Appendix 7B-1: Comprehensive Everglades Restoration Plan Adaptive Management Strategy

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Comprehensive Everglades Restoration Plan Adaptive Management Strategy

the journey to restore America's Everglades

April 2006

Why Adaptive Management?

This document contains the recommendations of REstoration, COordination and VERification (RECOVER) for integrating adaptive management (AM) into implementation of the Comprehensive Everglades Restoration Plan (CERP or Plan). Adaptive management provides resource managers with an active strategy for dealing with the considerable uncertainties that characterize management of large natural ecosystems. Adaptive management recognizes that natural systems are remarkably complex and difficult to predict. The current generation of numerical models often lack the predictive power to accurately characterize ecological responses to management actions, especially at large spatial scales. These uncertainties create great challenges for managers who must decide on actions to achieve complex resource or restoration goals. The guiding principles of AM are derived from the growing recognition in management agencies and institutions of: (1) the uncertainty associated with ecosystem level restoration; and (2) that the most promising means for reducing uncertainties about how these systems will respond to management actions is through the learning that occurs during and following the implementation of these management actions. For this reason, AM develops opportunities to increase knowledge by applying methods of scientific inquiry to the planning, implementation, and assessment of ecosystem management projects. In AM, every phase of project development seeks out structural, operational, and assessment measures that will shed light on key uncertainties, in order to create an expanding base of knowledge that will support current and future decision-making. Pre-construction predictions of ecosystem responses and monitoring of actual responses are interpreted and integrated through systematic monitoring and assessment programs.

The overall purpose of AM is to substantially improve the chance of success in achieving ecosystem goals when there is significant uncertainty about how this is to be accomplished. Adaptive management differs from earlier management traditions in its: (1) proactive approach to dealing with ecological and hydrological uncertainties; (2) use of modern ecosystem science and scientific practices; (3) active collaboration among scientists, planners and managers; and (4) emphasis on open, inclusive, and integrative processes for designing and implementing the components of the AM Strategy. Existing planning guidance provided by the U.S. Army Corps of Engineers (Corps) and CERP implementation procedures already apply several principles important to AM**. The purpose of the CERP AM Strategy is to extend and integrate the practice of AM across all components of the CERP program to fully realize the benefits of this management approach to achieving ecosystem restoration goals.**

Benefits of Implementing AM - The integration of AM principles into the Plan is beneficial to managers/decision-makers, project teams, scientists/technical experts, and stakeholders in the following ways:

Managers/Decision Makers

- Formal mechanism for addressing uncertainty and building flexibility into the Plan.
- Provides formal mechanism to expedite and facilitate system-wide decision making.

Project Teams

- Formal mechanism for elevation of system-wide problems faced at the project - level, to a team specifically designated to address them (System Planning and Operations Team [SPOT]).
- Assistance with design of robust project alternatives and incorporation of performance-based versatility.

Scientists/Technical Experts

- Opportunity to develop best available science through refinement of hypotheses, performance measures, etc.
- Formal forum for dialogue between scientists and managers on the interpretation of scientific data and its application to evaluation of Plan performance.

Stakeholders

- Additional opportunity to be part of the decision-making process for CERP implementation.
- Formal forum for expression of changing societal values.

What is Adaptive Management?

Adaptive management is a science- and performance-based approach to ecosystem management in situations where predicted outcomes have a high level of uncertainty. Under such conditions, management anticipates actions to be taken as testable explanations, or propositions so the best course of action can be discerned through rigorous monitoring, integrative assessment, and synthesis. Adaptive management advances desired goals by reducing uncertainty, incorporating robustness into project design, and incorporating new information about ecosystem interactions and processes as our understanding of these relationships is augmented and refined. Overall system performance is enhanced as AM reconciles project-level actions within the context of ecosystem-level responses.

Principles of CERP AM - **The goal of AM is to support improved decision-making and Plan performance over time**. At the heart of this is a "learning by doing" approach that integrates planning and design with ongoing monitoring, assessment, and evaluation. Five key principles are fundamental to this approach:

(1) Anticipating possible future uncertainties and contingencies during planning of qualitatively different options;
(2) Employing science-based approaches to build knowledge over time;
(3) Designing "robust" projects that can be adapted to uncertain or changing future conditions;
(4) Building shared understanding through collaboration and conflict resolution; and
(5) Reconciling competing objectives to benefit both nature and society.

