

The Galveston Bay Plan

*The Comprehensive Conservation and Management Plan
for the Galveston Bay Ecosystem*



October 18, 1994

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For the Galveston Bay Ecosystem

A Project of:
The Galveston Bay National Estuary Program



The Galveston Bay National Estuary Program
A Program of the TNRCC

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Galveston Bay National Estuary Program:

Frank S. Shipley, Ph.D.

Russell W. Kiesling

Karen A. Prince

M.A. Bengtson

Willie G. Lane

Jeanette O. Belk

Judy Eernisse

Groundwater Services, Inc.:

Charles J. Newell, Ph.D., P.E.

Grant A. Cox

Elaine A. Higgins

Elaine K. Gie

Christina R. Walsh

Don L. Beasley

Houston-Galveston Area Council:

Jeffrey M. Taebel, AICP



Policy Committee

The Honorable Rodney Ellis, Chair
Texas Senate

Mr. John Hall
*Chair, Texas Natural Resource
Conservation Commission*

Ms. Jane Saginaw
*Regional Administrator,
EPA Region 6*

Mr. James Blackburn
Galveston Bay Foundation

Ms. Terry Hershey
*Commissioner, Texas Parks and
Wildlife*

Mr. Charles Miller
*Past Chairman of the Board of Directors,
Greater Houston Partnership*

Mr. Charles W. Jenness
Chair, Texas Water Development Board

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Ms. Sharron Stewart, Chair

Mr. Ron Embry, Vice-Chair

Galveston Bay Public Forum

Dr. Don Bass, Chair

Program Director

Dr. Frank S. Shipley

Endorsements

THE CONCEPT OF INITIALLY STUDYING from a scientific viewpoint the state of the bay, and using those findings to draft the current plan, lends a special credibility and weight to The Plan. The Galveston Bay Plan currently bears the imprints of both the careful science and the consensus building process from a number of involved and concerned Bay users... We think The Galveston Bay Plan, as currently drafted has the promise of creating a real difference in the environment of Galveston Bay. We strongly support its implementation.

–Mayor’s Advisory Committee on the Environment (Houston), and the Texas Chemical Council

I am in support of The Plan as a mechanism to ensure that the ecological future of Galveston bay is protected. All those who contributed to The Plan did an excellent job in determining the vital environmental issues and balancing those issues with the fiscal realities that governments and business face today.

–Bob Lanier, Mayor of Houston

Philosophically The Galveston Bay Plan has the right approach by joining the issues of public welfare, economics and all aspects of the environment in considering the future of the bay. We fully support this approach... The Galveston Bay Plan’s approach of combining issues represents a quantum improvement; we look forward to fruitful results of cooperation with local communities.

–Robert A. Cole, Director, Lazy Bend Association

The [Greater Houston] Partnership believes it is possible to sustain a healthy productive and useful bay while maintaining the sound economic development of the Galveston Bay area. We recognize the proposed Galveston Bay Plan to be the next step in the important ongoing process of maximizing Galveston Bay’s value for all of its stakeholders. The key reasons for the support of The Galveston Bay Plan by the Greater Houston Partnership are:

- *The cooperative nature of the work by the various interests in the Galveston Bay Area utilizing the National Estuary Program format/process*
- *The sound scientific basis of the characterization of the bay from which The Plan was developed*
- *The proposed creation of the Galveston Bay Council to provide the foundation for continuing communication and cooperation by all parties*
- *The ability to review and adjust The Plan in the future through the advisory function of the Galveston Bay Council.*

–Greater Houston Partnership

On behalf of the Galveston District, Corps of Engineers, I am pleased to endorse this Draft Plan.

**–Major Ray Schultz, Deputy District Engineer,
Army Corps of Engineers**

Galveston Bay may be in better shape than some had presumed when GBNEP began; nevertheless, our collective concerns were not misplaced, as the studies do support an overall monitoring program to maintain a healthy and productive bay. If we are to sustain this bay as the environmental and economic resource we know it to be, we can only do so through a stewardship in which all parties appreciate the concerns of all of the bay interests. The time for that stewardship is now, before drastic measures are needed, while we can monitor and manage, rather than be forced to command and control... We... express our appreciation for the tremendous effort that has gone into the Draft CCMP. We fully expect the result of this public participation process to be a plan for the management of Galveston Bay whose implementation is a commitment shared by all stakeholders. To that end, the Port of Houston Authority pledges its cooperation and support.

–Port of Houston Authority

I believe that the GBNEP staff, Groundwater Services personnel, and all the public and industry representatives did a fine job of pulling together timely research, disparate points of view, and a wide variety of issues, initiatives, and jurisdictional conflicts to produce The Plan. The process of bringing together divergent perspectives and trying to forge a consensus on problems, solutions, and priorities was very useful. Furthermore, The Plan itself is a fine document—far more focused, concise, and easily implemented than most planning works.

–David A. Todd, Austin

Overall, [The Galveston Bay Plan] reflects one of the most polished and substantive plans I have had the pleasure to review.

**–Stephen Bugbee, EPA Permits
Washington, D.C.**

...Having over 23 years experience in coastal issues, policies, and resource management, I feel qualified to provide you with our support for the Draft Galveston Bay Plan... The Texas A&M Sea Grant College Program provides its endorsement and support for the Draft Galveston Bay Plan subject to any major, substantive revisions... Thanks to you and all of your staff for the hard work and excellent job given the numerous entities, organizations, officials, agencies, trade associations, and citizens that were involved in The Plan.

**–Mike Hightower, Sea Grant
Deputy Director**

On Behalf of the [Texas City] City Commission, we commend your committee and you [Senator Rodney Ellis] for the efforts exhibited on behalf of our beautiful Galveston Bay.

–Charles Doyle, Mayor of Texas City

The East Harris County Manufacturer's Association appreciates the opportunity to present further comments on what, in many ways, has become a model for future National Estuary Program plans. The Plan demonstrates that sound research, combined with consensus program development, yields quality results. The Plan is a tribute to those who worked so long and hard to get to this point. On the whole, the East Harris County Manufacturer's Association supports the draft Galveston Bay Plan.

**–C. L. Lancaster,
Chairman of the Board,
East Harris County Manufacturer's
Association**

The Galveston Bay Plan represents a thoughtful and insightful document that addresses significant issues of habitat destruction, water and sediment quality problems, and competing uses of the fragile Galveston Bay system, as well as proposes... a number of actions that should result in habitat protection.

–Texas Historical Commission

These plans as presented represent a major step forward in the comprehension and public presentation of this bay's increasing problems which are progressively eroding its sustainability and economic value.

–David Marrack, M.D.

[The Galveston Bay Plan] was well designed and thought-out and the clear and concise actions came together logically in the Action Plans... The level of detail in the draft is quite adequate, and has been sent to other Tier II and Tier III NEPs as a good example. These assets should help pave the way for a smooth implementation of The Plan. The draft reflects strong commitment, consensus-building, and leadership within the committees in attempting to address long-term problems in such a large, complex, and dynamic ecosystem as Galveston Bay. The commitment of the Management Conference in developing this strong draft CCMP is impressive and commendable.

**–EPA Office of Wetlands, Oceans, and
Watersheds
Washington, D.C.**

It is apparent from reviewing the proposed Plan that a great deal of time and effort has been put into developing a program that is balanced and allows for economic growth while protecting a valuable natural resource.

–Friendswood Development Company

As a long term participant in the Galveston Bay Program, we are pleased with the progress of the program toward the goal of sound and effective stewardship of the Galveston Bay system. The Plan reflects the dedication of the program staff and the virtues of combining careful research and consensus development.

–Houston Lighting and Power

Overall, I am impressed with the results of the GBNEP effort and the resulting Galveston Bay Plan Draft. You have discovered new facts, some contrary to popular conceptions, and developed a plan that will protect the Bay from future misuse.

–Hans R. Friedli, Citizen Monitor

The [Stormwater Management Joint Task Force] believes that protection of valuable natural resources such as Galveston Bay is critical to this region. In that regard we commend the GBNEP for their effort in protecting Galveston Bay. We encourage active involvement by local governments in the development of The Galveston Bay Plan.

**–Stormwater Management Joint Task
Force**

The Houston-Galveston Area Council supports the concept of a comprehensive Galveston Bay Plan to coordinate the management of this important resource... We commend the GBNEP Management Conference for its efforts to base its plan on sound scientific work, and for seeking consensus among the Bay's managers and users. We also appreciate the fact that local government input was invited and that our concerns have been addressed in major revisions to The Plan's implementation and financing strategies.

–H-GAC Board of Directors

The Board of Directors of the Gulf Coast Conservation Association has unanimously voted to support and approve the Galveston Bay National Estuary Program's Comprehensive Conservation and Management Plan. We would hope that all Texans realize the importance of the Galveston Bay system to our state's economy and ecology. We endorse the Management Plan as a viable tool for its restoration, maintenance, and protection. We would hope that this Plan receives the necessary support it so deserves.

–Gulf Coast Conservation Association

The League of Women Voters of Houston applauds the efforts of the Galveston Bay National Estuary Program Management Conference. We have been especially impressed with the attention given to obtaining input from the public at regular intervals... We feel that adoption of the [Galveston Bay Plan] by state and federal agencies, local governments, environmental and citizens' groups, commercial and industrial interests and recreational users is a step in the right direction.

**–League of Women Voters
of Houston**

We recognize the significant potential to our economy in protecting the bay and the challenge of managing our water quality for our area's large population. We feel that much can be accomplished through a comprehensive, cooperative approach of local, regional, and state governments and organizations to improve storm water management, habitat protection and shoreline erosion. We must be ever mindful of realistic potential for funding and seek to prioritize recommendations to address our most serious problems.

**–Sandra Pickett, Liberty
City Councilwoman**

I commend the Galveston Bay National Estuary Program staff for aggressively soliciting advice and comments from all interested parties during the development of The Plan. The Plan is a comprehensive document that appropriately addresses opportunities and problems in Galveston Bay and contiguous areas and recommends realistic approaches for management of the estuarine resources.

–Lial F. Tischler, Tischler/Kocurek

Mitchell Energy & Development Corporation commends the Galveston Bay National Estuary Program Management Conference ... for the quality of its review of Galveston Bay, a review that demonstrated the success of many existing control programs, such as point source controls in the Ship Channel area, in protecting the environmental quality of the Bay. Much of the design of the Comprehensive Plan has benefited from the quality of the review.

**–Mitchell Energy and Development
Corporation**

The Galveston Bay Foundation enthusiastically supports the proposed Galveston Bay Plan. The Foundation supports the concept of sustainable development for the Galveston Bay area, and believes that it is possible to have a healthy productive bay and continued economic development in the surrounding area. The Foundation believes that the proposed Galveston Bay Plan is an important next step in the process of maximizing the potential of Galveston Bay for all of its users.

–Galveston Bay Foundation

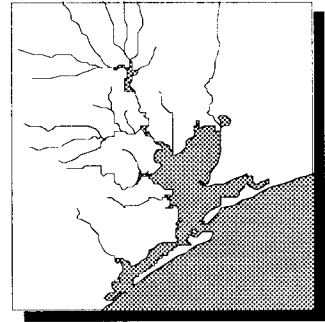
The Houston Audubon Society wants to emphasize...the importance that it places on a Comprehensive Conservation and Management Plan for Galveston Bay. The wise stewardship of this estuary is long overdue, and of utmost importance economically, recreationally and environmentally. We appreciate the countless hours that dedicated and learned people have devoted to The Plan, and hope that their good ideas will be implemented fully.

–Houston Audubon Society

The Fish and Wildlife Service has been an active participant in the GBNEP since its inception. As such, we have been pleased both with the consensus-building format of the GBNEP and the results of that process. The Service strongly endorses the Draft Plan and we fully intend to be active participants in its implementation. The Plan will be most complementary to the recent Service thrust towards an ecosystem approach to fishery and wildlife conservation.

–U.S. Fish and Wildlife Service

The Galveston Bay National Estuary Program



Texans increasingly express their expectations for a clean environment in terms of entire ecosystems. Until recently, our tendency was to view environmental problems in isolated pieces we could understand. Indeed, this view was institutionalized in an elaborate mosaic of fragmented jurisdictions. The Galveston Bay National Estuary Program (GBNEP) is a forerunner in elevating hands-on management of coastal environments to the level of the ecosystem; and in doing so, is encouraging an integration of traditionally disparate institutions.

The GBNEP was established under the authority of the Water Quality Act of 1987 to develop a *Comprehensive Conservation and Management Plan* (CCMP) for Galveston Bay. *The Galveston Bay Plan* is that plan. The purpose of *The Galveston Bay Plan* is to address threats to the bay resulting from pollution, development, and overuse. To address these threats, five years of work commenced in 1990, consisting of three phases: (1) identification of the specific problems facing the bay; (2) a bay-wide effort to compile data and information to describe status, trends, and probable causes related to the identified problems; and (3) creation of *The Plan* itself to enhance governance of the bay at the ecosystem level. The GBNEP accomplished this work through a cooperative agreement between the U.S. EPA (Region 6) and the State of Texas (administered by the Texas Natural Resource Conservation Commission).

The structure of the GBNEP reflects a strong commitment to consensus-building among all Galveston Bay user groups, government agencies, and the public. The GBNEP "Management Conference" consists of six Governor-appointed committees with broad representation, totaling approximately one hundred individuals. Meetings of these committees are also open to the public, and public participation in policy-setting and in bay management are considered strengths of the program.

List of Acronyms

The Galveston Bay Plan
Galveston Bay National Estuary Program

ASCS	Agriculture Stabilization and Conservation Service	EPA	U.S. Environmental Protection Agency
AVS	Acid Volatile Sulfides	ESA	Endangered Species Act
BEG	Bureau of Economic Geology	FC	Fecal Coliform
BMP	Best Management Practice	FDA	U.S. Food and Drug Administration
BR	Bureau of Reclamation	FEMA	Federal Emergency Management Agency
BUG	Beneficial Uses Group	FW	Freshwater Inflow and Bay Circulation Action Plan
CBC	Christmas Bird Count	GBC	Galveston Bay Council
C-CAP	Coast Watch-Change Analysis Program	GBF	Galveston Bay Foundation
CCC	Coastal Coordination Council	GBIC	Galveston Bay Information Center
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	GBP	Galveston Bay Program
CFU	Colony Forming Unit	GBNEP	Galveston Bay National Estuary Program
CMP	Texas Coastal Management Program	GCCA	Gulf Coast Conservation Association
COC	Contaminants of Concern	GCHDPCO	Galveston County Health District Pollution Control Division
Corps	U.S. Army Corps of Engineers	GCWDA	Gulf Coast Waste Disposal Authority
CPPRS	Citizen's Pollution Reporting and Response System	GIS	Geographic Information System
CPUE	Catch Per Unit Effort	GIWW	Gulf Intracoastal Waterway
CRP	Clean Rivers Program	GLO	Texas General Land Office
CWA	Clean Water Act	GOMP	Gulf of Mexico Program
CZARA	Coastal Zone Act Reauthorization Amendments	HCPCD	Harris County Pollution Control District
CZM	Coastal Zone Management	HEP	Habitat Evaluation Procedure
DBMS	Database Management System	HGAC	Houston-Galveston Area Council
DIMS	Data and Information Management Strategy	HGCSD	Houston-Galveston Coastal Subsidence District
DIR	Department of Information Resources	HHSD	Houston Health and Human Services Department
DO	Dissolved Oxygen	HL&P	Houston Lighting and Power
DoD	U.S. Department of Defense	HP	Habitat Protection Action Plan
DOI	Department of Interior	HSC	Houston Ship Channel
DPU	Houston Department of Public Utilities	HUD	U.S. Department of Housing and Urban Development
EHCMCA	East Harris County Manufacturer's Association	ICC	Interagency Coordinating Committee
EMAP	Environmental Monitoring and Assessment Program	ISTEA	Intermodal Surface Transportation Efficiency Act
EMC	Event Mean Concentration	LANS	Local Area Networks

continued

MARPOL	Marine Plastics Pollution Research and Control Act	SCS	Soil Conservation Service (Now the Natural Resources Conservation Service)
MOU	Memorandum of Understanding	SD	Spills/Dumping Action Plan
MUD	Municipal Utility District	SM	Shoreline Management Action Plan
NBS	National Biological Survey	SP	Species Population Protection Action Plan
NCP	National Oil and Hazardous Substances Contingency Plan	SPCC	Spill Prevention Control and Countermeasures Plan
NMFS	National Marine Fisheries Service	SWCB	Texas State Soil and Water Conservation Board
NOAA	National Oceanic and Atmospheric Administration	TAC	Texas Administrative Code
NPDES	National Pollutant Discharge Elimination System	TAMU	Texas A&M University
NPS	Non-Point Source	TBT	Tributyl Tin
NRDA	Natural Resource Damage Assessment	TCC	Texas Chemical Council
NRHP	National Register of Historic Places	TCOON	Texas Coastal Ocean Observation Network
NRI	National Resources Inventory	TCWS	Texas Colonial Waterbird Survey
NSF	National Science Foundation	TDA	Texas Department of Agriculture
NSSP	National Shellfish Sanitation Program	TDH	Texas Department of Health
ONRW	Outstanding Natural Resource Water	TEA	Texas Education Agency
OPA	Oil Pollution Act	TED	Turtle Excluder Device
OSPRA	Texas Oil Spill Prevention and Response Act	TEST	The Estuarine Sampling Team
PAH	Polynuclear Aromatic Hydrocarbon	TM	Landsat Thematic Mapper
PAR	Photosynthetically Active Radiation	TMDL	Total Maximum Daily Load
PCB	Polychlorinated Biphenyl	TNRCC	Texas Natural Resource Conservation Commission
PH	Public Health Protection Action Plan	TNRIS	Texas Natural Resource Information System
PIO	Public Information Office	TOC	Total Organic Carbon
POTW	Publicly-Owned Treatment Works	TPWD	Texas Parks and Wildlife Department
PPE	Public Participation and Education Action Plan	TSC	Technical Support Committee
PS	Point Source	TSCA	Toxic Substances Control Act
RCB	Research Coordination Board	TSS	Total Suspended Solids
RCRA	Resource Conservation and Recovery Act	TWC	Texas Water Commission (Now TNRCC)
RRC	Texas Railroad Commission	TWDB	Texas Water Development Board
RRT	Regional Response Team	TWRI	Texas Water Research Institute
RSC	Research Action Plan	TXDOT	Texas Department of Transportation
SAL	State Archeological Landmarks	UH	University of Houston
SAMP	Special Area Management Plan	USCG	U.S. Coast Guard
SARA	Superfund Amendments and Reauthorization Act	USCGMSO	U.S. Coast Guard Marine Safety Office
SB “#”	(under Regulatory Issues) Senate Bill No.	USDA	U.S. Department of Agriculture
		USDOT	U.S. Department of Transportation
		USFWS	U.S. Fish and Wildlife Service
		USGS	U.S. Geological Survey

continued

UT	University of Texas
WAN	Wide Area Network
WEF	Water Environment Federation
WQS	Water Quality Standard
WSQ	Water and Sediment Quality Action Plan
WVA	Wetland Value Assessment

Galveston Bay Plan

Executive Summary

Galveston Bay ranks high among the nation's great bay systems, providing huge economic benefits to the region and state. Remarkably, the bay's natural resources are self-renewing as long as the bay remains healthy and productive. However, Galveston Bay, like many other U.S. bays, now faces significant problems related to habitat loss and species declines, conflicting human uses, and pollution. Some management actions (for example, regulation of point sources of pollution) are already working to improve the bay. Other serious problems still need to be addressed if disasters noted in other U.S. bays are to be prevented. The bay's most serious problems, such as habitat losses and non-point source pollution, occur at the ecosystem level, and will require interdisciplinary solutions involving both natural resource agencies and bay stakeholders.

The Galveston Bay Plan is a Comprehensive Conservation and Management Plan produced by the Galveston Bay National Estuary Program under Section 320 of the Water Quality Act. *The Plan* was drafted by a partnership of state and federal agencies, local governments, stakeholders, interest groups, and the public. Over a five-year period, bay problems were agreed upon, numerous scientific studies conducted, and 82 management initiatives were established to address 17 specific problems.

WHAT PROBLEMS DOES *THE PLAN* ADDRESS?

Habitat Destruction and its Effect on Fish and Wildlife Populations

Destruction of coastal wetlands and underwater seagrass meadows has been substantial, with more than 30,000 wetland acres lost during four decades. These are productive nursery areas for the bay's seafood species, which also serve valuable functions to stabilize shorelines, moderate flooding, and remove contaminants. *The Galveston Bay Plan* proposes nineteen specific actions for habitat and fish and wildlife protection. Initiatives include direct acquisition of wetlands, economic incentives (such as tax breaks) for conservation by private land-owners, and habitat creation (such as utilizing dredged sediment from navigation channels to create wetlands). Efforts aimed at fish and wildlife protection include reduction of commercial fishing by-catch (incidental catch of non-target species in shrimp trawls), catch and release programs for recreational fisheries, and controlling harmful exotic species that displace Galveston Bay's native fish and wildlife.

Competing Human Uses of the Bay: A Balance Between Needs and Available Resources

A variety of bay problems result from the way various users of the bay compete for its scarce resources. For example, diversions of freshwater for use by the expanding population alter

circulation and salinity patterns in the bay, in turn affecting the abundance and distribution of fisheries species and the condition of coastal habitats. *The Galveston Bay Plan* will help determine freshwater needs for Galveston Bay in order to sustain ecological productivity in balance with human uses. Promoting water conservation and more efficient water usage are some of the tools that can be used to achieve these goals.

Shoreline development also can produce unintended problems such as habitat alteration and destruction, pollution, and loss of fish and wildlife abundance and diversity. Nearly 650,000 people live within two miles of the bay's shoreline, with steady population growth intensifying the need for better planning. *The Galveston Bay Plan* proposes five shoreline management actions to ensure compatibility of shoreline uses. These actions include the establishment of guidelines for shoreline development for residential, commercial, and industrial uses. Local governments along the bay's shoreline will have the opportunity to voluntarily coordinate with other shoreline communities in maintaining the shoreline values that draw people to the area and contribute to local economies. Other actions include minimizing negative effects of structures and dredging on publicly-owned lands and ensuring improved access to publicly-owned shorelines.

Water and Sediment Quality Problems

Regulation of point sources of pollution has resulted in substantial improvement of water quality in the upper Houston Ship Channel—a success in the making. But despite ongoing improvements, there are still concerns over source areas—limited areas with pollution or contamination problems. Non-point sources of pollution are of particular concern, with over 50 percent of Galveston Bay permanently or conditionally closed to oyster harvest due to fecal coliform bacteria contamination. *The Galveston Bay Plan* proposes sixteen specific actions to reduce water quality problems caused by non-point runoff. These actions include the implementation of storm water management programs which focus on residential neighborhoods, septic tanks, new development and road construction, and industrial and agricultural activities. Other actions would require treatment of wastes from boating and marina activities.

Other actions address aging sewage collection systems which create bypasses to the bay's tributary waters, improved monitoring, regionalization of smaller, less effective wastewater treatment systems, and elimination of harm associated with brine discharges from petroleum extraction. Several actions are designed to refine methods used by the state to determine allowable pollutant loadings for Galveston Bay and to ensure that pollutant discharges are regulated more effectively. Together, these actions are designed to ensure balanced but protective public policy for the benefit of future generations of Texans.

WHO WILL IMPLEMENT THE GALVESTON BAY PLAN?

The Galveston Bay Plan recommends implementation under a Galveston Bay Program of the Texas Natural Resource Conservation Commission (TNRCC), with a Galveston Bay Office of the commission to be located in the bay area. Several factors weighed in this decision:

- Most state initiatives in *The Plan* fall under the jurisdiction of the TNRCC. Initiatives estimated to cost about \$7.5 million over the first five years fall to the TNRCC, compared to some \$4.5 million for TPWD, and \$1.5 million for GLO (other state agencies were even smaller amounts).
- The National Estuary Program is a Water Quality Act program, and all other programs under the Water Quality Act are under TNRCC jurisdiction at the state level.
- The recent consolidation of natural resource management under the TNRCC by the Texas Legislature has given this agency a broad role for management of aquatic and marine ecosystems—a good fit with the comprehensive approach of *The Plan*.

A Program Director and staff of up to 15 TNRCC employees will oversee the work of implementation. The composition of the staff will reflect *The Plan's* initiatives, with expertise in wetlands and estuarine habitats, coastal resource conservation, non-point source issues, water quality, public health, and public education. Work of the staff will also include support actions provided by a regional monitoring initiative, research, and continuing public participation in bay policy.

The Galveston Bay Council

Unlike past management initiatives, *The Galveston Bay Plan* is a comprehensive plan. Diverse concerns for habitats and wildlife, competing resource uses, water quality, and human health cannot be adequately addressed without the involvement of multiple resource agencies and bay stakeholders. To achieve success, problems of a regional nature, those affecting the entire ecosystem, will require regionally coordinated actions. Therefore, *The Plan* proposes creation of a *Galveston Bay Council* to advise the TNRCC on all aspects of implementation. The Galveston Bay Council will consist of representatives of federal, state, and local natural resource agencies, the research community, local governments, citizens, and other Galveston Bay stakeholders. The Galveston Bay Council will:

- Provide a forum for technical and stakeholder review and input during *Plan* implementation
- Maintain agency commitments to implement *The Galveston Bay Plan*
- Advise TNRCC staff during preparation of progress reports, evaluations and *Plan* updates
- Authorize and make appointments to advisory committees as necessary
- Assess the success of the action plans and initiate revisions
- Address legislative issues and make recommendations to the legislature
- Set annual priorities for the implementation of the action plans

The Galveston Bay Council is a continuation of the partnership successfully utilized by the Galveston Bay National Estuary Program for the creation of *The Galveston Bay Plan*.

Consistency Review: Broader Options Under the Texas Coastal Management Program

Consistency review is an important tool for the implementation of *The Plan*. Federal consistency review under Section 320 of the Water Quality Act allows the Galveston Bay

Program to review federal assistance programs and federal development projects for consistency with *The Plan*. Consistency ensures that federal agency actions which affect Galveston Bay do not work at cross-purposes to the goals of *The Plan*.

While federal consistency review under Section 320 of the Water Quality Act gives the Galveston Bay Program the ability to review certain federal actions for consistency and seek "accommodation" by a federal agency proposing an action that is inconsistent with *The Plan*, it does not give the Galveston Bay Program the authority to stop such action nor to seek mediation.

There are two other types of consistency review *The Plan* may be able to use in the future. Under the CMP, the Coastal Coordination Council has the authority to review state actions that may adversely affect coastal natural resource areas for their consistency with the CMP. Additionally, once the CMP is approved by the National Oceanic and Atmospheric Administration for participation in the federal Coastal Zone Management Program, the Coastal Coordination Council will have the authority to review federal actions (licenses and permits, development projects, direct activities, and federal assistance) to determine their consistency with the CMP.

If enforceable policies of *The Galveston Bay Plan* are adopted by the CCC for a Special Area Management Plan (SAMP), then the state and federal consistency reviews under the CMP may be used to ensure that state and federal actions are consistent with *The Plan*. The enforceable policies associated with *The Plan* will be developed in an open consensus process and will be based on existing federal and state regulations and laws. A focus group that includes industry and other stakeholder representatives will work with the Galveston Bay Council in identifying enforceable goals and policies for inclusion of *The Galveston Bay Plan* as a SAMP under the CMP.

HOW MUCH WILL THE GALVESTON BAY PLAN COST?

Costs

Total Galveston Bay Program costs are estimated at \$2.0 million per year. Approximately \$1.0 million per year will be needed for Galveston Bay Program operating expenses. These funds will be used by the TNRCC to undertake actions identified in *The Plan* as Galveston Bay Program functions. These costs include establishing and staffing the Galveston Bay Program Office and supporting the Galveston Bay Council. An additional \$1.0 million per year will be needed as match money for grants. This "seed money" can be used to leverage outside funding, such as federal grants, to fund specific initiatives. Costs to implement actions in *The Plan* are estimated at \$36.5 million over five years, with variable annual costs averaging \$7.3 million per year. These costs include those to be incurred by federal, state, and local entities as well as the Galveston Bay Program for implementing new actions recommended by *The Plan*.

Sources of Funds

Of the \$2.0 million required annually for the Galveston Bay Program (\$1.0 million for the Program itself and \$1.0 million seed money to leverage grants and other sources), funding is to consist of \$1.5 million state funds and \$0.5 million federal funds. State funds are to be sought from the Texas Legislature as an appropriation to the TNRCC for establishment of the Galveston Bay Program to implement *The Plan*. The available funding options for implementation of new actions recommended by *The Plan* include federal, state, and private grants and assistance programs. Although funding from many of the regulatory agencies involved in the Galveston Bay Program cannot be formally committed over long time periods, there has been an informal commitment from these agencies to support the Program on a long-term basis.

