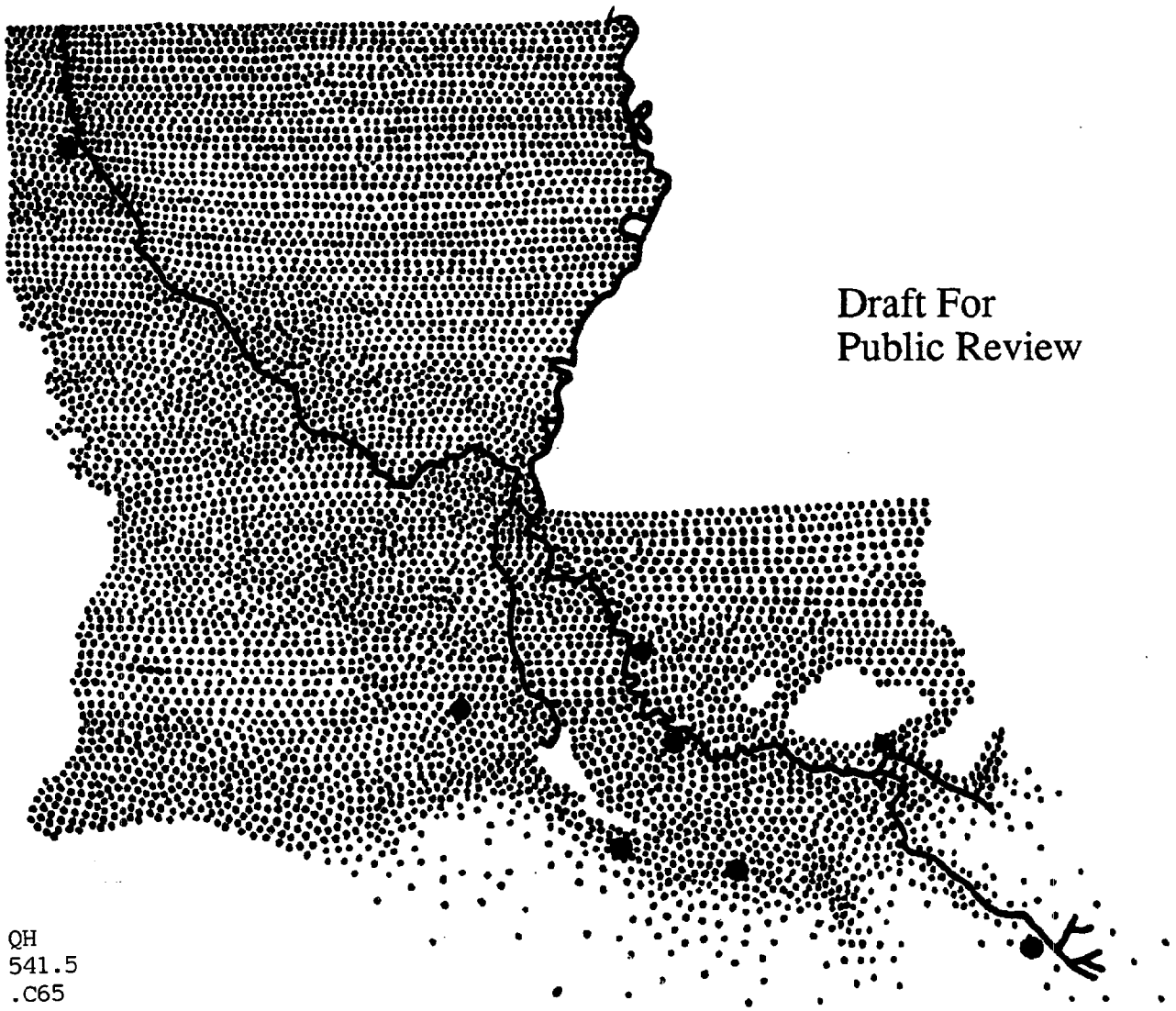
COASTAL LOUISIANA
HERE TODAY AND GONE TOMORROW ?

A Citizens' Program For Saving
The Mississippi River Delta Region
To Protect Its Heritage, Economy
And Environment



Draft For
Public Review

C)N TO RESTORE COASTAL LOUISIANA

April 1987

PREFACE

This draft report from the Coalition to Restore Coastal Louisiana is a citizens' plea for action. It reflects the research and experience of more than two dozen scientists and laymen who have been deeply involved in Louisiana coastal issues for many years. These individuals work for or are associated with a broad range of organizations concerned with maintenance and restoration of the coastal wetlands of the Mississippi River Delta region and the Chenier Plain to the West in Coastal Louisiana. The following people have contributed to and written the draft:

Robert Gorman, Catholic Social Services
Barry Kohl, Orleans Audubon Society
Harold Schoeffler, Save Our Coast
Michael Osborne, attorney
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Willie Fontenot, Louisiana Attorney General's Office
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Stuart Phillips, Sierra Club
James T.B. Tripp, Environmental Defense Fund
Richard Hayes, Save Our Coast
Randy Lanctot, Louisiana Wildlife Federation
Harvey Stern, Sierra Club
Darryl Malek-Wiley, Sierra Club
Brent Blackwelder, Environmental Policy Institute
Peter Carlson, Environmental Policy Institute
Sarah Chasis, Natural Resources Defense Council
Kirby Verret, United Houma Nation and Tribal Council
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Jim Isenogle, Jean Lafitte National Historical Park
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Ben Knous, Organization of Louisiana Fishermen
Joe Billiot, Organization of Louisiana Fishermen
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Donald P. Landry, Houma, Louisiana
David Zwick, Clean Water Action Project
Shirley Taylor, Sierra Club

In addition, the following scientists, without necessarily endorsing specific policy prescriptions, have contributed scientific material and reviews:

James Gosselink, Ph.D.,
Paul Templet, Ph.D.
John Day, Ph.D.
David Chambers
James Edmonson
Donald W. Davis, Ph.D.

An earlier draft of this report has been circulated to federal and state agencies, parish governments, fishermen's associations, research institutions, religious institutions, coastal landowners, scientific consulting firms and private business firms. We have received invaluable oral and, in some cases, written responses and hope and expect to receive additional comments.

We are releasing this report now to allow it to be widely circulated for review and comment to all interested parties, both in the State of Louisiana and nationally. We urge all knowledgeable and interested individuals, groups and agencies to comment. Comments should be sent to the Coalition to Restore Coastal Louisiana, 3420 Prytania Street, New Orleans, Louisiana 70115 by July 15, 1987. We intend to release a final report by mid-October 1987.

The Coalition's major task in the forthcoming months and years will be to complete this report and to work with responsible local, state and federal entities and business firms to accelerate adoption and implementation of a comprehensive and effective coastal protection and restoration plan. The Coalition welcomes new members who are in sympathy with the overall goals and general scope of action set forth in this report.

We dedicate this report to the memory of Joan Phillips, a courageous citizen voice for coastal conservation.

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SUMMARY OF RECOMMENDATIONS

This report is offered at a critical moment in Louisiana history. The state and the nation will either act now to save Louisiana's four million acres of coastal wetlands - forty percent of the nation's coastal marshes - or lose them forever.

The state, and several parishes, have taken steps in the right direction. Federal agencies have provided limited assistance. Nothing done to date, however, and nothing proposed matches the scale of what needs to be done. The stakes are enormous and demand a larger and more affirmative program. We need to think more boldly, agree more collectively and act more swiftly if we hope to retain more than a few museums of marsh along the Gulf of Mexico.

To that end, we have written this report. We have not attempted here to rewrite the literature of the Louisiana coastal zone. Few natural areas have been more studied with less result. We have, instead, concentrated on what needs to be done. Our recommendations, elaborated upon below, may be summarized as follows:

STRUCTURAL PROGRAMS

1. Accelerated fresh water diversion to the coastal marshes from the Mississippi River, the Atchafalaya River, and other fresh water sources.

Needed - A timetable for the implementation of four major fresh water diversions within the next five years.

2. Restoration of delta building, on a massive scale, for the Mississippi and Atchafalaya Rivers.

Needed - Separate provision for delta building and navigation access on these two river systems so that their sediments are used for land building and wetland nourishment.

3. Use of dredged materials for the restoration of coastal marshes.

Needed - A requirement that all dredged spoils from the construction and maintenance of all navigation projects and other canals in the coastal zone be used for marsh restoration.

4. Stabilization of the barrier islands by methods that provide maximum protection without continuing construction and maintenance.

Needed - Stabilization plans that rely on vegetation and natural processes rather than hydraulic engineering.

5. Full use of federal and state authority to accomplish these structural programs.

Needed - The recognition of full public coastal wetland values (approximately $10,000 per acre), and greater resort to federal discretionary authority under the Water Resources Act of 1986, the Land and Water Conservation Fund, and the Fish and Wildlife Coordination Act, in order to justify and implement remedial actions.

REGULATORY PROGRAMS

6. Full review of "marsh management plans" in the coastal zone, prior to their implementation.

Needed - A thorough review, under the National Environmental Policy Act, of the costs, benefits and short and long-term individual and cumulative impacts of "marsh management plans" (including levees and water control measures), before these plans are put into effect.

7. Legislative designation of "special management areas" within the coastal zone for areas of critical resource value.

Needed - The immediate designation of the Pontchartrain-Maurepas, Barataria Bay and Breton Sound estuaries as special management areas under the Louisiana Coastal Management Program and a fixed timetable for decisions on additional areas within the next three years.

8. Protective guidelines for the use of special management areas.

Needed - The immediate adoption of regulations for these areas more protective than those applicable to the coastal zone generally.

9. Authorization for parish coastal management programs more protective than general state guidelines.

Needed - Local authority to protect resources of local importance.

10. Increasingly stringent restrictions on permitting construction of canals for oil and gas access and other purposes.

Needed - State regulations that require use of all technically feasible alternatives to canals.

11. Regulation of all development in the coastal zone on a zero-sum basis: no more loss.

Needed - A mitigation rule that recognizes the secondary effects (approximately six acres to one) of access canals, pollution, and other development, and require, in the absence of alternatives, six-to-one replacement of direct wetland loss resulting from all new development.

INSTITUTIONAL PROGRAMS

12. A moratorium on federal flood control protection and other infrastructure grants for new development in the coastal zone.

Needed - Legislation modelled after the Coastal Barrier Island Resources Act which restricts federal funding for facilities which promote or support new development in coastal wetland areas.

13. A new and greatly expanded state funding mechanism for coastal restoration, relying on the primary users of coastal resources.

Needed - Legislation amending Section 213.22 of RS 49 requiring navigation, petroleum, and other interests, with a primary focus on off-shore oil and gas interests which use coastal pipeline canals and navigation channels, to contribute to an expanded Coastal Restoration Trust Fund to finance programs designed to restore damaged wetland areas.

14. Development of alternative means of access to oil and gas sites within the coastal zone, and the mandatory use thereof within three years.

Needed - Joint ventures in alternative access (hovercraft, helicopter, etc.), including federal, state, and private partnerships, with premiums for their early implementation.

15. Marsh restoration by means of plugging, backfilling, neutralizing wastes and other measures.

Needed - A fixed timetable for adoption of approved waste management technologies.

16. Requirement of alternative technologies for the disposal of wastes in the coastal zone.

Needed - The elimination of sewage, brine, and oil and gas drilling waste discharges through the required use of alternative technologies.

17. Coastal restoration on a sub-delta basis.

Needed - A new mechanism for planning coastal restoration (diversions, water management, special management areas, access) within natural geological and hydrological boundaries.

18. Legislation amending the State Coastal Zone Management Act to establish a State Office of Coastal Restoration responsible for development and implementation of a comprehensive state plan for coastal land loss abatement and restoration.

Needed - A State Office with clear public accountability, a comprehensive state legislative mandate, strong support from the Governor's Office, and adequate funding for coastal restoration.

19. A federal interagency task force, chaired by the Corps of Engineers and EPA, to be responsible for and to coordinate development and implementation at the federal level of a comprehensive plan for coastal land loss abatement and restoration.

Needed - Federal legislation that (i) states an unequivocal national interest in the maintenance and restoration of the Mississippi River Delta region, (ii) instructs the Corps of Engineers, the EPA, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service to work with the State of

Louisiana in the design and implementation of a comprehensive plan of action for coastal Louisiana, and (iii) requires the Corps to undertake on an emergency basis a study of the feasibility, design, and implementation of a large-scale Mississippi River sediment diversion program.

CHAPTER I

INTRODUCTION AND EXECUTIVE SUMMARY

A. The Coastal Resource

The Louisiana coastal zone is one of our premier geological, biological and cultural resources. It contains 40 percent of the country's coastal wetlands. Formed by the nation's largest river, the Mississippi, which drains 40 percent (Craig et al. 1979) of the 48 contiguous states plus significant areas of several Canadian provinces, it is far and away the largest and most active deltaic land mass in North America. The range, diversity and productivity of plants and animals, including endangered species of wildlife, which inhabit this zone is extraordinary (Viosca, 1927, 1928). In addition, this coastal zone performs vital water quality treatment and flood protection functions (Gosselink, 1984). All in all, as a geological and biological resource, it is a national treasure, comparable in its uniqueness to other national riches such as the Great Lakes, the Florida Everglades, the Grand Canyon, the Alaska Panhandle, Georges Banks or the fertile soils of the Plains States.

This zone is also a major cultural and economic resource. With the inclusion of New Orleans, it is home to millions of people. Indeed, 60-75% of the people of Louisiana live within 50 miles of the coast. The wetlands provide enormous benefits. Hundreds of thousands of people, from fishermen to foresters, depend on the healthy functioning of the wetlands for their livelihood. Everyone relies on the marsh for hurricane and flood protection as it absorbs storm surges and mitigates flood damage. With their natural beauty and abundant wildlife, the wetlands provide a unique attraction to tourists from all over the country. And the Louisiana delta is the cradle of Cajun culture; Native American tribes and countless immigrants have prospered here.

In addition, the Louisiana coastal zone is of enormous commercial importance. The coastal zone supports the largest coastal fin-fishery and shellfishery in the country, producing two billion pounds of fish and shellfish annually. The value of this production is enormous (Fruge, 1980; Coupe, 1985). The Louisiana Wildlife and Fisheries Commission issued over 63,000 commercial fishing licenses in 1985, including almost 16,000 commercial shrimp licenses (Roberts, 1986). The Louisiana

on-shore and off-shore coastal zone produces more than one-sixth of the nation's production of oil. Louisiana's off-shore oil production constitutes more than half of the U.S. off-shore Gulf of Mexico production. The Mississippi River also ranks as the country's most important inland navigational waterway.

B. The Coastal Problem

For millenia the Mississippi River has been "delta switching" every 1000 years or so, causing some areas of land to build while others deteriorate (Coleman and Gagliano, 1964; Frazier, 1967). The River builds a delta out into shallow shelf areas until its course becomes long, sinuous and inefficient. It then changes its course to follow a shorter, more efficient route to the Gulf, thereby changing or switching the location of the delta. This has led to a series of delta lobes in various stages of abandonment, as shown in Figure 1. The old deltaic lobes, no longer actively fed by riverine sediment, slowly break up and subside as their soft sediments compact, leading to deterioration and disappearance of the old lobe. But with a new delta always building, net coastal land gain in the Mississippi Deltaic Plain was historically between one and two square miles per year.

Since the turn of the century, however, this national resource has been eroding and sinking at an accelerating rate which now represents 80% of the nation's annual loss of coastal wetlands. A 1981 study calculated that the coastal wetlands of the Mississippi Deltaic Plain were disappearing at an annual rate of some 40 square miles or more than 25,000 acres (Gagliano et al., 1981). Combined with loss rates for the Chenier Plain, total coastal Louisiana wetland loss as of 1980 was 50 square miles per year. This rate is accelerating geometrically (Figure 2 and 3). Based on extrapolations from numerous studies, a recent analysis estimates that the 1987 annual loss rate is approaching 60 square miles (155 square kilometers) or more than 100 acres per day (Templet, 1986). Wetland loss since 1900 exceeds 1.1 million acres. Figure 4 shows where the land loss rates are most severe (Van Beek & Meyer-Arendt, 1982).

A recent study has calculated changes in the wetland system in the western Barataria Basin (Sasser et al., 1986). This study found that the "western Barataria Basin marshes were essentially stable from 1904, when Bayou Lafourche ceased to deliver river water to them, until 1945. Wetlands changed from marsh to open water at a rate of 0.20% per year between 1945 and 1956, and 0.32% per year between 1956 and 1969 (Table 2). Between 1969 and 1980 the annual rate of marsh loss to open

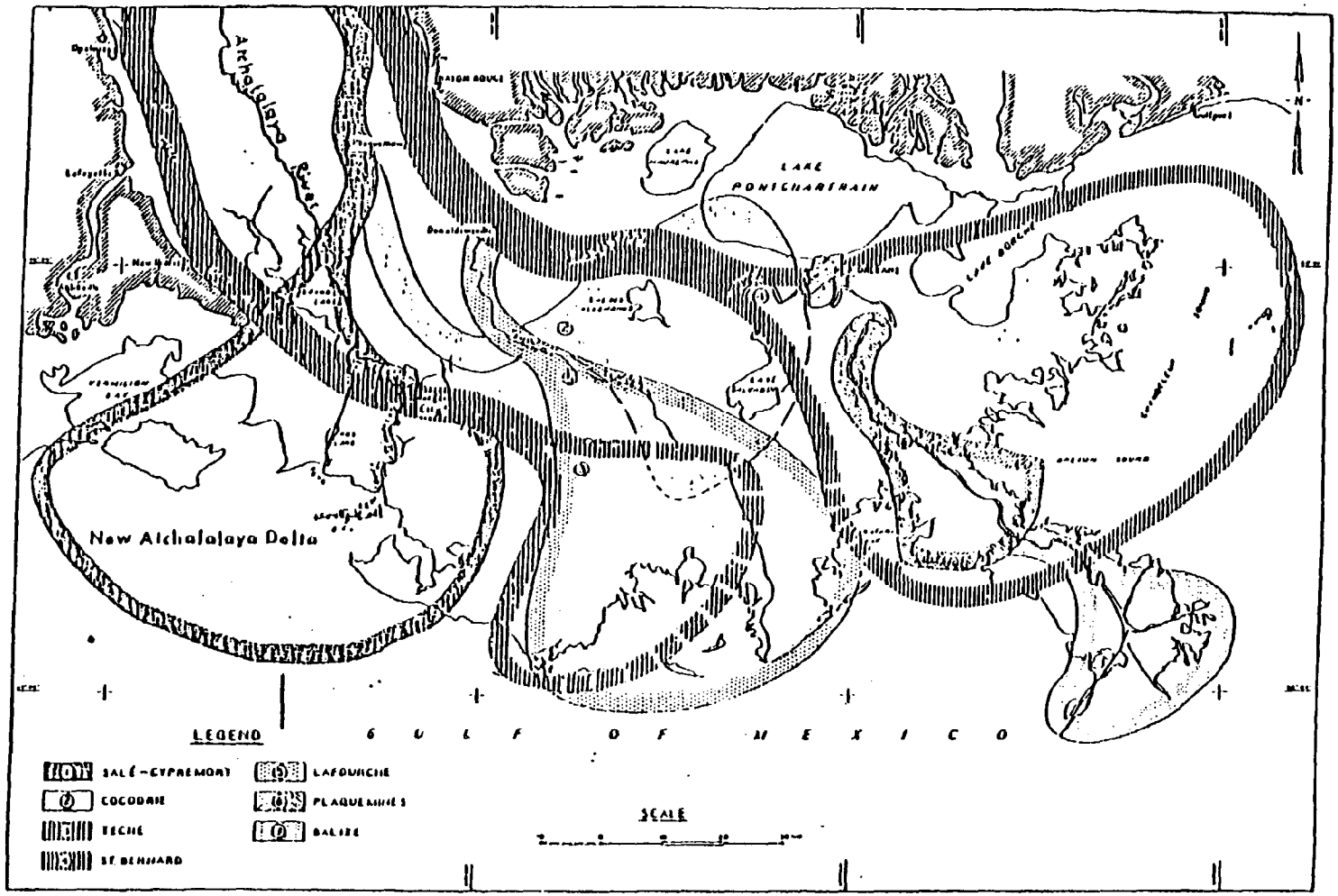


Figure 1 . Major delta lobes that have constructed the Holocene Mississippi River deltaic plain (modified from Kolb and van Lopik 1966). Note the location of the most recent lobe in the Mississippi River delta complex, the Atchafalaya delta.