Conflict Resolution and Collaboration

Two fundamental components of AM are collaboration and conflict resolution. Managing for uncertainty and addressing conflict at large spatial and temporal scales is a complex task. Differences of opinion are unavoidable and expected, and the emergence of conflict at some scale is likely and anticipated. Tackling uncertainty and successfully managing conflict demands openness, transparency, and accountability. Adaptive management anticipates both uncertainty and conflict and advocates an approach that incorporates openness, transparency, and accountability. Inclusion of these elements into the management of large-scale ecosystem restoration efforts promotes building collaborative working relationships through the use of incentives and trust building, and minimizing conflict with the inclusion of a dispute resolution process. Although collaboration requires more time and effort to cultivate at the beginning of the restoration process, a more sustainable and effective management approach results and the benefits to the system outweigh the initial investment. While collaboration and conflict resolution will take place throughout the processes described in this document, they are most important in Boxes 3 and 4 of the AM framework. During these portions of the framework, managers, scientists, and stakeholders will be most involved in negotiating competing interests and considerations to determine the best path forward for improved CERP performance.

Authorities and Background for CERP AM

Adaptive management has been an integral component of CERP since the Central and South Florida Project Comprehensive Review Study (Restudy). An adaptive assessment and monitoring plan was included in the original Restudy plan (USACE & SFWMD 1999). Congress recognized the importance of addressing ecosystem uncertainty in approving the CERP as a framework for restoration. The Water Resources Development Act of 2000 (WRDA 2000, Pub. Law 106-542, Dec. 11, 2000) provided funding for an Adaptive Assessment and Monitoring Program and required that Programmatic Regulations (Pro Regs) establish a process to ensure that new information resulting from changed or unforeseen circumstances, new scientific or technical information, or information developed through AM be integrated into implementation of the Plan. The Senate Committee on Environmental and Public Works report on WRDA 2000 (Senate Report No. 106-362) describes Congress' expectation:

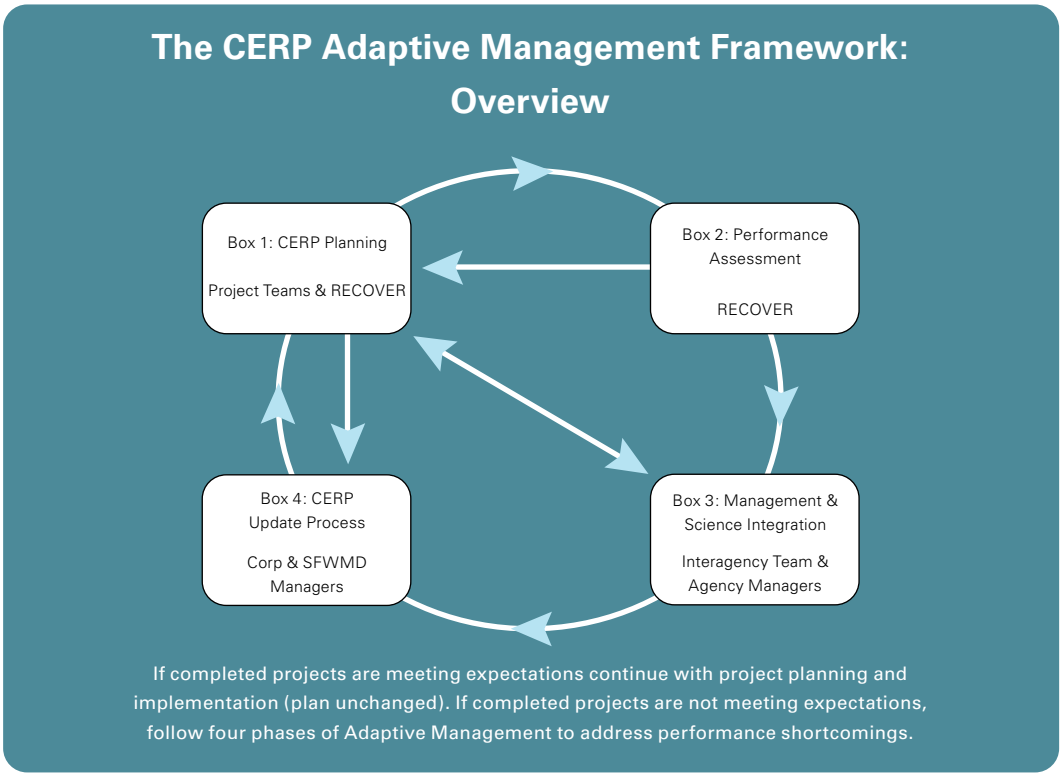
"The Committee does not expect rigid adherence to the Plan as it was submitted to Congress. This result would be inconsistent with the adaptive management principles in the Plan. Restoration of the Everglades is the goal, not adherence to the modeling on which the April 1999 Plan was based. Instead the Committee expects that the agencies responsible for project implementation report formulation and Plan implementation will seek continuous improvement of the Plan based upon new information, improved modeling, new technology and changed circumstances."

The Pro Regs (33 CFR, Part 385) directed the Corps and the South Florida Water Management District (SFWMD) to develop a CERP AM program. This program was to include a monitoring and assessment program to be developed by RECOVER, periodic technical assessments by RECOVER, periodic assessments of CERP performance, re-evaluations and updates to the Plan to be conducted by the Corps and SFWMD, and a mechanism for modifying the Plan through Comprehensive Plan Modification Reports.

