CWPPRA Adaptive Management Review
Final Report

by

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BACKGROUND

The Coastal Wetlands Planning, Protection and Restoration Act was signed into law by President George Bush in 1990. Since that time, Louisiana and six Federal agencies (U.S. Environmental Protection Agency, National Marine Fisheries Service, Natural Resources Conservation Service, U.A. Army Corps of Engineers, U.S. Fish and Wildlife Service, and U.S. Geological Survey/National Wetlands Research Center) have partnered to develop a series of annual priority project lists to target Louisiana's wetland loss. After several years of planning and establishing the restoration program, construction was completed on the first project (LaBranche Wetlands, PO-17) in April 1994. Since that time, a total of 60 CWPPRA projects have been constructed in Louisiana with project areas encompassing nearly 600,000 acres. The CWPPRA program has served not only to protect and create coastal wetlands, but in doing so, it has evolved from an initial emphasis of putting projects on the ground, to the current emphasis of addressing those areas in the coast with the highest need.

Coastal wetland loss was not recognized as a problem in Louisiana until the late 1970's (Craig et al. 1979, Gagliano et al. 1981). Consequently, the science of wetland restoration is relatively young (Day and Craig 1982). The basic technology necessary to restore and create many habitat types is available, but there are also habitats for which we currently have only rudimentary knowledge (Hackney 2000).

Predicting the success of restoration projects is an inexact science (National Research Council 1992). Environmental systems are inherently complex. Therefore, during the development of a restoration project, the knowledge about the state of the system, the prognosis for further development, and the measures needed to correct problems is often incomplete (Thom 2000). It is impossible to know the ecological consequences of people's actions without data and information; information on past changes can be used to predict future environmental reactions. In addition, the only way to manage complex systems is through collaboration in which information is shared among all user groups and managers.

Adaptive Management, which can be loosely defined as learning by doing, relies on an accumulation of evidences to support a decision that demands action (Walters and Holling 1990). Critical to this effort is the feedback of information among the various phases of project selection, engineering and design, construction, monitoring, and operations and maintenance. All phases of project management must be coordinated and must share information, not only to maximize the benefits on a project-by-project basis, but also to carry the information learned from past projects into the development of future projects.

The Adaptive Management Review was interpreted as a means to close some of the feedback loops between the different phases of project planning, implementation, and results monitoring. The Adaptive Management Review is CWPPRA's first large-scale evaluation of constructed projects in an attempt to institutionalize the feedback of information from existing projects to the benefit of those projects, as well as the benefit of future projects. Twenty-one percent of the projects reviewed in this Adaptive Management Review were non-CWPPRA projects. Those non-CWPPRA projects include Naomi (BA-03), West Pointe a la Hache (BA-04), and Turtle Cove (PO-10). Thus, all conclusions cannot be attributed to CWPPRA projects.

OBJECTIVES

The objectives of the review were to (1) improve the linkages among planning, engineering and results monitoring, (2) document changes made to the project in the different phases of project development and implementation, (3) recommend any changes that could improve the project and (4) learn from implemented projects so that future projects can be improved.

REVIEW PROCESS

The review was coordinated by Rick Raynie (LDNR) and Dr. Jenneke Visser (LSU) and involved members of six federal agencies, four universities, and the State of Louisiana representing the CWPPRA Environmental Work Group, Engineering Work Group, Academic Advisory Group, Monitoring Work Group, and Technical Advisory Group.

Five working groups were identified on November 28, 2001 to formulate a plan of action for this review. The working groups covered both specific project review components and program level review components. Project level review included Engineering, Physical and Biologic Response working groups. Program level review included Methods and Ecosystem working groups. All working groups had interdisciplinary representation from multiple agencies and at least one academic advisor.

The Engineering working group was tasked to identify the following:

Projects to be evaluated from an engineering standpoint. Ensure projects with available data and/or data that can be collected in allotted time frame are selected.
Engineering components of the selected projects.
Project construction goals
Project feature success criteria Was the project feature designed correctly? Was it built as designed? Did the project features create the desired physical alterations? Should this be based on the projects goals and strategies? Or should this be the physical parameters that were altered by the engineering features?
Identify data needs for project feature evaluation
Identify available data
Identify data gaps

The Response working group (combined from the physical and biotic groups) was tasked to identify the following:

Projects to be evaluated from a physical and biotic response standpoint. Ensure projects with available data and/or data that can be collected in allotted time frame are selected.
Project response goals (i.e., increase percent cover of intermediate marsh vegetation, increase marsh:open water ratio, stop shoreline erosion, etc.)
Project response success criteria i.e., did the percent cover of intermediate vegetation increase? Was the marsh:open water ratio increased? Was shoreline erosion halted?
Identify data needs for project response evaluation
Identify available data
Identify data gaps

The Ecosystem group was tasked to identify the following:

Performance indicators that can be used to evaluate projects across all project types and within every hydrologic basin. Performance indicators should be as much as possible applicable to a variety of project types. Some may have sublevels for different project types or explanations for interpretation of the indicator for different project types. The goal is to give each project the same type of review.

Inspiration sources for performance indicators:

1. Indicators development workshop BTNEP
2. Coast2050 criteria
3. WVA
4. Boesch, D.F. 1999. Measuring the Health of the Chesapeake Bay: Toward Integration and Prediction. Environmental Research Section A 82: 134-142. http://www.idealibrary.com/links/doi/10.1006/enrs.1999.4010

The Methods group was tasked with the following:

Projects to be evaluated from a methods review standpoint. Ensure projects with available data and/or data that can be collected in allotted time frame are selected.

Method response success criteria. The primary goal of that review is to summarize the best ways to apply certain methods and learn from past mistakes. This review may also be used to make suggestions on how to improve those projects that have one or more bad performance marks

Identify data needs for method evaluation

Identify available data

Identify data gaps

All participants met on January 15, 2002 to develop a comprehensive plan for completing this review. Each working group presented the results from their team meetings. Each team independently subdivided their projects by project-type and it was decided that once projects were selected, the reviews would be most beneficial if conducted by interdisciplinary teams organized by project-type, rather than by discipline. It was also decided at this meeting to focus the adaptive management review on the review of individual projects. The budget and time constraints combined with the relative recent construction of most projects precluded a thorough comparison of different restoration techniques.

For this review, and for the presentation of findings in this report, information is grouped by project-type. Reviews were completed on the following types of projects: Marsh Management/Hydrologic Restoration, Freshwater Diversion, Beneficial Use of Dredge Material, and Shoreline Protection.

Project Selection

Projects for review (see table 1) were selected by a consolidation of the projects selected by the disciplinary teams (Engineering, Physical and Biologic Response, Methods, and Ecosystem) and were subset from the complete list of constructed projects. Selection criteria included length of time since construction, length of monitoring data record, number of variables monitored, availability of project information, and similarity to other projects proposed for review. It should be noted that it became evident during this process that most projects had not been constructed long enough to have a sufficient amount of data with which to conduct a thorough review; and

Table 1. Restoration project selected for adaptive management review.

Restoration Method	Group	Location	Sponsoring Agency*	CWPPRA No.	State No.
Marsh management / Hydrologic Restoration	Active	Freshwater Bayou	NRCS	XME-21	ME-04
		East Mud Lake	NRCS	PCS-24	CS-20
	Passive	Brady Canal	NRCS	PTE-26b	TE-28
		Cote Blanche	NRCS	TV-04	TV-04
Freshwater Diversion		Naomi	State		BA-03
		West Pointe a la Hache	State		BA-04
		Caernarvon	WRDA: USACE & State		BS-08
Dredged Material	Barrier Islands	East Island	EPA	TE-20	TE-20
		Trinity Island	EPA	XTE-41	TE-24
		Whiskey Island	EPA	PTE-15bi	TE-27
	Wetland Creation	LaBranche	USACE	PPO-10	PO-17
		Atchafalaya	NMFS	PAT-02	AT-02
		Lake Chapeau	NMFS	PTE-23/26a/33	TE-26
Shoreline Protection	Bay/Lake	Turtle Cove	State		PO-10
		Lake Salvador	NMFS	BA-15	BA-15
		Cote Blanche	NRCS	TV-04	TV-04
	Canal	Cameron Prairie	USFWS	ME-09	ME-09
		Vermilion RCO	USACE	FTV-03	TV-03
		Clear Marais	USACE	PCS-27	CS-22

EPA= Environmental Protection Agency
NMFS= National Marine Fisheries Service
NRCS= Natural Resources Conservation Service
USACE= U.S. Army Corps of Engineers
USFWS= U.S. Fish and Wildlife Service
WRDA= Water Resources Development Act
State= State of Louisiana

therefore, the final list of projects that qualified for this review were composed, by default, of only the early projects. The planning and development process currently used in the CWPPRA program is significantly different than that of early years as a result of adaptive management changes having already been applied due to "lessons learned". Throughout the text in this document the projects are identified by their state number.

New teams were formed based on project type, and project-specific work groups were subset to conduct the actual project reviews. Each work group consisted of representatives from a minimum of the State, the federal sponsor, and academia (table 2). And each work group followed a specific outline which is the core of each report. This outline was developed based on the results of the different working groups and reflects the overall objectives of the adaptive management review.

LESSONS LEARNED AND RECOMMENDATIONS

For project-specific details, please refer to the completed reports in the Appendix. The remainder of this section presents a quick review of each project, the overall lessons learned and recommendations for each project, as well as overall recommendations for each project type.

Marsh Management/Hydrologic Restoration

Table 3 provides a quick overview of the review for the four Marsh Management/Hydrologic Restoration projects. Two of these projects will likely not have the desired restoration effect without modification. For ME-04 this is due to the fact that the construction, operation, and maintenance are under control of the landowner and some features were not completed. The water control structures funded by CWPPRA were a subset of a larger group of structures proposed by the landowner. Some of these proposed structures were not completed. In addition, operations of the water control structures are the landowners responsibility and are not always consistent with the objectives of the CWPPRA project. Documentation of operational changes is not always available to CWPPRA. Preliminary observations suggest that land loss continues in this project area. For TE-28, the construction of one of the designed features has been deferred to another CWPPRA project that is still in the design phase. Therefore, these two projects (ME-04 and TE-28) can not be currently operated as designed. The CS-20 project has structures that were built as designed, but one of the key structures was vandalized and has been inoperable for most of the project life. It was also discovered that the operational plan for this project was based on an erroneous marsh level, but this has been corrected. Despite these difficulties, preliminary observations suggest that land loss rates within this project may have decreased. Only one of these projects (TV-04) was built and operated as designed, and preliminary monitoring data suggest that the project is achieving the desired effect of reducing the rate of land loss .

Table 2. Project-specific work groups members for the CWPPRA Adaptive Management review. The team leaders are identified in bold print. Projects are identified by their state number.

HYDROLOGIC RESTORATION/MARSH MANAGEMENT

Agency	TV-4	ME-4	TE-28	CS-20
NRCS	**Cindy Steyer**	**Marty Floyd**	**Loland Broussard**	**John Jurgensen**
NRCS	Loland Broussard	John Jurgensen	Cindy Steyer	Marty Floyd
DNR Mon. Mgr.	Christine Thibodeaux	Karl Vincent	Todd Folse	Dona Weifenbach
NMFS	Joy Merino	John Foret	John Foret	Joy Merino
Academic	Erick Swenson	Erick Swenson	Denise Reed	Denise Reed
EPA	Ken Teague			Ken Teague
USGS	Greg Steyer			Greg Steyer
USACE		Richard Boe	Richard Abshire	
USFWS				
DNR	Herb Juneau	Mel Guidry	Darin Lee	Phil Pittman
		Kyle Balkum	Brian Babin	Garrett Broussard

BENEFICIAL USE OF DREDGED MATERIAL

Agency	AT-2	PO-17	TE-26	TE-20, 24, 27
NRCS	Marty Floyd	Marty Floyd	Marty Floyd	Cindy Steyer
	John Jurgensen	John Jurgensen	John Jurgensen	Loland Broussard
DNR Mon. Mgr.	John Rapp	Bill Boshart	Elaine Lear	TE-20 Todd Hubbell
	Darin Lee	John Troutman	Darin Lee	TE-24 Glen Curole
				TE-27 Todd Hubbell
NMFS	**John Foret**	Dianne Lindstedt	**Joy Merino**	TE-20 John Foret
				TE-24 Dianne Lindstedt
				TE-27 Joy Merino
Academic	Shea Penland / Mark Hester	Mark Hester	Mark Hester	Shea Penland
EPA	Jeanene Peckham	Jeanene Peckham	Jeanene Peckham	**Jeanene Peckham**
USGS	Bill Jones		Greg Steyer	
USACE		**Richard Boe**/ Jason Binet		TE-20 Jason Binet
USFWS				
DNR	Van Cook	**Phil Pittman**	David Burkholder	**Hilary Thibodeaux**
	Herb Juneau	David Burkholder	Hilary Thibodaux	Darin Lee
		George Boddie		
		Van Cook		
		Troy Barrilleaux/ Mike Miller Mark Mouledous		

(Continued)

Table 2. Continued.

