Restoration Coordination and Verification Five-Year Plan

A Plan to Support the Changing Needs of the Comprehensive Everglades Restoration Plan

Fiscal Years 2017–2021

September 30, 2016

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EXECUTIVE SUMMARY

The Restoration Coordination and Verification program (RECOVER) has accomplished many tasks over the past five years. RECOVER provided support to many Comprehensive Everglades Restoration Plan (CERP) projects, assisting them with adaptive management plans, performance measurements, and evaluation of alternative plans; developed and posted three System Status Reports (SSRs); developed a technical report on climate change impacts; participated in the development of a progress report to the United States Congress; documented knowledge gained; conducted a Monitoring and Assessment Plan (MAP) optimization and prioritization effort; began conducting annual science meetings with principal investigators and agency leads; developed and updated three CERP guidance memoranda; developed new and updated existing performance measures; collaborated on modelling efforts; developed an adaptive management integration guide and program-level plan; participated in several national and international conferences on ecosystem restoration; and reviewed reports being developed by other entities.

RECOVER strongly recommends that a comprehensive review of the science program is needed at this point in time to prepare for the next interval of science reporting, the 2019 SSR, and the 2020 Report to Congress. This document represents the plan to conduct this comprehensive review. It describes the scientific work that will be accomplished in the coming five years to continue delivering the answers and tools needed for the next steps of CERP implementation.

Given the pace of CERP implementation in recent years, new knowledge gained on ecological drivers and stressors in the Everglades and estuaries, and the past ten plus years of monitoring and development of restoration planning tools, RECOVER has determined the most crucial tasks that must be accomplished to assist CERP implementation between Fiscal Years 2017 and 2021. These tasks include (1) RECOVER involvement in project implementation during design, construction, and operation; reporting CERP's progress in achieving (2) interim goals and (3) interim targets; (4) evaluation and integration of Everglades science; (5) targeted adaptive management to inform CERP progress; and (6) communication of CERP science to maximize its usefulness to decision makers and CERP audiences.

In implementing this plan, RECOVER will consider findings from the 2014 SSR, the 2015 RECOVER Science Meeting, the *CERP Program Level Adaptive Management Plan*, the time horizons of MAP components, CERP and South Florida Ecosystem Restoration project construction contract schedules, and interim goals requirements. This effort will consider assessment of emerging models, sampling techniques, and equipment; new scientific findings; evaluations of hypothesis clusters; and resources needed for performance measure revisions. This is a work plan based on a strategy for determining the CERP science needs. The schedule of needs will be updated every 2 to 3 years and reflect CERP implementation. The plan provides budget estimates.

The products that are expected from this five-year effort are as follows:

- 2019 SSR
- 2020 Report to Congress
- Schedule of RECOVER and project interactions
- CERP guidance memorandum on RECOVER-project interactions
- Revised interim goals and interim targets
- Updated water budget
- Updated conceptual ecological models and hypotheses clusters
- Vulnerability analysis
- Updated performance measures
- Potential MAP update
- Prioritized uncertainties list
- Scopes of work for passive and active adaptive management strategies

The ability of RECOVER to accomplish its mission relies heavily on communication between RECOVER scientists and several parties including water managers and decision makers, restoration teams, networks of scientists, and diverse audiences and stakeholders of CERP. Without clear communication, the ability of our audiences to use our work diminishes, which undermines the utility of the work. Therefore, RECOVER proposes the following plan to identify strengths, weaknesses, and opportunities to incorporate more 'best communication practices' into our ongoing technical and scientific work. RECOVER will hone the practices over time based on feedback to continually improve effectiveness.

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ACRONYMS AND ABBREVIATIONS

AdH	Adaptive Hydraulics Model
AM	adaptive management
AWRA	American Water Resources Association
BACI	before-after-control-impact study design
BBCW	Biscayne Bay Coastal Wetlands
BCWPA	Broward County Water Preserve Area
CEM	conceptual ecological model
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
cfs	cubic feet per second
CGM	CERP Guidance Memorandum
CISRERP	Committee on Independent Scientific Review of Everglades Restoration Progress
DECOMP	Water Conservation Area 3 Decompartmentalization and Sheet Flow Enhancement Project
FY	Fiscal Year
GEER	Greater Everglades Ecosystem Restoration
IBBEAM	Integrated Biscayne Bay Ecological Assessment and Monitoring Project
IDS	Integrated Delivery Schedule
INTECOL	The International Association for Ecology
LRR	limited reevaluation report
MAP	Monitoring and Assessment Plan
NCER	National Conference on Ecosystem Restoration

NSM	Natural Systems Model
NSRSM	Natural Systems Regional Simulation Model
O&M	operations and maintenance phase
OMRR&R	operations, maintenance, repair, replacement, and rehabilitation phase
PDT	project delivery team
PED	preconstruction, engineering, and design phase
POC	point of contact
PPA	project partnership agreement
QASR	*Quality Assurance Systems Requirements Manual for the Comprehensive Everglades Restoration Plan*
RECOVER	Restoration Coordination and Verification program
Report to Congress	*Comprehensive Everglades Restoration Plan Central & Southern Project Report to Congress*
RSM	Regional Simulation Model
SAV	submerged aquatic vegetation
SEACOM	Florida Bay Seagrass Community Model
SFER	South Florida Environmental Report
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SSR	System Status Report
the Plan	Comprehensive Everglades Restoration Plan
USACE	United States Army Corps of Engineers
VE	value engineering
WCA	Water Conservation Area

RECOVER – THE SCIENCE BEHIND THE CERP

The Restoration Coordination and Verification program (RECOVER) provides essential support to the Comprehensive Everglades Restoration Plan (CERP or the Plan) implementation effort in meeting its goals and purposes by applying a scientific systemwide and integrative perspective to the planning and implementation of the Plan. RECOVER conducts scientific and technical evaluations and assessments for improving CERP's ability to restore, preserve, and protect the South Florida ecosystem while providing for the region's other water-related needs. RECOVER communicates and coordinates the results of these evaluations and assessments.

In accomplishing its mission, RECOVER adheres to the following principles:

- Restoration: The goal of restoration is the recovery and sustainability of the defining characteristics of the greater Everglades ecosystem.
- Science-based approach: Incorporates objective and fact-driven investigations, constructive debate, and peer review.
- Transparency and access: Offers transparency and universal access to tools and data.
- Consensus building: Uses fair processes and strives to reach consensus on conclusions and proposals.
- Inclusiveness: Uses multi-governmental and interdisciplinary collaboration to foster inclusiveness.
- Accountability: Meets schedules, maintains professional responsibilities, and efficiently provides quality products for CERP processes and teams.
- Adaptive management (AM): Seeks continuous improvement in the plan and its operations by using and building upon existing science and technology.

ACCOMPLISHMENTS

Table 1 lists RECOVER's accomplishments from Fiscal Year 2011 (FY2011) (October 1, 2010–September 30, 2011) through FY2016.

Table 1. RECOVER's accomplishments FY2011–FY2016.

	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Assessment Reports and Activities	Completed posting of web enabled *2009 System Status Report* (SSR; RECOVER 2010) Completed the *Scientific and Technical Knowledge Gained in Everglades Restoration (1999–2009)* document (RECOVER 2011a)	Initiated 2012 SSR	Completed the 2012 SSR Interim Update (RECOVER 2012a) Initiated 2014 SSR	Completed 2014 SSR (RECOVER 2014)	Completed 2015 Report to Congress (USACE and USDOI 2016)	Organized RECOVER Annual Science Meeting
Monitoring and Assessment (MAP) Plan Reviews	Initiated MAP optimization and prioritization effort	Completed MAP optimization and prioritization effort	Considered existing priorities for monitoring coverage		Organized RECOVER Annual Science Meeting (principal investigators and agency leads)	Five-year plan effort developed methodology for MAP review/update
Support to Projects	Provided scientific support to the Central Everglades Planning Project (CEPP) Conducted a regional evaluation for North Palm Beach Part I	Completed revision of CERP Guidance Memorandum (CGM) 40 (SFWMD and USACE 2012)	Conducted CEPP AM and Monitoring Plan (USACE and SFWMD 2014, Annex D) review United States Army Corps of Engineers (USACE) Ecosystem Restoration Planning Center of Expertise approved 8 RECOVER performance measures Conducted systemwide evaluation of CEPP Alternatives 1–4		Reviewed goals, objectives, and performance measures for use by Loxahatchee River Watershed Restoration Project	Reviewed monitoring plans and crosswalks in support of Biscayne Bay Coastal Wetlands (BBCW), C-111 Spreader Canal, Broward County Water Preserve Areas (BCWPA), and Picayune Strand Restoration

Table 1. Continued.

	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Performance Measures	Developed draft prey fish performance measure Developed draft slough performance measure	Finalized salinity performance measure for Florida Bay (RECOVER 2012b)			Revised prey fish performance measure Finalized the performance measure documentation sheet template	Began revising the Northern Estuaries salinity performance measure
Modeling Efforts					Collaborated with the Interagency Modeling Center on the test of Natural System Regional Simulation Model (NSRSM) for use in planning. Compared NSRSM to the Natural Systems Model (NSM) Developed the Biscayne Bay Salinity Adaptive Hydraulics (AdH) Model	National Park Service developed Biscayne Bay Simulation Model for Biscayne Bay salinity
Adaptive Management	Completed *The CERP Adaptive Management Integration Guide* (RECOVER 2011b) Aided in development of Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement (DECOMP), BCWPA, and BBCW AM plans (USACE and SFWMD 2010, 2012a, 2012b, respectively) Completed CGM 56 (SFWMD and USACE 2011)	Developed draft *CERP Program-Level Adaptive Management Plan*	Initialized AM integration effort for USACE design, construction, and operations	Developed Regional Management Option Matrices Prioritized uncertainties	Finalized *CERP Program-Level Adaptive Management Plan* (RECOVER 2015) Developed an SOP for the assessment of hydrology for AM Assisted with the development of the Loxahatchee River Watershed and Picayune Strand restoration projects AM plans	

Table 1. Continued.

	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Climate Change	Conducted modeling and evaluation of potential south Florida climate change scenarios (with sea level rise, increased temperatures, and hydrologic pattern variations)	Developed a technical report and geographic information system (GIS) mapping for impact of sea level rise and salt intrusion on Everglades peat		Assisted the USACE National Team in developing *Procedures to Evaluate Sea Level Change: Impacts, Responses and Adaptation* (particularly ecosystem restoration section) (USACE 2014)	Provided support to the development of the *Unified Sea Level Rise Projection, Southeast Florida* document (supports regional coordination of adaptation planning) (Southeast Florida Regional Climate Change Compact 2015)	Conducted scoping for RECOVER climate change risk and uncertainty effort Conducted evaluation of potential sea level rise Impacts on Cape Sable seaside sparrow Habitat in Everglades National Park (supports Everglades Restoration Transition Plan impacts evaluation)
Committee on Independent Scientific Review of Everglades Restoration Progress (CISRERP) Biennial Report Coordination		Reviewed 2012 SSR and MAP prioritization		Reviewed RECOVER long-term science needs, CEPP, climate change, and invasive species		Reviewed the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015)
Scientific Reviews	Reviewed extreme water levels in Everglades wetlands					Reviewed the Science Coordination Group *System-wide Ecological Indicator For Everglades Restoration 2016 Report*
Conferences		Participated in the International Association for Ecology (INTECOL) special session		Participated in the National Conference on Ecosystem Restoration (NCER)	Participated in the Greater Everglades Ecosystem Restoration (GEER)	Participated in NCER and the American Water Resources Association (AWRA) Annual Conference

CALL TO ACTION

Introduction

Given the past ten years of monitoring data, the pace of CERP implementation, new knowledge gained on major drivers and stressors such as climate change and exotics, and the completion of the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015), the RECOVER Leadership Group requested that a comprehensive review of the RECOVER science program be developed. Everglades program managers and the Committee on Independent Science Review of Everglades Restoration Progress (CISRERP) also encouraged RECOVER to develop a long-term monitoring strategy.

Background

The RECOVER Adaptive Assessment and Monitoring Program was authorized in the *Water Resources Development Act of 2000* (U.S. Congress 2000). The *Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Final Rule* (DOD 2003) instructs that RECOVER (1) develop an adaptive assessment program to assess responses of the system to implementation of the Plan, (2) design a monitoring program to measure status and trends towards achieving the goals and purposes of the Plan throughout the South Florida ecosystem, and (3) conduct monitoring activities and use the information collected and analyzed through the monitoring program as a basis for conducting assessment tasks. Assessment of the monitoring data should include, but not be limited to, the following: (1) determine if measured responses are desirable and are achieving the interim goals and the interim targets of the expected performance level of the Plan, (2) evaluate if corrective actions to improve performance or improve cost effectiveness should be considered, and (3) prepare reports on the monitoring program (§ 385.31). Preliminary investigations began in the early 2000s, and the majority of the current monitoring programs began around 2005. Some monitoring components were built on existing efforts and, therefore, have an even longer and more valuable data set.

Objective

The RECOVER program will develop a five-year plan that will consider findings from the *2014 System Status Report* (SSR; RECOVER 2014), the 2015 RECOVER Science Meeting, the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015), the time horizons of the Monitoring and Assessment Plan (MAP; RECOVER 2009) components, CERP and South Florida Ecosystem Restoration project construction contract schedules, and interim goals requirements (RECOVER 2005). This ongoing effort will consider current RECOVER efforts to assess emerging models, sampling techniques, and equipment; new scientific findings; evaluations of hypothesis clusters; and resources needed for performance measure revisions. The five-year plan will form a work plan based on a strategy for determining the CERP science needs. The schedule of needs from all of these sources will be updated every 2 to 3 years and reflect CERP implementation. The five-year plan will provide budget estimates.

Monitoring and Assessment Plan

The CERP RECOVER MAP was designed from the outset to focus on monitoring efforts that would collectively track key ecological components, from the smallest forms, like algal blooms, to top predators, like wading birds, alligators, and crocodiles. It was designed to give large-scale (over time and geography) information on patterns in the total system. The MAP was coordinated so that it both supported CERP project-scale monitoring, and complemented or leveraged other ongoing regional monitoring.

In response to budget changes in 2012, RECOVER selected the major monitoring components that were the most critical at the time and made reductions to level of effort, and either spatial or temporal monitoring and reporting changes.

Referring to the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Environmental Impact Statement* (USACE and SFWMD 1999) guiding principles, which stated, "The Comprehensive plan must be a flexible plan that is based on the concept of adaptive assessment—recognizing that modifications will be made in the future based on new information…", the five-year plan will consider changes to MAP goals and any new information not already a part of systemwide and regional hypotheses to inform the most appropriate monitoring for FY2017–FY2021.

Program-Level Adaptive Management Plan

The *CERP Program-Level Adaptive Management Plan* (RECOVER 2015) developed criteria for evaluating the level of uncertainties or questions about the ecosystem's response to restoration (i.e., flow rates in the Decomp Physical Model). These criteria produced risk rankings that were then used to determine the AM that are needed. These needs are described in the management option matrices. The *CERP Program-Level Adaptive Management Plan* incorporates the interim goals in the management options matrices as benchmarks for the comparison with field information during the implementation and operation of CERP projects in order to assess whether ecosystem performance is moving towards CERP restoration goals. The RECOVER five-year plan will consider the list of uncertainties most important to the management option matrices and the schedule for CERP implementation to inform the RECOVER science needs.

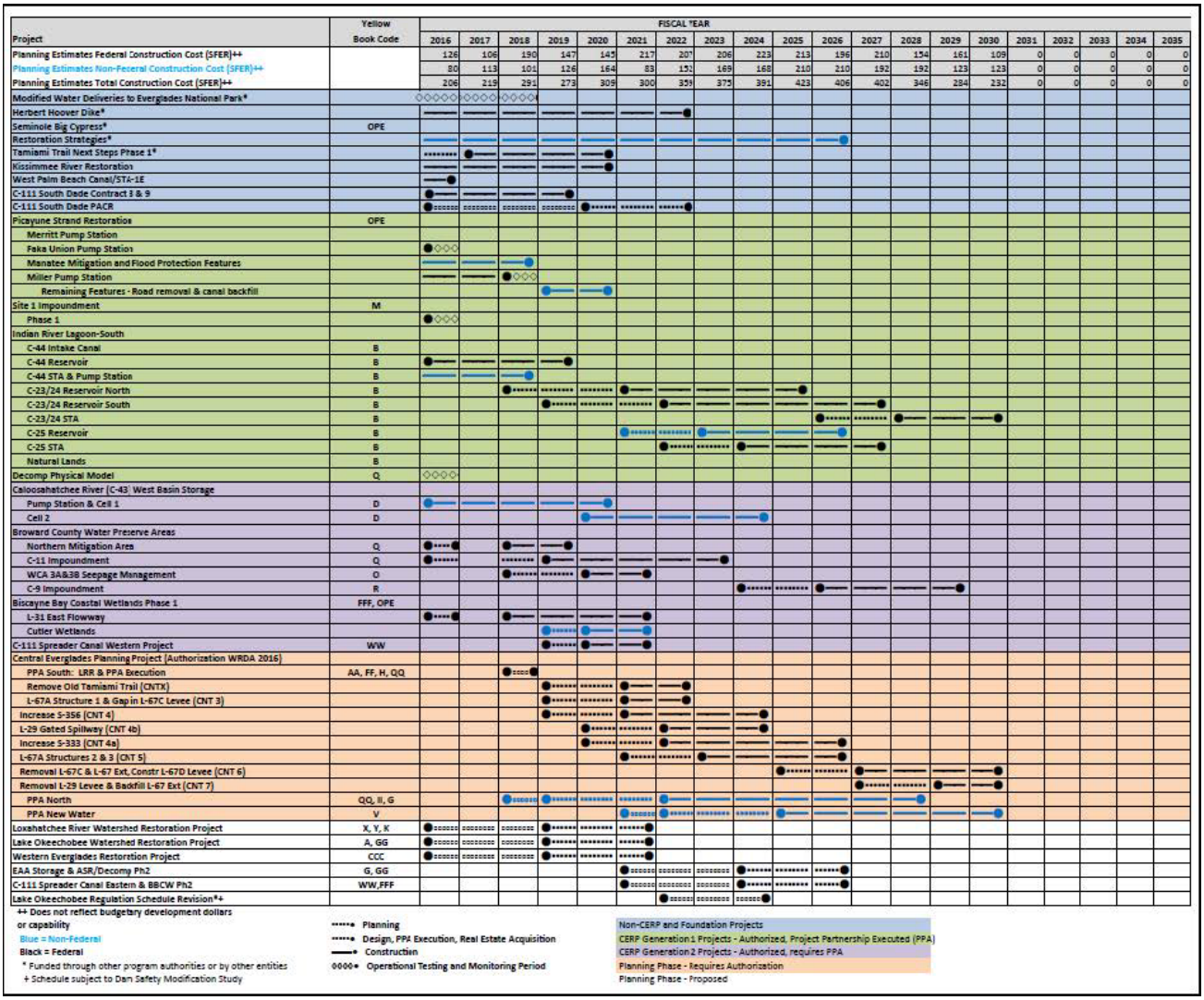
Conclusion

RECOVER strongly recommends that a comprehensive look at the science program is needed at this point in time to prepare for the next interval of science reporting, the 2019 SSR, and the *2020 Comprehensive Everglades Restoration Plan Central & Southern Project Report to Congress* (2020 Report to Congress). This effort also responds to the 2014 comments from CISRERP who stated, "A comprehensive reevaluation of the restoration-related monitoring is needed to determine its adequacy (considering budget pressures, the extended CERP implementation time frames, and the potential impacts of climate change and sea-level rise)" (NRC 2014). Over the next five years, RECOVER will review the science in a consistent and comprehensive way in light of current conditions and communicate the science needs to management. This five-year plan communicates the administration of RECOVER resources, lays forth the path to identify science

needs and risks, and prepares for future science needs in accordance with restoration implementation. The information in the five-year plan will be updated every 2 to 3 years to reflect CERP implementation through the RECOVER and Adaptive Assessment and Monitoring program management plan updates.

TOP PRIORITIES IN FISCAL YEARS 2017–2021

During the period of FY2017 through FY2021, RECOVER will continue with tasks that meet CERP Programmatic Regulations (DOD 2003) requirements and CERP needs, support project implementation beyond the planning phase, report CERP's progress toward achieving interim goals and interim targets, integrate science efforts across the Everglades system, implement targeted AM to meet the Integrated Delivery Schedule (IDS) restoration needs, and communicate CERP science to maximize its usefulness to decision makers and CERP audiences (**Figure 1**).