The Pro Regs define AM for the CERP as:

"…the continuous process of seeking a better understanding of the natural system and human environment in the South Florida ecosystem, and seeking continuous refinement in and improvements to the Plan to respond to new information, new or updated modeling; information developed through the assessment principles contained in the plan; and future authorized changes to the Plan in order to ensure that the goals and purposes of the Plan are fulfilled."

Major components of the CERP AM program have been initiated during the five years since WRDA 2000. RECOVER further developed the Applied Science Strategy as a means of organizing current scientific understanding to effectively support restoration of South Florida ecosystems (Ogden and Davis 1999). The major components of the Applied Science Strategy are the development of regional and total system conceptual ecological models, identification of performance measures and restoration targets, development and implementation of a system-wide monitoring program, and development of an assessment strategy. The RECOVER system-wide Monitoring and Assessment Plan (MAP) is being implemented, and guidance on development of integrated technical assessments has been prepared.



(Figure 1) The CERP Adaptive Management Framework - illustrates the four elements in the AM Framework.

The CERP AM Program

The CERP AM program is described in two documents: (1) the AM Strategy; and (2) the AM Implementation Guidance Manual. The **AM Strategy** includes a graphical overview of the CERP AM process (see Figure 1). This framework contains four process diagrams, called "boxes," that illustrate the major components of the CERP AM program. The four boxes describe the set of steps for integrating AM into: (1) project and system-wide planning; (2) measuring and assessing natural and human system responses to Plan implementation; (3) the identification of potential solutions to performance issues with the Plan; and (4) decisions by policymakers for improving the Plan. The AM strategy consists of the AM Framework and a condensed description of how AM is organized and integrated across the CERP program. The AM Strategy has been developed in consultation with stakeholders and participating state, federal, local, and tribal governments. The **AM Implementation Guidance Manual** is being developed for use by project teams, managers, and scientists working on CERP. The manual will provide detailed discussion, examples, and a step-by-step approach for each of the processes described in the AM Framework. The AM Implementation Guidance Manual will be released in Spring 2006.

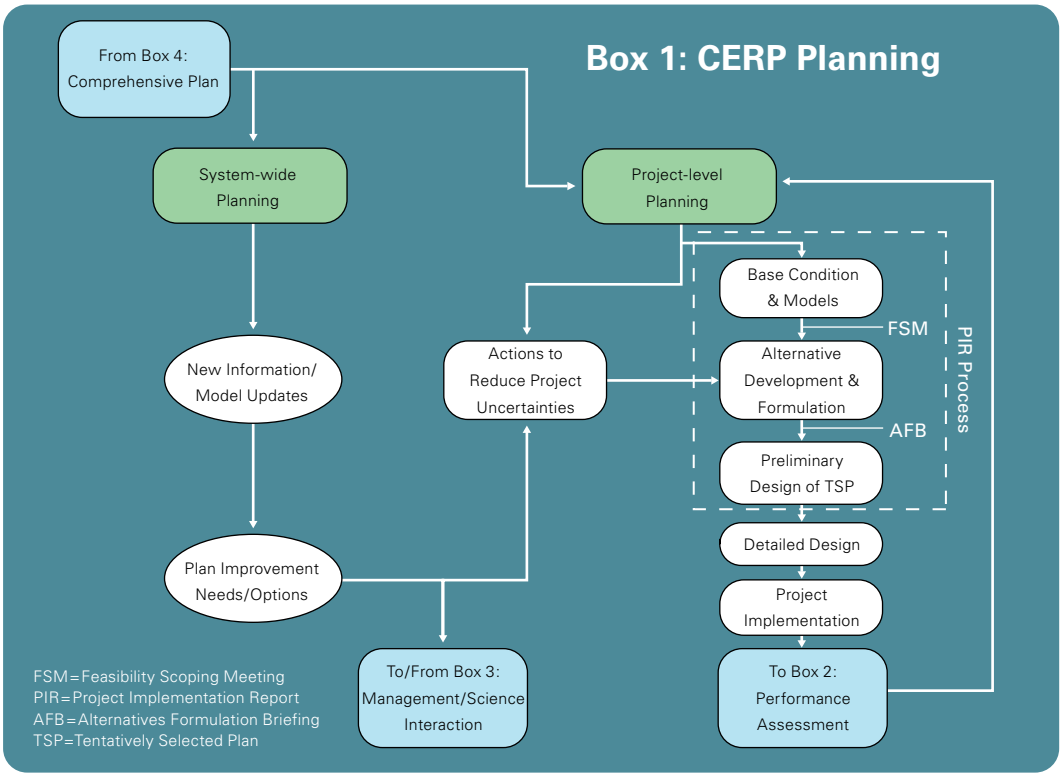
Box 1: CERP Planning

Adaptive management principles should be applied during CERP planning activities at both the system-wide and project-levels in order to anticipate and plan for performance uncertainties and incorporate performance-based versatility into project designs and recommended Plan improvements. There are several ways of addressing uncertainty: (1) anticipate uncertainty and build performance-based versatility or robustness into the design of the Plan and each individual project; or (2) detect and correct errors after project construction and make adjustments as they arise to ensure restoration goals are achieved. The former incorporates AM principles into the planning process while the latter option represents the traditional approach to planning activities .

