EXPERT PANEL ON DIVERSION PLANNING AND IMPLEMENTATION

Report #3

January 2015

Submitted to:
Coastal Protection and Restoration Authority

EXECUTIVE SUMMARY

The third meeting of the *Expert Panel on Diversion Planning and Implementation* focused on discussions in three broad areas: (1) stakeholder concerns; (2) biophysical monitoring; and, (3) ecosystems modeling. This report summarizes our findings and offers 10 specific recommendations for more effectively advancing the diversion planning process as it moves towards the 2014 and 2015 decision points. Panel recommendations were developed from, and built upon, recommendations in the first two Panel meetings. We note that CPRA has implemented a number of our previous recommendations, and we compliment the staff on their willingness to provide key information when requested by the Panel and to answer questions that arise during the meetings. We reiterate here that there continues to be a need for more in-depth peer review of each technical element, whether in the modeling work, the monitoring program, or in the socio-economic studies, in order to ensure that conclusions drawn from the technical analyses are in fact well supported.

1.0 INTRODUCTION AND BACKGROUND

The *Expert Panel on Diversion Planning and Implementation* (the Panel) held its third meeting in Baton Rouge on October 27-29, 2014. The Panel was established to provide expert advice and guidance on key issues that pertain to river diversions in recognition that diversions are an essential restoration tool in coastal Louisiana. Indeed, Louisiana's 2012 Comprehensive Master Plan states (p. 106) that "…sustainable restoration of our coast without sediment diversions is not possible". The Panel's official charge was thus to *provide technical input, review and guidance as plans are refined on diverting freshwater and sediment from the Mississippi and Atchafalaya rivers into adjacent estuarine basins to build, maintain and sustain coastal wetlands.*

The Panel, convened by The Water Institute of the Gulf (the Institute), is comprised of 12 members with backgrounds in a broad range of physical and biological sciences, social science, and engineering. The extensive experience of Panel members in other restoration programs, together with the particular blend of Panel expertise, was considered important for advancing our understanding of river diversions. The Panel recognizes that there is an expectation that they remain independent and objective, and that their role is advisory in nature. As such, the Panel is not in a position to make policy or implementation decisions. More information on the Panel, including the list of members and their professional expertise is included in Appendix 1.

The primary issues that the Panel will address over the next two years include: (1) evaluation of critical scientific and technical uncertainties; (2) identification of research that will be needed to reduce uncertainties; and, (3) review and comment on technical reports, model outputs, and other aspects of project development identified by the Panel or by the Coastal Restoration and Protection Authority (CPRA). The Panel anticipates that topics for consideration will vary from meeting to meeting and that the Panel will continue to be engaged in these topics between each of the formal meetings. The agenda for the first day of the meeting is given in Appendix 2. The second day of the meeting was not open to the public and the focus of those discussions is summarized below.

2.0 FOCUS OF MEETING #3

The primary focus of the open part of the third Panel meeting was to delve more deeply into stakeholder concerns about building diversions, and to discuss the status of biophysical monitoring and the plans for ecosystem modeling of fish and shellfish. The charge to the Panel for this meeting can be found in Appendix 3. Prior to the public meeting, we took a one-day field trip by boat to the Wax Lake Delta. The trip provided an opportunity for the Panel to see the low-lying landforms in the Delta and to discuss its evolution, the processes that deliver nutrients and sediments, and its function in providing fish and wildlife habitat. We take this opportunity to express our appreciation to all who helped organize and lead the trip. It was a valuable experience.

Discussion in the closed part of the meeting was focused heavily on the need by the Panel for a better understanding of CPRA's approach to addressing stakeholder concerns and how results from biophysical monitoring and modeling would be linked to socio-economic analyses. Seven of the 10 recommendations in the next section of this report are tied to stakeholder concerns, including those currently being addressed as well as those not underway, and to the question of how best to convey results of technical analyses to a diverse group of stakeholders. The Panel also discussed at length the status of biophysical monitoring and ecosystems modeling, and drafted three specific recommendations on these topics as immediate next steps in the planning process. Two of the 10 recommendations (#5, #10) have been repeated from Report #2.

Many of the findings and recommendations in this report have their origin in the discussions of uncertainty at the first Panel meeting. Given the complexity of the science and engineering associated with the design and operation of major freshwater and sediment diversions, and that there are no analogues of existing sediment diversions at an appropriate scale, it became clear that uncertainty was a highly relevant and pressing topic for consideration. All of the recommendations in the first two reports are still relevant and our goal in writing Report #3 was to revisit and provide more detail about our previous general recommendations.