Within *The Plan* individual actions have been assigned a priority rank of “High,” “Medium,” or “Low” based on deliberation by the Management Conference. In assigning these ranks, the Management Conference considered both the costs and probable outcomes of the actions, and made judgments about which were most significant in relation to the bay’s documents problems. The assigned rankings will help provide a guideline for expenditure of funds during implementation of *The Plan*.

Introduction

Half the earth's population lives on just five percent of its land. Coastlines, out of all inhabited areas, have historically been among the most highly valued by humankind. Coasts have acted as magnets for varied human activities, uses of marine resources, and permanent human development. Cities have sprung up to take advantage of abundant seafood, natural water transportation, and aesthetic and recreational qualities offered by the boundary between land and sea. Along the Gulf Coast, the population density is five times greater in coastal counties than in inland counties; people seem naturally attracted to the edges of the land.

Natural bay systems have been the most attractive coastal areas of all. Here, where rivers meet the sea in natural semi-enclosed basins, seafood is most abundant. The geographic setting offers a potential to link inland domestic economies (via rivers) and global commerce (via the sea). Cities located on bays become transformation and processing points for products like petroleum and wheat. Ports become entry points for products ranging from bananas to automobiles. By locating near a bay, industry gains cheap access to both raw materials and markets for its final products. Refineries and manufacturing plants are built. People follow jobs.

For decades, human development around the nation's great bay systems occurred with little regard for effects on the marine systems themselves. Of all natural environments, bays seemed most able to absorb tremendous human activity without much reduction in the bay's productive value. Fish and shellfish numbers remained high, although contamination of some areas required harvest closures to protect the public from disease. Certainly the ships were not slowed down, even if the waters were becoming polluted and the wetlands which produced the bountiful seafood were being lost.

In recent years major economic and environmental events have raised concerns about the capacity of coastal environments to sustain further human activity without damage. Worldwide, for example, fish provide more than half of all animal protein consumed by people, but fish declines have occurred in 13 of the world's 17 principal fishing zones. In Chesapeake Bay, historically the nation's greatest seafood producer, oysters, striped bass, and crab populations crashed so quickly that a management plan could not be developed and put in place in time to forestall disaster. Similar events have occurred in Puget Sound, San Francisco Bay, and in a number of east coast bays. Clearly, the nation's coastal resources are at risk.

Galveston Bay ranks high among the most significant bay systems in the nation. This premier Texas coastal resource provides substantial economic benefits. Remarkably, these benefits are self-sustaining as long as the bay remains healthy and productive. However, Galveston Bay,

like many other U. S. bays, now faces significant problems related to habitat loss, water quality, and related species declines. Some of these problems are only in their early stages, providing us with advanced warning in time to prevent larger disasters already seen in most of the world's principal fishing zones. Other problems in Galveston Bay such as wetlands loss, already exceed many other bays in severity.

Galveston Bay - A Premier Texas Resource

Galveston Bay benefits the state's citizens in many ways. Any list of important uses of the bay would probably include the following:

- The bay is a great place to fish. Approximately one third of the state's commercial fishing income comes from the bay. Over half of the state's expenditures for recreation fishing are related to Galveston Bay.
- The bay is also an important transportation artery; the Port of Houston is the third largest port in the country and sixth largest in the world by tonnage. Many of the area's petrochemical and other industries rely on the Houston Ship Channel, Intracoastal Waterway, and other channels for transportation.
- The bay is the final recipient of treated wastewater from over 1400 industrial and municipal point source discharges. This amounts to over 60% of the wastewater (by volume) discharged in Texas. It also receives non-point source pollutants in storm water runoff generated by agricultural, urban, suburban, and rural land users of the watershed.
- Galveston Bay provides important natural habitats for many species of particular environmental interest to Texans such as colonial waterbirds, shorebirds, dolphins, sea turtles, alligators, and numerous other species.
- Other uses of the bay include: cooling water, sailing, motorboat cruising, sightseeing, and oil and gas production.
- Most importantly, perhaps, is the value of Galveston Bay as a general indicator of the health of the environment. Most people realize that the bay is an important local ecosystem, and they have a keen interest in protecting and maintaining the productivity of the bay for future generations.

For Galveston Bay, adoption of *The Galveston Bay Plan* is the next step to assure this resource remains healthy and productive for future generations. For five years, state, federal, and local governments have deliberated among themselves and with those who derive their livelihood from Galveston Bay – business and industry, recreational and commercial fishing, shipping, and environmental organizations. *The Galveston Bay Plan* identifies and describes the problems specific to this bay system, based on sound scientific research described in detail in a companion document entitled "The State of the Bay". Moreover, *The Plan* prescribes custom-

tailored management initiatives to solve these problems utilizing a comprehensive, ecosystem-based approach. The result, this document, can provide balanced but protective public policy to assure Galveston Bay continues to benefit future generations of Texans.

HOW VALUABLE IS GALVESTON BAY?

One measure of the importance of establishing comprehensive public policy for Galveston Bay is the value of the bay and its resources. Several major sectors of the regional economy depend upon Galveston Bay, for example commercial fishing, recreation (including fishing and boating), and tourism. These activities directly depend upon the health and productivity of the bay, and therefore also on maintaining these qualities with sound management. Other values are more difficult to measure, such as the value of the bay for assimilating wastewater, or aesthetic values that draw people to the area, adding property values and general quality of life. Shipping, industrial activities and production of oil and gas are also huge economic assets tied directly to the bay.

Commercial Fishing

Galveston Bay is Texas' leading bay fishery, yielding over eleven million pounds of fish and shellfish annually. From three to five thousand commercial licenses have been issued annually in Galveston Bay in recent years, resulting in a total economic impact to the state of about \$358 million per year. Besides benefits from the bay itself, Galveston Bay supports a substantial portion of the offshore fishery, since species like shrimp grow up in the bay and are harvested as adults in the Gulf. Oysters are the single most important bay commercial species, however about half of Galveston Bay is subject to shellfish harvest closures as a result of health risks to consumers resulting from contaminated rainfall runoff.

Recreation

Gross business resulting from tourism and recreational uses of the Galveston Bay complex amounted to \$425.2 million in 1986. In that year, about \$122 million was directly spent in the region by people engaging in these activities – more than half the dollars spent on these activities on the entire Texas coast. Some 30 percent of the region's residents participate in some form of bay-related recreation, in addition to an unknown number of visitors from outside the five-county area studied.

For every pound of finfish caught commercially in Galveston Bay, more than six pounds of finfish are caught by recreational anglers. For its nearly 300,000 licensed recreational anglers, Galveston Bay supports some two million hours of sport fishing annually, creating economic benefits estimated at \$364 million in 1986. However, a fishing success rate of more than two fish per hour caught in the mid-1970s declined to about one fish per hour a decade later. All told, about half the sport fishing expenditures in Texas are associated with the Galveston Bay complex.

More than a thousand commercial boats were registered in the bay area in 1992, while nearly 100,000 pleasure vessels were served by 38 marinas. Some 63 percent of the marina wet slips in the state are found in this region, many concentrated in the "Yacht Capital of Texas," as Clear Lake is known.

Tourism

Since 1975, tourism has grown substantially in the counties surrounding Galveston Bay. Activity in 1992 provided more than 80,000 jobs and nearly \$7.5 billion in travel and payroll dollars. The proportion of these expenditures directly related to Galveston Bay is substantial, but unknown. The fastest-growing segment of the tourism industry is *ecotourism*; that is, tourist activity related to the attractions of nature. The potential for expanded ecotourism related to Galveston Bay has barely been tapped; currently over 21 potential ecotourism sites are known around the bay, but few have been developed for this purpose. For example, bird-watching at High Island and other locations around the bay attracts visitors from all over the United States and many foreign countries.

Wastewater Discharge

Some 60 percent of all wastewater discharged in Texas flows to Galveston Bay, including the output from about 45 percent of all municipal sewage treatment plants that discharge to the Gulf of Mexico. As the final destination for these domestic and industrial wastes, the bay provides a valuable (and incalculable) service to society by naturally processing this wastewater. In the past, Galveston Bay was overburdened with these wastes, resulting in the upper Houston Ship Channel becoming, some 25 years ago, one of the most polluted bodies of water in the nation. More recently, since passage of the Water Quality Act, a substantial expenditure of effort and dollars has helped clean up the waters of the upper bay (described in more detail below). While this progress continues, the natural processes at work in the bay will continue to provide a valuable function to the region by assimilating wastes.

Shipping, Industry, and Petroleum

The major ports of Houston, Galveston, and Texas City have enjoyed considerable growth in the last 40 years, with shipping more than doubling between 1970 and 1989 to more than 175 million tons per year. The cargoes reflect the dominance of petroleum and related industries in the area, with petroleum products representing 37 percent, chemicals and plastics 21 percent, crude petroleum 13 percent, and wheat 13 percent of shipping. Growth of the largest petrochemical complex in the nation around Galveston Bay was fueled early in the area's history by the substantial oil and gas deposits found beneath this region, with substantial petroleum beneath the bay itself. In total these activities provide literally trillions of dollars in economic impact, much of which can be directly attributed to the geographic and transportation advantages provided by Galveston Bay.

THE HUMAN ROLE PAST AND PRESENT

Fourteen thousand years ago, Paleo-Indians hunted woolly mammoths, mastodons, and large bison in the area that was to become Galveston Bay. At that time, the bay's shoreline extended up to 100 miles further into the Gulf than today. For the next 13,000 years, humans used the bay as a food source, leaving only piles of discarded shells and pottery shards to tell of their presence.

When Spanish and French explorers arrived looking for gold, and had to settle instead for trade with the local natives, the bay became increasingly used as a conduit for colonization and settlement. By 1815, the harbor at Galveston Island attracted mercenaries, called filibusters, and privateersmen who claimed to be helping the Mexicans make their break with Spain. Then by 1822, Anglo-Americans began to establish permanent development, and to dream of an independent Texas.

In 1836, the Republic of Texas became a reality following a victory by the Texans over Mexico in the Battle of San Jacinto, fought on the shores of Galveston Bay. During the Republic's brief, ten-year history, Houston and Galveston were founded as private ventures. When Texas was annexed into the United States in 1845, yet another war was fought with the Mexicans. This time, one of the main results of war was the stimulation of business and commerce.

By 1850, shipping was beginning to dominate the economy. For the next 60 years, a bitter rivalry grew between Houston and Galveston, each vying for dominance as a port. About the end of that period, two events occurred that radically altered human interaction with Galveston Bay. First, around 1903, an inquisitive oil scout began the bay's petroleum industry, and the first well was drilled about four years later on the shore of Tabbs Bay. Second, the U.S. Army Corps of Engineers completed dredging of the Houston Ship Channel across the bay and up the lower reaches of the San Jacinto River and Buffalo Bayou to Houston in 1914. As oil production and shipping expanded, the stage was set for vast industrial, cultural, and environmental changes.

PROBLEMS

Galveston Bay is an *estuary*, defined by D. W. Pritchard in 1967 as "a semi-enclosed body of water having a free connection with the open sea and within which seawater is diluted measurably by freshwater from land drainage." With all the physical forces at work in an estuary (the flow of rivers; the deposition of sediments; the ebb and flow of tides) conditions are constantly changing. Living species that evolved in estuaries are therefore adapted to tremendous variability and extreme conditions in their environment; they are robust. In fact, because of the dominance of natural change in estuaries, the whole system can absorb surprising perturbations from human activities. Although some individual resources in an estuary can be quite sensitive to perturbation (for example sea grasses), estuaries in general are not good examples of the "delicate balance of nature."

Yet, in spite of their capacity to endure human impacts, even estuaries have their limits. For some Galveston Bay resources, these limits have been exceeded. Before reviewing the current problems facing the bay, however, consider another chapter from Galveston Bay's history: the story of water quality in the upper Houston Ship Channel. This episode clearly illustrates how a concerted effort by local stakeholders working in partnership with government can restore the bay.

A SUCCESS IN THE MAKING: POINT SOURCES OF POLLUTION AND THE UPPER HOUSTON SHIP CHANNEL

In the mid-1960s, the upper Houston Ship Channel received so much pollution from municipal and industrial wastes that its upper 16 miles had become devoid of oxygen and biologically sterile. Jokes circulated about the "octane rating" of the Channel and the danger of its catching fire. Massive fish kills occurred downstream in the bay itself, where the Channel intersects open water. Incredibly, close to half a million pounds of biochemical oxygen demand entered the channel daily (BOD is a measure of the oxygen-robbing properties of pollutants); (see Figure IN-1). A book published in 1972 by the Conservation Foundation, titled "The Decline of Galveston Bay" chronicled the extreme degradation of water quality in those years.

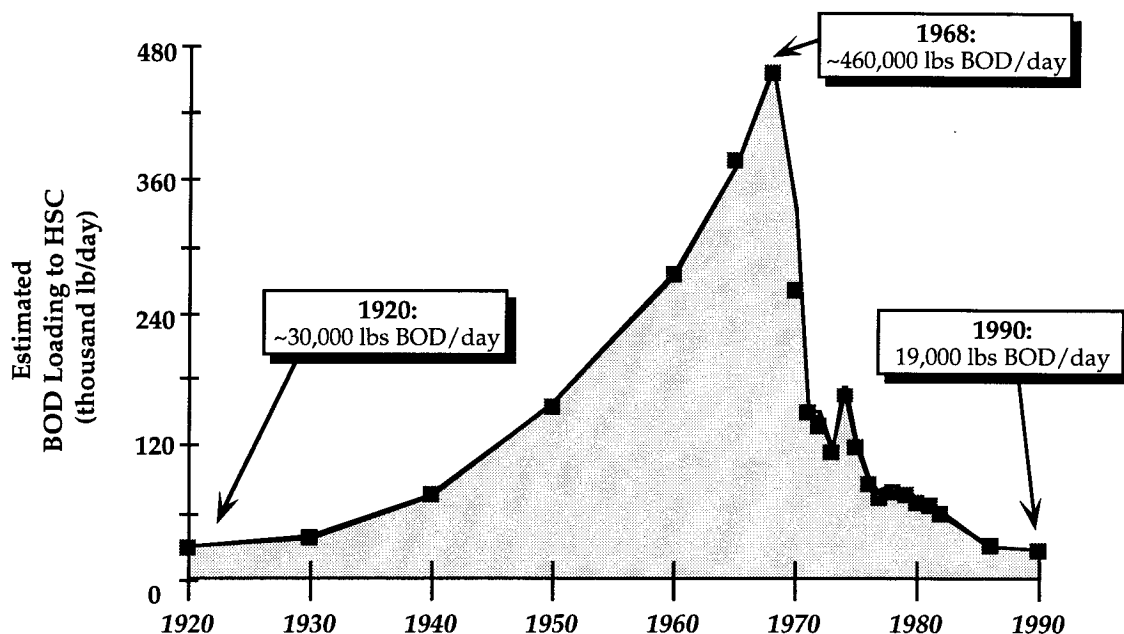


FIGURE IN-1. Changes Over Time in the Biochemical Oxygen Demand (BOD) Loadings to the Upper Houston Ship Channel (HSC) from Municipal and Industrial Point Sources

With the passage of the nation's first Water Quality Act in 1965, states were required to develop water quality standards for all navigable waters. This triggered a process of regulatory control of point source discharges under the National Pollutant Discharge Elimination System (NPDES), which optimistically put forth the goal of pollution elimination by 1984. After a somewhat confrontational beginning, industries and cities reached an

agreement with the newly-formed U.S. Environmental Protection Agency (EPA) and the State of Texas in 1971 on eleven specific cleanup measures, including limitation of BOD discharges to 35,000 pounds per day, dechlorination of all discharges, and performance of wasteload allocations bay-wide.

During the decade of the 1970s, industries along the upper Houston Ship Channel and the City of Houston poured a vast amount of human and financial resources into cleanup efforts. Since the initiation of NPDES point source controls, over \$1.1 billion from Texas Water Development Board (TWDB) loans and EPA construction grants have been spent on water and wastewater facilities in the five-county region surrounding Galveston Bay. The result of actions by cities and industry, working with state and federal resource agencies, is a continuing success story. By 1990, less than 19,000 pounds per day of BOD were being discharged, a whopping 95 percent reduction from mid-1960s levels – representing a return to levels of pollution discharge not known since the 1920s. Oxygen concentrations in channel waters increased and are continuing to improve today. Fish kills in the upper bay due to the influx of pollutants from the landlocked portion of the channel have stopped. Indeed, an increasing number of bay species have recolonized the upper channel itself, including shrimp, crabs, and a variety of fish species.

While some problems still plague the upper Houston Ship Channel (particularly related to toxic contaminants, sediment toxicity in some parts of the Upper Bay, produced water from petroleum production, and pollutants from non-point source runoff), the point source controls initiated 25 years ago are accomplishing their intended purpose. Because of this remarkable success, *The Galveston Bay Plan* does not establish a new emphasis on water quality permits and standards, which are already accomplishing beneficial water quality improvements.

WHAT PROBLEMS REMAIN?

Although an effective management program for point source discharges has been a major asset in maintaining the health of Galveston Bay, far less progress has been made for other problems which now threaten the future health and productivity of the estuary. These problems include the destruction of valuable habitat (which threatens fish and wildlife populations); the increasingly competitive uses and demands on the bay's resources; and degraded water and sediment quality in limited areas within Galveston Bay, particularly resulting from non-point sources of pollution. These issues are briefly described below.

Habitat Destruction and its Effect on Fish and Wildlife Populations

Problem

Habitat destruction has emerged as the single greatest environmental problem affecting the Galveston Bay system. Coastal wetlands and seagrass meadows are at highest risk. These valuable habitats are responsible for the great productivity of commercially and recreationally valuable fish and shellfish in Galveston Bay. Wetlands and seagrasses create productive nursery areas where the Gulf's abundant seafood species are nurtured. These habitats also

harbor a wide variety of plant and wildlife species, the diversity of which contributes to the bay's productivity.

Coastal wetlands serve many other important and beneficial functions. They stabilize shorelines, protecting property from the eroding forces of wind and waves. They protect upland areas from flooding by diverting and storing floodwaters. At the same time, they help purify these waters by removing sediment and contaminants from storm water runoff. Finally, wetlands help to recharge our groundwater supplies by storing surface water and allowing infiltration into underground recharge zones.

Fact: The Galveston Bay system has lost some 30,000 acres of wetland habitat (almost 20 percent) since the 1950s. This loss far exceeds the national average losses for estuarine wetlands. Furthermore, almost 90 per cent of the bay's sea grasses have been lost. Only a few hundred acres of seagrass meadow remain, mostly within Christmas Bay.

Fact: Ninety percent of the commercially and recreationally important fish and shellfish species in the Gulf of Mexico use coastal wetlands for one or more stages in their life cycle.

Proposed Solutions

The Galveston Bay Plan proposes nine specific actions for fish and wildlife habitat protection. The highest priority is to reverse the historical trend of wetland loss by restoring or creating 15,000 acres of wetlands. Dredged material from navigation channels will be used as a resource for habitat creation. Another priority is to rehabilitate existing wetlands that have been degraded by pollution, loss of circulation, or impacts from non-native species of plants (such as the Chinese tallow tree) and animals (such as grass carp and nutria). Other proposed actions include improvement of bird nesting sites, development of tax incentives to encourage habitat conservation, and acquisition of key habitats to ensure their long-term protection.

The Galveston Bay Plan proposes 10 related actions which target fish and wildlife protection. The major emphasis of these actions involves the strengthening of species management efforts to adequately protect commercially and recreationally important species as well as threatened and endangered ones. Other efforts will encourage the reduction of commercial fishing by-catch (incidental catch of non-target species in shrimp trawls) and the reduction of fish drawn into industrial cooling-water systems. Finally, other proposed actions will encourage catch and release programs for recreational fisheries and will develop strategies for controlling harmful exotic species that displace Galveston Bay's native fish and wildlife.

Competing Human Uses of the Bay: A Balance Between Needs and Available Resources

Problem

A wide variety of problems affecting Galveston Bay have one thing in common: they all reflect the way we choose to use the bay and how we compete for the bay's scarce resources to fulfill our needs. Problems of this type will continue to grow in the future as our population grows and as our needs for the bay's resources grow. Figure IN-2 shows population growth of about 3.3 million between 1850 and 1990 for the five county area

encompassing the majority of the lower Galveston Bay watershed. Our growing need for freshwater and negative shoreline impacts due to poorly planned development are examples of natural resource problems affecting the bay.

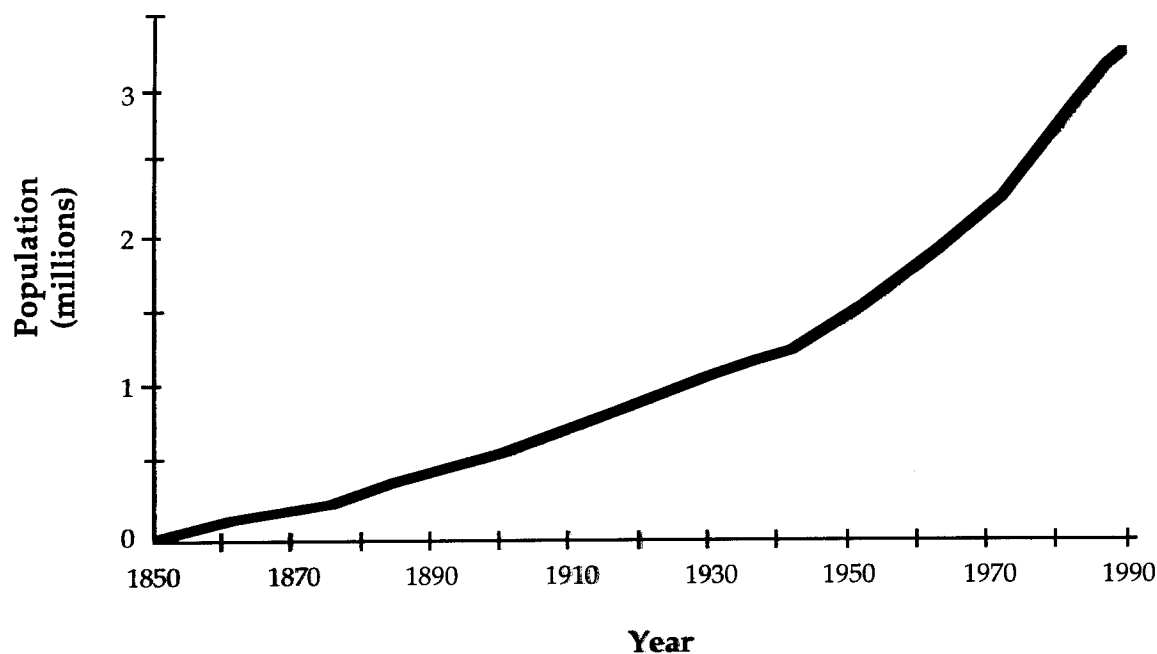


FIGURE IN-2. Population Growth from 1850 to 1990 in the Five-County Area (Brazoria, Chambers, Galveston, Harris, and Liberty)

Freshwater inflow is the life-blood of Galveston Bay. As freshwater from rivers mingles with saltwater from the sea, it forms a nurturing mixture that sustains the ecosystem and the organisms within it. The volume and timing of freshwater inflows are naturally dynamic, but sustained changes in these variables, or the location of inflow, will result in corresponding change to the ecosystem. As our population and need for freshwater continue to grow, diversions of freshwater could alter circulation and salinity patterns in the bay. These will in turn affect the abundance and distribution of fisheries species as well as alter coastal habitats.

Fact: Freshwater inflow alterations which impact bay salinity regimes and circulation patterns can negatively affect habitat such as wetlands and oyster reefs. Such alterations can also alter the distribution and abundance of fish and shellfish species that inhabit the bay.

Fact: Today, we use over 1.4 billion gallons of freshwater each day in the five counties bordering Galveston Bay.

Proposed Solutions

The Galveston Bay Plan proposes seven actions to address freshwater inflow and circulation issues in Galveston Bay. These measures include determining freshwater needs for Galveston Bay that would ensure its future ecological productivity. After the ecological needs of the estuary have been determined, strategies will be developed to assure that freshwater is available to sustain ecological productivity in balance with human uses. Promoting water conservation and more efficient water usage are some of the tools that can be used to achieve these goals.

Shoreline development is another significant human activity affecting the bay. Some coastal activities have produced unintended results for Galveston Bay such as habitat alteration and destruction, pollution, and loss of fish and wildlife abundance and diversity. Steady population growth has intensified the competition for limited coastal resources. Planning for shoreline use and development is the only way to ensure that the many competing needs for our shorelines can coexist. A comprehensive planning program for shoreline development would include guidelines for residential, commercial, and industrial development that would minimize adverse impacts to the bay.

Fact: 3.3 million people live in the five counties bordering the Galveston Bay system. Twenty percent of that population (almost 650,000 people) live within two miles of the bay or its tidal tributaries.

Proposed Solutions

The Galveston Bay Plan proposes five shoreline management actions to ensure compatibility of shoreline uses. These actions include the establishment of a planning program for shoreline development which would produce guidelines for residential, commercial, and industrial development. Local governments along the bay's shoreline would have the opportunity to voluntarily coordinate with other shoreline communities in maintaining the shoreline values that draw people to the area and contribute to local economies. Other actions include minimizing negative effects of structures and dredging on publicly-owned lands and ensuring improved access to publicly-owned shorelines.

Water and Sediment Quality Problems

Despite the ongoing successes of point source regulations, there are still concerns over source areas – limited areas where more pollutants have entered the water than the system can adequately assimilate. These areas are primarily located around the western bayous that empty into the bay, the same bayous on which we have built the majority of our homes and businesses. For example, aging wastewater collection and treatment systems are failing, resulting in bypasses and overflows which allow raw sewage to escape into bay tributaries.

Non-point sources of pollution are receiving particular management emphasis to ensure continued water quality improvement in Galveston Bay. These pollutant sources are geographically diffuse and are associated with every-day human activities. As rain water drains across the surface of the land, it picks up a wide variety of pollutants and carries them to the bay. The types and amounts of pollutants vary depending upon the way we use our

land. They include pollutants from roads and parking lots, driveways and yards. An observation by D. R. Baugh concerning Chesapeake Bay applies equally well to Galveston Bay: “. . . in order to continue improvements in the bay’s water quality, the next phase of the campaign must be bolder, with deeper societal commitment. We have achieved what in many ways is the easiest part of the cleanup, regulating point source discharges. We must now look at changing the way we think and act.”

Fact: Over 50 percent of Galveston Bay is permanently or conditionally closed to oyster harvest due to fecal coliform bacteria contamination associated mainly with non-point source runoff. In addition, runoff of excess nutrients, pesticides, and heavy metals is responsible for water quality impairment in many local bayous and portions of Galveston Bay.

Proposed Solutions

The Galveston Bay Plan proposes sixteen specific actions to reduce water quality problems caused by non-point source runoff. These actions include the implementation of storm water management programs for local municipalities. Components of a storm water program would focus on load reductions from residential neighborhoods, septic tanks, new development and road construction, and from industrial and agricultural activities. Other actions would require treatment of wastes from boating and marina activities.

Some point source concerns also remain for Galveston Bay, despite the existing regulatory program for permitted discharges. Primarily, the concern is wastewater which never reaches treatment plants and is never part of the permitted flow. As cities in the Galveston Bay watershed have grown, their aging sewage collection systems have suffered from soil settlement, corrosion, and larger-than-design flows. As a result, leaks allow entry of storm water during wet periods, exceeding the capacity of lines, lift stations, and treatment plants. The ultimate result is sewage bypasses to the bay’s tributary waters. Sewage can also leak out of broken lines and flow to groundwater or the storm sewer system.

Fact: In 1986, almost 19,000 pounds of oxygen-consuming pollutants (BOD) entered the Houston Ship Channel from bypasses and overflows each day (eleven percent of the annual BOD load, seven percent of the annual suspended solid load, and seven percent of the annual ammonia load). Since then the amount of overflow has been reduced by 60-90 percent due to improvements in the City’s collection system.

Proposed Solutions

The Galveston Bay Plan proposes six specific actions that will improve water and sediment quality associated with traditional point sources of pollution. These actions will address bypass and overflow issues and improve monitoring and enforcement for permitted discharges to ensure that discharge permit allowances are not being exceeded. *The Galveston Bay Plan* also recommends regionalizing smaller, less effective wastewater treatment systems and advocates eliminating environmental harm associated with brine discharges from petroleum extraction.

In addition to point and non-point source controls, *The Galveston Bay Plan* contains seven other actions that would improve water and sediment quality in Galveston Bay through improved management by state agencies. These actions are designed to refine methods used by the state to determine allowable pollutant loadings for Galveston Bay and to ensure that pollutant discharges are regulated more effectively. Other actions encourage existing state programs that are effective in pollution reduction in Galveston Bay such as the *Clean Texas 2000 Pollution Prevention Program*. Each of these actions is designed to enhance ecological productivity of the Galveston Bay system.