Project	Yellow Book Code	FISCAL YEAR 2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Planning Estimates Federal Construction Cost (SFER)++		126	106	190	147	145	217	207	206	223	213	196	210	154	161	109	0	0	0	0	0
Planning Estimates Non-Federal Construction Cost (SFER)++		80	113	101	126	164	83	152	169	168	210	210	192	192	123	123	0	0	0	0	0
Planning Estimates Total Construction Cost (SFER)++		206	219	291	273	309	300	359	375	391	423	406	402	346	284	232	0	0	0	0	0
Modified Water Deliveries to Everglades National Park*		◇◇◇◇◇	◇◇◇◇◇	◇◇◇◇◇																	
Herbert Hoover Dike*																					
Seminole Big Cypress*	OPE																				
Restoration Strategies*																					
Tamiami Trail Next Steps Phase 1*																					
Kissimmee River Restoration																					
West Palm Beach Canal/STA-1E																					
C-111 South Dade Contract 3 & 9																					
C-111 South Dade PACR																					
Picayune Strand Restoration	OPE																				
Merritt Pump Station																					
Faka Union Pump Station																					
Manatee Mitigation and Flood Protection Features																					
Miller Pump Station																					
Remaining Features - Road removal & canal backfill																					
Site 1 Impoundment	M																				
Phase 1																					
Indian River Lagoon-South																					
C-44 Intake Canal	B																				
C-44 Reservoir	B																				
C-44 STA & Pump Station	B																				
C-23/24 Reservoir North	B																				
C-23/24 Reservoir South	B																				
C-23/24 STA	B																				
C-25 Reservoir	B																				
C-25 STA	B																				
Natural Lands	B																				
Decomp Physical Model	Q	◇◇◇◇																			
Caloosahatchee River (C-43) West Basin Storage																					
Pump Station & Cell 1	D																				
Cell 2	D																				
Broward County Water Preserve Areas																					
Northern Mitigation Area	Q																				
C-11 Impoundment	Q																				
WCA 3A&3B Seepage Management	O																				
C-9 Impoundment	R																				
Biscayne Bay Coastal Wetlands Phase 1	FFF, OPE																				
L-31 East Flowway																					
Cutler Wetlands																					
C-111 Spreader Canal Western Project	WW																				
Central Everglades Planning Project (Authorization WRDA 2016)																					
PPA South: LRR & PPA Execution	AA, FF, H, QQ																				
Remove Old Tamiami Trail (CNTX)																					
L-67A Structure 1 & Gap in L-67C Levee (CNT 3)																					
Increase S-356 (CNT 4)																					
L-29 Gated Spillway (CNT 4b)																					
Increase S-333 (CNT 4a)																					
L-67A Structures 2 & 3 (CNT 5)																					
Removal L-67C & L-67 Ext, Constr L-67D Levee (CNT 6)																					
Removal L-29 Levee & Backfill L-67 Ext (CNT 7)																					
PPA North	QQ, II, G																				
PPA New Water	V																				
Loxahatchee River Watershed Restoration Project	X, Y, K																				
Lake Okeechobee Watershed Restoration Project	A, GG																				
Western Everglades Restoration Project	CCC																				
EAA Storage & ASR/Decomp Ph2	G, GG																				
C-111 Spreader Canal Eastern & BBCW Ph2	WW,FFF																				
Lake Okeechobee Regulation Schedule Revision*+																					

++ Does not reflect budgetary development dollars or capability
Blue = Non-Federal
Black = Federal
* Funded through other program authorities or by other entities
\+ Schedule subject to Dam Safety Modification Study

****** Planning
****** Design, PPA Execution, Real Estate Acquisition
****** Construction
◇◇◇◇* Operational Testing and Monitoring Period

Non-CERP and Foundation Projects
CERP Generation 1 Projects - Authorized, Project Partnership Executed (PPA)
CERP Generation 2 Projects - Authorized, requires PPA
Planning Phase - Requires Authorization
Planning Phase - Proposed

Figure 1. Integrated Delivery Schedule (IDS) 2016 Update.

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PURPOSE AND AUDIENCES OF THIS PLAN

The purpose of this plan is to guide RECOVER's focus for the next five years as Everglades restoration progresses. This plan identifies how RECOVER will influence and benefit Everglades restoration and communicate with Everglades audiences. This plan was created with the mindset of operating RECOVER strategically. This plan provides steps for prioritizing, making recommendations, and identifying resources needed from FY2017 to FY2021. Specifically, the plan will strongly influence the prioritization of RECOVER's yearly work plans, RECOVER updates, and follows a prioritized task work plan each fiscal year.

This plan will be updated to stay current with changing needs. At a minimum, RECOVER will update this plan in 2021 to close tasks that are complete and to target resources toward upcoming CERP priorities for the following five-year period or longer as needed.

WHAT IS DIFFERENT WITH THIS PLAN IN PLACE?

This plan will bring adjustments and refinement to RECOVER's work to keep it current with the ongoing implementation of Everglades restoration including new science for evaluating climate change vulnerabilities. For example, as CERP projects progress, RECOVER will integrate system-level and project-level restoration performance measures, monitoring, and active AM. Although our mission remains focused on the systemwide view of Everglades restoration, we expect to increasingly be able to integrate and leverage project-level and system-level efforts to accomplish the RECOVER missions. As we integrate systems and project goals, we become more cost efficient and can deliver increasingly more certain information to guide restoration. RECOVER will continue to provide essential support to CERP with technical work to consistently improve restoration of the South Florida ecosystem and will continue to report CERP's progress toward established goals and targets to our diverse audiences.

INTENDED AUDIENCES

Although the focus of this plan is primarily to guide the work of the RECOVER teams, we would like to also communicate this plan in a clear concise manner to agency managers and decision makers, partners whose work 'dovetails' with RECOVER's work (e.g., Department of Interior Task Force subgroups and partnering agencies), and the CERP science community. This plan was written in a format to suit the needs of these audiences; more details of these tasks are included in the appendices to this document and detailed work plans will be developed as part of RECOVER's yearly work plan development every year. The primary audiences were identified as those who need to know RECOVER's plans in order to provide approval and/or coordinate with RECOVER.

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RECOVER'S ROLE IN CERP IMPLEMENTATION

PURPOSE

A process is being developed for the value added interaction between CERP project teams and RECOVER for the implementation phases (design, construction, operation and maintenance, and replacement/rehabilitation phases) of CERP projects. Specifying roles of RECOVER in these project phases will provide value to CERP by ensuring that new science is incorporated into project design, construction and operations, thus providing the AM feedback loop and helping the project teams implement AM strategies. The new science is the knowledge gained from the monitoring and evaluation that RECOVER principal investigators have gathered and analyzed over the past 15 years as well as all relevant science being produced by the larger South Florida scientific community.

WHY IS THIS WORK IMPORTANT FOR CERP DECISION MAKING?

The proposed tasks will help Everglades managers know where and how RECOVER will provide information to the design, construction, and operation phases of CERP projects. This phase of CERP projects needs RECOVER interaction to inform the success of restoration projects. The process clearly defines the value added for each interaction. RECOVER will formalize the process in a CERP Guidance Memorandum (CGM). This CGM will establish the process and procedures, and provide guidance to the staff of the United States Army Corps of Engineers (USACE), South Florida Water Management District (SFWMD), and other members of project teams.

WHY IS THIS WORK IMPORTANT TO THE EVERGLADES OVERALL?

Establishing a process for incorporating new science and information into the design and operations of CERP projects is vital for Everglades restoration because new science and monitoring data is continuously evolving, and there are often substantial time gaps from when the projects were in the planning phase to when design begins. A process is needed where RECOVER can interact with project teams and provide new science and systemwide monitoring data to the teams as they move forward with actual design and construction. RECOVER will review and provide input to project-level monitoring plans, AM plans, and operation plans; obtain project-level data to include in the RECOVER SSRs; and also help the project teams update and identify AM opportunities in the design and operation of their project.

SUMMARY OF TASKS

Following is a summary of the tasks for RECOVER's Role in CERP Project Implementation:

- **Task 1:** Determine the RECOVER point of contact (POC) for each project. The POC will be responsible for coordinating with the project team and pulling RECOVER members together for required project interactions.

- **Task 2:** RECOVER coordinates with the project team to determine project-specific interactions based on the current project schedule.
- **Task 3:** Use the project-specific RECOVER interaction points to determine the RECOVER schedule for the next five years and to populate yearly work plans.
- **Task 4:** Develop a CGM draft of the RECOVER interaction in post-planning phases of projects.
- **Task 5:** Implement and track the RECOVER interactions with projects.
- Task 6: Develop reports to projects for incorporation into project implementation reports.

PROPOSED WORK FLOW AND TIMING OF TASKS

Table 2 provides the proposed work flow and timing of tasks for RECOVER's Role in CERP Project Implementation. Additional information can be found in Appendix A.

Table 2. Proposed work flow and timing of tasks for RECOVER's Role in CERP Project Implementation.

RECOVER's Role in CERP Project Implementation Tasks	FY2017	FY2018	FY2019	FY2020	FY2021
Task 1: Determine the RECOVER POC for each project.					
Task 2: Coordinate with project team to determine project-specific interactions.					
Task 3: Schedule RECOVER Interactions for the next five years.					
Task 4: Develop draft CGM.					
Task 5: Implement and track RECOVER interactions with projects.					
Task 6: Develop reports to projects for incorporation into project implementation reports.					

RECOMMENDATIONS FOR REFINEMENT OF CERP INTERIM GOALS

PURPOSE

This section provides guidance for RECOVER's work in the next 5 years to meet the terms in the CERP Programmatic Regulations (DOD 2003) regarding (1) developing and/or revising interim goals and (2) reporting on them in periodic reports to the United States Congress (§385.38 and §385.40). This guidance presents a two-phase process; phase one represents first steps in revising the existing interim goals before seeking policy guidance to continue into phase two, which will be to do the work necessary to amend the Interagency Interim Goals Agreement (U.S. Army et al. 2007).

WHY IS THIS WORK IMPORTANT FOR CERP DECISION MAKING?

Interim goals provide a means to evaluate the restoration success of CERP by tracking restoration performance and progress, providing a basis for reporting that progress at specified intervals of time, and for periodically evaluating the accuracy of predictions of system responses to the effects of CERP.

WHY IS THIS WORK IMPORTANT TO THE EVERGLADES OVERALL?

Interim goals measurement provide assurance for the protection of natural system and reflect on the incremental accomplishment of the expected performance level of the Plan. These significant measures help to communicate major findings to the United States Congress and the public.

SUMMARY OF TASKS

Phase 1

The steps for documenting our work will take place in three phases, in order to document each step toward a potential revision of the Interagency Interim Goals Agreement.

- **Task 1:** Review interim goal indicators by region for continued scientific and social importance to the CERP program. The following questions will be addressed:
    - Are there revised hydrologic and ecologic models for the indicator? Is there a new CERP project schedule?
    - Is there new scientific information for the indicator?
    - Has there been information developed from the AM program for the indicator?
    - Is field monitoring on-going for the indicator and do the methods of field monitoring line up with what is being predicted for the indicator?

- **Task 2:** Confirm and revise the list of indicators as needed. This task will incorporate feedback from the Science Review and Integration task to update conceptual ecological models (CEMs) and hypotheses clusters and the task to review of performance measures. RECOVER will coordinate the list of indicator revisions with the South Florida Ecosystem Restoration Task Force ecological indicators report, with emphasis on the 2018 report.

- **Task 3:** Review indicator documentation for individual indicators (RECOVER 2005) for scientific accuracy, including restoration goals. Revise and add as needed with new information. If needed, suggest changes to the MAP to bring into alignment the interim goal's metric and MAP metrics.

- **Task 4:** Recommend revisions to the MAP as needed to bring the interim goal target metrics in line with MAP monitoring.

- **Task 5:** Incorporate current information on tasks into the 2019 SSR.

Phase 2[1]

- **Task 6:** Vet a revised list of indicators to agencies, stakeholders, and the public.

- **Task 7:** Request incremental hydrologic modeling from the Interagency Modeling Center in 10-year increments using the IDS.

- **Task 8:** Run ecological models based on hydrologic modeling.

- **Task 9:** Make new predictions for incremental progress.

- **Task 10:** Report on findings in the 2020 Report to Congress.

- **Task 11:** Revise *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* report (RECOVER 2005).

PROPOSED WORK FLOW AND TIMING OF TASKS

Table 3 provides the proposed work flow and timing of tasks for RECOVER's Recommendations for Refinement of CERP Interim Goals. Additional information on can be found in Appendix B.

[1] Completion of Phase 2 will require a commitment of resources from the Interagency Modeling Center.

Table 3. Proposed work flow and timing of tasks for Recommendations of Refinement of CERP Interim Goals.

Recommendations for Refinement of CERP Interim Goals Tasks	FY2017	FY2018	FY2019	FY2020	FY2021
Phase 1					
Task 1 – Review interim goal indicators by region for continued scientific and social importance to the CERP program.					
Task 2 – Confirm and revise the list of indicators to reflect science and project priorities.					
Task 3 – Review indicator documentation for individual indicators for scientific accuracy, including restoration "targets." Cross-check with the MAP to determine that the monitoring metrics correspond with the interim goal measurements.					
Task 4 –Make adjustments to MAP implementation as needed based on Tasks 1 through 3 in order to report on progress on interim goals for the 2020 Report to Congress.					
Task 5 – Incorporate current information on tasks into the 2019 SSR.					
Phase 2					
Task 6 – Develop the scope for modeling.					
Task 7 – Request incremental hydrologic modeling.					
Task 8 – Run ecological models based on hydrologic modeling.					
Task 9 – Make new predictions for incremental progress.					
Task 10 – Report on findings in the 2020 Report to Congress.					
Task 11 – Revise *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* (RECOVER 2005).					

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RECOMMENDATION FOR REFINEMENT OF CERP INTERIM TARGETS

PURPOSE

An assessment of water supply and flood protection interim targets is needed in the form of a technical report that will inform the 2020 Report to Congress and explain progress to date, any updates of tools, and progress anticipated by 2025. RECOVER will base projections about interim targets on the project schedules in the 2016 Draft IDS. Also, RECOVER will correlate the relationship between water supply and management to inform progress towards interim goals.

WHY IS THIS WORK IMPORTANT FOR CERP DECISION MAKING?

Interim targets are used to measure and anticipate incremental improvements in water supply (agriculture and municipal/industry) and other socio-economic indicators over the course of CERP implementation. Measurement of progress and anticipated CERP progress as reflected by interim target evaluations assists managers in project implementation sequencing and in adaptively managing the system to achieve the optimum quantity, quality, timing, and distribution.

WHY IS THIS WORK IMPORTANT TO THE EVERGLADES OVERALL?

Interim targets provide a means for evaluating progress toward meeting other water-related needs of the region provided by the Plan throughout the overall planning and implementation.

SUMMARY OF TASKS

Here are the tasks needed to develop the technical report on interim targets:

- **Task 1:** Develop a timeline that reflects the schedule for evaluation of progress toward interim targets based on implementation of projects. RECOVER will review historic information and assemble updated water supply information and projections.

- **Task 2:** Develop a scope for model work to evaluate interim targets progress. An updated picture of where the built system water supply is today in relationship to the CERP assumptions is needed in order to gauge which projects will see progress towards interim targets. The ability of project implementation and IDS planning to contribute to CERP benefits as projected by the interim targets will be evaluated. This new knowledge will be used to recommend changes to project implementation for increased progress towards interim targets for both water supply and flood protections benefits.

- **Task 3:** Identify the appropriate models needed to update the interim targets such as using the Regional Simulation Model (RSM) in place of the South Florida Water Management Model (SFWMM) or an effort similar to the Band 1 analysis. This task will require resources for model runs and analysis. As a result, the first step in this

task is to develop a scope for the model work needed. This task will determine whether interim targets need to be updated using RSM and the output compared to the D13R Alternative from SFWMM (USACE and SFWMD 1999). Also, the baseline needs to be determined if the baseline; will it be pre-CERP or the Interim Structural and Operational Plan (ISOP) 2000 (USACE 2000). The hydrologic modeling performed for interim goals and interim targets are the same.

- **Task 4:** Identify information that will be reported in the 2019 SSR.
- **Task 5:** Perform analysis and/or model runs described in Tasks 1, 2, and 3, for the 2020 Report to Congress reporting on progress and projected progress on interim targets. This task requires resources for the Interagency Modeling Center to perform needed modeling.
- **Task 6:** Update the water budget to represent current conditions and provide water budget projections for the IDS project implementation schedule. This will require coordination with the effort to recommend refinement of interim goals.
- **Task 7:** Evaluate whether the targets are accurately represented by the models to provide the correct responses to changes in the system and address model performance as needed.
- **Task 8:** Incorporate current information on tasks into the 2019 SSR.
- **Task 9:** Update status on interim targets for the 2020 Report to Congress.
- **Task 10:** Identify scope for next five-year interval for the 2025 Report to Congress.
- **Task 11:** Revise *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* report (RECOVER 2005).

PROPOSED WORK FLOW AND TIMING OF TASKS

Table 4 provides the proposed work flow and timing of tasks for Recommendations for Refinement of CERP Interim Targets. Additional information can be found in Appendix C.

Table 4. Proposed work flow and timing of tasks for Recommendation for Refinement of CERP Interim Targets.

Recommendation for Refinement of CERP Interim Targets Tasks	FY2017	FY2018	FY2019	FY2020	FY2021
Task 1 – Match the interim targets to projects instead of timeframes.					
Task 2 – Develop a timeline for measurement of interim targets progress.					
Task 3 – Identify the appropriate models needed to update the interim targets.					
Task 4 – Identify information that will be reported in the 2019 SSR.					
Task 5: Perform analysis and/or model runs described in Tasks 1, 2, and 3.					
Task 6 – Update the water budget to represent current conditions and provide water budget projections for the IDS project implementation schedule.					
Task 7 – Evaluate whether the targets are accurately represented by the models.					
Task 8 – Incorporate current information on tasks into the 2019 SSR.					
Task 9 – Update status on interim targets for the 2020 Report to Congress.					
Task 10 – Identify scope for next five-year interval for the 2025 Report to Congress.					
Task 11 – Revise *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* (RECOVER 2005).					

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SCIENCE REVIEW AND INTEGRATION

PURPOSE

The goal of the Science Review and Integration effort is to assess the scientific assumptions of RECOVER's assessment framework, considering new scientific understanding gained over the past decade and how this may alter recommended restoration actions. Meeting this goal will enable RECOVER to address the most critical questions and needs of current and future restoration projects and their AM.

WHY IS THIS WORK IMPORTANT FOR CERP DECISION MAKING?

Over the past decade, understanding of the Everglades' ecological vulnerabilities and restoration needs has advanced. Concurrently, RECOVER has increased awareness of accelerating threats, especially those driven by climate change, sea level rise, and invasive exotic species. CERP is now engaged in a period of rapid restoration progress and it is important for RECOVER to integrate and incorporate new knowledge into restoration assessment and planning in order to effectively guide CERP implementation.

WHY IS THIS WORK IMPORTANT TO THE EVERGLADES OVERALL?

This effort is needed in order to successfully restore and sustain the connected and interdependent components of the greater Everglades ecosystem. CERP projects must function for the greater benefit of the ecosystem and integrative analysis is essential for RECOVER to serve CERP successfully. The need for RECOVER to conduct integrated scientific analysis is explicit in RECOVER's mission statement: RECOVER provides essential support to the CERP in meeting its goals and purposes by applying a systemwide and integrative perspective to the planning and implementation of the Plan. Integrative analysis entails not only the analysis of key parts or specific areas of the system, but also how the interaction and interdependencies of these parts and areas affects the system's response to multiple ecological stressors and restoration actions that operate on a wide range of scales. Our integrated understanding is essential for accurate evaluation of benefits and trade-offs at local and systemwide scales. This will include broad efforts to identify and evaluate potential climate change-related vulnerabilities due to sea level rise, rising temperatures, changing hydrologic patterns, and more frequent extreme weather events (droughts, intense rainfall, etc.)

SUMMARY OF TASKS

RECOVER has identified four major tasks to be accomplished over the next five years to advance delivery of integrated scientific analysis of the Everglades, thereby improving and, consequently, enhancing our ability to successfully restore and sustain the Everglades:

- **Task 1:** Review and update, as needed, CEMs and hypotheses clusters. Revisiting the assumptions and the information base of the CEMs and hypotheses clusters will help guide the other tasks listed here, as well as the interim goals and AM efforts.

- **Task 2:** Analysis of Everglades' vulnerability. Identifying and diagnosing the most vulnerable locations, species, and ecological components and functions in the system will clarify appropriate locations and scales of action for resolving crucial vulnerabilities. This will be document in a vulnerability assessment report.

- **Task 3:** Evaluate performance measures, providing recommendations for updates, removal, and new development. Reviewing the current set of performance measures and targeting key subjects for development will enhance our ability to identify options that managers can use to continue to improve and sustain both natural and human systems. Incorporate information from Interim Goals Phase I Task 2 and Phase 2 Tasks 5, 6, 7, and 8.