Source: Boesch, D.F., 1983

FIGURE 1

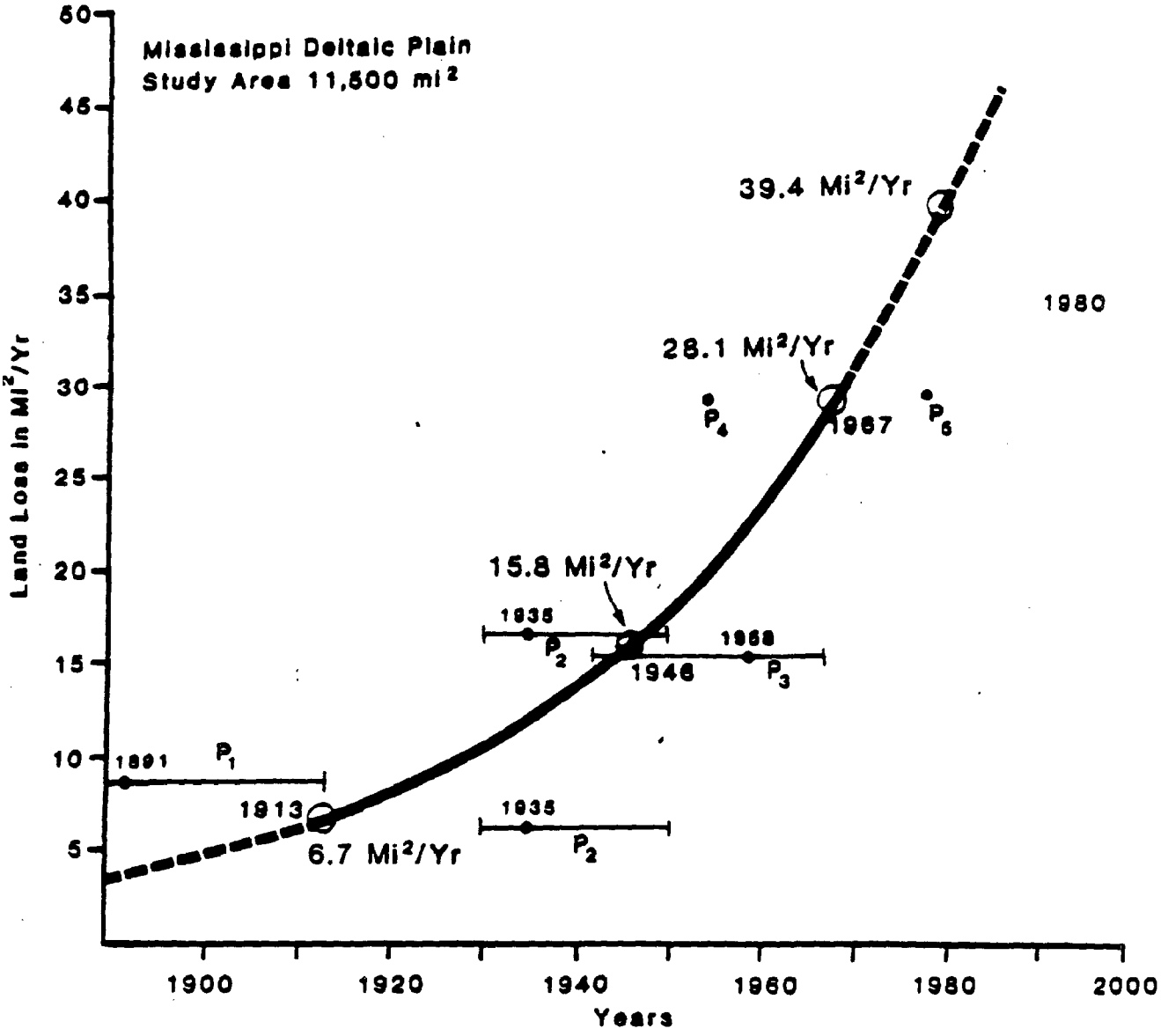


FIGURE 2-2. ACCELERATION OF LAND LOSS RATES IN THE MISSISSIPPI RIVER DELTAIC PLAIN (Gagliano et al. 1981)

Figure 2

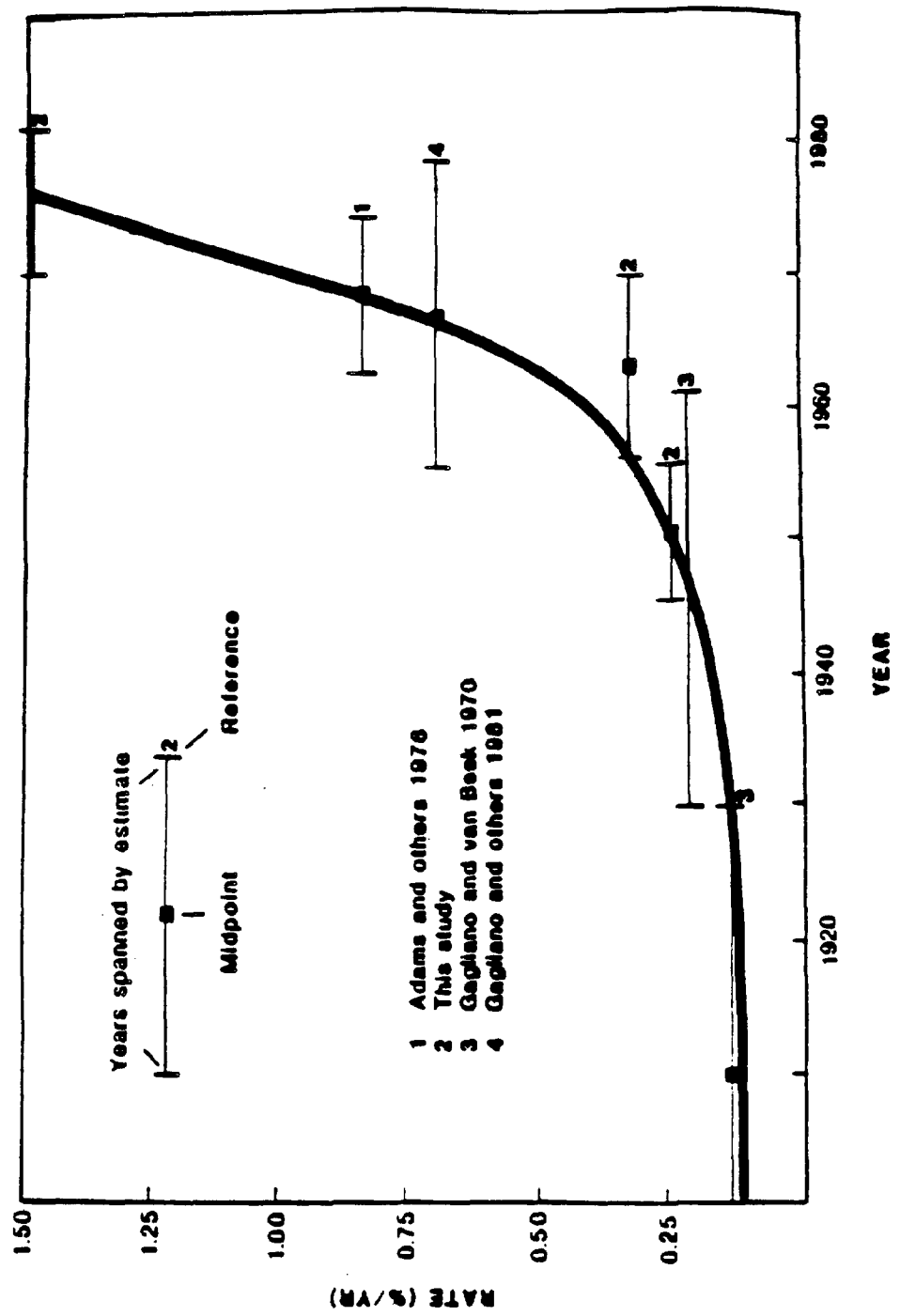


FIGURE 3 - Acceleration of the rate of wetland loss with time, in the Barataria Basin, Louisiana. The rate has increased from about 0.1% per year in the early part of the century, to about 1.5% per year at present.

From: Gosselink, J.C. 1984. The ecology of delta marshes of coastal Louisiana: A Community Profile. U.S. Fish & Wildlife Service FWS/OBS-84/09. 134 pp.

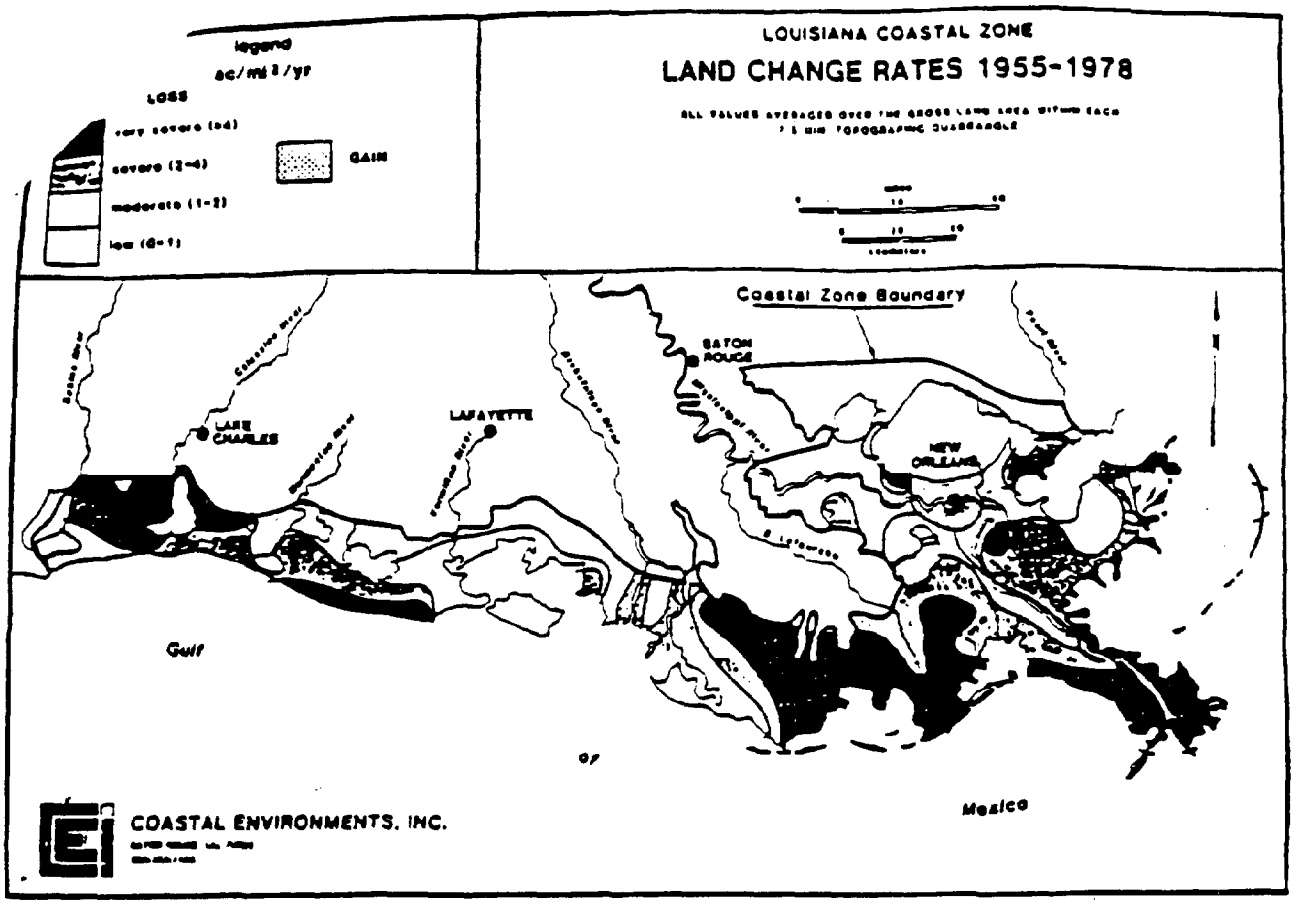


Figure 1. Relative rates of land loss in coastal Louisiana. The most rapid changes are occurring on the present Mississippi Delta, the southwest extent of the delta plain, and along the Chenier Plain. From van Beek and Meyer-Arendt (1982).

Figure 4

water increased drastically to 1.49% (Table 2)." Put in somewhat different terms, this same paper reported that in 1945, "91% of the marsh and natural levee area was solid or less than 10% water. By 1956, only 77% of the marsh was less than 10% water, by 1969 only 46% and by 1980 only 28%" (Sasser et al., 1986).

These erosion rates may be seen graphically by comparing the expanse of wetlands and open water in various basins of the Louisiana coastal zone in recent decades. Figure 5 shows these dramatic changes in western Barataria Basin by compairing 1945 and 1980 conditions (Sasser et al., 1986). Figure 6 depicts wetland erosion in the Chenier Plain by comparing 1956 and 1978 conditions (Turnipseed, 1986). Figure 7 compares 1956 and 1978 conditions to show the loss of wetlands at the mouth of the Mississippi River in Plaquemines Parish. Figure 8 depicts the life expectancy of this same area based on the assumption of a constant rate of land loss, probably an optimistic assumption (Gagliano et al., 1981). The state's barrier islands are suffering a similar fate. For example, Terrebonne Parish lost 42% of its barrier islands between 1955 and 1978 (Wicker et al., 1980).

This accelerating destruction is a travesty, not only for the state of Louisiana, but for the nation as a whole. It is now possible to contemplate that nearly all of this extensive maze of coastal marshes, swamps, bayous, bays and natural river levees will have largely disappeared, consumed by the Gulf, within our lifetime. The economic, cultural and environmental loss in terms of fishery, shellfishery, wildlife, flood protection and aesthetic resources - all renewable resources - would be immeasurable.

C. Causes Of Accelerating Coastal Land Loss

As we indicated earlier, the overall deltaic plain grew at a net rate by building a series of delta lobes. Natural subsidence (or sinking of the coast) due to such factors as dewatering, compaction, and downwarping was offset, on the average, by deposition of new sediments. Thus there was a balance between sinking and accretion. At any one location there could be land gain or land loss. But there was a net overall gain in wetland area over the past 5,000 years.

The reversal of this trend has been primarily caused by human activities. While subsidence has probably not increased due to human activities, sediment accretion has been greatly affected, because of both lowered input of new sediments and lowered wetland productivity which decreases the buildup of

Dozier, M.D. 1983 Assessment of change in the marshes of southwestern Barataria Basin, Louisiana, using historical aerial photographs and a spatial information system. M.S. thesis, LSU, Baton Rouge. 102 pp.

Figure 24. Computerized re-creation of the west side of Barataria Bay showing the change in wetlands between 1945 (a) and 1980 (b). Black is open water; marshes are shown as varying shades of grey (Dozier 1983).

FIGURE 5 - Land loss in Barataria Basin 1945-1980. In (B) the white area (most of the remaining land area) in the upper left is almost all leveed and dammed for agriculture and residences. (Dozier 1983).

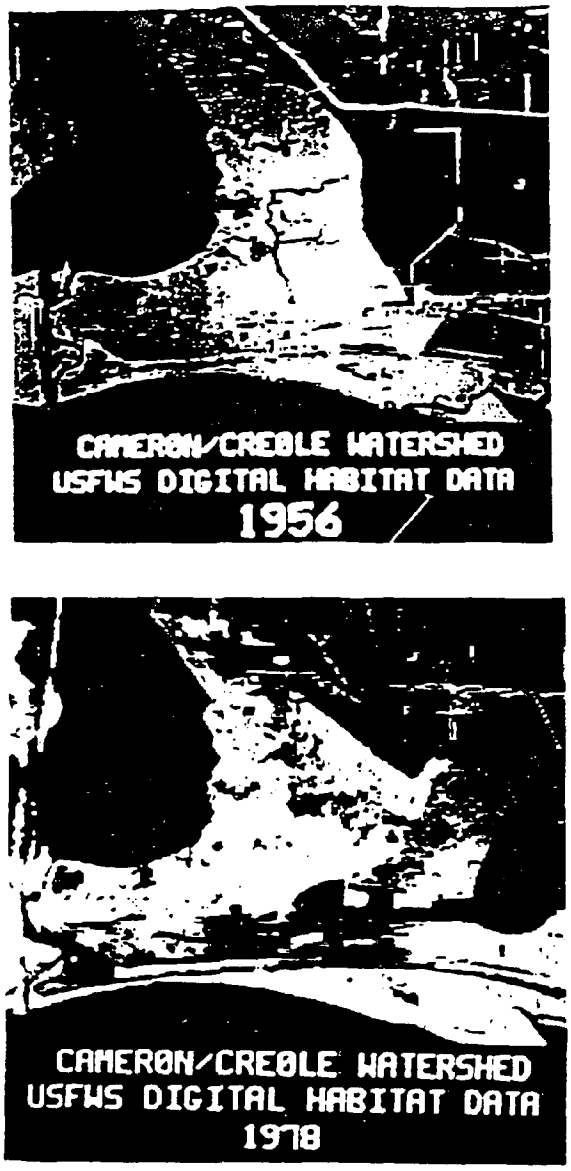
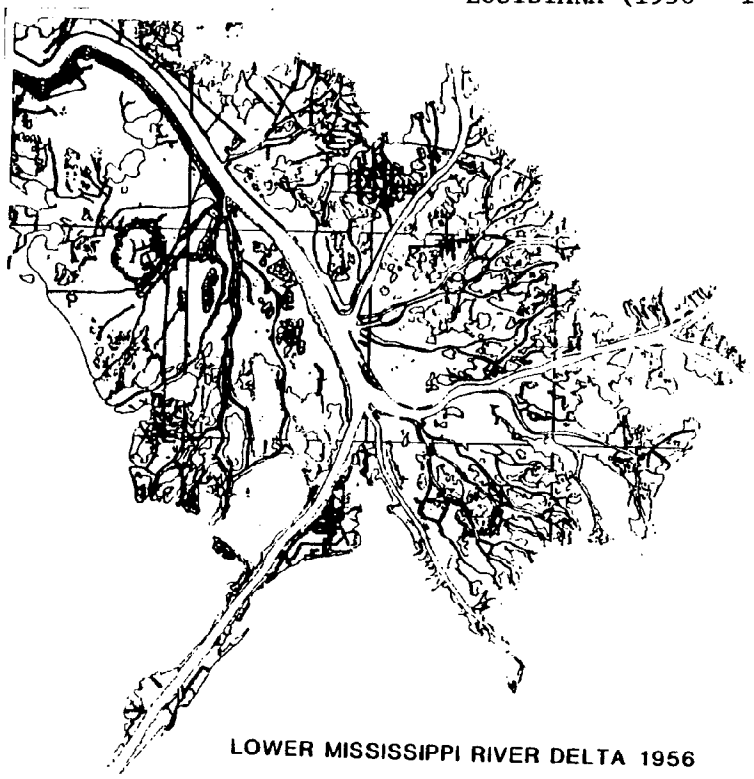


FIGURE 6 Digital reconstruction of habitats change in the Cameron/Creole watershed in western Louisiana between 1956 and 1978. The black area is water or developed land (along the Chenier in bottom photo - 1978 diagram); shades of gray denote different kinds of marshes.