TODAY'S PROBLEMS NEED A NEW KIND OF SOLUTION

The problems which currently plague Galveston Bay differ in fundamental respects from those of the past. The relatively simple (if expensive) solutions to end-of-the-pipe cleanups simply do not apply to problems like pervasive habitat loss, diffuse sources of non-point contamination, or freshwater inflow alteration. These are *ecosystem* problems, not limited to individual natural resources, nor circumscribed by political boundaries. These problems are complex and interrelated, involving the bay itself, its tributaries to some distance upstream, and the watersheds where humans carry on their daily activities. Their solution will require a fundamentally different approach in comparison to traditional bay management. Figure IN-3 compares the traditional approach to natural resource management in contrast to natural resource stewardship.

The traditional approach begins with a mandate from government, imposed on stakeholders through regulation and enforced compliance. Under this system, bay management has evolved into a collection of diverse and sometimes narrowly-defined initiatives, limited by the various state-wide and national mandates of the large number of agencies involved. The result of this system of governance is sub-optimal use of the bay's resources; and a lack of progress to solve issues which exceed the scope of traditional narrow jurisdictions.

In contrast, stewardship begins with those with the greatest interest in the bay – its citizen-owners. In this context, problems are agreed upon and ranked in importance early in the planning process, in close coordination with scientists. Communication and cooperation among regulators and local constituencies fosters an integration of government jurisdictions, each of which is unable to individually address system-wide problems. Adversarial relationships are replaced by an enhanced sense of responsibility for the bay's publicly-owned resources, at the grassroots level. The focus of this process is the ecosystem, rather than the individual natural resources it contains; the goal is agreement on a consensus plan for future comprehensive management. *The Galveston Bay Plan* is that plan.

THE NEXT STEP FOR A CLEAN AND HEALTHY BAY: *THE GALVESTON BAY PLAN*

To build on past successes in water quality improvement, today's problems require a regional partnership of stakeholders with a true voice in governance. Industries, fishing concerns, environmental organizations and private citizens with coastal interests and livelihoods can

become partners with the resource agencies, local governments, and environmental managers who care for the bay on behalf of the public. In developing *The Galveston Bay Plan*, the partnership approach has already proven effective. Continuing to work together during implementation offers the best hope for the future of this premier resource.

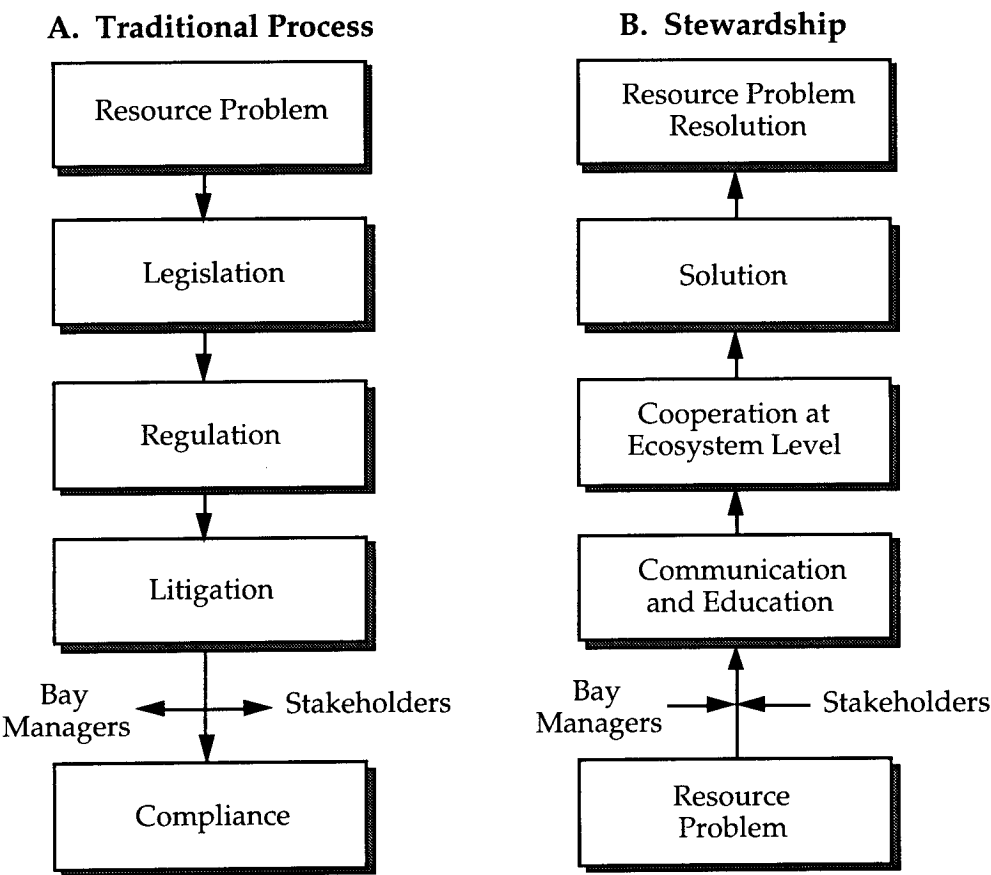


FIGURE IN-3: *Traditional natural resource management (a) contrasted with stewardship (b). Traditionally, individual problems prompted legislation and creation of a system of diverse regulatory mandates. Authority derived from a top-down, command-and-control approach, requiring continuous bureaucratic energy and resulting in a semi-adversarial relationship with stakeholders (quite effective for some problems). Stewardship, conversely, begins with stakeholders and resource managers agreeing upon the problems in the context of the entire ecosystem. Necessarily consensus-building takes longer and is more difficult than the traditional process, but helps stimulate a self-perpetuating sense of personal responsibility for public resources.*

A Bright Future

In the future, what would Galveston Bay be like under *The Galveston Bay Plan*? Consider just a few of the possibilities:

Habitats can be protected. The losses of wetlands would initially be stopped, then the trend of deterioration reversed by creation of new wetlands. For example, *The Plan* calls for use of material dredged from navigation channels and planting of marsh vegetation along currently barren, eroding shorelines. The necessary technology is already being developed in Galveston Bay through demonstration projects sponsored by partners of the Galveston Bay National Estuary Program.

Win-win partnerships can improve resource use. Currently competing uses can become complementary with some creative thinking. For example, fly ash byproducts from industry can be processed into pellets and placed in Galveston Bay to create new oyster reefs. The oysters then take over naturally and build their own permanent self-sustaining reef. This benefit to industry, commercial and recreational fishing, and the bay's overall ecological health has already been determined safe and effective in a Galveston Bay National Estuary Program demonstration project.

Non-point pollution can be cleaned up. Building on the point source cleanup of the last 25 years, non-point pollution can be reduced. Simple activities like the stenciling of storm drains by volunteers ("Please Don't Dump – Drains to Bay") can reduce the dumping of motor oil, antifreeze, paint solvents, and other harmful contaminants in neighborhoods. This program works, and is already catching on based on pilot projects started in Galveston Bay communities by the Galveston Bay National Estuary Program.

Seafood can be made safer. While the majority of seafood from Galveston Bay is safe to eat, curtailing sources of contamination under *The Plan* would further reduce the chances for seafood to become contaminated. Perhaps more importantly over the short run, seafood would be more routinely monitored for contamination (not currently occurring). Communicating the actual risks of seafood consumption to the public has been identified as a key element of *The Plan*.

Particularly sensitive areas can be protected forever. Christmas Bay, the pristine location of the last of the bay's seagrasses has already been designated a Texas Coastal Preserve. Similar action was taken for Armand Bayou; both projects were partnership actions by the Galveston Bay National Estuary Program, the Texas Parks and Wildlife Department, the Texas Natural Resource Conservation Commission, and the General Land Office.

The bay user community can know the results of their actions. A comprehensive monitoring program would (for the first time) routinely compile the information collected by numerous separate agencies, in an ongoing "State of the Bay" reporting process. The first State of the Bay report (already published) would be augmented with updates and periodic State of the Bay symposia, a forum for public agencies and stakeholders to recognize success and re-direct *Plan* activities where necessary. In addition, citizen monitoring programs could directly involve citizens of the bay community in assessing the health of Galveston Bay.

IMPLEMENTING THE GALVESTON BAY PLAN: THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION AND THE GALVESTON BAY COUNCIL

The TNRCC has been identified by the Management Conference as the lead implementing agency for *The Galveston Bay Plan*. Most initiatives in *The Plan* fall under the jurisdiction of the TNRCC. The Texas legislature has given the TNRCC a broad role for management of aquatic and marine ecosystems. As the state agency responsible for federal Water Quality Act programs, the TNRCC has sponsored the creation of *The Galveston Bay Plan* in partnership with EPA, and with the involvement of other agencies and stakeholders. Clearly, however, no single agency can tackle this formidable challenge by itself.

Unlike past management initiatives, *The Galveston Bay Plan* is a comprehensive plan. Diverse concerns for habitats and wildlife, competing resource uses, water quality, and human health cannot be adequately addressed without a true partnership. To achieve success, problems of a regional nature, those affecting the entire ecosystem, will require regionally coordinated actions among agencies. This need for cross-jurisdictional coordination was emphasized in a recent evaluation of current bay governance entitled *Framework for Action: Galveston Bay Management Evaluation*.

The need for partnership in implementing *The Galveston Bay Plan* is recognized in creation of the Galveston Bay Council. This Council will be composed of the agencies, industries, user groups, and public with interests in the bay. At every step of the way, the Council will advise the TNRCC concerning all activities related to *The Galveston Bay Plan*. This advisory role will be an strong active role that is not merely perfunctory. The Council will provide a forum for the many cross-jurisdictional management issues recognized for the bay.

This roundtable approach is precisely what created *The Galveston Bay Plan*. A strategic alliance of bay managers and stakeholders - the Management Conference - has already successfully undertaken many projects to benefit the bay and its related economies. One set of projects, the Action Plan Demonstration Projects funded by the EPA and others, has helped provide small-scale experience in implementation of actions that can be expanded for full-scale implementation under *The Plan*. These Action Plan Demonstration Projects included the following:

<u>Demonstration Project</u>	<u>Sponsoring Agency</u>	<u>Focus of the Project</u>
<i>Shoreline Erosion/Habitat Creation</i>	U.S. Soil Conservation Service	Creation of marshes using volunteers to plant cord grass.
<i>Houston Ship Channel Pollution Prevention</i>	Texas Natural Resource Conservation Commission	Pollution prevention assessments and training provided to Ship Channel industries for improved waste management and source reduction.
<i>Pump-out Facilities for Boaters</i>	Galveston Bay Foundation	Development and testing of facilities for sewage pump-out of recreational boaters. Education of local boaters regarding the use of pump-out facilities.

<u>Demonstration Project</u>	<u>Sponsoring Agency</u>	<u>Focus of the Project</u>
<i>Christmas Bay and Armand Bayou Coastal Preserves</i>	General Land Office Texas Parks and Wildlife Department	Compiled critical information for nomination of these areas as Coastal Preserves by the Texas School Land Board and Texas Parks and Wildlife Department
<i>Oyster Reef Creation</i>	Port of Houston, EPA	Evaluation of the use of coal combustion by-products in creation, placement, and restoration of oyster reefs in Galveston Bay.

However, the most important work is still in the future. Resource agencies and stakeholders alike have agreed on the need to continue to work collaboratively during the next, and even more important phase of the work: implementation of *The Galveston Bay Plan*.

In summary, *The Galveston Bay Plan* recommends implementation under a Galveston Bay Program of the Texas Natural Resource Conservation Commission (TNRCC). Because of the comprehensive nature of *The Plan*, a *Galveston Bay Council* will be created to advise the TNRCC during implementation. The Galveston Bay Program of the TNRCC will be carried out from a local Galveston Bay Office to be located in the bay area. The Galveston Bay Program will serve as the continuing focal point for implementation of *The Plan's* specific initiatives (see Chapter VIII for more detail). Figure IN-4 shows how *The Galveston Bay Plan* will help focus diverse environmental programs to benefit the bay.

What Will the Galveston Bay Program Do?

The overall goal of the Galveston Bay Program of the TNRCC will be to implement *The Galveston Bay Plan*. To accomplish this objective, activities carried out will include:

- Acquire, manage and disperse funds to implement *The Plan*
- Review federal, state, and local projects in an open process for consistency with *The Plan*
- Provide for coordination with the Texas Coastal Management Program (CMP) and the Coastal Coordination Council (CCC)
- Provide for coordination and communication among state and federal resource agencies for the many cross-jurisdictional issues
- Monitor implementation of specific actions by *The Plan's* partners
- Identify and communicate bay improvements to agencies, stakeholders, and the public, and redirect *The Galveston Bay Plan* where improvements lag
- Conduct public outreach and education to increase public awareness of Galveston Bay, and to advocate conservation of the estuary
- Evaluate the impacts of proposed actions on cultural resources and areas of historical significance

The Galveston Bay Plan

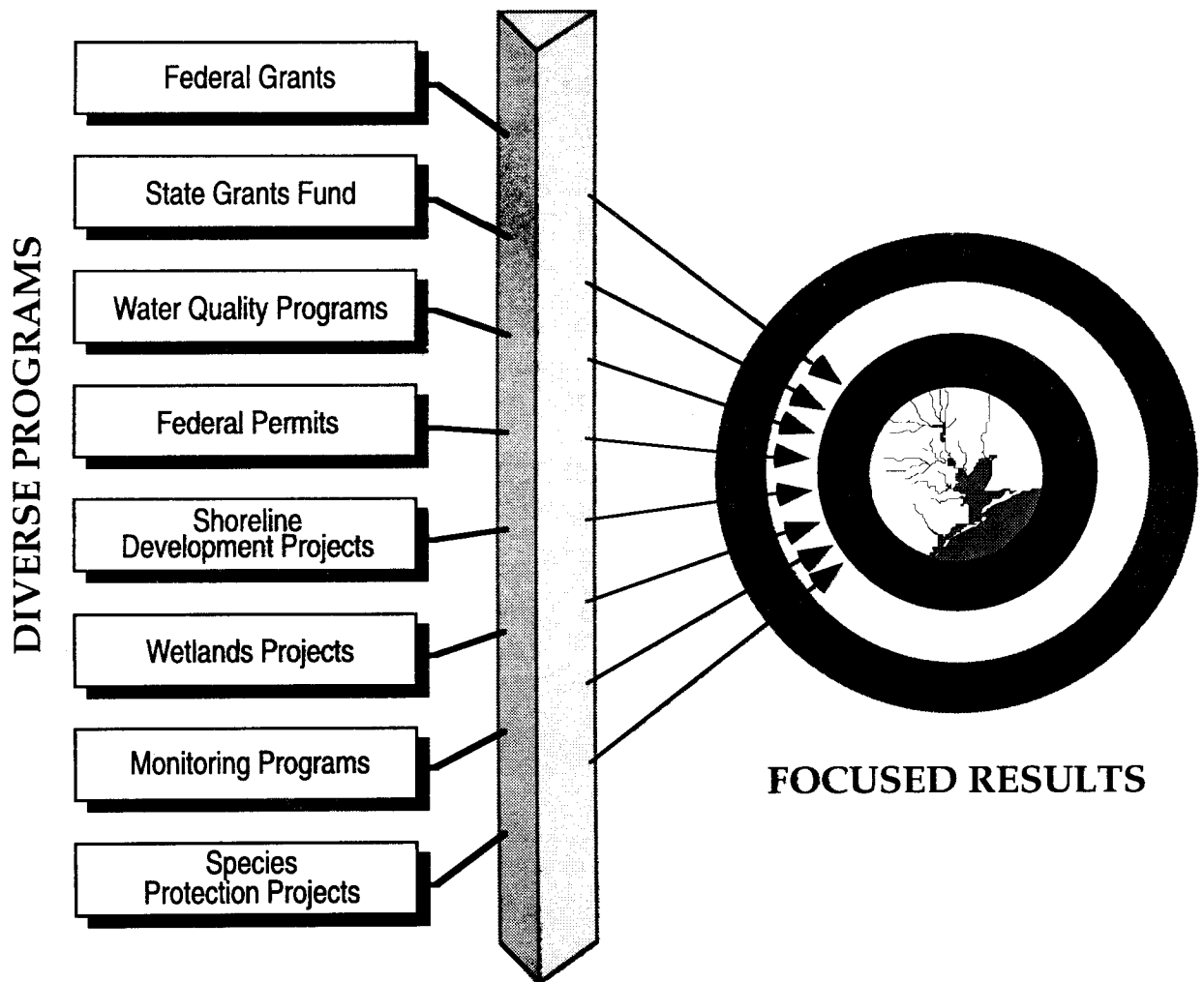


FIGURE IN-4. *The Galveston Bay Plan* Will Make Use of Many Existing Environmental Programs

The Galveston Bay Program will concern itself with five counties: Brazoria, Chambers, Galveston, Harris, and Liberty. However, county and watershed boundaries differ; the actual work initiatives in *The Galveston Bay Plan* will not be carried out in areas outside the watershed. Nor will the program be concerned with the upper watershed. While Galveston Bay's watershed extends north nearly to Oklahoma (including Dallas and Fort Worth), scientific work has shown that influences from the upper watershed are relatively less important in comparison to influences in the lower watershed downstream from Lake Livingston (on the Trinity River) and Lake Houston (on the San Jacinto River).

How Much Authority Will The Galveston Bay Program Have?

For the answer to this question, consider the various levels of authority which apply to coastal management (Figure IN-6). As shown in the figure, the Galveston Bay Program will have an intermediate level of authority not as strong as statutory programs like permitting, but not limited to just studying the problems. The Galveston Bay Program will serve as an open forum for consistency review of certain agency activities, to assure efficient, coordinated implementation of *Plan* actions.

Federal consistency review is prescribed for the National Estuary Programs under the Water Quality Act, and applies to federal assistance and federal development projects only. Ensuring the consistency of other types of federal actions (e.g., licenses and permits and direct activities) and of state actions (e.g., licenses, permits, leases, development projects) will depend on the relationship between *The Plan* and the Texas Coastal Management Program. For more information on the type of projects that will be subject to consistency review, see the Galveston Bay National Estuary Program Consistency Report.

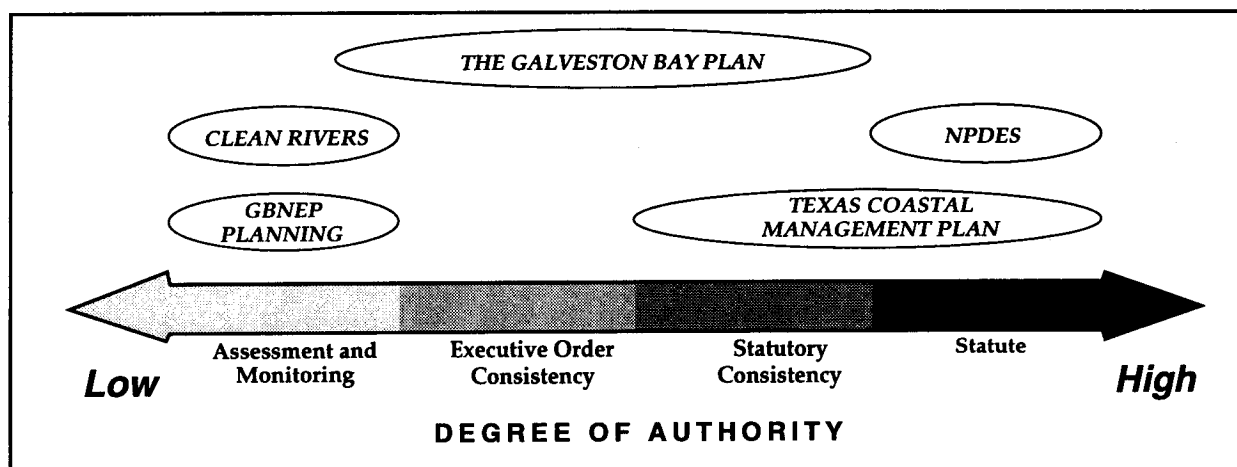


FIGURE IN-6. Levels of Authority Which Apply to Coastal Management

A Question of Consistency: *The Galveston Bay Plan* and the Texas Coastal Management Program

The Galveston Bay Program (GBP) may also provide input to the Coastal Coordination Council (CCC) in determining consistency of certain state and local projects on the Texas Coastal Management Program (CMP). The CCC has adopted rules that would allow it to adopt all or portions of the enforceable policies of *The Plan* as a Special Area Management Plan (SAMP) within the CMP. If enforceable policies are adopted as a SAMP, applicable state actions will also be reviewed for consistency with the provisions of *The Plan*. The GBP could participate in the CMP state consistency review process by providing comments to the CCC on actions subject to the CMP that occur within the Program's geographic coverage. With this relationship to the Texas Coastal Management Program, state consistency would occur under the ultimate authority of the Coastal Coordination Council, as already defined by law and

rules for all coastal activity. Note that the success of *The Galveston Bay Plan* does not rely on the use of a Special Area Management Plan approach, since it will be implemented regardless of the CMP process. Additional details concerning the consistency review process can be found in Section VIII of this document.

How The Galveston Bay Plan Was Created

The approach taken by the Management Conference to develop *The Galveston Bay Plan* was one of consensus-building among all Galveston Bay user groups, government agencies, and the public. This approach is based on a philosophy that the best governance for Galveston Bay can only be established by strong and direct involvement of the people who live and work in the Galveston Bay region. No environmental program in the history of the state has involved citizens and stakeholders more actively in environmental problem-solving. Working in a collaborative fashion, over 220 individuals helped to create *The Galveston Bay Plan* in three phases over a five-year period:

Phase One: Agreement on bay problems. A *Priority Problems List* was established by consensus of the Management Conference. This list provided guidance for the next step.

Phase Two: Scientific characterization of the problems. Over a four-year period, numerous scientific studies were carried out to determine the status, trends, and probable causes of the problems. This effort culminated in publication of a book entitled: *The State of the Bay: A Characterization of the Galveston Bay Ecosystem*. This step resulted in substantial re-definition of the bay's problems, providing a strong factual foundation for management planning. The Action Plan Demonstration Project program of the EPA has been helpful in providing funds for early implementation of critical actions, and other actions have been taken using other means. This "Action-now" approach has helped provide experience in implementation of work that can be expanded for full-scale bay management under *The Galveston Bay Plan*.

Phase Three: Development of solutions. *The Galveston Bay Plan* links a set of specific initiatives to the identified problems in Galveston Bay. These solutions were developed over three years by sixteen task forces established by the Management Committee of the GBNEP. In all, several hundred meetings were convened as *The Galveston Bay Plan* evolved through six complete revisions.

COSTS AND FUNDING FOR THE GALVESTON BAY PLAN

Costs

Costs for implementing *The Galveston Bay Plan* are of two types as shown in Table IN-1. First is the cost of the Galveston Bay Program itself, which will accomplish implementation of the

various initiatives in *The Plan*. Second are costs specifically associated with individual initiatives in *The Plan*.

**TABLE IN-1. Costs and Financing for Implementation
of *The Galveston Bay Plan***

Costs	Financing
Galveston Bay Program Base Program:\$ 1.0 million Match Funding: <u>\$ 1.0 million</u> Total: <u>\$ 2.0 million</u>	Texas General Revenue TNRCC\$ 1.5 million Federal Revenue <u>\$ 0.5 million</u> Total: <u>\$ 2.0 million</u>
Galveston Bay Plan Initiatives Habitat/Living Resources\$ 15.6 million Balanced Human Uses:.....\$ 6.0 million Water/Sediment Quality\$ 11.1 million Support Tasks <u>\$ 3.8 million</u> Total: <u>\$ 36.5 million</u>	Possible Revenue Sources: Grants..... Dedicated Revenue (other agencies) Contract Operations State Appropriations Private/Non-Profit Sources Total:..... <u>\$ 36.5 million</u>

The estimated annual cost for the Galveston Bay Program is \$1.0 million, to be used to establish a program office and staff to implement *The Galveston Bay Plan* and support the work of the Galveston Bay Program and its various committees. Added to this is another estimated \$1.0 million, to be used for matching funds to attract revenue from outside the region to implement specific initiatives. A review of possible grant programs to fund *Plan* initiatives has already been carried out. Funding from these programs is generally granted in amounts of three to twenty times the match amount provided by the local program.

The estimated annual cost for new *Galveston Bay Plan* initiatives is \$36.5 million, which compares well to the economic benefits that the Bay currently provides: \$358 million in fisheries, \$122 million in tourism, and \$364 million in sport fishery revenue. These expenditures would in some cases occur directly through entities carrying out the work (natural resource agencies, local governments etc.), and in some cases would occur through the Galveston Bay Program.

Funding the Galveston Bay Program

Section 320 of the Water Quality Act of 1987 authorizes the use of federal funds for a five-year planning process leading to completion of a Comprehensive Conservation and Management

Plan (CCMP), here *The Galveston Bay Plan*. These funds are limited to 75 percent of costs; in Texas, the 25 percent required match was supplied as Texas general revenue, appropriated to the TNRCC and expended through that agency to match Section 320 federal funds to carry out Management Conference activities resulting in this document. Upon completion of a CCMP, the Water Quality Act calls for implementation to be funded by states, but intends for existing federal programs (for example under other sections of the Water Quality Act) to be adopted for coordinated actions under the CCMP.

Funding the Galveston Bay Program is therefore to occur primarily with state funds. Of the \$2.0 million annually required for the Galveston Bay Program (\$1.0 million for the Program itself and \$1.0 million seed money to leverage grants and other sources), funding is to consist of \$1.5 million state funds and \$0.5 million federal funds. State funds are to be appropriated by the Texas Legislature to the TNRCC for establishment of the Galveston Bay Program to implement *The Plan*. Federal funds will be sought as a line item in the federal budget. Alternatively, federal funds could be derived from re-authorization of the Water Quality Act (which could provide for some limited implementation funds) or through an existing federal program such as watershed management activities under Section 104 of the Water Quality Act.

The state-federal funding partnership proved to be advantageous during creation of *The Plan* due to the involvement of programs at many levels of government. The continued partnership of both TNRCC and EPA is equally vital during the coming implementation phase of the program. The continued participation of EPA in the Galveston Bay Program is critical since numerous initiatives in *The Plan* involve federal actions under EPA jurisdiction.

Funding Galveston Bay Plan Actions

The available funding options for implementation of new actions recommended by *The Plan* include federal, state, and private grants and assistance programs. Many of these programs already provide assistance to natural resource agencies in the Galveston Bay region. The Galveston Bay Program will seek funds from a variety of sources to avoid creating a disproportionate financial burden on any one group. Potential sources of revenue for implementation of new actions recommended by *The Plan* are described below. A detailed financial report providing specific options for funding the new actions described in *The Galveston Bay Plan* has been developed in a separate publication, the Galveston Bay National Estuary Program Funding Strategy.

Grants

Grants will be sought from major federal assistance programs administered by the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture (USDA), and the U.S. Army Corps of Engineers. The Galveston Bay Program will also "pass through" grant funds to entities responsible for implementing *The Plan's* actions. A survey of grant programs has been completed, indicating this approach is feasible. Generally, these grant programs call for a local funding match ranging from five to 25 percent of the total. The seed money to be allocated for grant matching will allow the Galveston Bay Program to leverage these funds.

Contract Operations

The Galveston Bay Program may conduct activities under interlocal contract with other units of government. Contract services for non-profit and private sector entities may be provided by the Program if the activities are identified in or consistent with *The Plan*. This will allow the Program to adopt existing agency programs to accomplish the initiatives in *The Plan*.

Donations of Property

The Galveston Bay Program may receive donated property from public and private sources for the purposes of habitat preservation, providing public access, or implementing other programs of *The Plan*. The Program may also transfer such property to appropriate management entities (e.g., state or federal natural resource agencies).

Private and Non-Profit Sources

Revenue from non-profit foundations that support projects related to environmental conservation may be obtained by the Galveston Bay Program.

THE GALVESTON BAY PLAN IN THE CONTEXT OF OTHER COASTAL PROGRAMS

As *The Galveston Bay Plan* moves toward finalization, questions have arisen regarding how this program and a number of other existing coastal management programs "fit together." Many of these programs were created to address a particular concern and were not necessarily designed to "fit" others. The programs are the result of a variety of state and federal laws with different purposes and goals, are funded from numerous sources, are progressing along individual timelines, are working toward specific objectives, and are overseen by separate state and federal agencies. Most agencies and program managers recognize the need to develop partnerships with other programs and are cognizant of opportunities for coordination. The *Environmental Management Inventory of Galveston Bay* (GBNEP-24) catalogued numerous existing programs that may interact with *The Galveston Bay Plan*. Table IN-2 highlights potential areas of overlap and conflicts between the following key programs:

- Gulf of Mexico Program
- Texas Coastal Management Program
- The Galveston Bay National Estuary Program
- Texas Clean Rivers Program

All of these programs involve some degree of scientific assessment to guide eventual policy recommendations and management plans. The Gulf of Mexico Program attempts to identify priority problems that will require cooperation across state and national boundaries. The Texas Coastal Management Program attempts to promote greater cooperation among management agencies active in the Texas coastal region. The Galveston Bay National Estuary Program brings this focus down to the level of a single bay system. The Texas Clean Rivers Program moves this process inland by focusing on potential pollutant concerns upstream of coastal waters within individual river basins, some of which may carry drainage from across Texas.

