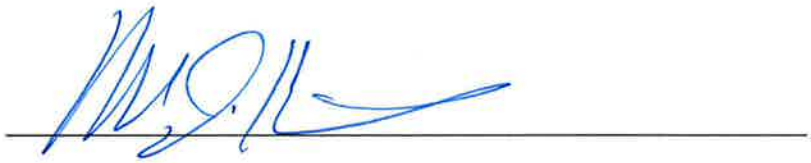
July14, 2010

Transmittal to Basin and Bay Expert Science Teams (BBESTs) and Basin and Bay Area Stakeholder Committees (BBASCs)

Report # SAC-2010-01

Title: Lessons Learned from Initial SB3 BBEST Activities.

The BBEST and BBASC groups from the Trinity/San Jacinto/Galveston Bay and the Sabine/Neches/Sabine Lake basins have completed and submitted their final reports, and their recommendations are now before the TCEQ for rulemaking on environmental flow standards in these basins. The Science Advisory Committee (SAC) thought it appropriate to reflect and report on lessons learned from the experiences of these first two BBEST groups. It is our hope that these observations will be helpful to the next group of BBEST and BBASC members as they undertake their respective responsibilities under SB3.



Robert J. Huston, Chairman, SB3 Science Advisory Committee

Lessons Learned From Initial SB3 BBEST Activities

Senate Bill 3 Science Advisory Committee

for Environmental Flows

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Document Version Date: July 14, 2010

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1.0 Introduction

The two initial Basin and Bay Expert Science Teams (BBESTs) have submitted their environmental flow regime recommendations to their respective Basin and Bay Area Stakeholders Committees (BBASCs) pursuant to the mandates of Senate Bill 3. The two initial BBESTs have taken different approaches and come up with different results. Thus, it is a good time for the Science Advisory Committee (SAC) to review their different approaches and work products to provide guidance to future BBESTs based on "lessons learned" from the first round of BBEST activities.

2.0 BBEST Membership

Appointment to a BBEST demands substantial public service and requires a meaningful level of effort and personal commitment. Members must be ready to roll up their sleeves and get to work. All members will likely find it necessary to commit time outside of the called meetings to familiarize themselves with the SB3 process, data about the basin/bay system, and SAC guidance. Members were chosen to bring their technical knowledge to the process. They are not selected to represent an interest group, which is the province of the stakeholder committee. The BBEST members must form a team focused on the goal of an environmental flow regime recommendation. Thus, team-building among its diverse members is an important activity and requires a commitment from each member.

3.0 BBEST Timeline

The BBEST will have at most 12 months to make a recommendation. Given this ambitious schedule and the complexity of the task, it is important for the BBEST to have a clear timeline of activities that will lead to report completion by the deadline.

BBEST members should be aware that this service will also likely require more than a 12-month commitment, and their budget should be structured to include that additional effort. It is probable that while considering the BBEST's environmental flow analyses and flow regime recommendations, the BBASC will require additional analyses, some of which the BBEST may do itself or some into which the BBEST may want to have input, to support formulation of their recommendations or further interpretation for the BBASC. Also, the BBEST is to cooperate with the BBASC in the development of a work plan that will be part of the adaptive management program to be embodied in the TCEQ rules resulting from SB3 activities.

4.0 BBEST Procedural Activities

The BBEST has a challenging task ahead of it, and if experience is a guide, there will be more work to accomplish than anticipated. Below is a list of activities that represents the minimum amount of work required by the BBEST.

1) Choose a chair. The chair will be required to guide the group's collaborative process designed to achieve consensus and ultimately finalize the flow recommendation report (with input from members). So, the chair must be chosen wisely.

2) Set meeting rules. It is important to agree upon procedural issues, e.g., quorum rules, decision process, meeting frequency, meeting locations, etc.

3) Create a record of action items at all meetings. The BBEST and any subcommittees or work groups of the BBEST should record all decisions upon which consensus was reached and action items that were identified in each meeting or conference call. The BBEST and/or subcommittees should review, approve, and document points of consensus by the following meeting. While there is no need to fully record all discussion, it is important to document decisions on action items, which creates a written record for those members who could not attend and helps avoid reopening group decisions already made.

4) Identify support. While the budget to support BBEST activities is helpful, it is not enough, and substantial in-kind support from other institutions and state agencies will be critical to complete tasks. It will be important for the BBEST to work with those institutions and staff from the state resource agencies to develop, as early as possible, a clear plan for the tasks to be undertaken and a timetable for getting the work done.