FRESH WATER DIVERSION

Agency	BA-4	BA-3	BS-08
NRCS	Cindy Steyer	John Jurgensen	Loland Broussard
DNR Mon. Mgr.	Bill Boshart	Bill Boshart	**Bruce Baird**
NMFS	Dianne Lindstedt	John Foret	Joy Merino
Academic	Charles Sasser	Gary Shaffer	Charles Sasser/Gary Shaffer
EPA		Ken Teague	Ken Teague
USGS	Greg Steyer		
USACE	Richard Boe		Richard Boe
USFWS			
DNR	**Van Cook**	Van Cook	**Chuck Villarrubia**
	Ed Haywood	**Paul Gremillion**	Paul Gremillion
	Paul Gremillion	Ed Haywood	Cheryl Brodnax
	John Troutman	John Troutman	John Troutman

SHORELINE PROTECTION

Agency	ME-9	CS-22	ME-4	TV-03
NRCS	Marty Floyd	Marty Floyd	Marty Floyd	Marty Floyd
	John Jurgensen	John Jurgensen	John Jurgensen	John Jurgensen
DNR Mon. Mgr.	Troy Barrilleaux	Mike Miller	Ralph Libersat	Ralph Libersat
NMFS	John Foret	Dianne Lindstedt	John Foret	Joy Merino
Academic	**Andy Nyman**	Andy Nyman	Andy Nyman	Andy Nyman
EPA	Wes McQuiddy	Wes McQuiddy	Wes McQuiddy	Wes McQuiddy
USFWS				
USACE		**Richard Boe**	Richard Boe/ Jason Binet	**Richard Boe**
DNR	Mel Guidry	Mel Guidry	**Mel Guidry**	Mel Guidry
			Agaha Brass	Deetra Washington

Agency	BA-15	PO-10	TV-4
NRCS	Cindy Steyer	Cindy Steyer	**Cindy Steyer**
	Loland Broussard	Loland Broussard	Loland Broussard
DNR Mon. Mgr.	Glen Curole/Darin Lee	John Troutman	Ralph Libersat
NMFS	**Dianne Lindstedt**/Joy Merino	John Foret	Joy Merino
Academic	Larry Rouse	**Larry Rouse**	Larry Rouse
EPA	Wes McQuiddy	Wes McQuiddy	Wes McQuiddy
USACE	Jason Binet	Richard Boe	
USFWS			
DNR	George Boddie	George Boddie	Herb Juneau
		Rick Raynie	**Agaha Brass**
			Deetra Washington

ME-04 Freshwater Bayou

Project Effectiveness

At this time, it can not be determined whether or not the project is working as expected. One reason is the deterioration of the spoil bank along Freshwater Bayou (FWB) Canal. This spoilbank has deteriorated to the point where it no longer functions adequately as a perimeter levee around this management unit. On high tides, water from FWB Canal enters the project area through breaches in the canal spoil bank. Water may also be entering from other sources as well. As designed and operated, the water control structures can not remove as much of the water as is entering the system, so ponding continues to occur. A point to remember is that these CWPPRA project structures are only a subset of structures used by the landowner to manage these wetlands. Bathymetry and hydrologic exchanges in this area are not clear and limit the evaluation of project effects.

Other possibilities which may have led to the inability to determine project effectiveness may be the weight of flapgates which may limit their ability to drain water out of the project area, and the change in southern portion of the project area to more of a flotant marsh.

Recommended Improvements

1. Rebuilding the spoil bank along FWB Canal and Acadiana Marina Canal to an elevation of 4.0 to 5.0 ft NAVD appears to be essential for achieving success with this project.
2. Lighten the flapgates on the structures so that they will operate even with low head differentials, and modify the structure operation plan to encourage a northwest to southwest flow pattern, in an effort to bring fresh, sediment laden water from White Lake and Schooner Bayou into the project area marshes.

Lessons Learned

1. Rock dikes break waves but they do not always stop water exchange between canal and marsh. Shoreline protection/stabilization projects along canal and marsh interfaces where salinity is a concern need to include building or rebuilding a perimeter embankment as a component along with some form of protection from wave energy (rock dike, rip rap, etc.)
2. The landowner intended to have the spoil banks along the west side of FWB Canal and along the north side of Humble/Acadiana Marina Canal repaired through a combination of mitigation for oil/gas projects on Vermilion Corp properties, possible maintenance dredging activity on these channels, and efforts of Vermilion Corp. Although endorsed at the time as a means to stretch state matching dollars and enlist more cooperative support of landowners, this piecemeal approach has not worked. As essential as these embankments are to managing water level and salinity in the project area, there is no mechanism in the Engineering & Design or the Operations & Maintenance plans to address this matter. Current embankment conditions are reducing the level of benefits the rock dike and additional structures could provide. Therefore, CWPPRA needs to have oversight of O & M. Additionally, the rock used was recycled from the Wax Lake Outlet structure and was smaller in size than normally used for this project type.

Table 3. Answers to the most important questions from the project review from the review of four hydrologic restoration projects.

	ME-04	CS-20	TV-04	TE-28
Construction completed:	1994	1996	1998	1999
Was project constructed as designed?	Construction, operation, and maintenance of water control structures are the landowners responsibility. Structures were not constructed and operated as designed. The rock dike along Freshwater Bayou is permeable and needs maintenance.	All water control structures were built as designed. The planting component was moved to local soil and water conservation district and resulting plantings were less than designed.	All water control structures were built as designed.	Some of the features from this project were deferred to the Penchant project, because of budget limitations. Including the structures that were supposed to increase freshwater inflow into the area and breaches in the southern part that allow saline water into the project area.
Was project operated as designed?	Flap gates are too heavy and do not allow sufficient drainage. Stop logs are improperly set by vandals and have design flaws.	One of the structures was vandalized one year after construction. Repair was done three years later and was unsuccessful. New repair is being evaluated. Original operation plan was based on wrong marsh elevation, this was corrected in 2000.	yes	No operation plan was in place after construction. Operation will start in 2002.
Physical response as required for healthy marsh?				
Inundation	Inundation frequency and duration data have not been finalized due to marsh elevation survey problems. Water does not drain with high wind tides and water is kept high during waterfowl season.	During the drought inundation was severely reduced causing compaction of the soil. High precipitation events lead to excessive inundation, which was caused by an incorrect operations plan.	Inundation frequency and duration falls within the range expected for healthy marshes, but is higher than in the reference sites.	This is not applicable because most of the project area contains floating marsh. However reducing water level fluctuations was one of the goals of the project.
Salinity	Salinity was within the range for healthy marsh, except during the drought. The permeable and low elevation rock dike along Freshwater Bayou and other cuts along the project perimeter allow saline water into the project area.	Salinity was higher than the range for healthy marsh. This was partially due to the vandalism on one of the structures and the extreme drought conditions in the area.	Salinity was in the range for the dominant vegetation, except during the drought.	Salinity was within the range for healthy marsh.
Biological response as required for healthy marsh?				
Vegetation cover and composition	Fresh and intermediate vegetation were targeted by this project. The southern and eastern ends of the project area are transitioning into brackish marsh.	Coast wide vegetation surveys indicate that the project area remained classified as brackish marsh.	Vegetation was not monitored. Casual observations and coast wide vegetation surveys indicate healthy marsh.	No post construction vegetation data is currently available.
Land loss rates	No post-construction photography has been analyzed. Ocular review of photographs suggest increased land loss in the project area.	No post-construction photography has been analyzed. Ocular review of photographs suggests reduced land loss in the project area.	No post-construction photography has been analyzed. Ocular review of photographs suggests reduced land loss in the project area.	No post-construction photography has been analyzed.

CS-20 East Mud Lake

<u>Project Effectiveness</u>
A great deal has been learned from this project. It is difficult to determine if the project is working or not working due to extremes in weather and vandalism at a critical structure. However, operations have been adapted to these conditions.

<u>Recommended Improvements</u>
1. Continue intensive monitoring and respond faster to maintenance of structures.
2. Oversee operation of structures.
3. Streamline the process such that when a problem is identified by the monitoring manager and brought to the attention of the project manager, it is addressed and repair is contracted and constructed in a timely manner. Minimize delays if possible.

<u>Lessons Learned</u>
1. See NRCS Post Construction meeting notes for lessons learned in construction and design and for recommendations for future structures.
2. In a brackish marsh, prevent ponds from drying out completely, even if outside water salinity is high. Reference area vegetation suffered less loss of cover and recovered more quickly than the project area even though it was exposed to salinities as high as the project area, however the project area was showing increased diversity as a result of freshening and therefore may have been more intolerant to elevated salinity levels.

TV-04 Cote Blanche

<u>Project Effectiveness</u>
Project construction has only been completed since January 1999. This was followed by two years of historic drought conditions so significant biological response to the structures has likely not occurred. The hydrologic response to the structures appear positive under these conditions, and longer datasets over a variety of environmental conditions will be necessary to better discern whether the project is performing as planned. This data, along with aerial photography that will be conducted in fall 2002, will improve evaluations of the project.

<u>Recommended Improvements</u>
1. Some additional monitoring elements that should be considered are water velocity, vegetation, and sediment accretion.
2. The shoreline protection should be extended further west. If a different material can be used that is engineeringly sound and more economical, then that should be used. Shoreline protection should be added to prevent erosion from circumventing the structures in Mud and Jackson Bayous and Humble-F Canal. Shoreline protection should be investigated where East Cote Blanche Bay is encroaching on School Bus Bayou (West of Humble Canal) and investigating the enlargement of some of the openings from the GIWW (NE) to allow more sediment delivery into the project area.
3. The landowner was going to try to have the oilfield company perform some work items prior to selling or abandoning the field. Our project recommendations should be integrated with the landowner needs. Also, if there is no longer an operator, determine if landowner would entertain idea of reducing the structure opening sizes.

As a follow-up to point three, the land owner and the land manager when contacted stated that there would likely be no objection to changing the weir with boat bay structures on the British-American and Humble-F Canals to plugs, as long as an option remained to temporarily remove rock to permit access if the need arose (Miami Corp. 2002).

Lessons Learned

1. The monitoring needs addressed in this document support a good argument for the Coastwide Reference Monitoring System (CRMS). Project planners constantly find that water level, elevation, salinity and other data is lacking in many coastal areas that is needed to better understand project area systems and develop appropriate project plans and features.
2. Sufficient geotechnical investigations (this was done for this project) and hydrologic modeling should be built into the design and evaluation of projects of this type.
3. EA, WVA and Monitoring Plan Goals and Objectives should have been more consistent. Agencies are attempting to do that now with more recent projects.
4. It was difficult to find a satisfactory reference area for this project, hence an area embedded inside the project boundaries was chosen. This particular reference area will provide adequate comparison for water level fluctuations, but not for land loss comparisons.

TE-28 Brady Canal

Project Effectiveness

We are unable to determine at this time how the project has performed. The reasons for this determination lie in the facts that have been set forth during this outline. To briefly re-iterate the reasons, the project was not constructed entirely as designed, pre-existing spoilbanks along Bayou Decade east of Jug Lake degraded between planning and construction phases which resulted in a loss of hydrologic control, the structure operation plan was not finalized before the end of construction, monitoring should be looking at how much sediment enters and exits the project to determine if the project is retaining sediment as outlined in the objective, biomass production plots should have been established to determine marsh health, and data collection instruments may not be located in areas that give the best answers to the goals and objectives.

Recommended Improvements

1. All project components, as initially planned, should be completed.
2. The project needs to be operated as it was originally intended.
3. Although not all members agreed on this point, some felt that more aesthetic and ecological alternatives to rock should be considered in the construction of remaining structures and in the maintenance of existing structures, if they can provide the same long-term protection at the same or better cost-effectiveness.

Lessons Learned

1. The structure operations plan needs to be completed before the end of construction.
2. If modifications to a project occur, the monitoring of the project may need to be altered. The process that is currently in place does not allow for the monitoring plan or monitoring budget to be altered very easily.