3.0 DISCUSSION, FINDINGS AND RECOMMENDATIONS

3.1 STAKEHOLDER CONCERNS

At the October Science Panel public meeting, CPRA identified eight major stakeholder concerns regarding sediment diversion planning and implementation, seven of which are directly applicable to the four sediment diversion projects currently under planning (Table 1)[1]. This section provides our assessment of the capacity of sediment diversion modeling, monitoring and other studies, as documented in existing reports and oral presentations, to address these concerns. It also provides specific recommendations in three major categories: (1) stakeholder concerns that technical tools and analyses under development are intended to address, but for which additional refinements must be considered; (2) stakeholder concerns that appear to not be addressed by planned analyses; and (3) recommendations for how output of models, data and other studies can be used to more effectively convey information to address stakeholder concerns.

[1] The eighth identified concern, "Diversions will not rebuild or sustain Cypress forests," is not directly applicable to the planned diversions under discussion and therefore not addressed here.

Table1. Major stakeholder concerns identified through CPRA stakeholder meetings that are directly relevant to the four major diversions under consideration.

1. Negative fisheries impacts (displacement of fisheries, fisheries kills, loss of livelihoods)
2. Doubts land building potential to reduce storm surge risk
3. Prefer smaller diversions instead of the larger planned diversions
4. Prefer dredging over diversion projects
5. Flooding concerns / increased water levels
6. Concerns regarding nutrients and invasive species
7. Large diversions take too long to build land

3.1.1 Stakeholder Concerns with Technical Analyses Currently Under Development

CPRA and their partners are assembling a set of analytical tools that can be used to inform stakeholders of the effects of sediment diversions. In particular, river, delta management and ecosystem models as well as system-wide ambient monitoring data are intended to provide a solid foundation for biophysical analyses that will support sediment diversion decision-making. They have been described in sufficient detail to assess their adequacy for this task. Panel charge questions two and three (Appendix 3), described in subsequent sections below, directly focus on improvements needed in ecosystem models and monitoring data collection to address stakeholder concerns. However, we find that four additional refinements are required of the collective set of tools in order to address stakeholder concerns.

(1) Improved Socio-Economic Analysis. Socio-economic analyses (SEA) are a key component of the technical analyses that are needed to support the decisions on sediment diversions. The following are types of SEA likely to be pertinent to the seven core concerns in Table 1.

- *Negative Fisheries Impacts.* It is desirable to evaluate community and household adaptations to negative fisheries impacts such as displacement of fisheries, fishery kills, and loss of livelihoods. Modeling is planned or is underway on how sediment diversions may drive changes in fish and shellfish communities. SEA should include shifts in the location of employment, issues with commuting from home, changes in costs to fuel and gear use associated with new fishing grounds, and the availability of infrastructure and services (fish processing and transportation, docking and landing sites, potable water supplies, wastewater treatment, and health care).
- *Land-Building Potential.* Analyses to show the extent and timing of land building associated with sediment diversions will soon be available. Questions regarding the potential for this land building to reduce the risk of storm surge can be informed by: analysis of the location of exposed communities, real estate, infrastructure, and public facilities and lands; potential losses due to damage to the built environment, including economic impacts on businesses and dislocation by subpopulations defined by various demographic characteristics (age, gender, income, education, etc.); and, by analysis of the costs of mitigating or adapting to those damages.
- *Preference for Smaller Diversions.* Determining the social benefits and costs of small versus large flow diversions requires analysis of how flow operations affect social welfare by way of, for example, changes in flood risk, fishery effects from salinity changes, and wildlife impacts.

- *Preference for Dredging.* Socioeconomic analysis of dredging versus diversions should include analysis of near- and long-term construction and operating costs, employment associated with construction and operation, and ecosystem services-related impacts and benefits of the alternative restoration options including, for example, implications for flood damages, community dislocations, and fishery impacts.
- *Flooding Concerns.* With regard to impact on flooding, it is essential that the biophysical models be used to compare diversion impacts to "without diversion" baseline predictions of flood probabilities and severity. These analyses should be linked to the societal costs of flooding as described above in the second bullet.
- *Nutrients and Invasive Species.* Diversion effects on nutrients and invasive species should be translated into their effect on outcomes more closely relevant to social concerns such as the effects of changes in vegetation-habitat-fishery relationships on coastal communities that rely on both commercial and recreational fishing.
- *Timeline for Building Land.* The concern about length of time it will take for diversions to build land relates to all of the above socioeconomic issues, but emphasizes that analysis take into account the time path of costs, risks, benefits, and social adaptations to ecosystem changes relative to the time path of baseline "without diversion" predictions. Projected impacts at different future points in time on social vulnerability by population subgroups and physical hazard vulnerability (commercial and residential structures, critical local infrastructure), employment, and related factors should be explained.