**TABLE IN-2. Comparison of CCMP and Other
Assessment and Management Programs**

Texas Coastal Management Plan	Texas Clean Rivers Program	Gulf of Mexico Program
<ul style="list-style-type: none"> • Bay may be special Management area under CMP • Both emphasize wetlands/habitat • Both require consistency review • Both build primarily on existing regulatory programs 	<ul style="list-style-type: none"> • River/coastal basins are key areas within Bay watershed • Both focus on watersheds • Both require regional watershed-based monitoring plans • Overlapping public outreach needs • Interim pilot projects under both • TCRP seen as avenue for ongoing study of Bay Issues 	<ul style="list-style-type: none"> • Key estuary along Gulf shoreline • Both emphasize wetlands/habitat • Both focus on watersheds • Both involve extensive research • Overlapping public outreach needs
Texas Coastal Management Plan	<ul style="list-style-type: none"> • River/coastal basins are key areas in coastal management process • Both emphasize Geographic Information System (GIS) development • Overlapping public outreach needs 	<ul style="list-style-type: none"> • Key state coastline along Gulf • Both emphasize wetlands/habitat • Overlapping public outreach
	Texas Clean Rivers Program	<ul style="list-style-type: none"> • Key watersheds draining into Gulf • Overlapping WQ assessment needs • Both focus on watersheds • Overlapping public outreach needs

Adapted from H-GAC

A NOTE ON ORGANIZATION

The following three sections of this document (Sections II, III, and IV) present action plans to solve bay problems. Section V describes research and public participation activities to support these actions. Section VI describes a regional monitoring plan to measure the effectiveness of actions taken to help redirect future activity. Section VII describes the significant role of the public in creation of this *Plan*, while the last section in the document deals with implementation, that is how the actions are to be implemented and funded through a comprehensive regional approach to problem-solving.

The action plans themselves – the heart of this document – are presented as follows:

Section II. Habitat and Living Resource Protection

- Habitat Protection
- Species Population Protection

Section III. Balanced Human Uses

- Public Health Protection
- Freshwater Inflow and Bay Circulation
- Spills/Dumping
- Shoreline Management

Section IV. Water and Sediment Quality Improvement

- Water and Sediment Quality
- Non-Point Sources of Pollution
- Point Sources of Pollution

In each of the action plans listed above, the content and format follows a standard format.

The Issues Brief description of the particular issue(s) addressed by the action plan.

Environmental Status Description of what we currently know about the issues being addressed, based upon scientific work carried out by the GBNEP. This information generally includes status, trends, and probable causes of problems. A companion to *The Galveston Bay Plan* entitled *The State of the Bay: A Characterization of the Galveston Bay Ecosystem* provides substantially more detailed information.

Management Status Description of regulatory and management programs related to current governance of the estuary, including agency jurisdictions and identified problems and needs. Information is based upon management reviews conducted specifically by the GBNEP. A companion report summarizing much of this information is entitled *Framework for Action: Galveston Bay Management Evaluation*.

Action Plan Purpose Brief statement describing the intended outcome of the action plan. Sets the overall direction for more specific goals; not necessarily in quantifiable terms.

Overview Ties the actions to specific priority problems, and objectives. This section includes a flow diagram to relate the following elements to one another.

Priority Problem Concise statement of the environmental problem to be addressed. May or may not be quantifiable. There may be more than one priority problem per action plan.

Goal(s) The broad, long-term solution to the problem; a single general statement (not necessarily quantified). There may be more than one goal per problem.

Objective(s) Environmental target toward which future progress toward the goal can be measured, often in quantifiable terms. More specific and short-term than the goal. May range from technically derived with high confidence, to best professional judgment. There may be more than one objective per goal.

Actions A specific action to be taken to reach the objective. There may be more than one action per objective. Each action includes the following information.

What: Concise description of the action.

How: The process involved in taking action, described in the form of consecutive steps involving specific entities.

When: Time line keyed to the steps under "How," indicating the schedule for the action.

Where: Where action will be accomplished and portion of estuary it is expected to affect.

Who: Agencies/institutions who will act, pay, and enforce; description of their commitments. Lead entity(s) are designated here.

Public Costs:

Table presenting estimated five-year costs of action for new initiatives.

Regulatory Issues :

Statement of any need(s) for legislation or regulation associated with the action.

The final level in this hierarchy, that of the individual action, is the core of *The Galveston Bay Plan*. Throughout, each action is presented utilizing a single page of concise information, with related actions cross-referenced in a footnote at the bottom.

The Support Action Plans (Section V) also utilize this format to describe research and public participation activities necessary to support the initiatives of *The Galveston Bay Plan*. The remainder of this document, chapters describing implementation, monitoring, and public involvement in creation of *The Plan*, follow a simple descriptive format.

Section VIII in particular, "Implementing and Funding *The Galveston Bay Plan*," contains several significant public policy recommendations. This section recommends that the Texas Natural Resource Conservation Commission create a new regional Galveston Bay Program to be located in the bay area, for implementation of *The Plan*. Cost and funding issues are addressed, as is enforcement of *The Plan* via consistency review of future actions which affect the bay. This section also defines the relationship between the Galveston Bay Program and the Coastal Coordination Council.

Within *The Plan* individual actions have been assigned a priority rank of "High," "Medium," or "Low" based on deliberation by the Management Conference. In assigning these ranks, the Management Conference considered both the costs and probable outcomes of the actions, and made judgments about which were most significant in relation to the bay's documented

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problems. The assigned rankings will provide a guideline for expenditure of funds during implementation of *The Plan*.



II.

Habitat/Living Resource Conservation

This section of *The Galveston Bay Plan* deals with maintenance and restoration of the critical habitats which make up the Galveston Bay Estuary ecosystem, and protection of the many species which make their home in the estuary or depend upon the estuary during a portion of their life cycle. Action plans were developed for two interrelated aspects of the bay's living resources.

Habitat Protection The continued health and biodiversity of the estuarine system depend on the maintenance of varied and abundant high-quality habitat, particularly wetlands. A trend of wetlands decline has been identified within the estuary, threatening the sustainable productivity of the bay. This problem of habitat degradation has been identified as the **most critical** of all the problems currently facing the bay. To meet this challenge, the Habitat Protection action plan calls for acquisition and/or conservation of existing wetland habitats; restoration or enhancement of degraded wetland habitats; beneficial use of dredged materials to create additional habitat; and minimization of erosion which leads to habitat loss. A variety of approaches, ranging from the development of tax incentive programs to the creation of bird nesting islands using dredged materials, have been recommended as effective means to protect the vital habitats of the estuary (see page 29).

Species Population Protection Species protection is inextricably linked to habitat protection, as all species are dependent upon the maintenance of their essential habitats. Even if habitats are maintained, however, pressure can be applied to species populations from a variety of sources, such as abnormal weather patterns, over-fishing, or the introduction of exotic species which drive out species from their original habitat. To closely monitor the status of species populations within the estuary, this action plan calls for the formation of a task force to coordinate and focus species management issues. To address current species management problems in the bay, the strengthening of species management plans; the reduction of by-catch, impingement, and entrainment; the protection of oyster reefs; and the control of exotic species is recommended (see page 53).

Habitat Protection

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
HP-1	High	Restore, create, and protect wetlands	44
HP-2	High	Promote beneficial uses of dredged material to restore and create wetlands.....	45
HP-3	High	Inventory degraded wetlands and fund remedial measures	46
HP-4	High	Implement a coordinated system-wide wetland regulatory strategy	47
HP-5	High	Acquire and protect quality wetlands	48
HP-6	High	Develop economic and tax incentive programs to protect wetlands	49
HP-7	High	Facilitate bird nesting on existing islands and beaches	50
HP-8	High	Build nesting islands using dredged materials.....	51
HP-9	Low	Reduce erosional impacts on wetlands and habitats	52

THE ISSUES

The Galveston Bay Estuary is composed of a variety of aquatic habitats ranging from open water areas to coastal wetlands that support numerous plant, fish, and wildlife species. Maintaining varied and abundant high-quality habitat helps ensure the health and biological diversity of the entire estuarine system. *The Galveston Bay Plan* advocates an ecosystem approach to habitat protection that will ensure the existence of an optimal variety and distribution of aquatic habitats, and will sustain the physical and hydrological connections required between adjacent habitats.

Strategies for the protection of the Galveston Bay estuarine habitats were evaluated by the Management Conference along with the results of technical research, and the historical and current management efforts of natural resource agencies. The following initiatives were identified as keys to the continued productivity and biological diversity of the estuary:

- Wetlands Management and Protection: Four actions were developed by the Management Conference to acquire, manage, and protect coastal wetlands. Improved coordination among the agencies involved in habitat management is recommended for

the development and implementation of a regulatory strategy applicable to all Galveston Bay estuarine habitats. Measures to halt declines in coastal habitat quantity and quality, better utilize existing manpower resources, maximize beneficial uses of dredged materials, and improve service to the public are also promoted by the actions.

- **Beneficial Uses of Dredged Materials:** Actions are proposed to support beneficial uses of dredged materials and minimize negative impacts on bay resources. Dredged materials can be used in a variety of beneficial manners such as creating, restoring, or enhancing estuarine habitats and building bird nesting islands. Obstacles to the use of dredged materials such as agency regulation, public resistance, availability of dredged materials, and costs can be overcome.
- **Erosion Mitigation:** Actions to minimize erosional processes that result in the loss of habitats are supported by *The Galveston Bay Plan*. Erosion threatens residential and industrial areas as well as plant and wildlife communities and may cause the loss of private and public lands. Common remedies to erosion problems such as the construction of bulkheads, shoreline stabilization and restoration measures often result in the loss of coastal habitat, sediment starvation, and interruption of the natural riverine sediment transport system that supplies nourishing sediments for fringing marshes.
- **Subsidence Reduction:** *The Galveston Bay Plan* endorses the efforts of the Harris-Galveston Coastal Subsidence District in reducing the rate of subsidence throughout the Galveston Bay Estuary. Subsidence, a permanent and irreversible sinking of the ground surface, is primarily caused by the excessive withdrawal of subsurface fluids, principally groundwater. Coastal habitat has been lost in areas of the Galveston Bay Estuary that are susceptible to flooding due to high tides, heavy rainfall and hurricane storm surge. Efforts of the Harris-Galveston Coastal Subsidence District have significantly reduced the rate of subsidence throughout shoreline areas in recent years, although subsidence remains a problem in the northwestern portion of the lower watershed. Therefore this action plan requires no further action other than endorsing the current work by the Subsidence District to correct remaining problems.

ENVIRONMENTAL STATUS

Status and Trends

Two bay habitats are of particular importance to the tremendous diversity and overall abundance of bay life. First, wetlands (including submerged aquatic vegetation) serve important biological, hydrological, and ecological functions in the bay ecosystem. Second, oyster reefs are important habitats as indicators of the overall condition of the ecosystem and are the basis for an important commercial fishery. Oyster reefs are discussed in detail in the Species Protection Action Plan. More information regarding wetlands (including bird habitat) follows.

Wetlands

Wetlands are transitional areas between land-based and water-based systems, normally covered by shallow water, or with a water table very near the surface of the ground. These areas include some of the most productive biological areas on the planet, and evidence indicates that wetlands are a more important part of the Galveston Bay system food chain than in many other bays. Galveston Bay's marshes are an important source of nutrients and organic matter which become food for organisms throughout the estuary.

Wetlands serve as vital habitat for many species of plants, fish, birds, and wildlife. In Galveston Bay, many of the principal fishery species rely on coastal wetlands during at least some part of their life cycle. These species include brown shrimp, white shrimp, blue crab, red drum, spotted seatrout, southern flounder, and Gulf menhaden. In the same way, wetlands are important nurseries to many non-commercial species that comprise a large part of the food web in Galveston Bay. Several bird species, such as snowy egrets, roseate spoonbills, tricolored herons, black skimmers, and great egrets use the marsh as feeding habitat.

Overall, coastal wetlands provide physical, chemical and biological processes that keep the bay ecosystem healthy. They serve as filtering zones for polluted runoff and provide beneficial organic nutrients to other bay habitats. They serve as good flood-control areas, releasing runoff water more slowly to the bay than the rapid discharge from man-made drainage systems. They even help treat the water by processing organic compounds and permitting excess sediment to settle out before reaching the bay. By stabilizing shorelines subject to wind and waves, wetlands reduce or prevent shoreline erosion, helping maintain water clarity in the process.

Extent of Wetlands in Galveston Bay

Based on recent studies, the Galveston Bay Estuary contains an estimated total of approximately 138,600 acres of vegetated wetlands (marshes and forested wetlands). Marshes constitute 94 percent (130,400 acres) of all vegetated wetlands. Salt and brackish marshes (108,200 acres) are much more prevalent than fresh or inland marshes (22,200 acres). Forested and scrub/shrub wetlands encompass approximately 8200 acres, or six percent of all vegetated wetlands. Submerged wetlands, commonly referred to as sea grasses, have a total mapped area of only 700 acres. Of these, the majority (386 acres) are found in Christmas Bay and most of the remaining areas near the Trinity River delta.

Bird Habitat

Bird populations have significant commercial, recreational, ecological, and aesthetic value to many users of the bay. In addition, they are important indicators of the health of the upper food web and the status of various bay habitats. Observers have noted 139 bird species associated with Galveston Bay wetlands and open-bay habitats. As most waterfowl breed elsewhere, control of Galveston Bay waterfowl by addressing local problems is limited.

While the total number of colonial waterbirds has remained relatively stable since the early 1980s, there has been a decline for estuarine-dependent bird species which feed at the marsh-bay interface (i.e., tricolored herons, snowy egrets, black skimmers, roseate spoon bills, and great egrets). This could be the direct result of habitat losses, or the indirect result of declines

in habitat-dependent species preyed upon by the birds. Inland colonial waterbirds (such as little blue herons, white ibises, cattle egrets, white-faced ibises, and great blue herons) showed no significant changes from 1973 to 1990. Open-water birds such as royal terns, Caspian terns, olivaceous cormorants, Forster's terns, and Sandwich terns showed increases in both the number of birds and the number of colonies over the same study period.

The total Intertidal flats on Bolivar Peninsula and on either end of Galveston Island are the primary habitats for migrating shorebirds, and the bay supports more than five percent of all mid-continental shorebird populations during their annual migrations.

Two roosting sites, but no nesting sites, are known for brown pelicans, an endangered species which declined in the 1960s due to the toxicity and bioconcentration of pesticides. This species has shown increases in Galveston Bay during the past few years, probably because of the reduction/and or elimination of specific pesticides known to be harmful. The bald eagle, an endangered species, has nesting sites in Chambers, Galveston, and Harris counties. The Arctic peregrine falcon and piping plover are listed as threatened in some of the counties around the bay, but do not nest in the area.

Emergent Wetland Losses Over Time

A comparison of the wetland distribution in the Galveston Bay estuary between the 1950s and 1989 indicates that a net decrease of approximately 19 percent of the total vegetated wetlands has occurred over this period (171,700 acres in 1950s to 138,600 acres in 1989, for a *net* loss of 33,400 acres). In some areas wetlands were created, so the net loss equaled a *gross* loss of 88,000. The overall rate of loss averaged approximately 1,000 acres per year between 1953 and 1979, and slowed to 720 acres per year between 1979 and 1989.

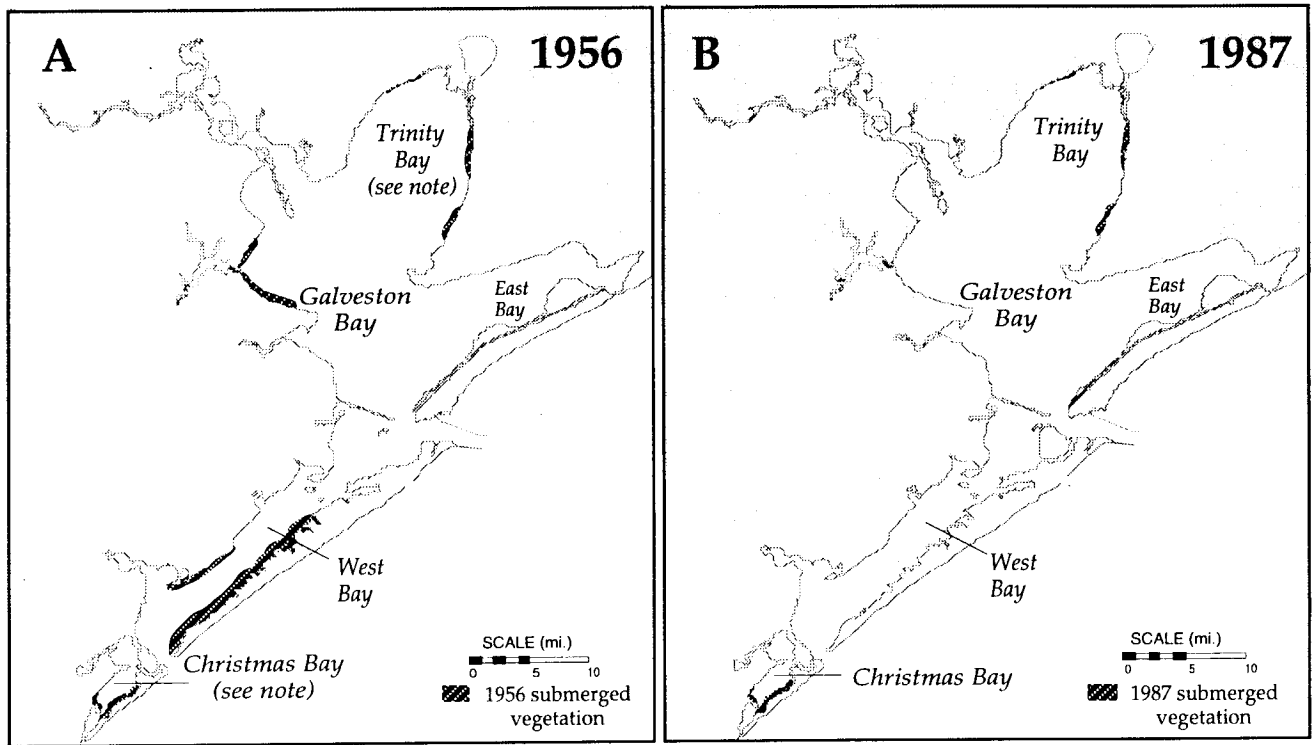
Total scrub/shrub wetlands decreased by 900 acres, representing a 25 percent loss of the 1950s resource. Forested wetlands, on the other hand, increased by 3,600 acres, representing almost twice the 1950s area. Almost all of this gain was in the Trinity River valley. Much of the gain in forested wetland area was due to 1) growth of shrubs and trees in areas previously mapped as scrub/shrub wetlands, and 2) interpretation inconsistencies among data from various years. In addition, most of the forested wetland gain since the 1950s, was due to the invasion of Chinese Tallow, an exotic species with rapid growth potential and low wildlife value.

The quality of coastal wetlands is as important as the total area. Pollution, fresh or salt water inflows, isolation, disturbance, and exotic species are capable of causing detrimental effects on wetlands with subsequent results for the quality of the bay. Declines in the quality of remaining wetlands could represent substantial problems capable of limiting the productivity of these areas.

Loss of Submerged Aquatic Vegetation (SAV)

The area of submerged aquatic vegetation (primarily sea grasses), an important and productive habitat type, decreased from 2,500 acres in the 1950s to just 700 acres in 1987 (see Figure HP-1). This represents a decline of 1,800 acres, or over 70 percent of the 1950s habitat. Although a definite cause-and-effect relationship is not known, the most plausible explanations for the losses are 1) subsidence and Hurricane Carla in Western Galveston Bay,

and 2) human activities such as development, wastewater discharges, chemical spills, and dredging. Light limitation has also been identified as a potential cause for the decline of SAV in Galveston Bay, although the large decline of suspended solids and phytoplankton in the bay over the past 20-30 years may not provide full support to this hypothesis.



Note: Although present, submerged aquatic vegetation was not mapped in Christmas Bay and Trinity Bay locations in 1956. The 1987 distribution of SAV in these locations is shown for comparison.

FIGURE HP-1. Change in Area of Submerged Aquatic Vegetation Between 1956 and 1987.

Causes of Wetlands Losses

Five main causes for wetland losses have been identified: 1) man-induced subsidence and associated relative sea-level rise; 2) erosion; 3) direct conversion for agricultural, urban, industry, and transportation purposes; 4) dredge-and-fill activities; and 5) isolation projects, in which shoreline areas have been artificially cut off from the bay system.

Subsidence

Subsidence became a serious problem in Harris and Galveston counties during the 1950s when the rapidly growing metropolitan area increased its demand for water. Rates of natural subsidence were dwarfed by rates associated with man-induced subsidence. Under the Harris-Galveston area are two aquifers with an abundance of inexpensive freshwater. As industry and municipalities tapped this resource, the rate of subsidence increased. From 1906 to 1987, the land subsided more than ten feet along the Houston Ship Channel. The Clear Lake

area, including the Johnson Space Center, lost six feet of elevation and nearly all of the two-county area sank at least one foot (see Figure HP-2). Conversion from ground water to surface water between 1976 and 1992 reduced subsidence from as much as 0.25 feet per year to 0.025 feet per year along Galveston Bay.

Approximately 26,400 acres of marsh were drowned since the 1950s due to the effects of subsidence. However, losses are offset to some degree by the growth of new wetlands in areas where the land surface subsided. In fact, a substantial amount of 1950s uplands, about 21,000 acres, was emergent wetlands in 1989. Some increases have resulted from implementation of extensive water management programs for waterfowl habitat. Development and expansion of wetlands in some areas appear to be associated with subsidence and faulting. Changes toward wetter soil conditions occur as land-surface subsidence results in lower surface elevations, thereby increasing the frequency and duration of inundation. Transitional areas and uplands with gentle sloping surfaces that grade into adjacent intertidal wetlands are prime candidates for this type of conversion.

While significant progress has been made to control subsidence in the flood-prone coastal areas, ongoing management of regional ground water resources is needed to continue improvement and stability. Since the 1970s, the cause of subsidence itself has been addressed. Regulation of ground water withdrawal by the Harris-Galveston Coastal Subsidence District has almost eliminated excessive pumping in the near-bay areas, virtually stopping further elevation loss around the bay.

Erosion

Shoreline erosion contributes to the conversion of vegetated wetlands to open water. Comparative shoreline data indicate that 78 percent of the shoreline in the Galveston Bay system eroded to some extent between the 1850s and 1982. Average rates of erosion have increased from 1.8 feet/year between the 1850s and 1930 to 2.4 feet/year between 1930 and 1982.

Natural causes of shoreline erosion include wave activity, storms, relative sea-level rise, and bluff failure. Wave activity, in order of increasing severity and decreasing incidence, is caused by the predominant southeasterly winds, strong northerly winds accompanying the passage of polar fronts, and extreme winds associated with tropical cyclones. Shorelines with long northerly and southeasterly wave fetches commonly have the highest rates of shoreline erosion.

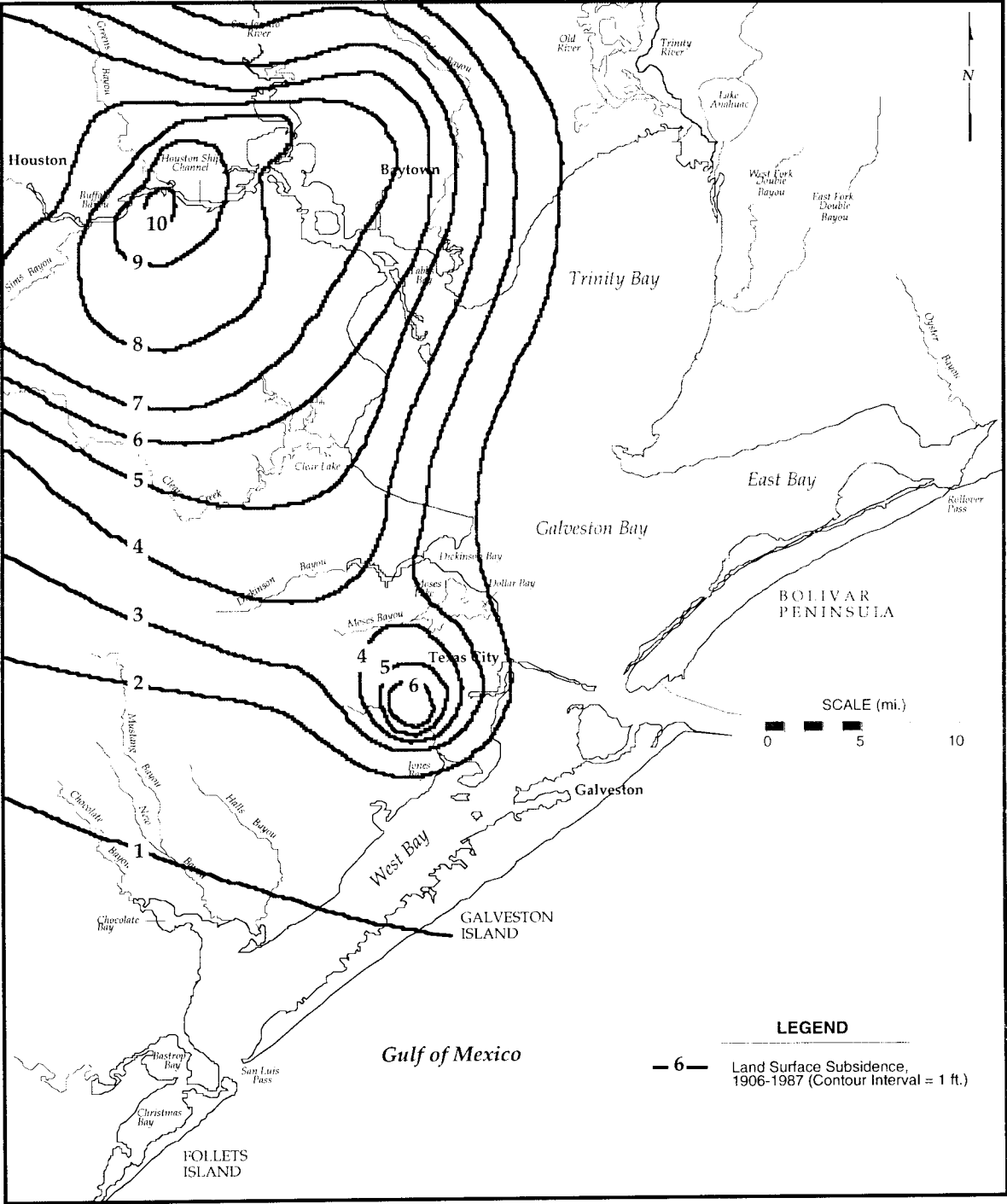


FIGURE HP-2. Land Subsidence in the Galveston Bay Area Between 1906 and 1987

Hurricanes are capable of producing the most dramatic changes in shorelines. During Hurricane Carla in 1961, more than 800 feet of land were eroded from one shoreline facing the gulf, while about 500 feet of accretion occurred on the bay side of the barrier island. In 1983, Hurricane Alicia was responsible for an 80-foot retreat of the vegetation line on Galveston Island, and caused most shoreline bluffs surrounding the bay to retreat between 5 and 20 feet. Tropical cyclones, in addition to producing destructive waves, raise bay water levels enough to cause waves to break on the middle and upper parts of the bluffs. Storm waves may exceed the low points along Galveston Island, Bolivar Peninsula, and Follet's Island and cause erosion on the landward side of the dunes.

Human causes of erosion include increased wave activity from commercial ships and recreational and fishing boats. Dredging in channels, waterways, and marinas also contributes to erosion problems. Structures like riprap, bulkheads, and groins have slowed erosion locally, but contribute to bay-wide erosion by removing shoreline-derived sediments.

Inland improvement projects such as damming rivers for hydroelectric power, water supply projects, and flood control projects, trap sediments that would ultimately be deposited into the bays and estuaries by natural stream flow. Such sediment provides a crucial replenishment to the shoreline and wetlands of the bay. When a regular flow of sediment is impeded from reaching the bay, natural sea level rise (estimated by one researcher to be about 0.8 ft per 100 years) can drastically affect marshlands, causing them to migrate inland. The slightest subsidence can further worsen this problem. Reductions in riverine sediments resulting from reservoir construction slow expansion of the Trinity Delta (the only area of extensive shoreline progradation in the last century). The construction of upland reservoirs has probably contributed to the acceleration of marsh erosion since the 1930s by robbing the bay of sediments transported down the rivers. In addition, reduced erosion rates due to changing land uses in the upper watershed may also be responsible for reducing sediment loads to the bay.

