remaining #'s (now 1, 2, and 3) are really the green, yellow and red flags.
- Did I miss discussion on the "trimmed hydrology?"
- We were trying to understand how Tom Fransen ran through that process in the model. He used the term Index B hydrology set, which we thought was too confusing. I suggested that we use the term "trimmed hydrology data set". He had it as 10-90. I thought it was better to define it one time.
- Are you uncomfortable with using the trimmed data set? You'd rather use the full data set?
- If you run the model with the whole data set and it says you have exceeded the threshold, then you run it with the trimmed data set, when we chop off those extremes, does it still raise a flag? If the answer is no, then those are dealing with those extreme low or high flows, and the drought protocols should be able to handle those things. But if it raises the flag even with those extreme ends cut off then you have something you really need to look at.
- So it is the yellow versus red flag.
- One is to go evaluate the source of this. Is it extreme high or low flow or is it a particular water usage pattern for that node.
- Or maybe that's one of those headwater nodes where there wasn't a great gage, or it wasn't calibrated that well, so it doesn't have that great a hydrology set in the first place so they have to figure it out.
- My impression was that statutory requirements, in the last sentence of the red flag section are a pretty low bar. I would say, "and also provide..." Don't assume that the drought plans, etc. necessary provide sufficient response.
- It's possible that a slight alteration by a lot of people might bring the usage back within the ecological threshold or the critical low flow. Once you identify a flag going up, what we hope to achieve is that we can recognize some modification, hopefully minor, that can bring us back to achieving that ecological integrity. We should be explicit that that is what we would like to see

happen. Our objective is that they evaluate it and see solutions that would bring things back to maintaining ecological integrity.

- It should already meet the statutory requirements.
- We are getting away from our scientific advice when we start talking about statutory requirements. I think we should strike that part and put in the ecological outcome we would like to see come from further review.
- It should say the objective of the review is maintaining ecological integrity.
- For the yellow flag, it is really about jiggering things around so that you maintain ecological integrity.
- This flag is one that will go up fairly often. We are trying to give DENR some direction that is something they can actually do. We wanted to suggest that they review to see if they can make adjustments to maintain the ecological integrity--get ahead of the curve while in the yellow. Start talking.
- That's the point of the yellow flag. They can look at the current situation, then look at the 2050 projections, then if in those 2050 projections the flag goes up, they look at what uses should not be allowed in the future, or need to be adjusted. There is a future and a current component to this action.
- **We should go ahead and refer to these as flags--green, yellow and red.**
- If we have red, yellow and green flags for responding to the first recommendation, then we need to identify the flagness of option number 2 (ecodeficit tool). We might say that diminishment of biological condition of more than 5-10% constitutes raising a red flag under option 2.
- How to incorporate critical low flow component in [new] #1 so it doesn't always exceed the threshold?
- There are 2 separate evaluations- critical low flow is to see if you're exceeding the duration.
- No, the threshold is the higher of the 2 values
- The CLF piece is complex- it will take more effort to develop the language; the concept is what is important to convey.
- Should we leave it and let DENR figure it out?
- We need to convey the CLF component; we don't need to define how it is used.
- [new] #3 should include same action items as in [new] #2 as well as "additional review"
- What is "unaltered?" (Is it different from baseline)
- [new] #4—We don't want "ecological" in the recommendation- permitted flow is not an ecological flow.
- We're saying it is a surrogate in the models, not that it is an ecological flow.
- Why wouldn't you run the permitted conditions?
- What are permitted conditions being used for here?
- To run in the model instead of a % flow-by
- How is that different than running prevailing condition? Why not say "not all prevailing conditions will meet these ecological thresholds" and recommend DWR evaluate prevailing conditions against future use?
- A suggested refocus- don't advise DENR on an immovable piece (permitted flow). That is already happening- that section should be deleted.
- What if upstream conditions above the node make it hard to meet permitted flow?
- This came from Fransen. He won't put flow-by in nodes with permitted flows. He will need to work it into the model anyway. He was maybe thinking current projects were kind of an eco-flow, and wanted to differentiate. It is okay to delete.
- #4 gets into something not in our framework- a different process.
- This section includes suggestions for how they operate it.

- To delete, it would leave a hole in how they evaluate those areas that may be different than flow-by.
- Don't lose the information- it's okay to delete. Consider how to let people know how to deal with existing permitted flows. Could raise it as something to consider in the adaptive management recommendation.
- **Ok, delete (new) #4. It's not our duty to tell DENR what to do with permitted conditions- it's outside our reach.**

**Decisions Made:**

**The EFSAB reached consensus on removing what had originally been #1 (then became new #4) in this section and opted to remove the heading “Evaluating Potential for Ecological Impacts of Future Water Use”. See Final Report for the final language of this entire section on page 19, under Section 3.1.1 Percentage of Flow Strategy.**

**TITLE: Discussion: Adaptive Management Section**

An EFSAB member proposed the following to be incorporated into the adaptive management recommendation:

- There needs to be a strong and clear statement that:
  - There is growing strong evidence that climate change is occurring.
  - It is difficult to determine the changes that will occur in the Southeast.
  - Changes in precipitation and temperature resulting in alterations to the hydrologic balance will affect flows in ways not predictable from historic records used for OASIS.
  - These alterations will affect predictions at the time scale for planning, jeopardizing the value of the exercise.
  - Adaptive management must include recognition of these changes in climate.

The EFSAB discussed this proposal and other potential changes to the adaptive management recommendation.