5) Establish subcommittees. The process of performing analyses and making recommendations is complex, and it may be useful to distribute the workload. Examples of subcommittees would be: Instream Flow, Estuarine Inflow, and Hydrology Subcommittees. These groups need to quickly respond to the requirements below and report back in a written format to the full BBEST early in the process. While the hydrology group is concerned mainly with flow analyses, the instream and estuarine groups are concerned mainly with biological resources and the definition and maintenance of ecological health.

5.0 BBEST Technical Activities

The BBEST is a technical committee that must perform an environmental flow analysis to recommend an environmental flow regime. "Environmental flow analysis" means the application of a scientifically derived process for predicting the response of an ecosystem to changes in instream flows or freshwater inflows [§Sec. 11.002 (15)]. "Environmental flow regime" means a schedule of flow quantities that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that are shown to be adequate to support a sound ecological environment and to maintain the productivity, extent and persistence of key aquatic habitats in and along the affected water bodies [§Sec. 11.002 (16)].

A previous Science Advisory Committee [SAC (2006)[1]] provided the following recommendation to the Governor's Environmental Flows Advisory Committee: a "sound ecological environment" is one that:

- sustains the full complement of native species in perpetuity;
- sustains key habitat features required by these species;
- retains key features of the natural flow regime required by these species to complete their life cycles; and

[1] http://www.twdb.state.tx.us/EnvironmentalFlows/pdfs/Meeting5/SAC_Recommendations.pdf

- sustains key ecosystem processes and services, such as elemental cycling and the productivity of important plant and animal populations.

The SB3 SAC has not tried to revisit this definition.

A series of logical steps that should lead an efficient BBEST to a recommendation are:

1) Obtain "reasonably available science." Resources are limited and this may limit seeking (and perhaps digitizing) obscure sources of data. Do not limit the search for information to the specific basin and bay, because studies or data in similar ecosystems may be employed by analogy or homology in making recommendations for the studied system. Essentially, this task is a literature review: with only limited exceptions it is unrealistic for the BBEST to create extensive original research or data sets.

2) Perform an environmental flow analysis. This is the core of the BBEST responsibilities. SB3 defines this as: "the application of a scientifically derived process for predicting the response of an ecosystem to changes in instream flows or freshwater flows." Regarding the use of a scientific process for predicting ecosystem response, the ideas described below are based on some specific experiences in the first two BBEST programs.

   Any process that starts out with a question or hypothesis and uses data to support conclusions is a scientific process, so long as the hypothesis is stated with precision and clarity, the data are used rigorously, and the conclusions are complete and objective. A fundamental goal of the scientific process is to establish cause-and-effect relationships between key variables. Such a relation is a hypothesis *per se*, but it generally emerges through a complex chain of variable identifications, data collections, and testing of subordinate hypotheses. In the context of environmental flows, the process should include the following:

   a. Statement of a clear purpose, i.e., the question to be addressed or problem to be solved, including careful definition of all of the operative parameters and how they are measured. SB 3 requires the flow regime to sustain a "sound ecological environment," but the BBEST will have to determine the current state or health of the ecosystem, set goals for the future in terms of resources to be protected, and delineate its measurement and interpretation of analyses.

   b. Description of the available background information, including the environmental resources to be protected. The key component of this step is the literature review to assemble reasonably available data.

   c. Framing of the technical questions to be resolved. For example, the most fundamental is: "what is the relationship between flow and indicators of health?" Because the data are subject to variability arising from sparsely distributed sampling in time and space, errors of measurement and the effects of factors other than inflow, any such relationship will be an imperfect approximation, whose evaluation will entail probability judgments, hence the employment of statistics.

   d. Documentation of all methods and procedures used in the research. This includes a clear description of the methodologies including a complete bibliography of data and literature resources found (and hopefully used). There generally, will be insufficient time to obtain new data, so use of the data obtained in the literature

review will have be relied upon to extract meaningful relationships between flow and environmental or ecological variables. For example, as stated in the estuary freshwater inflow guidance document, it may be useful to create relationships between ecological response and salinity or nutrients, because it is primarily the water quality condition of an open bay that drives biological response, and not flow itself. Likewise for instream flow recommendations, it may be useful to relate the habitat or water quality conditions to instream flow from which ecological health as indicated by a sensitive species may be inferred.

e. Presentation of results. The central information on flow recommendations should be formulated with the BBASC in mind, emphasizing the interpretation and application of the results (see Appendix). The scientific and technical audience will generally require a different level of presentation, detailing the analysis and statistical parameters of uncertainty. Appendices should be used for detailed analyses, as well as extensive or detailed charts, graphs, figures, or tables.