The concept of robustness is important to the AM Strategy and can be defined as the sensitivity of key design parameters to operate effectively given the variability and uncertainty of future events. The use of robust alternatives addresses the dilemma of making rational decisions today even though future conditions may be uncertain. Robustness is the ability of the Plan or individual project components to accommodate surprise and to perform well even under shifting conditions.

System-wide Planning - RECOVER will conduct periodic updates of the CERP as mandated by the Pro Regs to ensure the goals of the Plan are achieved. These updates are scheduled to occur at least every five years and will include evaluation of the Plan using new and/or updated modeling, which utilizes the latest scientific, technical, and planning information. The incorporation of an AM approach into the framework for restoration of the Everglades supports the improvement of system-wide performance as learning and knowledge about the ecosystem improves. Broad planning scenarios addressing new and/or updated modeling or information (e.g., sea-level rise or updated modeling assumptions) are examples of new information to be evaluated at the system-wide scale. Based on predicted Plan performance incorporating these scenarios, it will be determined whether the Plan is still able to meet its goals and objectives - provide the quantities and flows of water needed to achieve restoration while still providing for the other water related needs of the area. When appropriate, results of these system-wide evaluations will be used to initiate management actions within Box 3 (Management and Science Integration) that are necessary to adjust the Plan (see Figure 2).

Project-Level Planning - The CERP program is composed of 68 major components that are grouped into over 40 projects. Each project is associated with a multi-agency project team (PT) responsible for guiding the project through the planning process for CERP projects. This planning process is referred to as the Project Implementation Report (PIR) process. Because AM concepts have not been formally integrated into this planning process, CERP PTs have requested specific guidance for using AM for CERP project planning. To address this need, the CERP planning process was examined to determine the appropriate places for incorporation of AM principles; specifically, addressing scientific uncertainties and incorporating robustness into project planning (see Figure 2). AM principles can be applied during alternative development and formulation and during the development of initial details for the Tentatively Selected Plan. A more detailed implementation strategy for Box 1 is contained in the AM Implementation Guidance Document. Box 1 is graphically depicted in Figure 2.



(Figure 2) Box 1: CERP Planning - Both system-wide and project-level planning issues are addressed by the CERP AM Strategy.

Box 2: Performance Assessment

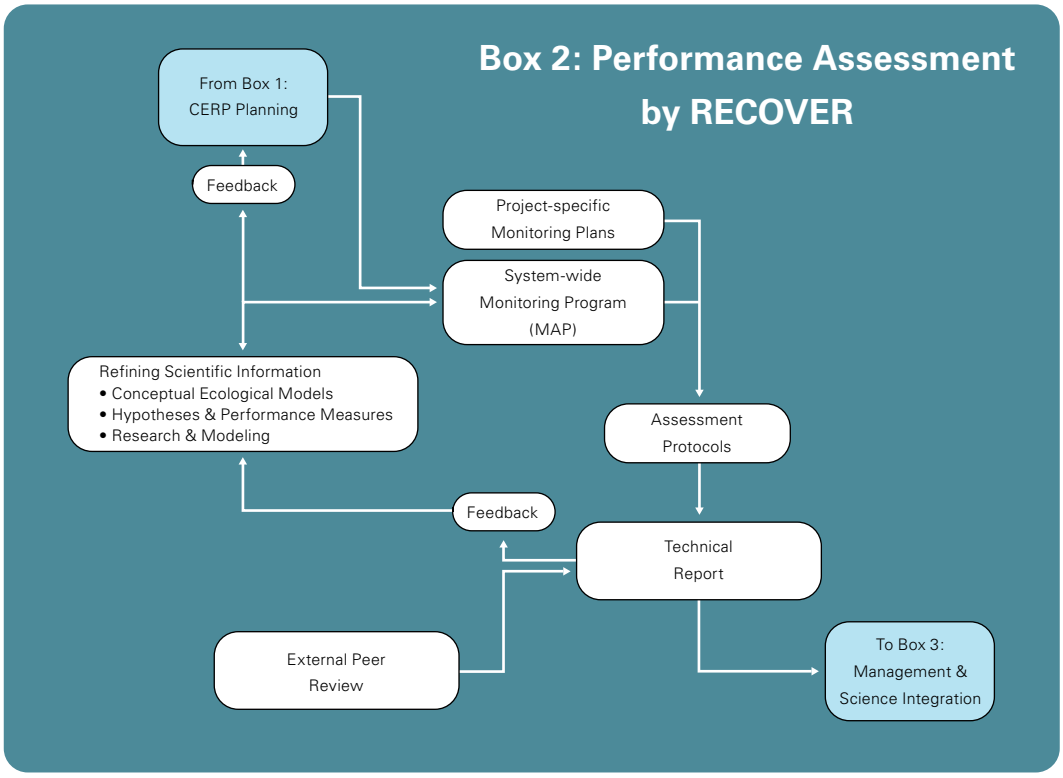
An essential element of AM is the development and execution of a scientifically rigorous monitoring and assessment program to analyze and understand responses of the system to implementation of the Plan. This assessment program relies heavily on the implementation of the integrated system-wide monitoring plan for CERP, entitled the CERP MAP. The scientific and technical information generated from the implementation of the monitoring program will be organized to provide a process for RECOVER to assess CERP performance and system responses and to produce system status reports describing and interpreting the responses. Additionally, in accordance with the Pro Regs, RECOVER is required to prepare a technical report at least once every five years; this report presents a system-wide assessment of whether the goals and purposes of the Plan are being met, including whether the interim goals and interim targets (IG/IT) are being achieved or are likely to be achieved. Where appropriate, project-level data will also be incorporated into the assessment of system performance as detailed in the RECOVER 2005 Assessment Strategy for the MAP (commonly referred to as MAP, Part 2). Figure 3 illustrates Box 2.