**Major Discussion items/concerns/questions:**

- Adding climate change may doom the report, though I agree with the suggestions.
- Can we refer to changes in precipitation and temperature without mentioning climate change?
- In the current recommendation, add a sentence- changes in hydrology, precipitation, evapotranspiration
- Land use change is an immediate threat that is also not addressed here.
- I'm uncomfortable not to address the drivers of hydrologic change. Is this a conservative framework? There are future scenarios that make this NOT conservative
- We're not reducing uncertainty, either.
- I was the one who recommended not to explicitly mention climate change because I was worried it would cause officials to shelve this document since there is skepticism in the Dept. about whether human activity causes climate change. The possibility of public officials' views preventing scientific professionals from expressing the truth has chastened me. I second the proposal to reintroduce climate change into the adaptive management section. The truth does not need to be subordinate here.
- We're hedging a bit based on how we think politicians will receive it.
- We are acknowledging that there is limitation of the OASIS model, since it uses a historical record rather than predictions.
- WaterFALL can simulate climate change modeling.

- Climate change is not the only reason you'll want to use adaptive management. Land use is even more likely to have an impact.
- Climate change could produce large and unpredictable changes in temperature and precipitation. The unpredictability is unlike land use change.
- It should reflect a list of why we would want an adaptive management approach, including climate change impacts and others.

#### **Decisions Made:**

1. The group reached consensus on a revised recommendation:

***There is uncertainty in the science and the existing models, thus a risk-averse strategy was used when devising recommendations. Changes in climate and land use are expected to have significant effects on patterns of temperature, precipitation, hydrology and ecology. Monitoring and predicting these changes will be critical for success in maintaining ecological integrity of North Carolina's rivers and streams. An adaptive management approach is required to continually advance the science and reduce areas of uncertainty. Therefore, DENR should:***

***1. Emphasize new data (hydrologic and biological) collection and evaluation in headwaters, in the coastal plain, and in large rivers, recognizing that current biological models and assumptions may not address these systems.***

***2. Adopt/design/develop strategies to:***

***a. Validate ecological thresholds (strategies should be informed by new data or research);***

***b. Track the impact of flow changes when they occur;***

***c. Modify characterizations, target flows, and thresholds based on new data, changing conditions (e.g., land cover, precipitation, hydrology) and lessons learned; and***

***d. Georeference nodes to facilitate analysis.***

#### **TITLE: Discussion: Threatened and Endangered Species**

The Board reviewed a rewrite of the recommendation regarding Threatened and Endangered Species (T&E), which had been revised prior to this meeting. Among other revisions, the rewrite removed language about T&E being broadly addressed by the PHABSIM approach.

#### **Major Discussion items/concerns/questions:**

- The gist of it is that the species-specific flow requirements of listed species are not fully understood, and they are listed species. We have a greater obligation there. I don't feel that we did a really robust evaluation of flow-habitat relationships for these species. The PHABSIM piece was related to an unaltered flow, 80% of an unaltered flow. Our recommendation is not about an unaltered flow. Ours is 80% of prevailing conditions.
- PHABSIM aside, in the analysis that was done with the ecodeficit tool, data for T&E are included in a general sense.
- Wherever there are aquatic riparian listed species, DENR is already required to develop site-specific management plans.
- Is the point that the PHABSIM results broadly address T&E through the various guilds? Even though they are not specifically addressed, the PHABSIM work gives some indication?
- The PHABSIM results are not directly translated into our statewide recommendation. It is not a direct translation. To say that T&E are broadly addressed by PHABSIM is correct, but to say that they are addressed by the statewide recommendation we are making is not an accurate statement to me.

- Does it help to say that T&E are not directly addressed by the statewide recommendations and add a statement that they may be addressed by the PHABSIM evaluations?
- What if we say that flow-habitat relationships for listed species have not been specifically addressed by the statewide recommendations and, therefore, species-specific flow requirements should be addressed on a site-specific basis?
- That's like saying we haven't addressed some other grouping of organisms. They are in the water. They are of the taxa that we assessed by the various means.
- We are just saying that they be considered. I would also change "maximum protection" to "adequate protection" or "appropriate".
- How about just protection.
- Add NMFS and remove NHP, leaving WRC and USFWS.

#### **Decisions Made:**

The group finalized and reached consensus on the language for the section of the report addressing threatened and endangered species to:

**“The flow requirements of listed species are often not fully understood. In order to conserve state and federally listed species, the EFSAB recommends that the flow needs of these species should be considered by the DENR in addition to the standard recommendations offered in this report. For planning purposes, portions of basins (e.g., nodes) that include listed species should be treated by DENR as needing additional analysis in consultation with the WRC, NMFS and USFWS. When a decision moves beyond planning, then applicable environmental review documents will be sought from appropriate agencies. The EFSAB also encourages DENR and other appropriate agencies to support further research on the flow requirements of listed species.”**

#### **TITLE: Discussion: Flow-Habitat Relationships**

Fred Tarver had rewritten the section of the report on Flow-Habitat Relationships. His revised version had since been reworked by Linda Diebolt, Chris Goudreau, and Jim Mead. Fred provided an overview of his revisions including:

- Removed discussion of IFIM to simplify.
- Encapsulated work done in piedmont by Jim Mead and in mountains by Fred.
- Moved some of the tables and graphs to put into an appendix or be removed from the report altogether and just put on the website.
- Tried to encapsulate through text what some of the graphs showed.
- Restructured to make more readable for potential readers who have not been immersed in the work of the EFSAB.
- Added a couple of charts that better summarized the results in an understandable way.

The facilitator suggested that the Board not try to wordsmith the document as a group, but that they instead provide comments and suggestions for the writing team that would further refine the section.

#### **Major Discussion items/concerns/questions:**

- For the outsider not immersed in the EFSAB's work, it still needs work. It is not understandable. Being new to the Board, I do not know what the charts are showing, and the text does not adequately clarify. Perhaps explanatory captions would help.
- Perhaps you could put at the beginning or the end of each section a description of what the section is telling you.
- Add to each section in bold a description of the purpose of that section and what this section is conveying (annotation below the title).