3) Use a collaborative process to achieve consensus. The BBEST is by design composed of individuals with different backgrounds who come to the group with different traditions and philosophies. A collaborative process will ensure that each view is understood by others and respected by all. SB 3 includes an adaptive management process, so it is possible to test, verify, or refute methodological assumptions by including them in the Work Plan [§Sec. 11.02362(p)]. To achieve consensus, there is a simple procedural issue, such as reaching consensus by voting or by acclamation. There has to be a decision process that drives consensus, which is based on the group agreeing on the interim decisions made in the environmental flow analysis to form the regime. More importantly it is recommended that early deadlines be set for the first draft of an environmental flow regime, so that the particulars can be discussed and debated within the group. This deadline should be at least two months prior to the deadline for submitting the final recommendation.

4) Recommend an Environmental Flow Regime. SAC guidance[2] summarizes methods that can be employed to define environmental flow regimes for Texas watercourses. Both spatial and temporal components are included in a flow regime. In past work by the state agencies, the temporal component has been addressed in both the Texas Instream Flow Program model of stream flow and the State Methodology for estuary inflow needs, but spatial considerations are limited. While the BBEST is not constrained to adopt either of these approaches, it must document the basis for choosing the spatial and temporal specifications used in their recommendations. The SAC guidance recognizes that statistical flow analyses are useful to identify implementable flow regimes, but the proper interpretation of these statistics is complex. This is not only because the statistical expression of a flow regime offers a convenient quantification of uncertainty underlying the ecosystem response to flow, but also because the ecosystem itself is a statistical response to a statistical time signal. Thus, it is also important to characterize uncertainty because the BBASC must be able to understand the potential range of ecosystem responses to a range of flow values.

[2] http://www.tceq.state.tx.us/permitting/water_supply/water_rights/eflows/resources.html

5) Write an environmental flow recommendation report. The appendix provides style guidelines. The report should be a consensus document that substantially all BBEST committee members can agree on. This may prove to be difficult. There are sometimes alternative interpretations of data or results, and in such cases, this must be explained explicitly. Often a disagreement will have as its root cause an information gap, either data or the perceived relationship between variables, so it is important to identify the studies and/or data collections needed to confirm or deny alternative models of ecosystem response to flows, because this will be an essential part of the work plans that must be developed after the regime is recommended.

6.0 Specific Technical Lessons Learned

There are some technical lessons learned from the first two BBEST efforts that could be useful for future efforts. While this is far from a comprehensive list, some of the more prominent findings are described below.

1. Identify a clear instream definition of "sound ecological environment" and ensure that the statistical distributions of flows (like those that might emerge from the HEFR tool) are linked to ecosystem indicators of soundness. While the history of Texas freshwater inflow studies is rooted in protecting characteristic sport and commercial estuarine fisheries, there is no such history on the instream side. Consequently, it is necessary to remember that the goal is to define a flow regime to maintain a sound ecological environment. This necessitates that sensitive biological indicators be identified and, where possible, a generally predictive relationship between flow and that indicator be established.

2. Address ecological complexity. The HEFR model computes a very large matrix of flow regimes but is primarily hydrology based, with little or no consideration of the actual flow requirements for specific aquatic organisms. For a flow matrix to become an environmental flow regime each flow component must be evaluated in terms of its function for sediment and/or geomorphic dynamics, water quality, and biology and/or ecology. The BBEST will have to determine how many spatial, temporal, and hydrological components of the flow regime are necessary to maintain a sound ecological environment. This is done primarily through the use of overlays, but the SAC has provided specific guidance on interpreting the HEFR flow matrices.[3] Much effort should be put into characterizing the relationships between flow, native species, key habitats, and ecological services first; and then use the hydrological analysis to identify the flow regime(s) that best address the ecological needs. Basically, the BBEST must identify two key ecological characteristics: 1) flow component magnitudes that maintain a certain amount of habitat to sustain aquatic populations in the watercourse, riparian zone, and floodplain, and 2) the flow component magnitudes that will limit the frequency and duration of the stressful conditions. The BBASC will want to know how each recommended flow component supports a sound environment.