Monitoring and Assessing System Performance - The implementation of the MAP allows natural and human system responses to be assessed relative to stated hypotheses for these ecosystems and evaluated relative to the trends or targets established for the Plan through performance measures (PMs) and targets. The MAP is a key component of a system-wide AM Strategy and is essential for the success of the CERP (RECOVER 2004a) by supplying the data necessary to assess system performance and modify the Plan to improve performance, if necessary.

RECOVER will use a hypothesis-based approach for assessment of system performance, which will provide a more robust and flexible approach than assessing individual PMs. The hypothesis-based approach recognizes the complexities of the ecological responses being detected by the MAP and CERP project-level monitoring and attempts to capture the mechanistic interactions of multiple stressors rather than relying on a single metric to characterize ecological complexity (RECOVER 2004b). Furthermore, the hypothesis-based approach is scientifically robust and incorporates AM principles such that it increases the likelihood of detecting undesired and unexpected responses of the ecosystem to CERP implementation and non-CERP actions.

IG/IT - Although the assessment PMs provide targets for pre-drainage restoration, the Pro Regs dictate that the incremental progress toward achieving CERP expectations be reported on a regular basis. To fulfill this need and determine if CERP performance is progressing as expected, the IG/IT have been established to document CERP's expected performance at five-year increments throughout the life of the Plan (RECOVER 2005c). The technical reports provided by RECOVER will help provide the means to determine if actual CERP performance is reaching the level predicted by the IG/IT. The utility of employing IG/IT lies in its ability to help detect whether the Plan is performing as expected so that refinements can be made. Additionally, as predictive capabilities improve and ecosystem relationships are better understood, the IG/IT will be fine-tuned to more accurately reflect CERP expectations. This incorporation of new information and subsequent refinement of the Plan to improve performance embodies the ongoing responsiveness of the AM process.

RECOVER Technical Report - The final product resulting from Box 2 is the RECOVER Technical Report. The Pro Regs state that "whenever it is deemed necessary, but at least every five years, RECOVER shall prepare a technical report that presents an assessment of whether the goals and purposes of the Plan are being achieved, including whether the IG/IT are being achieved or are likely to be achieved." The Technical Report represents RECOVER's system-wide science-based assessment of CERP performance toward achieving the goals and purposes of the Plan and will be used along with policy, legal, and cost considerations under Box 3 activities to produce the Assessment Report (see Figure 4).



(Figure 3) Box 2: Performance Assessment by RECOVER - Monitoring data is evaluated annually to assess the performance of CERP.