3. The goals and objectives of projects may need to be more specific. Targets which are ecologically significant may need to be placed on salinity values instead of identifying as “decrease variability.” The same may apply with water levels within a project.
4. Monitoring plans should not include specific years. Monitoring intervals should be referenced to years after construction because projects are not always completed on schedule at the time the monitoring plan is written.
5. More research is required during the planning stage of a project with respect to what has succeeded and failed on other similar type projects. Data should be studied more from other projects.
6. Structures should not be operated in a manner which is inconsistent with the goals of the project.
7. Structures should be designed so that the cost of adjusting the variable crested sections are minimal.
8. An Operation and Maintenance Plan should be developed prior to the 95% review phase and approved shortly after final inspection of all construction activities.
9. When two CWPPRA projects have overlapping project boundaries, significant project components of one project should never be deferred in anticipation that they could be installed in the second project.
10. There are plans to re-furbish the embankment along Bayou Decade and other breaches; however, it is DNR’s understanding that rock will be used to do this. There needs to be research to support the use of rock as an effective water control structure that can control salinities and water levels.
11. Although not unanimous among reviewers, some felt that alternative materials of bank refurbishment or bank stabilization should be investigated and pursued in place of rock.

Overall Marsh Management/Hydrologic Restoration Recommendations

1. Landowner agreements should be written in such a way that if they have to remove a structure temporarily, it must be replaced with the same design as the original.
2. Since structure operations are critical to project effectiveness, landowner agreements for Operation and Maintenance should be written such that DNR has ultimate responsibility for structure operations, and it is not left to the landowner to operate in a manner which is not consistent with the restoration project objectives.
3. Do not defer project features to have them included in other projects without a firm timeline of construction. This could render the project ineffective.
4. Sufficient geotechnical investigations and hydrologic modeling should be built into the design and evaluation of projects of this type
5. Plan, monitor, and evaluate project in the context of their surrounding ecosystem. Projects are influenced by their surrounding environment and may also be affected by adjacent projects. Planning, monitoring, and evaluation of projects needs to be done at a larger scale to capture synergies which may help explain responses. Planning and evaluating projects on a hydrologic basin-scale would improve our understanding of ecosystems and their responses to restoration projects.
6. In many instances, demands are to label projects a success or failure three years after construction, when in reality it will take many years of data collection to determine if

the project was effective or not. We cannot determine project effectiveness within the first 1-3 years.

7. Working with landowners to design structures which best meet both their needs and the needs of the restoration project is important.

Freshwater Diversion

Table 4 provides a quick overview of the major findings from the freshwater diversion projects. Operating diversions has been a challenge as many different resource user groups are affected by diversion structures. This has resulted in conservative use of the structures, which limits the ability to evaluate the potential benefits. However, in spite of the conservative operations, they seemed to have a positive effect on vegetation composition and biomass. In addition, the Caernarvon diversion has resulted in increases in overall wildlife and fisheries production (Chuck Villarubia, LDNR, pers. comm.). Louisiana Department of Wildlife and Fisheries (LDWF) sampling indicates white shrimp (*Panaeus setiferus*), redfish (*Sciaenops ocellatus*), and speckled seatrout (*Cynoscion nebulosus*) catches, and alligator (*Alligator mississippiensis*), waterfowl, and muskrat (*Ondatra zibethica*) counts are all greater since the Caernarvon diversion has been operating. Monitoring results show that the two siphon-diversions have minimal impacts on water levels in the project area and that concerns about erosion from the flow are not substantiated by the observations in the project area.

BS-08 Caernarvon

The project review team for this project was unable to provide a draft project review to be reviewed by the fresh water diversion project team. This was partially due to the difficulty in locating the supporting documentation for an adequate review. However, the effectiveness of this project will be reviewed by LDNR in detail during 2003.

BA-03 Naomi

<u>Project Effectiveness</u>

The goals, from project planning through monitoring, were not quantified and could have been improved (i.e. more meaningful) by including specific targets. An example given in the BA-03 Adaptive Management Report (section II.3), illustrates that to set a target salinity for a given location in the project area (e.g., 5 ppt isohaline) would have been more meaningful than to "decrease mean salinity". In this case, effectiveness could have been clearly decided by determining the average salinity at the proposed 5ppt isohaline. This approach is being used to operate and evaluate the Davis Pond freshwater diversion (Brady Carter, LDNR, pers. comm.).

Not only is the absence of quantifiable goals in CWPPRA and state projects a chronic problem and hindrance to determining project effectiveness, the continuing demand for project benefits to be realized "overnight" also seems to be a hindrance to evaluation of project effectiveness. In many instances, demands are to label projects a success or failure three years after construction, when in reality it will take many years of data collection to determine if the project was effective or not. In the case of the BA-03 project, 9 years of data collection is most likely sufficient to determine if the desired physical and biological responses are being achieved. However, data sets such as aerial photography are still small, and without more frequent data, it is impossible to show the compete picture of changes in the landscape.

Table 4. Answers to the most important questions from the project review from the review of two freshwater diversion projects.

	BA-03	BA-04
Construction completed:	1993	1993
Was project constructed as designed?	Outfall canal design was altered due to land rights.	yes
Was project operated as designed?	Law suits have reduced operation.	Law suits have reduced operation.
Physical response as required for healthy marsh?		
Inundation	Inundation was unaffected by siphon operation.	Inundation was unaffected by siphon operation.
Salinity	Yes, when operated as designed	Yes, when operated as designed
Biological response as required for healthy marsh?		
Vegetation cover and composition	Vegetation data indicate a slight freshening of the project area by 1997.	Vegetation data indicate freshening of the project area, especially in the immediate outfall area
Land loss rates	No after project photography has been analyzed.	No, but land loss rates in the project area have been reduced from 1.3% per year pre-construction to 1.0% per year post construction
Physical Response Notes:	Operation of the diversion did not significantly affect water levels in the project area, at the same time salinity was significantly reduced. This may be due to general annual salinity pattern in Barataria Bay.	Operation of the diversion mainly affects water levels in the immediate outfall area

Recommended Improvements

1. Maintenance had been very poor until recent installation of the new valving and piping system. A preventative maintenance system needs to be in place.
2. An improved security system needs to be implemented. There is virtually none at the present time. The siphon is at the mercy of anyone who wants to vandalize it.
3. An automated priming system needs to be installed to allow the individual pipes to be

quickly placed back in service when they lose prime. Output from the siphon would be increased substantially. Also, the siphon would then be available for service during much of the low river season when they are often not available. It should be noted that DNR has retained an engineering firm to provide recommendations on installation of such a system and on installation of instrumentation on the siphons. The firm will also provide recommendations regarding the feasibility of enriching the water intake stream with additional fine sediment.

4. Instrumentation such as flow meters and gauges possibly online should be installed to actually measure the flow values rather than the calculated spreadsheet values that are currently used to generate data. Current calculations are based on values from a logbook kept by Plaquemines Parish Government personnel and then mailed to DNR. The details of the logs are inconsistent. Records are entered only when parish personnel visit the siphons.
5. The current plan (no documentation) for operations is to run siphons at all times except when conditions such as loss of prime, oil spills, and tropical storms prohibit flow. A consistent plan for operation of the siphons operations is needed.

<u>Lessons Learned</u>

1. The effectiveness of siphon systems in mimicking the action of the river's overbank flooding was shown.
2. Concerns over soil erosion from such a system apparently did not materialize. This had been a major concern during the conception stage.
3. Need for a maintenance plan has again proven to be necessary.
4. Need for a security system is recognized from severe vandalism that has occurred at other projects. At present, serious vandalism has not occurred at the Naomi siphons but is possible without safety measures. Moderate vandalism, closing siphons and allowing them to lose prime, has occurred at Naomi. Security measures preventing access to the siphons would prevent this from happening in the future.
5. Politics have a very important role in operations. Concern about lawsuits involving this and other diversion projects contributed substantially to the failure to implement a maintenance plan as both the State and Parish were reluctant for a period of time to be involved with the project, illustrating how lawsuits can affect decision-making.
6. Project goals should be quantified as much as possible to aid evaluation of project effectiveness.
7. A range of flow (i.e. quantifiable) should be used in modeling not just "with" or "without" flow.
8. Consider outfall management from the beginning planning stages.
9. Reference areas were not included during the project planning or developmental stages but could be addressed in the future with the Coastwide Reference Monitoring System (CRMS).
10. Gated structures provide for greater flexibility in operations and should be the preferred technique for freshwater diversions.

BA-04 West Pointe a la Hache

Project Effectiveness

Project goals and objectives were simple and clear, however, no quantitative targets were set to use as indicators of project effectiveness. If the project reduced average salinity, it was effective; if the project increased (or decreased) land to water ratios in the project area, it was effective (or not); if the project increased relative abundance of marshhay cordgrass, it was effective. As is seen, none of the goals, from project planning through monitoring, were quantified and all could have been improved (i.e., more meaningful) by including specific targets. For example, to set a target salinity for a given location in the project area (e.g., 5 ppt isohaline) would have been more meaningful than to "decrease mean salinity". In this case, effectiveness could have been clearly decided by determining the average salinity at the proposed 5ppt isohaline. This approach is being used to operate and evaluate the Davis Pond freshwater diversion (Chuck Villarrubia, LDNR Monitoring Supervisor, pers. comm.).

Recommended Improvements

1. Maintenance had been very poor until recent installation of the new valve and piping system. A preventative maintenance plan needs to be developed.
2. An improved security system needs to be implemented. There is virtually none at the present time. The siphon is at the mercy of anyone who wants vandalize it.
3. A simplified priming system (i.e. fixed vacuum pump) needs to be installed to allow the individual pipes to be quickly placed back in service when they lose prime. Output from the siphon would be increased substantially. Also, the siphon would then be available for service during much of the low river season when they are often not available. It should be noted that DNR has retained an engineering firm to provide recommendations on installation of such a system and on installation of instrumentation on the siphons. The firm will also provide recommendations regarding the feasibility of enriching the water intake stream with additional fine sediment.
4. Instrumentation, such as flow meters and gauges possibly online, should be installed to actually measure the flow values rather than the calculated spreadsheet values that are currently used to generate data. Current calculations are based on values from a logbook kept by Plaquemines Parish Government (PPG) personnel and then mailed to DNR. The details of the logs are inconsistent. Records are entered only when PPG personnel visit the siphons.
5. The current plan for operations is to run siphons at all times except when conditions such as loss of prime, oil spills, and tropical storms prohibit flow. A consistent plan for operation of the siphons operations is needed.
6. An outfall management system needs to be implemented.

Lessons Learned

1. The effectiveness of siphon systems in mimicking the action of the river's over bank flooding was shown.
2. Concerns over soil erosion from such a system apparently did not materialize. This had been a major concern during the conception stage
3. Need for a maintenance plan has again proven to be necessary.
4. Need for a security system is recognized from severe vandalism that has occurred at other projects. At present, serious vandalism has not occurred at the West Pointe

siphons but may be probable without safety measures. Moderate vandalism, closing siphons and allowing them to lose prime, has occurred at West Ponte a la Hache. Security measures preventing access to the siphons would prevent this from happening in the future.

5. Politics have an important role in operations. Concern about lawsuits involving this and other diversion projects contributed substantially to the failure to implement a maintenance plan as both the State and Parish were reluctant for a period of time to be involved with the project, illustrating how lawsuits can affect decision-making.
6. The presence of large efficient bayous and canals in the project and the resulting lack of direct over-marsh flow of siphon water did not prevent water salinities throughout the project area from being lowered substantially. Many restoration projects contain such canals. Their presence may prevent over-marsh flow but may not impede lowering of project salinities.
7. Project goals should be quantified as much as possible to aid evaluation of project effectiveness. This lesson seems to have been learned, because operation of the Davis Pond diversion will be based on this same type of scenario (Chuck Villarrubia, LDNR Monitoring Supervisor, pers. comm.). An example of well-written, quantified goals is found in the monitoring plan for the LaBranche Wetlands Restoration Project (LDNR 1998). Those goals quantify the planned acres of land to create and the marsh-to-open water ratio targets for a given time frame.
8. A range of flow should be used in modeling not just "with" or "without" flow.
9. Consider outfall management from the beginning planning stages.
10. Reference areas were not included during the project planning or developmental stages but could be addressed in the future with the Coastwide Reference Monitorng System (CRMS).
11. Gated structures provide for greater flexibility in operations and should be the preferred technique for freshwater diversions.