Conversion

Conversion of wetlands to uplands has substantially contributed to wetland losses. Much of this loss has occurred in freshwater marshes as opposed to the saltwater or brackish marshes. Conversion to upland range was the most significant human land use change affecting wetlands, with 25,000 acres of wetlands lost between the 1950s and 1989 (primarily inland from West and Christmas Bays). While conversion appears to have natural causes, much of the change may be attributable to drainage ditches constructed to reduce flooding and increase the area available for livestock grazing. Other agricultural conversions claimed 5,700 acres of wetlands, and oil and gas production resulted in a net loss of 800 acres. Conversion to urban uses destroyed 5,700 acres of natural wetlands, although in some cases alternative beneficial habitats have been created (such as rice fields that support waterfowl).

Dredging and Filling

Dredging may also change water circulation patterns, alter freshwater flow patterns, or create oxygen-poor water conditions bay-wide. For example, construction of the Houston Ship Channel in the open portions of the bay breached Red Fish Bar, an oyster reef complex that stretched across the bay, and increased salinity in the upper bay. On a more localized scale,

the actual site of dredged material deposition will be affected. At open water sites, benthic habitat may be destroyed, and wetland habitat may be converted to uplands. The magnitude of each of these impacts will vary depending on 1) the nature and size of the dredging project, 2) the characteristics of the project site, and 3) the configuration of the disposal site. Dredging projects are shown on Figure HP-3.

Since the 1950s there has been only a 500 acre net loss of wetlands due to dredged material disposal, mostly associated with the Gulf Intracoastal Waterway. Since 1900 there has been an estimated loss of 7,070 acres of marshland have been lost to dredging, filling, and disposal activities. Of this loss, 2,920 acres was lost due to creation of designated disposal areas, 860 acres to navigation channels, and 3,290 to private dredge and fill operations (if the actual permitted activity was constructed) under the US Army Corps of Engineers Section 10/404 permit program.

Traditional dredging and dredged material disposal practices can directly eliminate, displace, or modify habitat through conversion to deep water coverage, erosion, and turbidity effects. Sedimentation and turbidity hinder filter feeders such as oysters, and disposal of dredged materials can convert wetlands to uplands. Dredge/fill projects may alter bathymetry, circulation, and salinity, thus affecting living resources. Some dredged material (particularly maintenance material from the upper estuary) may contain soluble contaminants that enter the water column which can produce toxicity or be taken up by organisms.

Isolation Projects

Isolation projects have resulted in large areas of open bay and marshland being separated from the bay proper, causing ecological changes that result in loss of wetlands. The most significant of these was the closure of Turtle Bay, now called Lake Anahuac, in 1936. Closure of this area near the mouth of the Trinity River eliminated about 6,000 acres of shallow bay bottom and 10,000 acres of marshland from the estuarine system. Overall, there has been a loss of 7,500 acres of bay bottom and 16,000 acres of estuarine marsh due to all isolation projects since 1900.

MANAGEMENT STATUS

Regulatory Basis

Although no comprehensive law has been passed to protect habitat or wetlands, these areas are partially protected under Section 404 of the Clean Water Act (CWA), the River and Harbor Act, the Endangered Species Act (ESA), the Fish and Wildlife Coordination Act, the National Environmental Policy Act and other regulatory programs. The U.S. Fish and Wildlife Service (USFWS) designates critical habitats for the conservation of federally listed endangered or threatened species under provisions of the ESA. The Fish and Wildlife Coordination Act requires USFWS and the National Marine Fisheries Service (NMFS) to review federally funded or permitted activities that may have an impact on endangered or threatened species and their habitats. USFWS uses its authority under the Fish and Wildlife Coordination Act to address impacts to wetlands and other habitats.

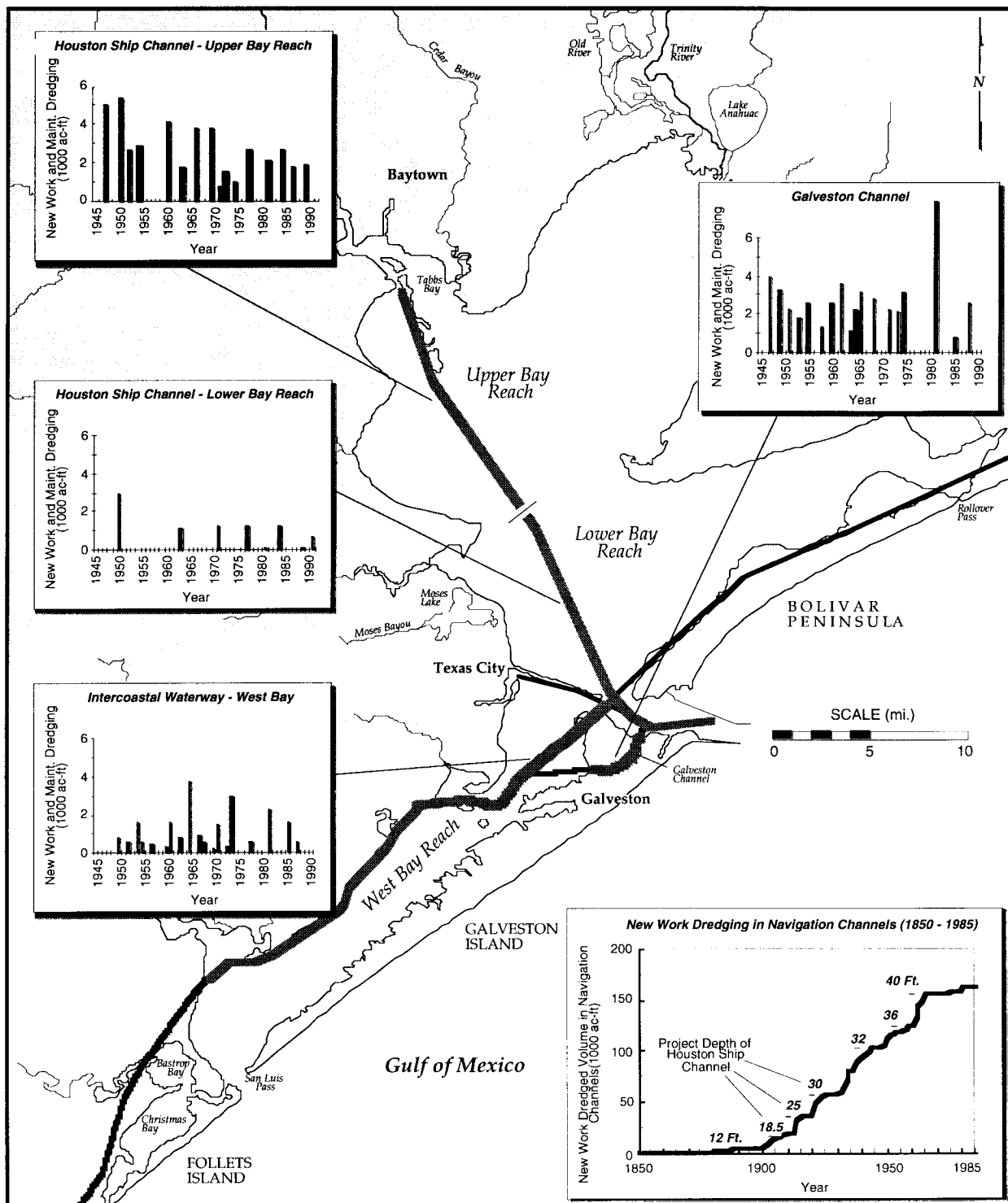


FIGURE HP-3. Major Dredging Projects in the Galveston Bay Area.

The U.S. Army Corps of Engineers (Corps) administers Section 404 of the CWA regulating the discharge of dredged or fill material into waters of the United States including wetlands. Section 404 is the primary federal regulatory program addressing wetlands. The Corps also administers the program through Section 10 of the River and Harbor Act of 1899, which requires a permit for any structure and/or work in the navigable waterways of the United States.

The Corps administers the Section 404 program with oversight from the Environmental Protection Agency (EPA). EPA's roles in the program include the following:

- Development of guidelines by which permit applications must be evaluated;
- Review of proposed permits;
- Prohibition of discharges with unacceptable adverse impacts;
- Interpretation of Section 404 exemptions; and,
- Enforcement of Section 404 violations.

Other federal agencies involved in wetlands programs include the USFWS, NMFS, the National Parks Service, the National Forest Service, the Soil Conservation Service, and the Bureau of Land Management. The USFWS administers the National Wetlands Priority Conservation Plan to aid in the identification of wetlands that warrant consideration for state and federal acquisition. The National Wetlands Inventory is maintained by the USFWS for information and maps on the status of wetlands. Federal projects that affect aquatic habitats can be reviewed under NEPA by the EPA, USFWS, NOAA, and other agencies.

Management of dredging activities in Texas is overseen by the Corps, the Texas General Land Office (GLO), port authorities and navigation districts. GLO is supportive of wetlands protection under its jurisdiction; but must also address the welfare of the citizens of the State, including important economic and social development.

The Texas Natural Resource Conservation Commission (TNRCC) certifies Section 404 permits and prohibits any permit that violates state water quality standards. The TNRCC also issues water quality certifications under Section 401, a program with potential wetlands protection applications. The Texas Parks and Wildlife Department (TPWD) reviews permits for the potential impact dredge and fill activities may have on wildlife habitats. Section 404 permits are also reviewed by the NMFS, USFWS, and the GLO. The developing Texas Coastal Management Program will address consistency of dredge and fill projects with other state and federal regulations.

The state and federal agencies are working towards the development of a management strategy to promote the beneficial uses of dredged material. Potential uses include enhancing or restoring marshes, shorelines, beaches and rookery islands.

Texas House Bill 552 regulates subsidence caused by groundwater removal by industry, farmers and cities. The Bill established the Harris-Galveston Coastal Subsidence District to monitor groundwater removal in Harris and Galveston counties. The district was charged to develop a regional plan to reduce groundwater use and provide for alternate water supplies.

The Plan has been successful in the areas where the District's efforts have been concentrated. Groundwater pumpage has decreased significantly in the Galveston Bay area and the Houston Ship Channel by conversion to surface water systems consisting of rivers, man-made lakes and reservoirs, and canals.

Problems

Most habitat regulatory problems stem from limited authorities of individual agencies with duplication of effort and a lack of resources for effective permit enforcement. Funds are inadequate for land purchase, which is the only effective method presently available for ensuring continued protection of habitat. The combination of fragmented and indirect authorities and low capacity along with the extreme importance of wetlands in cleansing the water and providing nursery habitat makes wetland loss perhaps the most important problem facing Galveston Bay.

The viability of the bay may depend on a comprehensive planning and management plan for dredged material which should be considered a resource for habitat creation and other uses. The current lack of consistent policy, interagency coordination, and funding limit disposal sites and beneficial uses for dredged material. Implementation of an efficient, coordinated review process would help to balance dredging with environmental productivity.

Other issues which may need to be addressed include 1) developing a system that indicates the degree of wetlands degradation (such as quality and function), 2) developing programs to prevent the future impoundment of coastal wetlands, and 3) development of water quality protection for submerged vegetation.

HABITAT PROTECTION ACTION PLAN

To provide optimal fish and wildlife habitat supporting the Galveston Bay system by effectively regulating wetland habitat to preclude net losses; conserving habitat through public ownership or control; implementing habitat creation, restoration, and improvement programs; reducing the adverse impacts from dredging and filling; and ensuring management practices that maximize beneficial uses of dredged material.

OVERVIEW

Priority Problem

Lost or degraded aquatic habitats: Vital Galveston Bay habitats have been lost or reduced in quality by a range of human activities, threatening the bay's future sustained productivity. Habitat loss has resulted from various processes including subsidence, erosion, conversion to agriculture, urban development, and dredging and filling activities.

Goal

Expand areas and restore quality of wetland habitats. Increase the quantity and improve the quality of wetlands and habitat for fish and wildlife in the Galveston Bay system.

Objective

Create or restore 15,000 acres of vegetated wetlands within 10 years. Specific targets include a) 1,400 acres of submerged aquatic vegetation; b) 5,000 acres of fresh marsh; and c) 8,600 acres of estuarine emergent marsh.

Action HP-1: Restore, create, and protect wetlands.

Action HP-2: Promote beneficial uses of dredged material to restore and create wetlands.

Objective

Restore natural functions and values to 50 percent of degraded wetlands within 20 years.

Action HP-3: Inventory degraded wetlands and fund remedial measures.

Goal

Halt the conversion of wetlands to other uses. Eliminate or mitigate the conversion of wetlands to other uses caused by human activities.

Objective

Sustain no net loss of existing wetland areas.

Action HP-4: Implement a coordinated system-wide wetland regulatory strategy.

Goal

Acquire existing wetlands and encourage conservation. Acquire existing wetland habitats and provide economic incentives for conservation. Placing wetland areas in permanently protected status will ensure future contributions from these areas for support of plant, fish, and wildlife species.

Objective

Place 50,000 acres of wetland and floodplain habitats in public ownership over the next 20 years. Include in this total both large tracts of land and small parcels not traditionally managed by public entities.

Action HP-5: Acquire and protect quality wetlands.

Objective

Develop economic incentives that would encourage landowners to protect wetlands from development.

Action HP-6: Develop economic and tax incentive programs to protect wetlands.

Goal

Restore and create colonial bird nesting sites. Restore deteriorated colonial bird nesting sites and create new islands where nesting habitat is inadequate.

Objective

Improve and protect habitat on ten major colonial bird nesting sites of the Galveston Bay system within five years.

Action HP-7: Facilitate bird nesting on existing sites.

Objective

Create two additional bird nesting islands within ten years.

Action HP-8: Build nesting islands using dredged materials.

Priority Problem

High erosion rates and loss of vegetation. Some bay shorelines are subject to high rates of erosion and loss of stabilizing vegetation due to past subsidence/sea level rise and current human impacts.

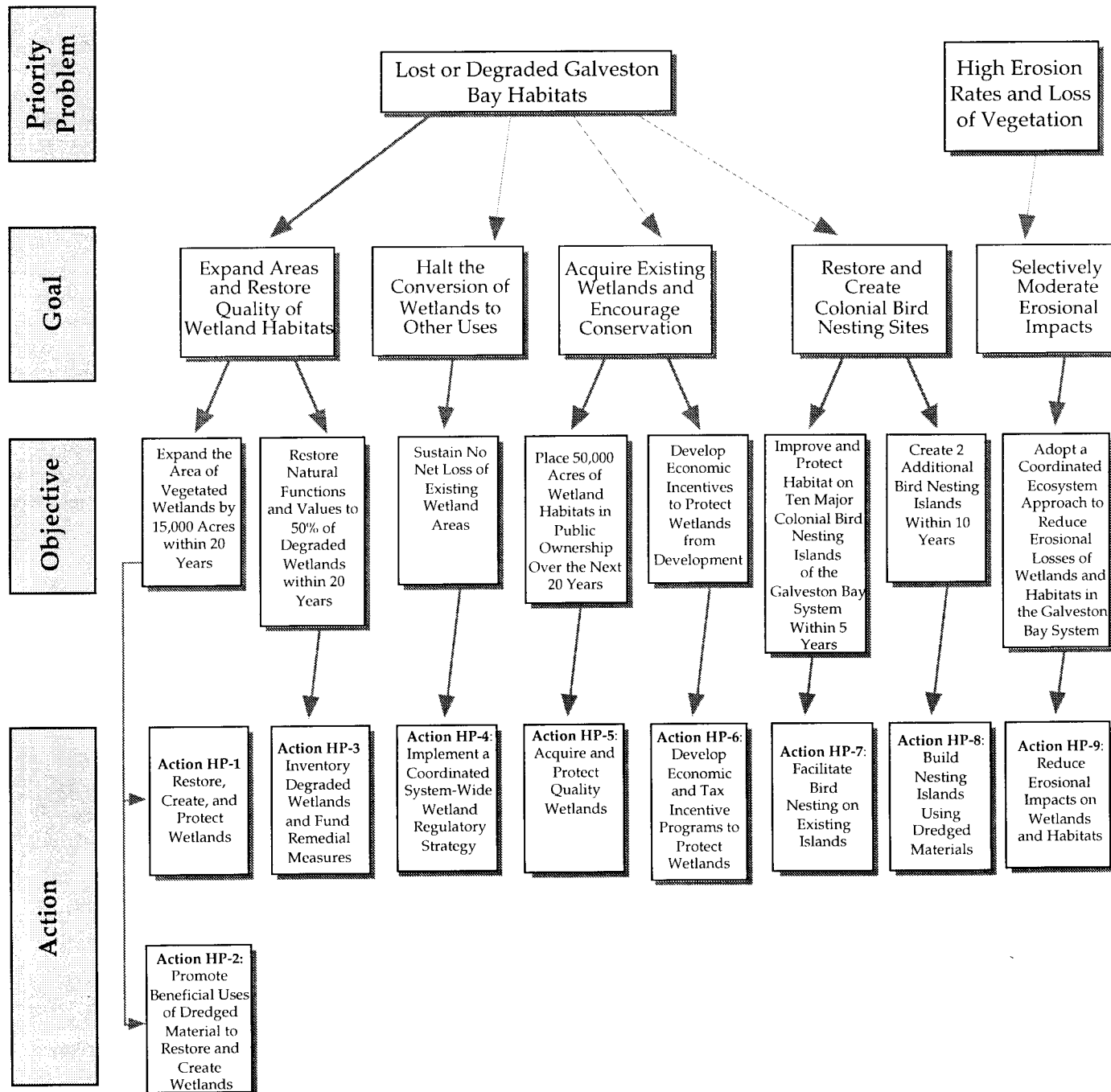
Goal

Selectively moderate erosional impacts. Selectively moderate erosional impacts to the bay and associated shorelines.

Objective

Adopt a coordinated ecosystem approach to reduce erosional losses of wetlands and habitats in the Galveston Bay system.

Action HP-9: Reduce erosional impacts on wetlands and habitats.



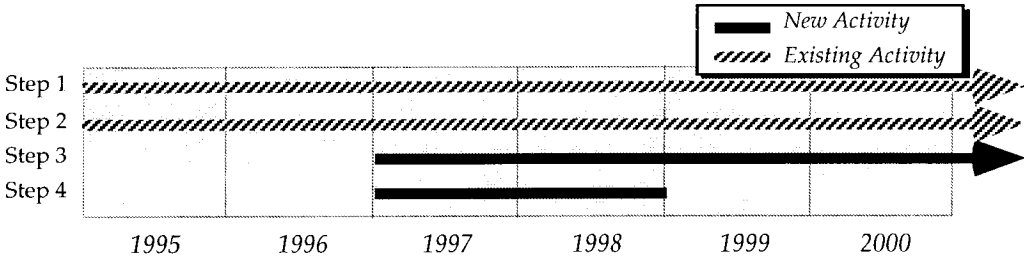
Habitat Protection Action Flowchart

ACTION HP-1:
Restore, Create, and Protect Wetlands

What Implement a wetland habitat restoration, creation and enhancement program to create or restore 15,000 acres of vegetated marine, estuarine, and shoreline wetlands within 10 years. Specific targets: a) 1,400 acres of submerged aquatic vegetation; b) 5,000 acres of fresh marsh; and c) 8,600 acres of estuarine emergent marsh.

- How**
- Step 1 TPWD, SCS, Corps, USFWS, and NMFS will create, restore, and protect wetlands and sea grasses utilizing proactive efforts such as Partners for Wildlife, Coastal Wetlands Planning Protection and Restoration Act (Breaux Bill), Department of Agriculture Wetland Reserve program, GBNEP, beneficial uses of dredged material, and other programs. Projects on state lands will require the approval of GLO.
- Step 2 TPWD and GLO will pursue ONRW through the TNRCC and other means of protection for excellent/high quality aquatic habitats. Utilize TPWD and GLO authorities to avoid adverse effects to submerged aquatic vegetation beds in Christmas Bay. Consider buoys to define a boat-free zone to eliminate damage from boat props, and consider eliminating clamming in submerged grass beds. Consider establishment of additional coastal preserves.
- Step 3 TPWD, USFWS, and GLO will increase public outreach and education to encourage habitat conservation practices: 1) coordinate and increase state, federal and private education programs to deliver a consistent message and maximize use of these limited resources; 2) improve recognition of businesses, governments, and individuals who promote and practice habitat conservation; 3) encourage cooperative education and awareness efforts between industry and government entities; 4) identify opportunities for hands-on experiences for the public to become involved (including using volunteers and inmates for labor-intensive cord grass planting). Balance effectiveness of marsh creation after accounting for all relevant factors such as wind, waves, depth, vessel traffic, etc.
- Step 4 TPWD, NMFS and National Biological Survey (NBS) will research the causes of seagrass loss (including water quality) and techniques to restore submerged aquatics. Evaluate the effectiveness of various marsh creation and enhancement techniques, such as thin layer disposal on subsiding marshes.

When



Where Galveston Bay Program Area

Who Lead entity: GLO, TPWD, USFWS, NOAA, and Corps. Other participants: NMFS, SCS, private conservation groups, private landowners, and citizens. Role of Galveston Bay Program: Coordinate by providing education, advocacy, and monitoring and reporting of progress.

**Public Costs of
New Actions (5 years)**

• TPWD.....	\$ 1,133,750	• Program	\$ 37,500
• GLO	\$ 125,000	• Other	\$ 3,000,000
TOTAL.....		\$ 4,296,250	

Beneficial uses of dredged material resulting from federal navigation projects require non-federal cost sharing. Possible Sources of Funding: USDA, NOAA, Corps, USFWS, USGS, EPA, DOT , and The Nature Conservancy.

Regulatory Issues Review and change existing federal, state, and local regulations which discourage habitat creation and restoration initiatives (e.g., liabilities).

Related Actions: HP-4 and HP-2.

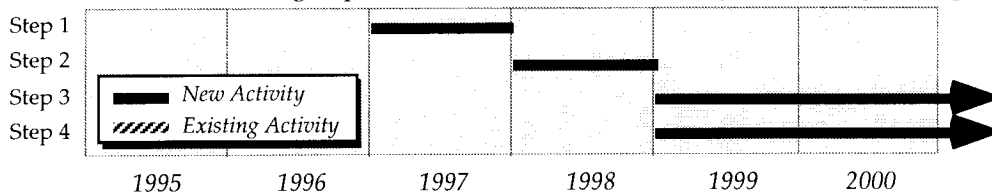
ACTION HP-2: Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands

What Develop a beneficial uses program for dredged material which 1) includes viable mechanisms for funding added costs of handling and processing material; and 2) encourages the beneficial disposal of dredged material.

How

- Step 1 Corps will establish a permanent Interagency Coordinating Committee (ICC) modeled on the Houston Ship Channel Beneficial Uses Group (BUG).
- Step 2 ICC will develop a *Comprehensive Dredged Material Management Plan* for the Galveston Bay estuary. *The Plan* will be a comprehensive construction and management program for federal navigation projects that recognizes the resource value, and minimizes the potential environmental impacts, of the dredged material. *The Plan* will address tasks listed in Step 3 below; items from HP-8, and HP-9, and other actions in *The Galveston Bay Plan* that deal with the use of dredged materials. The ICC will coordinate with developers of the state's Coastal Wetlands Conservation Plan (TNRCC, TPWD, and GLO) as they develop their comprehensive, long-term management strategy for dredging and disposal of dredged material.
- Step 3 Once plan is complete the ICC will implement the following tasks: a) review all new and maintenance dredging within the context of current authority; b) conduct a comprehensive bay-wide beneficial uses inventory; c) oversee impact studies that address species habitats, flood protection, and shoreline issues; d) continue to support development and verification of predictive models to assess impacts of circulation and salinity changes (e.g., effects of Texas City Dike); e) coordinate comprehensive disposal planning and improvement in disposal techniques; f) balance amount of available dredged material with amount of fill required for projects; g) develop an advanced testing program to determine existence of geographic distribution of contaminants for project-by-project dredging/filling in order to manage contaminated sediments safely; h) establish beneficial uses of dredged materials; and i) work with conservation groups to generate public support for implementation of beneficial uses of dredged material.
- Step 4 Corps will seek additional funding required to meet federal consistency and management plan criteria.

When



Where Galveston Bay Program Area.

Who Lead entity: Corps and agencies serving on the ICC. Other participants: GLO, TXDOT, TNRCC, TPWD, and local sponsors. Role of Galveston Bay Program: Tracking and reporting progress. Advocate increasing Corps budget to develop beneficial uses program.

Public Costs of New Actions (5 years)

• ICC.....	\$ 150,000	• Program	\$ 6,750
• Others	\$ 262,500		
TOTAL.....		\$ 419,250	

Non-federal cost share could be substantial. Increased dredged material disposal costs must be addressed in congressional authorization and appropriation. Possible Sources of Funding: USDA, NOAA, Corps, USFWS, USGS, and EPA

Regulatory Issues None identified at this time.

Related Actions: FW-7, HP-4, HP-1, HP-8, HP-10, WSQ-1, WSQ-2, and WSQ-3.

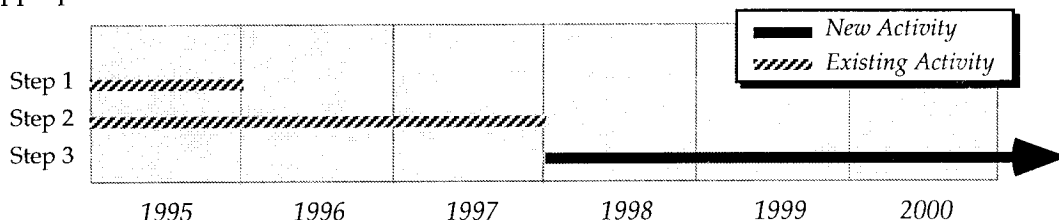
ACTION HP-3: Inventory Degraded Wetlands and Fund Remedial Measures

What Inventory degraded wetlands, identify the causes of deterioration, and fund remedial measures for restoration of 20 percent of degraded wetlands within 20 years. Such measures will include re-establishing sediment sources, restoring hydrology, and others as appropriate.

How

- Step 1** USFWS will take the lead and coordinate with other resource agencies to develop a definition of a degraded wetland for use in inventory and ranking. Higher quality wetlands such as coastal marshes will be emphasized over wetlands in stormwater ditches and impoundments.
- Step 2** USFWS, TPWD, and NMFS will complete an estuary-wide inventory of habitat, and rank degraded habitats in order of increasing need for remediation under existing legal mandate.
- Step 3** USFWS, SCS, National Biological Survey (NBS), NMFS, TPWD, and GLO will evaluate the effectiveness of various marsh creation and enhancement techniques, such as thin layer disposal of dredged materials on subsiding marshes. Evaluate the techniques employed for marsh restoration and creation and prepare a descriptive list of the relative effectiveness of each. Enhance degraded wetlands through restoration of natural functions and values. Work with conservation groups to generate public support for state and federal appropriations for habitat restoration.

When



Where Galveston Bay Program Area.

Who Lead entity: USFWS, NBS, private landowners. Other participants: GLO, TPWD, Corps, NMFS, SCS, and EPA. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD.....	\$ 45,750	• USFWS.....	\$ 45,750
• Program	\$ 11,250	• Others	\$ 183,000
TOTAL.....		\$ 285,750	

Unable to estimate cost of remedial measures until after inventory completed. Possible Sources of Funding: USDA, NOAA, Corps, USFWS, USGS, EPA, and DOT.

Regulatory Issues Review and change existing state, and local regulations which discourage habitat creation and restoration initiatives.

Related Actions: HP-5, HP-4, HP-2, and NPS-3.

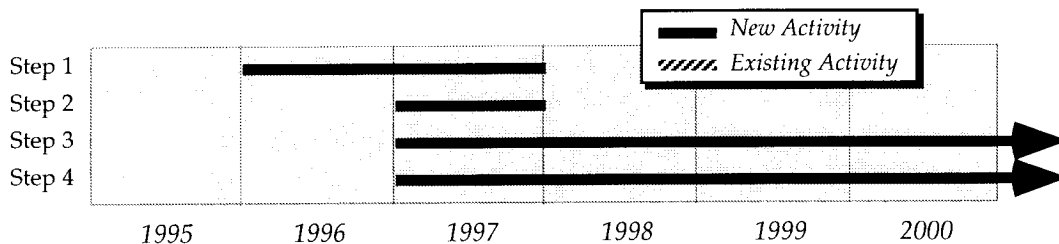
ACTION HP-4: Implement a Coordinated System-Wide Wetland Regulatory Strategy

What Implement a coordinated and effective system-wide wetland habitat regulatory program to 1) minimize licensing uncertainty; 2) provide for appropriate mitigation and monitoring by the permittee; 3) standardize mitigation guidelines/criteria; 4) provide for expanded enforcement oversight and improved enforcement by regulators; and 5) eliminate federal economic support for activities not meeting consistency criteria.