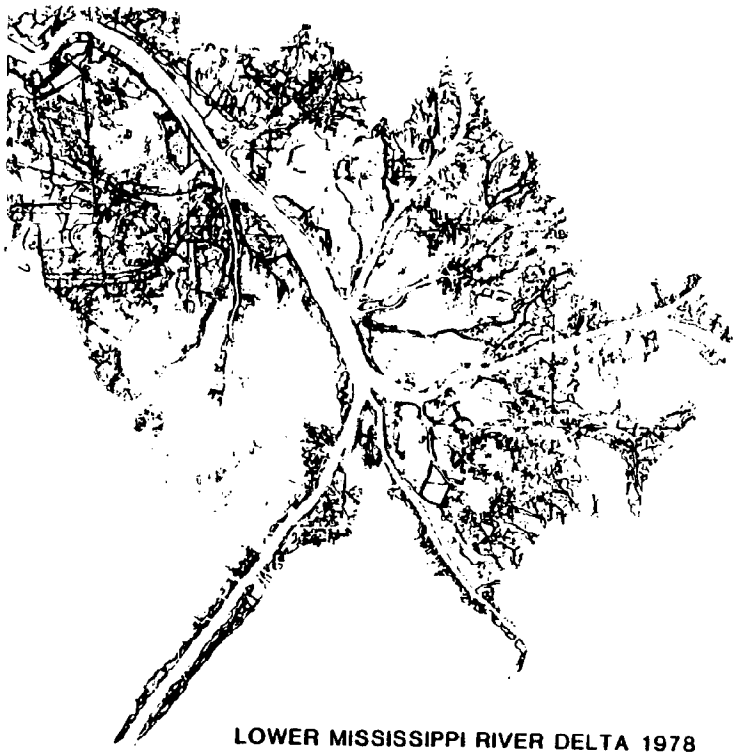
From: Turnipseed, D.P. 1986. Spatial and temporal analysis of coastal wetland loss with remote sensing. M.S. thesis, LSU, Baton Rouge, 101 pp. (based on data from Wicker, and others, Coastal Environments, Inc., Baton Rouge, La.).

[redacted]LAND CHANGES IN THE LOWER MISSISSIPPI RIVER DELTA,

LOUISIANA (1956 - 1983)



LOWER MISSISSIPPI RIVER DELTA 1956



LOWER MISSISSIPPI RIVER DELTA 1978

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1 0 1 2 3 4 5
MILES

HABITAT TYPE	1956 ACREAGE	1978 ACREAGE	ACREAGE CHANGE	% CHANGE
MARSH	183361	97408	-85953	-46.9%
FORESTED WETLANDS	7904	4309	-3595	-45.5%
UPLANDS	6358	13990	+7632	+120.0%
OPEN WATER	468867	550783	+81316	+17.3%

1956-1978 HABITAT CHANGE

HABITAT TYPE	1978 ACREAGE	1983 ACREAGE	ACREAGE CHANGE	% CHANGE
MARSH	97408	95632	-1776	-1.8%
FORESTED WETLANDS	4309	5552	+1243	+28.8%
UPLANDS	13990	12027	-1963	-14.0%
OPEN WATER	550783	553279	+2496	+0.5%

1978-1983 HABITAT CHANGE

FIGURE 7

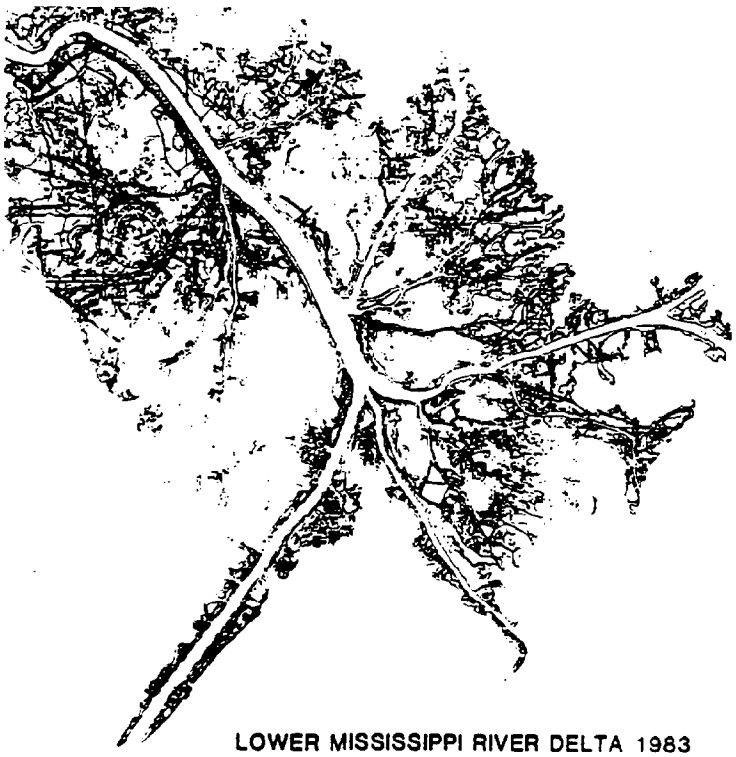
NATIONAL WETLANDS RESEARCH CENTER
U.S. Fish and Wildlife Service
Slidell, Louisiana

FIGURE 7 (continued)

NATIONAL WETLANDS RESEARCH CENTER
U.S. Fish and Wildlife Service
Slidell, Louisiana

WETLAND CHANGES IN THE LOWER MISSISSIPPI RIVER DELTA,

LOUISIANA (1956-1983)



LOWER MISSISSIPPI RIVER DELTA 1983

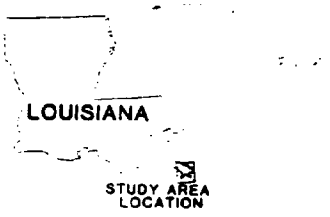


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Figure 8

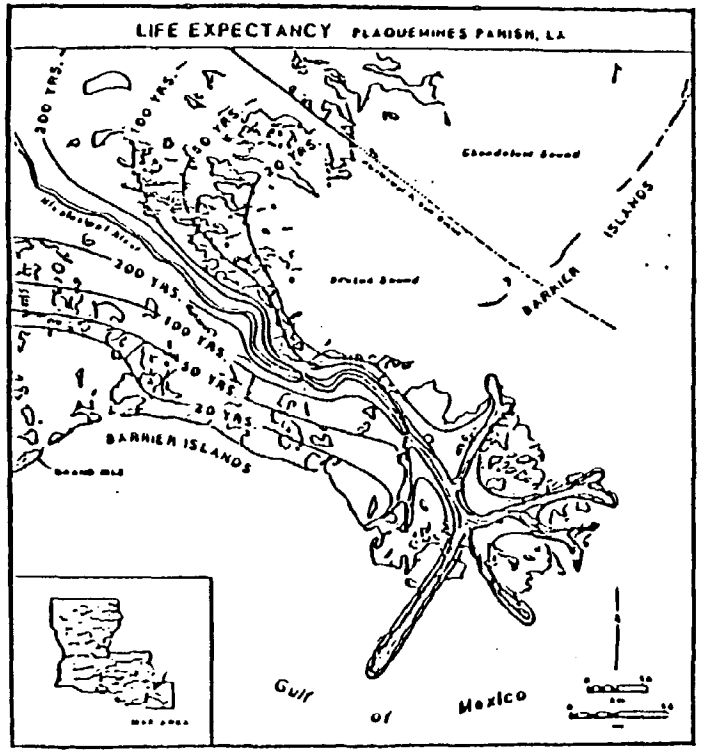


Figure: Life Expectancy - Plaquemines Parish, La.

Source: Gagliano et al. 1981.

organic soils (John Day, personal communication).

The accretion deficit and resulting net land loss are related to major economic uses of the Mississippi River and coastal zone for navigation, flood control, and oil and gas production. These important enterprises have for decades been carried out in a manner which has led to wetland sediment starvation (Viosca, 1927) and delta destruction (Gagliano et al., 1973, 1976; Templet & Meyer-Arendt, 1986). The challenge today is to decouple these undertakings -- navigation, flood control and oil and gas production -- from wetland destruction. Technological ingenuity and management can separate these exploitative and sustainable functions. The short-term costs of employing these advanced techniques will undeniably be substantial. The long-term costs, however, of not proceeding along this path of high tech environmental engineering are far greater.

The major causes of the net rate of land loss in coastal Louisiana are two. First, the United States Army Corps of Engineers (ACOE), at the direction of the Congress and with the support of the state of Louisiana and much of the public, has for decades managed the Mississippi River primarily for navigation and for flood control. To this end, the Corps has built guide levees and jetties designed to keep the River flowing within the main river channel, thus reducing sediment deposition and maintenance dredging costs. These river control structures confine the life-sustaining sediment to the river channel and transport it to deep Gulf of Mexico waters so that most of these sediments are discharged over the edge of the continental shelf. These sediments therefore are lost from the coastal zone and are not available for delta building. Starved of these sediments, wetland soils which are soft and unconsolidated continually subside and erode. In addition, Mississippi River tributary dams and other activities have significantly reduced the sediment load which the River carries (Keown et al., 1980).

The second major cause of coastal erosion is construction of navigation and access canals. These destroy coastal wetlands directly and indirectly (Turner et al., 1982; Deegan et al., 1984; Craig, Turner & Day, 1979). In fact, as we discuss in more detail in chapter III, the indirect marsh loss resulting from alterations in hydrology, loss of over-marsh sheet flow, increased salt water intrustion, impoundment of marshes and acceleration of local subsidence rates by massive spoil banks is much more serious than the direct loss.

While any single oil and gas access canal, navigation canal, channel or ditch constructed for any purpose may have only a minor effect on the entire coastal system or even its sub-basin, the cumulative impact of these canals on the coastal zone is devastating. Scientific investigations have shown that the rate of wetland loss in a particular sub-basin is associated with and influenced by the density of canals there, as shown in Figure 9 (Scaife, et al., 1983). Approximately 8% of the marshes in coastal Louisiana have been converted to canals and associated spoil banks. Scaife et al. (1983) attributed at least one half of coastal marsh loss directly or indirectly to canals.

These massive physical alterations of the coastal zone are augmented by other phenomona. Pollution from toxic chemicals and oil field brines is a significant problem. In addition, the effects of sediment misdirection and canal construction are compounded by sea level rise. Due to real changes in the volume of ocean water, sea level has been rising about 0.25 centimeters per year or 25 centimeters per century, much less than the rate of compaction or subsidence of coastal sediments of about 1 centimeter per year or 100 centimeters per century (Baumann and DeLaurie, 1982). There is increasing scientific evidence, however, that actual sea level rise may accelerate due to atmospheric warming resulting from the "greenhouse effect." Scientists predict that sea level rise by 2075 may range from 38 to over 200 centimeters depending on the global level of combustion of fossil fuels and emissions of other greenhouse gases (Hoffman et al., 1983; Hicks et al., 1978). Such a rise would lead to increased flooding of coastal wetlands (Nummedal, 1983). The rate of real sea level rise in future decades is clearly a factor which will affect coastal management.

D. Need For Action

The extraordinary values of the Louisiana coastal resource, its accelerating rate of disintegration, and the nature of the causes of that loss compel an action program. That action program must deal with the fundamental problem of sediment starvation in the coastal zone. This whole program can quite properly be viewed as a comprehensive mitigation project for federally sponsored and regulated and state supported navigation, flood control and energy production activities in the coastal zone.

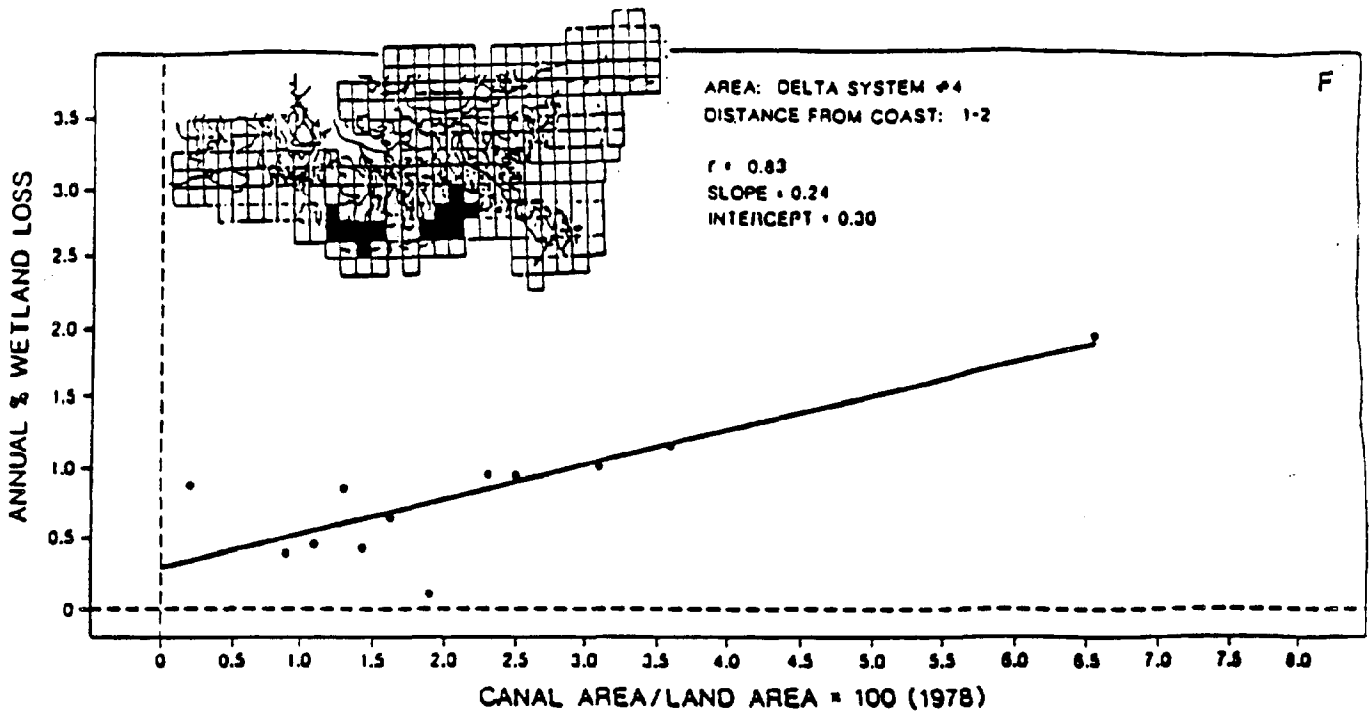


FIGURE 9

Annual rate of wetland loss as influenced by canal density. The rate increases as canal density increases.

Scaife, W.W., R.E. Turner, and R. Costanza. 1983. Coastal Louisiana recent land loss and canal impacts. ENVIRON. MANAGE. 7:433-442.

The program must have three basic goals:

(1) enhancement of sediment and fresh water input to the coastal zone via diversion of Mississippi and Atchafalaya River sediments and water and capture of resuspended sediments;

(2) repair or restoration of disturbed wetlands and barrier islands transected by existing canals; and

(3) a phase-out and halt to construction or expansion of canals.

An effective action program must thus encompass:

(1) programs for constructing major Mississippi River diversion works, including a major one south of New Orleans which incorporates structures to separate the navigation channel from delta building processes;

(2) programs for rebuilding and restoring disturbed wetlands through plugging and backfilling of canals and capture of resuspended sediments and eroding barrier islands through beach nourishment and dune building; and

(3) regulatory programs which drastically restrict construction of access and navigation canals by mandating use of alternative means of access for oil and gas equipment and by imposing mitigation requirements which will fully compensate for both direct and indirect land loss where dredging of canals is permitted.

Such a program could slow and ultimately reverse the loss of coastal wetlands. Evidence that diversion of water and sediment can accomplish delta building in shallow water areas is presented in Figure 10, which shows land building by the Atchafalaya River in the Atchafalaya Bay (Van Heedon, 1983). Studies have shown that not only are Atchafalaya River sediments forming a new delta in the Bay, but they are also maintaining and enhancing wetlands around the Bay. Likewise, ample evidence exists that degraded wetlands can be restored and that less damaging alternative technologies for oil and gas exploration, development and transport are available and feasible.

Why is neither the state nor the nation taking action to reverse land loss in coastal Louisiana? First, existing legal mechanisms for regulating activities in the coastal zone are not as strong as they should be. Further, major economic interests

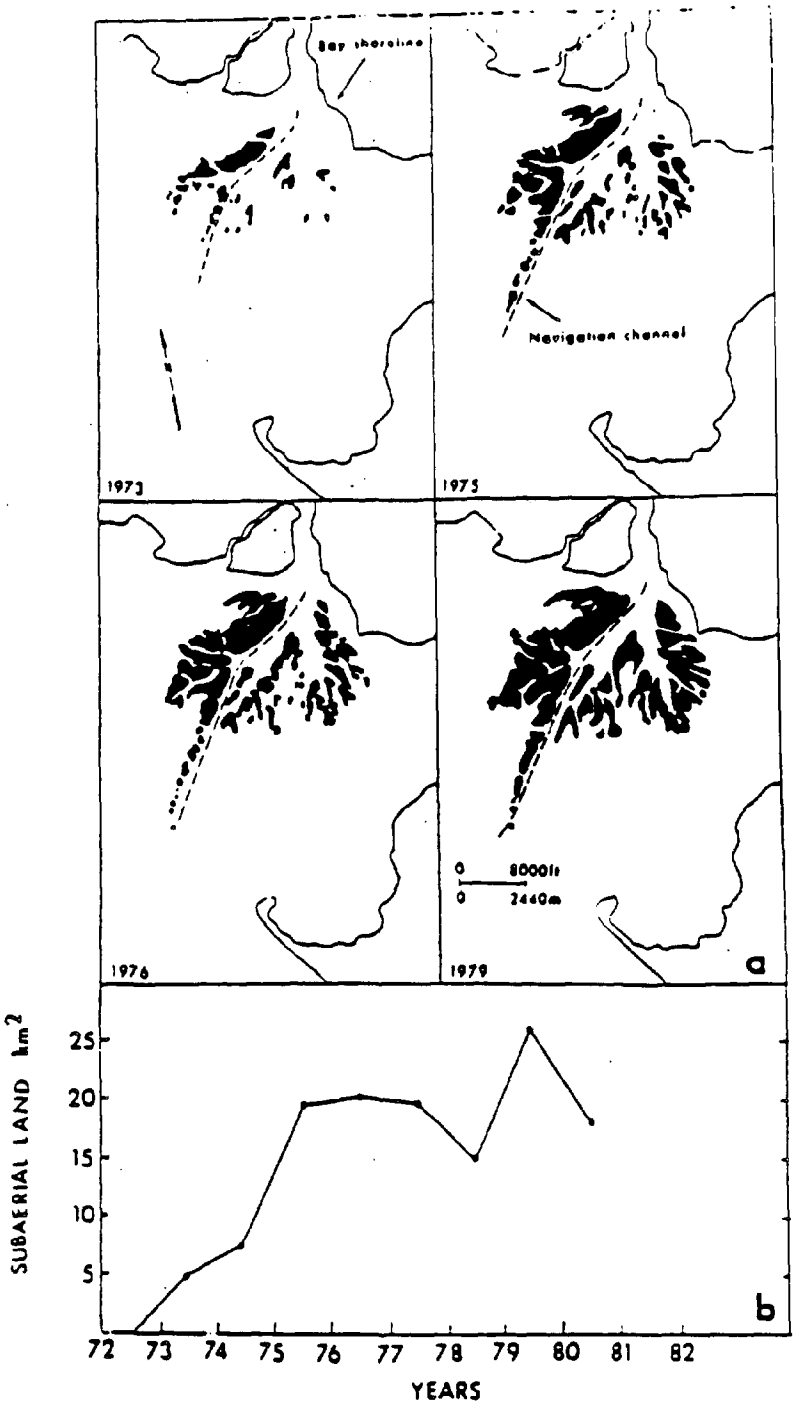


FIGURE 10

This figure illustrates the potential for wetland formation on the Louisiana coast. The black area are islands in Atchafalaya Bay that have been built since 1973 by sediments from the Atchafalaya River. This delta is currently about 25 KM^2 of land and a second delta is building rapidly a few miles to the west.