- **Task 4:** Evaluate the MAP, providing recommendations for a revision. Ensure that the MAP incorporates new knowledge and focuses on identifying thresholds of vulnerabilities and the most promising restoration solutions, to accurately and effectively inform CERP's AM process. Promoting a more insightful and focused MAP enhances the AM program and will provide managers with the capacity to act more quickly even in the face of risk with the knowledge that they have the best information and scientific support on their side.

- **Task 5:** Develop a 2021 MAP update. Determine the scope of the update.

PROPOSED WORK FLOW AND TIMING OF TASKS

Table 5 provides the proposed work flow and timing of tasks for Science Review and Integration. Additional information can be found in Appendix D.

Table 5. Proposed work flow and timing of tasks for Science Review and Integration.

Science Review and Integration Tasks	FY2017	FY2018	FY2019	FY2020	FY2021
Task 1 – Update CEMs and hypotheses clusters.					
Task 2: Conduct vulnerability analysis and develop report.					
Task 3: Update performance measures.					
Task 4: Evaluate the 2009 MAP.					
Task 5: Develop 2021 MAP Update.					

OPPORTUNITIES FOR ADAPTIVE MANAGEMENT

PURPOSE

This section outlines the process that will be used to identify adaptive management (AM) opportunities to inform CERP project planning, design, and operations over the next 5 to 10 years and ensure improved likelihood of achieving restoration success. AM is a structured management approach to address uncertainties about restoration planning, design, and operations by testing hypotheses (e.g., operational tests, physical models, and targeted pre- and post-project monitoring), linking scientific results to decision making, and adjusting design and implementation, as necessary, to improve the probability of restoration success. AM helps answer key questions for restoration scientists, engineers, managers, and governmental and non-governmental stakeholders regarding the optimum approach for achieving restoration goals. It incorporates new monitoring data and other relevant information into decision making in order to improve CERP program and project design and execution.

WHY IS THIS WORK IMPORTANT FOR CERP DECISION MAKING?

This section describes how RECOVER will work with scientists, planners, engineers, hydrologists, water managers, and project and program managers to identify and implement priority AM strategies to inform CERP projects in the next 5 to 10 years based on the IDS.

For example, the Central Everglades Planning Project (CEPP) approved project implementation report (USACE and SFWMD 2014) includes an AM plan that identifies critical uncertainties to address as part of improving CEPP implementation. One AM strategy in the CEPP AM plan is the need to implement active vegetation management to jump start restoration succession associated with increased restoration flows in northern Water Conservation Area (WCA) 3A, WCA 3B, and Everglades National Park. It is expected that without active vegetation management, restoration of degraded landscapes could take many decades. This RECOVER plan, when executed, will evaluate this need in light of all the other AM needs, and recommend a path forward to implement priority AM efforts to support immediate CERP implementation needs.

CERP and non-CERP projects that will be examined including the following:

- Planning – Loxahatchee River Watershed Restoration Project, Big Cypress – L-28 Interceptor Modifications (referred to as Western Everglades), and Lake Okeechobee Watershed

- Design – Biscayne Bay Coastal Wetlands, Broward County Water Preserve Areas, CEPP, and Indian River Lagoon – South C-23, C-24, and C-25 Basins

- Construction and Operations – Combined Operations Plan and C-111 Spreader Canal Western Project, Caloosahatchee River (C-43) West Basin Storage Reservoir Project, C-44 Reservoir and Stormwater Treatment Area Project (Indian River Lagoon – South), Picayune Strand Restoration Project, and Biscayne Bay Coastal Wetlands

WHY IS THIS WORK IMPORTANT TO THE EVERGLADES OVERALL?

This effort should help inform the next set of integrated science priorities, which will in turn help inform CERP implementation based on the IDS. It will ultimately ensure AM science is relevant to and supports CERP planning, design, and operations.

SUMMARY OF TASKS

RECOVER has identified five tasks related to AM:

- Task 1: Update *CERP Guidance Memorandum 56: Guidance for Integration of Adaptive Management (AM) into Comprehensive Everglades Restoration Plan (CERP) Program and Project Management* (SFWMD and USACE 2011).

- **Task 2:** Update uncertainties related to achieving both program- and project-level CERP restoration goals and objectives. This task will be informed by RECOVER's CEM update effort (Science Review and Integration Task 1), expected to take place in FY2017. This task will result in an updated list of CERP uncertainties and potential AM strategies. This will help ensure the most up to date understanding of CERP implementation and achieving CERP restoration goals and objectives before prioritizing uncertainties in the next task.

- **Task 3:** Categorize and prioritize uncertainties associated with ecosystem vulnerability (risk), which will be informed by RECOVER's Everglades ecological vulnerability analysis (Science Review and Integration Task 2). Uncertainties to be addressed with AM will be prioritized using criteria that help ensure AM will be useful and information is most relevant to support CERP program and project management decision making.

- **Task 4:** Update *The CERP Adaptive Management Integration Guide* (RECOVER 2011b).

- **Task 5:** Develop passive and active AM strategy scopes of work. AM strategy scopes of work will be requested in the form of pre-proposals from key Everglades experts. These three- to five-page pre-proposal requests will identify general AM strategies to address prioritized decision-critical uncertainties, as well as identify likely monitoring parameters. This task will estimate costs and timing to ensure they are feasible and can be supported for implementation by RECOVER and agency management.

- **Task 6:** Schedule, design, and recommend AM strategies for implementation. AM strategies will be designed in the form of a science plan for one or two of the highest priority strategies. Appropriate technological, environmental, and management review will be sought, and AM strategies will be recommended based on scheduled need. The end result will be that the most critical AM strategies will be ready to implement at the right times to provide key information

to support CERP project planning, design, and operation decisions to improve restoration performance.

PROPOSED WORK FLOW AND TIMING OF TASKS

Table 6 provides the proposed work flow and timing of tasks for Opportunities for AM. Additional information can be found in Appendix E.

Table 6. Proposed work flow and timing of tasks for Opportunities for AM.

Opportunities for AM Tasks	FY2017	FY2018	FY2019	FY2020	FY2021
Task 1 – Revise CGM 56					
Task 2 – Update uncertainties related to achieving both program- and project-level CERP restoration goals and objectives.					
Task 3 – Categorize and prioritize uncertainties associated with ecosystem vulnerability (risk).					
Task 4 – Update *The CERP Adaptive Management Integration Guide* (RECOVER 2011b).					
Task 5 – Develop passive and active AM strategy scopes of work.					
Task 6 – Schedule, design, and recommend AM strategies for implementation.					

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COMMUNICATION

PURPOSE

The purpose of the five-year communication effort is to continue to improve and update the communications plan for RECOVER. Over the next five years, RECOVER will document existing strategies for communicating RECOVER science, evaluate communication methods, develop communication strategies, and implement them.

WHY IS THIS WORK IMPORTANT FOR CERP DECISION MAKING?

The ability of RECOVER to accomplish its mission relies on communication between RECOVER, decision makers, restoration teams, scientists, water managers, and other CERP stakeholders.

WHY IS THIS WORK IMPORTANT TO THE EVERGLADES OVERALL?

RECOVER is required to provide reporting every five years. This is accomplished through SSRs and Reports to Congress. There are many other types of information that also need to be communicated such as performance measures used in planning new projects, information about the risks to restoration success associated with uncertainties, and opportunities for AM. Managers and project delivery teams use this information to make decisions about CERP restoration planning and implementation, and stakeholders are better informed about the status of restoration.

SUMMARY OF TASKS

RECOVER has identified four tasks related to communication:

- **Task 1:** Document existing strategies for communicating RECOVER science.
- **Task 2:** Evaluate successful communication methods used by RECOVER, other ecosystem restoration programs, and other environmental or business communication tools. Identify the types of RECOVER work needing to be communicated, other types of audiences, and available methods for achieving the objective. RECOVER will seek expertise from communication experts
- **Task 3:** Develop a strategy for communicating various types of RECOVER work. Define metrics, timelines, and responsibilities for communication and incorporate them into the scope of each effort. Develop a communication plan that outlines these strategies. The communication plan will be published in the updated *RECOVER Program Management Plan* for use by all RECOVER members.
- **Task 4:** Implement the strategy for communicating RECOVER work and assess the communication elements using the metrics defined in the communication plan.

PROPOSED WORK FLOW AND TIMING OF TASKS

Table 7 provides the proposed work flow and timing of tasks for Communication. Additional information can be found in Appendix F.

Table 7. Proposed work flow and timing of tasks for Communication.

Communication Tasks	FY2017	FY2018	FY2019	FY2020	FY2021
Task 1 – Document existing communication strategies.					
Task 2 – Evaluate applicable communications methods.					
as part of the 2019 SSR					
Task 4 – Implementation and assessment.					

FIVE-YEAR SCHEDULE OF TASKS AND PRODUCTS

Table 8 lists the five-year schedule of products and **Figure 2** provides a flow chart and timeline of the tasks being undertaken to produce these products.

Table 8. Five-year schedule of products.

	FY2017	FY2018	FY2019	FY2020	FY2021
Support to Projects	CGM of RECOVER-project interactions	RECOVER reports to projects for incorporation into project implementation reports			
Interim Goals			2019 SSR	2020 Report to Congress	Updated recommendations
Interim Targets					
Science Review & Integration		CEM updates	Vulnerability assessment report	Updated and new performance measures	Updated MAP
AM	Revised AM CGM	Updated CERP AM Integration Guide			Active AM scopes or planning studies
Communication			Communication strategies		
Reports	RECOVER-project interactions CGM Revised AM CGM	Updated CERP AM Integration Guide	2019 SSR vulnerability assessment report	2020 Report to Congress New or updated performance measure documentation sheets	Interim goals and interim targets recommendations update MAP update

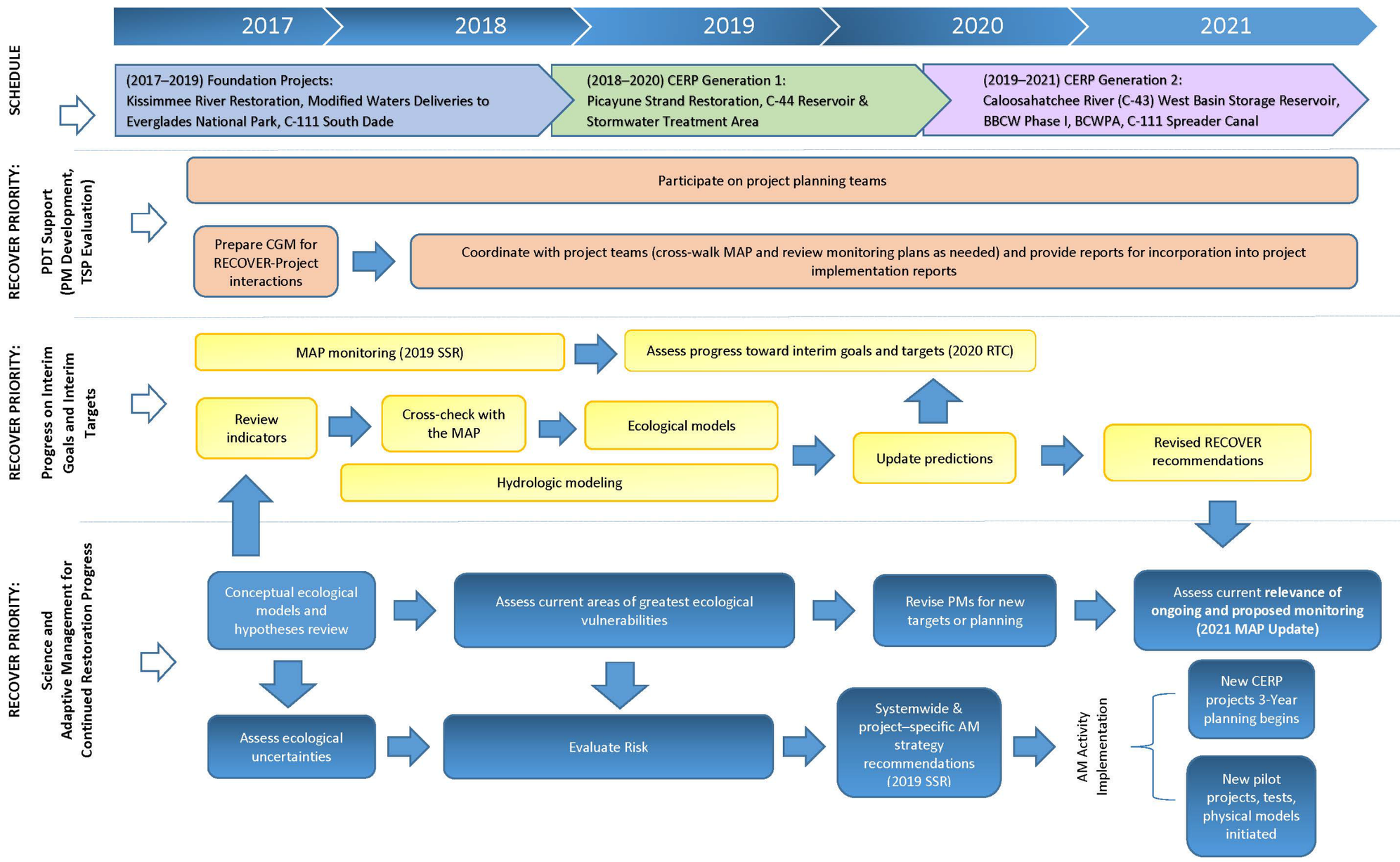

Figure 2. Summary of RECOVER's five-year plan FY2017–FY2021. (Note: AM – adaptive management, BBCW– Biscayne Bay Coastal Wetlands, BCWPA – Broward County Water Preserve Areas, CERP – Comprehensive Everglades Restoration Plan, CGM – CERP guidance memoranda, MAP – Monitoring and Assessment Plan, PDT – project delivery team, PM – performance measure, RECOVER – Restoration Coordination and Verification Program, RTC – Report to Congress, SSR – System Status Report, TSP – tentatively selected plan.)

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FIVE-YEAR BUDGET

The five-year budget is provided in **Table 9**. The budget represents projections for planning purposes. The budget is for labor unless otherwise specified as contracted resources.

Table 9. Five-year budget.

	Fiscal Year Year in Plan	2017 1	2018 2	2019 3	2020 4	2021 5
PDT Support	USACE	$50,000	$40,000	$25,000	$25,000	$25,000
	SFWMD	$50,000	$40,000	$25,000	$25,000	$25,000
	DOI	$25,000	$20,000	$20,000	$20,000	$20,000
Interim Goals	USACE	$25,000	$40,000	$25,000	$50,000	$40,000
	SFWMD	$25,000	$40,000	$25,000	$50,000	$40,000
	DOI	$25,000	$40,000	$25,000	$30,000	$25,000
IG/IT Modeling	IMC	$150,000	$150,000	$150,000	$175,000	
Interim Targets	USACE	$25,000	$50,000	$30,000	$50,000	$30,000
	SFWMD	$25,000	$50,000	$30,000	$50,000	$30,000
	DOI	$25,000	$25,000	$ 5,000	$10,000	$5,000
Science Review & Integration	USACE CNT	$275,000	$275,000	$275,000		$275,000
	USACE	$ 325,000	$325,000	$400,000	$ 325,000	$325,000
	SFWMD	$300,000	$300,000	$400,000	$275,000	$350,000
	DOI	$150,000	$150,000	$200,000	$150,000	$150,000
Adaptive Management	USACE CNT				$275,000	
	USACE	$150,000	$150,000	$100,000	$100,000	$80,000
	SFWMD	$150,000	$150,000	$100,000	$100,000	$80,000
	DOI	$70,000	$70,000	$50,000	$50,000	$50,000
Five-year Plan Summary **RECOVER FUNDS**	**USACE CNT**	**$275,000**	**$275,000**	**$275,000**	**$275,000**	**$275,000**
	USACE	**$575,000**	**$605,000**	**$580,000**	**$550,000**	**$500,000**
	IMC	**$150,000**	**$150,000**	**$150,000**	**$175,000**	
	SFWMD	**$550,000**	**$580,000**	**$580,000**	**$500,000**	**$525,000**
	DOI	**$295,000**	**$305,000**	**$300,000**	**$260,000**	**$250,000**
Monitoring and Assessment Plan **AA&M FUNDS**	USACE CNT	$3,550,000	$3,550,000	$3,550,000	$3,550,000	$3,550,000
	USACE	$500,000	$500,000	$500,000	$500,000	$500,000
	SFWMD CNT	$650,000	$650,000	$650,000	$650,000	$650,000
	SFWMD	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
	DOI					

(Note: DOI – Department of Interior, IG – interim goals, IMC – Interagency Modeling Center, IT – interim targets, PDT – project delivery team, CNT – Contract, AA&M – Adaptive Assessment and Monitoring Authorization, SFWMD – South Florida Water Management District, and USACE – United States Army Corps of Engineers.)

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GLOSSARY

Active Adaptive Management (AM): An AM approach in which multiple designs or operational criteria (e.g., field tests) are implemented to test competing hypotheses about specific uncertainties regarding hydrological, ecological, or water quality responses to management actions.

Adaptive Management (AM): In general, AM is a formal process for continually improving management policies and practices by learning from their outcomes (Taylor et al. 1997). In the context of Everglades restoration, Comprehensive Everglades Restoration Plan (CERP) AM is a structured management approach for addressing uncertainties by testing hypotheses, linking science to decision making, and adjusting implementation, as necessary, to improve the probability of restoration success.

Alternative D13R: The modeling alternative that was designated as the initial draft plan by the team that formulated the Comprehensive Review Study described in the *Central and Southern Florida Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* (USACE and SFWMD 1999; http://141.232.10.32/pub/restudy_eis.aspx).

Before-After-Control-Impact (BACI): A study in which the response on control and impacted sites are measured both before and after the impact. It is also referred to as a Bayesian approach.

Comprehensive Everglades Restoration Plan (CERP) Adaptive Management (AM) Strategy: Describes the scientific approach that uses performance measures, monitoring, triggers, and thresholds to inform restoration progress and support decisions regarding the need to adjust CERP program or projects to improve restoration performance *(RECOVER 2006;* http://141.232.10.32/pm/recover/recover_docs/am/rec_am_stategy_brochure.pdf*)*.

Comprehensive Everglades Restoration Plan (CERP) Guidance Memorandum (CGM): Document that captures and publishes program manager guidance to staff and project teams working within the Comprehensive Everglades Restoration Plan (CERP) program. CERP CGMs are available online at http://141.232.10.32/pm/program_docs/cerp-guidance-memo.aspx.

Conceptual Ecological Model (CEM): Non-quantitative planning tool that identifies the major anthropogenic drivers and stressors on natural systems, the ecological effects of these stressors, and the best biological attributes or indicators of these ecological responses. The CEMs developed for south Florida can be found at http://141.232.10.32/pm/recover/cems.aspx.

Hypothesis Cluster: A portion of a conceptual ecological model that reflects the major attributes and stressors of systems expected to be affected by Comprehensive Everglades Restoration Plan (CERP) implementation. These clusters contain testable hypotheses to work towards explaining uncertainties. Most hypothesis clusters were most recently published in the *2009 System Status Report* (RECOVER 2010; http://141.232.10.32/pm/ssr_2009/cerp_ssr_2009.aspx) and the *CERP*

Monitoring and Assessment Plan (RECOVER 2009; http://141.232.10.32/pm/recover/recover_map_2009.aspx.). Some have been updated in subsequent System Status Reports.

Integrated Delivery Schedule (IDS): A schedule of federal projects cost shared with the local sponsors or the Central and Southern Florida Project, which include the Comprehensive Everglades Restoration Plan (CERP), Kissimmee River Restoration, and the Everglades and South Florida Critical Projects. The IDS provides an overall strategy and sequence for planning, design, and construction based on ecosystem needs, benefits, costs, and available funding.

Interim Goals: A means by which the restoration success of the Comprehensive Everglades Restoration Plan (CERP) may be evaluated throughout the implementation process. CERP interim goals are described in the *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* (RECOVER 2005; http://141.232.10.32/pm/recover/recover_docs/igit/igit_mar_2005_report/ig_it_rpt_main_report.pdf.

Interim Structural and Operational Plan (ISOP): This plan enabled the United States Army Corps of Engineers to maintain water levels, particularly in the western Cape Sable seaside sparrow populations that would maximize breeding seasons for the sparrow.

Interim Targets: A means for evaluating the progress towards other water related needs of south Florida provided for in the Comprehensive Everglades Restoration Plan (CERP). CERP interim targets are described in the *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* (RECOVER 2005; http://141.232.10.32/pm/recover/recover_docs/igit/igit_mar_2005_report/ig_it_rpt_main_report.pdf.