Overall Freshwater Diversion Recommendations

1. DNR should maintain Operation and Maintenance control over operations to ensure consistency with restoration objectives.
2. More control is possible with gated structures. Siphons have had issues with losing and not being able to maintain prime, and have limited utility when water levels are low.
3. Do not overlook the potential benefits of many smaller diversions vs fewer larger ones. Many smaller diversions allow greater flexibility in terms of operations, and they can also be constructed faster than large diversions.
4. The ultimate measure of project effectiveness is land loss, however, this is limited because of difficulties identifying suitable reference areas. The Coastwide Reference Monitoring System (CRMS) would provide a baseline for evaluating effectiveness of freshwater diversion projects.
5. Measurement of actual discharge volumes are critical to operating diversions and evaluating their effects. Instrumentation to measure discharge should be built into the structure during the design phase.
6. Be aware and take steps to minimize or eliminate the potential for conflict and litigation with other resource user groups.

Dredge Material Projects

The barrier island restoration project team was unable to provide a draft project review to the dredged material review team. Therefore, these reviews have not received the benefit of a full team review. A draft report has been completed for each of the barrier island projects reviewed, but these reports currently lack the adaptive management section. We are fairly confident that these reports will be completed in future adaptive management reviews, if such reviews are authorized.

Table 5 provides a quick overview for the three marsh creation projects. These three projects show that it is very difficult to attain, or even determine, the correct elevation for a healthy wetland. This is partially due to the past difficulty in measuring actual elevations within the Louisiana coastal zone. Wetland creation requires very accurate elevation measurements.

It wasn't until very recently (2001) that DNR worked with the NGS to establish a vertical control network across the coastal zone of Louisiana. Before this time, the elevation reference network that was in place was outdated and inaccurate. Also, the elevation of a "healthy" marsh cannot necessarily be determined by measuring the elevation of areas in or adjacent to restoration project areas.

Incorrect elevations resulted in sediments that were stacked too high in one of the three marsh creation projects reviewed (AT-02). Containment of dredged material was also a problem in one of the three reviewed projects (TE-26), and de-watering of one of the project areas (PO-17) was hampered by vandalism. Getting the construction contractor to stack material to the right height requires very close inspection. Because of subsidence and hence high rates of relative sea-level rise in Louisiana, it has often been assumed that it is prudent to err on the high side when creating marsh with dredge material (i.e., overfill with the expectation that the material will eventually settle and compact to the correct elevation some time in the future). However, a more sustainable, although admittedly more costly, alternative may be to achieve the optimal elevation sooner and include a maintenance component in the project after several years. By achieving the correct marsh elevation earlier in the project life, natural, self-sustaining accretion processes (including mineral sedimentation and plant belowground and aboveground productivity) will be initiated and the created marsh will be providing some of the critical wetland functions at an earlier date than if overfilled. As the marsh settles over time, a subsequent, pre-planned maintenance component consisting of marsh nourishment with fluid dredge material could be utilized to fine tune the elevation and provide an infusion of sediments and nutrients that would stimulate productivity and enhance the overall natural sustainability of the project so that the created area does not revert to the degraded habitat that existed prior to project construction.

Table 5. Answers to the most important questions from the project review from the review of three marsh creation projects.

	PO-17	AT-02	TE-26
Construction completed:	1994	1998	1999
Was project constructed as designed?	yes	Legal concerns removed one of the main distributary channels from the project. Contractor's elevation surveys were incorrect and dredged material was stacked to high.	Settlement of material was based on rule of thumb and containment dikes failed. Number of acres created was less than designed due to budget constraints.
Was project operated as designed?	Local duck hunters reduced dewatering of sediment after construction with unauthorized water control structures. Tidal exchange has been hampered by unauthorized closure of natural breaches in the containment dike.	not applicable	not applicable
Physical response as required for healthy marsh?			
Inundation	Inundation frequency is lower than for healthy marsh at present time.	not measured	Created marsh has lower elevation than the adjacent marshes, leading to more frequent and longer inundation than required for healthy marsh.
Salinity	Salinity is in the correct range.	not measured	Salinity is in the correct range.
Biological response as required for healthy marsh?			
Vegetation cover and composition	Vegetation in the project area has gone through a succession of early colonizers and is moving in the direction of an intermediate marsh.	Vegetation in the created area is dominated by willow trees not the desired intertidal vegetation however, it is consistent with higher elevations of active delta lobes.	The created marsh was planted with *Spartina alterniflora*. Adjacent marshes are dominated by *Spartina patens*. *S. alterniflora* has a wider elevation range and can tolerate more flooding than *S. patens*.
Land to Water Ratio	The created area currently may contain slightly more land than the desired ratio of land to open water. However compaction and subsidence will eventually bring the project area to the target land-water ratio, and it is currently ahead of predicted schedule.	It is too early to tell.	No post-construction photography has been analyzed.

PO-17 LaBranche Wetlands

<u>Project Effectiveness</u>
Monitoring and general observation of the project area is showing a conversion of the vegetation in the area from woody species to herbaceous species. Also, monitoring is showing that the land-to-water ratio is very close to the project goal of 70 % land to 30 % water and that the elevation is almost entirely within the target range. The hydrology of the area is not the same as adjacent areas, but development of a certain hydrology was not a project goal. In addition, the adjacent areas are degraded marsh and may not serve as a reasonable target for hydrology.

<u>Recommended Improvements</u>
The review team reached consensus on the following recommendations:

1. Remove any remaining un-permitted barricades/structures to increase tidal exchange.
2. Re-survey staff gauges for more reliable elevation data (this has been conducted through the Adaptive Management review process).
3. Establish a reference area with target marsh elevation.
4. Add a maintenance component to address landowner/lessee issues.

The review team could not reach consensus on the following recommendations:

5. Gap containment dikes to increase tidal exchange, after consolidation of dredged material.
6. Level containment dikes to marsh elevation unless habitat diversity is desired and thought to be important in order to follow mandates of Executive Order 13186 (Protection of Migratory Birds).
7. Re-grade high elevations in project area to target elevation.
8. Add a maintenance lift of dredged material to the project area to lessen open water conversion.
9. Dredge tidal creeks or add trenasses.

<u>Lessons Learned</u>
The team reached consensus on the following lessons learned:

1. Data gathered during pre-construction (biological and engineering) should be utilized to a greater degree, and a greater degree of coordination between biologists and engineers should occur.
2. Staff gauges should be surveyed to NAVD for more reliable data.
3. Reference areas should be selected with the same elevations, marsh types, salinities, and soil characteristics as the project area.
4. There needs to be a clear understanding between the CWPPRA agencies and the landowners and lessees of the property that no modifications of project components is allowed without the written consent of the agency that acquired the real estate easement.

The team could not reach consensus on the following lessons learned:

5. Dredging or creating trenasses for tidal creeks and ponds should be part of the construction phase.
6. Containment dikes should be leveled to marsh elevation once dredge material has consolidated. Some feel that containment dikes could be left in tact to maintain habitat

diversity to follow mandates of Executive Order 13186 (Protection of Migratory Birds), while others feel that this containment dikes should not be left in-tact, regardless.
7. More frequent aerial photos for monitoring should be included in budgets.

AT-02 Atchafalaya Sediment Delivery

Project Effectiveness
Castille Pass appears to be working as designed while Natal Channel appears to be distributing more water than before the project, but rapidly reducing its ability to act as distributary channel because of shoaling. After just four years, it is too early to tell yet whether the project will create the 1,900 acres projected, however, it seems somewhat questionable that this expectation will be met. Data for the first year post-construction indicate an increase of 78.4 acres. It is the opinion of the review committee that the average creation of 95 acres per year will not be met.

Recommended Improvements
Maintenance dredging of Natal Channel to –10 ft NGVD. There is substantial loss of depth in the channel as it makes the turn to the south around Teal Island. The longevity of the Natal channel, section B, is in doubt. Natal channel section B is the portion of the channel as it curves around Ivor Island. It should be noted, however, that the deleted north channel is attempting to form on its own. It is the opinion of this group that the Natal Channel would have been much healthier had the north split channel been dredged as originally planned.

Lessons Learned
1. The developed hydrologic model should have included the entire project area rather than specific channels to help identify natural developing areas. The model should include a sediment transport component. This exercise may also assist designers in better mimicking natural bifurcation and channel depths of the Atchafalaya Delta system.
2. Incorporation of more intensive, and accurate, pre- and post-construction surveys which include areas immediately outside construction area.
3. Develop well-defined project target(s).
4. Closer examination of project conceptual goals and verify the projected areas to be created.
5. Closer construction inspection. There was an apparent deposition of dredge material within the project reference area.
6. Habitat mapping of the project area at growing seasons one and three facilitated a better understanding of early succession of vegetative communities on dredge material. It was found that vegetation communities, on these created delta lobes, began to respond to the influences of elevation and the associated hydrologic gradient between the second and third growing seasons. In the case of this project, habitat mapping at growing season one was supplied by LDWF. However, if this is considered as a component of future dredge material monitoring plans, and the cost must be included within the LDNR/CRD budget, strong consideration should be given to postpone the mapping until after the dredge material has settled (this may change on a project by project basis). By waiting until dredge material settles, competition between plant communities for their preferred elevation range has largely taken place, and a reduction in the presence of annuals in the understory has occurred. This offset of monitoring will facilitate more reliable comparisons to reference islands and the budgeted monitoring funds can be better utilized. Additionally, by waiting for the above to

occur, assessments of what has been created as a result of dredging will be a more accurate tool for future project planning.

7. There are some monitoring elements, that if conducted in the period immediately following construction, could greatly contribute toward the understanding of how quickly dredge material de-waters, and therefore, improve the planning of dredge material projects in the Atchafalaya Delta. The most notable are topographic and bathymetric surveys. In the case of this project, the dewatering and compaction processes may have been inaccurately captured by the as-built survey in October 1998 because it was surveyed during the same period as Big Island Mining (AT-03) - immediately following its construction phase which was six months later than AT-02. This is apparent through comparisons of elevation, using analysis of variance, between the as-built and post-construction survey conducted in October 2000. This test indicated no significant difference in elevation between 1998 and 2000. Due to the fluid nature of the dredge material placed in the AT-02 project area, the possibility of the dredge material not de-watering and decreasing in elevation was unlikely. Overall, close attention must be paid by engineering and monitoring sections to the logistics of monitoring variable implementation when trying to capture early construction processes. If this is collectively done, the loop of communication between groups can only strengthen the likelihood of future project success and understanding.

TE-26 Lake Chapeau

<u>Project Effectiveness</u>
The project created marsh, but not as much as originally planned.

<u>Recommended Improvements</u>
Another dredge placement may be done to increase the elevation to that of the surrounding marsh elevation and establish the hydrologic separation. Then, seed the new fill areas and backfill the pipeline canal.

<u>Lessons Learned</u>

1. Consideration needs to be made of any damage that may occur to the marsh as a result of pipeline corridors to the dredge fill areas.
2. Containing the slurry is very difficult and multiple dredge placements may be needed to attain marsh elevation.
3. Contractors are paid by the amount of material cut from the borrow area, not the benefits (acres created in this case) attained. Therefore, the goal for the contractor is to move material, while the project goal is to create marsh. This leads to compromising the goal of creating marsh to fit budget constraints and complicates estimating marsh creation costs.

Overall Dredge Material Recommendations

1. Investigate payments to contractors for actual area/volume filled as an alternative to the current payment for cut method. Could have another dredging cycle in Operation and Maintenance budget 2 or 3 years after initial dredging with no downtime and cost for waiting and dewatering. This could possibly be done as “marsh nourishment” where a relatively thin layer of fluid dredge material is placed on the marsh surface after most settlement and compaction has occurred to a) optimize elevation needed to maximize plant productivity, and b) increase long-term sustainability of marsh elevation.

2. Better construction oversight is needed to minimize damage to existing marsh during construction which may later need to be mitigated.
3. Improve the definition of targets and goals in terms of target elevations, desired vegetative communities, and target years.
4. Consider staged construction, incremental filling, as an alternative to a one-time fill. This will contribute to achieving the goals of a) optimizing the elevation needed to maximize plant productivity and b) increasing long-term natural sustainability of marsh elevation via accretion process that include plant belowground (and aboveground) productivity.
5. Create Operation and Maintenance budgets for Dredge Material projects to allow for fine-tuning: re-working of sediments and/or additional lifting if target elevations are not met.
6. Potentially delay or reduce vegetation monitoring within the first three years until dredge material has settled, and vegetation community has stabilized.
7. Potentially delay the installation of plants on dredge material for at least one year to allow for sediment compaction and dewatering ONLY in relatively low salinity areas where a) natural recruitment is anticipated to occur, and b) where the material is not of a very high density – i.e. difficult to walk/plant until it consolidates. In general, planting should always be in the budget and always done as soon as possible.