- It's going to be difficult to make that section lay-worthy.
- It would be helpful to have Index B explained in terms of habitat.
- The point is that the recipient of the report is DENR.
- I have a co-worker who spent 4 hours reading that section with me. If you would like an outsider who read the original to look at it and see if the re-write makes sense, let me know.

**Proposed Actions or Identified Decisions to be made:**

**Chris, Fred, and Linda will revise this section and submit it for the EFSAB's review by 10/31/13.**

**TITLE: Discussion: Report Review and Finalization**

On October 22, the facilitator noted that the RTI/USGS Report would be finalized (adding a graph and correcting a few minor typos) and included as Appendix D. The facilitator reviewed the documents created for assessing the many comments and suggested revisions from the Board's review of version 4.1 of the report prior to this meeting. For several sections of the report she had shown the original text in 4.1, then showed the proposed revisions. The EFSAB divided into two groups. Everyone in one group took the first half of the document showing proposed revisions; the other group took the other half. Then each individual reviewed their half of the revisions, providing comments on whether they agree with the change, and if not, why. The facilitators collected the comments.

The report was then revised on October 23 to version 4.2 based on comments/revisions provided on October 22 and over night. The facilitator led a review of version 4.2 of the report beginning with issues that the facilitators had identified as needing addressing.

**Major Discussion items/concerns/questions:**

- Acknowledgements (people who contributed to the process from the beginning)
- Update References
- What writing style to use?
- Executive Summary **[Tom Cuffney will write one of approximately 2 pages]**
- Removed section on tools **[consensus]**
- Title **[Tom Cuffney will write]**
- Photos to include
- Submitted to whom? [DENR]
- Add date.
- Tribute to Steve Reed
- Re-title some sections
- Number sections and subsections.
- Table of Contents

The Board then went through sections of the report, word-smithing some language. All of the changes made are included in the final report.

**Decision Made:**

**With the understanding that there was additional work to be done on the glossary, acronyms and reference sections, labeling all figures and tables correctly, putting the report into consistent outline format, searching for terms to be corrected [historic versus historical, for example], re-writing the flow-habitat relationships section, and making the use of articles consistent, the EFSAB reached full consensus on moving the document forward and submitting it to DENR. The EFSAB would receive the finalized document for final review before submission.**

## II. Oct. 2013 Meeting Orientations and Sept. 2013 Meeting Summary Approval

Members and alternates of the Ecological Board Science Advisory Board introduced themselves and their affiliations. Guests in attendance and the facilitation team also introduced themselves. Everyone who attended the meeting was reminded to sign-in.

A brief orientation was conducted of the meeting facilities (restrooms, concession) and available technology (webinar).

The EFSAB approved the September 24 & 25, 2013 meeting summary, and it has been posted to the NC Water.org website.

## III. Presentation: Overview of the RTI/USGS Report

**Presenter:** Jennifer Phelan, RTI

Jennifer provided an overview of the RTI-USGS report, chapter by chapter.

1. Purpose of report- to document NC data, methods and results of their work in support of ecological flows.

2. Stream classification- with the proposed classification, we didn't know the degree by which the classes described the biology, which was the purpose of a bio fidelity analysis. We found that with the classes developed using USGS data, the classes were very sensitive to flow metrics. As small as a 10% change in the period of record would cause a jump in stream class. When we tried to use modeled data, we found only 50% match rate between USGS data and modeled data- we found it indicated a problem with the classification. See Table 4 in the report.

This gave rise to the BEC, biological-environmental classification system. The objective was to develop and implement an easy to understand system to apply all across the state. It wasn't as easy as we thought- we didn't find any distinct stream classes that could be built. Pre-existing a-priori classes were best: for benthics- Omernick Level 3; for fish-Ecological drainage units (EDU).

We didn't gain anything further to add other physiographic variables.

3. Flow-biology relationships

She drew a graph of flow and biological response. A lot of effort went into this; we tried a lot of approaches from hierarchal, statistical, biological perspectives. P. 16 is biological responses (and in pp. 5-8). For fish- 156 species were measured in NC, grouped into 6 flow based habitat guilds. We did analyses on sensitivity of guilds, found riffle run guild was most sensitive to alteration, and it had the greatest distribution across the state. We adopted that as response metric for fish. We could characterize fish by abundance, species richness, or Shannon-Weaver Diversity index, which integrated the 2 so we chose that one.

Tom Cuffney spent time on methods for benthos. We looked at 108 metrics, evaluated them on how well they responded, range over which they responded, and relevance to state for assessing water quality. We chose EPT Richness.

For flow change, we recommended using WaterFALL model because we could generate records at each biological monitoring station. We used PNV (potential natural vegetation) layer vs. 2006 NLCD as current land use, which is the full human influence of flow alteration plus land use. We used a 1967-2006 climate record.

That's the hydrology data. For flow metrics, 94 were evaluated (pp. 18-19); some came from TNC, and some from Vogel et al. We developed a list based on goals of NC, in consultation with Fred and Jim, and focused on those that were meaningful to management in the state, and focused on reductions in flow. Then we went through an iterative process to narrow them down. A large number of metrics were

highly correlated (like month by month). The final list of metrics is on p. 21, Table 9. Six metrics were selected because they were useful for management; focused on reductions of low flows, represent magnitude, timing, and duration of flow. They could also be modeled by WaterFALL and have a low degree of intercorrelation redundancy.

This resulted in a total of 12 potential relationships (with flow metrics on x axis –, biological response on y axis). The following steps were then taken.