Monitoring and Assessment Plan (MAP): A single, integrated, system-wide monitoring and assessment plan developed by the Restoration Coordination and Verification program (RECOVER) that is used and supported by all participating agencies and tribal governments as the means of tracking and measuring the performance of the Comprehensive Everglades Restoration Plan (CERP). The latest CERP MAP document was published in 2009 (RECOVER 2009; http://141.232.10.32/pm/recover/recover_map.aspx).

Passive Adaptive Management (AM): An AM approach in which a single design or operational plan is implemented and monitored to test hypotheses about the hydrological, ecological, or water quality responses to management actions in order to address uncertainty.

Performance Measures: Planning tools used to determine the degree to which proposed alternative plans are likely to meet restoration objectives, or implemented plans have met restoration objectives. Restoration Coordination and Verification performance measures are available online at http://141.232.10.32/pm/recover/eval_team_perf_measures.aspx.

Program-Level: Scale of adaptive management applied for the entire Comprehensive Everglades Restoration Plan (CERP) program including all project components and operations.

Programmatic Regulations for The Comprehensive Everglades Restoration Plan (CERP). The CERP Programmatic Regulations are part of the *Code of Federal Regulations* (33 CFR 385) that implements the provisions of section 601(h)(3) of the *Water Resources Development Act of 2000* (U.S. Congress 2000). Their purpose is to ensure that the goals and purposes of CERP are achieved and to establish the processes necessary for implementing the plan (DOD 2003; http://141.232.10.32/pm/pm_docs/prog_regulations/111203_prog_regs_final_rule_fed_reg.pdf).

Project-Level: Scale of adaptive management applied for a Comprehensive Everglades Restoration Plan (CERP) project that includes all project phases (i.e., planning, design, engineering, construction, operations, and maintenance). Information on CERP projects can be found at http://141.232.10.32/pm/projects/project_list.aspx.

Report to Congress: This term refers to the report required by the *Water Resource Development Act of 2000* (Section 601) and the *Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Final Rule* (DOD 2003) to be submitted to the United States Congress on the progress of CERP implementation every five years. The report notes accomplishments in areas that include construction, outreach activities, new science, and funding for that five-year period and what is anticipated over the next five years. Reports to Congress can be found online at http://evergladesrestoration.gov/content/cerp_reports_congress.html.

Restoration Coordination and Verification Program (RECOVER) Executive Committee: A committee of RECOVER team members who guide and report on the status of RECOVER efforts to the RECOVER Leadership Group. The RECOVER Executive Committee is made up of two team members from each from the United States Army Corps of Engineers, South Florida Water Management District, and Department of Interior.

Restoration Coordination and Verification Program (RECOVER) Leadership Group (RLG): The RLG is responsible for coordinating and integrating the activities of the RECOVER technical teams and ensuring that the overall focus and direction of the implementation process remains consistent with the goals of system-wide restoration. The leadership group is a standing team consisting of the two RECOVER program managers from the United States Army Corps of Engineers and South Florida Water Management District plus one member from United States Environmental Protection Agency, National Oceanic and Atmospheric Administration, United States Fish and Wildlife Service, United States Geological Survey, National Park Service, Miccosukee Tribe of Indians of Florida, Seminole Tribe of Florida, Florida Department of Agriculture and Consumer Services, Florida Department of Environmental Protection, and Florida Fish and Wildlife Conservation Commission.

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APPENDIX A: ADDITIONAL INFORMATION FOR RECOVER'S ROLE IN CERP IMPLEMENTATION

INTRODUCTION

There is clear guidance for the Comprehensive Everglades Restoration Plan (CERP) on how the systemwide science group, Restoration Coordination and Verification (RECOVER), interacts with the project teams during the project planning phase in their review of performance measures, alternatives, and the project-level monitoring plan. However, there is no guidance on RECOVER's role once the project is authorized and goes into the subsequent implementation phases: design, construction, operation and maintenance (O&M), and operation, maintenance, replacement, and rehabilitation (OMRR&R) phases. Specifying roles in these project phases will provide value to CERP by ensuring new science is incorporated in to project design, construction, and operations; provide the adaptive management (AM) feedback loop; and help the projects implement AM strategies. Several CERP projects are now in the implementation phases, but there is a lot of new science and monitoring data from RECOVER that was not available when the projects were in the planning phase. A process is needed where RECOVER can interact with project teams and provide new science and systemwide monitoring data to the teams, review project-level monitoring plans and AM plans, provide input to project operation plans, obtain project-level data to include in the RECOVER System Status Reports (SSRs), and help the project teams identify AM opportunities in the design and operation of their project. In addition, for many of these projects, the monitoring plan was written and approved years ago and the project-level monitoring plan relied heavily on the RECOVER systemwide *CERP Monitoring and Assessment Plan* (MAP; RECOVER 2009) to cover a large portion of the required project-level monitoring. Since the beginning of CERP, many of the MAP and other agency monitoring programs have changed or been eliminated and a review of the monitoring plan needs to be done to ensure the intent of the project-level monitoring plan is met.

PURPOSE

The purpose of this task is to develop a process for the interaction between the project teams and RECOVER for the implementation phases of CERP projects and identify the value-added for each interaction. RECOVER, with input from the project teams, has developed a draft generalized process diagram for the interaction of RECOVER with the project teams during the implementation phases. From this generalized process, RECOVER will develop a CERP Guidance Memorandum (CGM) to provide direction to RECOVER as well as the project teams regarding RECOVER's role in the implementation phases. This process will allow RECOVER to determine what project interactions are likely to take place over the next 5 to 10 years based on the Integrated Delivery Schedule (IDS).

RECOVER ROLE DURING PROJECT PLANNING

During CERP project formulation and development of the project implementation report process, RECOVER has defined where in the process they can provide information and assistance to the project delivery teams (PDTs). This work on defining RECOVER's roles during project

planning was completed in 2005 and is provided here as background. **Figure A-1** shows where in the plan formulation process RECOVER inserts itself and what RECOVER provides at each of those points in the process. RECOVER interacts with the PDT at 10 points during the Planning Phase (numbers refer to those in **Figure A-1**):

1. RECOVER Input to Project Management Plan
2. RECOVER Overview Presentation
3. Systemwide Modeling Assumptions
4. Performance Measure Development: RECOVER Performance Measures Presentation
5. Performance Measures Consistency Review
6. Plan Formulation: RECOVER Regional Evaluation Presentation
7. RECOVER Monitoring Plan Presentation
8. RECOVER Evaluation of Project Alternative Plans
9. Systemwide Benefits Analysis
10. Project Monitoring Plan Review
11. Project Operating Manuals

RECOVER conducts reviews of projects to ensure they remain consistent with the systemwide goals and objectives of CERP. RECOVER reviews each project's goals, objectives, and performance measures. Projects are encouraged to review RECOVER's performance measures and incorporate any that apply. RECOVER reviews every project's alternatives once they are developed (usually scheduled around the time of the project's alternative formulation briefing) and reports on how well each alternative performs in the context of the system as a whole.

RECOVER has used the South Florida Water Management Model (SFWMM), the Regional Simulation Model (RSM), or other project-specific models to evaluate project plans at the system scale. RECOVER reviews each project's draft monitoring plan to ensure consistency between projects and the system-level MAP. This review may uncover opportunities for combining efforts, avoiding duplication, and taking advantage of economies of scale. RECOVER also ensures that each project's data collection and analysis are consistent with the MAP and the *Quality Assurance Systems Requirements (QASR) Manual for the Comprehensive Everglades Restoration Plan* (USACE and SFWMD 2007). A review is scheduled as soon as a draft monitoring plan has been prepared, early if the project is doing baseline monitoring, later if not, but before the draft project implementation report is completed. RECOVER is available to provide assistance in developing each project's draft operating manual and interim operating strategy in order to optimize the performance of each feature in the context of the rest of CERP and the overall system-level goals.

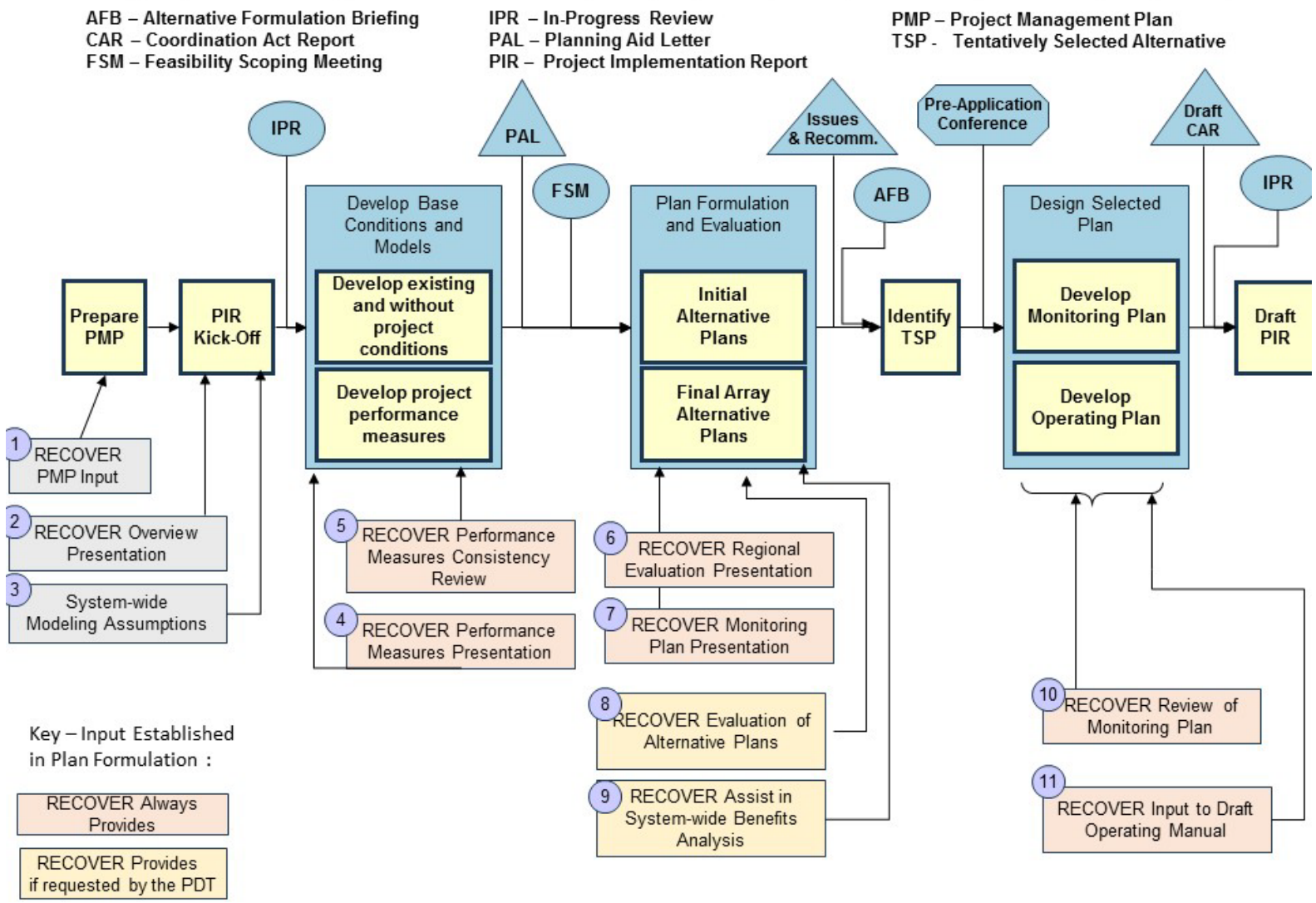


Figure A-1. RECOVER–PDT interactions during plan formulation. (Note: The terms and the process has changed slightly since the diagram was created in 2005, but the general RECOVER interactions remain the same.)

PROPOSED RECOVER ROLES DURING PROJECT IMPLEMENTATION

A process is needed to define how and when RECOVER interacts with PDTs during implementation. The process will ensure new science is incorporated in to project design, construction, and operations; provide the AM feedback loop; and help PDTs implement AM strategies. RECOVER also needs to coordinate with the project team to ensure that project-level data is included in the RECOVER SSRs and that the pertinent systemwide data is provided to the project teams to be included in their reporting efforts.

RECOVER, along with project team members, developed a draft process for this interaction between the project teams and RECOVER for the implementation phases of the project (**Figure A-2**). The process was developed by examining existing guidance and having discussions about what is needed and practical. This new process will be vetted by RECOVER, project teams, and upper management. The new process will be developed into a CGM. The process depicted in **Figure A-2** and outlined below is a generalized process for CERP projects; each project will be a little different based on the type and timeline of where it is in the implementation phase. This process will be applied to each CERP project, but specific points of interaction will be determined for each individual project.

PDTs that are formed during the planning phase do not always stay intact once the project is through the planning phase; however, some do, for example Picayune Strand Restoration Project. This process ensures continuity and communication between the project and RECOVER given that some PDTs do not stay intact. Once the CERP project is authorized by congress, this is the trigger for RECOVER to begin coordination with the project team. For this process, the first critical point of RECOVER interaction is to have the RECOVER point of contact (POC) contact the project manager to find out if there is a PDT, and if not, who is still involved on the project team. If the South Florida Water Management District (SFWMD), the local sponsor, moves forward with design and construction of certain phases of a CERP project before it is authorized by congress, RECOVER will initiate coordination with them when design begins.

RECOVER proposes to interact with the project teams at 8 points during project implementation. Steps 1, 3, 4, 6, 7, and 8 will be required RECOVER inputs, while Steps 2 and 5 will be optional depending on the scope of the project.

1. **Project and RECOVER Communication Begins.** RECOVER will provide a POC to assist the project/technical team as the project features are refined during design. RECOVER will also provide any new science during this scoping phase to evaluate potential changes to the project that may result in a limited reevaluation report (LRR) for the project. Prior to project authorization including both SFWMD and United States Army Corps of Engineers (USACE) led design efforts, RECOVER will coordinate with the project team to ensure new science is provided to inform the design and environmental permitting, and monitoring is in place to capture preconstruction conditions for future benefit calculations and later revisions to the project monitoring plan.

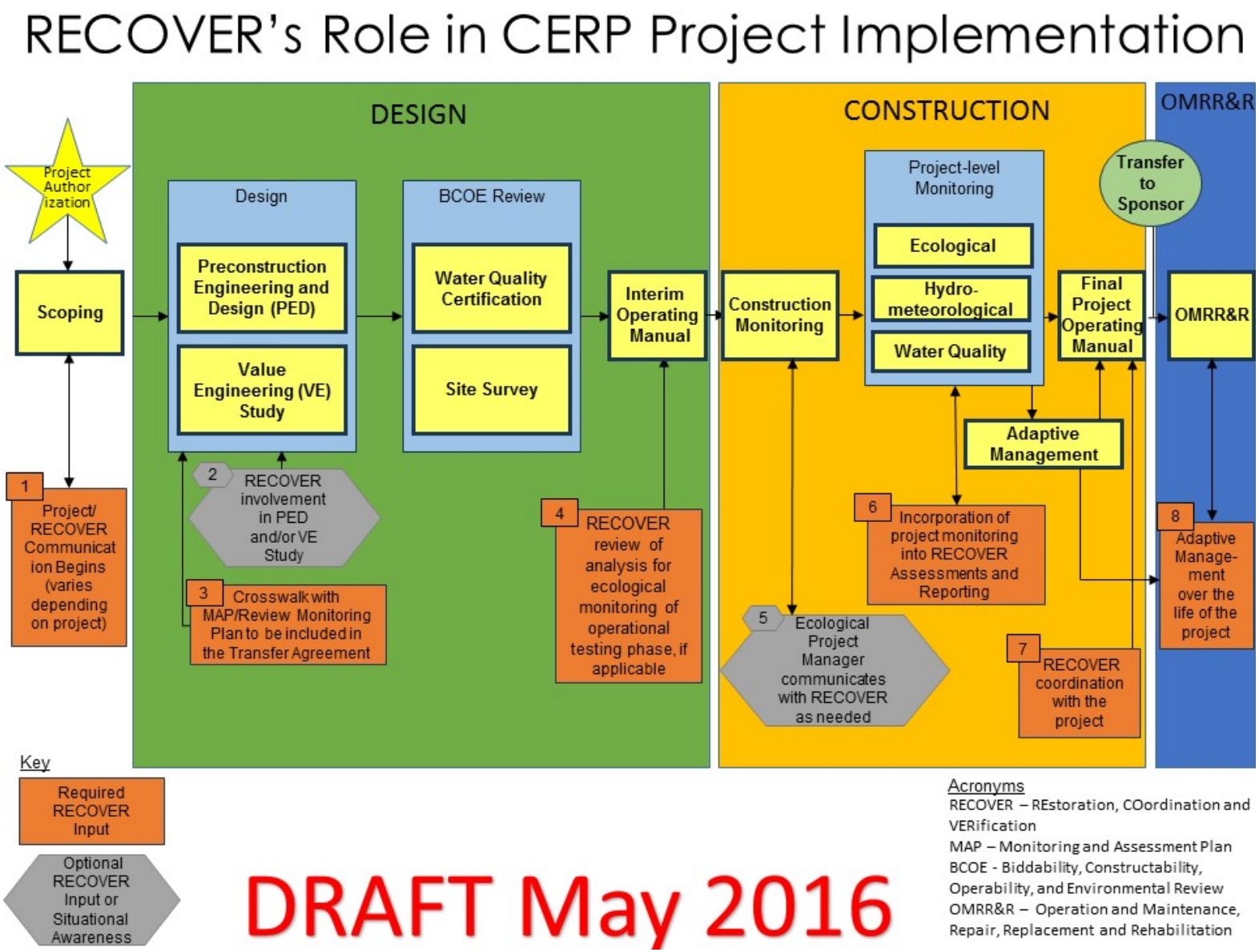


Figure A-2. RECOVER–project team interactions during project implementation.

RECOVER's Role in CERP Project Implementation

★ Congressional Authorization is the trigger point for REstoration, COordination and VERification (RECOVER) to begin coordination with the project team during project implementation that includes design, construction, and Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) phases. If SFWMD begins design and construction on a phase of a project before it is authorized, RECOVER will initiate coordination with SFWMD at that time.

1 Project and RECOVER communication begins – RECOVER will provide a point of contact to assist the technical team as the project features are refined during design. Evaluate potential changes to project (LRR?) and changes necessary based on new science.

2 RECOVER involvement in Preconstruction, Engineering and Design (PED) and/or the Value Engineering (VE) Study – RECOVER will provide updated scientific information and lessons learned from prior project implementation or Monitoring and Assessment Plan (MAP) monitoring that may be applicable to design. RECOVER point of contact will be involved in the VE Study to ensure optimum project benefits in response to new information and adaptive management options.

3 Crosswalk of the Project-level monitoring plans with the MAP to ensure coordination of project-level and system-wide monitoring to ensure project monitoring needs are covered, restoration success identified, RECOVER monitoring can be leveraged as baseline monitoring prior to project implementation (project design and construction schedule), and adaptive management (AM) plan can be implemented. Coordinate and finalize monitoring plans.

4 Interim Operating Manual - RECOVER review of analysis of ecological monitoring of operational testing phase, if applicable (i.e., Modified Waters Delivery incremental testing).

5 Construction Monitoring – Ecological Project Manager (Picayune Strand example) communicates with RECOVER to ensure construction ecological/ecosystem performance issues are addressed.

6 Project-level Monitoring – Incorporation of project monitoring into RECOVER assessments and reporting

- RECOVER input on Project Adaptive Management Plan Implementation – Key Uncertainties, Management Option Matrices, etc.
- Evaluate project performance on a system-wide level to maximize restoration results through AM of operations and when/how to move forward with phases of project construction
- Close communication with the project biologist to be aware of anything unexpected or changes that could be addressed through AM
- RECOVER to coordinate with project when drafting the System Status Report (SSR) to incorporate project-level monitoring
- RECOVER to check in with the project two times a year to look at adaptive management actions
- Data Management and Reporting – Information Data Management (IDM) may coordinate data management with RECOVER to include system-wide data
- Projects report in the South Florida Environmental Report (SFER)
- RECOVER reports in the SSR
- Communication between RECOVER and the project teams
- Consistency review

Required RECOVER Input

Optional RECOVER Input or Situational Awareness

DRAFT

7 Final Project Operating Manual – RECOVER coordination with the project and input with results of monitoring and assessments

8 OMRR&R –Adaptive management of the system over the life of the project – how is this done?

Figure A-2. Continued.

2. **RECOVER Involvement in Preconstruction, Engineering and Design (PED) and/or the Value Engineering (VE) Study.** RECOVER will provide updated scientific information and lessons learned from prior project implementation or MAP monitoring that may be applicable to design. RECOVER POC will be involved in the VE study to assist in identifying optimum project benefits in response to new information and AM options.