Shoreline Protection Projects along Bays or Lakes
Table 6 provides a quick overview of the findings for the three Bay/Lake Shoreline restoration projects. The demonstration project along the shoreline of Lake Salvador (BA-15 phase I) was poorly designed, but many lessons have been learned from the experience. Two projects (PO-10 and TV-04) used different techniques (gabion foreshore dike and PVC wall) that were developed for poor soil conditions. Both techniques have promising results with material accreting behind the structures and reversal of shoreline erosion. The project with a traditional foreshore rock dike (BA-15 phase II) also appears to be functioning as designed as typified in other similar projects using this technique.

Currently, all the non-vegetative materials used to reduce shoreline erosion in the projects reviewed for this report do not naturally occur within the Louisiana coastal zone. We should investigate broadening the tools in the restoration toolbox with native materials to see if any can stand up to the erosive forces along many of our shorelines. In the absence of these tools, future projects remain dependent on the use of non-native materials.

Table 6. Answers to the most important questions from the project review from the review of three bay/lake shoreline protection projects.

	PO-10	BA-15	TV-04
Construction completed:	1994	Phase 1: 1997 Phase 2: 1998	1998
Was project constructed as designed?	Design went through several changes to account for weak soils. The final design was a gabion structure that was built as designed.	Phase 1 consisted of four experimental structures designed for a five year lifetime (demo) constructed in front of state property. These structures were built as designed with the exception of the geotube. Phase 2 consisted of rock breakwaters and earthen dike behind it created from dredged material.	Structural integrity of the PVC wall was found to be low during construction and design was strengthened. Budget constraints shortened and changed the alignment of the wall.
Was project operated as designed?	Not Applicable	Not Applicable	Not Applicable
Physical response as required for healthy marsh?			
Inundation	Not Applicable	Not Applicable	Not Applicable
Salinity	Not Applicable	Not Applicable	Not Applicable
Shoreline Erosion	Shoreline behind the structure accreted, while reference area eroded. Shoreline accretion was most rapid in the area, behind a 6 ft gap in the structure.	Within 5 years of the construction, all phase 1 structures failed structurally making it difficult to asses their impact on shoreline erosion. Vinyl sheet pile and geotubes reduced wave heights the most. The phase 2 rock breakwaters have reversed shoreline erosion.	No after construction measurements have been made. Field observations indicate sediment accretion behind the PVC wall structure.
Biological response as required for healthy marsh?			
Vegetation cover and composition	Not Applicable	The created area behind the phase 2 structure has vegetated with willow trees.	Not Applicable
Land loss rates	No photography has been analyzed. However, shoreline erosion in the project area has been reversed. The project was justified based on the vulnerable marshes behind a narrow shoreline strip, but land loss rates in this area have not been evaluated.	Pre-construction project photography was obtained, but the land loss monitoring component was removed.	No post-construction photography has been analyzed. Ocular review of photographs suggests reduced land loss in the project area.

PO-10 Turtle Cove

Project Effectiveness
This project has worked as planned. The response has been very positive with sediment accreting behind the structures, emergent vegetation becoming established, and shoreline erosion being reversed.

Recommended Improvements
No recommendations are being made to improve this project.

Lessons Learned
This project went through many changes during the design and permitting stages due to findings during geotechnical investigations. Although these changes delayed project construction, the result was a very successful project without major mid-construction modifications. This project is a good example of a well planned, carefully thought out project.

1. Elevations were not tied in prior to construction and as a result, final elevation of the structure was 0.75 ft lower than anticipated. Future projects should have elevation references established and tied into the vertical control network prior to construction.
2. Well qualified construction inspection and oversight and well qualified contracting officers are essential to ensure that projects are constructed as designed and that problems which occur in the field are handled in the best possible way as to not compromise the goals of the project.
3. The gabion structure was durable and had a low settlement rate for a highly organic area. This structure type could possibly be used in other areas of the state where shoreline erosion along highly organic shorelines is problematic.
4. Future investigations are recommended to include relative performance of gabions and adjacent rock breakwaters, in terms of effectiveness and cost.

BA-15 Lake Salvador

Project Effectiveness
Phase I.
Wave energy reductions for different wind directions were determined. In contrast, monitoring was not able to determine the effect of the structures on the shoreline change rate due to the ineffective structure placement, structural failure, and statistical dependence. Since structural failure occurred prior to the end of the project period, the ability to adequately determine the performance of the structures as intended was not fully assessed and does not rule out the use of these structures in the future. Furthermore, the data on wave reduction shows that wave energy was reduced and could potentially be further reduced if the structures maintained their integrity, and are optimally positioned and oriented relative to the shoreline.

Phase II.
At this time it appears that Phase II goals and objectives were attained. Shoreline change analysis and field observations have determined that the natural shoreline transgression rate has slowed. Note that this determination is based upon only two years of data.

Recommended Improvements

1. Prior to construction, optimal orientation with respect to the shoreline should be determined for placing structures.
2. Prior to construction, optimal distance from shoreline should be determined for placing structures. For example, this project demonstrated that structures need to be placed closer to the shoreline.
3. Preconstruction and site specific data should be incorporated into structure design and placement.
4. If different structure types are employed, these should be placed in statistically independent settings to eliminate interaction of structures.
5. All projects should be designed and constructed to last through the standard CWPPRA project period (20 years post-construction).
6. Use flexible armor over any geotubes built in the future to protect the fabric covering from weathering from the sun and waves.
7. Conduct frequent post construction inspections and maintenance for demonstration projects.
8. Post construction reports and inspections on integrity and functioning of structures can have bearing on physical and biological response and should be evaluated.
9. Remediate structural failure immediately.
10. Project managers and sponsors need representation on site often during construction.
11. Operations and maintenance is needed for this project type to provide for functional inspection and minor remediation of structures. Operation and Maintenance budgets for demonstration projects are typically very small and may not be sufficient to make necessary adjustments after construction.
12. Demonstration projects should include contingencies for removal of structures.

Lessons Learned

1. Demonstration projects should be designed and built for the anticipated life of a standard CWPPRA project (20 years) in order to adequately access/predict performance. This project was under designed to meet project goals.
2. Demonstration projects should have several structural integrity inspections within short time periods following construction. Current monitoring plans typically focus on "response" and do not include engineering inspections.
3. Consider fewer treatments and more replication for this type of demonstration project.
4. The short time period of the study is problematic and may not be representative of the variable environmental conditions for the life of a project, therefore results are inconclusive.
5. Structure placement can cause a structure(s) to be ineffective and statistically dependent. Therefore, structure placement is as important as the type of structure selected to reduce erosion rates along the shorelines.
6. Bolts on structures need to be secured at construction.
7. Post construction inspections and maintenance are extremely important and could have potentially prevented structural failure.
8. A post construction report on integrity and functioning of structures can have bearing on physical and biological response.
9. Regular inspections of structures should occur to prevent or arrest structural failure.

10. Structural failure should be remediated quickly.
11. Grated Apex and Angled Timber Fence structures are not as effective in reducing wave energy as the Geotextile Tubes and Vinyl Sheet Pile structures.
12. Geotextile Tubes and unreinforced Vinyl Sheet Pile structures were not as durable (as built) in this project as those tested in open water areas with low amplitude, high frequency waves
13. The reinforced vinyl worked well considering the wave fetch. However, they are more suitable in a low wave fetch environment. They should be built with supporting structure.
14. Project design should account for 3-D dynamic movement (horizontal and vertical forces) of structures.
15. Protection, such as flexible armor, should be considered to prevent disintegration of the structures fabric liner.
16. Islands created landward of the structures in Phase II could have had an effect on shoreline erosion rates and cannot be compared to Phase I. However, designing a structure with this additional land building component shoreward of the structure may serve as a reinforcement structure.
17. Rock was most durable, least expensive but is foundation dependent.
18. Fill material for geotextile tubes should not be rigid under conditions where differential settlement could occur.

TV-04 Cote Blanche (shoreline component)

<u>Project Effectiveness</u>
Project construction has only been completed since January 1999. This was followed by two years of severe drought conditions, so significant biological response to the structures has likely not occurred. Analysis of water level data beyond 1999 is currently being conducted. This data, along with aerial photography that will be conducted in fall 2002, will improve evaluations of the project.

<u>Recommended Improvements</u>
1. An additional monitoring element that should be considered is sediment accretion.
2. The shoreline protection should be extended further west. If a different material can be used that is more feasible from an engineering standpoint and more economical, then that should be used. Shoreline protection should be added to prevent erosion from circumventing the structures in Mud and Jackson Bayous and Humble-F Canal. The addition of shoreline protection should also be investigated where East Cote Blanche Bay is encroaching on School Bus Bayou, west of Humble Canal.

<u>Lessons Learned</u>
1. The monitoring needs addressed in this document support a good argument for the Coastwide Reference Monitoring System (CRMS). There is constantly a lack of water level, elevation, salinity and other data in many coastal areas that are needed to better understand project area systems and develop appropriate project plans and features.
2. Sufficient geotechnical investigations (this was done for this project).
3. Environmental Assessment (EA), Wetland Value Assessment (WVA), Ecological Review (ER), and Monitoring Plan Goals and Strategies should have been more consistent. Agencies are attempting to do this with more recent projects.

4. Annual post-construction inspections of the structures are necessary to monitor structure integrity. Funding is built into the Operations and Maintenance budgets for these inspections.

Shoreline Protection Projects along Canals

Table 7 provides a quick overview of the findings of the four Shoreline Protection projects along navigation canals. Most of the shoreline protection projects along canals were intended to prevent canal shoreline erosion, however, at least one project was approved based on the assumption that shoreline protection would prevent predicted land loss increases within the adjacent interior marshes. While shoreline erosion may have accelerated loss of interior wetlands, we have learned that it is not always the only source of loss. Within the ME-09 project area, shoreline erosion has been halted, however interior wetland loss may persist.

In addition, we have learned that "shoreline protection" is not synonymous with "hydrologic barrier". The shoreline protection at ME-04 was presumed to be sufficient to block saltwater intrusion from encroaching into the interior wetlands. We have seen that although the rock dike may be an effective damper of wave energy, it is not always impermeable to water movement. Although shoreline projects are typically viewed as simple and straight forward, we have learned that this is not the case and care must be taken in the planning and design of future projects.

ME-09 Cameron Prairie Refuge Protection

Project Effectiveness

This project as designed may not have addressed the only causes of wetland loss within this project area. Current debate relative to whether or not interior wetland loss persists in this area begs the discussion of whether or not shoreline erosion was the only cause of wetland loss. It was assumed that protecting the shoreline would have also protected the interior wetlands from degradation, however, this may not be the case. Current CWPPRA planning and selection procedures would likely have not claimed much of the interior area within this project as being protected from loss, given the features proposed. In the case of shoreline erosion, the project has demonstrated the ability to eliminate and even reverse shoreline erosion in the protected project area. Shoreline change rates for the project and reference areas since construction are 9.8 $\pm$ 7.1ft/yr (3.0 $\pm$ 2.2m/yr) and -4.1 $\pm$ 3.1ft/yr (-1.2 $\pm$ 0.9m/yr), respectively, creating an estimated 3 acres of new land between the rock dike and the shoreline.

Recommended Improvements

The extent and cause of possible ongoing wetland loss in the project area needs to be determined. Once the cause is determined, protection and restoration options can be evaluated. It should be noted, however, that agreement has not been reached on whether or not interior wetland loss

Table 7. Answers to the most important questions from the project review from the review of four canal shoreline protection projects.