Box 3: Management and Science Integration by RECOVER and Agency Managers

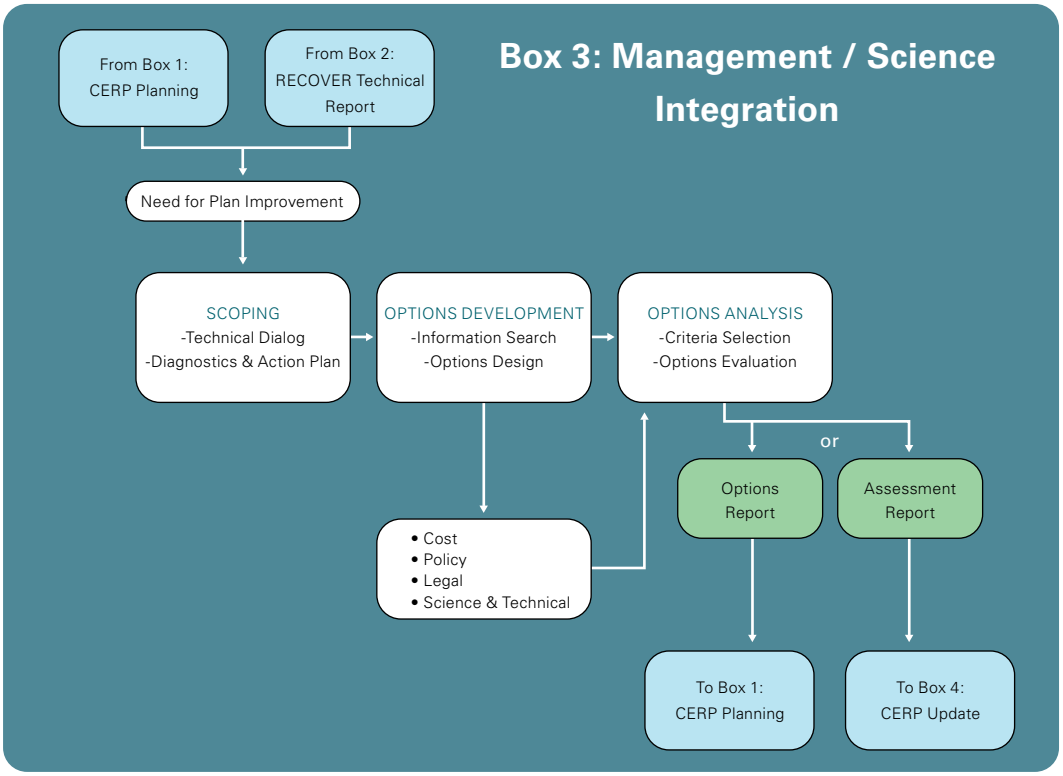
Box 3 represents the phase of the AM process in which scientists and managers collaborate in the development of options for addressing the challenges and opportunities presented by new knowledge about, or unexpected events within, the Everglades ecosystem. These options are decision-relevant, science-based, and solution-oriented and aid in addressing the challenges and opportunities that may have system-wide implications for the CERP program. Activities encompassed within Box 3 are triggered by new knowledge that reveals a potential opportunity to improve conditions in the South Florida ecosystem or a problem that could require a change to CERP implementation. The products of Box 3 are an Assessment Report to assess if the goals and purposes of the Plan are being achieved or a less formal Options Report that details options and recommendations to be used during the CERP planning process in Box 1. CERP decision-makers are the primary audience for the Assessment or Options Report. Because the issues that trigger an Assessment Report have far-reaching effects resulting in strategic, policy, and economic implications for the CERP program as a whole, participation by CERP managers is a necessity during this phase of AM.

The System Planning and Operations Team - The SPOT, an interdisciplinary multi-agency group chaired by the Corps and SFWMD, is responsible for overseeing and coordinating Box 3 AM activities in consultation with additional members from participating agencies and tribal governments. SPOT complements RECOVER's technical and scientific capabilities when policy decisions by CERP sponsoring agencies and/or National Environmental Policy Act (NEPA) documentation are required. RECOVER is not a policy-making body and their documents are not self-executing; therefore, the SPOT is designated to prepare decision documents and to provide the vital link between RECOVER's work and policy and/or NEPA processes. Although the SPOT is the entity that is accountable for completing the work of Box 3, the work itself is a multidisciplinary effort that includes managers and scientists from multiple agencies and extends to stakeholders and the public.

Overview of Box 3 Actions - The Box 3 process is comprised of three basic activities illustrated in Figure 4: (1) scoping; (2) options development; and (3) and options analysis. The objectives of *scoping* are to recognize whether implementation feedback is significant enough to trigger a Box 3 assessment and, if so, then to diagnose the resources and actions needed to develop the assessment. Scoping is accomplished via a structured dialogue involving scientists, managers and stakeholders. The goal of the dialogue is for experts and agency managers to develop a common interpretation of the scientific and technical information which may have implications for management decisions affecting the CERP program.

If scoping leads to a decision to proceed, SPOT moves to *options development*, which involves investigation of the problem and formation of potential solutions. Options development involves a strategic search for useful ideas, management measures, and more effective management approaches. Unlike project or system-wide planning, options development does not involve evaluation of detailed designs for alternatives. Instead, the options developed are qualitatively different approaches (e.g., operations, field tests, construction, and/or land acquisition), representing differing strategies for improving performance of the Plan.