The Panel is aware of several SEA efforts that are already underway or being contemplated. These include an LSU-led commercial fisheries study, a Coastal Atlas being developed by The Water Institute that brings together statewide social and biophysical data to facilitate subsequent analysis, and an LSU and RAND study to quantify the economic implications of the "no restoration action" baseline. However, the Panel has not been provided with specifics regarding the methods or data to be used in these analyses and thus cannot at this time offer specific comments regarding these analyses.

Because there is a wide variety of socio-economic analyses that differ in their underlying philosophies, methods, and data requirements, the most appropriate approach is a function of the audiences for, and uses to which, socio-economic analysis will be applied. Questions to consider include: What specific research questions will be addressed by each study? What data will be collected? Will there be common sets of variables collected across studies? Are there plans to integrate the socioeconomic data with biological and physical models (e.g., via SWAMP)?

Ideally, the various socio-economic approaches employed by CPRA would be complementary and consistent (for example in the way baseline versus diversion-specific outcomes are measured, and in use of common variables and measurements across multiple studies that utilize socio-economic data). Socio-economic analyses require close linkage between diversion-specific biophysical outcomes (relative to baseline) and socio-economic impacts. These linkages should be explored and addressed early in the development of any socio-economic analysis plan. For example, CPRA should consider how geospatial social and economic indicators might be scaled to match the scale of a range of potential changes to biophysical systems. The scale of impacts could be local (e.g., changes in location, size and operation of diversions). Alternatively, social-economic system-wide change could result from a change in state and federal policies (e.g., recent flood insurance policy changes (2014) due to federal Biggert-Waters Act).

To better understand the ongoing work and to enable the Panel to provide more specific feedback and recommendations, the Panel requests that CPRA provide a detailed description of approaches to SEA of diversion effects prior to the next Panel meeting. This should emphasize: (1) developing an explicit, overarching conceptual model that links biophysical outputs to SEA; (2) articulating a short, but clear statement by CPRA regarding its goals and audiences for SEA; and, (3) furnishing details regarding the work plans, data, and methods to be used by diversion study socioeconomic project teams. A corollary request is for the Panel to be briefed on the relationship between the studies and efforts to coordinate approaches and data among the teams involved.

Recommendations:

1. **Clearly articulate the CPRA vision for the uses of diversion-related SEA analyses and provide the panel with its vision of the audiences for SEA. It will be important to establish if the goal of socio-economic analysis is intended to be an input to government deliberation, a monetary valuation of coast-wide restoration benefits for public outreach purposes, an input to stakeholder deliberations in communications and education strategy, a targeted evaluation of compensation payments or landowner incentives, or some other purpose.**

(2) Diversion Operational Scenarios to Weigh Stakeholder Concerns. While some of the costs and benefits of large versus small diversions were considered in the 2012 Comprehensive Master Plan, a strong perception exists among certain stakeholder sectors that small diversions are likely to provide fewer adverse effects than larger ones. Given that a finite number of sediment diversions under consideration has now been established, decisions about operation of those diversions (e.g., timing and rate of flows) constitute the remaining management lever available to control the spatiotemporal extent of benefits and adverse effects, including the extent of fisheries effects as well as flood risk from diversion projects. Ultimately, the development of a water operations manual containing contingency rules will be a delicate decision-making process and will be subject to debate among various interest groups.

CPRA is building the linked biophysical models and scoping the socio-economic valuation methods that can be used to evaluate sediment diversion operational scenarios. The outputs of these operational scenario analyses are important tools focusing public discourse on how best to balance the benefits and adverse effects of sediment diversions relative to a “No-Project” option. There are compelling reasons to begin a public discussion now. First, the desired outcomes of the operating rules may influence the design of the projects. The designs will also determine what operating rules will be possible and which ones cannot be considered because of limitations of the physical infrastructure. Second, substantial periods of time may be required to reach consensus within CPRA and among interest groups about what the operating rules should be. Third, operating rules may offer tradeoff opportunities among interest groups (e.g. land-building versus adverse fisheries effects). Finally, the development of predictive hydrologic and ecological models depends on knowing what rules will be in effect – the rules will act as boundary conditions for some models, and those models are now under construction. Having at least a broad outline of the operating rules will result in more efficient model building.

