

2.0 Performance Measures as Evaluation and Assessment Tools

Performance measures will be used during two components of the adaptive management process: evaluation of expected plan performance and assessment of actual plan performance (see Section 3 Relationship to CERP Adaptive Management Framework for more details). For adaptive management to be successful, assessments (see Section 2.2) must be compared to planning expectations. This requires that indicators used for planning be assessed during implementation. Indicators used for evaluations of plans are limited by available tools. Many more indicators can and will be monitored and assessed as CERP progresses. Additionally, metrics and targets of indicators used for both evaluation and assessment may differ because it may not be practicable to use the same metric and target for planning purposes as it is for assessment purposes. This may make comparing expected responses to actual responses difficult. Methods that will reconcile the different metrics and targets to enable the comparison must be developed.

The specific application of performance measures to evaluation (planning) and assessment processes is discussed in the following sections. In many cases, we are not yet able to apply performance measures to either process, but the indicator is considered important enough in assessing CERP success to be included. Also, in some instances, neither evaluation nor assessment targets are specific. As additional research and monitoring are conducted, and ecological models are either developed or refined, RECOVER will refine and improve both evaluation and assessment restoration application and targets.

2.1 Evaluation Applications

During CERP project plan development and CERP updates, effects of different combinations of water management operations and features such as canal, levees and pump stations need to be estimated. Different alternatives need to be compared to select the plan that will best meet CERP goals and objectives. Several simulation methods can be used to evaluate the system's response to a possible alternative. These methods include computer simulation, post-processing of computer modeling results, and use of regression models. All simulation models are basically mathematical models that attempt to integrate and show interactions between multiple environmental and man-made components.

Most, if not all, simulation methods require input of climatic variables. Since we can not predict weather, a historic period of record (currently 36 years or less) is used instead. Results of these simulations can not be interpreted as predictions of actual conditions expected to occur at a given time in the future. We can only approximate how certain features of the natural system would have responded to the rainfall conditions present in the period of record in combination with a fixed set of land use characteristics and water management practices. While output from these models are not predictions, these models are intended to provide some estimates of how average values of certain natural system features can be expected to respond over the long term. Hence, we 'evaluate' performance during the planning process, not 'predict' it. These estimations are

especially useful in comparing alternate plans and adaptively managing a project or program.

Computer simulation models are simplified representations of existing conditions (e.g., topography, vegetation) and processes (e.g., rainfall, levee seepage). These models are designed to operate at very specific spatial and temporal scales. Usually, they are optimized to accurately represent only a few features of the system. They can not be expected to accurately simulate all of the complex interactions occurring between climate and hydrologic cycles, trophic webs and vegetative communities. Therefore, not all of the CERP system-wide performance measures needed to assess the system will be applied to evaluations.

The South Florida Water Management Model (SFWMM) is currently used for system-wide evaluations and for trying to determine system-wide effects of project alternatives. Due to the large spatial scale of this model (grids are 2 miles by 2 miles), very little, if any, differences can be seen for different alternatives of specific projects. Project teams usually develop or modify smaller scale models to compare alternatives. Currently, the Regional Simulation Model (RSM) is being developed. It can operate at smaller, variable scales.

Habitat suitability and water quality can be derived from SFWMM or other computer model hydrologic output even if they were not modeled explicitly. These post-processing methodologies may allow estimations of ecological attributes to assist in selection of plans and may even provide some insight into interactions between stressors and attributes.

The ability to evaluate performance measures is constrained by availability of simulation or computer modeling tools, their spatial and temporal scales, and their associated uncertainty. Uncertainty is discussed further in Section 16 of this report. In the absence of adequate models, best available science and best professional judgment are used when conducting an evaluation. Assessments of the system can aid in refining this professional judgment.