3. **Crosswalk of the Project-level Monitoring Plans with the MAP.** RECOVER will conduct a crosswalk of the project-level monitoring plans with the MAP to ensure coordination of project-level and systemwide monitoring. During this process, RECOVER will ensure that project monitoring needs are covered, restoration success is identified, RECOVER monitoring can be leveraged as baseline monitoring prior to project implementation (project design and construction schedule), and an AM plan can be implemented. The project team will finalize monitoring plans to be included in the transfer agreement with the local sponsor.

4. **Interim Operating Manual.** During development of the project's interim operating manual, RECOVER will review the analysis of ecological monitoring conducted during the operational testing phase, if applicable (i.e., Modified Waters Delivery to Everglades National Park incremental testing).

5. **Construction Monitoring.** During construction monitoring, communication between the Ecological Project Manager (i.e., Picayune Strand Restoration Project) and RECOVER must take place to ensure construction ecological and ecosystem performance issues are addressed as needed.

6. **Project-level Monitoring** – Incorporation of project monitoring into RECOVER assessments and reporting will be as follows:

    - RECOVER input on project AM plan implementation including key uncertainties, management option matrices, etc.

    - Evaluate project performance on a systemwide level to maximize restoration results through AM of operations and when and how to move forward with phases of project construction.

    - Close communication with the project biologist to be aware of anything unexpected or changes that could be addressed through AM.

    - RECOVER to coordinate with project when drafting the SSR to incorporate project-level monitoring.

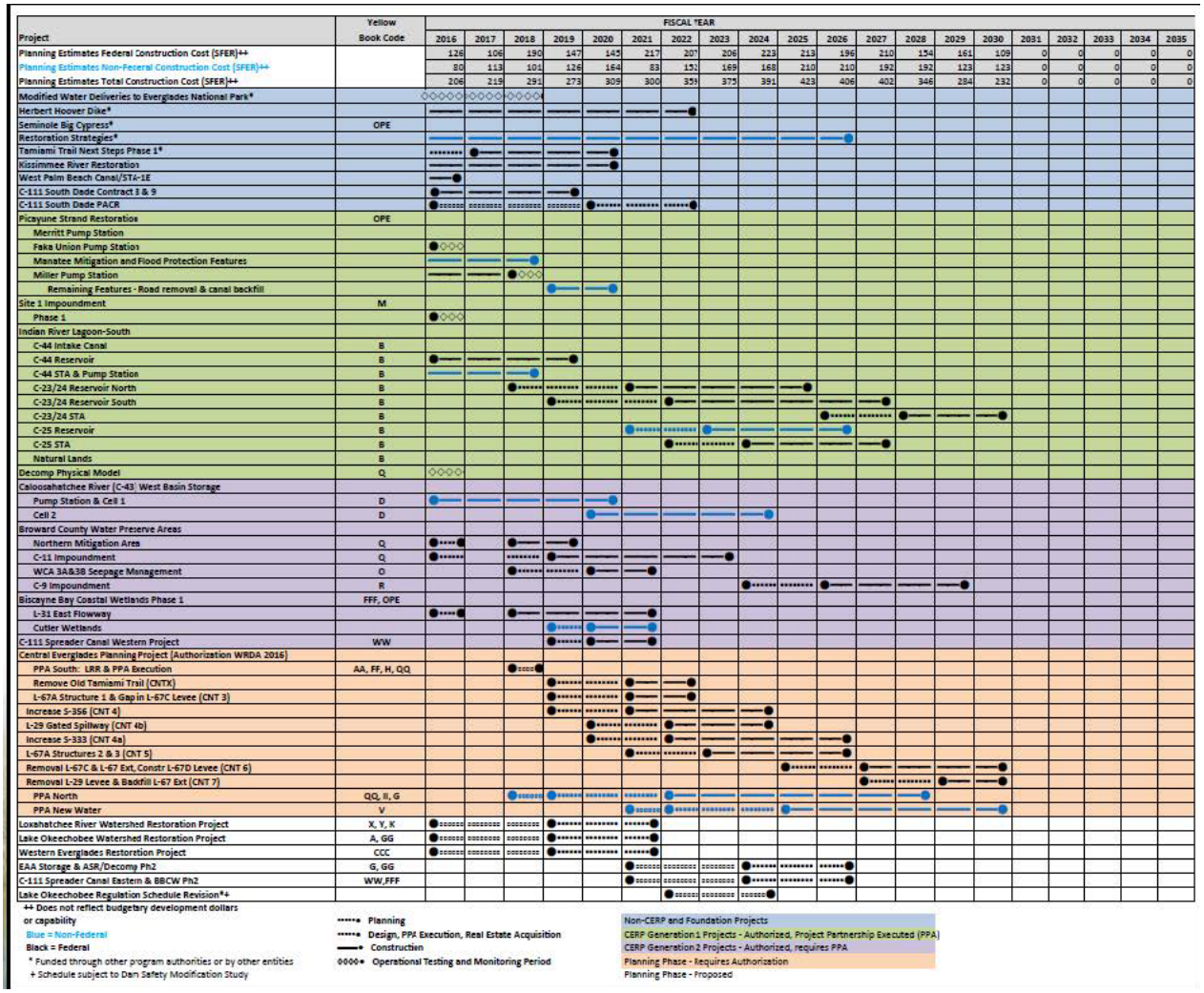
    - RECOVER to check in with the project two times a year to look at AM actions.

- Projects manage monitoring data; RECOVER manages MAP monitoring data.
- Projects report in the South Florida Environmental Report (SFER); RECOVER reports in the SSR.
- Communication between RECOVER and the project teams.
- Consistency review.

7. **Final Project Operating Manual.** RECOVER coordination with the project and inputs with results of monitoring and assessments.
8. **OMRR&R.** Adaptive management of the system over the life of the project. Help the project teams implement AM strategies.

PROJECT INTEGRATED DELIVERY SCHEDULE

The IDS provides the sequencing strategy for planning, designing, and constructing federal projects cost-shared with local sponsors as part of the South Florida Ecosystem Restoration Program, based on ecosystem needs, benefits, costs, and available funding. The IDS synchronizes program and project priorities with the State of Florida and is needed to request required funding to plan and build South Florida Ecosystem Restoration Program projects. It is a living document that is updated as needed to reflect progress and/or program changes. The order of the projects maximizes holistic benefits to the regional system as early as possible, ensures continued stream of construction, which provides for steady increase in regional ecosystem benefits, ensures additional projects will be ready in order to continue progress on Everglades restoration, and remains consistent with project dependencies and constraints. **Figure A-3** shows the 2016 IDS update and is the schedule used by RECOVER and the project teams to determine the role of RECOVER for each project over the next five years. This high-level schedule provides a framework for RECOVER to focus on for this five-year plan effort.



Project	Yellow Book Code	FISCAL YEAR 2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Planning Estimates Federal Construction Cost (SFER)++		126	106	190	147	145	217	207	206	223	213	196	210	154	161	109	0	0	0	0	0
Planning Estimates Non-Federal Construction Cost (SFER)++		80	113	101	126	164	83	151	169	168	210	210	192	192	123	123	0	0	0	0	0
Planning Estimates Total Construction Cost (SFER)++		206	219	291	273	309	300	359	375	391	423	406	402	346	284	232	0	0	0	0	0
Modified Water Deliveries to Everglades National Park*		◇◇◇◇◇	◇◇◇◇◇	◇◇◇◇◇																	
Herbert Hoover Dike*																					
Seminole Big Cypress*	OPE																				
Restoration Strategies*																					
Tamiami Trail Next Steps Phase 1*																					
Kissimmee River Restoration																					
West Palm Beach Canal/STA-1E																					
C-111 South Dade Contract 3 & 9																					
C-111 South Dade PACR																					
Picayune Strand Restoration	OPE																				
Merritt Pump Station																					
Faka Union Pump Station																					
Manatee Mitigation and Flood Protection Features																					
Miller Pump Station																					
Remaining Features - Road removal & canal backfill																					
Site 1 Impoundment	M																				
Phase 1																					
Indian River Lagoon-South																					
C-44 Intake Canal	B																				
C-44 Reservoir	B																				
C-44 STA & Pump Station	B																				
C-23/24 Reservoir North	B																				
C-23/24 Reservoir South	B																				
C-23/24 STA	B																				
C-25 Reservoir	B																				
C-25 STA	B																				
Natural Lands	B																				
Decomp Physical Model	Q	◇◇◇◇																			
Caloosahatchee River (C-43) West Basin Storage																					
Pump Station & Cell 1	D																				
Cell 2	D																				
Broward County Water Preserve Areas																					
Northern Mitigation Area	Q																				
C-11 Impoundment	Q																				
WCA 3A&3B Seepage Management	O																				
C-9 Impoundment	R																				
Biscayne Bay Coastal Wetlands Phase 1	FFF, OPE																				
L-31 East Flowway																					
Cutler Wetlands																					
C-111 Spreader Canal Western Project	WW																				
Central Everglades Planning Project (Authorization WRDA 2016)																					
PPA South: LRR & PPA Execution	AA, FF, H, QQ																				
Remove Old Tamiami Trail (CNTX)																					
L-67A Structure 1 & Gap in L-67C Levee (CNT 3)																					
Increase S-356 (CNT 4)																					
L-29 Gated Spillway (CNT 4b)																					
Increase S-333 (CNT 4a)																					
L-67A Structures 2 & 3 (CNT 5)																					
Removal L-67C & L-67 Ext, Constr L-67D Levee (CNT 6)																					
Removal L-29 Levee & Backfill L-67 Ext (CNT 7)																					
PPA North	QQ, II, G																				
PPA New Water	V																				
Loxahatchee River Watershed Restoration Project	X, Y, K																				
Lake Okeechobee Watershed Restoration Project	A, GG																				
Western Everglades Restoration Project	CCC																				
EAA Storage & ASR/Decomp Ph2	G, GG																				
C-111 Spreader Canal Eastern & BBCW Ph2	WW,FFF																				
Lake Okeechobee Regulation Schedule Revision*+																					

++ Does not reflect budgetary development dollars or capability
Blue = Non-Federal
Black = Federal
* Funded through other program authorities or by other entities
+ Schedule subject to Dam Safety Modification Study

Planning
Design, PPA Execution, Real Estate Acquisition
Construction
Operational Testing and Monitoring Period

Non-CERP and Foundation Projects
CERP Generation 1 Projects - Authorized, Project Partnership Executed (PPA)
CERP Generation 2 Projects - Authorized, requires PPA
Planning Phase - Requires Authorization
Planning Phase - Proposed

Figure A-3. IDS 2016 Update.

PROJECT-SPECIFIC RECOVER INPUT

RECOVER team members met with project managers to review the proposed process in **Figure A-2**. RECOVER will determine a POC for each project (Task 1). That POC will coordinate with the project team to determine where that project is in the implementation phase. The POC will be responsible for coordinating with the project team and pulling the correct RECOVER team members together for the required project interactions. RECOVER will coordinate with project teams to determine project-specific interactions based on the current detailed project schedule. This will involve a crosswalk between the detailed project schedules and the generalized process flowchart (**Figure A-2**) to determine where over the next 5 years in the implementation phases RECOVER should insert itself and what RECOVER provides at each of those points in the process. Over the next year, RECOVER and the project teams will review the detailed schedule of each CERP project below, and where they are in the implementation phase to determine the extent of RECOVER interaction needed. The information below provides a quick snapshot of where each

project is in the implementation phase of the project. Task 2 of this effort will fine tune the details for each project to provide a detailed analysis of where and how RECOVER needs to interact as well as the resources required for each RECOVER interaction with each project. This new process is important to all the CERP projects listed below because in ensures RECOVER is aware of the current implementation of each project as well as ensures the latest systemwide science and AM options are available to the projects so the project can be built to gain the maximum benefits.

Picayune Strand Restoration Project

The Picayune Strand Restoration Project has features in all phases. Merritt Pump Station has recently transferred to the O&M phase. Faka Union Pump Station will transfer into OMRR&R phase in January 2017. Miller Pump Station construction is expected to be complete in August 2017 and transfer into O&M in September 2018. The Southwest Protection Feature is being modeled and potentially redesigned from what is in the LRR. Construction on the Southwest Protection Feature is expected to start in 2018. Remaining construction includes canal plugging and backfill, which is currently underway and expected to continue in 2017. If construction proceeds as scheduled, all project features will be complete by 2021. After a three-year waiting period, estuary monitoring will begin. Monitoring in the freshwater wetlands areas begins one year post the completion of a given feature. Merritt Canal area monitoring began in summer 2016. RECOVER may be involved in revising the draft AM plan for the project.

Site 1 Impoundment

Construction of the Site 1 Impoundment Phase 1 was completed on January 9, 2016. The project is scheduled to be transferred into O&M in late 2016. Phase 2 will not be constructed. RECOVER will not need to be involved during the O&M phase of Site 1 Impoundment Phase 1.

Indian River Lagoon – South (C-44, C-23/24, and C-25 Basins)

Construction of the C-44 Stormwater Treatment Area is expected to start in late 2017, pump station construction is expected to start in late 2018, C-44 Reservoir construction is expected to start in early 2021, and the full facility is expected to be in interim operations in 2021. RECOVER will coordinate with the project team during construction of all the features and review the interim operating manual, as well as coordinate with monitoring and AM.

Caloosahatchee River (C-43) West Basin Storage Reservoir

The reservoir will be constructed through four contracts. Contract 1 is preloading and demolition of former irrigation infrastructure and is underway. Contract 2 is for construction of S-476, a 195-cubic feet per second (cfs) pump station. Contracts 1 and 2 have been awarded and are underway. Contract 3 for construction of S-470, a 1,500-cfs pump station, is in the design phase and is scheduled to be awarded in September 2017. Contract 4 for construction of embankments and associated structures is in the design phase and is scheduled to be awarded in September 2017. Contract 4 will undergo a VE study in 2016. Communication with RECOVER on the monitoring crosswalk and schedule is underway. There will be operations plan coordination with RECOVER before the plan is finalized.

Broward County Water Preserve Areas

The project is currently still in the design phase for the Northern Mitigation Area. A contract to construct the Northern Mitigation Area will be awarded by 2018. The C-11 impoundment and seepage management area will be in construction in 2018. The project partnership agreement (PPA) was executed in August 2016. The monitoring plan is being reviewed by the project team with input from RECOVER. Monitoring coordination needs to be finalized in 2017.

Biscayne Bay Coastal Wetlands Phase 1 Components

Deering Estates is in the OMRR&R phase. RECOVER will be incorporating project-level monitoring into the 2019 SSR. The L-31 East Flow-way is in the design phase (except for the four culverts already constructed by SFWMD) and RECOVER will coordinate with the project team. The design of the Cutler Wetlands component needs to be updated prior to construction with input from RECOVER. Areas of RECOVER insertion in the project include the following:

- Developing salinity performance measures and target for Biscayne Bay Coastal Wetlands (BBCW) Project. This is on-going. The Southern Coastal Systems Team has been working on this for several years.
- Aerial photo interpretation for BBCW.
- Assistance from CERP RECOVER MAP Component Integrated Biscayne Bay Ecological Assessment and Monitoring Project (IBBEAM) principal investigators is needed to access performance of the nearshore area for estuarine fish, epifauna, submerged aquatic vegetation, and nearshore salinity.
- Coordination of project monitoring data to be included in the 2019 SSR.

C-111 Spreader Canal

The project is currently under construction. The monitoring plans were revised in March 2016. The project operating manual is also being revised this spring, and will require RECOVER input on operations to maintain regional benefits while addressing constraints. The next steps involve a real estate takings analysis in Fiscal Year 2017 (FY2017) and executing a PPA in FY2018, which would immediately transfer the project to the OMRR&R phase. RECOVER will be involved with incorporating the revised project monitoring plans into assessments and reporting during the monitoring period and checking in with AM actions. RECOVER will be involved in AM during the OMRR&R period.

Central Everglades Planning Project

The Central Everglades Planning Project (CEPP) is awaiting authorization. Monitoring and AM plans have been completed. Once authorized, RECOVER will be involved with the VE study and the crosswalk of the monitoring plan with the MAP. RECOVER involvement will be needed in design of PPA for South features in 2018, and coordination of monitoring and AM task execution as early as 2018.

Loxahatchee River Watershed Restoration Project

The project is in the planning phase. RECOVER will be involved as depicted in **Figure A-1** beginning at Step 6. In 2017, RECOVER will review and provide input on the monitoring and AM plans and will provide a regional evaluation of project performance in 2017.

Lake Okeechobee Watershed Project

The project is in the planning phase. RECOVER will be involved as depicted in **Figure A-1**. This project will be kicking off at the end of FY2016 and RECOVER will be involved beginning at Step 1.

Big Cypress - L-28 Interceptor Modifications Project (Western Everglades Project)

The project is in the planning phase. RECOVER will be involved as depicted in **Figure A-1**. This project was kicking off in 2016 and RECOVER will be involved beginning at Step 1.

CERP GUIDANCE MEMORANDUM DEVELOPMENT

Initial program guidance was published in August 2000 in the *Master Program Management Plan, Volume I – Management Processes* (USACE and SFWMD 2000), which is regarded as the baseline program guidance document for CERP implementation. Since the initial Mater Program Management Plan was published, USACE and SFWMD program managers have made decisions on a wide array of issues that directly affect their staff's execution of the program. The program managers translated their decisions into CGMs. CGMs establish the processes and procedures, and provides guidance to the staff of the USACE, SFWMD, and other members of PDTs and other project teams. RECOVER will formalize the process laid out in this document in a CGM to establish how RECOVER interacts with the projects teams during project design, construction O&M, and OMRR&R phases. CGMs are signed by the USACE Ecosystem Branch Chief and the SFWMD Office of Everglades Policy and Coordination Bureau Chief.

RECOVER-PROJECT INTERACTIONS EXAMPLE

Table A-1 provides an example of how RECOVER-project team interactions are planned and tracked. The table will be updated and the rest of the project interactions will be added as part of Task 2.

Table A-1. Example of a detailed RECOVER-project team interactions.

Project and Phase	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Picayune Strand Restoration Project						
Merritt Pump Station	O&M[1]					
Faka Union Pump Station	O&M[2]					
Manatee Mitigation and Flood Protection Features		Construction[3]				
Miller Pump Station	Construction	O&M				
Site 1 Impoundment						
Phase 1	O&M					
Indian River Lagoon – South						
C-44 Reservoir	Construction	Construction	Construction	O&M		
C-44 Stormwater Treatment Area & Pump Station	Construction	Construction	O&M			
C-23/24 Reservoir North		Design	Design	Design	Construction	Construction
C-23/C-24 Reservoir South			Design	Design	Design	Construction
C-25 Reservoir					Design	Design
C-25 Stormwater Treatment Area						Design

Table A-1. Continued.

Project and Phase	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Caloosahatchee River (C-43) West Basin Storage Reservoir						
Pump Station & Cell 1	Construction	Construction	O&M			
Cell 2		Design	Construction	Construction	O&M	
Broward County Water Preserve Area						
C-11 Impoundment	Design	Construction	Construction	Construction	Construction	
Water Conservation Area 3A & 3B Seepage Management		Design	Design	Construction	Construction	
C-9 Impoundment						
Biscayne Bay Coastal Wetlands Phase 1						
L-31 East Flow-way	Construction	Construction	Construction	Construction		
Cutler Wetlands			Design	Construction	Construction	
C-111 Spreader Canal Western Project			Design	Construction	Construction	

Table A-1. Continued.

Project and Phase	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Central Everglades Planning Project						
PPA South: LRR & PPA Execution	Planning					
Remove old Tamiami Trail		Design	Design	Construction	Construction	
L-67A Structure 1 & Gap in L-67C Levee		Design	Design	Construction	Construction	
Increase S-356			Design	Design	Construction	Construction
L-29 Gated Spillway				Design	Design	Construction
Increase S-333				Design	Design	Construction
L-67A Structures 2 & 3					Design	Design
Removal L-67 C & L-67 Extension						
Removal L-29 Levee & Backfill L-67 Extension						
PPA North		Planning	Design	Design	Design	Construction
PPA New Water					Planning	Design

Table A-1. Continued.

Project and Phase	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Loxahatchee River Watershed Restoration Project	Planning	Planning	Design	Design	Design	
Lake Okeechobee Watershed Restoration Project	Planning	Planning	Planning	Design	Design	Design
Big Cypress - L-28 Interceptor Modifications Project (Western Everglades Project)	Planning	Planning	Planning	Design	Design	Design

1. Provide MAP monitoring data to the project team to look at AM changes.
2. Provide new data on a project-level uncertainty.
3. Incorporate project monitoring into the 2019 SSR.