How

- Step 1** TNRCC will adopt water quality standards to strengthen Section 401 permit certification criteria for wetlands. Monitoring (with citizen involvement when appropriate) should be conducted to follow-up on all issued Section 10 and Section 404 permits for compliance with permit stipulations and to assess the effectiveness of mitigation.
- Step 2** GLO will coordinate an effort for federal and state resource agencies (EPA, Corps, USFWS, NMFS, GLO, TPWD, and TNRCC) to agree on an MOU to standardize mitigation criteria, policies, and requirements. The MOU will address acceptable wetlands assessment methodologies, mitigation banking, mitigation ratios, reporting requirements, CMP consistency, and special measures such as performance bonds. Reassess which Nationwide permits are appropriate for regionalization.
- Step 3** EPA will investigate use of advanced identification provisions of 40 CFR 230.80 to carefully evaluate the granting of new Section 10/401 permits in sensitive areas or other areas unsuitable for development.
- Step 4** FEMA and HUD will evaluate actions with federal consistency criteria to ensure that habitat protection is considered as a priority in the implementation of flood control management and issuance of federal flood insurance and other economic supports for development in floodplains and other identified sensitive zones. (Note: TWDB and FEMA have been studying the Trinity River floodplain for the past two years with the objective of eliminating flood insurance in the flood prone sites by buying out the willing sellers).

When



Where Galveston Bay Program Area

Who Lead entity: Corps, EPA, FEMA, USFWS, TPWD, TWDB, TNRCC, NMFS, HUD, GLO, HGAC, RRC, private citizens. Role of Galveston Bay Program: Coordinate by monitoring and reporting progress.

Public Costs of New Actions (5 years)

• GLO	\$ 86,250	• Program....	\$ 37,500
• TNRCC	\$ 123,750	• Other	\$ 72,000
TOTAL.....		\$ 319,500	

Possible Sources of Funding: NOAA, Corps, USFWS, and EPA Office of Water.

Regulatory Issues Generate an MOU as described above. Water quality standards and 401 certification can also be used to assure minimal protection of wetlands.

Related Actions: HP-5, HP-6, HP-1, HP-2, HP-3, HP-7, HP-8, NPS-2, NPS-11, and PPE-5.

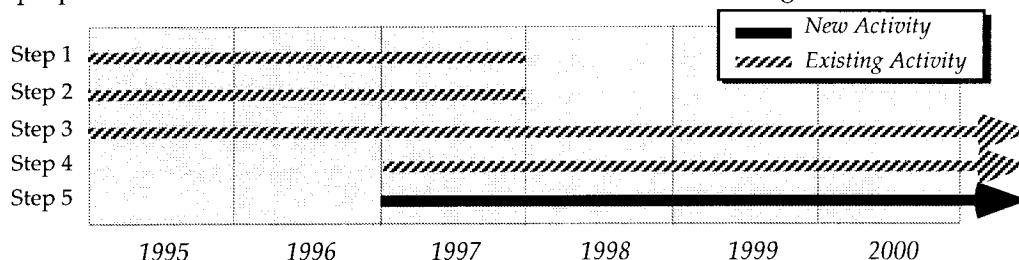
ACTION HP-5: Acquire and Protect Quality Wetlands

What Identify highest priority aquatic wetlands throughout the watershed which can be protected by public ownership or through permanently protected status by private entities. Expand state and federal programs to acquire 1) these high priority tracts, 2) other tracts of habitat and non-developmental easements, 3) smaller blocks of habitat, and 4) non-traditional areas such as wading bird and fisheries habitats. Encourage habitat acquisition by private conservation organizations and voluntary conservation programs by land owners.

How

- Step 1** USFWS, TPWD, GLO, and EPA will conduct a detailed inventory of coastal aquatic habitats (all coastal aquatic habitats, not just jurisdictional wetlands) and an accompanying quality assessment, particularly for habitats interspersed with or in close proximity to development. Habitats will be ranked for acquisition based on this inventory. As part of the state's Coast Wetlands Acquisition Act, GLO will work with the TPWD in certifying coastal wetlands most essential to the public interest and assign priorities for acquisition. In addition, GLO, TPWD, EPA, and other agencies will develop the Coastal Wetlands Priority Acquisition Plan, which will 1) create a framework, criteria, and guidance for identifying key wetlands, 2) identify key wetlands, and 3) identify possible funding sources.
- Step 2** TPWD, GLO, and GBP will examine methods of raising or securing funds for habitat acquisition on a statewide and local level. Private conservation groups will be included in fund raising process and in the generation of public support for state and federal appropriations for habitat acquisition. All appropriate federal and state funding programs will be investigated for acquisition and mgt. of wetlands.
- Step 3** TPWD and USFWS will expand private cooperative joint acquisition and management programs with state and federal entities.
- Step 4** TPWD, USFWS, and National Park Service will elevate acquisition in the estuarine wetlands and bottom land forested habitats of the San Jacinto River and Trinity River floodplains to a higher level of priority.
- Step 5** Corps will utilize provisions in the Water Resources Development Act of 1986 for habitat acquisition. Acquired properties will be turned over to USFWS and/or TPWD for management.

When



Where Galveston Bay Program area.

Who Lead entity: TPWD, USFWS, GLO. Other participants: Corps, National Park Service, EPA, NMFS (on a consulting basis), private sector, and private conservation groups. Role of Galveston Bay Program: Coordinate by providing advocacy at the state and federal level.

Public Costs of New Actions (5 years)

• TPWD	\$ 1,584,375	• Program ...	\$ 99,750
• USFWS	\$ 1,537,500	• Other	\$ 3,046,875
TOTAL.....		\$ 6,268,500	

Market value of wetlands and floodplain habitat ranges from \$300 to \$750 per acre. Significant public and private costs may be involved in acquiring tracts of land from land owners willing to sell. Possible Sources of Funding: USDA, NOAA, USFWS, USGS, NPS, EPA, DOT, and The Nature Conservancy.

Regulatory Issues Congressional authorization and appropriation will be required for federal funding appropriations to acquire wetlands.

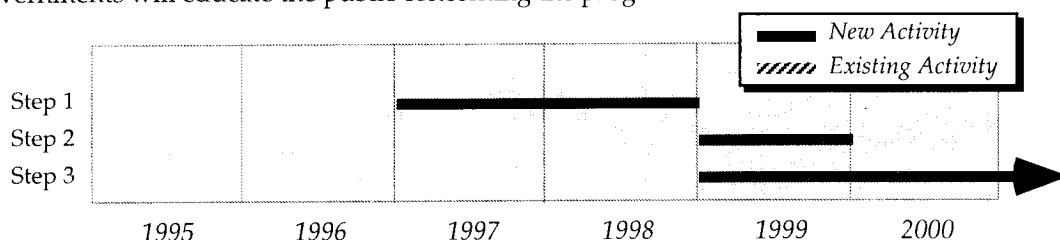
Related Actions: HP-4.

ACTION HP-6:**Develop Economic and Tax Incentive Programs to Protect Wetlands**

What Develop and implement an ad valorem tax incentive and development disincentive program to be administered by a local government entity. Heighten awareness of existing economic incentives that would encourage aquatic habitat protection to ensure that people are not taxed for highest and best use for property. Seek to put into place a "Wetlands Exemption" (like an agricultural exemption), thereby reducing tax liability for leaving wetlands in their natural state.

How

- Step 1 Local governments will conduct studies to explore use of ad valorem tax incentive and other existing economic incentives that would encourage aquatic habitat protection (primarily freshwater and saltwater emergent wetlands and forested wetlands).
- Step 2 Local governments with support from state natural resource agencies and the Galveston Bay Council will sponsor legislation to implement the program, and solicit public opinion. Note that Proposition 2, which is an ad valorem tax relief measure currently in development, includes wetlands on the current draft list of qualifying properties.
- Step 3 Local governments will educate the public concerning the program.

When

Where Galveston Bay Program Area

Who Lead entity: Local governments. Other participants: GLO, TPWD, Galveston Bay Council, private sector, and private conservation groups. Role of Galveston Bay Program: Coordinate by educating private landowners about programs and advocating for positive legislative changes.

**Public Costs of
New Actions (5 years)**

• TPWD.....	\$ 80,000	• Program	\$ 22,500
TOTAL.....		\$ 102,500	

Decreased tax revenues and increased indirect private costs may result from less intensive land development. Individuals would experience some tax relief and benefit from incentive programs. Possible Sources of Funding: USDA, Corps, SCS, NOAA, USFWS, and NPS.

Regulatory Issues New tax incentives may require legislation or regulation. The Federal Assistance Program (Water Bank Program) will reward the property owner for preserving wetlands. A definition of wetlands applicable to this initiative would need to be developed or adopted.

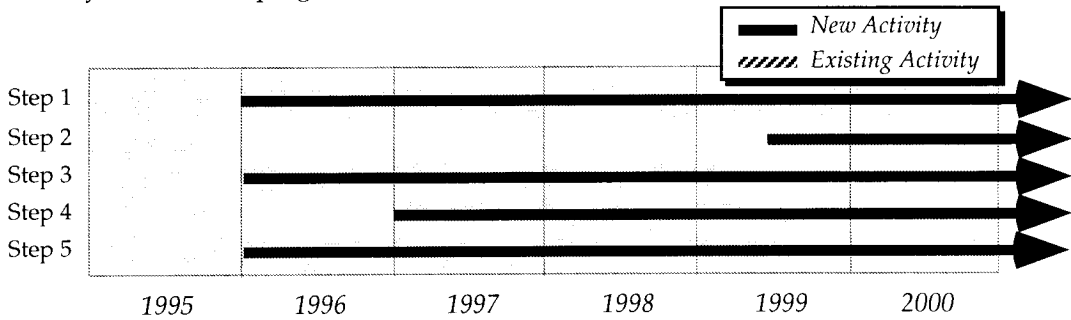
Related Actions: HP-4 and HP-1.

ACTION HP-7:
Facilitate Bird Nesting on Existing Sites

What Induce more intensive and dependable bird use of existing islands by regrading the islands to maintain minimum required elevations above sea level, managing the vegetation, and placing signs warning people to stay away from these islands, particularly during the nesting season.

- How**
- Step 1 USFWS and TPWD will improve coordination with and aid to private groups for erecting signs, providing protection, conducting research, and improving habitats. Habitats include both islands and beaches such as Bolivar Flats and San Luis Pass (important to least terns and black skimmers). Monitor populations on managed islands at frequencies sufficient to determine if proposed actions are successful in increasing bird nesting on these islands.
 - Step 2 USFWS and TPWD will promote beneficial uses of dredged material to restore, enhance, or create suitable bird nesting islands.
 - Step 3 USFWS and TPWD will improve enforcement of existing state and federal statutes protecting colonial nesting birds. Increase public education regarding existing laws, i.e., Migratory Bird Treaty Act.
 - Step 4 USFWS and TPWD will explore and promote the use of Corps Section 1135 (Water Resources Development Act of 1986) and Section 204 (of the 1992 Water Resources Development Act) funds for bird rookery and foraging habitat improvements.
 - Step 5 USFWS and TPWD will use existing programs (i.e., North American Waterfowl Management plan, Breaux Bill, Partners for Wildlife) and foster partnerships with National Audubon Society, Ducks Unlimited, etc., to secure funding and help for restoration and creation of bird nesting islands (to induce more intensive and dependable bird use). Enlist the aid of concerned citizen groups to participate in the actions necessary to make this program a success.

When



Where Bird nesting islands and other sites within the Galveston Bay estuary.

Who Lead entity: TPWD, USFWS, and GLO. Other participants: Private organizations and interested citizens.
Role of Galveston Bay Program: Tracking.

Public Costs of
New Actions (5 years)

• TPWD.....	\$ 143,500	• USFWS	\$ 37,500
• Program	\$ 11,250		
TOTAL.....		\$ 192,250	

Use of volunteers and private groups for some of this work will help reduce costs. Section 1135 projects require a 25 percent non-federal cost-sharing sponsor. Possible Sources of Funding: NOAA, Corps, and USFWS.

Regulatory Issues No regulatory needs were identified for this action.

Related Actions: HP-8 and SP-1.

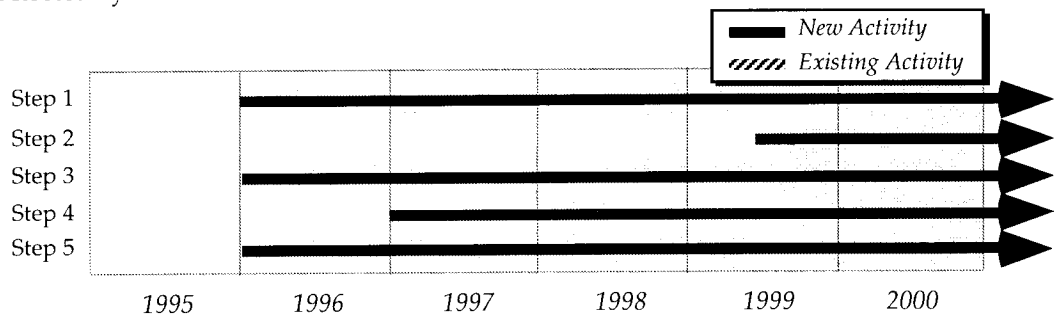
ACTION HP-8: Build Nesting Islands Using Dredged Material

What Use dredged material from public or private activities to build islands at a location and of a size amenable to colonization, and where there is a demonstrated need (i.e., underutilized feeding habitat).

How

- Step 1** Corps will improve operations and maintenance coordination on methods for using dredged material on existing bird rookery islands.
- Step 2** Corps will promote beneficial uses of dredged material to restore, enhance, or create suitable bird nesting islands (some may be part of Houston Ship Channel beneficial uses plan). Monitor concentrations of hazardous/toxic constituents potentially present in dredged materials.
- Step 3** Corps will explore and promote the use of Section 1135 (Water Resources Development Act of 1986) and Section 204 (of the 1992 Water Resources Development Act) funds for bird rookery and foraging habitat improvements.
- Step 4** USFWS and TPWD will use North American Waterfowl Management plan, Breaux Bill, Partners for Wildlife, National Audubon Society, Ducks Unlimited, etc., to secure funding for creation and restoration of nesting islands. Monitor bird populations on new islands to determine if proposed actions are successful in increasing bird use of these islands. Monitor stability of islands and recommend remedial actions if necessary.

When



Where Bird nesting islands within the Galveston Bay estuary.

Who Lead entity: USFWS, Corps, and GLO. Other participants: Local dredging sponsors. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD.....	\$ 17,500	• Corps	\$ 37,500
• Program	\$ 11,250		
TOTAL.....		\$ 66,250	

Beneficial uses (such as bird islands) associated with federal projects require a non-federal cost share. Possible Sources of Funding: NOAA, Corps, USFWS, EPA, and appropriate project sponsors.

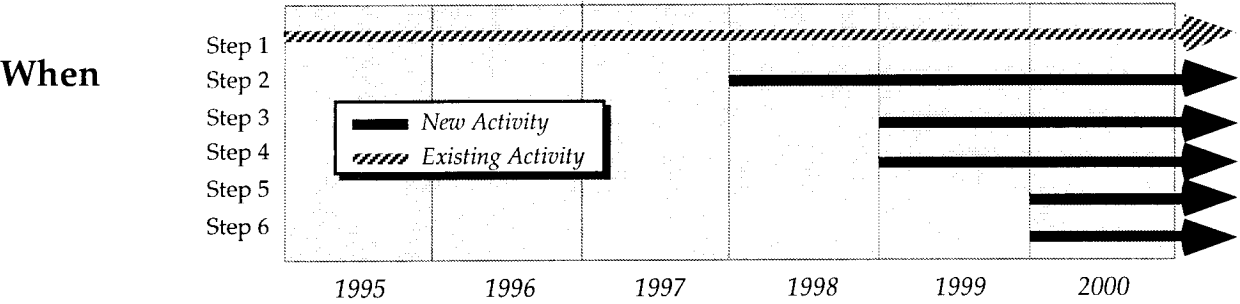
Regulatory Issues Appropriate permits will be necessary for dredging activities needed to complete this action. Houston Ship Channel project requires congressional authorization and appropriation.

Related Actions: FW-7, HP-2, and WSQ-7.

ACTION HP-9:
Reduce Erosional Impacts on Wetlands and Habitats

What Establish an integrated bay-wide erosion management program to develop, apply and publicize methods for erosion prevention for wetlands and bay habitats.

- How**
- Step 1 HGCSD will manage the subsidence that contributes to erosion by continuing conversion from groundwater to surface water and aggressively promoting conservation in coordination with the Subsidence District programs.
 - Step 2 GLO, SCS, and others will establish a bay-wide survey and ranking system for erosion problems. Use the data obtained to ground truth erosion rates implied by aerial photography.
 - Step 3 SCS and others will pursue nonstructural methods to prevent erosion (i.e., planting of marsh grasses and the use of dredged material disposal to create salt marshes).
 - Step 4 GLO will establish and publicize economic and legal incentives for non-structural shoreline management, i.e., mitigation banking, tax incentives, adopt-a-marsh programs.
 - Step 5 GLO and TPWD will study the effects of sand and gravel mining on erosion. As indicated by research, improve management of riverine sediments where technically, economically, and environmentally feasible during the construction and review process for new reservoirs or surface impoundments (see also Action FW-5).
 - Step 6 GLO will investigate means to reduce erosion and restore eroded fringing marsh in sensitive areas of the bay such as Christmas Bay where the width of the Intracoastal Waterway (GIWW) has been increased by erosion. Research the correlation between magnitude and rate of shoreline erosion to hull configuration, draft, speed, and other appropriate factors for vessels commonly using the bay. Perform a wind wave analysis to distinguish between a ship wake and wind wave erosion problem. Evaluate wake damage caused by recreational vessels, and implement boater education and enforcement to prevent boat-related erosion problems.



Where Galveston Bay Program shoreline.

Who Lead entity: SCS and GLO. Other participants: UT, BEG, Corps, Sea Grant, NMFS, TPWD, TWDB, USFWS, NBS, TNRCC, Bureau of Reclamation, USCG, San Jacinto River Authority, and Trinity River Authority, Subsidence District. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)	• TPWD	\$ 25,250	• GLO	\$ 200,250
	• Program	\$ 11,250	• SCS	\$ 100,000
	TOTAL		\$ 336,750	

Costs of erosion prevention may be offset by reduced property losses. Costs not available for existing subsidence management program. Possible Sources of Funding: USDA, NOAA, Corps, USFWS, USGS, EPA, and DOT.

Regulatory Issues Standards for erosion may be appropriate for inclusion in Wetland General Permits.

Related Actions: FW-2, FW-5, FW-6, HP-1, NPS-1, NPS-2, NPS-3, and NPS-6.

Species Population Protection

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
SP-1	Medium	Implement a bay-wide effort to strengthen species management	64
SP-2	Medium	Return oyster shell to designated locations within the bay	65
SP-3	Medium	Promote the development of oyster reefs using alternate materials.....	66
SP-4	Medium	Set aside a portion of reef habitat as scientific research areas or preserves.....	67
SP-5	Medium	Encourage continued development of gear to reduce commercial by-catch.....	68
SP-6	Medium	Conduct educational programs about catch and release.....	69
SP-7	Medium	Investigate potential measures to reduce impingement and entrainment	70
SP-8	Medium	Develop management plans for endangered or threatened species.....	71
SP-9	Low	Improve enforcement of prohibitions against introduction of exotic species	72
SP-10	Low	Identify and implement techniques for the control of problem exotic species.....	73

THE ISSUES

The overall health of the Galveston Bay estuary, as measured by its diversity of species and the populations of its major recreational and commercial species, is generally considered to be fair to good. However, some species within the estuary have experienced declines, with the primary suspected causes identified as loss of habitat, fishing, impingement and entrainment, and other types of human intervention. There is concern that these conditions may cause declines in other species. Because species within the estuarine environment are dependent on one another for maintenance of the food chain, the preservation of species populations is critical to the ecological health of the Galveston Bay system. Preservation of habitat is the most essential requirement for effective protection of species populations, as the fate of species is closely linked to that of habitat. The numerous species that depend on the various habitats provided by this estuary require a broad habitat management perspective which encompasses the entire ecosystem to ensure that the variety and distribution of habitats are fully protected.

In order to facilitate adoption of a regional ecosystem perspective towards species population protection, the species protection initiatives recommended by *The Plan* include:

- **Species Conservation:** Several actions are nominated to reverse the declining population trends for marine organisms and birds. These actions include strengthening species management efforts, developing management plans for endangered and threatened species, promoting favorable habitat conditions for oysters, and increasing efforts to reduce by-catch, impingement, and entrainment.
- **Species Protection:** Initiatives are endorsed by *The Plan* to reduce the threat to native species and habitats posed by the introduction and proliferation of exotic species. The development of legislation to regulate importation of exotic species and of effective control measures for detrimental exotic species are proposed.

ENVIRONMENTAL STATUS

Status and Trends

The Galveston Bay Estuary is an extremely productive and biologically diverse ecosystem. The estuary produces the largest shellfish catch on the Texas coast, is inhabited by at least 162 species of finfish, and serves as the home or as an important feeding and resting stop for many species of birds. Due to the interaction between species in maintenance of the food chain, biodiversity of the ecosystem is essential to the continued health of the Galveston Bay System. However, the many uses of the Galveston Bay Estuary inevitably pose potential threats to the survival of many estuarine species.

General

Based on recent studies of the estuary, the overall health of living resources in the Galveston Bay Estuary is fair to good. There are no observed wholesale declines in species population abundance, and the number of species in different trophic levels indicate that energy and material movement through the food chain is occurring more or less naturally. There have been significant increases in some populations, including American alligator, red drum, spotted seatrout, Atlantic croaker, black-bellied plovers, willets, sanderlings, western sandpipers, olivaceous cormorants, and brown pelican. These increases indicate that the ecosystem is still functional and that species management programs, in general, are working.

However, long-term population declines in striped bass, green turtle, and diamondback terrapin have occurred, and recent population declines have been observed for white shrimp, blue crab, mottled ducks, northern pintail, blue-winged teal, and several species of near-shore feeding colonial water birds. Phytoplankton abundance has varied widely since the late 1950s, first increasing significantly and then decreasing for reasons not well understood at this time, but possibly linked to lower nutrient loadings associated with improved wastewater treatment. In addition, the long-term decline in wetlands acreage, which serves as a critical habitat and nursery for many aquatic species, if not stopped, holds a potential threat to the health of this estuary.

By-Catch

The commercial harvest of shellfish, recreational fishing, urban development, and industrial activities continue to put significant pressure on the renewable resources of the estuary. The annual 3.5-million pound shrimp harvest from the Galveston Bay System impacts finfish and other aquatic invertebrates of commercial or ecological value by generating "by-catch", the unwanted or untargeted portion of the shrimp trawler's catch. Although significant variation by season was noted, a recent study conducted during 1992 showed the overall weight of finfish captured by shrimp trawlers to exceed shrimp landings by a factor of 2.6. Relatively few recreational species were caught by trawls, except for spot, Atlantic croaker, and sand seatrout. An assessment of the ecological damage resulting from trawling by-catch is complicated by a shortage of data regarding the survival rates of the by-catch organisms returned to the bay.

Recreational fisherman catch and release approximately two fish for every fish landed, with the annual catch-and-release total estimated at 1.2 to 3.5 million fish per year in the Galveston Bay Estuary. Again, little data is available regarding the survival rates of the released fish, although available literature suggests that up to 30 percent of released spotted seatrout die from related injuries or stresses within seven days of release.

Impingement

The impingement of fish and crustaceans at the cooling water intakes of power generating stations bordering Galveston Bay represents an additional source of fish mortality. An estimated 32 million organisms, representing a total biomass of 234,000 kg, are impinged per year into the cooling system of four power plants which have been evaluated. Studies indicate that most impinged organisms survive, with survival rates for crustaceans ranging from 30 to 95 percent, and survival rates for fish ranging from 10 to 90 percent. However, considerable uncertainty is included in this estimate of survival rate, which may be considerably lower under typical operating conditions. Commercially and recreationally important species such as spotted seatrout, black drum, red drum, and southern flounder were infrequently impinged.

Other Aquatic Losses

Numerous fish kills, due to accidental spills, wastewater releases, seismic detonation, and storm water runoff, have been reported within the Galveston Bay Estuary and associated tributaries. Finally, natural causes, such as freezes, red tides, droughts, storms, etc., are major factors in the variation of species populations over time.

Oysters

Overall, Galveston Bay appears to have grown substantial oyster reefs in the last 20 years, although data is not available to definitively characterize the size or health of the current oyster population compared to previous periods. The location and mechanisms of reef accretion suggest that natural responses to changes in circulation and salinity by the oyster population are primarily responsible for this increase, rather than the direct production of new reef habitat by human activities. Some reef growth has been attributed to the transport of oyster shell off reef edges onto the surrounding bay bottom by oyster harvesters and

leaseholders. Within the bay, projects are currently underway to create additional reef habitat using alternate materials, such as coal combustion by-products, as reef substrate.

Birds

Observers have noted 139 bird species that are associated with Galveston Bay wetlands and open-bay habitats. Based upon the limited available data, the total number of colonial water birds appears to have remained relatively stable since the early 1980s. The number of active colonies, consisting of gravel and shell bars, marshes, cypress stands, dredged material islands, and industrial and developed locations, have increased from 20 in 1973 to 42 in 1987. Although the total number of these birds appears to have remained constant, there are now fewer wading marsh feeders, perhaps due to the overall decline in wetlands acreage. The loss of these marsh birds has been accompanied by an increase in open-bay feeders.

Brown pelicans, an endangered species which declined in the 1960s due to toxicity and bioconcentration of pesticides, have shown increases in Galveston Bay over the past few years, probably because of a reduction in pesticide pollution. Other threatened or endangered bird species present in the Galveston Bay system include the piping plover, Eskimo curlew, interior least tern, bald eagle, peregrine falcon, and wood stork.

Endangered Species

Sea turtles were once present in the bay in relatively large numbers, and supported a commercial fishery in Galveston in the 1890s. Today the following sea turtles that reside in Texas waters have been identified as threatened or endangered species: the leatherback sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, and the green sea turtle. Apparent long-term declines in the population of diamondback terrapin and green turtle populations have been observed in the Galveston Bay Estuary (at one time a commercial turtle fishery operated in the Galveston Bay area). Little is known about the behavior and habitat selection of Texas sea turtles. Currently the National Marine Fisheries Service (NMFS) is using satellite, radio, and sonic tracking of sea turtles in estuarine and offshore waters to provide more data on turtle biology.

Exotic Species

In many locations worldwide, the introduction of exotic species has had a dramatic impact on the ecology of estuarine systems. For example, within San Francisco Bay, the unintentional introduction of the Asian marine clam *Potamocorbula amurensis* has resulted in a ten-fold reduction in the phytoplankton levels within a two year period and has caused a potentially catastrophic disturbance of the estuarine food web. The development of faster cargo ships and increased worldwide trade has heightened the potential for such unintentional introductions of harmful species. Within the Galveston Bay Estuary, the introduction and proliferation of exotic opportunistic species has also contributed to the degradation of some portions of the estuarine habitat. Significant populations of nutria, a large beaver-like rodent which strips vegetation within freshwater and brackish water marshland, and grass carp, which strips aquatic vegetation, have been reported in the Trinity River and San Jacinto River portions of the estuary. The encroachment of fire ants into the estuarine ecosystem poses an increasing threat to nesting bird populations.

Probable Causes

In the analysis of species population decline, it can be difficult to separate the effects of human activities on estuarine species from climatic and other naturally-induced cycles. For blue crab, one of two commercial species for which chronic population declines have been identified, commercial harvest appears to be a factor in population decline.

For white shrimp, the other species for which chronic population declines have been identified, a significant population decline was observed from 1982 through 1990, leading to concern about the condition of the white shrimp population. Similar declines were noted in the Aransas, Corpus Christi, and Laguna Madre estuaries. This long term trend of population decline was reversed in 1991, when sampling results exhibited a rebound to 1983 population levels (see Figure SP-1). This rebound is probably the result of increased freshwater inflow due to extremely wet conditions in 1990 and 1992, and management regulations implemented in 1990 that prohibit harvesting of white shrimp during two summer months. In the case of both blue crab and white shrimp, the relative effect of human activities versus that of naturally-induced cycles on species population is difficult to evaluate with certainty.