2.2 Assessment Applications

Progress towards restoration will be assessed at regular intervals as CERP is implemented. The assessment will not simply be a status of individual performance measures with respect to individual targets. Instead, it uses a hypothesis-based approach, which is more robust, flexible and more consistent with an adaptive management process (see Section 3). The hypotheses are expected responses and relationships captured in a set of CERP-specific conceptual ecological models (see Sections 9 to 12, and 14). The hypothesis-based approach recognizes complexities of ecological responses by assessing their status and trends using multiple performance measures or clusters of physical, water quality and ecological attributes. This more holistic approach attempts to capture mechanistic interactions of multiple stressor-response pathways rather than relying on one metric to characterize ecological complexity. This approach is more scientifically robust and increases the likelihood of detecting unexpected responses.

The final draft of the *Monitoring and Assessment Plan (MAP), Part 2, 2006 Assessment Strategy for the MAP* (RECOVER 2006), referred to as the Assessment Strategy, provides guidance for the following:

1. Estimate direction and magnitude of change in performance measures from reference state both annually and cumulatively over multiple years.
2. Compare current performance measure status with its desired trend and target.
3. Evaluate consistency of monitoring results with MAP hypotheses.
4. Determine if unanticipated events are indicated.
5. Describe how these events are affecting desired outcome.

Physical, chemical and ecological data (i.e., multiple performance measures) are integrated and interpreted to assess causal inferences comprising each hypothesis. Integration and interpretation of multiple physical and chemical stressor impacts on a specific ecological attribute, as described in a CERP hypothesis, will require application of quantitative statistical and modeling methods as well as integration methods such as multiple lines-of-evidence and weight-of-evidence approaches. No single model can address complex temporal and spatial scale issues that characterize CERP. The draft Assessment Strategy (RECOVER 2006) presents a very brief overview of statistical, modeling and weight-of-evidence approaches that have been used to analyze, integrate and interpret monitoring data to infer relationships between stressors and effects described in MAP hypotheses.

Information will be integrated across modules (Lake Okeechobee, Northern Estuaries, Greater Everglades, Southern Estuaries and Water Supply and Flood Protection) to provide a system-wide synthesis of the information and an evaluation of CERP progress. This requires identifying those physical, chemical and ecological attributes that are critical to measuring restoration success at a system-level and that will be reported to the public and Congress as the keys to assessing restoration success. One approach for addressing this requirement within our current analytical limitations is to use “defining characteristics” identified in the Total System Conceptual Ecological Model (Ogden et al. 2005). Using this point of departure, all lines of evidence needed to evaluate defining characteristics or interim goals (see Section 5) are identified. Weighing relative importance of lines of evidence will make synthesis more robust.

If monitoring trends and research results are inconsistent with or do not support hypotheses or the interim goals and targets, the following adaptive management options may be initiated: 1) modify the hypotheses, conceptual ecological models, and/or the associated performance measures, 2) modify tools (e.g., hydrologic models), 3) identify system-wide hydrological and/or ecological needs to improve CERP performance.

The following assessment reports will be developed:

1. Principle investigator reports will cumulate data on an annual basis to provide a cumulative assessment of hypotheses and performance measures at the MAP component and module level.
2. Annual module group reports will provide module-level assessment of hypotheses and performance measures, review progress towards achieving interim goals, and identify unexpected events. These reports integrate multiple performance measures to provide an assessment of module-level hypotheses.
3. The biennial System Status Report will provide a synthesis and interpretation across modules. It will evaluate CERP's progress in achieving interim goals.
4. The Five-Year Technical Report will integrate trends and findings from System Status Reports and identify problems in system performance that require corrective action.

2.3 References

Ogden, J.C., S.M. Davis, T.K. Barnes, K.J. Jacobs and J.H. Gentile. 2005b. Total system conceptual ecological model. *Wetlands* 25(4):955-979.

www.evergladesplan.org/pm/recover/recover_docs/cems/cem_use_of_cems.pdf

RECOVER. 2006. Monitoring and Assessment Plan (MAP), Part 2, 2006 Assessment Strategy for the MAP, Final Draft. Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. December 2006.

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