	ME-09	ME-04	TV-03	CS-22
Construction completed:	1994	1994	1996	1997
Was project constructed as designed?	A rock breakwater was built as designed.	The rock breakwater was constructed using smaller rock sizes than usual designs, because Wax Lake weir removal material was used. This resulted in a leaky dike that did not prevent saline waters from intruding in the project area.	This project changed considerably from the approved project. The constructed project consists of 6,269 ft of foreshore rock dike along the east bank of Vermilion River Cutoff. No features were installed on the west bank, and no sediment trapping structures were built, due to budget limitations.	The constructed foreshore rock dike was longer and closer to the shoreline than designed.
Was project operated as designed?	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Physical response as required for healthy marsh?				
Inundation	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Salinity	No data collected, even though project was justified as preventing saline waters from entering the 247 ac project area.	Salinity was within the range for healthy marsh, except during the drought.	Not Applicable	No data collected, even though project was justified as preventing saline waters from entering the project area. It is assumed that this was accomplished by keeping the shoreline intact.
Shoreline Erosion	Shoreline behind the structure accreted, while reference area eroded.	Immediately after construction some accretion occurred behind the rock dike. Recently, shoreline erosion behind the rock dike is occurring but at a slower rate than in the reference area.	There have been some problems with the early DGPS measurements of the shoreline position. These measurements indicate increased shoreline erosion after the project was built. 1998 and 2000 field measurements at five locations show accretion behind the structure at two locations and no shoreline movement at three locations.	Shoreline has accreted west of Brandon Canal and erosion occurred east of Brandon Canal. The erosion in the eastern part is attributed to the fact that the foreshore dike was actually constructed on the shore and vessel wakes can overtop the dike. Shoreline erosion has continued in the reference site just west of the project.
Biological response as required for healthy marsh?				
Vegetation cover and composition	Not Applicable	Fresh and intermediate vegetation were targeted by this project. The southeastern end of the project area is transitioning into brackish marsh.	Not Applicable	Coast wide vegetation surveys indicate that the project has remained a fresh water marsh.
Land loss rates	Although shoreline erosion has been reversed, interior marsh loss may continue. Ocular review of aerial photos suggest loss, but this may be the result of water level or seasonal differences and should be investigated further.	No post-construction photography has been analyzed. Ocular review of photographs suggests increased land loss in the project area.	Ocular comparison of the pre-construction photography and the 2000 Brown Marsh photography indicates that the northern part of the project area continues to erode, but the rest of the shoreline and the interior marshes appear to be stable.	Post-construction photography is scheduled for 2006. The review states that the project area has been maintained as it was (stable fresh water marsh).

exists. Differences in water levels and photography dates confound the interpretation of aerial photography, giving the impression of interior wetland loss, however, refuge personnel suggest that no loss is occurring. New aerial photographs immediately could be acquired as close to 1 November as possible. As scheduled, only one more aerial photograph is planned for 2009. By the time that image has been analyzed the project will be 15 years old and it would probably be too late to collect sufficient data to determine the cause of loss if loss is proceeding as indicated by the available aerial photographs. If new aerial photographs confirm that wetland loss is rapid, then the cause of ongoing wetland loss in the project area needs to be determined. Once the cause is determined, protection and restoration options can be evaluated.

Lessons Learned

These lessons were learned and changes were incorporated into CWPPRA procedures before this review:

1. Goals and objectives must be clearly stated to prevent ambiguity.
2. Two, albeit conflicting, rules were adopted by CWPPRA that requires a re-evaluation of the decision to construct if the project area or costs change by more than 15% or 25%. See sections 5.d(1) and 6.e.(2) of CWPPRA (2002) for those rules. If those rules had been in place when this project was planned, then the rock dike probably would have been tied into the existing shoreline near the original project boundaries rather than being doubled because as planned this project was one of the least cost effective projects on the first project priority list.

These lessons were learned as a result of this review and are available to CWPPRA planners:

1. Before- and after-construction aerial photographs need to be taken at similar times of the year.
2. Interior wetland loss may not always be caused by loss of a protective shoreline. In such cases, protecting the shoreline has not prevented loss of adjacent interior wetlands.
3. Projects that protect more acres of marsh than are anticipated to erode should be classified as something other than shoreline protection, or not classified at all. There are no benefits of classifying projects (as to hydrologic restoration, shoreline protection, etc.). This is not a new conclusion; Nyman (1998) found that 19% of CWPPRA projects were misclassified, and that all misclassifications reduced rather than increased monitoring budgets. The cost of classifying this project as a shoreline protection project is that there were no funds available to collect water level data, water salinity data, and vegetation data that could be used to support or refute the land loss data, and no data to identify the cause of marsh loss in the project area if marsh loss is occurring. Assembling and analyzing a data set sufficient to eliminate likely but unreal causes of wetland loss in the project area probably will take three to five years.
4. A Coastwide Reference System may provide the data to determine if the interior marsh loss is as unusually high as it appears.
5. Aerial photography, even when properly timed, is insufficient to determine causes of marsh loss.

ME-04 Freshwater Bayou

Project Effectiveness

The shoreline protection component of this project was constructed with rock from the dismantling of the Wax Lake Weir, and as such, there was no control over the size of the rock, or several other construction criteria. In addition, this project is similar to several other rock projects, and it was decided by the Shoreline Protection and Marsh Management/Hydrologic Restoration teams to combine the two reviews into one for this project. Results can be found under ME-04 in the Marsh Management/Hydrologic Restoration section.

TV-03 Vermilion River Cutoff

Project Effectiveness

Project effectiveness is difficult to address for this project since the project was completely redesigned during project planning and the monitoring plan does not reflect some of the changes made to the project during construction. The success criteria should be the stabilization of the shoreline behind the rock dike. Surveys of the rock dike and shoreline will be conducted in the near future to determine if the dike has stopped erosion of the shoreline.

Recommended Improvements

1. Add more rock to the existing dike as determined necessary through the maintenance and monitoring programs to maintain the elevation of the dike.
2. Extend the rock dike to the south to protect the area that would have been protected if cost overruns had not occurred.
3. Armor the three points of land along the west side of the Vermilion River Cutoff (VRC) that would have been protected if cost overruns had not occurred.
4. Revise the monitoring plan to reflect the current project design.
5. Aerial photography is being flown to document the land/water ratio in an area for which there are no project goals. Either the photography needs to be discontinued or a goal needs to be added to assess project effects in that area.

Lessons Learned

1. Up to date surveys should be taken before projects are constructed.
2. Datum planes need to be decided upon and agreed to by all parties involved before project construction. This problem has been solved for PPL9 and subsequent projects. For those projects, monuments will be constructed within or near the project area.
3. Soil borings need to be taken in order to design the project properly. This is a straightforward requirement that should not be overlooked in order to save money or time.
4. The cross section of rock dikes may be reduced from the designs originally proposed by the USACE. The USACE is changing its attitude toward dikes used for coastal restoration projects.
5. Need to update Wetland Value Assessments (WVA's) and monitoring plans to reflect the project as actually constructed. Currently this is only required when there is a major shift in project purpose or change in design that results in a change in protection area of 20%.
6. Do not use relict data from early project designs to develop monitoring plans.
7. For projects that were modified during construction, the monitoring plans need to be revised to reflect the actual project design.

8. Projects should not be modified during construction because of cost overruns. Today, there are mechanisms within the CWPPRA Standard Operating Procedures to provide additional CWPPRA funding (within limits) if cost overruns occur during construction.

CS-22 Clear Marais

Project Effectiveness
The monitoring program is documenting the erosion protection provided by the project. The following is repeated from the draft Three-Year Comprehensive Monitoring Report: "The project has shown that, not only protecting the shoreline, but also increasing land to water ratios behind the rock breakwater can be obtained in a few years. Shoreline gains have occurred at 24 of the 34 sampling sites behind the rock breakwater. Shoreline losses have occurred at all of the reference sites. Overall, the project has shown a positive response of gaining 12.99 ft/yr of land behind the breakwater."

Recommended Improvements
The first recommended improvement is to install secondary monuments on the east and west ends of the project in order to improve future elevation maintenance surveys. It is also suggested that on all shoreline protection projects, maintenance surveys should be used to monitor and evaluate shoreline protection features, including accretion and toe scour. The maintenance survey would need to include a DGPS shoreline survey of the vegetated marsh edge in both the project and a reference area.

Lessons Learned
1. Due to the minimal settlement occurring at this project, the use of geotextile fabric may not be necessary in areas with similar soil types. Other projects in similar soils should be investigated to determine if geotextile is necessary.
2. There may not be a necessity to monitor land/water ratios if maintaining a certain ratio is not a project goal or objective.
3. Information is being collected through a cooperative effort between the monitoring program and the maintenance program to document accretion behind the dike. This project benefit is not captured in the project goals or objectives, but is believed to be worthy of documentation. Both the monitoring and maintenance programs are contributing to surveys so that efforts are not duplicated.

Overall Shoreline Protection Recommendations
1. Post construction inspection is extremely important.
2. Pre-construction soil borings, surveys, and geotechnical investigations are essential.
3. Shoreline projects should not be assumed to remedy interior wetland loss without additional information. Much of this is currently being done during boundary determinations involving both engineers and biologists. For example, ME-09 assumed that interior wetland loss was the result of shoreline erosion and water exchange. The shoreline has been stabilized, and exchange limited, but interior wetland loss may persist.
4. Shorelines can be a critical component of larger hydrologic projects, however many shoreline projects may be misclassified as such, since their main objective in reality may have been to restore a hydrologic barrier, and not simply to stop shoreline erosion.

5. Re-evaluate the way that monitoring budgets are determined for shoreline projects, and potentially have LDNR Biological Monitoring Section (BMS) Manager, working closely with the Economic Working Group, provide monitoring estimates prior to funding, rather than basing monitoring funding level on project-type.
6. Evaluate correlation between settlement plates and structure rates of compaction, with soil types.

Programmatic Recommendations

Project Planning
The three main components for an effective adaptive management plan for a restoration project are: 1) a clear goal statement, 2) a conceptual model, and 3) a decision framework (Thom 2000). All of these should be developed during the planning stage.

<u>Goals</u>
Project goals have evolved from the Environmental Assessment (EA) and Wetland Value Assessment (WVA) planning stages through the engineering and design, construction and monitoring stages, and sometimes the original intent of the project is lost or becomes secondary. Project goals should be identified early in the process and should not change unless the intent of the project changes. Currently, there is a perceived success/failure decision associated with the goals and objectives. The goals and objectives are deliberately vague to prevent such a decision. We think that this can be improved by clearly defined success criteria and targets. Evaluation of the project would document the projects ability to move towards the target (For an example of this approach see Zedler and Calloway 2000). If a project is moving away from the target, the cause can be determined and operation and maintenance plans can be adjusted.

Better correlation is needed among EA, WVA, and Monitoring Plan to establish clearly defined success criteria and targets by which projects will be evaluated. More importantly, project goals should be identified prior to the selection of project features and should address the documented causes of wetland loss. Current CWPPRA Task Force policies require that the WVA, EA, Ecological Review, and Monitoring Plan contain clear goals and objectives. This being the case, more thought should be put into project goals and strategies during the planning phase, targets should be set, and success criteria identified, so that monitoring expectations are more clearly defined and project effects can be measured along trajectories of change. Determination of project effectiveness for a 20-yr project cannot be determined after 2-3 years, however, with clearly defined targets, we should be able to evaluate if a project is moving towards the target. We can then make necessary adjustments to operation and maintenance plans to ensure that the project remains moving in the intended direction. We recommend that targets be identified for all CWPPRA projects. For new projects this should be done during the phase 1 evaluation of the project. For projects that are already constructed this needs to be done as soon as possible.

<u>Conceptual Models</u>
Causes of wetland loss for some of the reviewed projects were sometimes not well documented during the planning stages and were often based on landowner and local observation, but not on data collection and scientific review. The current process has been revised so that the cause of wetland loss are are more thoroughly investigated during the planning stages. Those presumed causes are also identified in the Wetland Value Assessment reports. If causes of wetland loss are

not accurate, the likelihood of failure to reduce land loss is increased. A good conceptual model of the controlling physical factors and the resulting system structure and function is necessary for a successful restoration project (Thom 2000). If the project is not moving towards its structural goals, the project manager can go back to the conceptual model to understand what went wrong and recommend corrections to the operation and maintenance plan of the project (Thom 2000). The process of writing down the controlling factors along with the desired system structure and function is a useful exercise for providing the basis for the design of the project (Thom 2000). We have made a first attempt at this conceptual model for each project with the comparison to literature data on physical parameters and biological structure in healthy marshes. But good conceptual models should be developed based on the monitoring data that have been gathered to date and any other data sources from Louisiana coastal wetlands. The Planning and Engineering Work Groups within CWPPRA are working with numerical models on more recent projects than the ones reviewed in this report. It is becoming more standard practice to develop hydrologic and other models to estimate project effects and to fine-tune project designs based on these model predictions.

Decision Framework

This can also be thought of as a contingency plan which gives a set of alternative actions if project monitoring indicates that change is needed. If alternative actions are defined upfront when planning the project, and if written down in a simple form (e.g. flow diagram) that can be revised, decisions on actions can be easily made (Thom 2000). Zedler (1996) used flow charts to show how project results fit into the decision process.

Construction

Several projects were reduced in scope between planning and construction completion in order to stay within the approved budget. In many cases, this has made the project sub-optimal and it is doubtful whether these projects can ever reach the level of restoration they were intended to achieve. The CWPPRA Task Force will need to decide if these projects should be upgraded so that they can reach their full potential or if they should be deauthorized so that the money allocated for operation, maintenance, and monitoring can be used for better designed projects. These types of problems should diminish for future projects with the cash flow approach to project funding and more detailed engineering review of the project features and costs.