Van Heerdon, I.L. 1983. Deltaic sedimentation in eastern Atchafalaya Bay, LA. Ph.D. Disst. LSU, Baton Rouge, 117 pp.

have no short-term incentives to support changes in the management of Mississippi River water and sediments or in state and federal regulatory programs. Most fundamentally, the state lacks a strong and focused political will to deal boldly with the causes of land loss. Without such a state initiative, the federal government is not apt to do its part. There is no understanding at the national level of the magnitude of the biological and economic disaster occurring in coastal Louisiana.

1. The State Role

The state of Louisiana must gain control of the fate of its most basic land and water resources. To do so, it must manage all uses of the coastal zone. The state and its citizens must stand up and articulate a vision of the future which respects our most basic resources and does not condone denigration of those resources for short-term economic advantages.

This report is therefore intended to express, clearly and concisely, the views of a new coalition of individuals and groups very concerned with coastal management. It is intended to bring into the mainstream of political debate state recognition of the necessity of and justification for a dramatic program of action to bring about coastal restoration in Louisiana. Without such a program, and as its coastal oil and gas resources are gradually depleted, coastal Louisiana will become a replicate of stripmined Appalachia -- a series of scars and blemishes on the coastal seascape. Louisiana has based its economy on a non-renewable resource. As oil and gas reserves are depleted, the State's economy will have to depend increasingly on its renewable resources, such as its fishing industry, and new industry and service centers for jobs. No other state tolerates such massive desecration of its land and water resources. Despite its phenomenal oil and gas and other natural resources and key location at the mouth of the Mississippi River, Louisiana is poor by many indicia of economic well-being. It has tolerated abuse of its coastal wetland resources and has failed to manage the exploitation of its oil and gas resources for the long-term social and economic betterment of the state. This has to change.

The state must undertake a comprehensive action program for coastal restoration, including a canal and barrier island restoration program and the phasing out of canal construction. So that the state will have a clear institutional capability of fashioning and aggressively implementing, with strong coastal parish support, such a program it must set up an Office of Coastal Restoration with a clear legal mandate from the

legislature to pursue this program, strong support from the Governor's office, and adequate funding. In addition, the head of this office must be directly accountable to the legislature, the Governor and, most important, the public.

The state must find additional sources of revenues to finance its share of the costs of this program. It should therefore amend Section 213.22 of its Revised Statutes 49 to expand the Coastal Environment Protection Trust Fund into a Coastal Restoration Trust Fund with a continuous source of funding. To support this Fund, we suggest consideration of the following: a pipeline use fee on the off-shore oil and gas industry reflecting the historic damage which this use has imposed on coastal resources, a navigation fee on vessels servicing the off-shore industry and on other bulk commodity carriers, and a modestly increased coastal severance fee. Other approaches may be necessary. All of these fees should be dedicated in full to the expanded Coastal Restoration Trust Fund and used to finance the state's share of the design and implementation of this action program. The Office of Coastal Restoration should coordinate the efforts of other appropriate state agencies, including the Departments of Natural Resources, Environmental Quality, and Transportation and Development, the Louisiana Wildlife and Fisheries Commission, and the Louisiana Geological Survey.

2. The Federal Role

The state and its citizens must play a major role in initiating and implementing a comprehensive coastal land loss abatement and restoration program. On the other hand, given the national dimensions of this phenomenon, a federal role in structuring a coastal land building program is essential. The federal government must, with state and parish input, undertake public works projects which will distribute Mississippi and Atchafalaya Rivers waters and sediment as beneficial resources for land building and coastal wetland nourishment. The size of the Mississippi River, the existing federal role in River management for navigation and flood control, the lack of any major federal mitigation program, and the huge cost of large-scale freshwater and sediment diversions make a central federal role absolutely critical.

The ACOE and the U.S. Environmental Protection Agency must jointly oversee this federal effort. Together with other key federal agencies, such as the Fish and Wildlife Service and the National Marine Fisheries Service, the ACOE and EPA should form a federal task force to expedite federal coordination of and

support for the action program in cooperation with the State Office of Coastal Restoration and supporting state agencies.

Abatement of land loss and coastal restoration in Louisiana through proper management of the Mississippi and Atchafalaya Rivers must be a high priority on the national environmental agenda. Without broad public support throughout the nation, the necessary federal initiative, in an era of severe budgetary constraints, will not be possible.

3. The citizen role

Environmental and other citizen organizations must play a central role in the design and implementation of a comprehensive and effective state and federal plan for Mississippi deltaic plain land loss abatement and coastal restoration. To ensure strong and effective public support and oversight, citizens must coordinate their efforts - hence the creation of the Coalition to Restore Coastal Louisiana.

CHAPTER II

RESOURCE GOALS

Before we present the environmental action plan in detail, we must articulate our goals for the coastal zone and the rationale behind them. Our goals must be realistic - attainable through an action program which is technically, legally, economically, politically and sociologically feasible. It accomplishes little to present ambitious resource goals without the will and programmatic framework to make them possible. Without such a commitment goals are a snare and illusion. On the other hand, a powerful objective and goals energize the action program.

The tragedy of coastal Louisiana is most succinctly and painfully reflected in its land loss statistics. The resource objective, simply put, must be to halt continued loss of coastal wetlands and barrier islands, and to restore the historic delta building process. This objective is a restatement of the purpose of the federal Clean Water Act - to maintain and restore the chemical, physical and biological integrity of the Nation's waters - as applied to Louisiana's coastal wetland system. The first component of this objective is therefore to maintain what remains of the coastal system - to stop the accelerating erosion. The second part of the objective is to restore the coastal zone - to revitalize its natural deltaic functions.

Consistent with this objective, we propose the following goals:

First, the Mississippi and Atchafalaya Rivers shall be managed to maximize use of their sediment load and freshwater for the restoration and creation of coastal wetlands;

Second, existing dredged spoil piles and newly dredged material shall be used for the most beneficial coastal restoration uses, including plugging and backfilling of canals, wetland maintenance, and rehabilitation of barrier islands;

Third, all destruction of existing wetlands through construction of new or expanded canals, channels and levees, except in compelling public emergencies, shall phase down and cease as quickly as feasible, and all dredged materials from maintenance dredging of existing canals or channels shall be put to beneficial wetland restoration use.

All three goals are essential ingredients of a coastal maintenance and restoration program. The coastal zone suffers from massive sediment starvation. Our goals are designed to undo that starvation by leaving wetland sediments in place and introducing riverine sediments into the shallow coastal wetland system. All relate to the fate of coastal sediments. Riverine sediments entering the coastal zone should add to and not bypass existing coastal wetlands. Sediments which have been removed and misplaced should be relocated to restore damaged areas. Coastal wetland sediments in place should not be removed. Resuspended sediments should be trapped to build and restore wetlands.

If we can design, implement and enforce an action program to accomplish these goals, coastal land loss in Louisiana will gradually abate, and coastal delta building will gradually accelerate. As erosion decrease and coastal sediment accumulation proceeds, the coastal zone may gradually stabilize overall; eventually, the process of land building may once again outpace the process of natural erosion.

We now turn to a description of our action program.

CHAPTER III

THE ACTION PROGRAM

In furtherance of the three resource goals described in Chapter II, our action program has three major components: (a) maximum use of the Mississippi River and distributary system to introduce fresh water and sediment into the coastal zone for land building and wetland nourishment, (b) beneficial use of dredged material for wetland and barrier island restoration, and (c) access canal and navigation channel mitigation and regulation.

A. Mississippi River Water And Sediment Diversion

An effective program for land loss abatement and coastal restoration must redirect the enormous water and sediment energies of the Mississippi River to wetland nourishment and land building. The River's delta building capacity has been greatly reduced. First, an elaborate system of levees and jetties directs the flow of the main channel of the Mississippi River, and the sediment it carries, into deep Gulf waters. Further, the tributary dams and reservoirs in the Mississippi River Valley upstream of Louisiana trap sediments that would otherwise be transported to the delta region. Given this reduced capacity, all possibilities for productive diversion must be explored.

The only significant land building in progress in coastal Louisiana is in the Atchafalaya Bay, where the Atchafalaya River is building a delta. It is also nourishing shoreline wetlands particularly to the west into the Chenier Plain almost to the Rockefeller Refuge. Even though a navigation channel in Atchafalaya Bay disrupts this delta building function, the Bay is sufficiently shallow that a significant portion of Atchafalaya river sediments contribute to land building and nourish coastal wetlands to the east and west of the Bay. This may change if the ACOE proceeds as planned to extend the East Guide Levee of the Atchafalaya, known as the Avoca Island Cutoff Levee Extension, to the Gulf, thus reducing introduction of sediments to the wetlands of Western Terrebonne Parish.

1. A General Assessment of a Diversion Program

Throughout coastal Louisiana, man-made levees cut off natural distributaries of the Mississippi River from riverine water and sediment that would otherwise nourish coastal wetlands. In addition to the main channel of the Mississippi River and flood protection and/or navigation levees which extend to its mouth with jetties extending into the Gulf, other major levees which cut off distributary flows include the East and West Guide Levees in the Atchafalaya Basin, the Avoca Island Levee, which is an extension of the East Guide Levee below Morgan City, and the levees which have cut off Bayou LaFourche and other former distributaries from the Mississippi River. In addition, the Old River Control Structure restricts flows of the Mississippi River into the Atchafalaya Basin.

The coastal Louisiana marshes are eroding because they are not accreting at a rate sufficient to keep up with apparent sea level rise, i.e., the combined effect of real sea level rise and coastal subsidence. Because the sediments are unconsolidated, they are naturally compacting and sinking. Without riverine sediment inputs to maintain the wetlands, coastal Louisiana (including natural levees, man-made levees, and wetlands) is sinking below the level of the sea. Some stream-side marshes are accreting at a rate sufficient to maintain their elevation. However, the vast expanses of inland marshes in the coastal zone accrete typically at the rate of only seven millimeters a year through addition of material such as root mass and detrital litter and mineral sediment input, such as resuspended bottom sediments. These marshes need at least another five to six millimeters of sediment per year to offset sediment compaction and real sea level rise, although it must be emphasized that the variations in necessary marsh sedimentation rates may be considerable and should be known in planning marsh restoration strategies. If sea level rise accelerates as a result of atmospheric warming, the amount of external sediment necessary to raise coastal marshes enough to keep pace with apparent sea level rise must likewise increase. The only source of external sediment for the coastal marshes is the Mississippi and Atchafalaya Rivers.

Many options are available for modifying management of the Mississippi and Atchafalaya River water and sediments to fulfill three principal purposes: land building, navigation, and flood control. Land building and wetland nourishment through fresh water and sediment diversion serve a major flood control and storm damage reduction function for inland communities, including New Orleans. The navigation and land building

functions require physical separation by strategically placed environmental engineering projects. Many diversion structures are already in place or can be put in place at relatively modest engineering cost. Ultimately, however, some very sophisticated engineering works must be designed and constructed to separate the main flow of the Mississippi River south of New Orleans for delta building from the navigation channel to the Gulf.

The state and the nation as a whole will benefit in the long term from large diversions of River waters and sediments for land-building because of the additional productivity and flood protection values of new and well-nourished coastal wetlands. Nevertheless, there are several potential impediments: engineering feasibility, the cost and financing of diversion projects, and the short-term impacts of particular diversion projects on a wide range of interests, including navigation, the sports and commercial fishering industry, coastal residential communities and private coastal landowners. In Chapter IV, we discuss these economic impacts of our water and sediment management proposals on different interest groups, as well as a financing plan. In Chapter VI we propose some institutional techniques for accomodating these impacts.

2. Diversion Systems in Place

The Atchafalaya River is the largest distributary of the Mississippi. It reaches the Gulf in less than half the distance of the Mississippi main stem. Up until the early 1950's, it was gradually capturing the Mississippi. In 1963, the ACOE completed construction of the Old River Control Structure at Simmesport which, pursuant to the Flood Control Act of 1954 (P.L. 83-780), is designed to regulate flows between the Mississippi and Atchafalaya Rivers on a 70/30% latitude flow basis. The Atchafalaya River may therefore be viewed as a large diversion system for Mississippi River waters and sediments.

Even though the Atchafalaya River guide levees, the Avoca Island levee, and Atchafalaya Bay navigation channel restrict the widespread and efficient distribution of Atchafalaya River sediments, the sediment transported by the Atchafalaya River is now building a delta in the Atchafalaya Bay and nourishing wetlands to the west and the western Terrebonne marshes. Diversion of a greater percentage of flow of the Mississippi River than authorized by Congress, through the Old River Control Structure into the Atchafalaya Basin, would therefore promote land building and marsh nourishment in the Atchafalaya Bay region.

One strategy would be to increase the diversion of Mississippi River waters into the Atchafalaya River incrementally up to 40% or 50% (except during low flow periods when more flow in the Mississippi is needed to maintain navigation to the Gulf and prevent salt water intrusion and other water quality problems (Templet, 1987)). Such increased diversion through the Atchafalaya Basin could accelerate sedimentation within both the Basin and the Bay, and contribute to salt water intrusion further up the Mississippi River channel during low flow periods. Therefore, incremental increase on a seasonal basis when flows are not too low would allow for its effects to be analyzed in the field so that the efficacy and feasibility of increasing Atchafalaya flows could be determined. Increased distribution of water and sediment into the Atchafalaya Basin and Bay should be viewed as an interim measure until the mainstem Mississippi River sediment diversion project, discussed below in 3e, is in place. Once this latter project is operational, a return to 70/30 distribution of flows would no longer mean a waste of a major portion of the River's sediment and fresh water.

Within the Atchafalaya Basin, two outlets presently exist: the Lower Atchafalaya River and Wax Lake Outlet. Since Wax Lake Outlet has gradually been capturing this River, the Corps is constructing a new control structure to restrict flows through the Outlet. However, the Outlet should still be assessed and used as a sediment diversion channel to nourish coastal wetlands in East Cote and West Cote Blanche Bays, Vermilion Bay and coastal areas to the West.

Finally, the Bonnet Carre Spillway, now used to reduce flood stages on the Mississippi River by diverting up to 250,000 cfs into Lake Pontchartrain, could be opened as a diversion structure at high flow at a modest cost. The Spillway contributes fresh water and sediments into the Lake Pontchartrain Basin. Its value as a diversion structure, however, is limited because it can function only when river stages are sufficiently high. Further, additional diversions into western Lake Pontchartrain may adversely affect, at least temporarily, commercial and sports fishing in the Lake.

3. New or Expanded Diversions

The ACOE is working on the design of three Mississippi River diversion structures - Caernarvon, Davis Pond and Bonnet Carre (north of the present spillway), as shown in Figure 11. These diversion projects would deliver freshwater to,

respectively, the Breton Sound Basin, the Barataria Basin, and Lake Pontchartrain. The ACOE estimates that these projects would reduce wetland loss in these basins by, respectively, 16,500, 83,000 and 10,500 acres over the next 50 years. Their status is described in Table 1. These diversions are valuable "prototype" structures, but by themselves they are small and designed only to control salt water intrusion, not divert sediment. While they represent an important first step towards a diversion program, they underscore the need to do much more.

Our action program extends far beyond these small projects. ACOE should reopen former natural diversions and construct new diversions to introduce riverine water and sediments into the Western Terrebonne, Lafourche, Barataria, Breton Sound and Pontchartrain Basins.

a. The Lake Verret and Western Terrebonne Basins

The Lake Verret Basin east of the Atchafalaya Basin East Guide Levee is now sinking, starved by man-made levees of virtually all riverine sediments. Bottomland hardwood forests are being converted to cypress swamp; swamps are becoming open water; forests are dying (Connor, 1986). The Avoca Island Levee, an extension of the Atchafalaya East Guide Levee below Morgan City, reduces riverine sediment flows into marshes in western Terrebonne Parish above the Avoca Island Cutoff. Only 3% of the Atchafalaya River flow now goes into the western Terrebonne marshes. While freshwater input is restricted, the largest navigation canal in Terrebonne Parish, the Houma Navigation Canal, has become a 400 foot wide conduit for salt water, causing sodium levels in Houma's water supply to rise.

Prior to construction of the East Guide Levee, and later the Avoca Island Levee, the natural hydrologic boundaries of the Atchafalaya Basin on the east encompassed this Lake Verret watershed and the coastal expanse from the Atchafalaya Bay to the west bank of Bayou LaFourche. We propose constructing at least one diversion structure in the East Guide Levee to introduce riverine sediment from the now confined Atchafalaya Basin into the Lake Verret Basin and from there into the Western Terrebonne Basin. The structure could be built either where the Levee crosses and obstructs the Upper Grand River or further south, west of Lake Verret. A diversion further up in the Verret Basin would introduce sediment beneficially throughout the Basin; it would also affect more communities, such as Pierre Part, Gibson and Amelia.

In view of the great need to introduce riverine sediment into the Lake Verret Basin and Western Terrebonne marshes, the extension of the Avoca Island Levee which the ACOE is considering would be counterproductive. It would further reduce inputs of riverine sediments into Western Terrebonne. Indeed, the ACOE should consider construction of a control structure at the point where Bayou Chene used to enter the Atchafalaya River to facilitate movement of sediment into these Western Terrebonne marshes. Finally, the channel width of the Houma Navigation Canal should be restricted through backfilling or bank stabilization.