Step 1: Determine what type of regression we wanted to attempt. You can see the data looks a little messy. Based on literature regarding ecology and flow biology relationships, we tried to focus on upper limits of response, using quantile regression. This represents the upper limit of biological response attributed to the x-axis. Everything below is also influenced by something else. We chose 2 possible analytical approaches that focused on that: 80<sup>th</sup> quantile regression, and also the upper limit regression, which took the upper 20% data and drew line. 80<sup>th</sup> quantile is most scientifically defensible as it was used in Potomac and other literature. Figures 9-10 show these processes.

Step 2: Determine if we should describe relationships as linear or non-linear. We saw a drop in response. Regarding the significance of relationships, in some cases it was linear or non linear. For management purposes, we decided to adopt the linear relationship since it's easier for managers to adopt.

Step 3: Decide whether to do the flow-biology relationships by region or state. The BEC class system was by a *a priori* class systems- Omernick level 3, ecological drainage units for fish. We were not very successful developing flow-biological relationships by class. That might be due to not enough data. But we had strong significant relationships statewide.

Step 4: Decide whether to normalize data or use raw data for state level analyses. If analyzed at state level, we should account for inter-basin variation. Table 12-13 shows why we should do normalization. There were variations between basins. Much appreciation to Tom for pointing this out- maybe some of the variation is due to variation of hydrology in the basins. It turned out to be the case. Figures 14-15 shows EPT richness by eco-region, divided by excellent (reference) sites. In general the reference sites in mountains have higher EPT richness than piedmont, than coastal. Figure 15 focuses on excellent sites, where you see the inverse is true. The mountains have the lowest amounts of flow alteration; the piedmont has more altered hydrology. We did back-casting and found a larger portion of changes in biology could be attributed to altered hydrology. This showed we did not need to normalize; we could use the raw data.

We did a statewide analysis, linear regression, on raw data.

Q: The fact you did it on raw data makes sense. Are there any other sources in literature to justify that decision? You're using raw data for EPT. I would expect it to change between mountain and piedmont, coastal, regardless of hydrology. Some of the change would be due to normal differences; some would be attributed to man-made hydrology

R: These are sites that are naturally different in hydrology. These are excellent sites. You're not looking at flow alteration per se. If we had normalized it we would compound the errors.

R: State level analysis- I'm not aware if anyone has done anything on this large of a scale. You do have portion of table showing what deviation is accountable by flow.

Q: Use of excellent, good classes in coastal plain. I don't know if this is an EPT thing or fish. They use the term natural condition in the coastal plain; they pulled away from using the excellent, good, good-fair for swamp systems. Curious how that was addressed in coastal plain.

R: For invertebrates the state is still using good, excellent, fair.

Q: Fishes have a natural swamp condition not included in the classification system.

R: We didn't adopt the state's fish classification system. We produced an index comparable to benthic class. For each basin took 80<sup>th</sup> percentile, then took 80<sup>th</sup> percentile of that- the best of the best for what that could be for fish.

Q: What do you think the chinks in the armor are on this? If you were an expert witness trying to tear it apart, what would you say?

R: Biggest problem is the data are over such a large time period. Every 5 years they go back to monitor in a basin. 1989 was earliest record. We took the most recent record for each site. Getting

the type of relationships we're getting with such broad data tells me we're picking up a pretty good signal.

Q: If you had more info, do you think the regional models would have shown more significance? It's a subjective question. The regional models didn't show as much significance but you'd hope to see it if you had the data to back it up.

R: A lot of the break down has been in trying to compartmentalize, because these things are continuous. If you have discrete units and you're sampling away from the edges you may get good differentiation, but in reality these things don't have hard edges. Also the number of sites is huge.

Q: Are there ways going forward to validate the approach, in a standardized or supplemental data collection, to do a number of stratified sites on an annual basis, looking at some of the outliers?

R: Think about Kim Meitzen's work- she found that the same site over time was very messy. She found so much influencing biology one day to the other.

R: A better strategy would be to wait 5-10 years, and then repeat this process. Take parts that worked well, now looking at another 2 data points for each site and see if you come up with similar set of relationships. I would consider that strongly validated. Routine, annual sampling at same site would probably not lend clarity.

Important, this tells us this is the reaction over the state on average. It is not predicting what is happening at a single site. If you want to undermine it in a statistical way, go to a single site and try to predict what will happen. It's just there to tell you that you have a probability of having an account. Think of what's going into this. You have a 40-year record, also not acknowledging the Clean Water Act and changes that may have happened in water quality. Keep in mind what has gone into the relationships and the strength.

Q: Was that comment included in SAB report? Statement that it is not a site-specific model where you could take and predict a response at a site?

R: It should be in your report- its' not a predictive model. You want to know what potentially can happen. You don't want many models at each site. What you want to know, if you have flow changes, what is likely to happen to the biology in the state. It's not an estimate of what will happen on a specific creek.

Q: Do you think you'd have same level of success if you used other guilds?

R: Yes, for invertebrates there are others that would work. Average tolerance worked well but didn't have the same range as species richness.

C: On the fish side, a balance of number of data points and sensitivity. We did look at pools, showed less sensitive. Riffle guild was most sensitive.

R: It's not documented here, but we will put into a manuscript the contrast between riffle-run and pool guild. In many ways that would be good to include, it supports the whole theory. Yes our sensitive guilds are responding more strongly than less sensitive guilds (pool).

C: It's not necessary for us to include in our report.

C: Anyone who questions it could go to that document, which would be peer reviewed.

Q: The selection of the 80<sup>th</sup> percentile, is that another item that someone might suggest other options that could have been chosen?

R: If somebody was upset by it we could do the 90<sup>th</sup> percentile. 90<sup>th</sup> shows the same strength  
Are there any other holes, things we need to defend?

With respect to final product, refer to figures on pp. 34, 35...these are what we'd recommend to include in your report, on these pages.

Q: Specific to this graph, don't you force your intercept to be 100?