The final activity associated with Box 3 is an *options analysis*, which entails screening of options and development of recommendations. The output from the options analysis phase is either an Assessment Report or an Options Report depending upon which box in the AM Framework initiates the action (i.e., Box 1 prompts development of an Options Report while Box 2 prompts development of an Assessment Report). The Assessment or Options Report will contain the findings from the options analyses for an array of potential solutions. To the extent that each solution is developed, the report will document its viability using the criteria employed in the options analysis. The report will describe the anticipated benefits and drawbacks of each viable option as well as explain how options differ in their expected ability to improve Plan performance and address social values. The Options Report is not,



(Figure 4) Box 3: Management/Science Integration - Results of scientific interpretation of monitoring data are presented to CERP managers and Plan improvements are discussed.

in itself, a decision document, but will be submitted through Box 1 (CERP Planning) to the Corps and SFWMD decision-makers, with coordination through the Design Coordination Team and the CERP Quality Review Board (QRB). On the other hand, when the Assessment Report is produced, the Corps and the SFWMD shall transmit it to the Secretary of the Army, the Secretary of Interior, and the Governor of Florida as established by the Pro Regs.

Box 4: CERP Update Process

The final element of the AM framework involves the decision to alter the CERP through adjustments in project plans or operations, or alterations to the sequencing of projects. The actions encompassed within Box 4 will occur under the guidance of senior management within the Corps and SFWMD in consultation with other agencies, tribal governments, and stakeholders. Once SPOT and CERP managers have produced an Assessment Report outlining options to improve Plan performance, this information will be forwarded to agency decision-makers. While the entities that assemble the Assessment Report in Box 3 may recommend a preferred option, this recommendation is in no way binding during the activities of Box 4 (Figure 5). The selection of the preferred option by senior management from the Corps and SFWMD will be considered the option that best represents societal values, scientific input, and reconciliation of policy conflicts. At the conclusion of this process, decision-makers will have decided what action, if any, should be taken to improve performance of the Plan or to resolve any identified problems with the Plan that may be impeding the attainment of CERP goals and objectives.

Modification of the CERP - If decision-makers determine that modification of the CERP is required to improve Plan performance, the options laid out in the Assessment Report (Box 3) will be considered, any recommended option contained within the Assessment Report is non-binding to the decisions made in Box 4. In general there are three alternatives available to decision-makers:

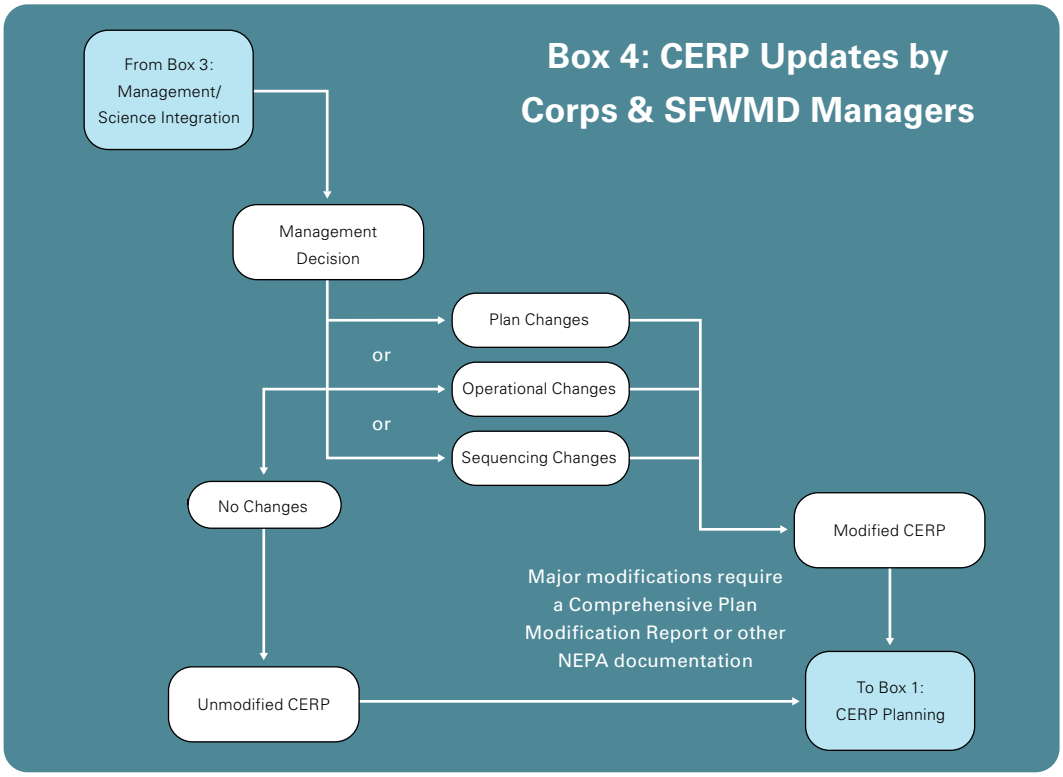
(1) Alter sequencing of project implementation to adjust the storage, treatment or delivery of water;
(2) Implement operational changes to improve project performance, or
(3) Make adjustments to the Plan. These changes could include adding, deleting or modifying individual project components.