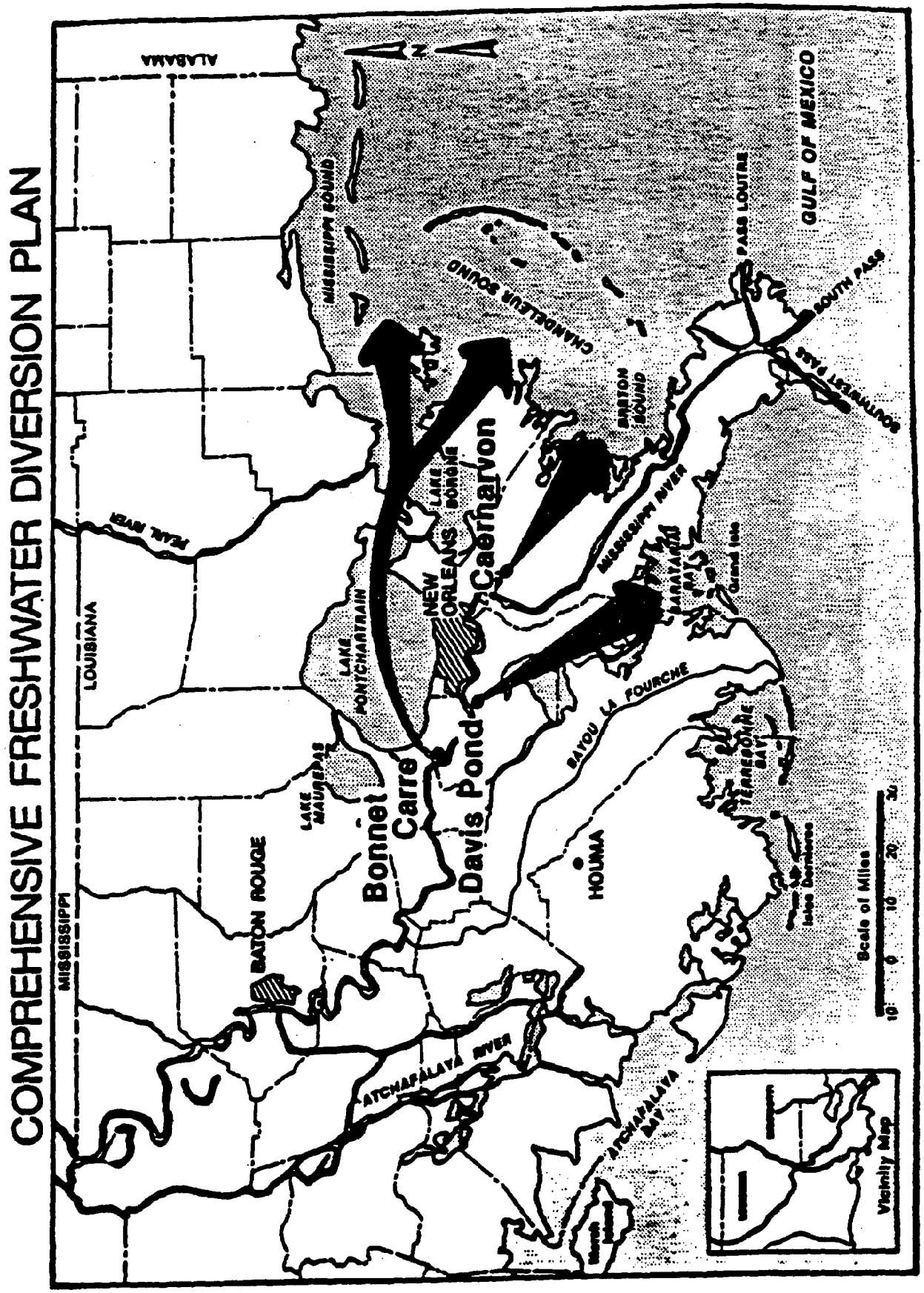
b. Bayou LaFourche Basin

The interior and central coastal marshes of Terrebonne Parish and western LaFourche Parish are rapidly deteriorating. The area around Timbalier Bay, for example, is experiencing rapid coastal erosion. Shorelines just south of Port Fourchon are eroding at a rate of some 100 feet per year, and salt water comes all the way up Bayou LaFourche to Lockport, some 50 miles from the Gulf. Bringing large amounts of water and sediment into this region, built up thousands of years ago when Bayou LaFourche was the Mississippi River's main channel to the Gulf, is a major challenge.

Before the construction of a levee, pumping unit and control structure along the south bank of the Mississippi River at Donaldsonville, Bayou LaFourche functioned as a natural, rather modest distributary of the modern Mississippi River. It now functions as a canal and drainage ditch. Furthermore, the La Rose to Golden Meadow Hurricane Protection Levee imposes a barrier to inputs of water and sediment into surrounding marsh areas. In addition, salt water intrusion is increasing in the LaFourche Basin.

Ideally, Bayou LaFourche should function as a distributary of the Mississippi River, carrying more water and sediments into the rapidly eroding and sinking wetlands of LaFourche and eastern Terrebonne Parishes and the Barataria Basin. An ambitious diversion project at this point would entail restoring Bayou LaFourche, much as the State of Florida is restoring the Kissimmee River. In the lower reaches of Bayou LaFourche, furthermore, such a diversion structure out of the Bayou near Leeville could introduce some additional sediment and fresh water towards Timbalier Bay.

FIGURE 11



Source: ACOE, Mississippi River Diversion Projects: Justification for Authorization and Funding

TABLE 1

STATUS OF ACOE's
THREE FRESHWATER DIVERSION
PROJECTS AT CAERNARVON,
DAVIS POND AND BONNET CARRE

CAERNARVON

- Congress has authorized the Caernarvon project under the Mississippi Delta Region Project. Detailed engineering and design plans have been completed and preparation of specifications is underway. Funding of about $23 million is required for construction. If funds are made available, construction could be underway by the fall of 1987.

DAVIS POND

- The New Orleans Corps District has recommended to the Office of the Chief of Engineers in Washington, D.C., that Davis Pond be constructed under the Mississippi Delta Region Project. If this recommendation is accepted, funding of about $35 million for detailed engineering and design studies and construction would be required.

BONNET CARRE

- Detailed engineering and design studies are underway for the Bonnet Carre project and are scheduled for completion in 1989. The project awaits both Congressional authorization for construction and funding at a level of about $57 million.

Source: ACOE, Mississippi River Diversion Projects: Justification for Authorization and Funding

We recognize, however, that development along the banks of Bayou LaFourche is so extensive that a large diversion project would compel large-scale relocation of communities and businesses. In addition, Bayou LaFourche, even if enlarged somewhat, would not have the capacity to carry very large amounts of water and sediments south.

Short of fully restoring Bayou LaFourche, it would still be useful to divert an increased flow of fresh water through the Bayou to other conduits which can channel it into marsh. The need remains, however, to introduce more sediment into the LaFourche and Terrebonne wetlands. The large-scale Atchafalaya Basin diversion projects described in (a), in particular the diversion through the East Guide Levee, could contribute sediment to eastern Terrebonne marshes via the GIWW or other channels. The Mississippi River diversion program described below in (e) and an expansion of the diversion facility planned at Davis Pond designed to introduce sediment as well as water to areas to the east of Bayou LaFourche could also serve this objective. Because of the complexity of diverting Atchafalaya or Mississippi River water and sediments in a manner which would help to abate erosion of and restore the interior Terrebonne marshes, we would urge the ACOE to examine this issue comprehensively and expeditiously.

c. Upper Barataria Basin

The Upper Barataria Basin is deteriorating rapidly as wetlands break up and salt water intrudes. The Lafitte National Park east of Lake Salvador is eroding. The ACOE is considering a structure at Davis Pond, described above (Figure 10), which will divert some 10,000 cfs of top River water. This structure will beneficially divert fresh water, but not sediment, to the Upper Barataria Basin. It should be constructed expeditiously. However, the ACOE should assess a larger diversion facility at the same general site to carry a substantial quantity of sediment as well as fresh water into the Upper Barataria Basin. A large diversion structure at Davis Pond would push oyster beds, which have been moving north into polluted areas in response to salt water intrusion, south again and, over a period of years, re-establish the historic pattern of oyster growth in the Basin. In addition, State Highway 90 is now restricting flows from Lac Des Allemandes into Lake Salvador. Portions of the highway should be elevated to augment this flow.

The Upper Barataria Basin is eroding not only because of sediment starvation but because man-made channels in the Basin accelerate introduction of salt water up through Little Lake. The ACOE now maintains a channel between Grand Isle and Grand Terre Isle. Its natural sill should be allowed to develop. Indeed, the entire Barataria Waterway project should be modified in both the Lower and Upper Bay, including Dupre Cut, to retard the movement of salt water and encourage entrapment of sediments.

d. The Lake Maurepas Basin

The Lake Maurepas Basin is beginning to erode rapidly as sediments compact and salt water intrudes. Mississippi River water and sediments should be diverted into this Basin. Possible locations for such diversion structures are Bayou Manchac and Blind River.

e. Diversion of the Mississippi River below New Orleans

Utilization of Mississippi River waters and sediment for land building must include a major diversion project South of New Orleans. Although this program could include one or more smaller diversion structures, ultimately a large structure must be designed and built which separates the main flow of the River with its waters and sediments for land building from the navigation channel. The channels through the mouth are becoming increasingly hard to maintain for navigation as the mouth rapidly shrinks back, subsiding at a rate of 2-1/2 to 3 feet per century, and riverine sediments, trapped between levees, settle out in the channel.

We propose construction of a new navigation channel to the East into Breton Sound at or close to Empire with large-scale Mississippi River sediment and fresh water diversion into the Barataria Basin. The physical separation of the navigation channel from the main flow of the River, with its waters and sediments committed to delta building, would require construction of a massive public works project, either a lock system or hydraulic gates. The locks or gates would have to open to allow ships and barges to pass between the River and the navigation channel. The new channel must reach deep Gulf waters in the shortest possible distance and be constructed so that it will not erode.

Large-scale diversion of the Mississippi River into Barataria Bay could be sited near Empire, or, more productively, further up the River, with river-side and sea-side levees south to Venice maintained to protect populated areas. Indeed, long-term maintenance of those levees below Empire may be more feasible with large-scale sediment diversion at or near Empire since erosion of wetlands along the sea-side levees to Venice would be retarded. Alternatively, the diversion could be sited at or just below Venice, with no maintenance of navigation levees or jetties south of the diversion so that the River would flow freely to the west, building new deltas and nourishing coastal wetlands. Obviously, a properly sited large-scale diversion of the Mississippi River west into Barataria Bay would contribute to rapid land building in that eroding Basin: in the short-term, it could adversely affect some productive fishing areas. Additional fresh water and/or sediment diversion projects could be sited at Caernarvon near Belle Chasse or further south near Empire. The siting and design of the diversion works will significantly affect their impacts.

Without doubt, large-scale Mississippi River diversion works would be a massive and expensive undertaking requiring sophisticated engineering for both navigation and ecological objectives. The ACOE should proceed on an accelerated schedule with an engineering feasibility study to select the best location and control works for this structure. It should then be designed and constructed expeditiously. Our goal is to have these navigation and diversion works in place by 1997.

The ACOE is now considering reconstruction of the jetties in the Gulf at the mouth of the river at an estimated cost of $150 to $350 million. These costs will inevitably escalate in a losing battle against nature. Our diversion program would eliminate the costs of the increasingly futile enterprise of maintaining deep draft navigation to the Gulf through the River mouth. In the long term, as we explain in Chapter IV, our diversion strategy should reduce the capital and operating costs of maintaining the navigation channel and levees at the mouth of the Mississippi River.

4. Use of Resuspended Sediments to Maintain Existing Wetlands and Create New Wetlands

The River is not the only source of sediments to the coastal zone. In fact, at the present time the major direct source of sediments to most coastal wetlands is resuspended bottom sediments. Resuspension takes place when winds cause

mixing of bottom sediments into the water, and sedimentation in wetlands occurs when sediment-laden waters flood wetlands on high tide. This occurs most often during frontal passages during the winter. Southerly winds preceding the front resuspend sediments and flood marshes. Baumann et al. (1984) reported that 70-80% of total sedimentation in non-riverine affected wetlands in most years is associated with frontal passage. Therefore, this type of sedimentation should be encouraged.

Accretion is enhanced by the construction of brush fencing baffles which calm the water and thus encourage sedimentation and inhibit resuspension by tidal currents or wind induced turbulence. Long-term accretion rates (over 25-30 years) of 3-5 cm/yr have been routinely achieved in the Netherlands, although accretion rates would be lower in Louisiana due to a diurnal tide with a smaller range (30-50 cm) than that in the Netherlands. Studies in the Netherlands and other coastal areas show that marsh vegetation will begin to colonize when the elevation of the sediment surface reaches a certain minimum elevation and that the rate of accretion increases significantly when vegetation is present.

Baffles, or similar obstacles, have been employed by the Louisiana Department of Wildlife and Fisheries in the Missisippi Delta and by the ACOE on the north shore of Lake Pontchartrain. They are presently being used for rebuilding wetlands in St. Charles Parish. This low-tech strategy could be widely used in the coastal zone where river sediments are not readily available to slow the rate of land loss and create wetlands. It will be most useful in saline, brackish, and intermediate marshes. Salt and brackish marshes are closest to the coast and to large waterbodies and thus to sources of resuspended sediments. Large storms, including hurricanes, are a major force for moving sediments onto marshes. Thus, marshes closest to the coast may benefit substantially from large storm events.

5. Control of Toxic Waste Discharges

Preservation and restoration of coastal wetlands can play a very useful and cost effective role in improving water quality in the coastal zone. Coastal wetlands can, in particular, trap sediments and recycle municipal, industrial, agriculturally related (and other non-point source) nutrient-rich wastes. Wetlands can, in some cases, also accelerate the breakdown of biodegradable toxic wastes. Indeed, in general, wastewaters containing biodegradable nutrient and organic compounds, following treatment in accordance with Clean Water Act

standards, should be discharged into wetlands, which provide additional treatment, rather than directly into open waterbodies.

The state and EPA must, however, aggressively implement Clean Water Act programs designed to control toxic waste discharges from all sources. Protection of the quality of the raw water supplies for New Orleans and other major communities in the state should be sufficient reason to do so. But it is also imperative that the sediments that are diverted be as free as possible of toxic organic, heavy metal and other contaminants that fish, shellfish and other forms of wildlife can bioaccumulate. The importance of controls on toxic discharges is highlighted by recent reports from the Sierra Club Delta Chapter (Sierra Club Delta Chapter, 1987), and the American Water Works Association (AWWA) Research Foundation (Grayman, 1986).

Some states, such as New Jersey, have begun to institute a reasonably stringent bioassay requirement for industrial effluents designed to protect aquatic life. Others are adopting numerical ambient water quality and effluent standards designed to protect aquatic life and potable water supplies. EPA Region VI and the state of Louisiana must develop stringent industrial toxic waste effluent standards to limit toxic wastes entering the Mississippi to protect the quality of its waters and sediments and in turn to protect ecologically sensitive commercial fisheries areas. EPA should also ensure increasingly stringent limits on toxic waste discharges into the Mississippi River and its tributaries by industries outside of Louisiana.

In addition, discharges of agricultural pesticides that affect the quality of the River's waters and sediments should be reduced through the expansion of wetland buffers along bayous and streams in agricultural areas where stream banks are now cleared. Also, careful management of pesticide applications and protection of existing floodplain wetlands from conversion is important to protect the quality of River water and sediments. Proper implementation of the Swampbuster provision in the 1985 Food Security Act and of the Clean Water Act Section 404 program should effectively retard further conversion of wetlands to agricultural use.

Finally, when brines from oil and gas production facilities are discharged into fresh surface waters, they contaminate those waters and damage vegetation by raising the salinity. The state should mandate reinjection of brines into the strata from which they were derived. Such reinjection might also help to retard

subsidence due to removal of oil and gas.

B. Beneficial Use Of Dredged Material For Restoration

The coastal zone is laced with eroding canals. At the same time, numerous dredged spoil piles contribute to wetland loss by interfering with the flow of water and sediment. The materials in these piles could be used for backfilling and plugging of canals. The proposed state Office of Coastal Restoration which we describe in Chapter VI should evaluate which piles could beneficially be removed and which canals should be backfilled and/or plugged.

Scientific studies have shown that spoil bank removal helps to restore marsh overland water flow patterns and that the most successful re-establishment of submerged and emergent vegetation has occurred where backfilled canals have also been plugged (Neill, 1986). Hundreds and probably thousands of canals, many of them constructed prior to the era of any state or federal regulation of their design, could be plugged to prevent salt water intrusion into fresh water wetlands and, in some cases, backfilled using their dredged spoil piles.

The State Office of Coastal Restoration should inventory specific restoration projects in all parts of the coastal zone, including plugging and backfilling of man-made canals, unplugging natural waterbodies, removing dredged spoil piles, planting vegetation, reconstructing barrier islands, and constructing water control structures. The Office should assess each of these restoration projects primarily in terms of its expected contribution to an increase in wetland acreage. The Office should then implement this program both through its own projects and by enforcement of its mitigation rule for permit applicants as described in C. 2, infra, on a case-by-case basis. Any plugs must be well-designed and armored, and a permittee who constructs such mitigation works must be responsible for their long-term maintenance.

While the State's barrier islands will benefit from the diversion program, they could also benefit, particularly in the interim before comprehensive diversion works are in place, from restoration projects which take advantage of dredged materials. These islands provide valuable habitat for fish and wildlife and protect the interior salt marshes from rapid erosion during Gulf storms. The best and cheapest form of reconstruction is beach nourishment and dune building. Experience in Terrebonne Parish has shown that this kind of natural reconstruction can be effective in rebuilding barrier islands. By contrast, use of

hard structures, such as concrete walls, is very expensive and not as effective (Edmonson, 1986; Jones). Dredged materials should be used for this purpose as part of mitigation requirements for permittees or as a part of barrier island restoration programs which the coastal parishes carry out with the cooperation of the state Office of Coastal Restoration.

Restoration work to limit erosion and prevent salt water intrusion is also needed on the Mississippi River Gulf Outlet, Houma Navigation Canal, Fresh Water Bayou and other navigation channels. Finally, all dredged materials from necessary channel maintenance work should be used for wetland restoration purposes.

C. Canal Regulation

1. Canal Construction and Expansion

The extensive construction of new canals and expansion of existing canals through wetlands of coastal Louisiana contribute very substantially to wetland loss, both directly and indirectly, by:

i. converting wetlands to open water;

ii. placing dredged material on wetlands along the banks of the canals, thus converting wetlands to dredged spoil banks, impounding wetlands causing marsh habitat to drown, and submerging adjacent wetlands through formation of levee flank depressions;

iii. altering the flow of fresh water and nutrients, including disrupting inputs and dispersions of detrital material;

iv. allowing crew boat, shrimper, workboat and barge-induced wave action which erodes exposed canal banks;

v. inducing salt water intrusion which in turn kills wetland vegetation and promotes sediment compaction and erosion.

Scientists at the Louisiana State University Center for Wetland Resources have shown that the indirect loss of wetlands associated with canal construction that is due to erosion, wave wash and subsidence may be as much as five times the direct loss

due to canal construction. Deegan et al. (1984) suggest that the secondary loss from canals is 14 to 78% of the area lost to canals and their spoil banks. In Terrebonne Parish, Fish and Wildlife Service studies indicate that indirect impacts are about six times direct impacts (Fruge, personal communication). Other studies (see Figure 9) have also shown that, the more canals in a defined hydrologic region, the higher the rate of wetland loss (Scaife, 1983).

Thus, if the direct loss of wetlands due to canal construction in a given year were 5,000 acres in coastal Louisiana and, over time, the secondary and cumulative impact is three to five times the direct loss, the eventual contribution of canal construction to coastal wetland loss - 15,000 to 25,000 acres or 23 to almost 40 square miles from one year's worth of canal construction - is obviously very significant. Any meaningful coastal land loss abatement program therefore must severely restrict construction of new canals and expansion of existing canals for any purpose.

a. Navigation canals

Under our action program, construction of new navigation canals or expansion of existing navigation canals would not be allowed, except in the unlikely event of a demonstrable emergency affecting public safety. The Port of New Orleans, other smaller coastal ports and the New Orleans District Corps of Engineers are considering navigation canal expansion plans. None, including widening and deepening of the GIWW, is consistent with this action program. We have considered the special case of the Mississippi River in A above. In addition, all dredged spoils from navigation and channel maintenance dredging should be used for wetland creation and restoration.

b. Oil and gas access canals

Coastal Louisiana is strewn with tens of thousands of miles of canals constructed to service the oil and gas industry. The continued development of the oil and gas resources of coastal Louisiana does not require continued construction of access canals to transport equipment for exploration and development. Canal construction often represents the cheapest technique for providing access when only short-term expenses to the permit applicants themselves are considered. It is, however, decidedly not the only technique.

Louisiana needs to make the transition away from oil and gas access policies which rely primarily on canal construction to policies that rely on alternative access technologies. This will require a fundamental shift in regulatory approach. At present, any permit applicant who proposed an alternative but more expensive technique for transporting oil and gas equipment to a drilling site would put itself at a competitive disadvantage. The regulations create an incentive for the industry to demonstrate the infeasibility of alternative techniques and so justify continued use of canals. Instead, state and federal regulatory programs should be technology-forcing. Denial of state and federal canal construction dredge and fill permits based on the availability of alternative access technologies would have this effect. The Coastal Management Division of the Louisiana Department of Natural Resources (to be expanded into the new Office of Coastal Restoration) and the New Orleans District of the ACOE must adopt a clear, uniform set of regulatory ground rules so that all players in this vital industry will be treated equally and will know what the regulatory agencies expect of them.