The restoration of the Kissimmee River in north central Florida provides an example of the interaction between the restoration construction project and operating rules. On the Kissimmee River, the U.S. Army Corps of Engineers and South Florida Water Management District have been restoring a 100-mile reach of the river by reintroducing more natural sinuous channel morphology and establishing more natural flows in the river using four flow control structures (low-head dams). The infrastructure construction has been an almost ten-year effort, but as construction has approached completion the project stalled because of debates about appropriate operating rules. Rules to rehydrate floodplain areas, introduce specific seasonal fluctuations of flows, and special provisions for the benefit of certain species proved difficult to integrate with each other, and the delay in resolving the problem led to a two-year delay in the project. If discussions about operating rules had begun early in the project, the delays could have been avoided.

Recommendations:

2. **Begin a public discussion on the types of operational scenarios under consideration, how models will be used to evaluate these scenarios, and how stakeholder feedback will be incorporated into decisions on operations.**

(3) Evaluating Risks/Benefits of Flooding. It is particularly important to discuss with stakeholders the costs/benefits of land building for protection against storm surges inland of diversions, the effects of river and receiving basin flood levels by way of diversion operation and the role of building new land in mitigating sea level rise. River and delta management models under development have predicted water levels as well as extent and elevation of new land built as outcome variables. Theoretically, these two variables can be parleyed into determinations of effect on risk of flood events, including those caused by sea level rise and storm surge. However, the methodologies for how this would be done have not been articulated to the Panel. We recognize that sediment diversions may not be considered in the category of "flood protection" projects in which such analyses may be considered integral to their planning. That said, given the expressed concern of stakeholders, it would be wise to include evaluation of risks and benefits of floods and have these outcomes linked to socio-economic analyses.

Recommendations:

3. **Develop in the near term a more explicit conceptual approach of how model output would be used to determine effects of flooding. We further recommend that such evaluation be coupled with the various operational scenarios and various times-horizon targets (ranging from years to at least decades from when diversions become operational), compared to a "No Action" scenario.**

(4) Comparisons between Dredging and Sediment Diversion to Build Land. Use of dredging is an alternative or a complement to sediment diversions as a means to restore coastal wetlands. The cost-benefits of dredging were compared with sediment diversions in the 2012 Comprehensive Master Plan; sediment diversions were found to provide greater and longer-lasting land building benefits, despite initially high costs. However, the preference of some stakeholder sectors for dredging over sediment diversions persists, presumably because of perceptions of reduced effects on fisheries. CPRA has completed dredging-based marsh reconstruction projects and therefore presumably has refined data on the costs per unit area and the quality of habitat provided by these projects. The footprint and spatio-temporal effects of dredging projects can be also represented in the biophysical and ecosystem models and in the socio-economic evaluation for a side-by-side comparison with sediment diversions.

Recommendations:

4. **Include dredging restoration projects as an alternative restoration strategy for further discussion with stakeholders, ensuring that, as with diversion operation scenarios, there is upfront discussion with stakeholders on details of the dredging scenarios that will be used for comparison.**

3.1.2 Stakeholder Concerns That Currently are not Being Addressed

The Panel has identified two areas, discussed below, that are not being addressed and do not appear to be in the planning process.

(1) Ecological Impacts of Elevated Nutrients from Diversion Waters. Freshwater and sediment diversions will introduce river waters containing higher nutrient levels than historic concentrations under which many of the present coastal wetlands were built. Although many authors have weighed in on this issue in the peer-reviewed scientific literature, the results are conflicting and variable, depending upon dosing levels considered and wetland community type. For example, one major concern is that elevated nutrients will accelerate belowground decomposition in marshes with highly organic soils typical in freshwater habitats and inactive deltas, thereby compromising their ability to vertically accrete in the face of sea level rise. Another issue is whether high levels of dissolved Nitrogen will drive compositional shifts in wetland communities, favoring less desirable taxa such as *Phragmites* and *Typha*. Models that are being developed to address these issues are by necessity limited by data collection on the current conditions where, even close to freshwater diversions, the magnitude of nutrient loading is much lower than may be anticipated with the planned sediment diversions.

Stakeholder concerns echo these scientific uncertainties. Based on common themes from the literature, speaker presentations, and summarized stakeholder comments, the panel has identified several specific questions relating to nutrient impacts for which analyses may be limited by the extent of existing information: (1) What are the effects of elevated nutrient inputs on maintenance of existing wetlands and to what degree are those impacts context-specific (*e.g.*, highly organic marshes *vs*. inorganic sediment-dominated marshes)? (2) How will elevated nutrients affect the structural (*e.g.*, root:shoot ratios and soil strength) and compositional (*e.g.*, dominance of species and shifts in community assemblages) integrity of existing wetlands? (3) How will elevated nutrients affect accretion dynamics? Given the importance of these issues to the ecosystem and to stakeholders, additional experimental research is urgently needed. In the Panel's experience large scale in-marsh experiments can be extremely useful in addressing these types of questions.