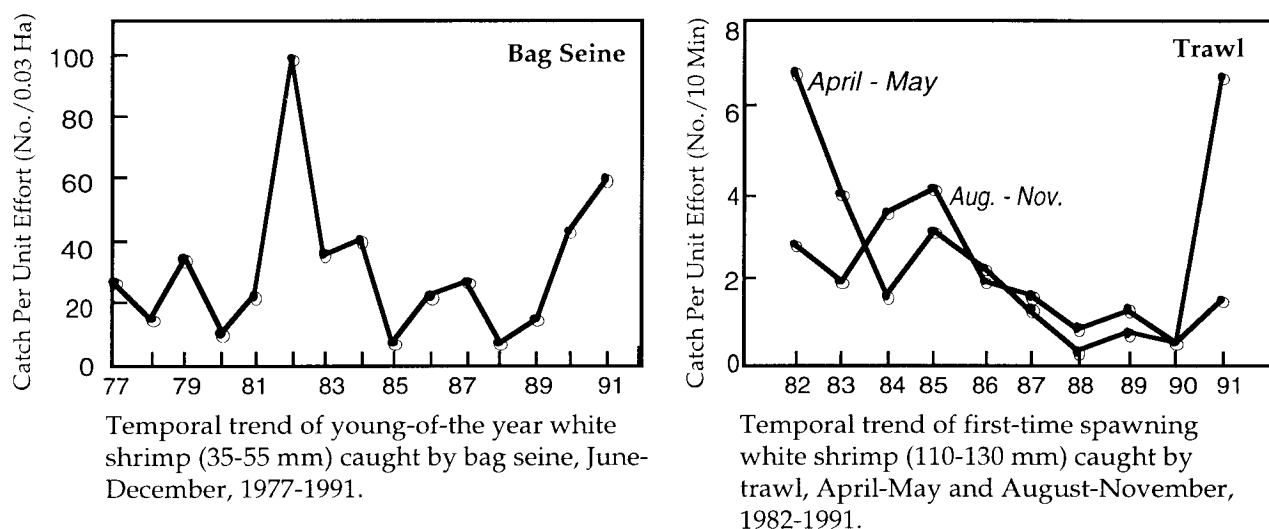


FIGURE SP-1: Temporal Trends for White Shrimp

The long-term health of species populations is dependent on the maintenance of essential wetlands habitat. Any decline of high-quality wetlands nursery habitat would certainly affect the fisheries of blue crab, white and brown shrimp, spotted seatrout, red drum, southern flounder, and other commercially and recreationally valuable species. In the Galveston Bay Estuary, a 19 percent loss in wetlands has occurred since the 1950s due to subsidence, conversion of land to other agricultural usage, and other human activities. Quantity and quality of habitat is the most important issue affecting bird populations and nesting patterns. For this reason, actions aimed at preserving estuarine bird populations are primarily addressed in the Habitat Action Plan.

Adequate freshwater inflows to the estuary are also essential to the long-term health of species populations within the Galveston Bay system. Freshwater inflows affect circulation, salinity regimes, and nutrient loading within the estuary, and are therefore critical for the maintenance of high-quality habitat. Circulation of water within the estuary, which can be affected by dredging and construction projects, is also essential to the preservation of salinity gradients and the health of species populations. Freshwater inflow and circulation issues are addressed in the Freshwater Inflow and Bay Circulation Action Plan.

MANAGEMENT STATUS

The U.S. Fish and Wildlife Service (USFWS) determines whether species are endangered or threatened in accordance with provisions of the Endangered Species Act (ESA). Any species that is proposed or listed as endangered or threatened is protected from removal, sale or distribution. The USFWS also develops plans for the recovery of federally listed endangered and threatened species.

The Fish and Wildlife Coordination Act requires USFWS to review federally funded or permitted activities that may affect an endangered or threatened species. USFWS is also responsible for improving and maintaining fish and wildlife resources through refuge management, disease and population distribution studies and enforcement of the ESA.

The National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) administers the ESA as it applies to marine fish and mammals. NMFS is responsible for the conservation, management, and development of marine resources and the protection of endangered marine species. Conservation and protection of habitats are also the responsibilities of the NMFS. The Fish and Wildlife Coordination Act requires the NMFS to comment on proposed federally funded or permitted activities that may have an impact on marine life and habitat. NMFS implements several other laws, including the Magnuson Fishery Conservation and Management Act, that are intended to prevent overfishing. Under the Magnuson Act, fishery management plans are required to be developed and implemented to maintain the optimum sustainable yield from certain marine fisheries.

The Texas Parks and Wildlife Department (TPWD) is the principal agency that establishes and enforces limits on the recreational and commercial harvest of species in the Galveston Bay estuary system. The Texas Parks and Wildlife Code provides the TPWD with the authority to preserve and protect the state's natural and coastal resources including fish and wildlife. TPWD programs include acquisition of land, management of fish and game resources, protection of species listed under the ESA, research on species populations, and designation of scientific areas. Under the Fish and Wildlife Coordination Act, TPWD also reviews and comments on federal permits potentially affecting the wildlife resources of Texas.

TPWD works with the Texas General Land Office (GLO) and private and public organizations in the Texas Coastal Preserve Program to protect coastal natural resources. The goals of the Coastal Preserve Program are:

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TPWD works with the Texas General Land Office (GLO) and private and public organizations in the Texas Coastal Preserve Program to protect coastal natural resources. The goals of the Coastal Preserve Program are:

- Protect fragile biological communities
- Protect unique coastal areas
- Identify methods for recognizing preservation and enhancement opportunities
- Actively involve all concerned and knowledgeable persons and organizations

Waterfowl management is also a responsibility of TPWD. The Department is involved in acquiring and managing waterfowl habitat and provides nesting boxes to enhance waterfowl reproduction. TPWD also conducts an urban and non-game wildlife management program, focusing on species such as songbirds.

TPWD works closely with USFWS to maintain an active program for the conservation of endangered and threatened species. The Resource Protection Division of TPWD maintains an inventory of all threatened and endangered species for potential listing under the ESA.

Species protection measures implemented by TPWD, USFWS, and NMFS have proven generally effective in protecting species populations from long-term or irreversible decline. In the case of white shrimp, a species for which a long-term decline was identified, shrimping in nursery areas was restricted in 1979, followed by a ban on shrimping in two summer months and a ban on springtime night shrimping in 1990. The white shrimp population has recently rebounded to historical levels. In response to declining populations of red drum and spotted seatrout, commercial sale was banned in 1981, net fishing was disallowed in 1988, and minimum and maximum size limits and daily bag limits for recreational fisherman were implemented in 1988. Because of these management actions, the red drum and spotted seatrout fisheries are exhibiting a rebounding population trend. The TPWD is currently considering new fishing limitations for blue crab, due to their apparent population decline within the Galveston Bay estuary system.

State advisory committees have also been established for shrimp, blue crab, and oysters. These committees periodically conduct public meetings to review fishery status and to consider initiatives for protection of these commercially important species.

SPECIES POPULATION PROTECTION ACTION PLAN

To assure the conservation, restoration, and enhancement of the total natural community of living species in Galveston Bay, both for the maintenance of balanced, indigenous populations which determine overall ecosystem health, and for the long-term vitality of human recreational and economic activities which depend on these renewable living resources.

OVERVIEW

Priority Problem

Certain species of marine organisms and birds (such as blue crab and birds classified as wading marsh feeders) have shown a declining population trend, with the primary suspected causes identified as loss of habitat, fishing, impingement, and other types of human intervention. Because species within the estuarine environment are dependent on one another for maintenance of the food chain, the preservation of species populations is critical to the ecological and economic health of the Galveston Bay system.

Goal

Reverse the declining population trend for affected species of marine organisms, and maintain the populations of other economically and ecologically important species.

Objective

At a minimum, maintain fish and crustaceans at population levels within 50 percent of the 1975-1985 mean.

Action SP-1: Implement a bay-wide effort to strengthen species management.

Objective

At a minimum, maintain oyster population levels within 50 percent of 1983-1993 mean levels.

Action SP-2: Return oyster shell to designated locations within the bay.

Action SP-3: Promote the development of oyster reefs using alternate materials.

Action SP-4: Set aside a portion of reef habitat as scientific research areas or preserves.

Objective

Reduce by-catch within the estuary by 50 percent by the year 2007, accounting for seasonal patterns.

Action SP-5: Encourage continued development of gear to reduce commercial by-catch.

Action SP-6: Conduct educational programs about catch and release.

Objective

Reduce current levels of fish mortality caused by impingement/entrainment by 50 percent by 2007.

Action SP-7: Investigate potential measures to reduce impingement and entrainment

Objective

Increase the populations of endangered and threatened species.

Action SP-8: Develop management plans for endangered or threatened species.

Priority Problem

Some exotic/opportunistic species (like nutria, grass carp, and fire ants) threaten desirable native species, habitats, and ecological relationships. Significant populations of nutria, a large beaver-like rodent which strips vegetation within freshwater and brackish water marshland, and grass carp, which strips aquatic vegetation, have been reported in the Trinity River and San Jacinto River portions of the estuary. The encroachment of fire ants into the estuarine ecosystem poses an increasing threat to nesting bird populations. The development of faster cargo ships and increased worldwide trade has heightened the potential for introductions of harmful species.

Goal

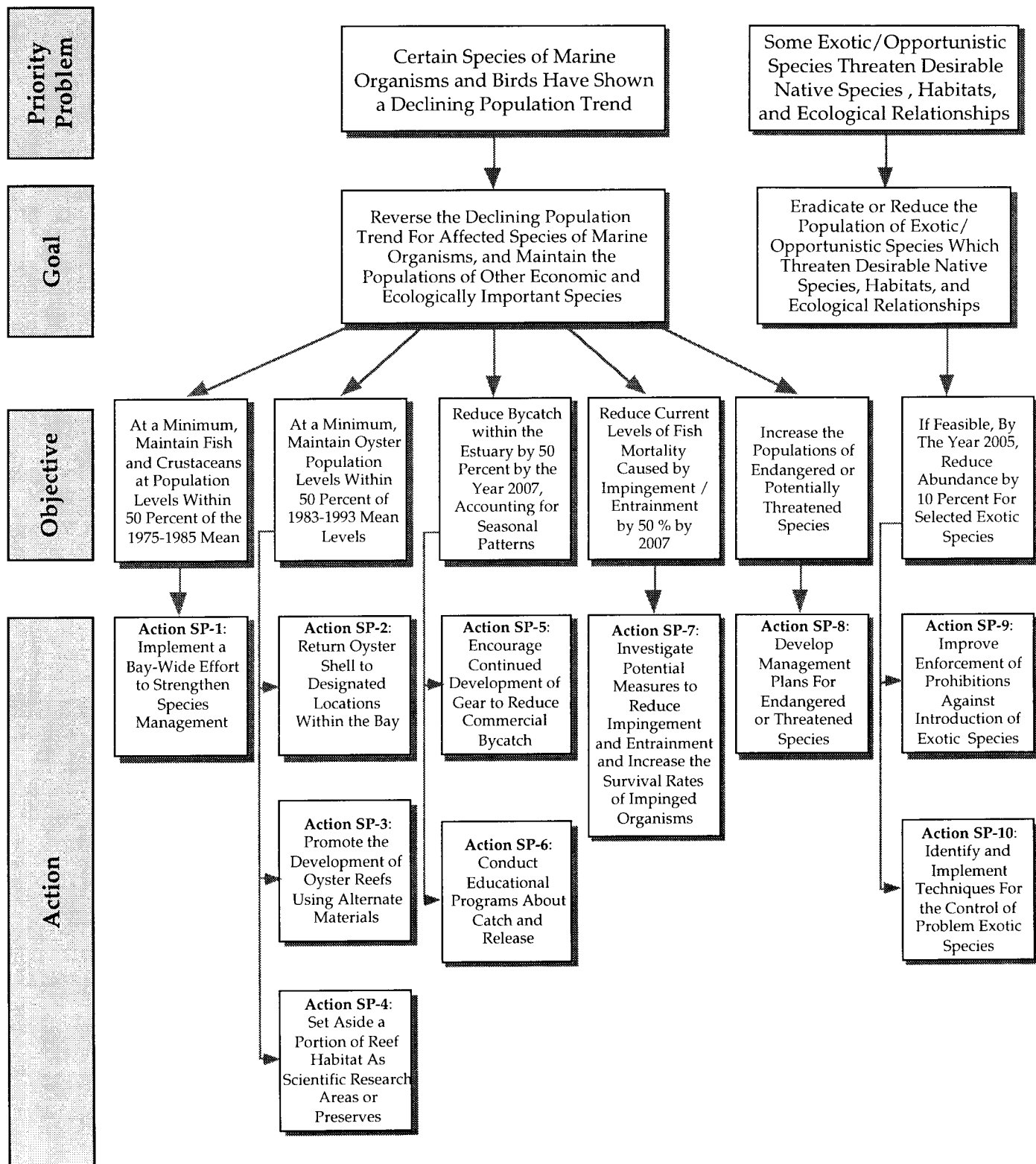
Eradicate or reduce the population of exotic/opportunistic species which threaten desirable native species, habitats, and ecological relationships. Prevent the introduction of additional exotic species.

Objective

If feasible, by the year 2005, reduce abundance by 10 percent for selected exotic species, including nutria and grass carp.

Action SP-9: Improve enforcement of prohibitions against introduction of exotic species.

Action SP-10: Identify and implement techniques for the control of problem exotic species.



Species Population Protection Action Flowchart

ACTION SP-1:**Implement a Bay-Wide Effort to Strengthen Species Management**

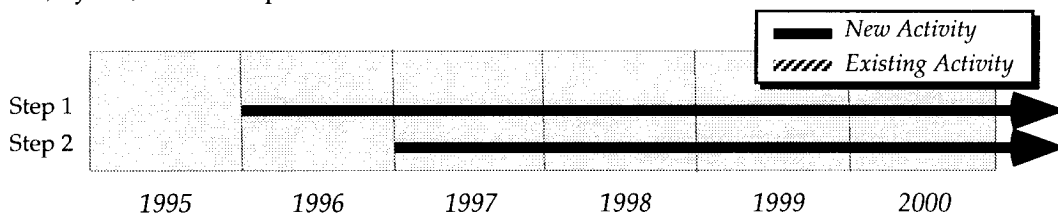
What Implement a bay-wide effort to strengthen species management and protect biological diversity, including better coordination with state programs concerned with species management.

How

Step 1 Establish a permanent Galveston Bay species advisory committee to serve as a forum for species management issues affecting the Galveston Bay Estuary. The Committee will:

- a. Be comprised of representatives from the public, industry, commercial fishing interests, TPWD, EPA, NMFS, USFWS, local government, etc.
- b. Work with the TPWD and other appropriate entities to determine the need for creation and implementation of additional species protection plans or modification to existing plans. The blue crab management plan will be reviewed first in light of recent declining population trends. If appropriate, multi-species protection and biodiversity protection will be addressed.
- c. Address reasons for identified declines in species populations.
- d. Investigate possible reintroduction of reduced/extirpated species, such as the Gulf Salt Marsh Snake, with appropriate species/habitat management plans.
- e. If needed, recommend seasonal or area closures of the estuary. Evaluate implementation of a incentive-based system to price and distribute fishery rights, such as through individual transferable quotas.
- f. Coordinate with development of the Regional Monitoring Plan to ensure that *The Plan* includes collection of data required for species management.
- g. Identify areas where additional research is required, including time/trend analysis on factors affecting blue crab population and population of other affected species.
- h. Work with the TPWD and other entities in plan development and review.
- i. Conduct public hearings, and make a report to the biennial State of the Bay Symposia regarding the status of estuary species.

Step 2 The interagency advisory committee will designate a representative to represent Galveston Bay interests at meetings of the statewide species advisory committees. Statewide committees have been established for blue crab, oyster, and shrimp.

When

Where Galveston Bay Program Area.

Who Lead entity: Newly formed species advisory committee, with lead role played by TPWD. TPWD and Galveston Bay Program will organize creation of committee. Other participants: USFWS, TNRCC, GLO, EPA, CCC, Corps, SCS, NMFS, private conservation groups, industry, and the public. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• USFWS	\$ 84,375	• TPWD	\$ 294,000
• Program	\$ 48,750	• Others	\$ 490,625
TOTAL		\$ 917,750	

Potential Sources of Funding: NOAA and USFWS.

Regulatory Issues Potential establishment of additional management plans or regulatory action by TPWD or other entities. No current legislation needed.

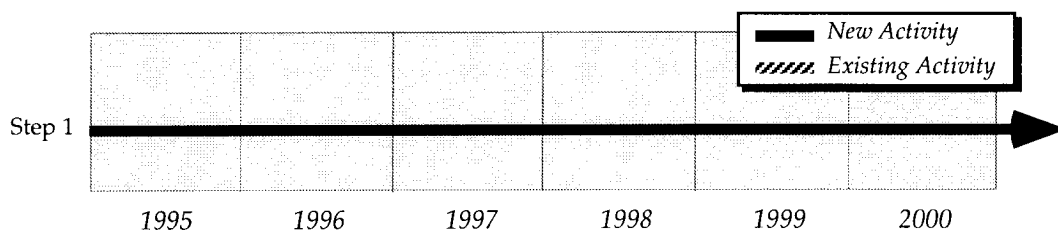
Related Actions: HP-7 and HP-8.

ACTION SP-2:**Return Oyster Shell to Designated Locations Within the Bay**

What Develop regulations and operate a program which results in oyster shell being returned to designated locations within the bay, in order to encourage the creation of additional reef acreage.

How

Step 1 The TPWD has been developing a program that would require the return of oyster shell to designated locations within the bay by commercial oyster harvesters. Funding constraints have slowed the initiation of this program. Complete development of the regulations and operate a program which results in oyster shell being returned to designated locations within the bay, in order to encourage the creation of additional reef acreage.

When

Where Oyster shell to be returned to designated areas with the bay, as determined by TPWD, with input from the species advisory committee (see SP-1).

Who Lead entity: TPWD. Other participants: Oyster Advisory Committee, NMFS, and commercial oyster harvesters. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD.....	\$ 423,000	• Others	\$ 30,000
• Program	\$ 9,000		
TOTAL.....		\$ 462,000	

Potential Sources of Funding: NOAA, USFWS, EPA, and Texas Legislature.

Regulatory Issues Funding for this program will require an appropriation from the Texas Legislature. Permits will be required from GLO on state-owned lands.

Related Actions: SP-3.

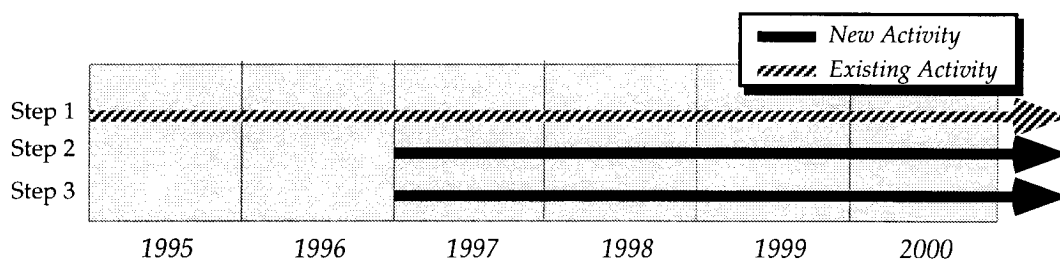
ACTION SP-3: Promote the Development of Oyster Reefs Using Alternate Materials

What Continue and expand programs which promote the development of oyster reefs using alternate materials.

How

- Step 1** Houston Lighting and Power (HL&P), under the sponsorship of the Port of Houston Authority and oversight of various state and federal agencies, is currently conducting an experimental project involving the creation of five acres of reef substrate using coal combustion by-products. This project will be completed and then monitored and evaluated to determine the feasibility of creating reef substrate using alternate materials (Note: this project includes a careful evaluation of long-term contamination potential).
- Step 2** USFWS and TPWD will make additional efforts to identify potential reef substrate materials, will identify optimal locations for reef creation, and will encourage the creation of additional reef acreage by utilizing these materials.
- Step 3** GLO will consider methods to streamline state leasing procedures for oyster reef creation.

When



Where Bay-wide, in areas amenable to reef creation.

Who Lead entity: HL&P (Step 1); USFWS and TPWD (Step 2). Other participants: GLO, TDH, TAMU, Corps, and industry. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD	\$ 73,500	• USFWS	\$ 36,000
• Program	\$ 11,250	• Others	\$ 27,000
TOTAL.....		\$ 147,750	

Potential Sources of Funding: Primary funding provided by HL&P. Additional Potential Sources of Funding: NOAA, USFWS, and EPA. Currently, the five-acre coal combustion byproduct reef indicates costs of about \$100,000 per acre for this type of project.

Regulatory Issues The current leasing process required for the placement of reef substrate needs to be streamlined.

Related Actions: SP-2.

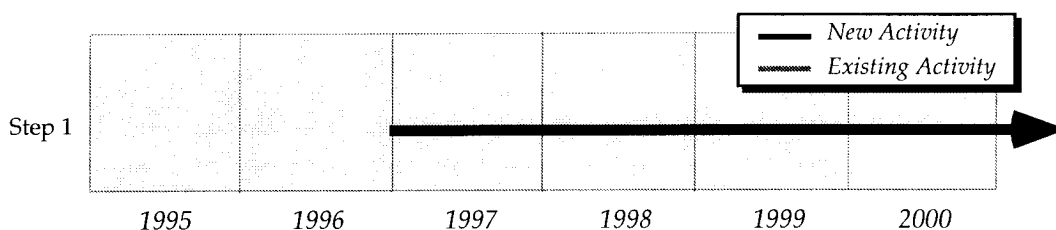
ACTION SP-4: Set Aside a Portion of Reef Habitat as Scientific Research Areas or Preserves

What Set aside a portion of reef habitat as scientific research areas or preserves. The ecology of reef growth and adaptation in the Galveston Bay Estuary requires further study. The creation of new reef habitat offers an excellent opportunity for study of oyster reef accretion and growth processes.

How

Step 1 Designate areas of reef habitat as preserves or research areas by the TPWD. The TPWD will select sites based on input from scientists, commercial oyster harvesters, and the general public. The TPWD will encourage the investigation of reef ecology and the comparison of natural and new oyster reefs established using alternate materials. The TPWD will consider the National Estuarine Research Reserve System in connection with the action to set aside reef habitats.

When



Where At designated locations within the bay, as determined by TPWD.

Who Lead entity: TPWD. Other participants: USFWS, GLO, TDH, NMFS, Sea Grant, industry, and the general public. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD	\$ 30,000	• USFWS	\$ 6,750
• Program	\$ 6,750	• Others	\$ 20,250
TOTAL		\$ 63,750	

Potential Sources of Funding: NOAA, Army Corps of Engineers, and USFWS.

Regulatory Issues May require action by the Texas Legislature or other entities in addition to TPWD. Permits will be required from GLO on state-owned lands.

Related Actions: RSC-2.

ACTION SP-5: Encourage Continued Development of Gear to Reduce Commercial By-Catch

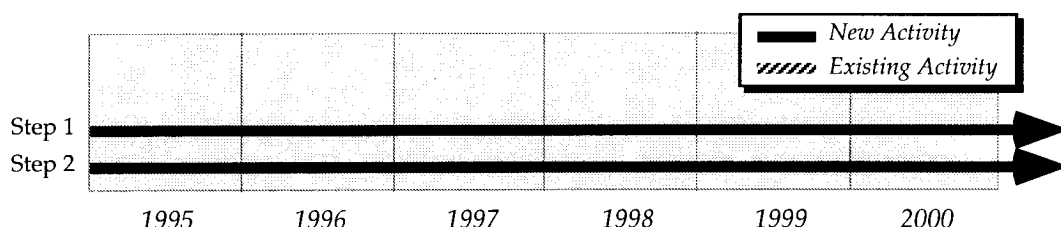
What Encourage continued development of gear and devices to reduce by-catch, and recommend the use of gear and/or devices which can be shown to be both technically and economically feasible and that can significantly reduce by-catch.

How

Step 1 NMFS, with the input of other agencies and groups, will identify gear and devices which can potentially reduce commercial by-catch and continue on-going education programs.

Step 2 NMFS will conduct or sponsor research to optimize design of gear and devices, and will conduct or sponsor pilot studies to assess practicality under actual conditions. These studies will include information regarding the survival rates of by-catch organisms.

When



Where Galveston Bay Program Area.

Who Lead entity: NMFS. Other participants: USFWS, TPWD, Sea Grant, and the commercial fishing industry.
Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• NMFS	\$ 875,000	• Program....	\$ 11,250
• Others.....	\$ 22,500		
TOTAL.....		\$ 908,750	

Potential Sources of Funding: NOAA and USFWS.

Regulatory Issues NMFS has already mandated the use of Turtle Excluder Devices (TEDs).

Related Actions:

ACTION SP-6: Conduct Educational Programs About Catch and Release

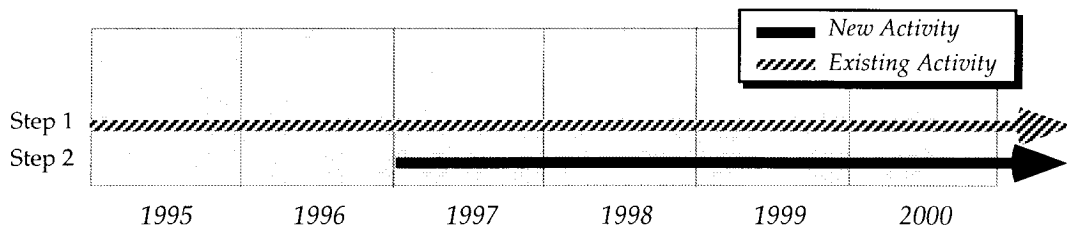
What Conduct educational programs about catch and release (including enhancement of survival rates for released fish) targeted at recreational fishermen.

How

Step 1 TPWD will continue to produce literature about catch and release (including enhancement of survival rates for released fish). The literature will be distributed to recreational fishermen.

Step 2 As part of an effort to increase awareness concerning the environmental importance of catch and release fishing, TPWD will establish a certification program for instructors. Certified instructors will provide catch and release workshops at bay area marinas, piers, and tackle shops.

When



Where Galveston Bay Program Area.

Who Lead entity: TPWD. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD	\$ 90,000
• Program.....	\$ 6,750
TOTAL.....	\$ 96,750

Potential Sources of Funding: NOAA and USFWS. Sea Grant will be considered as a potential funding source for catch and release education programs.

Regulatory Issues None.

Related Actions: PPE-8.

ACTION SP-7

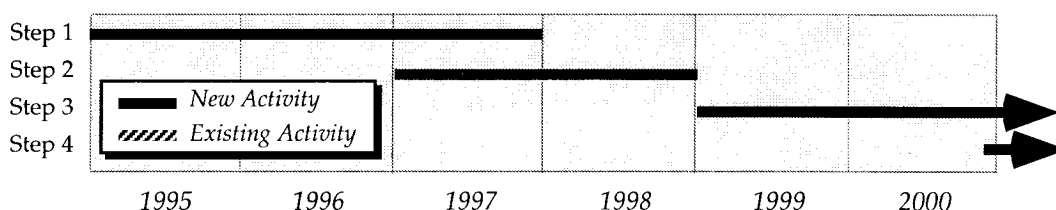
Investigate Potential Measures to Reduce Impingement and Entrainment

What Investigate potential measures to reduce impingement and entrainment and increase survival rates of impinged and entrained organisms at power generation stations which utilize bay water for cooling.

How

- Step 1 HL&P has conducted and plans to conduct research on potential technology to reduce impingement and entrainment at its five power generation stations which utilize bay water for cooling.
- Step 2 Based on these studies, HL&P will identify practicable methods for reducing impingement and entrainment.
- Step 3 HL&P will support research on impingement reduction methods and monitor the ongoing EPA development of regulations establishing plant intake design standards.
- Step 4 HL&P will implement the requirements of EPA's forthcoming intake design standards regulations.

When



Where At the five HL&P power generation stations which utilize bay water for cooling.

Who Lead entity: HL&P. Other participants: TPWD, USFWS, and Sea Grant. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD	\$ 22,500	• USFWS	\$ 22,500
• Program	\$ 6,750	• Sea Grant.....	\$ 6,750
TOTAL.....		\$ 58,500	

Potential Sources of Funding: Primary funding provided by HL&P. Additional Potential Sources of Funding: NOAA.

Regulatory Issues Any future electric generating stations may have to comply with a proposed CMP policy which states that facilities that use once-through cooling shall be located and designed to have the least adverse effects practicable, including impingement and entrainment of estuarine organisms.