If the Corps and SFWMD determine that major changes to the Plan are necessary to achieve the goals and objectives of the Plan, they will prepare a Comprehensive Plan Modification Report using the formal process outlined in the Pro Regs. The report will contain appropriate NEPA documentation to supplement the Programmatic Environmental Impact Statement included in the "Final Integrated Feasibility Report and Programmatic Environmental Impact Statement" dated April 1, 1999. Minor adjustments to the Plan may be made through individual PIRs or the System Operating Manual.

No Modification to the CERP - If performance expectations are being met, then no changes to the Plan would be required.

Roles and Responsibilities

The adjacent table identifies the roles and responsibilities of all parties involved with the implementation of the AM program for CERP. As can be gleaned from the table, RECOVER and the PTs are primarily responsible for Box 1, RECOVER for Box 2, SPOT and the Sponsoring Agencies for Box 3, and the Sponsoring Agencies for Box 4. Stakeholders and the public have an opportunity to provide input and review planning and decision documents in each of the boxes of the AM Framework.



(Figure 5) Box 4: CERP Updates by Corps and SFWMD Managers - Recommendations from the RECOVER Assessment Report are reviewed and acted upon by the Sponsoring Agencies.

Roles and Responsibilities in the AM Process

Organization	Box 1: CERP Planning	Box 2: Performance Assessment by RECOVER	Box 3: Management/Science Integration	Box 4: CERP Updates by Corps & SFWMD Managers
CERP Quality Review Board (QRB)	Authorizes expenditures for implementing AM (i.e., modeling, field tests) that address project uncertainties. Establishes priorities and schedules.	No roles and responsibilities.	Apply outputs from Assessment and Options Reports to accomplish agency objectives. Provides input on options design.	Facilitate approval of Assessment Report recommendations. Identify and implements actions to address Assessment Report recommendations.
Sponsoring Agencies (Corps & SFWMD)	Conduct CERP planning activities.	Conduct project-level monitoring for CERP. Provide input to RECOVER assessments and coordinates development of RECOVER MAP-related products (i.e., monitoring and assessments).	Participate in dialogue and approve action plan during scoping. Identify constraints and requirements for options and participate in development of options. Participate in the screening of options during options analysis.	Review the Assessment Report and determine if changes to the Plan are required to meet the goals and objectives of CERP. Develop a CPMR and accompanying NEPA documentation if necessary.
Partnering Agencies	Provide review of, and comments on, CERP planning documents. Active participation as part of CERP PTs.	Provide results of non-CERP monitoring. Review CERP monitoring strategies. Participate in RECOVER Adaptive Assessment and Monitoring (AA&M) activities.	Participate in scoping dialogue. Identify constraints and requirements for options . Participate in options development and screening.	Review and comment on the Assessment Report.
REstoration, COordination and VERification (RECOVER)	Implement AM strategies (i.e., modeling, field tests). Conduct periodic CERP updates. Elevate system-wide planning issues to SPOT. Perform regional evaluations and provide consultation to PDTs on project-level AM.	Designs and implements system-wide monitoring and assessment program. Prepares RECOVER Technical Report assessing performance of the Plan.	Participate in scoping dialogue. Provides scientific and technical support duringoptions development. Participates in options analysis, which leads to preparation of an Assessment or Options Report.	Supports incorporation of actions related to the approved Assessment Report into system-wide planning and operations.
System Planning and Operations Team (SPOT)	System-wide issues identified in Box 1 can trigger SPOT to initiate Box 3 activities to address them. Additionally, high levels of uncertainty can prompt requests by the PTs for technical assistance on system-wide issues generated at the project level.	No roles and responsibilities.	Coordinate dialogue and review of project uncertainties and system-wide issues and develop action plan during scoping. Coordinate information gathering and options development. Coordinates screening of options to improve Plan performance and Pro Regs requirements for Assessment Report.	Develops and coordinates recommendations for improvement to the Plan.
Project Teams (PTs)	Interact with RECOVER to confirm project goals and contributions to the Plan. Seek guidance from RECOVER on the development of robust project alternatives and regional evaluations. Elevate system-wide or regional issues to SPOT.	Coordinate project-level monitoring with the RECOVER MAP.	Participate in dialogue during scoping. Provide input to options development and options analysis phases.	Incorporate actions resulting from the approved Assessment Report into project-level planning, design, and operations.
Stakeholders and Public	Provide review of, and comments on, CERP planning documents.	Provide review of, and comments on, monitoring strategies. Review and comment on RECOVER MAP-related products (i.e., monitoring and assessment reports). Review and comment on the RECOVER Technical Report.	No roles and responsibilities during scoping. Provides comments and input during options development and options analysis.	Review and provide comments on the Assessment Report.

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Additional information can be found at the following website: www.evergladesplan.org.