R: When you scale.

Q: P value was for what?

R: For the true intercept, we may have to re-do that to put the non-scaled intercept (table 16, 17)

C: You may want to check that.

Chapter 4- ecological flow framework- the idea behind it was to place flow-biology curves into a management framework, as there was no obvious threshold that could be adopted. That gave us the driver to develop an ecological flow framework, which was the working river concept that is behind

Table 18. For rivers with excellent conditions of flow, allow only 5% change in biology. If good, less allowed. It shows how the flow framework fits onto those curves. Finally, we showed 2 contrasting stream segments that are different by size and alteration of flows.

The other thing we wanted to highlight with this approach using the Neuse and Eno was to show how the % ecodeficit looks different based on difference in size of river. Tables 20-23, shows how you need to do it on a season-by-season basis. Summer ecodeficit is different than winter ecodeficit.

That's it. Any other questions, thoughts, or concerns?

None.

**Decision: The group tested consensus for including the RTI-USGS report as an Appendix for reference in the EFSAB Report – the group was at full consensus with all 1's.**

## **IV. Discussion: Continued Review and Development of EFSAB Recommendations**

Comments made by EFSAB members on the draft report prior to this meeting had indicated areas of the recommendations that needed to be revisited for clarification and agreement. The facilitators provided a list of those areas that they identified:

1. Critical Low Flow
2. Statewide Ecological Flow Evaluation
3. Ensure that the scenarios for when a flag is raised are described completely.
4. Adaptive Management Recommendation—consider adding climate change
5. What else?

### **Critical Low Flow**

The Board began by reading the revised recommendations section (version 4.1). They then discussed the section on critical low flow. In addition to some editorial comments, substantive comments included:

- Critical low flow is important for maintaining ecological integrity.
- We have not had adequate time to determine a specific number.
- Asking DENR to identify a critical low flow is important.
- It is not just the number; it is how you react.
- The important point is to avoid a scenario where the 80% flow-by goes below the critical low-flow. The critical low flow becomes the flag.
- You will sometimes hit the critical low flow without withdrawals during drought.
- I think it is the duration that we are concerned about. With a withdrawal scenario, the duration of the low flow will be extended; we want it closer to the natural duration.
- I would hope it would identify not necessarily where the threshold was reached, but would stimulate DENR to evaluate whether they have plans to react to droughts. I'm trying to think of how this would work so just reaching the threshold under normal conditions wouldn't cause them to always do additional work. We want to link it in their planning tool to a duration; we're not saying what the duration or threshold is.
- When we rewrote that section, we got away from specific % flow-by and critical low flow numbers. Whatever DENR figures out its part of this evaluation. We have a pretty good handle on the % flow-by since Fransen provided that example. But we haven't discussed the critical low flow, if not the number then the duration. If there has to be additional language that addresses that, maybe that gets everyone on the same page.
- Is anyone uncomfortable with the Alberta Method?
- Yes, they basically shoot down their own method a lot in there. They use weekly rather than daily time steps...its pretty much focused on a couple basins. It shouldn't prevent us with

including a critical low flow just because it doesn't apply well to NC. We haven't had the opportunity to see what it looks like for NC streams.

- The language in bold does not suggest the Board is recommending Alberta; it just uses Alberta as an example.
- The Alberta paper cites a lot of different approaches. Many use 7Q10, which we do not want to recommend.
- Should we refer to the paper as a review of methods and a proposed method?
- I don't think that discussion of the Alberta paper belongs in the recommendations section
- How can we refer them to an undefined low-flow threshold?
- We encourage DENR to look at it and figure it out.

**The EFSAB agreed that Jaime, Chris, Fred and Jeff would revise the discussion of critical low-flow in the report and present that to the EFSAB after lunch.**

**The EFSAB also agreed (all 1's) that in discussion of the 2 tools, under #1 (line 632 of version 4.1), the first sentence should be revised to say: In the basin wide hydrologic models, use 80-90% flow-by combined with a critical low flow component as the ecological flow threshold.**

## **Discussion About Evaluating Potential for Ecological Impacts of Future Water Use (Flag-raising)**

In addition to editorial changes, discussion included:

- The permitted flows (in #1 in version 4.2) are grandfathered, not ecological flows.
- **We should move #1 down to be # 4 (with new language), as an exception to the others. (All yes)**
- I agree. That's how we did coastal and headwaters.
- Remove "In the absence of permitted flow requirements" from line 751, then #2 becomes #1.
- Don't use the word "deemed"
- Doesn't it get included in prevailing conditions?
- Yes, but it isn't attributing it directly to that. It gets blurred.
- Fransen isn't going to put 80% flow-by in those nodes. He still wants to know, when looking at the entire basin, what is going on does that now cause that node to now fail, using a different set of criteria.
- **Rewrite the section on the permitted flows. (Chris, Tom T., Jeff)**
- The remaining #'s (now 1, 2, and 3) are really the green, yellow and red flags.
- Did I miss discussion on the "trimmed hydrology?"
- We were trying to understand how Tom Fransen ran through that process in the model. He used the term Index B hydrology set, which we thought was too confusing. I suggested that we use the term "trimmed hydrology data set". He had it as 10-90. I thought it was better to define it one time. If somebody has a better way of saying it, that's great.
- I have seen that term.
- We need to be careful about the extent to which DENR influences our advice to them. It seems like they are writing a handbook along with our advice. Let's make sure what we write constitutes our best scientific advice and let DENR do what they can with it.
- This came about because last time we agreed that we would use Fransen's basic flag-raising approach.
- Are you uncomfortable with using the trimmed data set? You'd rather use the full data set?