The most obvious alternative to canal construction is directional drilling. Most drilling offshore is now directional. Some offshore wells extend 12,000 feet horizontally for 4000 feet vertically, i.e., the drilling angle is 20 degrees off the horizontal. In this manner, one offshore drilling platform can reach many underground areas. This technology can and should be widely used in coastal Louisiana. The Coastal Management Division of DNR, with technical assistance from the Louisiana Geological Survey, in the last four years has been reviewing coastal oil and gas access canal permit applications to assess the potential for directional drilling. Based on cost and technical criteria, DNR has required use of directional drilling in an increasing number of cases. In part because of this review, the average length of oil and gas canals in the coastal zone has steadily decreased since 1982 (Johnston, 1987).

Directional drilling should be required in the coastal zone as an alternative to access canal construction when its use is technically feasible. Because of the density of existing canals in most parts of the coastal zone, it is feasible to reach many exploratory zones by directionally drilling from existing canals. In the future, as the industry explores deeper geologic strata, this technology will improve.

Other techniques, including use of hovercraft or helicopters to transport equipment for seismic work and development, are also available. Such transport technologies are used extensively in oil and gas exploration and development work, not only in offshore Louisiana, but in hostile environments in the Arctic, the North Sea and elsewhere. Where such technologies can be used to transport equipment in module fashion, they should be used. Since the oil and gas industry has not been willing to experiment with such equipment, the state Office of Coastal Restoration must undertake a pilot project to demonstrate the feasibility of its use on a priority basis. Assuming the pilot project is successful, the Office should then mandate use of helicoptors, hovercraft, or other alternatives where directional drilling is not possible.

Even in those situations where alternative technologies are not now available to conduct oil and gas exploration and development, state and federal regulatory agencies should not automatically issue permits for canal construction. Significant portions of coastal Louisiana have retained extensive areas of reasonably high quality, undisturbed wetland expanses. These areas should be protected.

Indeed, the simplest approach to accelerating the transition away from canal dredging to alternative technologies is for the regulatory agencies to adopt a strict policy of rapidly phasing out and then prohibiting construction of new and expansion of existing canals except in the rare circumstances involving a matter of public safety. Construction of all linear canals should be prohibited immediately. In addition, all hydraulic bucket dredging with placement of dredged spoils in spoil piles along the banks of canals which create upland barriers to flows of water, sediment and nutrients should also be prohibited immediately. Pending completion of the state coastal restoration program that provides detailed information on specific uses of dredged material for mitigation, dredged materials should be sprayed or broadcast over wetlands or otherwise used to nourish or restore specific wetlands.

A complementary approach is for these agencies to adopt mitigation rules for canal construction that have the practical effect of eliminating the cost differential between canal construction and alternative techniques. This would create economic incentives for the oil and gas and related service industries to make a rapid transition from reliance on canal construction to alternative access technologies. With the elimination of any economic incentive on the part of the

industry to construct canals, the primary question in the alternatives analysis becomes whether an alternative technique is technically feasible. We discuss such a mitigation rule below in C,2 and in Chapter VI, Sections A, C,1, and C,6.

c. Pipeline canals

Former pipeline installation procedures simply called for dredging a canal and laying the oil and gas pipeline on its bottom. As a result, pipeline canals wide enough to drive a large motor boat through are found throughout the coastal zone.

In recent years, the ACOE and the state Coastal Management Division have been requiring permittees to backfill pipeline canals as they are built and to utilize the push-pull method for laying pipelines to reduce damage to wetlands. This method has reduced wetland loss although, with compaction, some loss still occurs. In addition, pipelines are usually laid along the shortest distance which is a straight line. The state and federal regulatory agencies should require the routing of pipelines around sensitive areas and along existing pipeline corridors.

2. Mitigation

Under our program of action some dredging of canals will continue, though at a greatly reduced rate. Existing navigation canals may be maintained at existing dimensions where there is sound economic justification for their continued use. Further, oil and gas exploration and development carried out with directional drilling or alternative transport technologies may still entail some incremental dredge and fill activities. In addition, in some cases, particularly during the phase-out period, new oil and gas access canals will be constructed. The state and ACOE should develop a clear mitigation rule applicable to all canal dredging operations and then authorize mitigation projects in accordance with this rule to accomplish coastal restoration programs which are specifically delineated in the State Restoration Plan as described in B.

Such a mitigation rule should be designed to compensate fully for and offset both the direct and indirect long-term land loss. Mitigation for any permit which authorizes direct loss of wetlands should require the use of the material dredged and other suitable material, including existing dredged spoil piles, to create, through backfilling or plugging canals or otherwise, an expanse of wetlands five to six times the direct loss. All such mitigation should also be done in accordance with the

coastal restoration program established by the state Office of Coastal Restoration. All maintenance dredged material is sediment which can contribute to land building and wetland restoration. It should therefore be used for canal and barrier island restoration projects as described in B above. The state and ACOE should immediately incorporate into their permitting programs such a mitigation rule.

Furthermore, to create economic disincentives to canal construction and to promote restoration, the state and the ACOE should adopt a policy of including, as a condition of any dredge and fill permit to construct an access canal in wetlands, a requirement that the permittee refill the canal to its original contour after settlement or compaction when it is no longer in active use. The regulatory agencies should impose bond requirements sufficient to assure that such restoration will be accomplished. The large oil and gas production companies for whose benefit these canals are being constructed should guarantee these bonds.

Finally, all new canals should be designed in a non-linear manner so that they follow natural hydrologic contours and maintain water quality in accordance with state water quality standards for dissolved oxygen and other parameters at all depths. In addition, the ACOE should be required to maintain the width and depth of federal navigation canals and, as erosion of channels occurs, to restore the authorized dimensions through introduction of sediment or other means. The ACOE now does little to prevent bank erosion, as is all too evident at the Missisippi River Gulf Outlet and numerous other navigation canals.

3. Marsh Management

The idea of marsh management has received considerable attention in coastal Louisiana. Marsh management involves impoundments and semi-impoundments where wetlands are surrounded by levees, and weirs control exchange of water and organisms. This type of management has a number of objectives including the following: fixing private boundaries to assure control over oil and gas and renewable resources, control of salt water intrusion, promotion of fisheries and waterfowl productivity, and enhancement of marsh growth.

At present numerous marsh management plans are in effect, and proposed plans indicate that much of the coastal zone could be incorporated into such managed areas in the near future. Major private landowners, as well as the Louisiana Department of

Wildlife and Fisheries, the U.S. Fish and Wildlife Service, and the Soil Conservation Service, are using this approach. It is imperative that the utility of marsh management be carefully evaluated and that such proposals be analyzed in terms of their compatibility with an overall coastal restoration plan.

During the last century and early in this century, large tracts of wetland were impounded and drained for agricultural use. Most of these efforts have been abandoned due to soil shrinkage and breach of levees during hurricanes. A few remain drained, however. Since World War II a number of wildlife refuges have been created by impoundment or semi-impoundment. Management of these areas has ranged from very active (the Rockefeller Refuge) to passive (Lacasine). It is not likely that much more area of wetland will be converted by agricultural and wildlife impoundments. However, with the proliferation of spoil levees from dredged canals, an increasing area is being accidently impounded to some extent, with significant environmental impacts. A well studied example of the effects of such impoundment is in the swamps of the upper Barataria Basin.

Large, private impoundments, designed to fix boundaries, control saltwater intrusion, and control the harvest of fish and shellfish, are becoming increasingly prevalent in the coastal zone. Confronted with accelerated coastal erosion and inaction by public agencies, coastal landowners are considering these types of impoundments mainly in intermediate and fresh marshes which are beginning to be affected by saltwater. The Soil Conservation Service is assisting, and thus subsidizing, some of these private schemes. These impoundments, however, may affect sediment and water distribution and movement of marine organisms, and their cumulative impact is likely to be significant.

Further, many of the impoundments under consideration may be far too large to be effectively managed. The Department of Wildlife and Fisheries is of the view that 2000 to 3000 acres is the largest impoundment that can be effectively managed. Yet some of the projects now being considered are far larger than this.

Individual, moderately sized impoundments may have a minor impact in terms of the overall coastal zone. But such projects may occupy 25-35% of the coast. Such large-scale impoundment of coastal wetlands will inevitably have significant cumulative impact on coastal wetlands in terms of hydrology, distribution of sediment and nutrients, and marine fisheries. The magnitude of these impacts is subject to considerable scientific

uncertainty. In addition, the impacts of specific marsh management plans depend on whether coastal erosion, including accelerating salt water intrusion, continues unabated in the absence of any comprehensive state program or whether a program of action which includes large-scale Mississippi River fresh water and sediment diversion is being aggressively implemented.

The goal of any marsh management project should be to conserve and maximize the amount of wetland acreage which can be sustained for a significant period of time both within and outside of the impoundment. In our view, the State Coastal Management Division and the ACOE should not grant any more permits for marsh management plans over 500 acres until after preparation of a generic EIS which addresses individual and cumulative impacts of these plans on coastal wetland resources both within and outside of the managed areas. The GEIS should consider the impacts of different sizes of impoundments, alternative, non-traditional weir flap gates and the number of proposed impoundments. The GEIS should assess these impacts both on the assumption that the State and federal agencies do and that they do not have in place an action program which incorporates comprehensive sediment and fresh water diversion, canal restoration and strict canal regulation. The primary resource standard which the GEIS should use in assessing impacts of alternative management concepts is the effect on wetland acreage. Further, the Office of Coastal Restoration should determine which, if any, of these marsh management plans are consistent with the State's comprehensive coastal restoration plan.

4. Regulation of Oil and Gas Pumping Waste Fluids

We proposed above that brines from oil and gas exploration and development wells should not be dispersed into the aquatic environment because of their toxic effects. Instead, they should be reinjected into appropriate geologic strata. Reinjection has other benefits in addition to pollution prevention. Withdrawal of oil and gas and associated fluids, particularly from shallow deposits in the coastal zone, contributes to coastal subsidence. Brine reinjection repressurizes subsurface layers partially offsetting any subsidence which withdrawal of hydrocarbon deposits may cause.

CHAPTER IV

THE BENEFITS, COSTS AND FINANCING OF LOUISIANA'S COASTAL RESTORATION ACTION PROGRAM

Having presented our coastal restoration action program, we must now address the overall benefits and costs of maintaining and restoring Louisiana's coastal zone resources, the funding of the program and steps to moderate short-term adverse consequences of the program for particular groups or interests.

A. Benefits And Costs Of Coastal Restoration

Coastal wetlands constitute one of the nation's most important biological resources. With 40% of those wetlands in Louisiana, this coastal zone ranks as a major national biological resource. The magnitude of the loss of coastal wetlands nationwide every year is unacceptable. The fact that 80% of this loss occurs in the Mississippi River Deltaic and Chenier Plains in coastal Louisiana means that the nation's attention should focus on the Lower Mississippi River. In addition, 60% to 75% of Louisiana residents live within 50 miles miles of the coast. Many of these Louisianians trace their ancestry to Acadian settlers. These Cajuns who fled persecution flourished along the bayous of Louisiana. The Cajun culture has made, and continues to make, a unique contribution to American history. Others in the delta are descendants of Native American tribes such as the Houmas, Coushattas, Tunica-Biloxis, Chitimacha, and the Jena Band of the Choctaws. People are drawn to the wetlands for jobs, while others come because the delta is a "sportsman's paradise." Continuation of coastal wetland erosion would mean a devastating loss of homes, farms, fisheries and recreational areas.

1. Valuation of Coastal Louisiana Wetlands

One measure of the benefits of our action program is to look at estimates of the economic values of Louisiana's coastal wetlands. All economists who attempt to place monetary values on these coastal wetlands will freely admit that their methodologies are imperfect and data deficient. Under the best of circumstances, there are values, such as option value - the value which non-users place on a unique resource to know that it is there and could be used - which are almost impossible to capture. In addition, the capitalized value of an annual stream

of wetland benefits is highly dependent on the discount rate, which reflects the value which people today put on retention or production of a resource for future use, and the predicted value of coastal wetlands for fish and wildlife, recreation, water quality management, storm buffer protection and other functions in future years. It is reasonable to expect that, if coastal Louisiana wetlands erode and subside in the absence of a coastal restoration plan, their value would rise.

Robert Costanza and Stephen Farber have recently made an effort to place monetary values on coastal Louisiana's wetlands in reports to DNR and Terrebonne Parish. They have used and compared two valuation methodologies: willingness-to-pay (WTP) and energy analysis (EA). The summary of the estimates of the WTP valuation and the EA based economic value, and a comparison of the two, are shown in Tables 2, 3 and 4.

In our view these values are highly conservative. They assume that future annual values will remain at 1983 levels when in fact those values may rise rapidly as people in Louisiana and the nation begin to recognize the extent of loss occurring. In addition, these estimates ignore the considerable value to the nation as a whole of knowing that the country's largest deltaic system will remain.

Louisiana has lost over one million acres of coastal wetlands in this century. If the present rate of acceleration of coastal land loss continues, Louisiana could lose its next one million acres within 20 to 25 years. Recognizing the crudity of available methodologies and data, we accept a capitalized value for these one million acres, discounting any option value, of $10,000 per acre and an annual benefit of $200 to $250 per acre. The one million acres therefore has a capital value of $10 billion, with a present annual stream of economic benefits of $200 to $250 million. These annual benefits would rise considerably in future years if the remaining wetland resource shrinks absent implementation of our action program.

This analysis also suggests the dimensions of the economic loss of coastal Louisiana wetlands due to accelerating erosion. If the 1987 loss is 40,000 acres, the annual loss in 1987 and every year thereafter for just this acreage is $8 to $10 million. The capitalized value of this loss is $400 million.

2. Costs of Continued Loss of Louisiana's Coastal Wetlands

Table 2

Tables 6.1

Summary of WTP Valuation of Terrebonne Wetlands, using 1983 Dollars*

Valuation Category (1)	Annual per Acre Value of Wetlands (2)	Per Acre Present Value at Various Discount Rates 8% (3)	3% (4)
Commercial Fishery	$ 25.37	$ 317	$ 846
Trapping	12.04	151	401
Recreation	3.07	46	191
Storm Protection	128.30	1,915	7,549
Total	$168.30	$2,429	$8,977
Option and Existence	?	?	?

*The present values for recreation and storm protection assume population growth rates of 1.3%.

Table 3

Table 2.7.3 Gross primary production and EA based economic value estimates for relevant Louisiana wetland and marine habitats

Habitat Type	Total Energy Captured Measured by GPP[a] kcal/m²/yr)	Annual Equivalent Dollar[b] Value ($/ac/yr)		Net Marsh-Aquatic Change in Annual Value ($/ac/yr)	Present Value ($/ac) assuming specified discount rate[d] 8%	3%
Salt marsh	48,000	624				
Salt aquatic	6,600	86		538	6,700	18,000
Brackish marsh	70,300	914				
Brackish aquatic	5,130	67		847	10,602	28,200
Fresh marsh	48,500	630				
Fresh aquatic	9,300	121		509	6,400	17,000
Coastal plankton	3,600	47	Average	631	7,900	21,000
Spoil banks[c]	13,000	169				

[a] GPP is gross primary production. Values are from Hopkinson 1979.

[b] Based on conversion factors of 0.05 coal equivalent (CE) kcal/GPP kcal 15,000 CE kcal/1983 dollar, and 4,047 m²/ac. The overall conversion factor from GPP (in kcal/m², to estimated economic value (in $/ac/yr) is therefore: (.05 x 4047)/15000=.013. See the DNR report for details.

[c] Estimated from values for upland systems.

[d] Rounded to nearest $100.

R. Costanza and S. Farber, "The Economic Value of Wetlands in Terrebonne Parish, Louisiana", a Final Report to the Terrebonne Parish Jury (September 1985)

Table 4

Table 2.8.1
Summary of Wetland Value Estimates (1983 dollars)

Method	Per Acre Present Value at specified discount rate 8%	3%
WTP based		
Commercial Fishery	$ 317	$ 846
Trapping	151	401
Recreation	46	181
Storm Protection	1915	7549
Total	$2429	$8977
Option and Existence Values	?	?
EA based		
GPP conversion	6,400-10,600	17,000-28,200
"Best Estimate" at present	$2429-6400	$8977-17000

R. Costanza and S. Farber (1985)

It is now not unrealistic to envision the disappearance of virtually the entire coastal wetland system which the Mississippi River took thousands of years to build, within a matter of decades. Dollar valuations aside, the economic, cultural, and environmental cost of this loss is plainly massive. The loss of habitat for coastal fisheries, shellfisheries and wildlife would be enormous. Louisiana ranks first in the U.S. in tonnage of fisheries landings - over one billion pounds annually. This production is worth hundreds of millions of dollars to the American economy. The loss for social and cultural purposes -- for those whose recreational and employment opportunities depend on the proper ecological functioning of this unique coastal zone -- would be devastating. The biological diversity and the geological uniqueness of this coastal complex is irreplaceable. Beyond these impacts, however, the present Louisiana coast would become uninhabitable as the forces of the sea march inexorably inland, and maintenance of the Mississippi River's navigation system as we know it today would become increasingly untenable.

To avoid this devastation, Louisiana and the nation must take dramatic steps <u>now</u> to abate land loss and coastal pollution and restore deltaic functions. Such action will be expensive, but the alternatives would be more so. Remedial action several years down the road would inevitably be much more expensive and less effective than actions taken now, and would come at a time when Louisiana's coastal oil and gas resources had dwindled further.

To do nothing at all would be pure folly. As land loss continued, coastal communities would gradually abandon the coastal zone. The state might then consider constructing a great system of dikes and seawalls to compensate for the loss of the coastal wetland buffer and accelerating land subsidence - Louisiana's own Great Wall of China or Berlin wall, poised to keep out the barbaric forces of the Gulf. Finally, these changing coastal realities would require a new navigation system. Finally, these changing coastal realities require a new navigation system. The costs of all this would be simply staggering.

B. The Financing Program

Funding the action program will entail very sizeable outlays by local parishes, the state, the federal government and private industry. Expenses include the costs of the Action Program described in Chapter III, as well as the research and

demonstration projects described in Chapter V and compensation of adversely affected parties described in Chapter VI.

In our view, the federal government should be expected to pay for the design and construction of most or all of the diversion program. Traditionally, the federal government has financed the flood control and navigation works of the Mississippi River and its tributaries. Adding a major environmental objective is certainly no reason to diminish the federal share. Further, the nation as a whole benefits from Mississippi River navigation, and the flood control works in Louisiana are part of a larger historic project throughout the Mississippi River Basin to control water flows. Yet the federal government has not mitigated or offered compensation for the enormous environmental costs to coastal Louisiana of constructing, expanding and maintaining the vast levee structure of the Mississippi and Atchafalaya Rivers for navigation and flood control purposes. The comprehensive sediment and water diversion program that we propose in our action program can be fairly viewed as a mitigation offset for the flood control and navigation works of the Mississippi River and tributaries project which has benefitted the nation. Federal funding is therefore appropriate.

The state must also fashion a plan to finance its share of this action plan, for if the state does not do its considerable part, it cannot expect the nation to help pay for reworking the navigation system of the Mississippi River below New Orleans to accomodate the proposed sediment management plan.

We propose amendment of Section 213.22 of the State Coastal Zone Management Act, Revised Statutes 49, (establishing the Coastal Environment Protection Trust Fund), to provide for a Coastal Restoration Trust Fund to cover state and parish costs of this program. This Fund would have a continuous source of revenues, in contrast to the existing Coastal Environment Protection Trust Fund which received a one time grant of $40 million. The Office of Coastal Restoration, described more fully in Chapter VI, should administer this Fund. The State should use this Fund exclusively for coastal restoration and canal regulation programs described in Chapter III, B and C, and to pay for the state share, if any, of the diversion program.