Recommendations:

5. **Work with local scientists to develop a scale-appropriate experimental design that encompasses a range of nutrient levels, as well as a comparison between highly organic vs. mineral sediment-dominated marshes. Such a study should then be funded by CPRA so that results can inform diversion decision making. The results of this study should be subject to peer-review, and the results shared with stakeholders. [Note: this is similar to Recommendation #5 in Report #2].**

(2) Effects of Diversions on Spread of Invasive Species. There are numerous non-native plant and animal species in the Delta, several of which are considered to have negative effects on the Louisiana economy and environment. We collectively refer to these species as "invasives." Many of these species are

dispersed primarily or secondarily by water (hydrochory), raising the concern that diversions may provide dispersal corridors and enhance spread from infested areas into intended restoration sites (http://is.cbr.tulane.edu/InvasiveSpecies.html). These species also tend to be more prevalent in low salinity conditions; thus, diversions may provide additional habitat conducive for their establishment and expansion.

Despite the scientific uncertainty (see Panel Report #2) and concerns raised by stakeholders, there do not appear to be any specific efforts to predict effects of diversions on spread of invasive species and concomitant socioecological impacts. Also, there appear to be some gaps in the monitoring approach. In some cases, species known to have serious ecological and economic impacts (*e.g.*, *Eichhornia crassipes*, *Salvinia minima*, *S. molesta*) would not be detected at all under the current protocols, as they are not emergent vegetation. The current monitoring scheme also has limited sites on emerging land in restored proto-deltas. Other noxious species known to cause ecological and navigation problems (e.g., clog waterways) and already documented in the area (USDA Plants Database; *Hydrilla verticillata*, *Myriophyllum spicatum*) are not included in the monitoring plans presented to the Panel.

In the current scheme, the only way that invasive species are represented in the overall analysis of diversion effects is if they are detected in the monitoring network of sites, at which time they are assigned a CC score = 0, a value easily masked by the presence of native species in the final FQI calculation for a site. The Panel also notes that in some cases, the presence of highly productive invasive species may have unanticipated benefits in land-building efforts, e.g., elevated accretion. The potential for negative (and potentially positive) impacts of invasive species requires their inclusion in modeling and decision-making.

Recommendations:

6. **Prepare a white paper for peer review and broad dissemination to identify potential hazards associated with invasive species, and appropriate and effective approaches to address these concerns. The potential for invasive species to influence restoration outcomes and affect socioeconomic interests in the Delta should be addressed in the proposed technical approach (see Panel Report #2). Risks should be effectively communicated to stakeholders.**

3.1.3 Stakeholder Concerns with Translation of Technical Analyses to Stakeholders

The previous two sections focused on strengthening the analytical tools and technical analyses needed to address stakeholders concerns. In this section, we focus on need for a description of how these technical outputs will be the basis for communication and exchange with stakeholders on diversion benefits and adverse effects. Public discourse on the benefits, costs, design, and operation of the diversion projects is crucial to successfully meeting the restoration goals. The projects cannot succeed without general public support, and general public support is tenuous in the absence of a thorough description of benefits, adverse effects and associated costs of different scenarios under consideration.

Testimony before the Panel showed that many citizens do not have a clear understanding of the projects, so they feel unable to establish informed opinions and participate in public discussions. This issue is further complicated by language barriers, degree of technical literacy, and media through which different target audiences can be effectively reached. CPRA has made admirable efforts to provide informative public presentations, and considerable investment of talent and information has gone into these presentations. CPRA presentations and visual materials (such as printed matter and PowerPoint slides) are, however, complicated and characterized by densely packed information and are focused towards a more technical audience. An additional challenge will be developing a clear articulation of the modeling and socioeconomic output, including ecosystem and societal costs and benefits associated with the different scenarios that can be effectively communicated to diverse public audiences.

The resolution of this issue of communicating complicated river and delta engineering, natural sciences, and socio-economic processes lies in the engagement of public communications specialists. The engagement of the LSU Coastal Sustainability Studio is a strong step toward resolving the public communication issue. The creation of innovative presentations that include maps that citizens can easily interpret, animated illustrations that demonstrate natural and social processes, and representations that convey the workings of engineering works can help with public education. Simplification of the message is key to bringing citizens into the overall decision process.