- If you run the model with the whole data set and it says you have exceeded the threshold, then you run it with the trimmed data set, when we chop off those extremes, does it still raise a flag? If the answer is no, then those are dealing with those extreme low or high flows, and the drought protocols should be able to handle those things. But if it raises the flag even with those extreme ends cut off then you have something you really need to look at.
- So it is the yellow versus red flag.
- One is to go evaluate the source of this. Is it extreme high or low flow or is it a particular water usage pattern for that node.
- Or maybe that's one of those headwater nodes where there wasn't a great gage, or it wasn't calibrated that well, so it doesn't have that great a hydrology set in the first place so they have to figure it out.
- My impression was that statutory requirements, in the last sentence of the red flag section, is a pretty low bar. I would say, "and also provide..." Don't assume that the drought plans, etc. necessary provide sufficient response.
- It's possible that a slight alteration by a lot of people might bring the usage back within the ecological threshold or the critical low flow. Once you identify a flag going up, what we hope to achieve is that we can recognize some modification, hopefully minor, that can bring us back to achieving that ecological integrity. We should be explicit that that is what we would like to see happen. Our objective is that they evaluate it and see solutions that would bring things back to maintaining ecological integrity.
- Be above the threshold.
- It should already meet the statutory requirements.
- We are getting away from our scientific advice when we start talking about statutory requirements. I think we should strike that part and put in the ecological outcome we would like to see come from further review.
- It should say the objective of the review is maintaining ecological integrity.
- For the yellow flag, it is really about jiggering things around so that you maintain ecological integrity.
- It is demand-side management, basically.
- This flag is one that will go up fairly often. We are trying to give DENR some direction that is something they can actually do. We wanted to suggest that they review to see if they can make adjustments to maintain the ecological integrity--get ahead of the curve while in the yellow. Start talking.
- That's the point of the yellow flag. They can look at the current situation, then look at the 2050 projections, then if in those 2050 projections the flag goes up, they look at what uses should not be allowed in the future, or need to be adjusted. There is a future and a current component to this action.
- **We should go ahead and refer to these as flags--green, yellow and red.**
- In line 735, we have a subtitle. We should not have a subtitle there. Also, if we have red, yellow and green flags for responding to the first recommendation, then we need to identify the flagness of option number 2 (ecodeficit tool). We might say that diminishment of biological condition of more than 5-10% constitutes raising a red flag under option 2.
- **The EFSAB decided that a small group would work on rewriting this section and present to the group.**

During lunch, a small group made revisions to a section of the **Statewide Ecological Flow Evaluation recommendation** called: ***Evaluating Potential for Ecological Impacts of Future Water Use***

The language in 4.2 for this section included a bullet starting "Existing permitted flow requirements (e.g., FERC licenses) will be deemed as ecological threshold levels". The following discussion referred to this section as well as how to evaluate critical low flows.

- How to incorporate critical low flow component in #1 so it doesn't always exceed the threshold?
- There are 2 separate evaluations- critical low flow is to see if you're exceeding the duration.
- No, the threshold is the higher of the 2 values
- The CLF piece is complex- it will take more effort to develop the language; the concept is what is important to convey.
- Should we leave it and let DENR figure it out?
- This is a repeat of the ecological flow recommendation. It is incomplete because our analysis is incomplete. We need to convey the CLF component; we don't need to define how it is used.
- #3 should include same action items as in #2 as well as "additional review"
- What is "unaltered?" (Is it different from baseline)
- #4 don't want "ecological" in the recommendation- permitted flow is not an ecological flow.
- We're saying it is a surrogate in the models, not that it is an ecological flow.
- Why wouldn't you run the permitted conditions?
- What are permitted conditions being used for here?
- To run in the model instead of a % flow-by
- How is that different than running prevailing condition? Why not say "not all prevailing conditions will meet these ecological thresholds" and recommend DWR evaluate prevailing conditions against future use?
- A suggested refocus- don't advise DENR on an immovable piece (permitted flow). That is already happening- that section should be deleted.
- What if upstream conditions above the node make it hard to meet permitted flow?
- This came from Fransen. He won't put flow-by in nodes with permitted flows. He will need to work it into the model anyway. He was maybe thinking current projects were kind of an eco-flow, and wanted to differentiate. It is okay to delete.
- #4 gets into something not in our framework- a different process.
- This section includes suggestions for how they operate it.
- To delete, it would leave a hole in how they evaluate those areas that may be different than flow-by.
- Don't lose the information- it's okay to delete. Consider how to let people know how to deal with existing permitted flows. Could raise it as something to consider in the adaptive management recommendation.
- **Ok, delete (new) #4. It's not our duty to tell DENR what to do with permitted conditions- it's outside our reach.**

**The EFSAB reached consensus on removing (new) #4 in this section and opted to remove the heading "*Evaluating Potential for Ecological Impacts of Future Water Use*". See Final Report for the final language of this entire section on page 19, under Section 3.1.1 Percentage of Flow Strategy.**

## **Discussion about Adaptive Management Recommendation**

An EFSAB member proposed the following to be incorporated into the adaptive management recommendation:

- There needs to be a strong and clear statement that:
  - There is growing strong evidence that climate change is occurring.
  - It is difficult to determine the changes that will occur in the Southeast.
  - Changes in precipitation and temperature resulting in alterations to the hydrologic balance will affect flows in ways not predictable from historic records used for OASIS.

- These alterations will affect predictions at the time scale for planning, jeopardizing the value of the exercise.
- Adaptive management must include recognition of these changes in climate.

The EFSAB discussed this proposal and other potential changes to the adaptive management recommendation. The main points of their discussion follow here:

- Adding climate change may doom the report, though I agree with the suggestions.
- Can we refer to changes in precipitation and temperature without mentioning climate change?
- In the current recommendation, add a sentence- changes in hydrology, precipitation, evapotranspiration
- Land use change is an immediate threat that is also not addressed here.
- #3c “changing conditions” covers all that
- Add (e.g. land cover, hydrology, precipitation)
- Add “emphasize new data collection in headwater streams”
- Add something about permitted flows here? (no)
- Do we address the high end of the hydrograph? (That is in the front part of the document)
- Specify types of data? (biological, hydrological)

Changes were made to reflect this discussion.