Revenues for this Fund should come from those industries which have contributed to coastal erosion. The off-shore and coastal oil and gas industry has contributed to coastal land loss through construction of access and pipeline canals, use of navigation channels, and subsurface hydrocarbon withdrawals. To

a lesser degree, shippers of bulk commodities which rely on the existing system of Mississippi River levees and jetties for maintaining deep-draft navigation also have contributed to coastal land loss. As a source of revenues for the Coastal Restoration Trust Fund, we therefore propose imposition of additional fees on the industry.

The state recently increased severance taxes on extraction of coastal oil. See Table 5. Further increases may be somewhat limited, although the State should consider basing severance taxes on on-shore gas on its percentage of value rather than a flat rate and in this manner increasing its revenues from on-shore gas production. Furthermore, the on-shore oil and gas industry under our action program will be internalizing the additional costs of developing coastal oil and gas resources without the use of canals. The Louisiana off-shore oil and gas industry, on the other hand, has never paid fees or surcharges to the state commensurate with the damage caused by its use of coastal pipelines and navigation channels, including Bayous Chene, Boeuf and Black, the Atchafalaya Bay channel, the Mississippi River, the Mississippi River Gulf Outlet, the Gulf Intracoastal Waterway, and other canals. Its level of production is substantial. See Table 6. It is both fair and efficient to impose signicant fees on this industry.

Several years ago, the state attempted to impose a First Use Tax on off-shore natural gas. Several states successfully challenged that tax on constitutional grounds because it discriminated between in-state and out-of-state use of that gas. Under our proposal, the tax, in the form of a coastal pipeline or other transportation fee, should be imposed on all off-shore oil and gas producers using those pipelines or other modes of transportation into Louisiana irrespective of the destination of the oil and gas. Further, all of the tax should be dedicated to the Coastal Restoration Trust Fund. In our view, pipeline and navigation, lockage or other use fees imposed on the off-shore oil and gas industry should make up a very large portion of the funding needs of the state Coastal Restoration Trust Fund.

A tonnage fee on bulk commodities which are shipped in deep-draft vessels using the Lower Mississippi River and a lockage fee imposed on those vessels are also justified. The fees could be used as a source of revenue for the state Coastal Restoration Trust Fund. Alternatively, the federal government could impose such fees to help fund construction of the diversion works.

TABLE 5

LOUISIANA LEASE AND ROYALTY INCOME

Year	Total	Year	Total
1946	$ 9,785,686.60	1967	$135,965,066.57
1947	18,598,106.99	1968	150,108,735.78
1948	32,354,203.72	1969	156,268,176.97
1949	19,372,458.31	1970	147,323,684.41
1950	20,753,081.73	1971	160,752,766.08
1951	21,853,545.45	1972	146,269,110.42
1952	29,714,695.99	1973	138,167,418.82
1953	30,373,805.99	1974	209,384,451.83
1954	70,385,900.79	1975	174,751,193.30
1955	116,262,194.79	1976	189,212,955.21
1956	92,787,189.93	1977	223,331,123.17
1957	78,381,232.38	1978	283,326,000.00
1958	55,419,191.15	1979	265,879,945.22
1959	126,191,819.04	1980	545,914,446.27
1960	66,105,335.77	1981	391,404,031.00
1961	76,173,780.48	1982	624,529,812.54
1962	87,850,562.30	1983	545,206,481.00
1963	109,375,050.19	1984	497,959,159.00
1964	112,675,943.68	1985	526,300,000.00
1965	118,036,442.16	1986	405,300,000.00
1966	154,142,606.10	(Department of Natural Resources)	

OIL AND GAS SEVERANCE TAXES *

Fiscal Year	Total	Fiscal Year	Total
1953-54	$ 76,094,730	1970-71	$ 249,079,291
1954-55	75,865,959	1971-72	236,484,125
1955-56	83,475,385	1972-73	259,454,515
1956-57	95,266,813	1973-74	380,767,316
1957-58	94,074,315	1974-75	539,571,517
1958-59	123,098,506	1975-76	507,139,740
1959-60	132,552,912	1976-77	485,339,599
1960-61	143,545,609	1977-78	466,346,422
1961-62	146,201,197	1978-79	458,009,265
1962-63	159,485,491	1979-80	513,150,906
1963-64	169,630,150	1980-81	803,146,949
1964-65	174,523,196	1981-82	971,677,140
1965-66	200,261,245	1982-83	859,930,363
1966-67	213,773,395	1983-84	803,182,600
1967-68	233,070,145	1984-85	731,759,504
1968-69	234,567,908	1985-86	653,580,534
1969-70	243,115,993		

* Oil, natural gas, natural gasoline and condensate taxes; Department of Revenue and Taxation

Louisiana Division, Mid-Continent Oil and Gas Associations, Louisiana Oil and Gas Facts, 24th Edition

TABLE 6

LOUISIANA OIL AND GAS PRODUCTION (1984)

Production Onshore and in State Waters in the Gulf of Mexico

TOTAL CRUDE	151,398,713	bbls.
North Louisiana	29,590,376	
South Louisiana onshore	96,690,421	
South Louisiana offshore	25,117,916	
TOTAL CONDENSATE	35,844,231	bbls.
North Louisiana	3,140,006	
South Louisiana onshore	30,785,661	
South Louisiana offshore	1,918,564	
TOTAL NATURAL AND CASINGHEAD GAS	2,095,597,000	MCF
North Louisiana	386,892,055	
South Louisiana onshore	1,390,697,247	
South Louisiana offshore	318,007,698	
Average Daily Production		
Crude oil	414,790	bbls.
Condensate	98,203	bbls.
Natural and Casinghead Gas	5,741,361	MCF

Production in Federal Waters in the Gulf of Mexico

Crude	286,179,678	bbls.
Condensate	31,844,944	bbls.
Natural and Casinghead Gas	3,578,740,570	MCF
Average Daily Production		
Crude oil	784,053	bbls.
Condensate	87,246	bbls.
Natural and Casinghead Gas	9,804,768	MCF

Total Louisiana Production (Onshore, Offshore and Federal Zone)

Crude oil	437,578,391	bbls.
Condensate	67,689,175	bbls.
Natural and Casinghead Gas	5,674,337,570	MCF

Proved Reserves of Louisiana Oil and Gas (Onshore, Offshore and Federal Zone, as of January 1, 1986)

Crude Oil	2,661,000,000	bbls.
Decrease from Previous Year	19,000,000	bbls.
Natural Gas	41,085,000,000	MCF
Decrease from Previous Year	1,263,000,000	MCF

Mid-Continent Oil and Gas Association, Louisiana Division, Louisiana Oil and Gas Facts, 24th Edition

C. Imposition Of Costs On Different Coastal User Groups

While the long-term benefits of the action program are substantial, it will also impose certain short-term costs on several coastal user groups. It is important that these groups, as well as the public at large, understand what these costs are to make sure that they are fairly distributed and to minimize them through compensation or otherwise where they are not fairly imposed.

1. The Oil and Gas Industry

Given the economic make-up of Louisiana, it is evident that the on-shore and off-shore oil and gas industry will have to bear a considerable portion of the cost of the implementation of the action program in two respects. First, since an essential component of the action program is a rapid phase-out of construction of new or expanded canals, including access canals for transport of oil and gas exploration and development equipment, the costs of exploring for and developing oil and gas reserves in the coastal zone may rise. At least until technological innovation proves otherwise, the cost of alternative access technologies, including directional drilling, will typically be greater than the cost of canal construction. The on-shore oil and gas industry will bear this cost internally. Second, a significant portion of the costs of our coastal restoration action program will fall on the off-shore oil and gas industry which will face higher costs in the form of substantial pipeline fees and navigation lockage fees. In addition, on-shore oil and gas severance taxes may eventually have to increase.

Is it equitable to impose substantially higher costs and offshore oil and gas transport and pipeline fees? We think so. The oil and gas industry, through construction of pipeline trunks, use of navigation channels, canal construction and withdrawal of shallow deposits of oil and gas, has imposed large external costs, in the form of accelerated coastal erosion, on present and future generations of Louisiana's citizens. Imposition of higher fees on the oil and gas industry, particularly on the off-shore industry, is both fair and efficient in that that industry has played a major role in creating this historical environmental debacle. The pipeline and major navigation channels which the off-shore industry has constructed and/or used have been and continue to be a major cause of coastal erosion and subsidence. The industry has been a major beneficiary of the system of Mississippi River levees

and jetties that block natural diversion of its waters and sediments for land building.

What will be the economic and social consequences of imposing additional costs on Louisiana's on-shore and off-shore coastal oil and gas industry - for the economics of that industry, employment in Louisiana in that industry and the State's economy? The rate of oil and gas exploration and development may slow somewhat as costs rise. The industry, including its myriad service industries, will have to make investments in new kinds of transport technologies and techniques and reduce investments in dredging equipment. Even in the face of substantial increases in the costs of exploring for and developing oil and gas deposits in both on-shore and off-shore of Louisiana, these costs should still be less than they are in other parts of the world where the industry faces far greater physical impediments to successful operations. Nor will this remarkable liquid source of wealth migrate away.

Some might argue that the present depression in the industry makes this an inopportune time for strengthening regulatory policies and imposing higher taxes. However, Louisiana's coastal zone should not be held hostage to the vicissitudes of the world oil market. If the costs of developing oil and gas in coastal Louisiana rose significantly to offset and prevent wetland loss, the federal government could dampen the impacts of such environmental protective measures on the domestic oil and gas industry by imposing an equivalent fee on imported oil and gas.

In addition, while these additional costs and fees may lead to some reduction in overall coastal Louisiana oil and gas development, such retardation will occur eventually in any event as the state's on-shore and off-shore reserves are gradually depleted. The State's economy will have to adjust accordingly, and the state would do well to control that adjustment and its resource future. Despite the extraordinary wealth which the coastal zone has produced with its enormous oil and gas production, Louisiana ranks as a relatively poor state. If imposition of additional controls and costs reduces short-term output of oil and gas, there is some benefit in postponing the rate of depletion of Coastal Louisiana's oil and gas reserves. What is not discovered and pumped today can be discovered and pumped tomorrow. Leaving domestic oil and gas in the ground may serve future national energy needs. It is ironic for the federal government to be purchasing foreign oil and sticking it into the ground in Louisiana in the Strategic Petroleum Reserve while oil and gas is pumped out of coastal Louisiana with

considerable environmental damage.

2. Navigation and the Port of New Orleans

Navigational interests will be affected economically in several respects. A halt to any expansion of navigation channels, including those servicing Morgan City, New Iberia and other coastal communities, the GIWW, and the Mississippi River south of New Orleans, will have some effect on the cost of shipping. However, these navigation channel expansion projects typically have vitality only because of anticipated federal subsidies. As those subsidies for new construction are reduced as a result of changes in cost sharing formulas or budgetary constraints, the practical implications of this prohibition are diminished.

The proposed massive diversions of the Mississippi River south of New Orleans for delta building, coupled with a system of navigational locks or gates to separate the navigational and delta-building functions of the Mississippi River, will have some effect on the movement of ships into and out of the River and the Gulf. In addition, deep-draft shipping, including ships servicing the off-shore oil and gas industry, would pay special navigation lockage fees to help defray the costs of the diversion program. Since maintaining the Mississippi River south of New Orleans through the existing system of levees and jetties imposes enormous environmental costs on coastal Louisiana, such a system of navigation fees is efficient and equitable.

If we compare our action programs for Mississippi River navigation to continuation of the status quo, however, the consequences of the diversion program on navigation may be favorable economically. Because of gradual changes in the hydraulic gradient of the Mississippi River as it approaches the Gulf and subsidence of its levees, maintenance of the existing navigation channel in the River through its elongated delta into the Gulf, let alone construction and maintenance of a 55-foot channel, will become technically and economically increasingly untenable. Furthermore, while the initial capital costs of our River management and navigation proposal would be high, long-term navigation channel maintenance costs might be reduced. The Corps and Port of New Orleans and, indirectly, shipping interests and taxpayers would not have to struggle to maintain the existing, let alone an expanding, navigation channel through the mouth of the Mississippi River to the Gulf.

3. The Chemical Industry

Our program of action will impose some modest additional costs on the refining, petrochemical and organic chemical industry both in the State and elsewhere. Its shipping costs may rise modestly. Further, the industry will have to make substantial investment in source reduction and pollution control technologies to neutralize toxic waste on site or otherwise abate toxic waste discharges.

If the action program is to be effective in dramatically reducing the introduction of toxic contaminants into the state's coastal waters and sediments, the chemical industry must absorb these additional pollution control costs. States that have enforced stringent toxic waste pollution control programs have not lost industry in the process. The chemical industry will not leave Louisiana when the state implements an effective toxic waste discharge program.

4. Agriculture

Agricultural pesticides and nutrients used to increase agricultural production both in Louisiana and elsewhere in the Lower Mississippi River and tributary basins contribute to contamination of coastal surface waters and sediments. Agricultural landowners and land tenants will bear the costs of reducing these pollution loads through retention of wetland buffers that otherwise might be cleared and drained, reconversion of cleared agriculture areas to wetlands in low-lying wetland areas as water quality buffers, and adoption of alternative pest and weed control management techniques.

Further, farmers in the Red River backwater area may experience some increase in the duration and frequency of backwater flooding in low-lying flood-prone converted wetland areas in response to any increase in flows of water into the Atchafalaya River from the Mississippi River. These farmers have vigorously opposed an increase in flows from the Mississippi River through the Old River Control Structure into the Atchafalaya Basin for this reason. By limiting flows which otherwise would go down the Atchafalaya River, the Old River Control Structure in effect subsidizes and makes possible agricultural operations in some portions of the Red River backwater area. As a matter of political reality, some farmers may require compensation for crops which they are not able to grow on flood-prone areas as flows into the Atchafalaya River are increased. In addition to the Coastal Restoration Trust

Fund, other sources of funding would include conservation reserve contracts under Section 1231(c), Subtitle D, Title XII of the 1985 Food Security Act, and other USDA production agreements.

5. Fishing, Shellfishing, and Hunting

Commercial and sports fishermen, shellfishermen and coastal hunters harvest the bounty of coastal wetlands. While many of these groups therefore stand to benefit from coastal land loss abatement and restoration in the short-term, and all will benefit in the long-term, individual shell fishermen who lease specific waters from the state and individual fishermen who use waterbodies which may fill in or be plugged may suffer economically from specific sediment diversions, reintroduction of fresh riverine waters in the coastal zone and canal restoration projects.

6. Coastal Resource Landowners

Corporate and private landowners in the coastal zone should benefit economically in the long-term from our sediment management plan which would abate erosion of privately owned coastal wetlands. On the other hand, other landowners may suffer short-term economic losses due to specific diversions which may reduce the rent values of specific hunting or trapping lease holdings.

Some coastal landowners will also be affected financially by the phased-in prohibition on construction or expansion of oil and gas access canals. However, landowners in general will still be able to obtain substantial revenues from leasing holdings for oil and gas production sites and extraction. Chapter VI, C analyzes some of the legal issues relating to determination of boundaries of private coastal land holdings and public access -- issues which have significant economic consequences for coastal landowners.

7. Coastal Residential Communities

Certainly, fishing, trapping and other resource-dependent activities will be enhanced overall and local storm protection measures in the form of flood insurance fees and flood protection works will be far less expensive with the diversion program in place. More important, without the action program in place, many coastal residential communities will not survive continued coastal erosion. Eventually these coastal residents would be compelled to move inland, forsaking their real estate.

Some might resort to dikes, forced drainage systems or ring levees, but these are environmentally destructive and economically dubious investments, whose enormous, if not prohibitive, expense would not appropriately be subsidized by the government. In short, the cultural and economic salvation of coastal communities lies in the aggressive institution of our coastal action program.

On the other hand, individual coastal residential communities may be adversely affected economically by particular water and sediment diversions. Some low elevation dikes and ring levees may still be needed even under sediment diversion scenarios. Some compensation for relocation costs could also be financed through the Coastal Restoration Trust.

8. The Federal Government

The federal government now spends large sums maintaining the navigation channel in the Mississippi River with its navigation levees and jetties to the Gulf. Our Mississippi River diversion proposal calls for diversion structures which would require federal financial assistance.

Construction of hydraulic gates or locks in the river south of New Orleans to separate the delta building and navigation functions of the River would cost a large sum - probably considerably more than the capital costs of constructing the proposed 55 foot channel to the Gulf. Our diversion proposal would, however, obviate the need to construct the 55-foot channel to the Gulf, a project which has a capital cost of $300 to $400 million. It would also eventually eliminate the need for the federal government to fund maintenance of the existing navigation levees below habitable areas in Plaquemines Parish. Thus, the long-term maintenance costs of our Mississippi River navigation proposal may be less than the costs of retaining the navigation channel.

In general, the longer term benefits of our action program are immense. Given its history of active involvement in Mississippi River flood control and navigation matters, the federal government should be expected to cover most of the costs of the proposed sediment diversion projects.

CHAPTER V

RESEARCH AND DEMONSTRATION PROJECTS

The action program which we are proposing requires considerable scientific and engineering as well as management input. We hesitate to use the term scientific research for fear that some opposed to coastal restoration may use it as an excuse to temporize and do nothing. On the other hand, the Louisiana coastal zone is such a complex geologic and ecological system supporting so many conflicting economic uses that scientific and management research is crucial to effective implementation of the program. Much of the research, however, is needed to refine techniques and measurements. It should therefore be carried out in the form of operational-scale demonstration projects and short-term focused research intended to facilitate design of the best solution to the resource problem at hand. These projects, described below, should be structured to accelerate, not delay, implementation of this action program.

Access alternatives: The oil and gas and related service industry is in the best position to develop new and improved alternative technologies for obtaining access to oil and gas resources without construction of canals. If the state and federal regulatory agencies flatly prohibited construction of access canals, the industry would use and improve other techniques. The state and federal regulatory systems, however, require the ACOE and state DNR to consider the practicality or feasibility of alternatives. Because the industry does not want to be compelled to use more expensive and more sophisticated alternative techniques, it has every incentive to avoid demonstrating their practicality. The transition to a coastal oil and gas development future without access canals will be facilitated if the state, together with its universities as well as industry, makes that demonstration.

The state Mineral Board, in cooperation with the state Office of Coastal Restoration which we describe in Chapter VI, should create incentives for demonstration projects to show the capabilities of directional drilling. When leasing some state owned lands, wetlands or bay bottom, the Mineral Board should specify that the lessees must utilize this technology. While this might mean lower lease fees, the state could acquire considerable knowledge about their technology and create incentives to improve it.

For years, environmentalists and resource agency personnel have identified use of hovercraft or helicopters as an alternative to dredging of canals for transporting oil and gas exploration and development equipment, particularly in ecologically sensitive areas. Such technologies are available. The oil and gas industry uses them in off-shore, Arctic and other hostile environments. As we proposed in Chapter III C, the state Office of Coastal Restoration should immediately implement a demonstration program with airborne vehicles to transport equipment, perhaps in modular fashion for on-site assembling.

Wetland management at the sub-basin level: Our action program primarily focuses on the entire coastal zone. For management purposes, it is useful to divide the coastal zone into basins or sub-basins as to which there are somewhat different management objectives and priorities. The existing Environmental Management Units may provide useful geographic sub-basins, particularly where they reflect geologically pertinent boundaries. Intensified research is needed with the active participation of coastal parishes, the Office of Coastal Restoration and the state's universities, to establish priorities and plans for each sub-basin on an areawide basis. Such analysis should include review of cumulative impacts, wetland restoration opportunities and priorities, techniques for making the best use of dredged materials, identification of the least disturbed wetland areas which should be preserved, optimal diversion projects, impacts of anticipated sea level rise due to atmospheric warming, and other needs.