REFERENCES

RECOVER. 2009. *CERP Monitoring and Assessment Plan*. Restoration Coordination and Verification, c/o United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. December 2009. Available online at http://141.232.10.32/pm/recover/recover_map_2009.aspx.

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APPENDIX B: ADDITIONAL INFORMATION FOR RECOMMENDATIONS FOR REFINEMENT OF CERP INTERIM GOALS

BACKGROUND

As defined in the *Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Final Rule* (DOD 2003; §385.3), interim goals are used for two major purposes in the Comprehensive Everglades Restoration Plan (CERP or the Plan). First, the interim goals are used in CERP planning as a guide for project design, as a criterion for development of CERP project scheduling, and to assist in comprehensive plan updates and modification. Second, they are used as benchmarks for the comparison of field information during the implementation and operation of CERP projects in order to assess whether the ecosystem that is modified by CERP project implementation is achieving its expected restoration goals. In this context, interim goals are expected to play a significant role in driving the adaptive management program for CERP, and are used to report to the United States Congress on restoration progress.

The 2007 Interim Goals Interagency Agreement (U.S. Army et al. 2007), signed by the Secretaries of the Army and Interior and the Governor of Florida states (*emphasis added*):

> C.3.c. The interim goals will be modified through amendment of this Agreement, in consideration of RECOVER assessments and recommendations, <u>to reflect any new information related to Plan implementation, including revised hydrologic models, project schedules, new scientific and technical information, information developed through assessment and adaptive management</u>, and future authorized changes to the Plan integrated into the implementation of the Plan. Amendments to this Agreement will be developed utilizing the process outlined in Section 385.38(d) of the Programmatic Regulations.

Each interim goal is comprised of two parts (RECOVER 2005). The first is the goal indicator, or what aspect of the natural system thought to be indicative of a restored ecosystem. Indicators can be individual species (e.g., wood storks and other wading birds) or represent a particular landscape type (e.g., Everglades tree islands). The second part of the interim goals is the prediction of how the indicators will respond to restoration efforts over time, in order to track our restoration progress.

ECOLOGICAL MODELING TOOLS AND ASSESSMENT MONITORING

Table B-1, which is adapted from the *Central & Southern Florida Project, Comprehensive Everglades Restoration Plan, 2015 Report to Congress* (USACE and USDOI 2016), lists the predictive tools that have been completed, the monitoring available for assessment, and the plans for predictions and assessments of interim goals for each indicator.

Table B-1. Ecological modeling tools and assessment monitoring.

Interim Goal Indicator	Predictive Tools Complete	Monitoring Available for Assessment	Plans for Predictions and Assessments of Interim Goals
Northern Estuaries			
Oysters	Oyster mechanistic model and habitat suitability index.	Mapping of the extent of live oyster beds performed every 5 years. The latest mapping was done in 2012.	Modeled predictions based on the Integrated Delivery Schedule (IDS) and continued mapping every 5 years after flow and salinity regimes restored through Indian River Lagoon - South, Central Everglades Planning Project (CEPP), and Lake Okeechobee Watershed projects.
Submerged Aquatic Vegetation (SAV)	SAV simulations for 3 important species: manatee grass, wild celery, and shoal grass.	Mapping performed at least every 5 years. The latest maps were Caloosahatchee River Estuary in 2014 and Indian River Lagoon in 2015.	
Lake Okeechobee			
SAV	Areal SAV coverage predictions based on lake stages and the amount of nearshore area that can be potentially colonized.	Yearly monitoring produce vegetation maps. For SAV, the July–August annual nearshore SAV mapping coverage data are used since they have the most significant correlation with lake stage. A subset of nearshore sites are also monitored during the spring, fall, and winter.	Ongoing comparison of annual summer areas coverage data as it correlates to average monthly May (vascular) and July (*Chara*) lake stages. An annual vascular score is also based on the average May lake stage.
Algal Blooms	Algal bloom frequency is predicted. The model also predicts the ratio of diatoms to blue-green algae.	Quarterly monitoring and assessment of algal biomass and annual mean cyanobacteria, diatoms, and chlorophyll *a* are used to assess conditions in relationship to nutrients.	Ongoing assessment and future use in determining planning and storage options.

Table B-1. Continued.

Interim Goal Indicator	Predictive Tools Complete	Monitoring Available for Assessment	Plans for Predictions and Assessments of Interim Goals
Greater Everglades			
Aquatic Fauna Regional Populations in Everglades Wetlands	Logistic model parameterized to predict small fish densities based on the time between drying events.	Dry season and wet season trophic prey concentrations are monitored in the Monitoring and Assessment Plan (MAP) and are used to build the model and provide field level assessment.	Evaluate the effect of restoration by continued monitoring to assess the predicted effects on the ecosystem of the following projects based on the IDS: Modified Water Deliveries to Everglades National Park Decomp Physical Model, C-111 South Dade, C-111 Spreader Canal, Restoration Strategies, Tamiami Trail Modifications: Next Steps, and CEPP.
Large Fish	A generalized logistic model predicts largemouth bass catch-per-unit-effort based on the average length of drying events in days for each study site.	Catch-per-unit-effort for largemouth bass is monitored in the wet season in Everglades marshes.	
American Alligator	An American alligator production index has been developed as an update of the 2004 Spatially Explicit Species Index Model. The model integrates five probability functions: (1) habitat availability, (2) breeding potential, (3) courtship and mating, (4) nest building, and (5) nest flooding.	No MAP data were collected 2013–2015 due to cutbacks in funding. Temporary funding sources were found outside of the MAP for those years and it is anticipated that MAP will resume alligator data collection in Fiscal Year 2016. Alligator abundance surveys are conducted in both the wet and dry seasons yearly in Everglades marshes.	

Table B-1. Continued.

Interim Goal Indicator	Predictive Tools Complete	Monitoring Available for Assessment	Plans for Predictions and Assessments of Interim Goals
Systemwide Wading Bird Nesting Pattern	(1) A wood stork foraging potential model has been developed to predict the relative suitability of foraging conditions for wood storks within Everglades freshwater marshes during the breeding season. (2) A wading bird nesting model developed in the Gawlik lab at Florida Atlantic University predicts the number of nests for the great egret, white ibis, and wood stork. (3) The spatial foraging condition model was used to evaluate wading birds in the technical evaluation of CEPP for great egret, white ibis, and wood storks. This model focuses on hydrologic characteristics.	Wading bird nesting and prey availability are monitored at multiple locations throughout the Everglades. This data has been used to develop and calibrate the models and assess current conditions in the field of several key wading bird species such as wood stork, great egret, and white ibis.	Predict the effect of restoration progress by modeling the progress of the following projects and continued monitoring activities: Modified Waters Deliveries to Everglades National Park, Decomp Physical Model, C-111 South Dade, C-111 Spreader Canal, Restoration Strategies, Tamiami Trail Modifications: Next Steps, and CEPP.
Snail Kite	A Florida apple snail population model has recently been used as a proxy for the Everglades snail kite and includes the Everglades Depth Estimation Network (EDEN) water level model information.	University of Florida conducts range-wide surveys from Everglades National Park north to the Kissimmee Chain of Lakes, and most major wetlands in between. Overall population and as many nest locations as possible (~400) are monitored until the nestlings are ready to fledge, at which point they are banded. Nest location monitoring and banding activity run from about January through October, and the actual resight surveys run from March through July.	Predictions based on systemwide restoration progress and continued monitoring of the species.

Table B-1. Continued.

Interim Goal Indicator	Predictive Tools Complete	Monitoring Available for Assessment	Plans for Predictions and Assessments of Interim Goals
Southern Coastal Systems			
SAV in Southern Estuaries	The Florida Bay Seagrass Community Model (SEACOM) is a seagrass community ecological simulation model that assesses the impact of management strategies on the Florida Bay SAV community. The model predicts biomass and species composition of turtlegrass, shoal grass, and widgeongrass.	Annual SAV monitoring is performed in much of Florida and Biscayne bays. This long-term data set of monitoring has been used to develop and calibrate the model and is used to track the actual annual changes to these communities in relation to water quality changes.	Predictions based on the IDS and subsequent evaluation of the effects of C-111 Spreader Canal Western Project, Biscayne Bay Coastal Wetlands (portions), and Modified Water Deliveries to Everglades National Park.
Juvenile Shrimp Densities in Florida Bay and Biscayne Bay	A shrimp production index simulates growth, survival, and potential harvests from a specified monthly cohort as a function of salinity and temperature.	MAP shrimp density monitoring in Florida Bay was eliminated due to lack of funding in 2012. Limited nearshore monitoring remains in Biscayne Bay.	
American Crocodile	An American crocodile hatchling growth and survival salinity index is calculated for August through December, the period following hatching when hatchlings are most vulnerable to high salinities.	MAP monitoring data was collected until 2012. Monitoring has continued in Everglades National Park and by Florida Power & Light on their properties and Turkey Point Nuclear Power Plant.	

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APPENDIX C: ADDITIONAL INFORMATION FOR RECOMMENDATIONS FOR REFINEMENT OF CERP INTERIM TARGETS

BACKGROUND

Interim targets were established for the Comprehensive Everglades Restoration Plan (CERP or the Plan) to evaluate progress towards providing for other water related needs of the region, including water supply and flood protection, throughout the implementation process (DOD 2003, Section 285.39 (a)(1) and (2)). The Restoration Coordination and Verification program (RECOVER) is responsible for updating the interim goals and interim targets as described in the *Programmatic Regulations for the Comprehensive Everglades Restoration Plan; Final Rule* (DOD 2003, Section 385.31 (b) (4) Adaptive Management Program): "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 interim goals and interim targets are being achieved or are likely to be achieved." Additionally, the interim targets and interim goals shall be consistent with each other.

In 2005, RECOVER published *The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan* (RECOVER 2005). In 2007, the Interagency Agreement on Interim Targets was signed by the Secretary of the Army and the Governor of the State of Florida (U.S. Army and State of Florida 2007).

The interim targets were assessed using evaluations of the South Florida Water Management Model (SFWMM) using climate data for the period 1965–1995. The interim targets included the following:

- Water Volume
- Water Supply for the Lower East Coast Service Area
- Water Supply for the Lake Okeechobee Service Area
- Ability to Protect the Biscayne Aquifer from Saltwater Intrusion
- Ability to Protect the Southern Biscayne Aquifer from Saltwater Intrusion
- Flood Control: Root Zone Groundwater Levels in the South Miami-Dade Agricultural Area East of L-31N

Later, two additional interim targets were developed:

- Flood Control: Groundwater Stages for Miami-Dade, Broward, Palm Beach, and Seminole Tribe Surface Water Management Basins
- Flood Control: Flood Water Removal

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APPENDIX D: ADDITIONAL INFORMATION FOR SCIENCE REVIEW AND INTEGRATION

INTRODUCTION

The purpose of this section is to guide the review and potentially update the scientific groundwork of the Restoration Coordination and Verification program's (RECOVER's) assessments and framework to ensure that our efforts are focused on addressing the most critical questions and needs of current and future restoration projects and their adaptive management (AM). Increasing awareness of accelerating threats (especially climate change, sea level rise, and invasive exotic species) and new knowledge gained during the first decade of RECOVER monitoring will inform this update.

BACKGROUND

The Comprehensive Everglades Restoration Plan (CERP or the Plan) is in a period of rapid restoration progress and a need exists for RECOVER to provide insight of how management actions can best effect Everglades restoration. RECOVER's scientific assessments and framework for serving CERP planning and implementation include the development of conceptual ecological models (CEMs; Ogden et al. 2005a), derived restoration performance measures, and design of the *CERP Monitoring and Assessment Plan* (MAP; RECOVER 2009) and its component hypothesis clusters.

The need for RECOVER to pursue integrated scientific analysis is explicit in RECOVER's mission statement: RECOVER provides essential support to CERP in meeting its goals and purposes by applying a systemwide and integrative perspective to the planning and implementation of the Plan. Integrative analysis entails not only the analysis of key parts or specific areas of the system, but also how the interaction and interdependencies of these parts and areas affects the system's response to restoration actions and environmental stressors including climate change. Such integrated understanding is essential for accurate evaluation of benefits and trade-offs at a system level. To date, we have successfully addressed this need through the identification of suites of indicators and performance measures that were thought to reflect the defining characteristics across the greater Everglades landscape, and especially reflect dependence of the system on hydrologic conditions. This approach has been highly informative (e.g., guiding Central Everglades Planning Project [CEPP] evaluations), but can be improved via the development of hydrologic, biogeochemical, and ecological models that are more tightly linked (NRC 2010) and reflect broader functional interdependencies of the ecosystem.

The responsibility for RECOVER to analyze, understand, and communicate information on the status and dynamics of the greater Everglades ecosystem is a huge challenge. Factors increasing the difficulty of Everglades assessment are the system's large spatial scale, ecological complexity, and the varied history and distribution of hydrologic and water quality impacts. When we combine these factors with the accelerating and intensifying impacts of climate change and exotic invasive species, the challenge of Everglades assessment becomes starkly apparent. Perhaps no greater and imminent environmental problem solving challenge exists on earth.

However, RECOVER scientists are confident we can meet this challenge by leveraging decades of accrued knowledge gained, well established cooperative and transparent protocols for teamwork, and the sustained commitment of multiple agencies and other institutions.

OVERVIEW OF TASKS

RECOVER has identified four major tasks to be accomplished over the next five years to advance delivery of integrated scientific analysis of the Everglades, thereby improving and, consequently, enhance our ability to successfully restore and sustain the Everglades:

- **Task 1:** Review and update, as needed, CEMs and hypothesis clusters. Revisiting the assumptions and the information base of the CEMs and hypothesis clusters will help guide the other tasks listed here, as well as the interim goals and AM efforts.

- **Task 2:** Analysis of Everglades' vulnerability. Identifying and diagnosing the most vulnerable locations, species, and ecological components and functions in the system will clarify appropriate locations and scales of action or resolving crucial vulnerabilities.

- **Task 3:** Evaluate performance measures, providing recommendations for updates, removal, and new development. Reviewing the current set of performance measures and targeting key subjects for development will enhance our ability to identify options that managers can use to continue to improve and sustain both natural and human systems.

- **Task 4:** Evaluate the MAP, providing recommendations for a revision. Ensure that the MAP incorporates new knowledge and focuses on identifying thresholds of vulnerabilities and the most promising restoration solutions, to accurately and effectively inform CERP's AM process. Promoting a more insightful and focused MAP enhances the AM program and will provide managers with the capacity to act more quickly even in the face of risk with the knowledge that they have the best information and scientific support on their side.

- **Task 5:** Develop a 2021 MAP Update. Determine the scope of the update.

SUMMARY OF TASKS

Task 1: Update Conceptual Ecological Models and Hypothesis Clusters

Description

CEMs as used in CERP, are non-quantitative planning tools used to identify major ecological and anthropogenic drivers and stressors on natural systems, the ecological effects of these stressors, and biological attributes or indicators of these ecological responses (Ogden et al. 2005a). A set of CEMs has been developed for South Florida restoration to support integration of

science and policy and they are key components of the AM program developed for CERP (**Table D-1** and **Figure D-1**). These CEMs are being used as planning tools to guide and focus scientific support for South Florida restoration initiatives and to build understanding and consensus among scientists and managers regarding the set of working hypotheses that explain the sources and effects of major anthropogenic changes in the natural system.

CEMs have become an essential part of South Florida's restoration planning process because both scientists and managers depend on the models to help build scientific consensus regarding ecosystem linkages and responses, to identify performance measures used both to plan the design of the restoration programs and assess responses of the natural systems during implementation of each program, and to determine research needs. Managers appreciate these models because of their role in organizing effective application of science in support of decision making for restoration. Scientists value the intellectual and integrative processes of developing working hypotheses and laying out linkages in CEMs as a basis for identifying gaps in knowledge and setting research priorities.

The RECOVER program is responsible for coordination and application of science to support CERP implementation. The major components of the Applied Science Strategy are the CEMs, performance measures that include restoration targets, a systemwide MAP, a performance measure assessment protocol, and an AM plan. 'Hypothesis clusters' are the backbone of the latest MAP (RECOVER 2009); they depict causal relationships among ecosystem components and how these relationships are expected to change with restoration. Each region has developed hypothesis clusters (**Table D-2**).

Table D-1. Regional CEMs published in *Wetlands* in 2005.

Lake Okeechobee	Northern Estuaries	Greater Everglades	Southern Coastal Systems
Lake Okeechobee[a]	Lake Worth Lagoon[b]	Big Cypress Regional Ecosystem[f]	Biscayne Bay[j]
	Caloosahatchee Estuary[c]	Everglades Mangrove Estuaries[g]	Florida Bay[k]
	Loxahatchee Watershed[d]	Everglades Ridge and Slough[h]	
	St Lucie Estuary[e]	Everglades Southern Marl Prairies[i]	

a. Havens and Gawlik 2005
b. Crigger et al. 2005
c. Barnes 2005
d. Van Arman et al. 2005
e. Sime 2005
f. Duever 2005
g. Davis et al. 2005a
h. Ogden 2005
i. Davis et al. 2005b
j. Browder et al. 2005
k. Rudnick et al. 2005

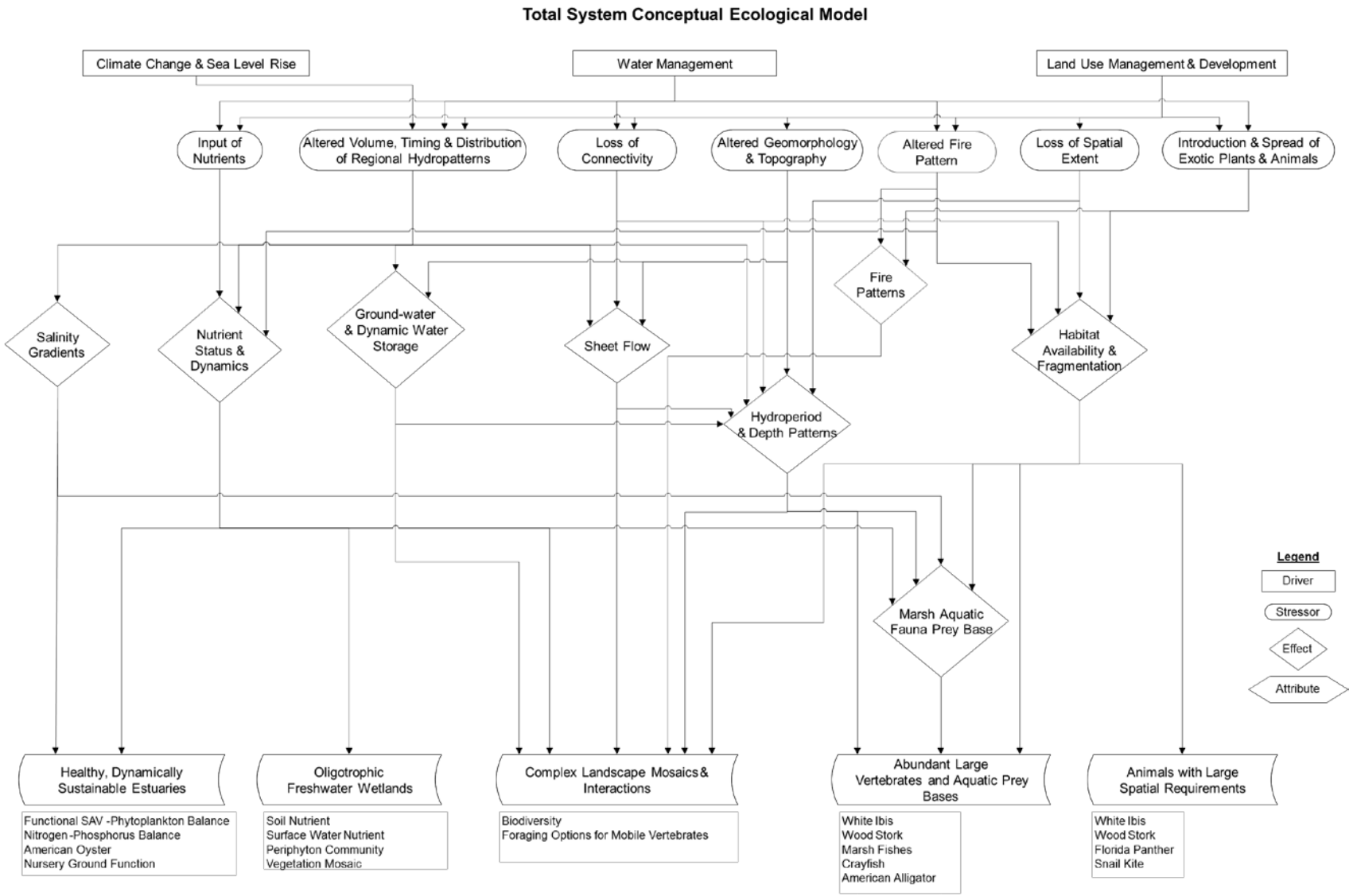

Figure D-1. An example of a CEM: the Total System Conceptual Ecological Model (Ogden et al. 2005b).