A communication plan should describe how stakeholders can meaningfully provide input into the process and outline the steps CPRA would follow to ensure accountability for response to public inputs. Furthermore, we would like to see some innovative thinking about ways to better engage affected communities such that they can become proactive in this process. For example, such communities can be encouraged to work with local planners to develop an action plan for how they will address diversion effects on their communities. Such plans could be submitted for funding through grant or low-interest loans for implementation in advance of project completion.

An example of how innovative changes in communication can be effective is the process of dam removal on Wisconsin rivers. Initially there was considerable public uncertainty about the process because many citizens were uncertain about whether they would find the landscape outcomes of dam removal to be acceptable. There was particular concern about the appearance of the rivers once the dams and their associated lakes were removed. The Department of Natural Resources, Trout Unlimited, and American Rivers used computer generated images to alter photographs of the rivers as they existed (with dams and reservoirs in place). Then they altered photographs to show what the rivers would look like without these features. Citizens and decision makers then had a vastly improved discussion about the pros and cons of each dam removal project. Similar renditions would be easily accomplished for the various diversion projects. Other, equally innovative approaches to communication are important CPRA investments.

Recommendations:

7. **Draft a communication plan that provides a conceptual approach for how these technical outputs will be translated, tailored to specific locations and to each of the numerous target audiences. This communication plan should be coupled with examples of the types of key graphics from outputs of models, monitoring and other studies as well as a description of how CPRA will use social and traditional media, interactive websites, and other forms of outreach and education to engage stakeholders in dialogue on the outcome of technical analyses.**

3.2 Biophysical Monitoring

Overall, the number of biophysical variables monitored and the broad spatial and temporal coverage of the monitoring network are impressive. This extensive dataset can be a very powerful tool for developing diversion strategy, detecting diversion impacts, and guiding adaptive management. However, the Panel has identified some key gaps. A fundamental and essential data measurement that is missing in the physical monitoring program presented to the Panel is an assessment of the spatial and temporal distribution of suspended sediments (i.e., concentration and grain-size distributions) and sediment fluxes in the receiving basins. These data are needed to determine how far diverted sediments travel and contribute to changing landforms, and are essential for a restoration plan that is designed and implemented to move sediment. Priority should be given to measurements within potential receiving basins, and at a sufficient temporal resolution to capture seasonal variability. While some data are being specifically collected to support the modeling, suspended sediment monitoring is essential to understanding changes in this system and should not wait for implementation of the System-Wide Assessment and Monitoring Program (SWAMP). It should begin now.

High quality data on bathymetry/topography as well as wave measurements are also critical for hydrodynamic modeling, and to establish a baseline that can be used to monitor post-diversion project success. The proposed timeline of assessing bathymetry (every 10 years) and topography (every 5 years) at the basin wide scale is not adequate to address the scientific issues and stakeholder concerns regarding sediment diversion projects. Once a particular receiving basin has been identified for project implementation, bathymetry and topography should be collected at the project scale to allow more accurate modeling and to serve as a baseline to measure project success. It is critical that bathymetry and topography are measured again within a few years of implementation (~2 years), but then the frequency of measurement can be extended as a function of on-the-ground conditions. More frequent bathymetry measurements will help determine if the project is progressing as planned or requires modification, and may help alleviate stakeholder concerns about project success if it can be shown that the basins are following a trajectory of steadily filling in, even if emergent land takes decades to build. Selected coring of bottom sediments can help determine depositional patterns and characteristics in the receiving basins.

Lack of measurement of wave forcing in the receiving basins should be remedied in 2015 as recent scientific literature indicates that waves are a leading cause for marsh erosion. These measurements will help address stakeholder concerns about project success as well as be used to adaptively manage implementation of the diversions. Wave stations and/or other wave monitoring alternatives (e.g., radar) should be implemented to calibrate wave hindcast models for various wind conditions occurring over an entire year.

Data from CRMS and SWAMP should be used to their full capacity to detect and evaluate potential ecological changes through time and space in response to initiation of diversions, and a more explicit description of how analyses of monitoring information will be used to develop and guide adaptive management decisions is needed. Plans for data collection are appropriately ambitious. However, it remains unclear how the set of variables will be analyzed and results integrated to evaluate the ecological effects of diversions, and specifically how the results will be used to guide future decisions. For example, vegetation data could be analyzed in ways that will allow documentation of potential community shifts, rather than a singular focus on Floristic Quality Index (FQI) or percent coverage. Additional analyses of the data are needed. The vegetation data are inherently multivariate (i.e., a collection of individual species abundances in the community), but FQI collapses all of that information into a single value for a site. To fully detect and capture early vegetation changes, multivariate community analyses (*e.g.*, ordination) could be conducted, updated with each census, and made available, e.g., incorporated into the “report card” function on the monitoring site. Graphical display of ordination results provides an effective way to evaluate and visualize community stasis/change.