Design changes, whether before or during construction, need to be coordinated with monitoring and Operation and Maintanance (O&M) to ensure that project goals are not compromised, nor are other aspects of the project, and also so that modifications can be made to Monitoring and O&M plans and budgets, if necessary. This could be accomplished by having a project management team consisting of the personnel involved in all aspects of the project and two academic advisors. This project management team should improve the communication among the biologists and engineers involved with the project. In addition, such a team can provide the institutional memory, which is sometimes lost with changes in personnel and associated changes in project managers.

Closer construction inspection is necessary to avoid contractor changes during construction that compromise project goals, strategies, or ability to evaluate project effectiveness.

Demonstration Projects

Even though demonstration projects are typically only 5-years in duration, to be able to truly evaluate their effectiveness, they should be constructed with the same 20-year quality and durability as a typical project (not "downsized"). In addition, demonstration projects should be funded with a contingency for removal at the end of the 5-year demonstration period, and since evaluation of demonstration projects requires more intense data collection than typical projects, budgets to evaluate project effectiveness should be proportionately larger than standard project budgets.

Landrights

Current CWPPRA policy includes the development of landowner agreements to allow LDNR supervisory control of operation and maintenance. However, since the proper construction *and* operation of structures are critical to project effectiveness, landowner agreements for structure construction *as well as* operation and maintenance should be written such that LDNR has ultimate responsibility and authority. It should not be left to the landowner to construct and/or operate structures in a manner which is not consistent with the restoration project objectives.

Operations and Maintenance

Structure operations are critical to project effectiveness. We have seen this with both Marsh Management/Hydrologic Restoration projects, and Freshwater Diversions. Projects should not be constructed without LDNR or a CWPPRA agency maintaining control over operations and maintenance.

Operations and maintenance plans should incorporate contingency plans for extreme weather years when possible. The operation and maintenance plan should clearly identify steps to be taken when the project does not progress towards the intended targets. This could be accomplished through the program management team's use of the decision framework (both discussed above).

Not all projects have enough money built into their maintenance budgets to repair degraded areas, this is especially true on barrier islands both for vegetative plantings and material placement. Due primarily to funding constraints, barrier island projects typically donot include maintenance. While adding maintenance would likely increase longevity, it would also substantially increase their cost. Efforts are beginning to try and address this but cost constraints are hampering their adoption.

Monitoring

Projects should be planned, monitored, and evaluated in the context of their place in the surrounding environment. Basin-level evaluation reports which incorporate project effectiveness as well as cumulative effects of projects would improve our understanding of coastal ecosystems. These three-year comprehensive monitoring reports should combine monitoring as well as corresponding O&M information for the same projects. These reports should evaluate the changes in the physical environment due to the design and/or operations of the structures (which is more of a traditional O&M issue) in light of the data traditionally used to determine if the biological responses to the project are keeping up with the project goals (which is more of a traditional "monitoring" issue). Interdisciplinary support from the academic community is recommended for the evaluation of project effectiveness and cumulative effects. In the near future, the proposed Coastwide Reference Monitoring System could provide more of this context of the surrounding environment.

Classifying projects based on project features has limited the goals and objectives, monitoring emphasis, and monitoring budget on some projects, severely limiting the ability to evaluate project effectiveness. For example, Cameron Prairie Refuge assumed that interior land loss was the result of water exchange with the Gulf Intracoastal Waterway (GIWW). The project was designed to stop shoreline erosion along the GIWW, and assumed that this would also stop interior wetland loss. The project was very effective at stopping shoreline erosion; however interior wetland loss in undetermined and further analysis is needed to determine if timing of aerial photography or differences in water level during photo acquisition may be giving false indication of interior land loss. ,We recommend that the practice of tying the monitoring budget to the project type be reevaluated. Monitoring budgets should be based on the data necessary to effectively measure the physical driving forces and the intended structural outcome, so that the project can be adaptively managed.

Fisheries monitoring has only been conducted on one project in the Chenier Plain, and is planned for one project in the Deltaic Plain. Evaluations done on this component are based primarily on empirical data. Monitoring priorities should be encouraged to utilize existing scientific literature and studies, and lessons learned from other CWPPRA projects to better focus data collection in critical areas essential to the evaluation and adaptive management of ongoing restoration projects.

Other Concerns

As the evaluation process and feedback loops continue to evolve, other concerns emerge which will need to be addressed in future reviews, and with future projects. For example, overburden material from dredge borrow areas, especially in barrier island projects, is often too fine to be utilized on the islands in unconfined conditions and because of this, has not been included in calculations for placement, either as a cost of disposal or potential for creation in other areas. These borrow areas may also have an ecological impact that has not been accounted for in environmental analysis. This and other similar issues will need to be addressed as we continue to learn from our progress.

Workshop

The results of this review were presented at discussed at a workshop at the Burden Research Center in Baton Rouge on August 12 and 13, 2002. This workshop was attended by 114 different individuals with 100 people attending the first day and 84 the second day. As expected the majority of the attendance came from CWPPRA agency personnel (68 individuals). The remaining attendees included individuals from nine different engineering firms, four Louisiana universities, three coastal parishes, three environmental groups, the Louisiana Department of Wildlife and Fisheries, the National Wetlands Research Center, and the National Research Council. The National Research Council (NRC) will use this review as a case study in their review of Adaptive Management (Dr. Carl Hershner, NRC, pers. comm.).

CONCLUSION

The adaptive management review has unearthed a wealth of information on each of the reviewed projects. We have shown that many projects experienced significant changes between the planning and construction phases; many projects are functioning as planned, but some are not. The project review teams have recommended changes that could improve each of these projects and we have summarized the lessons learned at the programmatic level.

We have also identified previously undocumented adaptive changes at the project-specific and programmatic scales that have improved restoration effectiveness. The CWPPRA program has evolved over the past decade based on new information and advances in science. These advances in science are used in all phases of project planning, implementation, and evaluation.We hope that adaptive changes will continue to improve the effectiveness of coastal restoration in Louisiana. The Adaptive Management Review has been a valuable exercise and we recommend that this type of review be repeated for all constructed projects. It is up to the CWPPRA Task Force to pursue some or all of these recommended changes.

LITERATURE CITED

Craig, N. J., R. E. Turner, and J. W. Day, Jr. 1979. Land loss in coastal Louisiana (USA). *Environmental Management* 3:133-144.

Day, J. W., Jr. and N. J. Craig. 1982. Comparison of the effectiveness of management options for wetland loss in the coastal zone of Louisiana. In: D. F. Boesch (ed.) *Proceedings of the Conference on Coastal Erosion and Wetlands Modification in Louisiana: Causes, Consequences and Options*. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Gagliano, S. M., K. J. Meyer-Arendt, and K. M. Wicker. 1981. Land loss in the Mississippi River deltaic plain. *Transactions of the Gulf Coast Association of Geological Societies* 31:295-300.

Hackney, C. T. 2000. Restoration of coastal habitats: expectation and reality. *Ecological Engineering* 15:165-170.

Louisiana Department of Natural Resources 1998. LaBranche Wetlands: Monitoring Plan. Baton Rouge, LA: Louisiana Department of Natural Resources, Coastal Restoration Division. 7 pp.

National Research Council, Academy of Sciences. 1992. *Restoration of Aquatic Ecosystems : Science, Technology, and Public Policy*. National Academy Press. Washington, DC.

Nyman, J. A. 1998. Technical audit of the Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Report submitted to the Louisiana Department of Natural Resources Coastal Restoration Division, Baton Rouge, LA. 55pp.

Thom, R. M. 2000. Adaptive management of coastal ecosystem restoration projects. *Ecological Engineering* 15:365-372.

Walters, C. J., and C. S. Holling. 1990. Large-scale management experiments, and learning by doing. Ecology 71:2060-2068.

Zedler, J. B., (ed.). 1996. *Tidal wetland restoration: a scientific perspective and southern California focus*. California Sea Grant College System, University of California, LaJolla, CA.

Zedler, J. B, and J. C. Callaway. 2000. Evaluating the progress of engineered tidal wetlands. *Ecological Engineering* 15:211-225.

COMMENTS ON THE DRAFT FINAL REPORT

The following comments are included here because some of the content is more than editorial, and is important to be recorded. Comments on the Draft Final Report were received from NRCS and USFWS. Comments were submitted on earlier versions by more reviewers, however are not included here. While every attempt was made by the authors to incorporate these comments, some of them could not be incorporated into the Final report. Please read these for what they are (agency viewpoints and interpretations), and not as representative statements from all of the CWPPRA agencies, the State, or Academia.

Natural Resources Conservation Service (NRCS)
October 23, 2002

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RE: Comments on the Adaptive Management Executive Summary

The process of applying Adaptive Management is part of sound fundamental water resource planning. Using the feedback mechanism of the planning process by investigating installed projects improves the long-term efficiency of project selection and design. It also provides opportunities to make operational and maintenance adjustments to existing projects to improve benefits. I am pleased that we are documenting our experiences in this program in order to move forward and make better decisions and assist others in dealing with coastal wetland loss. However, I see several problems with this document that must be addressed.

In reviewing this document several things became apparent. First, this document is not an Executive Summary, but a collection of program notes and project details that should not be listed in a summary. This document should summarize the results by project type of lessons learned, general positive notes by project type, and general negative notes by project type. The detailing of items about all projects that were reviewed under this exercise do not need to be placed here, rather placed in the body of the document.

Second, this document should discuss the positives and negatives, rather than dwell on the negatives. In the past twelve years, we have learned quite a lot from all of the projects, including demonstration projects, and have continually modified our approaches as a result of new information, often directly coming from previous projects. It has not been until recently that we have had enough information from projects in order to make design changes. However, we have annually looked at ways to improve the ecological evaluations, engineering review and cost process, and improve the detail of the economic evaluations of projects under the CWPPRA Program. NRCS has used internal data on previous construction projects to improve designs, cost estimation, and improve project construction times. This is all a part of the learning curve from dealing with a new program.

Third, it is stated several times that rock riprap is not a suitable natural material to be used in coastal restoration projects. The Coastal Wetlands Planning, Protection, and Restoration Act mandates that the Task Force look at cost-effectiveness in project selection and to date very few alternative materials have proven to be cost-effective. Material selection is highly dependent on the site-specific conditions of wave energy, water depth, salinity, and soil properties. NRCS has supported and will continue to support demonstration projects that look at new materials and techniques to help arrest the problem of coastal wetland loss.

Fourth, NRCS has a concern over the statement that proper maintenance budgets do not exist on projects. The Task Force had all but three projects re-evaluated and updated for operation and maintenance costs on Priority Lists 1 to 7 in 1998. At that time, all evaluated projects had a rigorous review between the Federal and State sponsors to determine the necessary operation and maintenance and expected maintenance cycles. The information was used to fully fund the expected work with a construction contingency on maintenance work. The engineering work group now makes a detailed estimate of operation and maintenance needs for projects since PPL-8. Under Cash Flow, each project is supposed to have the operation and maintenance budget updated to correspond to the final design to be constructed. Finally, there is a built-in cushion for cost-overruns in the CWPPRA Standard Operating Procedure, which applies to all phases including Operation and Maintenance of a project.

Fifth, NRCS understands the need on this first adaptive management review that we utilize State Only projects. The concern of sufficient data resources and time frames made it important to include the State Only projects. However, it is not clear in the summary which program had the various problems. The summary should document the two program problems separately, so the public will not be confused. The CWPPRA program has been internally utilizing adaptive management to make corrections in many of the areas discussed on an annual basis. An example is to look at the modifications that the Task Force has made to improve the project selection process through additions of secondary criteria to incorporate Coast 2050 Criteria and others such as, risk and uncertainty, sustainability, and longevity. The Environmental Work Group has made many improvements to the Wetland Value Assessment models. The Engineering Work Group has improved its review process to better handle project construction cost estimates and to improve Operation and Maintenance (O&M) estimates. The Economic Work Group has improved the costs system to help improve long-term cost estimates. The final point on improvements is that the Cash Flow projects are approved in two phases in order to better calculate project construction and O&M costs.

Sixth, NRCS understands the need for better monitoring, however, the cost of detailed monitoring on every project would be cost prohibitive. We support the idea of the Coastwide Reference Monitoring System. We are required by the CWPPRA legislation to ensure benefits, but it does not state the detail level of work to meet this mandate. We should do detailed monitoring on some projects across basin, project type, and marsh type. However, we feel that the intent of CWPPRA was to put projects on the ground to protect our valuable coastal resources and not become a research program.