Table D-2. Hypothesis clusters from the 2009 MAP (RECOVER 2009).

Lake Okeechobee Module	Northern Estuaries Module	Greater Everglades Module	Southern Costal Systems Module
Emergent-Submerged Vegetation Mosaic	Oyster Health and Abundance	Sheet Flow and Water Depth Patterns	Water Quality and Phytoplankton
Macroinvertebrate Community	Submerged Aquatic Vegetation	Oligotrophic Nutrient Status	Salinity
Native Freshwater Fish	Benthic Infaunal Invertebrates	Landscape Patterns of Ridge and Slough Peatlands and Adjacent Marl Prairies in Relation to Sheet Flow, Water Depth Patterns and Eutrophication	Submerged Aquatic Vegetation
Water Quality and Phytoplankton	Fisheries	Wading Bird Nesting in the Mainland and Coastal Everglades in Relation to the Aquatic Fauna Forage Base	Estuarine Nursery Habitat
		American Alligator Density and Body Condition in Relation to Hydrologic Patterns and Artificial Canal Habitats in the Everglades	Oyster
		Ecosystem Characteristics of Everglades Coastal Wetlands in Relation to Freshwater Inflows	Predator Prey Interactions of Wading Birds and Aquatic Fauna Forage Base
			Native Vegetation Mosaic

Each hypothesis cluster, as depicted in MAP 2009, shows the minimum set of variables that must be monitored and understood if CERP is to achieve the goal of ecological restoration (**Figure D-2**; RECOVER 2009). The development of the hypothesis clusters was based on the scientific understanding of cause-and-effect relationships for specific attributes in the Everglades ecosystem that we have prioritized for monitoring. The cause-and-effect relationships were codified in the CEMs. The CEMs focus and support the hypothesis clusters and, thereby, RECOVER's science for CERP.

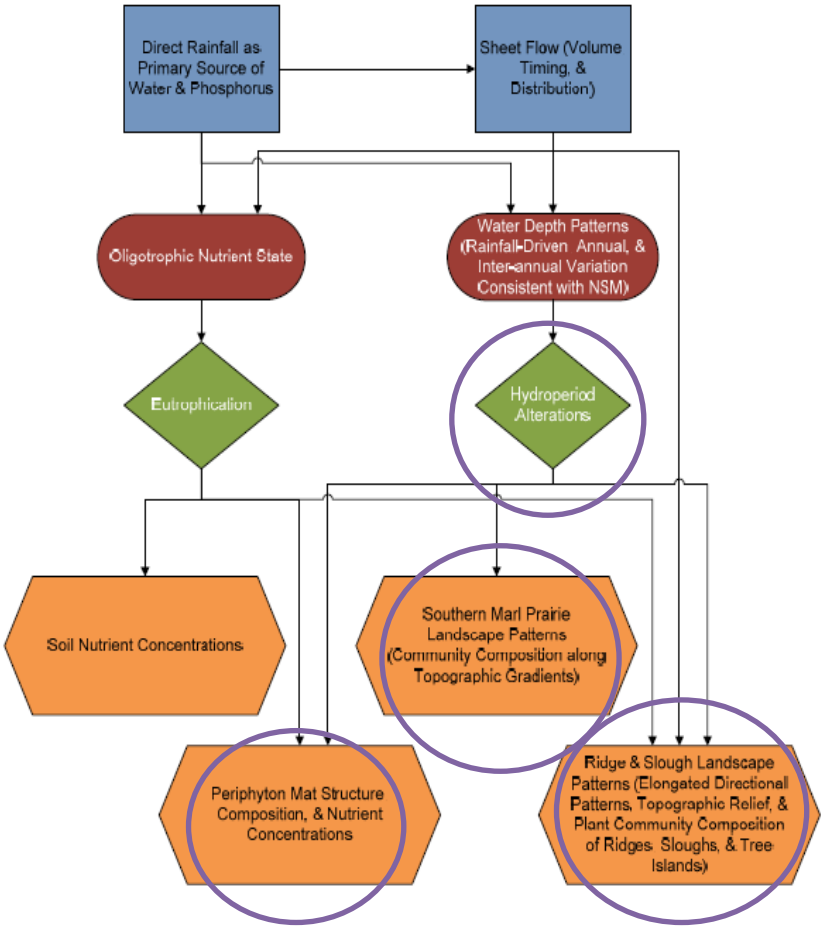

Figure D-2. An example of a hypothesis cluster: Greater Everglades Interrelationships of Sheet Flow, Water Depth Patterns, Oligotrophic Nutrient Status, and Landscape Patterns Hypothesis Cluster Diagram (RECOVER 2009). Key: blue squares = drivers, red ovals = stressors, green diamonds = ecological effects, orange hexagons = attributes, purple circles = current MAP monitoring efforts.

Objectives

The objective of Task 1 is to review the CEMs and associated hypothesis clusters in light of knowledge gained since their development and to recommend refinements, if needed. Currently, the refined CEMs and hypothesis clusters can be used to fulfill the requirement for CEMs in new planning studies, such as those specified in the South Florida Ecosystem Restoration Integrated Delivery Schedule (IDS). These CEMs can confirm or point to needed changes in future MAP monitoring efforts. They can contribute to CERP assessments and status reports by illustrating how water management and restoration actions directly affect the ecosystem.

Potential questions to be asked and addressed during this effort include the following:

1. Do findings from current and past monitoring efforts merit refinements to the relevant CEMs and, if so, what refinements?

2. What potential modifications may be needed in related hypothesis clusters, given greater understanding of the clusters' hypothesized relationships and refinements in the CEM(s)?

3. For a given update of a CEM and hypothesis cluster, is there a related portion of the MAP that should be reviewed for consideration of a commensurate change in monitoring or research?

4. How would this group of potential refinements improve CERP planning and AM, including water management operations of ongoing projects and the development and evaluation of future project plans?

Approach and Implementation

Identification of the CEMs for review and refinement using criteria such as relevance to planning studies and/or linkage to an interim goal or interim target is the first step, then identifying the hypothesis clusters within the CEM for review and refinement is the next step. Since the CEMs are broader in scope and typically cover a large geographic region, focusing on the CEMs first, enables RECOVER to recognize changes that can then influence a set of related specific hypotheses. The review may be limited to the CEMs and hypothesis clusters currently in use, so as to minimize the time spent on this task.

Efforts will be made to incorporate all available sources of new knowledge and uncertainty. Examples include South Florida Ecosystem Restoration Task Force Science Coordination Group efforts, RECOVER System Status Reports (RECOVER 2007b, 2007c, 2010, 2012, 2014), the *Scientific and Technical Knowledge Gained in Everglades Restoration (1999–2009)* document (RECOVER 2011), and the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015). Refinement of the CEMs should include a broad set of participants from each module (region).

This effort may be iterative as information gained from other tasks within RECOVER's five-year planning effort (such as Task 2, which includes an ecological vulnerability analysis) could warrant a recheck of the updated CEMs and hypothesis clusters.

Task 2: Vulnerability Analysis

Description

The vulnerability analysis will identify areas, ecological components, and processes that are most vulnerable to stress of various types and the expected ability of current or future restoration actions to mitigate or, at least, minimize this vulnerability. It will also identify information needs and recommend programmatic modifications and specific adaptations to mitigate or minimize vulnerability. This effort should be broadly based, consider multiple scales, and consider identification of tipping points.

Vulnerability is the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a stress or disturbance. This definition and the concepts it addresses have emerged from several decades of research focused on the practice of risk assessment and reduction. A vulnerability assessment should (1) anticipate the intensity of stressors or disturbance events and (2) account for the resilience inherent in different portions of the system and how differences in resilience across space are likely to influence damages to an ecological system that might result over a range of stressor or disturbance intensities.

The concept of resilience is often coupled with the concept of ecological resistance in the context of disturbances. Resistance refers to the ability of an ecological system or component to tolerate a disturbance, resulting in little change. Resilience refers to the ability of a system or component to recover (including consideration of the rate of recovery) after a damaging disturbance. The resilience of a system is often evaluated in terms of the amount of change a system can undergo (e.g., how much disturbance or stress it can handle) and still remain within the set of natural or desirable states (i.e., remain within the same "configuration" of states, rather than maintain a single state). The vulnerability assessment will account for the resilience and resistance concepts, and use a broad base of scientific knowledge to identify key ecological thresholds ("tipping points") where there is elevated risk of serious and potentially irreversible degradation to an ecological system.

The following are suggested elements for inclusion in any vulnerability analysis, particularly those aimed at advancing sustainability:

- Multiple interacting perturbations and stressors and the sequencing of them
- Exposure beyond the presence of a perturbation and stress, including the manner in which the coupled system experiences hazards (i.e., fire, hurricane, or cold snap)
- Sensitivity of the coupled system, including its components, to the exposure

- The system's capacities to cope or respond (resilience), including the consequences and attendant risks of slow (or poor) recovery
- The system's restructuring after the responses taken (i.e., adjustments or adaptations)
- Nested scales and scalar dynamics of hazards, coupled systems, and their responses
- Identification of tipping points

Objectives

The objective of Task 2 is to determine which attributes or areas in the greater Everglades ecosystem are most vulnerable to ecological collapse if restoration efforts in each regional area are not concentrated on or expedited. These efforts should also identify information needs and recommend programmatic modifications or adaptations to mitigate or minimize vulnerability.

Approach and Implementation

The primary steps for the vulnerability assessment are (1) a review of other case studies, (2) identification of appropriate methodologies, (3) a pilot test of the selected methodology, (4) screening and assessment of the most vulnerable Everglades attributes and areas, and (5) reporting on the assessment findings. RECOVER estimates that this task will take about 3 years, with Steps 1 and 2 implemented in the first year and Steps 3 through 5 in the second and third year. The vulnerability analysis will produce a variety of outputs. An example of potential products can be found at the following website:
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0146756

A review of the existing ecologically-based vulnerability assessment methodologies (other case studies) should first be undertaken to see if there is an existing framework that can be adopted or modified slightly for our use in the Everglades ecosystem (Step 1). Once an approach is determined to be applicable, RECOVER would identify the entities that should be assessed for vulnerability (Step 2). These could be specific geographic locations in the system, ecosystem functions, types of habitat, or specific species of plants or animals. That list could then be prioritized by degree of risk, combined with ecological and societal importance (e.g., is the species under consideration a listed species or will habitat loss cascade into a broader change of ecosystem state) or by expedience (e.g., if a habitat at risk is not restored soon, a tipping point will be reached). Once a general approach and specific methods are identified, a pilot of the assessment methodology will begin to test how this will work for the Everglades system (Step 3). Pending the success of this pilot, RECOVER regional groups and a systemwide group will screen potential system attributes, functions, and areas for more in-depth analysis of vulnerability (Step 4). Selected components will then be ranked and, to the extent possible, tipping points will either be identified or recommendations for research that could lead to such an identification will be provided (Step 4). The final step is to report on the findings (Step 5).

At the same time as Task 2 is being undertaken, Task 1 would also be underway and the results of any modifications made to the CEMs and hypothesis clusters and the development of new or modification of existing performance measures should be incorporated into Task 2 as soon as possible.

Task 3: Update Performance Measures

Description

The development of performance measures in restoration planning in South Florida has had a long history predating CERP implementation. As RECOVER was forming in the 1998–1999 timeframe, the overall development of performance measures for CERP came under the RECOVER umbrella, such that an integrated, cohesive, and agreed-upon set of measures would be used in the further CERP planning and implementation.

RECOVER has developed performance measures for evaluating modeled systemwide performance and assessing, through monitoring, actual systemwide performance of CERP in meeting its goals and objectives. Performance measures are planning tools used to determine the degree to which proposed alternative plans are likely to meet restoration objectives, or implemented plans have met restoration objectives, and to help guide system operations at both short- and long-term time scales. Performance measures identify systemwide hydrological, ecological, and water quality attributes expected to respond to CERP implementation and were developed from the regional CEMs discussed under Task 1. RECOVER performance measures reflect the essential hydrological and biological characteristics (RECOVER 2007a) and need to be updated as new science is garnered from the MAP and technical improvements to restoration tools emerged.

Objectives

Each of the four regions in RECOVER has on-going work identified in their Fiscal Year 2016 (FY2016) work plans regarding performance measures, including development of new measures and refinement of existing measures. The objective of Task 3, therefore, is to link and coordinate these performance measure efforts to the outcomes from Tasks 1 and 2 of the overall Science Review and Integration effort, while not stopping current works-in-progress.

Approach and Implementation

Each regional team will appoint a performance measure lead who will stay apprised of the work of the teams working on Tasks 1 and 2 of the Science Review and Integration effort. At the appropriate juncture, the regional teams will assess any needed revisions to existing performance measures, or development of new performance measures, and will develop a detailed, prioritized inventory for their region of performance measure needs. This task will start with the performance measures as posted as of July 21, 2016, on evergladesrestoration.gov (http://141.232.10.32/pm/recover/eval_team_perf_measures.aspx). The initial step will be to recommend for deletion those measures no longer relevant or unused in order to concentrate our efforts on the most important and currently relevant performance measure. The inventories will guide future annual work plans and will include modeling needs. The deliverable will be a

prioritized inventory of performance measure tasks by region will be incorporated into future RECOVER work plans for the upcoming fiscal year. This task is expected to take six months to complete, and is scheduled to be done in the fourth year.

Task 4: MAP Evaluation

Description

The purposes of the CERP MAP are (1) to provide a framework that supports measurement of systemwide responses in order to determine how well CERP is achieving its goals and objectives; and (2) support and enable AM for guiding management operations (particularly water management operations) and updating and improving the Plan when needed.

Initially, the MAP had three broad objectives: (1) establish a pre-CERP reference condition (e.g., the condition prior to implementation of restoration activities and significant anthropogenic changes associated with CERP) including variability for each of the performance measures; (2) provide an assessment of the systemwide responses of CERP implementation; and (3) detect unexpected responses of the ecosystem to changes in stressors resulting from CERP activities (RECOVER 2001, 2003). The MAP was significantly revised in 2004 based on extensive input on the draft of the report (RECOVER 2004), including feedback by the National Research Council (NRC 2003). The 2004 MAP was revised in 2009 and expanded upon these themes to include the linkages of monitoring with AM, interim goals, project-level assessments, and MAP sustainability (RECOVER 2009).

The MAP 2009 is based upon:

- Recommendations from the National Research Council (NRC 2006)
- Completion of the 2006 and 2007 System Status Reports (SSRs) (RECOVER 2007b, 2007c)
- Incorporation of CERP project-level monitoring into the MAP
- Hypothesis clusters derived from the CEMs
- Uncertainties regarding funding for the MAP
- Slowdown in other complementary monitoring programs
- Delays in the IDS

Objectives

The monitoring components under the Adaptive Assessment and Monitoring Program have been modified over time since the 2009 MAP (RECOVER 2009) to allow for new knowledge gained and increasing or decreasing amounts of information about an indicator. The actual monitoring work from the MAP 2009 was impacted by budget availability and shifting priorities. As RECOVER

implements this five-year plan for FY2017 through FY2021, there is potential for conducting a more comprehensive MAP update that will consider factors such as the latest developments in the CEMS and hypothesis clusters, the ecological vulnerability analysis, and evaluation of the performance measures. This update will incorporate new science knowledge gained since the last MAP update from the SSRs, principal investigators, annual reports, and new pertinent research, with the most recent recommendations from the National Research Council and latest IDS in mind. Planned construction activities as well as climate change and sea level rise will be factored into this update as well.

Approach and Implementation

Regional and AM subteams will meet to amend the uncertainties associated with the MAP. Then, a strategy will be developed to prioritize these uncertainties for actual monitoring. Other adjustments driven by Tasks 1 through 3 will be made at this time. It is anticipated that this task will require one year to complete and it will begin in FY2020.

The result of this activity will be an evaluation of the 2009 MAP and documentation of the current state of knowledge, the current IDS, and its degree of implementation, *Water Resources Development Acts*, and predictions of climate change and sea level rise. This will include an accounting for MAP projects that are appropriate to continue as is, to continue with modification, and to create to address the current state of CERP implementation as well as future restoration issues and uncertainties. The evaluation of the MAP will be used to develop the 2021 MAP as the final task for the science integration effort. Determine the scope of the 2021 MAP so that updates can be provided in five-year intervals until the ecological changes in the system as a result of CERP implementation have stabilized.

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APPENDIX E: ADDITIONAL INFORMATION FOR OPPORTUNITIES FOR ADAPTIVE MANAGEMENT

INTRODUCTION

Adaptive management (AM) is a structured management approach to address uncertainties about restoration planning, design, and operations by testing hypotheses (e.g., operational tests, physical models, and targeted pre- and post-project monitoring), linking scientific results to decision making, and adjusting design and implementation, as necessary, to improve the probability of restoration success. AM helps answer key questions for restoration scientists, engineers, managers, and governmental and non-governmental stakeholders regarding the optimum approach for achieving restoration goals, and incorporates new monitoring data and other relevant information into decision making in order to improve CERP program/project design and execution.

The Restoration Coordination and Verification program (RECOVER) will work with scientists, planners, engineers, hydrologists, water managers, project managers, and program managers to identify and implement priority AM strategies to inform Comprehensive Everglades Restoration Plan (CERP or the Plan) projects in the next 5 to 10 years based on the Integrated Delivery Schedule (IDS).

CERP and non-CERP projects that will be examined include the following:

- Planning Phase – Loxahatchee River Watershed Restoration Project, Big Cypress – L-28 Interceptor Modifications (referred to as Western Everglades), and Lake Okeechobee Watershed

- Design – Biscayne Bay Coastal Wetlands, Broward County Water Preserve Areas, Central Everglades Planning Project (CEPP), and Indian River Lagoon – South C-23, C-24 and C-25 Basins

- Construction and Operations – Combined Operations Plan and C-111 Spreader Canal Western Project, Caloosahatchee River (C-43) West Basin Storage Reservoir Project, C-44 Reservoir and Stormwater Treatment Area Project (Indian River Lagoon – South), Picayune Strand Restoration Project, and Biscayne Bay Coastal Wetlands

BACKGROUND

CERP was authorized with the requirement to implement the Plan using AM principles (*Water Resources Development Act of 2000* [U.S. Congress 2000], Section 601). AM was not a new concept to natural resources management where ecological uncertainties can be high (Walters 1986, Gunderson 1999, Johnson 1999). Congress recognized that an AM approach must be used to address key uncertainties about how to best implement the various project components to ultimately achieve CERP restoration goals and objectives. The *Programmatic*

Regulations for the Comprehensive Everglades Restoration Plan; Final Rule (DOD 2003) set up a framework for the CERP AM Program. AM implementation was further recommended for water resource development projects nationwide by the National Research Council in *Adaptive Management for Water Resources Project Planning* (NRC 2004). Detailed technical guidance was provided on how to implement AM for CERP at both the program and project levels within both *The Comprehensive Everglades Restoration Plan Adaptive Management Integration Guide* (RECOVER 2011b) and *CERP Guidance Memorandum 56: Guidance for Integration of Adaptive Management (AM) into Comprehensive Everglades Restoration Plan (CERP) Program and Project Management* (SFWMD and USACE 2011). This guidance was consistent with the approach laid out in the *Adaptive Management: The U.S. Department of Interior Technical Guide* issued in 2009 (Williams et al. 2009) and *The Application of Adaptive Management to Ecosystem Restoration Projects*, which is a technical note produced by the United Army Corps of Engineers (USACE) Engineers Research and Development Center (Fischenich and Vogt 2012). Several project-level AM plans have been developed since the AM plans were required by USACE and CERP policy (LoSchiavo et al. 2013). Finally, the *Comprehensive Everglades Restoration Plan Program-Level Adaptive Management Plan* was developed to describe the various current AM and monitoring strategies being implemented to address key CERP uncertainties (RECOVER 2015).

This plan presented in this document will evaluate the AM strategies and opportunities to ensure CERP is generating critical information to inform decisions about the best plans, designs, and operations to maximize restoration performance in the most cost-effective way possible. It will do so utilizing the process shown in **Figure E-1**, which was developed by the USACE Engineer Research and Development Center (Fischenich and Vogt 2012). The basic AM process includes the following steps: (1) develop a restoration program and project AM plan, (2) design, build, and operate the project, (3) monitor selected parameters to measure project performance, and (4) assess monitoring results to support decisions on whether to continue project monitoring with no adjustment (inconclusive), adjust the project if goals and objectives are not being achieved, or determine whether the project has been successful.