Recommendations:

8. **Address key data needs by: (1) expanding the monitoring program immediately to include an assessment of suspended sediment to ensure sampling is sufficient to identify seasonal changes and the influence of storm events. A more robust program would include a) continuous monitoring by adding turbidity sensors to the Coastwide Reference Monitoring System (CRMS) stations, which would be calibrated with the water sampling program, and b) selected coring of bottom sediments to determine depositional patterns and characteristics in the receiving basins; and (2) quantifying sensitivity of the DELFT-3D modeling to initial bathymetry/topography and wave action to determine whether best available data are sufficient to make decisions about particular receiving basins.**

3.3 Ecosystems Modeling

The ensemble multi-model approach under development to examine ecosystem impacts of diversions includes EwE with Ecospace and CASM. These models, although both based on bioenergetics principles and food web connections, take different approaches to some components and appear complementary. Thus they should provide some contrasting results useful in assessing potential diversion impacts to fishery populations and other ecosystem components. There are several structural aspects to the modeling approaches that need attention. For example, the choice of functional groups and the functional relationships between key environmental factors such as salinity and the distribution, growth, mortality, and production of trophic groups need to be clearly defined, explained and reviewed by experts. These relationships will have a dominant impact on model outcomes and will affect model utility.

One significant challenge to reconciling potential differences in model outputs from these two ecosystem modeling pathways is ensuring compatibility in the hydrodynamic model outputs (DELFT 3D and/or ADH) that underpin the ecosystem models. Unless coupling of the hydrodynamic and biological models is done in comparable ways, it will be impossible to determine if the physical or biotic modeling components determine differences in ecosystem/biotic predictions from the two ecosystem models. Additional challenges relate to how the two ecosystem models use environmental drivers to interact with model parameters (and which ones) and how they accommodate animal movement in response to changing environmental conditions. The trophic groups used in the two models need to be similar because the specific functional groups or species included can strongly influence model outputs and conclusions. An additional structural modeling challenge is setting the initial annual cohort values for species that recruit every year or the initial biomass values for multi-year species. The way these key structural modeling questions are addressed will influence the utility of the models for prediction and project assessment.

Availability of adequate monitoring data continues to threaten the success of ecosystem modeling efforts. The fishery independent database collected and assembled by LDWF continues to be the primary source of data being used, despite the apparent general consensus by LDWF, CPRA, and the modelers that these data were not intended for this purpose and may not be adequate. For some important trophic groups, such as benthic infauna that are food for juvenile fish, there is little information on abundance or distribution, and no monitoring is being planned for these aspects of the food web. The lack of initial biomass estimates for many intermediate trophic groups may pose more challenges to interpretation and validation than is currently appreciated. Monitoring and modeling of some important fishery species, such as oysters, also remains problematic.

While there appears to be some capacity in the models to overcome information gaps such as initial biomass estimates, it will not be apparent whether this lack of information is critical until the models are run and calibration with time series data attempted. We continue to stress the recommendation #4 from the Report #2 (June 2014) that proposes an independent group be tasked with assessing the adequacy of the base biotic sampling and data availability. Several conceptual and tactical issues have been identified that may lower the utility of the current fish sampling for modeling and assessing success. For example, estimating catch efficiency of the different gears for each trophic group is challenging, and the need for intercalibration should be assessed. Additionally, the spatial distribution of the samples may not be adequate because proportionally few stations exist in freshwater sections of the basins.

Improved monitoring of juvenile fish and their prey will undoubtedly improve the ecosystem models, and this information is necessary to more directly monitor diversion impacts on these populations and inform adaptive management efforts. Monitoring and modeling of other species that are currently not well incorporated would help to address stakeholder concerns about other target species.

Recommendations:

9. **Develop a peer-review process for both the EwE and CASM models as they are developed (including the bioenergetic parameter choices) using independent modelers familiar with these approaches. This peer review should be part of the model development process and not delayed until publication of results, when there will be little chance to make midcourse corrections.**

10. **Assemble an independent working group of approximately eight scientists in early 2015 to assess the adequacy of consumer monitoring data and the plan for tasks and approaches that have been proposed. This group should include scientists with expertise in bioenergetics models, including the EwE model and linking ecosystem models to hydrodynamics models, coastal fish ecologists who understand the ecology of species in Louisiana marshes and the parameterizations (diets, temperature and salinity response curves), and statisticians who can evaluate spatial and temporal bounds of monitoring. [Note: This is a slightly modified version of Recommendation #4 in Report #2].**

Appendix 1:
ABOUT THE EXPERT PANEL ON DIVERSION PLANNING AND IMPLEMENTATION

The Expert Panel on Diversion Planning and Implementation was established to provide independent advice as plans for implementing sediment diversion projects along the Mississippi and Atchafalaya rivers that support coastal restoration are refined.