3. Address variability. While the focus of the BBEST is on defining needed environmental flows for rivers and bays, the effects of the recommendations if implemented as standards need to be considered. This is one area where cultures clash. Engineers typically deal

[3] http://www.tceq.state.tx.us/assets/public/permitting/watersupply/water_rights/eflows/sac_discussionpaper

with standards and will likely be concerned about the low magnitude of "goodness of fit" that is typical with predictive ecological models. In contrast, ecologists use ecological and environmental variability as a tool to understand basic processes. In fact, the level of variability is compounded for ecologist because organisms interact not only with the physical environment, but also with their biological environment as well. Predation, competition, and population growth dynamics are biological processes that will control ecological relationships without regard to the physical-chemical environment. Implicit in this discussion is uncertainty, which is driven by both knowledge gaps and natural variability. The BBASC will want to know how variability in flow regimes relates to variability and uncertainty in ecosystem response.

4. State expectations in the selection of flow gages. Some BBESTs have concentrated on main stem locations that are heavily modified and some have included smaller streams that are essentially natural. There is room for judgment on what types of streams to consider, but it may be helpful if the objectives for a stream are explicitly stated during the selection process. For example, a stream that is essentially natural may have as an objective to maintain the essential natural habitat and flow regime characteristics. A stream that is heavily modified may have different aspects and limitations. A location that has an existing upstream flood control reservoir may have human habitation in the now-protected floodplain so that overbank flows are no longer an appropriate component of an environmental flow regime. Where a stream is heavily influenced by return flows, this should be recognized and appropriate objectives developed. Having a consensus on the rationale for selecting particular gage locations and the environmental expectations for the stream clearly stated will tend to be more desirable than not addressing the topic, thus leaving room for miscommunication and disagreement.

5. Period of Record. The period of record used for selected gages should be consistent with the expectations. For example, if a stream has a gage record that encompasses both a natural and modified period, the period selected should reflect one or the other, consistent with the expectations stated. Another example is the isolation of types of hydroclimatology of particular concern, e.g., extended droughts. Simply taking the entire period of record for use in flow regime software has the potential to generate misunderstandings.

6. The BBASC members should be provided with adequate information to enable them to judge the uncertainty latent in the ecosystem response to flow, and how this uncertainty may be incorporated into margin of safety associated with the BBEST inflow regime recommendation. Ideally, the BBEST report would discuss the implications of uncertainty in the recommendations by evaluating a range of effects on ecological health of the recommended regime. However, should the BBEST be unable to provide an analysis of ensemble effects, then the implications of the attendant uncertainty needs to be addressed.

7.0 BBEST-BBASC Interactions

The BBEST environmental flow recommendations are sent to both the Environmental Flows Advisory Group (EFAG) and the BBASC. The BBASC is to create their own environmental flow recommendation in the form of suggested standards, which will take into account existing human water-needs to balance water supply with water for the environment. There is the

potential for constructive interaction between the BBEST and the BBASC during the BBASC's deliberations and development of a balanced flow regime.

While the primary mission of the BBEST is to produce science-based flow regime recommendations, it is essential that there be coordination with the BBASC. While the roles of the BBEST and BBASC are different and a separation needs to be maintained, the BBASC must be well informed on the process and aware of the trade-offs already inherent in the BBEST's recommendations and, to the extent possible, of the implications of varying from the recommendations the trade-offs made and the effects of various decisions made by the BBEST. This aspect is important during the development of recommendations and is also discussed further below (see "Post-Recommendation Activities").

One potential way for the groups to interact is to ensure regular, planned communication between the BBEST and the BBASC. That way, the BBASC can see how the science committee is addressing its charge, help with gathering information for analyses, digest and be prepared to act on the BBEST recommendations. This is particularly important to assist stakeholder committee members who may not be full-time water professionals in getting fully engaged in the process and not just being faced with a very detailed BBEST report and only a short time to digest it and participate in development of flow standard recommendations. This early interaction could also help the BBASC get a head start on thinking about strategies that might be used to meet potential flow standards.

Joint discussions could include a discussion of the management goals and objectives. For example, is there a desire to recreate the pre-reservoir flow pattern and environment, or is the goal to maintain the present day environment? Such joint endeavors need to respect the role of the BBASC as the decision maker regarding balancing all water demands. However, the BBEST is uniquely positioned to bring important technical understanding to assessment of the impact of various tradeoffs.