Facilitator: does this section meet your interests?

- I think we should better address climate change but I don't want to hold this up.
- I'm uncomfortable not to address the drivers of hydrologic change. Is this a conservative framework? There are future scenarios that make this NOT conservative
- We're not reducing uncertainty, either.
- Could we couch climate change in phrases that we haven't explored? We would acknowledge that we expect to have impacts but haven't explored them, as an introductory paragraph of the adaptive management recommendation.
- Add- monitoring and predicting changes in temperature and precipitation.

**The EFSAB made edits to the adaptive management recommendation that incorporated the concerns discussed. [Facilitators' note: Further changes were made the following morning.]**

## **Revisit Threatened and Endangered Species Recommendation**

The Board took a few minutes to review the rewrite of the recommendation regarding Threatened and Endangered Species (T&E), which had been revised prior to this meeting. Among other revisions, the rewrite removed language about T&E being broadly addressed by the PHABSIM approach. Comments and discussion points included:

- The gist of it is that the species-specific flow requirements of listed species are not fully understood, and they are listed species. We have a greater obligation there. I don't feel that we did a really robust evaluation of flow-habitat relationships for these species. The PHABSIM piece was related to an unaltered flow, 80% of an unaltered flow. Our recommendation is not about an unaltered flow. Ours is 80% of prevailing conditions.
- PHABSIM aside, in the analysis that was done with the ecodeficit tool data for T&E are included in a general sense.
- Not sturgeons; not freshwater mussels.
- To say that we have not addressed T&E at all I think is not...
- I'm not saying that we did not address them at all. I'm saying...

- If it is flowing from the rest of the document, then this paragraph is dealing specifically with T&E. Wherever there are aquatic riparian listed species, DENR is already required to develop site-specific management plans.
- Is the point that the PHABSIM results broadly address T&E through the various guilds? Even though they are not specifically addressed, the PHABSIM work gives some indication?
- For some species we developed some really specific...
- Absolutely.
- The PHABSIM results are not directly translated into our statewide recommendation. It is not a direct translation. To say that T&E are broadly addressed by PHABSIM is correct, but to say that they are addressed by the statewide recommendation we are making is not an accurate statement to me.
- Does it help to say that T&E are not directly addressed by the statewide recommendations and add a statement that they may be addressed by the PHABSIM evaluations?
- Again, I don't think we need to put a caveat in there that would be an out where you wouldn't consider listed species separately.
- What if we say that? What if we say that flow-habitat relationships for listed species have not been specifically addressed by the statewide recommendations and therefore species-specific flow requirements should be addressed on a site-specific basis?
- That's like saying we haven't addressed some other grouping of organisms. They are in the water. They are of the taxa that we assessed by the various means. I don't see it as a big deal.
- If you lead off with the second sentence, saying that they are not fully understood, strike potentially more limiting because we are not trying to lead people. We are just saying that they be considered. I would also change "maximum protection" to "adequate protection" or "appropriate".
- How about just protection.
- I like the first sentence; I think it is a good introduction to the paragraph.
- Add NMFS and remove NHP, leaving WRC and USFWS.

**The Board opted revisit the proposed changes the next day.**

## **V. Report Review**

The facilitator noted that the Board will have completed the substance of their recommendations once the Board approves the T&E. The next step would be to finalize the report. The facilitator noted that the RTI/USGS will be finalized (adding a graph and correcting a few minor typos) and included as Appendix D. The revisions to the Flow-Habitat Relationships section of the report were also not included in the version of the report that the Board was working with today. Chris, Linda, and Fred had been working on revising that section to improve readability for anyone not immersed in the work of the EFSAB. Those revisions would be sent out this night and reviewed on the second day of this meeting.

The facilitator reviewed the documents created for assessing the many comments and suggested revisions from the Board's review of version 4.1 of the report prior to this meeting. For several sections of the report she had shown the original text in 4.1, then shown the proposed revisions. The EFSAB divided into two groups. Everyone in one group took the first half of the document showing proposed revisions; the other group took the other half. Then each individual reviewed their half of the revisions, providing comments on whether they agree with the change, and if not, why. The facilitators collected the comments.

The meeting adjourned.

**October 23, 2013**

## **VI. Orientation to the October 23 Meeting**

After introductions, the facilitators introduced the agenda for the day:

- Revisit the flow-habitat relationships section
- Revisit Critical Low Flow
- Revisit the Adaptive Management Section
- Revisit the Threatened and Endangered Section
- Review and revise sections of the report, which had received conflicting comments/proposed revisions

## **VII. Discussion: Continued Review and Development of EFSAB Recommendations**

### **Threatened and Endangered Species**

The group finalized and reached consensus on the language for the section of the report addressing threatened and endangered species to:

**“The flow requirements of listed species are often not fully understood. In order to conserve state and federally listed species, the EFSAB recommends that the flow needs of these species should be considered by the DENR in addition to the standard recommendations offered in this report. For planning purposes, portions of basins (e.g., nodes) that include listed species should be treated by DENR as needing additional analysis in consultation with the WRC, NMFS and USFWS. When a decision moves beyond planning, then applicable environmental review documents will be sought from appropriate agencies. The EFSAB also encourages DENR and other appropriate agencies to support further research on the flow requirements of listed species.”**

### **Revisit the Adaptive Management Section**

An EFSAB member asked to revisit the Adaptive management recommendation, to better address his interest in communicating the importance of addressing hydrologic changes due to climate change. Suggestions to amend the recommendation were sent.