Freshwater and sediment diversion projects: The action program describes several freshwater and sediment diversion projects. Research is needed to identify additional sites to convey water and sediment into the eastern Terrebonne Basin and other locations which the currently proposed diversion structures will not help. The goal should be elimination of the sediment deficit in all wetland areas. More intensive research is needed to design the large-scale Mississippi River diversion project below New Orleans to accomplish the far-reaching environmental objectives which we have described in III A. In addition, research is needed into mechanisms to enhance the distribution of sediments from the diversion outfall channels. Finally, more scientific research is needed to address current sedimentation and causative sediment transport processes to ascertain where, when and how sediment should be delivered to marsh areas to contribute effectively to marsh accretion.

Basic coastal scientific research: The geologic and ecological processes operating in the coastal zone are complex. Understanding them in appropriate depth is essential for effective detailed design and implementation of this action program.

Economic research: As we have outlined in Chapter IV, the action program will have net long-term benefits for virtually all user groups in the coastal zone, but it will also lead to short-term costs for some individual coastal communities, landowners and fishermen, as well as the oil and gas and related service industry. Efficient implementation of this action program requires (a) an understanding of the distribution of these short-term costs and benefits, and (b) institutional responses that moderate or offset those costs, perhaps by transferring some of the economic benefits to those suffering a temporary disadvantage.

Education research: The parishes and the Office of Coastal Restoration, with assistance from the state's universities and others, must put together strong education programs on coastal Louisiana problems for elementary and high school students of all ages, as well as community and four-year colleges. These programs should encompass coastal cultural history, civics and detailed scientific information about the geology and biology of the Lower Mississippi River, including the coastal zone, its erosion and subsidence, causes thereof, the economic and social values of restoring its wetlands and remedial programs.

Greenhouse effect research: Ongoing research at EPA and elsewhere is indicating how atmospheric warming due to the greenhouse effect will accelerate sea level rise. It is essential to determine how sea level rise, which is predicted under various fossil fuel consumption scenarios, will contribute to the acceleration of coastal erosion and subsidence in Louisiana.

CHAPTER VI

THE LEGAL AND INSTITUTIONAL FRAMEWORK AND LEGISLATIVE AGENDA FOR THE ACTION PROGRAM

Implementation of our action program requires adequate legal authority and institutional capability at the state, local and federal government level. Existing legal and staff resources are inadequate to the task of implementing and enforcing the action program forcefully.

A. Institutional Structures

1. Federal

At the federal level, the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency must play major roles in implementing the Mississippi River Delta restoration action program. In particular, the ACOE should proceed immediately with technical assessments of large-scale diversions of the Mississippi below New Orleans. Other federal agencies, including the Fish and Wildlife Service, the National Marine Fisheries Service (NMFS), and the Federal Emergency Management Agency, also have important roles to play in view of their statutory mandates to protect water quality, wetlands, and fish and wildlife habitat and to prevent storm damage to coastal communities. To ensure maximum effectiveness, these agencies should form a federal task force dedicated to this project. In addition, federal legislation, similar in scope to the Coastal Barrier Island Resources Act, is necessary to restrict federal subsidies for infrastructure investments which promote new development in flood-prone, coastal wetland areas.

2. State

At the state level, institutional responsibility for the state Coastal Zone Management program lies with the Coastal Management Division of the State Department of Natural Resources. Responsibility for water quality and pollution control programs reside in the Department of Environmental Quality. Other responsibilities reside in the Wildlife and Fisheries Commission.

Despite yeomen efforts by the staff of the Coastal Management Division, serious institutional problems limit DNR's effectiveness in restricting canal construction, designating

special management areas with strong environmental protection rules, designing and implementing a wetland restoration program, including plugging and backfilling of canals, and working with federal agencies on diversion projects. DNR has other conflicting mandates, such as its responsibilities for leasing state-owned lands and bottoms for oil and gas development. The Coastal Management Division has a sufficiently low status in DNR that its administrative head is inadequately accountable to the public, the state legislature and the Governor for the success of the Division's coastal protection efforts.

In Louisiana coastal restoration is such a large issue, so important for the future well-being of the state, as well as the nation, that the state must have a strong administrative office responsible for implementing a coastal restoration action program and administering the Coastal Restoration Trust Fund. While much of the legal authority to implement this program at the state level may exist, the state legislature should amend RS 49, its Coastal Zone Management Act, to establish a new Office of Coastal Restoration.

This Office must have a clear legislative mandate to design and implement, through coordination with other state agencies, a comprehensive coastal protection and restoration plan, including all of the elements of our citizens' program. Its administrative head must be directly accountable to the public, as well as the legislature and the Governor. Support from the Governor's Office is essential. The Office must have expertise in engineering, design, construction, and environmental and economic assessment. Funding for this Office and its program through the expanded Coastal Restoration Trust Fund must be assured. This Office must be lodged in a department whose mandate and capability would allow it to function effectively in accordance with these criteria. One candidate would be the Department of Environmental Quality.

More specifically, the state legislation should provide that the Office of Coastal Restoration has the following powers and duties:

(i) to phase out construction of new or expanded canals within a fixed period not to exceed five years;

(ii) to require the oil and gas industry to use directional drilling where it is technically feasible and otherwise to use other technologies for transporting equipment, such as airborne vehicles;

(iii) to conduct an airborne vehicle access pilot project and to require use of such equipment where directional drilling is technically not feasible;

(iv) to identify areas in the coastal zone where plugging and backfilling of canals would contribute to wetland restoration and to implement that program;

(v) to work with EPA to designate special management areas in the coastal zone with specific enforceable management objectives, including prohibition of canal dredging;

(vi) to establish fully compensatory mitigation rules for any actions which damage coastal resources, taking into account long-term land loss impacts;

(vii) to assess private marsh management programs for consistency with the coastal restoration program and to permit them only if they further the restoration objectives of the program and do not interfere with public use of public waterbodies;

(viii) to impose and collect fees on off-shore oil and gas coastal pipeline use and deep draft navigation;

(ix) to work with the Corps of Engineers and other federal agencies in structuring a comprehensive diversion program;

(x) to acquire lands and take other appropriate actions with respect to coastal communities, landowners and fishermen to facilitate implementation of the diversion program;

(xi) to cooperate with the coastal parishes in implementing their coastal protection programs, to delegate to the parishes certain legal powers for controlling uses of the coastal resources where the parish programs are at least as protective of coastal wetland resources as the state program, and to assist the parishes in funding coastal barrier island restoration projects.

Pending adoption of this state legislation, a state and federal task force should proceed aggressively to develop a consensus regarding immediate remedies, such as diversion and creation of marsh with dredged materials, and to undertake preparation of a comprehensive coastal restoration action plan with opportunities for full participation by the private and public sector, including representatives of conservation

organizations.

At the parish level, existing programs are hamstrung by an inability to impose more stringent environmental protection conditions on permits affecting a "state interest," e.g., permits for oil and gas access canals, than DNR is willing to accept. State legislation should make clear that coastal parishes which are delegated coastal regulatory authority may adopt and enforce more stringent environmental regulations affecting all permits than the state Office of Coastal Restoration does (see item xi, above).

B. Implementation Of The Mississippi River Diversion Program

1. The Corps of Engineers Authority

The Corps of Engineers has broad authority under its Mississippi River and Tributaries, Louisiana Coastal Areas Study and Mississippi Delta Basin congressional authorizations to plan, design and construct diversion projects. The New Orleans District is designing three small fresh water diversion projects. The Corps of Engineers has the authority under existing congressional authorization to study and assess the large fresh water and sediment diversion project South of New Orleans which our action program describes.

Several aspects of our overall freshwater and sediment diversion program will require action by the U.S. Congress and the state legislature. Implementation of a program that would increase flows above 30% at the Old River Control Structure into the Atchafalaya River and Bay for delta building would require congressional approval. More important, the major diversion project below New Orleans will create some impediment to free-flowing navigation on the Mississippi River between New Orleans and the Gulf. Construction of and federal funding for such a large-scale diversion program would require Congressional approval.

2. Private Versus Public Entitlements in the Coastal Zone

The diversion projects raise other kinds of legal issues because it is estimated that private landowners claim title to 3 of the 3.5 million acres of coastal wetlands, the state claiming the remainder. Insofar as a diversion project results in erosion prevention and land building it must be determined who owns the newly accreted land and what duties and

responsibilities ownership entails. This legal and policy quagmire is further complicated by the fact that the state historically has not aggressively sought and claimed title to new open waters formed as a result of coastal erosion and subsidence. On the other hand, it has asserted ownership of the newly accreted delta in the Atchafalaya Bay. Further, coastal landowners are constructing levees, dikes and control structures to retain and privatize their wetlands. They are then controlling access by fishermen to obtain revenues to compensate them for their works. In addressing this complex issue, we have to consider what action is fair to the state and public who will help finance the diversion program and what action will provide proper incentives to private landowners to support the action program.

In the absence of implementation of a comprehensive coastal restoration program, the state should initiate a process to determine over which newly formed open waters resulting from erosion and subsidence it should claim ownership. With the action program in place, coastal landowners should be entitled to claim ownership to newly accreted wetlands adjacent to existing wetlands which they own and which lie within the boundaries of their legal title with proven historic ownership back to 1920. The state, on the other hand, should claim ownership to newly accreted blocks of wetlands which are formed in open waterbodies not adjacent or proximate to privately held wetlands and outside of the 1920 legally definable boundaries. Although the state is normally entitled to claim title to man-induced accretion of wetlands, under the state's waterbody management law a coastal landowner may reclaim what was lost through erosion as far waterward as its 1920 property line. In practice, precise delineation of these property lines is almost impossible.

Under this scheme, implementation of a coastal restoration program would have major benefits for coastal landowners. It should retard erosion of wetlands and their conversion to open waters to which the state might be able to assert title. It should also help to restore wetland areas in some cases. Thus, in the context of this program, coastal landowners should be able to establish fixed boundaries to their holdings, which would be of particular use in terms of establishing entitlement to ownership of oil and gas resources. The State or coastal parishes should also be able to derive additional property tax revenues from these wetland areas.

Further, in Chapter III, we propose that no more state or federal permits for large private impoundments be granted pending completion of a generic EIS which considers the individual and cumulative environmental and social impacts of past, pending and proposed marsh management projects and alternatives, including limiting private impoundments which serve mariculture and other private economic uses to a specific but small percentage of the total private acreage in the coastal zone. There is ample legal justification for a delay in granting permits for large private impoundments pending completion of a GEIS given their enormous cumulative environmental and social implications. At the same time, the State's Attorney General should accelerate analysis of public versus private entitlement issues affecting coastal resources and aggressively implement the State's policy of assuring public use of navigable waterbodies.

Because of the growing legal conflicts over use of renewable resources in the coastal zone, the Office of Coastal Restoration should investigate options for increasing public ownership of coastal wetlands, leaving ownership of subsurface mineral rights in private hands where they are now. Public ownership would clearly increase options for sound environmental management and control of renewable resources consistent with the public interest. We are heartened by the establishment of the Bayou Sauvage National Wildlife Refuge. Through the Coastal Restoration Trust Fund and federal wetland acquisition programs, both the federal governments and private groups such as the Nature Conservancy should pursue all possible efforts to acquire coastal wetlands.

3. Legal Arrangement to Moderate Temporary Economic Impacts

By introducing water and sediment into sub-basins experiencing subsidence and erosion, diversion projects may temporarily reduce some present economic values. Some floodplain areas in coastal communities may experience increased flooding; shellfishermen may find shellfishing grounds which they are leasing to be rendered less valuable temporarily. Under certain limited circumstances, the diversion of water and sediment which floods privately owned lands may arguably deprive coastal land owners of certain use rights which might entitle them to compensation.

The State through its Office of Coastal Restoration will have to develop institutional programs which are capable of moderating the temporary economic impacts of the diversion program on affected landowners, coastal communities and shellfishermen. For example, if, as part of the large-scale Mississippi River diversion project South of New Orleans, the ACOE does not maintain the riverside and seaside levees at some point below which there are coastal residences, the state must be in a position to compensate those residents and/or relocate them. For the diversion program to work, institutional mechanisms, such as land acquisition and regional transfer of development rights programs, and funding for them, must be in place to facilitate relocation of some coastal residences. Shellfishermen whose lease values are diminished should receive alternative use rights. Funding for all of these costs would come primarily from the Coastal Restoration Trust Fund.

C. Enforcement Of State And Federal Regulatory Programs

1. Strengthening the Permit Program

Construction, expansion, and maintenance of canals for oil and gas equipment transport, navigation, drainage or other activities involves discharges of dredged or fill materials into waters of the State and the United States, including wetlands. Under Section 404 of the federal Clean Water Act, the New Orleans District Corps of Engineers (NOD), using EPA's 404(b) guidelines, has the authority to grant or deny permits in coastal Louisiana for such discharges. Similarly, the State Coastal Management Division of DNR has regulatory authority over most activities, including canal construction, in coastal wetlands under the State and federal Coastal Zone Management Acts and guidelines which DNR has adopted.

a. Findings of practicable alternatives

In recent years, these state and federal programs have led to some modifications of dredging practices in the coastal zone but very few outright permit denials. Quite aside from questions of political will, both state and federal regulatory programs have suffered similar shortcomings. While both programs are intended to protect wetland resources, the applicable regulations require DNR and the NOD to find that practicable or feasible alternatives to canal construction are available or that adverse impacts on wetlands are unacceptable before denying a permit. For these programs to protect wetlands effectively, these agencies must conduct the requisite

investigations to support findings that technical alternatives are available and that cumulative impacts of canal construction are significant and in general unacceptable. The statutory authority to conduct such investigations and make such findings exists. These findings about alternatives and impacts can and should be in part generic to establish basic ground rules that DNR and NOD should use in reviewing permit applications.

The regulatory agencies should be in a position to make both sets of findings. Obviously, a clear general finding that alternatives to canal construction are available would be technology-forcing. While the EPA 404(b) guidelines state that the Corps is to take cost, as well as technical feasibility, into account in assessing practicability, the Corps, like DNR, has considerable discretion as to how much additional cost an applicant must bear before an alternative becomes impracticable. The fact that an alternative may cost many times the cost of canal construction does not make it impracticable, particularly if all competitors face similar cost constraints. Impracticality is in part a matter of unfairness. So long as all firms that might seek permits to construct canals know that the state and federal regulatory agencies have found that more expensive alternatives are available, they will suffer no competitive disadvantage from using those alternatives.

To facilitate implementation of this policy on alternatives, the Office of Coastal should conduct a rulemaking to incorporate these concepts.

b. Adoption of full compensation as a mitigation standard

Both the state and the ACOE have the authority to require applicants which are granted permits that involve wetland degradation to compensate for the damage caused. The CEQ NEPA regulations at 40 CFR 1508.20 define mitigation in terms of avoiding, minimizing, rectifying through rehabilitation, reducing or compensating for impacts. In its May 13, 1986 Final Determination Concerning the Sweedens Swamp Site in Attleboro, Massachusetts, Pursuant to Section 404(c) of the Clean Water Act, EPA made it clear that avoidance of wetland loss through selection of alternatives is the best form of mitigation. Where DNR or the Office of Coastal Restoration and the ACOE do allow mitigation in the form of restoring degraded wetlands as a condition for a permit allowing canal construction, they should require full compensation for all losses, direct and indirect. Their regulations should incorporate such clear mitigation requirements.

Mitigation which is authorized by the state or ACOE through the permit process should not be ad hoc; it should all be in furtherance of specific restoration projects which the action program has identified. These restoration projects could be in the form of creation of new wetland acreage, construction of sediment trapping devices, plugging and/or backfilling abandoned canals, and removing plugs from natural waterbodies or installing structures to re-establish natural water and nutrient flow. Other than using materials dredged in connection with the permitted canal construction, the applicant should be required to import into the coastal zone appropriate kinds of soils to reconstruct eroded wetlands based on this replacement formula at locations which the state or NOD selects.

Alternatively, where the state and ACOE authorize other forms of mitigation, they should require comparable levels of compensation, although they are harder to measure. If removal of a plug from a natural waterbody, plugging or backfilling a manmade canal, or planting seedlings or salt marsh vegetation restores more nearly natural hydrologic and wetland conditions to a large expanse of wetlands, what is the appropriate measure of compensation? While such projects, when properly designed and maintained, may contribute to wetland restoration, their contribution is limited. At a maximum, the state should allow a 5% wetland enhancement factor. With a risk factor of at least two, plus incorporation of the 5:1 indirect to direct wetland loss ratio described above, an applicant would have to demonstrate that a mitigation project of this sort affects beneficially at least 200 acres of wetlands for every one acre destroyed (20 x 2 x 5). Through bonding conditions, the applicant should also be financially responsible for maintaining the project for at least 20 years. The state should initiate a rulemaking also for the purposes of adopting such clear compensation rules.

Since the cost of complying with this mitigation requirement would be considerable, it would begin to force applicants for dredging permits to internalize the social and environmental costs of canal construction. In the process, the differential between the cost of canal construction and other alternatives would be greatly diminished, or might disappear.

2. Effective Use of Programs for Protecting Special Areas

Portions of the coastal zone which are particularly sensitive to erosion or have expanses of undamaged wetlands should be immediately off-limits to canal construction or

expansion. State DNR has the authority to designate special management areas subject to special regulatory constraints. It has not used this authority to date to designate any special management areas in the coastal zone, other than the Lake Pontchartrain Special Management Area still under review, or specifically to restrict construction of oil and gas access canals. It should do so. The State should forthwith designate, not only the Pontchartrain-Maurepas, but also the Barataria Bay and Breton Sound estuaries, as special management areas, and adopt generic regulations for special management areas more environmentally protective of those areas than the guidelines generally applicable to the coastal zone.

Similarly, EPA has the authority under Section 404(c) of the Clean Water Act to designate aquatic areas as non-disposal sites for dredge and fill activities where such activities would have an unacceptable adverse impact on important ecological functions, including fish and shellfish spawning or nursery habitats, wildlife breeding areas or areas important for recreation. Most of coastal Louisiana could qualify for this designation. In addition, EPA has a program for advanced identification of wetland areas which are generally unsuitable as disposal sites, as well as those which are possible future disposal sites, as provided in 40 CFR 230.80. EPA has used its 404(c) power in one case in coastal Louisiana. It is a powerful tool for implementing this action program. Certainly, all newly accreted or nourished deltaic areas which result from any Mississippi or Atchafalaya River water and sediment diversion projects, as well as mitigation sites, should qualify for special area management, advanced identification, or 404(c) non-disposal status.

The DNR Division of Oil and Gas leases state-owned lands and water bottoms in the coastal zone for oil and gas exploration and development. In lease offering notices and in leases it should impose conditions on access and mitigation in accordance with this action program.

CONCLUSION

The State of Louisiana has begun to comprehend the magnitude and seriousness of coastal zone erosion. While it has taken some first steps to address this calamity, it lacks an overall plan with a clearly defined set of objectives. At the same time, the nation has hardly begun to perceive the nature of this coastal wetland loss.

We consider accelerating loss of coastal Louisiana to be unacceptable. Management techniques and technologies for addressing the root causes of coastal erosion and subsidence are at hand. The purpose of this action program is to delineate a set of bold but realistic resource goals for coastal management and to set forth an action program to attain those goals. Implementation of this program will require concerted and active citizen support in the state for measures that will greatly restrict canal construction and therefore compel changes in the way the oil and gas industry does business in coastal Louisiana. It will also require support from a nation which understands the extraordinary ecological and geological uniqueness and value of this coastal zone so that Congress will authorize the Corps of Engineers and other federal agencies to develop and fund a program for redirecting the water and sediments of the Mississipi River.

In recent years it has been too common for people to decry coastal land loss without being willing to define a program which adequately addresses the underlying causes of land loss, to describe the short-term costs of that program as well as long-term benefits, or to refine the additional legal authorities needed to make such an action program work. We hope we have avoided these pitfalls. This action program states clearly what has to be done. Let us begin.

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