Some environmental flow recommendations may apply to stream segments that are immediately below either proposed reservoirs or existing reservoirs whose water rights are subject to amendment, so these recommended environmental flows could impact reservoir stage and habitat. Evaluation of these impacts is one area in which the BBASC may request technical assistance from the BBEST. It is possible to perform WAM runs to quantify changes in reservoir levels and surface area under different environmental flow regimes, and this type of information, coupled with an appropriate biological assessment, could be useful to the BBASC in its consideration of overall environmental flow requirements and its efforts to balance environmental flow needs with those for other purposes, including human needs.

Finally, Texas basins and bays are large and it is likely members will be more or less familiar with different environmental components. So, other potential interactions between the BBEST and BBASC could include joint field trips to introduce members of both groups to resources with which they may not be familiar.

8.0 Archiving

An important final activity of the BBEST is the creation of a permanent archive comprehensively documenting the process, including the minutes of meetings, data obtained, analyses performed, and the chain of materials used for the environmental flow regime recommendation, including the complete BBEST report, appendices, computer files, model output, statistical products, data

bases, and additional supporting materials. These materials should be digital and web-accessible, for use by other scientists, the general public, and BBESTs from other basins. If there are no local resources for such an archive, then the BBEST should contact the SAC for help as there may be mechanisms to archive information at a State Agency or academic institution.

9.0 Post-Recommendation Activities

Experience in the first two basins has clearly demonstrated the need for continued interaction between the BBEST and the BBASC during the BBASC's deliberations and development of a balanced flow regime. The BBEST should be called upon to explain and discuss its recommendations with the BBASC. Equally important, the BBEST, in cooperation with state agencies, can help the BBASC select tools and methodologies and formulate assumptions to help assess the effect of the BBEST recommendations on water supply needs. The SAC is developing guidance on WAM utilization for this purpose. An appropriate level of participation by BBEST members could make this assessment and BBASC recommendation process more efficient and consensus-based.

Once the flow regime recommendation is made, the BBEST is charged to assist the BBASC in developing a Work Plan that will identify data gaps and recommend a monitoring program as part of the adaptive management requirements of SB 3. While the SAC is developing and will be issuing a guidance document on work plan development, it is important for the BBEST to keep future activities in mind while preparing the literature review, gathering data, and analyzing the results for the recommendation because it is much easier and more efficient to identify data gaps during these initial steps rather than have to repeat the activity. One other way to set up the work plan is to use care in choosing the ecological health indicators because these will likely have to be monitored in the future.

Appendix: Report Style Guidelines

There are a few style and formatting guidelines commonly used in technical writing that may be especially useful in preparing the BBEST final report:

1) Write for the reader. The main target audience of the BBEST document is the BBASC and the EFAG). These two groups represent a broad spectrum of state and local leadership and the general public, and they are not exclusively a technical audience. The main text of the document should therefore contain a logical progression of material, with careful attention given to complete definitions of the terminology, and interpretation of the flow recommendations. The document should be well-presented and "reader friendly," with cogent graphics and tables. A part of the target audience will be technically trained and experienced scientists and engineers, who will require more detailed and sophisticated presentation. It is suggested that frequent citations to the literature and to self-contained appendices be included in the text to address the concerns of these readers.

2) Avoid redundancy. Do not repeat materials in reviewed documents, TIFP reports, SB3 language, or SAC guidance. Summary statements and citations to the relevant documents are sufficient. Do not repeat introductory material throughout the document.

3) Be concise and avoid technical jargon. When technical terminology is necessary, clearly define the terms. Use appendices where there is a need for extensive technical detail.

4) All figures and tables should stand alone. Include a complete caption or legend, detailed headings and keys to the labels and content of the figures. The legend should have three parts: title, stub, and notes. The title should be a concise sentence describing the contents. The stub should contain additional information to amplify the title. Notes include abbreviations, units, or other information needed to interpret the figure or table.

5) Put detailed technical analyses in appendices. Background information (e.g., as committee or contractor reports), detailed analyses, and additional supporting material can be placed in appendices. However, make sure to properly reference the appendices in the text, and them in the report. Each appendix should be a stand-alone document with title and front matter, explanatory text (perhaps citing other appendices) and references. Do not relegate critical information (i.e., information that drives decision making) to an appendix. Include critical information in the main report, in at least a summary fashion, citing the appendix for more detail.

6) Include a detailed list of references cited in the report as part of the main report. It is also often useful to have an appendix with a listing of the documents that were included in the literature review but not referenced in the report.