Nine specific CERP AM activities were identified in *The CERP AM Integration Guide* (RECOVER 2011b) that provide more detail about how to integrate the AM process in **Figure E-1** into CERP program and project implementation and successfully implement AM to support CERP implementation. Not all projects and associated uncertainties can be addressed through AM, which is why the nine CERP AM activities support a process to identify which uncertainties could benefit from AM. New developments in structured decision making by the Department of the Interior could also further improve this process.

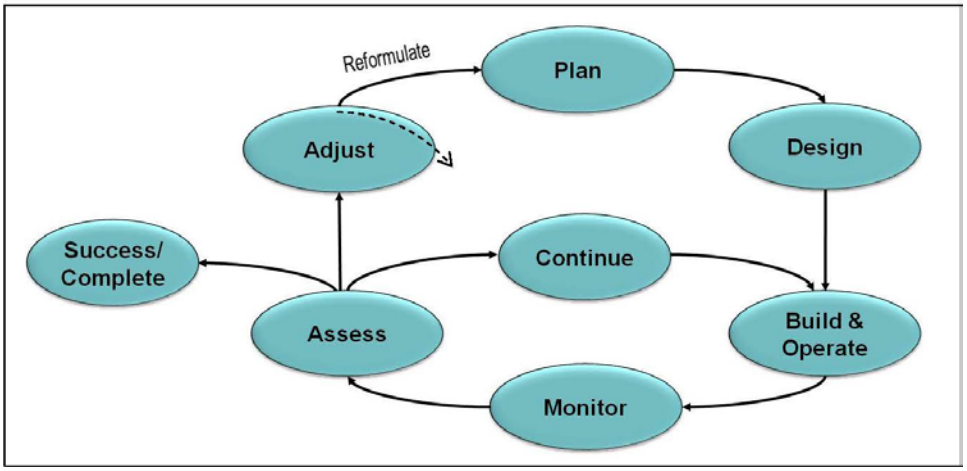

Figure E-1. AM process from the USACE Engineer Research and Development Center's *The Application of Adaptive Management to Ecosystem Restoration Projects* (Fischenich and Vogt 2012) modified from Nyberg 1999. (Note: This diagram shows how AM is conceptually represented in USACE and internationally.)

KEY ACTIVITIES

This section summarizes the key activities that need to be addressed as part of any AM strategy as described in *The CERP AM Integration Guide* (RECOVER 2011b). In addition, this section points out the linkage to other RECOVER five-year plan tasks that support the overall CERP AM program including conceptual ecological models (CEMs), hypotheses clusters, performance measures, interim goals, the *CERP Monitoring and Assessment Plan* (MAP; RECOVER 2009), and MAP synthesis and reporting. The key activities are as follows:

- **Activity 1:** Stakeholder engagement is key to ensuring key issues and concerns are considered, information is shared collaboratively to inform and build trust among stakeholders, and identifying creative solutions that can address or acknowledge stakeholder interests while still achieving restoration goals and objectives.

- **Activity 2:** For AM to be applicable, goals and objectives must be clearly defined for what the restoration program or project must achieve. For CERP, the overarching goals can be found in Table 5-1 of the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* (USACE and SFWMD 1999). RECOVER further clarified the vision for CERP restoration success as part of *A Vision Statement for the Comprehensive Everglades Restoration Plan* (USACE and SFWMD 2003). CERP projects clearly identify their goals and objectives in project implementation reports that can be found on www.Evergladesrestoration.gov.

- **Activity 3:** Uncertainties must be prioritized to focus on those that are decision-critical uncertainties that, if not addressed, will likely impair decision making during CERP planning and implementation and increase the risk that the program

or project(s) will not meet desired restoration goals and objectives. Two key criteria should be considered: (1) risk of insufficient information to support decision making, and (2) ability to inform other projects or project components. CEMs are a tool used to describe a suite of causal hypotheses that address uncertainties about achieving restoration goals and objectives. CEMS link environmental stressors and their effects on major ecological attributes. A degree of uncertainty is associated with each of those hypothesized relationships that are key to getting restoration right.

- **Activity 4:** Hypotheses about expected performance focused on ecosystems stressors, processes, and attributes that will respond to restoration are the basis for performance measure development. RECOVER systemwide and regional performance measures describe desired targets to be achieved for CERP. Interim goals are a subset of these performance measures used to evaluate expected performance for a group of restoration projects that move incrementally towards the full CERP restoration target. For projects, performance measures are identified in the project implementation reports.

- **Activity 5:** Development of AM plans identify how science will be used to test management actions and inform management options to adjust implementation, if necessary.

- **Activity 6:** The MAP (RECOVER 2009) sets up the systemwide monitoring necessary to measure CERP systemwide and regional performance and confirm or refute hypotheses outlined in the CEMs and MAP. Project-specific monitoring and AM plans have been developed for some projects that leverage the MAP and identify additional monitoring necessary to confirm performance at a project scale.

- **Activity 7:** Monitoring data is synthesized and reported to decision makers to support any necessary changes in restoration implementation

TASKS

The tasks being conducted for the Opportunities for Adaptive Management effort are as follows:

- **Task 1:** Review and update CERP uncertainties

- **Task 2:** Categorize and prioritize CERP and project uncertainties associated with Everglades ecosystem vulnerabilities (risk)

- **Task 3:** Develop passive and active AM strategy scopes

- **Task 4:** AM strategy design and schedule

Task 1: Review and Update CERP Uncertainties

Goals and Objectives

Any AM actions must first define and identify the environmental uncertainties that have the potential to undermine the success of Everglades restoration. This task builds upon the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015) looking forward to what uncertainties are relevant to CERP implementation over the next 5 to 10 years. Task 1 will produce a refined list of CERP uncertainties categorized by region, complexity, relevance, and potential for developing an active or passive AM strategy. The objective of Task 1 is to review the CEMs in collaboration with those performing the Science Review and Integration tasks and to ask the following questions:

- Do findings from past and current MAP and AM efforts merit refinements to the list of regional uncertainties and, if so, what refinements?
- Can these refined uncertainties be prioritized and categorized according to importance, understanding, and predictability (initiated in Task 1 and finalized in Task 2)?
- How would the proposed refinements inform the planning, design, and scheduling of active and passive AM strategies?

Process

The *CERP Program-Level Adaptive Management Plan* (RECOVER 2015) compiled all CERP related uncertainties and described current AM strategies to address them. This plan looks forward to what uncertainties are relevant to address CERP implementation over the next 5 to 10 years. This large list of uncertainties needs to be sifted, sorted, and prioritized according to AM practicality and importance. Reviewing and refining the AM uncertainties will start with a review of the Total System CEM (Ogden et al. 2005) because it is relevant to the entire system and refinements made to it will influence the prioritization and justification of a final suite of implementable AM science plans (see Task 4). Organizing the remaining existing CEMs (Barnes 2005, Browder et al. 2005, Crigger et al. 2005, Davis et al. 2005a, 2005b, Duever 2005, Havens and Gawlik 2005, Ogden 2005, Rudnick et al. 2005, Sime 2005, Van Arman et al. 2005) into the order in which they should be reviewed will follow. Order will be determined by criteria developed by the expanded RECOVER AM Subteam and coming out of the initial Science Review and Integration tasks. Potential criteria may include relevance to planning studies expected in the near future as identified by the IDS and/or linkage to an interim goal or interim target.

As part of the Science Review and Integration tasks mentioned early in this plan, a series of workshops will be held to review the existing CEMS and hypothesis clusters prior to the refinement of the AM uncertainty list. This effort will be informed by consideration and incorporation of other compilations of new knowledge and uncertainty. The effort to review CEMS and hypotheses clusters also will be informed by a broad set of participants, including project managers, engineers, hydrologists, planners, the South Florida Ecosystem Restoration

Task Force Science Coordination Group, academic participants, and representatives from the USACE National Ecosystem Restoration Planning Center of Expertise. The groups will use various RECOVER documents, including the RECOVER SSRs (RECOVER 2007a, 2007b, 2010, 2012, 2014), *Scientific and Technical Knowledge Gained in Everglades Restoration (1999–2009)* (RECOVER 2011b), and *CERP Program-Level Adaptive Management Plan* (RECOVER 2015).

The effort to refine the CEMs is anticipated to last no more than one year. However, refinement of the complete set of AM uncertainties is expected to take more time than the refinement of the CEMs, so the timeline should be planned accordingly. This effort will be iterative as information gained from other tasks within RECOVER's five-year planning effort (such as the Science Review and Integration Task 2 ecological vulnerability analysis) could warrant a focused recheck of the uncertainties and the CEMs if analysis reveals key new uncertainties that pose a risk to achieving restoration success.

RECOVER will then coordinate with managers on the key uncertainties that could be informed by AM. If necessary, the CEM review order established for the Science Review and Integration section may be adjusted to prioritize and design a set of AM science plans (Tasks 3 and 4 below) at the regional level.

Products

The products for this effort is an updated list of consolidated and refined uncertainties, grouped by region and linked to appropriate projects, the IDS, and the updated CEMs.

Task 2: Categorize and Prioritize CERP and Project Uncertainties Associated with Everglades Ecosystem Vulnerabilities (Risk)

Goals and Objectives

This tasks will prioritize CERP and project uncertainties most relevant for AM implementation and needed to ensure CERP restoration success. The criteria outlined in *The CERP AM Integration Guide* (knowledge, risk, and relevance) will be used with a few updated methods (RECOVER 2011b).

Process

Evaluation criteria must first be defined and agreed to by the expanded AM Subteam to help categorize and prioritize uncertainties. The following criteria are suggested but could be modified prior to executing this task:

- Categorize uncertainties by level of understanding (knowledge) – Identify the degree of understanding associated with each uncertainty. This typically can be determined as high, medium, or low.

- Categorize uncertainties by ecological vulnerability (risk) – Uncertainties will be categorized by degree of ecological vulnerability related to achieving CERP restoration success. Ecological vulnerability is defined as the risk that an

ecosystem will experience large-scale harm, to which it has limited ability to cope or adapt, and from which it may not return to its unharmed condition. Ecological vulnerability is a product of exposure, sensitivity, and lack of resilience to harm. Ecological vulnerability should be related to a particular area of the Everglades that is to be restored, as identified as part the Science Review and Integration tasks discussed earlier in this plan. Ecological vulnerability can be linked to ecosystem restoration uncertainties by examining (1) areas where there maybe unintended consequences associated restoration actions, (2) recent trends in ecosystem process and attributes that suggest they are in decline, or (3) areas where ecological succession is not well understood or may take decades. Those ecosystem processes and attributes that are most vulnerable pose the most risk to getting restoration right.

- Categorize uncertainties by relevance to decision makers (relevance) – AM is only appropriate if the information gained to address a particular uncertainty will help inform a restoration decision. Problems and associated restoration decisions must be defined clearly as part of this task. The Department of Interior AM problem scoping criteria (Williams et al. 2009) can be used to help frame the decision. Those uncertainties that are related to CERP restoration planning, design, or operations over the next 5 to 10 years as described in the IDS are most relevant. Those uncertainties that do not link clearly with any restoration decisions are not relevant for AM. This tasks will require coordination with planners, engineers, water managers, program managers, and project managers to ensure the restoration decisions are appropriately defined.

- Hold a prioritization workshop – The expanded RECOVER AM Subteam (including knowledgeable engineering, planning, and water management leads) will prioritize uncertainties based on the three prior criteria, order them by when they would need to be implemented to timely support restoration decisions and number of restoration projects that will benefit. During this workshop, team members may identify potential AM strategies to consider in addressing priority uncertainties.

- RECOVER and broader scientific community review – The prioritized list of uncertainties will undergo RECOVER and CERP agency review to ensure they are scientifically, technically, and management relevant.

Products

The products of this task will be (1) a prioritized list of uncertainties and potential AM strategies (active and passive AM) and (2) a narrative document that explains how refinements can inform the planning, design, and scheduling of active and passive AM strategies.

Task 3: Develop Passive and Active AM Strategy Scopes

Goals and Objectives

Conceptual designs for each AM strategy will be developed with costs and schedule for implementation.

Process

A 3 to 5 page scope of work will be developed for each priority active AM strategy. Passive AM strategy scopes will be developed in coordination with the other tasks discussed in this plan. The RECOVER AM Subteam will identify small teams to develop each proposal based on the nature of the expertise needed (estuarine or freshwater, fish and wildlife or vegetation, or engineering or hydrology). Teams will have 2 to 3 months to put together scopes of work that will be evaluated by the expanded RECOVER AM Subteam. The following list provides guidance on needed information:

- CERP AM Uncertainty – The uncertainty is a question faced during planning or implementation regarding the best restoration actions to achieve desired goals and objectives within constraints, which cannot be fully answered with available data or modeling. Uncertainties were screened and prioritized to determine which to include in the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015).

- CERP Restoration Problem and Decision to Inform – What restoration actions, designs, and operations will be tested and how will that information inform restoration decisions in the future?

- Associated CERP Project Features and Location – Structures or measures to which the uncertainty and strategy pertain.

- Expectations or Hypotheses to Be Tested to Address the Uncertainty, and Attribute(s) That Will Be Measured – A scientific approach begins with a well-informed, pointed, detailed statement that will be tested. It leads to proper identification of what to measure, how to measure, how often to measure, how to analyze, etc. Ideally, the hypotheses at a minimum must be supported by CEMs and literature. More Information on attributes to be measured include the following:

    - What values for the specific attributes will indicate meaningful change to address the uncertainty? *Values ideally are provided by predictive models or best professional judgment.*

    - What is the timeframe in which changes to this attribute are expected to be measurable?

  - Is this attribute complimented by other monitoring programs within and outside of CERP? In other words, will existing monitoring be leveraged from RECOVER, project, or non-CERP agency funded programs.

  - Given the IDS schedule for the projects to be informed, when should this monitoring begin and end?

- Methodology for Testing Each Expectation or Hypothesis (Including Frequency of Monitoring) and for Reporting – More information on what to measure, how to measure, how often to measure, how to analyze, and when and how to report results. Please note that the *CERP Program-Level Adaptive Management Plan* (RECOVER 2015) varies in the level of methodology detail provided; in several cases the details will be formed during CEPP's detailed design phase. In all cases, methodology will be reviewed, updated, and adjusted if needed by agency subject experts, before initiation, to best meet the intent of the *CERP Program-Level Adaptive Management Plan*.

- Triggers/Thresholds That Indicate Good CERP Performance or Need for Adaptive Management Action – Triggers or thresholds are a point, range, or limit that signifies when restoration performance is veering away from expectations and is trending toward an unintended outcome. Triggers/thresholds should be described per attribute to be monitored because each should result in an outcome that informs management decisions.

- Management Options That May Be Chosen Based on Test Results – Management options are provided in case a performance trigger or threshold is crossed, which would indicate that CERP performance needs to be adjusted. The management options are suggested paths forward and adjustments that can be made to keep CERP progressing toward objectives and within constraints. The management options should be summarized in tables after each region's strategies.

- Costs – Estimated resources in labor and contract dollars to implement the AM strategy. Rough order magnitude costs and schedule will be appropriate. Estimates should include any environmental, engineering design, or model analysis needed to implement appropriately.

After proposals are submitted, they will be reviewed for completeness by the expanded AM Subteam members, which will include agency managers, project managers, members of the RECOVER Leadership Group, and members of the RECOVER Executive Council, in addition to the existing AM Subteam. During a one-day meeting, the expanded AM Subteam members will hear presentations on each scope and provide feedback to confirm hypotheses and expected performance, review and update potential actions, and review and update monitoring needed. The AM Subteam will confirm those AM strategy proposals that are viable and request updates to AM strategy proposals that need improvement. Final proposals will undergo RECOVER and

management review to ensure they are scientifically sound and beneficial from a restoration management perspective.

Products

The products of this effort will be an expanded AM strategy scopes of work and a schedule supported by RECOVER and agency management.

Task 4: AM Strategy Design and Schedule

Goals and Objectives

This task will produce the science plans needed to implement the most relevant and critical AM strategies (plans), with an emphasis on active AM. These plans will include detailed methodologies and potential actions that incorporate physical features such as mesocosms, physical models, operational field tests, treatments and controls, and modified MAP monitoring stations to address project and program-level vulnerabilities and uncertainties.

Activities

The most important aspect of Task 4 is to develop detailed science plans. This is crucial because science plans demonstrate the feasibility, relevance, and integration of the project and program levels for Everglades restoration, so that each AM effort can provide planning, design, and operations guidance to CERP as a whole. Science plans are peer reviewed and reviewed for permitting needs.

The AM strategy scopes that are deemed viable in Task 3 above will go back to the teams that developed them to then develop a more detailed and implementable science plan. The key to a successful, well designed, and implementable active AM science plan is the ability of the approach to experimentally manipulate a stressor or driver within the footprint of the larger restoration landscape without causing irrevocable damage to the ecosystem. This can be in the form of pilot studies, physical models, modified water deliveries, exclusion fences, faunal replacements, and chemical treatments, to name a few.

Upon reaching Task 4 it will be clear which areas within the system are more vulnerable than others and the level of certainty about how these areas can be made more resilient without possible negative side effects, so that an AM approach can be considered. There will always be the potential for restoration-environmental trade-offs with AM. The uncertainties are usually associated with not understanding the degree of the trade-offs and whether there is an ideal point that optimizes competing objectives. AM can work well for these kinds of uncertainties because it can experimentally manipulate a stressor or driver to create a response surface.

To meet these goals and objectives, Task 4 will also structure the criteria and science panels needed to review these science plans to determine any modeling, engineering, design, and environmental review that may be needed to implement the strategy, as well as whether the science is sound, approach is feasible, and statistics are accurate. Reviewers will need to include those on the AM Subteam, those involved in the Science Review and Integration effort, project

managers, hydrologists, environmental leads, statistical experts, and planning leads. If an AM science plan has the potential to alter current ecosystem goods and services, then this review panel may also include non-governmental organization representatives, tribal leaders, and staff from other government agencies such as the United States Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission. When the Task 4 request for proposals and detailed science plans is made public, it should be clear that there are specific and possibly unique operational and physical AM options that can move Everglades restoration forward.

Science plans with replication tend to have the strongest power. However, replication is not always appropriate because it can involve large geographic regions and fiscal resources. Science plans that use a before-after-control-impact (BACI) or Bayesian approach can focus on causality as long as the sampling extent and frequency are at a credible interval, relevant to the drivers or stressors.

The science plans should follow the following template:

- Introduction – This provides the relevant background with an emphasis on the conceptual models, uncertainties, and vulnerabilities reviewed in Tasks 1 and 2 above in conjunction with those involved in the Science Review and Integration effort.

- Goals and Objectives – This provides specific hypotheses and causal relationships that will be explored in the science plan.

- Justification – Why is this science needed? This provides the specific relevance to CERP, CEPP, and a particular project design (if appropriate). Here it is important to present and discuss restoration goals, trade-offs, trends, legal issues, and mandates.

- Methods – The details of the AM approach is presented here. This would include the design of any structures or operational protocols that are needed. It must include detailed numeric, statistical, operational, structural, and procedural methods needed to meet the stated goals and objectives.

- Costs and Schedule – A quarterly breakdown of the costs associated with the monitoring design, sampling extent and frequency, construction, permitting, etc.

Task 4 will require an extensive process of careful review of all proposed AM science plans to ensure they are implementable. For example, the Decomp Physical Model was a well-designed, valuable AM plan needed to achieve the restoration goal of sheetflow. It required the manipulation of the hydrology to create high water conditions, which could, in turn, be damaging to tree islands. Tree islands are significant biodiversity hot spots and also culturally significant to the Miccosukee Tribe of Indians of Florida. An important and needed AM plan can be optimized, redesigned, or moved with the help of an expanded review team. Team members will link final

selected AM plans to the current IDS as part of a final process of scheduling and implementing any new AM strategy.

Products

The product of Task 4 will be an executive summary of the schedule, costs, designs, and implementation needs for the top three recommended AM science plans. It will include as an appendix, a comprehensive, prioritized list of AM science plans with suggested funding at the CERP program or project level, whichever appropriate.

CHALLENGE

The challenge of any AM program is making sure that the information that is learned is significant and relevant to restoration success and that there are mechanisms in place to make the needed adjustments to the restoration design. The tasks are designed to examine all uncertainties associated with CERP implementation. Those uncertainties that are timely and relevant to address planning, design, and operations decisions based on the IDS or are decision-critical because of the risk they pose to achieving success (e.g., vulnerable ecosystem attributes and processes) will be prioritized for implementation over the next 5 to 10 years.

CONCLUSION

This plan for conducting AM is designed to address "How do we restore an historic Everglades with the amount of water that will be available?" This plan guides CERP and increases the probability of restoration success by focusing on highly vulnerable areas where CERP can have the greatest restoration impact. Ultimately, the information gained from targeted AM strategies will help inform decisions related to MAP monitoring priorities and actions to 'jump start' restoration and improve resiliency in areas that are vulnerable to climate change and other key drivers of change.

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