Discussion points:

- I was the one who recommended not to explicitly mentioning climate change because I was worried it would cause officials to shelve this document since there is skepticism in the Dept. about whether human activity causes climate change. The possibility of public officials' views preventing scientific professionals from expressing the truth has chastened me. I second the proposal to reintroduce climate change into the adaptive management section. The truth does not need to be subordinate here.
- We include consideration of the effects; we haven't included the term.

- What they would react to is whether it is anthropogenic, so include whether it is anthropogenic or naturally caused- the fact that it is happening is what is important, not the causes.
- Why emphasize those differences?
- Including “natural” may help make it more likely to be read.
- We’re hedging a bit based on how we think it will be received by politicians.
- We are acknowledging that there is limitation of the OASIS model, since it uses a historical record rather than predictions.
- WaterFALL can simulate climate change modeling.
- Climate change is not the only reason you’ll want to use adaptive management. Land use is even more likely to have an impact.
- Climate change could produce large and unpredictable changes in temperature and precipitation. The unpredictability is unlike land use change.
- It should reflect a list of why we would want an adaptive management approach, including climate change impacts and others.

The group worked together and revised the recommendation to meet their interests.

#### **Resulting recommendation:**

***There is uncertainty in the science and the existing models, thus a risk-averse strategy was used when devising recommendations. Changes in climate and land use are expected to have significant effects on patterns of temperature, precipitation, hydrology and ecology. Monitoring and predicting these changes will be critical for success in maintaining ecological integrity of North Carolina’s rivers and streams. An adaptive management approach is required to continually advance the science and reduce areas of uncertainty. Therefore, DENR should:***

***1. Emphasize new data (hydrologic and biological) collection and evaluation in headwaters, in the coastal plain, and in large rivers, recognizing that current biological models and assumptions may not address these systems.***

- 2. Adopt/design/develop strategies to:***
- a. Validate ecological thresholds (strategies should be informed by new data or research);***
  - b. Track the impact of flow changes when they occur;***
  - c. Modify characterizations, target flows, and thresholds based on new data, changing conditions (e.g., land cover, precipitation, hydrology) and lessons learned; and***
  - d. Georeference nodes to facilitate analysis.***

**Decision: Consensus was tested- all EFSAB members accepted the recommendation (all one’s.)**

#### **Revisit Critical Low Flow**

The writing group assigned to revise the language for addressing a critical low flow component of the statewide recommendation presented their revisions. **The revisions were approved and incorporated into the Final Report on page 20, under Section 3.1.1 Percentage of Flow Strategy.**

#### **Revisit Flow-Habitat Relationships**

Fred Tarver had rewritten the section of the report on Flow-Habitat Relationships. Linda Diebolt, Chris Goudreau, and Jim Mead had since reworked his revised version. Fred provided an overview of his revisions including:

- Removed discussion of IFIM to simplify.
- Encapsulated work done in piedmont by Jim Mead and in mountains by Fred.

- Moved some of the tables and graphs to put into an appendix or be removed from the report altogether and just put on the website.
- Tried to encapsulate through text what some of the graphs showed.
- Restructured to make more readable for potential readers who have not been immersed in the work of the EFSAB.
- Added a couple of charts that better summarized the results in an understandable way.

The facilitator suggested that the Board not try to wordsmith the document as a group, but that they instead provide comments and suggestions for the writing team that would further refine the section. EFSAB comments included:

- For the outsider not immersed in the EFSAB's work, it still needs work. It is not understandable. Being new to the Board, I do not know what the charts are showing, and the text does not adequately clarify. Perhaps explanatory captions would help.
- The figure captions could be more explanatory.
- Perhaps you could put at the beginning or the end of each section a description of what the section is telling you.
- Add to each section in bold a description of the purpose of that section and what this section is conveying (annotation below the title).
- It's still dense.
- That's okay if it has to be, but then it needs to be explained.
- It's going to be difficult to make that section lay-worthy.
- It would be helpful to have Index B explained in terms of habitat.
- The point is that the recipient of the report is DENR.
- I don't think all sections of the report need a Reader's Digest summary.
- I have a co-worker who spent 4 hours reading that section with me. If you would like an outsider who read the original to look at it and see if the re-write makes sense, let me know. I have permission from the company for her to do that on the clock, and she is available to do it.

**Chris, Fred, and Linda will revise this section and submit it by 10/31/13.**

## **What Else?**

The facilitator then asked if the EFSAB identified any remaining areas that need addressing in the recommendations.

- A section that was redundant was removed.
- Board members suggested changing some language in places. These changes are captured in the final report.

## **VIII. Discussion/Review of Requested Edits to the EFSAB DRAFT Report**

The facilitator led a review of the report beginning with issues that the facilitators had identified as needing addressing. Discussions included:

Acknowledgements (people who contributed to the process from the beginning)

Update References

What writing style to use?

Executive Summary **[Tom Cuffney will write one of approximately 2 pages]**

Removed section on tools [**consensus**]

Title [**Tom Cuffney will write**]

Photos to include

Submitted to whom? [DENR]

Add date.

Tribute to Steve Reed

Re-title some sections

Number sections and subsections.

Table of Contents

The Board then went through sections of the report, word-smithing some language. All of the changes made are included in the final report.

**With the understanding that there was additional work to be done on the glossary, acronyms and reference sections, labeling all figures and tables correctly, putting the report into consistent outline format, searching for terms to be corrected [historic versus historical, for example], re-writing the flow-habitat relationships section, and use of articles, the EFSAB reached full consensus [all ones] on moving the document forward and submitting it to DENR. The EFSAB would receive the finalized document for final review before submission.**

The facilitator congratulated the EFSAB on completion of their work.