Finally, we agree that further work needs to be done on enhancement of some projects. The CWPPRA legislation mandates that a project provides for the long-term protection and enhancement of coastal wetlands and its dependent fish and wildlife resources. One suggestion made is to look at the addition of dredge material placement during a marsh creation maintenance cycle in order to maintain marsh elevation. NRCS believes this is a good idea, however, a potential problem will be the impact on the established plant communities. We support the need for a demonstration project to help establish these impacts and find what level of sediment will help maintain long-term marsh elevation while not being detrimental to the overall health of the project plant community thus fish and wildlife resources.

NRCS is supportive of this effort and happy to have been able to work on the Adaptive Management process. We understand the need for such a process to fully document needed changes in methods and procedures to improve the coastal wetlands planning and implementation process. This documents the work and reasoning for improvements in the CWPPRA process. We have attached detailed comments for incorporation into the Executive Summary.

Sincerely,

Bruce Lehto,
ASTC/WR/RD

Attachment

cc: John Saia, USACE-New Orleans District, New Orleans, LA
Tom Podany, USACE-New Orleans District, New Orleans, LA
Gerry Bodin, US Fish and Wildlife Service, Lafayette, LA
Richard Hartman, National Marine Fisheries Service, Baton Rouge, LA
Troy Hill, Region 6, EPA, Dallas, Texas
Bill Good, LDNR/Coastal Restoration Division, Baton Rouge, LA

US Fish and Wildlife Service (USFWS)
***(NOTE: Comments on for programmatic Action Items document were omitted, since that document was prepared for the October 9, 2002 CWPPRA Task Force meeting and is not included as a part of the Final Report. Also, references to page numbers were based on the previous draft and may not be accurate in the Final Report) ***

October 25, 2002

Dr. Jenneke Visser
CWPPRA Academic Assistance Coordinator
Coastal Ecology Institute
Louisiana State University
Baton Rouge, Louisiana 70803

Mr. Richard Raynie
CRD Monitoring Section Manager
Louisiana Department of Natural Resources
P. O. Box 44027, Capitol Station
Baton Rouge, Louisiana 70804

Dear Dr. Visser and Mr. Raynie:

Our biologists have reviewed the final draft of the CWPPRA Adaptive Management Review Executive Summary and Programmatic Action Items, and we submit the following comments for your consideration**.**

Executive Summary

General Comments

The document is too lengthy for an executive summary. The General Comments provided at the end of the document are unnecessary for that summary. Some sections are repetitious and could be shortened considerably. For example, several of the Recommended Improvements, Lessons Learned, and other conclusions for the two freshwater siphon projects (i.e., Naomi and West Pointe a la Hache) are identical; if they were combined, a much-abbreviated discussion would be sufficient. This is also true for the dredged material and shoreline protection projects.

References to projects in the text and in tables should be by project name and not only by project number. Using project names would avoid confusion by readers unfamiliar with the project numbering system.

Basic information should be added regarding each project's effectiveness. Clear, concise statements should be added in the project effectiveness sections to indicate the amount of marsh restored or created, shoreline erosion reduced, or salinity levels reduced by each project. Statements are often made in the project effectiveness sections indicating that the project may not create or protect as much marsh as originally planned. Since those statements are included, the actual protection and restoration statistics should also be included as supporting information.

NOTE: Specific editorial comments were addressed in the December 20, 2002 revision and were removed from this letter.

We appreciate your leadership during this review. If you have any questions regarding our comments, please contact Kevin Roy, Martha Segura, or Darryl Clark (337/291-3100).

Sincerely,

David W. Frugé
Supervisor
Louisiana Field Office

cc: Corps of Engineers, New Orleans, LA
NRCS, Alexandria, LA
NMFS, Baton Rouge, LA
EPA, Baton Rouge, LA
FWS, Cameron Prairie NWR, Bell City, LA
LA Department of Wildlife and Fisheries, Baton Rouge, LA
LA Department of Natural Resources (CRD), Baton Rouge, LA
LA Department of Natural Resources (CRD), Abbeville, LA
LA Department of Natural Resources (CMD), Baton Rouge, LA

GENERAL COMMENTS

The general comments below were received after the Adaptive Management Workshop and after the first Draft Report was circulated for review. Several iterations of editorial comments were received from many reviewers between August and October 2002. Editorial comments were incorporated into the document whenever possible, but the following general comments were also received and are included here so that they are properly recorded.

Dr. Bill Good
Administrator
Louisiana Department of Natural Resources
Coastal Restoration Division

First, let me commend you on an adaptive management job well done!
I feel that you have taken a giant step towards closing some of the major information feed-back loops that needed to be addressed in our coastal restoration program. This will hopefully continue to develop in future years, and we will one day wonder how we could have ever conducted a program of this scale and complexity without such a tool.

It seems to me that we are now at a point where we should once again make some positive changes in our monitoring program. One general statement--some of the data we have been collecting no longer seem cost-effective to collect, store, analyze and report. At the same time we now see information needs that did not previously seem important. Just as apparent is the need to integrate information across programs--lessons learned from CWPPRA need to be combined with those from WRDA and the state-only projects--in this case, the whole is clearly more than the sum of the parts.

It was also clear that, in general, the information needs relevant to the Monitoring Program are complementary with those of the Operations and Maintenance Program. With this in mind, I would like to make the following three-part suggestion:

1) The 3-year comprehensive monitoring reports should be integrated with a corresponding 3-year comprehensive O&M reports for the same set of projects. These reports would evaluate the changes in the physical environment due to the design and/or operations of the structures (which is more of a traditional "O&M" issue) in light of the data traditionally used by the scientists to determine if the biological responses to the project are in keeping with the project goals (which is more of a traditional "monitoring" issue). This would integrate these endeavors, which have not necessarily been conducted jointly. The benefits would be similar to those we see resulting from the Ecological Review process, which are in large measure due to taking a holistic approach to predicting a project's success based on an iterative evaluation of its changes to the physical environment and the resultant effects on the biological community in question. This would also provide efficiencies in field travel, monitoring and O&M costs. More importantly, the operations would be based directly, at least in part, on biological feedback; and the biological interpretation of project effects would include the O&M activities related to the structures in addition to the usual suite of data.
2) The combined O&M and monitoring reports would be on a basin-level basis. For example, all the projects in the Calcasieu/Sabine basin would be evaluated collectively--both at the project level and at their collective level. This would greatly facilitate the evaluation of

possible systemic or cumulative effects. In some instances, e.g. the Caernarvon project, we are already looking at the basin-level effects of a single project. Most of our projects are much smaller in their influence, but at some point we will hopefully be seeing basin-level influences from the combined effect of the projects out there. This should also assist in making appropriate coordinated operations adjustments in order to assist in achieving desired cumulative effects. Furthermore, if these reports were performed as part of the interaction of basin-level teams, the efficiencies in meetings and in the collection and organization of the information becomes apparent.

3) These three-year combined reports should be used as a basis for the Report to Congress, which is also on a three-year cycle. For example, in 2005 we could do 3-yr comprehensive reports on all projects, and then roll this up into our 2006 Report to Congress. Obviously, the Coastwide Reference Monitoring System would also lend tremendous support to and feed directly into this integrated, comprehensive approach. This would also better fit the needs of large-scale efforts such as the LCA, other regional planning activities, interpretation of landscape-scale land/water changes, and large-scale modeling efforts. This would also provide a more systematic approach for O&M and Monitoring field activities.

Most importantly, the adaptive management approach you have recently conducted needs to continue, evolve, and be imbedded in our combined O&M and Monitoring data collection/analysis/reporting program. A workshop on a three-year basis as a prelude to the Report to Congress may be a catalyst to make sure this happens.

Thanks for the opportunity to provide input into the recent Adaptive Management effort. It has been a very interesting and productive experience.

Dr. Mark Hester
Department of Biological Sciences
University of New Orleans

Below are some comments/suggestions in regard to Adaptive Management Review lessons learned for marsh creation:

In regard to the point made in O&M "Initial plantings may be most successful at least 1 year after material placement" – I think we need to add that our review did not include saline marshes, where hypersaline conditions may occur if the material is above the intertidal and remains devoid of vegetation for a period of time. This recommendation of waiting to plant only applies to relatively low salinity wetlands where a) natural recruitment is anticipated to occur and b) where the material is not of a very high density – i.e., difficult to walk/plant until it consolidates. In general, planting should always be in the budget and should be done as soon as feasible.
Also under O&M, the "maintenance dredging" needs to be clarified as being more of a "marsh nourishment" where a relatively thin layer of fluid dredge material can be placed after most of the settling and compaction occurs (5-7 years) post construction to a) optimize the elevation needed to maximize plant productivity and b) increase long-term natural sustainability of marsh elevation via accretion process that include plant belowground (and aboveground) productivity. Under construction, the multiple stages or lifts are to achieve the same goals stated in 3a and 3b above.

Joseph I. Vincent
Member
Conservation Committee
Sierra Club, Delta Chapter

Dear Jenneke,

This letter will be sent to you as part of an e-mail message, which will also have other attachments. Thanks again for all your hard work and excellent organization of the CWPPRA Review Meeting in Baton Rouge on 8/12 & 8/13. As you are accepting comments until 8/23/02, I'd like to submit these, and hope that they will be given serious consideration. Although I am not a professional biologist or engineer, I have been active in attempting to protect Louisiana's wetlands for over 30 years.

One thing I learned at the meeting was that bulkheads and rock dikes constructed as part of CWPPRA projects are usually built as straight lines because they are thusly more cheaply constructed. I have been fighting with the Corps for many years over bulkheads, particularly those that typically involve solid placement of dredged material to completely cover riparian habitat behind a bulkhead in order to ostensibly retard/prevent erosion. This, of course, completely ignores the high value of and critical role played by riparian habitat, of the zone where land and water naturally meet, and the need for creatures, water, detritus and nutrients to be able to pass from one to the other and vice versa.

This also holds true for the structures erected as part of CWPPRA projects, and indeed, gaps have been incorporated into bulkheads and rock dikes with varying results. I am attaching to the e-mail message a JPEG file, which is a simple drawing of a possible construction for a gap - one which allows free passage of organisms and some suspended matter and detritus while at the same time removing the type of wave energy that causes shoreline erosion. This is a rough drawing, and it would be important to possibly rotate the structure to best meet the normal incoming wave activity at an angle that both prevents a direct hit on the outermost portion and simultaneously ensures that no direct path is found through the gaps in the structure. I also propose that a modified system of staggered, non-contiguous bulkheads be used to counter small-scale erosion, rather than the old dredge-and-fill method virtually always used now.

And, of course, the distance at which the bulkheads, breakwaters and dikes made of the various materials is optimum must be much further studied, as became obvious at the review meeting.

Which brings us to the materials to be used, and in particular, to the one I made mention of to you and to others – PVC plastic must <u>not</u> be used. I am also attaching to the e-mail message just one tiny article from Greenpeace's web site on the dangers of PVC plastic. Quite frankly, it is irresponsible to use it, as you'll see. And there is a huge amount of information available about why PVC plastic needs to stop being produced. There are other kinds of plastic that have far fewer dire consequences for humans and other life forms, and they are readily available and not prohibitively expensive. The environmental cost of using PVC plastic is enormous.

Another thing I mentioned at the meeting, which is absolutely critical, is that the CWPPRA folks and permitting folks be on the same page. That is, as again in the example I cited, the State and Corps permitted the dredging of State-owned water bottoms and of coastal marsh for the construction of a 60 home Venetian-style subdivision featuring an 8-foot-deep canal system, bulkheads and fill placement on West Cote Blanche Bay at the same time that $10K per acre were being spent to try to retard shoreline erosion and marsh loss in east Cote Blanche Bay –

insanity! And both the Corps and State continue to issue hundreds of wetlands-destructive permits every year. It is totally senseless to intentionally allow the destruction of wetlands at the same time we attend dozens of meetings and spend over $40,000,000 per year to save wetlands. Either we really try to save wetlands or we quit pretending and making fools of everyone involved.

Dr. Andy Nyman showed us photos of a coastal marsh that's still breaking up despite a CWPPRA shoreline protection project nearby, said photos clearly indicating the continued and progressive breakup of the marsh for many years after a marsh buggy cut across it. Come on down to McArthur Avenue in Harvey, just about 8 blocks from my house, to where you'll see a brand-new fleet of huge marsh buggies sitting there for hire. I assure you that these marsh buggies represent a tremendous investment in capital, and that they weren't purchased because they're not going to be used. Here, again, if the State intends to protect wetlands, then it is imperative that marsh buggies and air boats be kept out!

Most of the other things I'd recommend were suggested by your presenters and participants. I looking forward to seeing improvements based on experience and on these and the other comments you may receive. If these are gathered and made available on your web site, I'd appreciate being so notified.