This independent panel is expected to meet approximately three times per year. It will identify critical scientific and technical uncertainties, suggest specific research to reduce uncertainty, and review and comment on technical reports, model outputs, and other aspects of project development. Given the issues surrounding the complexity of the design and operation of a major sediment diversion, the panel's recommendations will be in an adaptive management context. Meetings of the panel will be structured to ensure key input is received from a variety of local experts, stakeholders, and citizens. Panel reports will be presented at meetings of the CPRA Board.

The Expert Panel was formed at the request of CPRA, which is also funding the effort. The Water Institute of the Gulf provides staff and logistical support to the panel.

MEMBERS

Member	Affiliation	Expertise
Dr. John T. Wells	Virginia Institute of Marine Science (Panel Chair)	Deltaic Processes
Dr. Loretta Battaglia	Southern Illinois University	Restoration Ecology and Climate Change
Dr. Philip Berke	Texas A&M University	Urban Land Use and Environmental Planning
Dr. James Boyd	Resources for the Future	Economics and Environmental Policy
Dr. Linda Deegan	Marine Biological Laboratory	Fish Ecology, Biogeochemical Cycling and Nutrient Delivery
Dr. William Espey Jr	Espey Consultants Inc	Civil/Coastal Engineering and Water Resources
Dr. Liviu Giosan	Woods Hole Oceanographic Institution	Morphodynamics and Sedimentation
Dr. William Graf	University of South Carolina (Emeritus)	Rivers and Water Resources Management
Dr. Matt Kirwan	Virginia Institute of Marine Science	Coastal Landscapes and Sea Level Change
Dr. Tom Minello	NOAA Southeast Fisheries Science Center	Fisheries Ecology
Dr. Martha Sutula	Southern California Coastal Water Research Project Authority	Water Quality Management, Systems Ecology
Dr. John Teal	Woods Hole Oceanographic Institution (Emeritus)	Coastal Wetlands Ecology

Appendix 2:
MEETING #3 AGENDA

October 28, 2014
Crowne Plaza, 4728 Constitution Avenue
Baton Rouge, LA

8:30	Welcome and Panel Introductions Review Agenda	Dr. John Wells (Panel Chair) Virginia Institute of Marine Science
8:45	Diversions Update	Mr. Kyle Graham Coastal Protection and Restoration Authority
9:45	Expectations of System Response to Diversions	Dr. Woody Gagliano Coastal Environments, Inc. Dr. Gene Turner Louisiana State University
10:30	Break	*Coffee*
10:45	Broader Effects of Diversions	Mr. Karim Belhadjali Coastal Protection and Restoration Authority Ms. Sandy Nguyen Coastal Communities Consulting Mr. Mike Benge Delacroix Corporation *Discussion with Panel*
12:15	Lunch	
1:30	Monitoring Wetlands and Water in Coastal Louisiana	Mr. Rick Raynie Coastal Protection and Restoration Authority
2:00	Adaptation of the CASM to Evaluate Food Web Dynamics and Species Responses in Louisiana's Estuaries	Dr. Shaye Sable Dynamic Solutions
2:45	Break	*Coffee*
3:00	Ecosystem Modeling for Fish and Shellfish: What to Expect?	Dr. Kenny Rose Louisiana State University Dr. Cam Ainsworth University of South Florida *Discussion with Panel*
4:30	Public Comment Period	
5:00	Adjourn	

Appendix 3:
CHARGE FOR MEETING #3

(1) CPRA has identified a number of stakeholder concerns regarding sediment diversion planning and implementation. What specific recommendations would the expert panel have regarding the types of information that need to be developed prior to the upcoming decision points in order to alleviate these concerns? How could that information be developed and conveyed to stakeholders?

(2) Are the monitoring data being collected being used appropriately in the analyses that have been presented to the panel? Are there key limitations of the data that can be remedied in time to inform the forthcoming CPRA 'decision to implement' toward the middle of 2015?

(3) Are the modeling approaches for fish and shellfish appropriate to support the types of decisions being made by CPRA in late 2014 and late 2015? What else could be done in terms of predicting/understanding potential fish/shellfish response to no action and large sediment diversions in time to inform these decisions? What key limitations need to be explicitly acknowledged by CPRA as they use the model outputs to inform the decisions?