Related Actions:

ACTION SP-8:**Develop Management Plans for Endangered or Threatened Species**

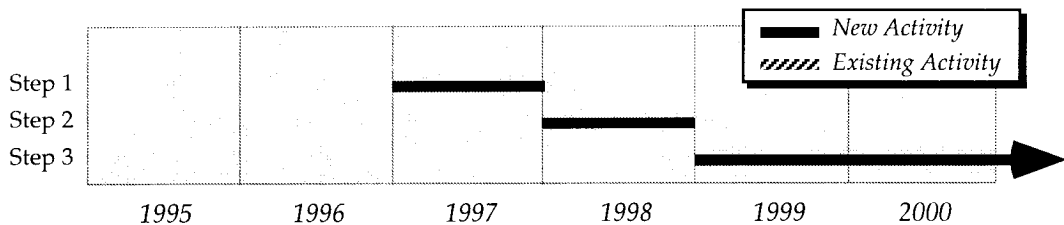
What Develop management plans for the diamondback terrapin and other endangered, threatened, candidate species, or other species of concern. Adopt management plans already in place for sea turtles and other endangered species.

How

Step 1 TPWD will identify species present in the Galveston Bay Estuary which are endangered or candidate endangered species.

Step 2 For those species of concern (see above) lacking management plans, including the diamondback terrapin, TPWD will adopt NMFS or USFWS management plans or develop a Galveston Bay management plan for protection of the identified species.

Step 3 TPWD will take appropriate measures to implement plans.

When

Where Galveston Bay Program Area.

Who Lead entity: TPWD. Other participants: USFWS and NMFS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TPWD..... \$ 182,250	• Program\$ 6,750
• USFWS.....\$ 6,750	• NMFS..... \$ 6,750
TOTAL..... \$ 202,500	

Potential Sources of Funding: USFWS and Corps.

Regulatory Issues None.

Related Actions:

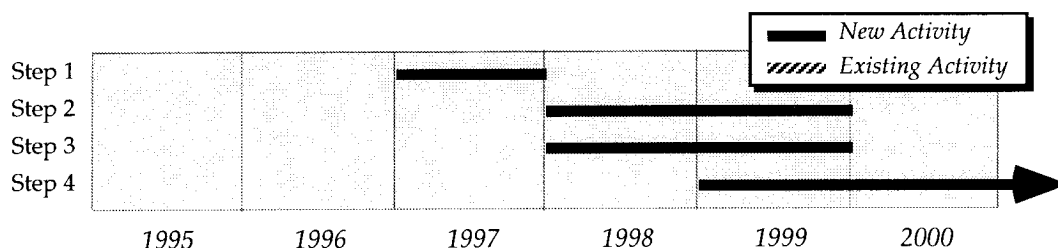
ACTION SP-9: Improve Enforcement of Prohibitions Against the Introduction of Exotic Species

What Identify appropriate legislation which regulates the introduction of exotic species, and use available tools to improve the enforcement of prohibitions against the importation of exotic species.

How

- Step 1 USFWS will identify appropriate national-level legislation which regulates the introduction of exotic species.
- Step 2 USFWS will disseminate information regarding these regulations to enforcement agencies, commercial shippers, and the public
- Step 3 USFWS will conduct training of enforcement officials and hire additional enforcement officials, as needed, to improve enforcement of the regulations.
- Step 4 USFWS will secure the passage of legislation or the creation of regulations which prohibits the discharge of bilge water within the Galveston Bay System. USFWS, TPWD, and USCG will enforce the prohibition.

When



Where Galveston Bay Program Area.

Who Lead entity: USFWS, TPWD, USCG. Other participants: NMFS and EPA Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• USFWS	\$ 252,250	• Others	\$ 13,500
• Program	\$ 6,750		
TOTAL		\$ 272,500	

Potential Sources of Funding: USFWS and Corps.

Regulatory Issues Clarification of the scope of enforcement authority will be required.

Related Actions:

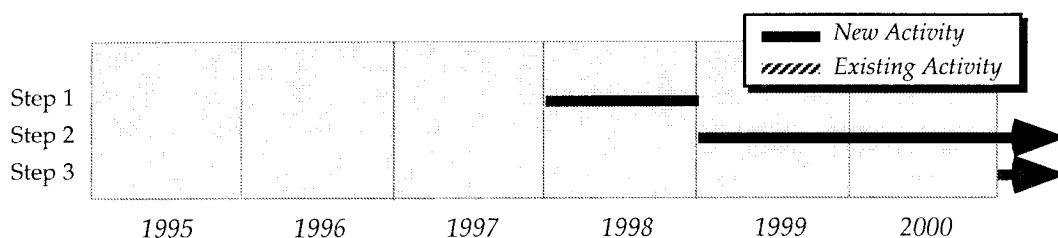
ACTION SP-10: Identify and Implement Techniques for the Control of Problem Exotic Species

What Identify and implement effective techniques for the control of problem exotic species populations, such as nutria, grass carp, and fire ants. Within the Galveston Bay Estuary, the introduction and proliferation of exotic opportunistic species such as nutria, grass carp, and fire ants have contributed to the degradation of some portions of the estuarine habitat.

How

- Step 1 TPWD will identify effective techniques for the control of problem exotic species (i.e., nutria, grass carp, and fire ants).
- Step 2 TPWD will conduct pilot test to determine effectiveness of species control techniques.
- Step 3 TPWD will expand successful programs to control populations of exotic species.

When



Where Trinity River and San Jacinto River portions of the estuary (nutria and grass carp); low-salinity marshes (nutria); and bird nesting areas (fire ants).

Who Lead entity: TPWD. Other participants: NMFS, USFWS, and SCS. Role of Galveston Bay Program: Tracking.

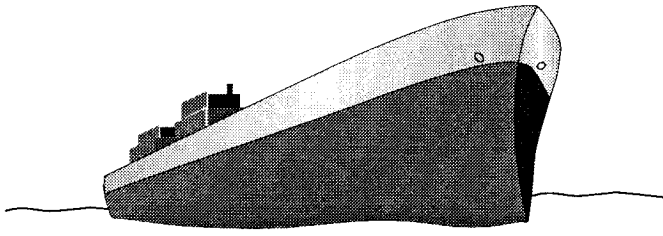
Public Costs of New Actions (5 years)

• TPWD	\$ 150,000	• Others.....	\$ 13,500
• Program	\$ 4,500		
TOTAL.....		\$ 168,000	

Potential Sources of Funding: USFWS and Corps.

Regulatory Issues Need stronger enforcement programs.

Related Actions:



III.

Balanced Human Uses

This section of *The Galveston Bay Plan* deals with maintaining a balance between public access to bay resources and the environmental requirements of a healthy ecosystem. Action plans were developed to address four categories of human uses of the bay.

Public Health Protection Requirements for monitoring seafood and shellfish taken from the bay are considered in order to maintain adequate public health standards and reduce potential health risk resulting from consumption of seafood contaminated with toxic substances. Measures are recommended for decreasing the risks associated with using the bay for contact recreation ([see page 92](#)).

Freshwater Inflow and Bay Circulation Adequate seasonal inflow of high quality freshwater is critical to the living resources of the bay, therefore this action plan recommends that freshwater inflow be managed on a comprehensive watershed basis. A phased approach is supported beginning with increased understanding of the issues and building towards improved management of the volume, timing, and quality of freshwater inflows to the estuary ([see page 93](#)).

Spills/Dumping This action recognizes and supports the continuing spill contingency planning response efforts already in place. Additional public education and storm water screening efforts are recommended to eliminate shoreline and water-borne debris by reducing the amount of trash reaching the bay ([see page 109](#)).

Shoreline Management Comprehensive planning for shoreline development in the area immediately adjacent to the bay is recommended to address impacts from new and existing structures. In addition, access to publicly owned shoreline resources should be provided in a manner that minimizes degradation of the bay ([see page 127](#)).

Public Health Protection

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
PH-1	Medium	Develop a seafood consumption safety program	90
PH-2	Low	Enhance the TDH Shellfish Sanitation Program	91
PH 3	Low	Develop a contact recreation advisory program.....	92

THE ISSUES

Galveston Bay is the state's largest estuarine source of seafood, and is one of the major oyster producing areas in the country. Commercial and recreational fishing represents a nearly one billion dollar per year industry. Molluscan shellfish (oysters, clams, and mussels) and other seafood (crabs, shrimp, and finfish) harvested from Galveston Bay are consumed by millions of individuals. Maintenance of adequate public health standards within estuarine seafood is important for the protection of the general public, and is also critical for the long-term stability of the fishing industry. *The Galveston Bay Plan* recommends the following initiatives for public health protection:

- **Risk Management:** Galveston Bay receives the largest total amount of industrial and municipal effluent of all Texas estuaries, and also receives significant amounts of contaminants from non-point sources via storm water runoff. Loading estimates for a large number of metals and organic chemicals are incomplete, and insufficient data are available regarding the distribution of potentially toxic compounds within estuarine waters and sediment. Fish and shellfish from Galveston Bay are not routinely sampled for toxic contaminants, nor are consumer risks routinely assessed by any government entity and communicated to the public. To address this situation, the Public Health Protection Task Force of the Galveston Bay National Estuary Program (GBNEP) recommends additional research to establish risk-based standards for toxic contaminants within seafood. Based on established standards, the implementation of a seafood

sampling, analysis, and risk communication program is recommended to safeguard the quality of seafood produced from the Galveston Bay Estuary.

- **Shellfish Sanitation Program:** The Texas Department of Health (TDH) has controlled the harvest of shellfish from Galveston Bay for approximately 40 years, and the quality of produced molluscan shellfish has been maintained at a level which has posed a minimal risk of illness. However, limited funding is available for this shellfish program, and accordingly, shellfish closures are larger than would be necessary with greater frequency of field sampling. To address this problem, an expansion of the shellfish sampling program, including more frequent sampling, is recommended.
- **Contact Recreation Advisory Program:** All open bay areas of Galveston Bay presently conform to current Texas water quality standards for contact recreation. However, fecal coliform concentrations exceeding the state standard for contact recreation have been observed from three tidal tributaries on the more developed western side of the bay: Buffalo Bayou Tidal, Clear Creek Tidal, and Dickinson Bayou Tidal; and additional problems have been reported at Highland Bayou, the Diversion Canal, Moses Lake, Moses Bayou, Offats Bayou, Galveston Ship Channel, the Texas City Dike, and Chocolate Bayou. To ensure that contact recreation only occurs in areas that are in conformance with state water quality standards, this action supports the development of a contact recreation advisory program focusing on potential problem areas on the west side of the bay.

ENVIRONMENTAL STATUS

Status and Trends

The major public health issues associated with the Galveston Bay Estuary are 1) the consumption of molluscan shellfish, primarily oysters; 2) the consumption of other seafood (crabs, shrimp, and finfish); and 3) contact recreation.

Water Quality Standards

A measurement of the number of microorganisms in natural waters is used to determine if those waters are safe for different uses, such as contact recreation (swimming, wading, etc.), non-contact recreation (boating), and shellfish harvesting. For example, if there are too many bacteria in the waters of the bay, then there is a chance that a swimmer will become ill from contact with the water. As would be expected, water relatively free of bacteria is needed to harvest filter feeders such as shellfish than for swimming, while more bacteria can be tolerated for non-contact as compared to contact recreation.

Because it is difficult to measure all of the different microorganisms in water, fecal coliform bacteria are currently used as an indicator parameter. In the Galveston Bay system, the State of Texas uses fecal coliform counts to determine if waters are safe for three different uses:

- 1) A water is acceptable for **harvesting shellfish** if the fecal coliform count is less than 14 fecal coliform colonies per 100 milliliters of water and not more than 10 percent of the samples exceed 43 fecal coliform colonies per 100 milliliters of water.
- 2) A water is safe for **contact recreation** if the fecal coliform count is less than 200 fecal coliform colonies per 100 milliliters of water as a geometric mean based on five samples collected over a 30-day period; and the fecal coliform count is less than 400 in greater than 90 percent of all samples, based on at least five samples taken during any 30-day period. If 10 or fewer samples are analyzed, only one sample can exceed 400 colonies per 100 milliliters.
- 3) A water is safe for **non-contact recreation** if the fecal coliform count is less than 2000 fecal coliform colonies per 100 milliliters of water.

Although the fecal coliform test has been used successfully (as measured by an overall good quality of shellfish from Galveston Bay sold for human consumption) for many years, it is by no means an ideal indicator organism. One major limitation of the test is that it is subject to many false positive results (that is, it may indicate that a health risk exists when one does not exist). On the other hand, the test does not directly measure several of the naturally occurring pathogens, such as *Vibrio vulnificus*, which may be harmful if contacted or consumed. Through the National Indicator Study, research is currently underway on the national level to investigate potential replacements for the fecal coliform test which may reduce the incidence of false positives while providing a higher level of protection against other pathogens. Development and adaptation of an improved testing procedure, however, is not anticipated within the next several years.

Seafood Monitoring

The Galveston Bay Estuary supports a major commercial and recreational fishery, which sustains such species as white shrimp, flounder, sea trout, blue crab, oysters, black drum, red drum, and menhaden. However, despite the fact that the bay receives waste waters from one of the largest industrial centers in the country, the TDH has no funding for routine fish tissue sampling and analysis. Instead, the current TDH seafood advisory program must rely upon fish tissue studies that may be conducted by other organizations, agencies, or researchers.

To date, two seafood consumption advisories have been issued within the Galveston Bay Estuary. The first consumption advisory, which was issued in 1990 and is still in effect, recommends only limited consumption of catfish and blue crab taken from the Houston Ship Channel and a contiguous portion of the upper Galveston Bay, due to the detection of dioxin within samples of these two species in this portion of the estuary. The second advisory is based on three toxic compounds discovered in fish from Clear Creek, one of the principal tributaries on the bay's western shoreline. The contaminated fish were found in the vicinity of the former Brio Refining Company, a U. S. Environmental Protection Agency (EPA) Superfund site where a cleanup of toxic industrial compounds is in the early stages.

Available information to characterize the risk from eating seafood from Galveston Bay is extremely limited. Because of the lack of historical information, GBNEP recently sponsored a

study which investigated the risk attributable to toxic contaminants in five species of fish and shellfish harvested from four separate locations within Galveston Bay. The contaminants included in the study were heavy metals, polynuclear aromatic hydrocarbons (PAHs), selected chlorinated pesticides, and polychlorinated biphenyls (PCBs). These contaminants were measured in the tissues of oysters, blue crab, spotted seatrout, black drum, and southern flounder from Morgans Point (at the mouth of the Houston Ship Channel), Eagle Point (near San Leon, on the west side of the bay), Carancahua Reef (in West Bay), and Hanna Reef (in East Bay). The results of the study indicated Morgans Point to be the most contaminated sampling site, with contamination of seafood tissue generally decreasing downbay. The study measured the estimated risk level associated with consumption of average amounts of seafood in some parts of the bay to be above the benchmark risk level used by the EPA in previous studies to identify possible problems. Additional research will be required, however, to obtain a more comprehensive understanding of potential risks associated with seafood consumption.

Shellfish Harvesting

The Galveston Bay Estuary is the largest producer of oysters in Texas, typically accounting for 50-80 percent of total state production. TDH administers a molluscan shellfish classification and monitoring program which determines those areas of the bay open to oyster harvesting. This program utilizes the fecal coliform test as an indicator of the possible presence of disease-causing bacteria.

Based upon the results of comprehensive sanitary surveys, the TDH has categorized the majority of estuary waters into four classifications for oyster harvest: 1) Approved, 2) Conditionally Approved, 3) Restricted, and 4) Prohibited. *Approved areas* are acceptable for direct market harvesting under all but very unusual situations. *Conditionally approved areas* are subject to occasional changes which make them unacceptable for harvesting, such as elevated fecal coliform concentrations in water triggered by a significant rainfall. Following a temporary closing of a conditionally approved area, the area must be re-sampled to confirm acceptable harvesting conditions prior to being reopened. *Restricted areas* are unacceptable for harvesting without cleansing of the shellfish before entry into the market. The fourth category, *prohibited area*, is used in several areas immediately surrounding sewage treatment outfalls entering directly into growing areas. Harvesting is not allowed from prohibited areas for any reason. Harvest classification areas as 1991 are shown on Figure PH-1, with restricted and prohibited areas combined under the category *Polluted Area*.

Due to the inherent conservatism of the fecal coliform test as an indicator of bacterial contamination (it *overestimates* the actual health risk), and because of a shortage of funding which restricts the frequency of shellfish area sampling, the current program results in limited shellfish harvesting in larger portions of the bay and for longer periods of time than would be warranted based on public health considerations alone. However, the program has succeeded in ensuring the production of shellfish which, on the whole, present a minimal risk of illness to consumers. In those instances when illness has been linked to shellfish consumption, improper handling of shellfish following harvest, rather than the produced shellfish itself, has most frequently been identified as the source of the problem.

Contact Recreation

The current Texas water quality criterion for contact recreation is 200 fecal coliform colonies per 100 milliliters of water. All open bay areas of the estuarine system are generally in conformance with this standard. Fecal coliform concentrations within western bay tributaries declined dramatically during the 1970s and 1980s, reflecting the influence of improved wastewater treatment. However, fecal coliform levels above the standard have recently been reported from three tidal tributaries on the west side of the bay: Buffalo Bayou Tidal, Clear Creek Tidal, and Dickinson Bayou Tidal. Additional problems have been reported at Highland Bayou, the Diversion Canal, Moses Lake, Moses Bayou, Offats Bayou, Galveston Ship Channel, the Texas City Dike, Chocolate Bayou and several urbanized freshwater tributaries.

Potential risks from pathogens associated with contact recreation in the open parts of the bay system are considered to be relatively low, with increased risks in tributaries, waters receiving large quantities of urban drainage, and areas with poor circulation. Variation in recreational water quality due to rainfall and changes in circulation patterns make real-time information concerning water quality virtually impossible to attain. Currently, no routine sampling program exists within the estuary to monitor fecal coliform or toxicant concentrations in contact recreation areas.

Probable Causes

Studies of toxicants within the Galveston Bay Estuary show concentrations to be generally higher in the upper bay, near the source of the largest municipal and industrial discharges, as compared to the middle and lower bay. Sources of toxicants within the bay system include wastewater discharge from industrial facilities, municipal treatment plant outfalls, storm water runoff, oil and gas production wastes, and airborne combustion by-products from vehicular and industrial sources. Some toxicants, such as PCBs and heavy metals, can remain in estuarine sediments for many years, acting as long-term potential sources of contamination. Point source discharges are known to have declined over the last several decades. At present, a complete picture of contaminant sources and distribution is beyond the scope of the available data.

Recent studies of the bay have identified a static to decreasing trend for fecal coliform loadings to the bay over the last 20 to 30 years, and a decreasing trend for fecal coliform concentration within the Houston Ship Channel over the last 10 to 20 years. The primary source of fecal coliform bacteria to the estuary is non-point source runoff. Urban areas contribute much higher fecal coliform concentrations as compared to less developed areas, due both to higher concentrations in storm water runoff and the added contribution from sewer leaks and overflows. Point sources represent an insignificant source of fecal coliform bacteria to Galveston Bay, because disinfection, which is typically applied to point source discharges, is very effective in controlling fecal coliform concentrations. Shoreline septic systems contribute only a small volume of water to the bay. While the water quality impact of these shoreline septic systems is not currently known, they may possibly have an impact in specific areas of restricted circulation, such as Dickinson Bayou and other side-bays and tributaries.

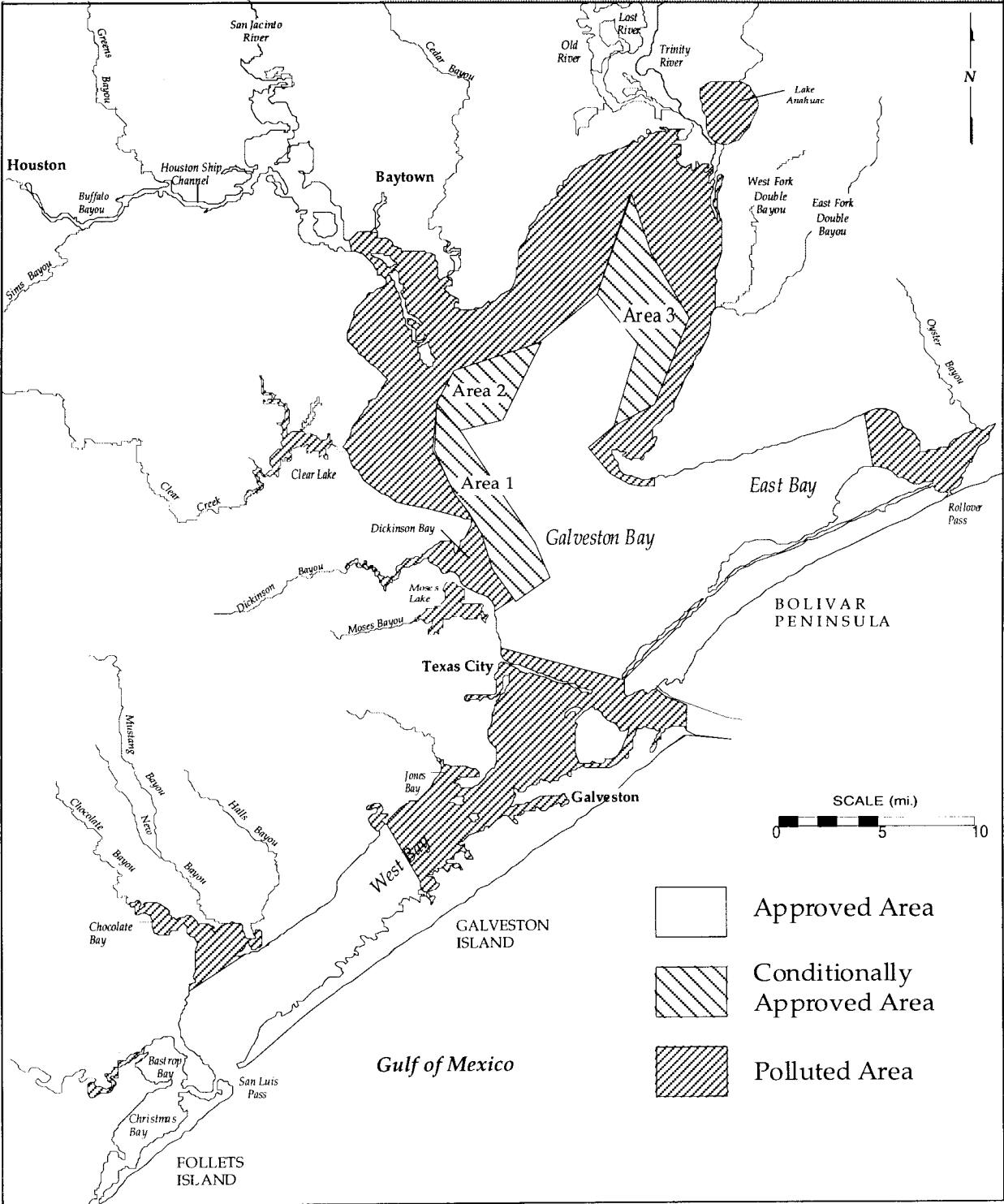


FIGURE PH-1: Shellfish Harvesting Areas, 1991

MANAGEMENT STATUS

Seafood Monitoring

Currently, there is no program for routine monitoring of toxic contaminant concentrations in fish and shellfish harvested from Galveston Bay. Monitoring of toxic contaminants in fish tissue is expensive due to the sophisticated laboratory analyses that must be performed. Under current funding limitations, establishment of a seafood monitoring program that includes routine periodic sampling and analysis of fish tissue is not possible.

When potential problems are identified by fish tissue studies conducted by other organizations or agencies, the TDH may issue seafood consumption advisories or area closures under the authority of the Texas Aquatic Life Law. Prior to issuing a consumption advisory or area closure, the TDH performs a risk assessment based upon the data provided in the fish tissue study.

If a risk assessment indicates an imminent health hazard, the affected area is declared *Prohibited* for the taking of affected species. Fishing or harvesting of affected species from the *Prohibited* area is a violation of the law. An imminent hazard would exist if one meal or a few meals resulted in immediate or acute health problems. If a hazard exists, but frequent long term consumption is required to cause the health effects, a *Consumption Advisory* would be issued. If the risk assessment indicates that observed concentrations do not present a health hazard, TDH advises the originating agency and the public is notified. Two seafood consumption advisories have been issued to date for the Galveston Bay area.

Shellfish Harvesting

The National Shellfish Sanitation Program (NSSP) is a cooperative effort between the federal Food and Drug Administration (FDA), state governments, and the shellfish industry to classify shellfish growing areas and to certify interstate shellfish shippers as described by the NSSP Manual of Operations. States voluntarily adopt these guidelines that include provisions for the following activities:

- Conducting sanitary surveys of growing areas
- Delineating prohibited growing areas (for example, the TPWD classifies all oyster waters as open to oystering, closed to oystering, or conditionally closed to oystering under certain circumstances).
- Inspecting shellfish plants
- Issuing certificates to shellfish dealers in compliance with state sanitary laws

The FDA evaluates each state's compliance with the NSSP guidelines. The FDA's activities include inspection of shellfish processing plants, growing areas, and test laboratories. The FDA publishes a monthly list of shellfish dealers certified by the states to pack and ship shellfish.

The TDH Division of Shellfish Sanitation Control oversees the human health aspects of consuming and processing crabs and shellfish. The state has adopted the NSSP guidelines as regulations. TDH's responsibilities include:

- Classifying shellfish growing waters
 - Sampling shellfish for contaminants which affect human health
- Regulating the harvesting, processing and shipping of shellfish
 - Inspecting and licensing of processing plants

In addition, the TDH periodically collects water samples, analyzes the samples for fecal coliform concentration, and adjusts the harvest status of oyster fishing areas based on the sampling results.

The Texas Parks and Wildlife Department (TPWD) has responsibility for the enforcement of laws concerning harvesting and depletion of seafood, including oysters and other shellfish. TPWD game wardens regulate the harvesting activities of commercial oyster boats.

Shellfish classifications in Texas are relatively conservative because of the limited sampling effort that can be achieved under current funding constraints. Of the 331,000 acres available for shellfish production in Galveston Bay, 60 percent were closed in 1990 under the procedures established by the TDH shellfish sanitation program. With increased sampling, it is believed that unnecessary closures could be significantly reduced, opening more of the bay to commercial oyster harvest. Policing of closed or restricted areas is also severely limited by funding. Approximately 20 game wardens from the TPWD are employed in the Galveston Bay area but only a small portion of their time can be allocated to oversee the 200-400 active commercial oyster boats.

Contact Recreation

No contact recreation advisory program is currently in place within the Galveston Bay Estuary. Although fecal coliform concentrations in excess of the state contact recreation standard have been documented in western bay tributaries where contact recreation is known to take place, no routine sampling or public notification is performed in these areas due to a lack of available funding. Effective implementation of such a program would be complicated by the constantly changing conditions in near-shore areas, which make accurate characterization of bacterial conditions virtually unachievable on a real-time basis.

Pollution Reduction

A fundamental component of a long-term strategy for the reduction of potential health risks associated with seafood consumption is a reduction of contaminant loadings to the estuary. This aspect of public health protection is addressed in the action plans primarily concerned with water quality (Water and Sediment Quality, Non-Point Sources of Pollution, and Point Sources of Pollution). The actions included under this Public Health Protection Action Plan focus upon the characterization and management of current and future public health risks posed by human-caused impacts to the estuary. Information regarding potential public health

problems identified during the course of these actions will be provided to the agencies and entities concerned with pollution reduction, to facilitate identification and reduction of the contaminant sources.

PUBLIC HEALTH PROTECTION ACTION PLAN

To maintain and enhance the Galveston Bay environment to ensure that seafood produced is safe for human consumption and water quality is safe for contact recreation.

OVERVIEW

Priority Problem

Seafood from some areas in Galveston Bay may pose a public health risk to subsistence or recreational catch seafood consumers as a result of the potential presence of toxic substances. Fish and shellfish from Galveston Bay are not routinely sampled for toxic contaminants, nor are consumer risks routinely assessed by any government entity and communicated to the public. The current risk level represented by seafood consumption is difficult to quantify, due to a shortage of high-quality sampling data.

Goal

Reduce potential health risk resulting from consumption of seafood contaminated with toxic substances.

Objective

By the year 2000, reduce the risk of consumption of Galveston Bay seafood containing tissue concentrations of toxic substances above risk level standards established by the TDH.

Action PH-1 Develop a seafood consumption safety program.

Priority Problem

About half of the bay is permanently or provisionally closed to the taking of shellfish because of high fecal coliform bacterial levels that may indicate risk to shellfish consumers. Of the 331,000 acres available for shellfish production in Galveston Bay, 60 percent were closed in 1990 under the procedures established by the TDH shellfish sanitation program. With increased sampling, it is believed that unnecessary closures could be significantly reduced, opening more of the bay to commercial oyster harvest.

Goal

Reduce oyster reef harvest closures.

Objective

Increase oyster reef areas open to harvest by 25 percent on a spatial and temporal basis by August 31, 1995, as compared to a 1988 baseline (the last major reclassification of Galveston Bay oyster reef areas was conducted in 1988).

Action PH-2: Enhance the TDH Shellfish Sanitation Program.

Priority Problem

Some tributaries and near-shore areas of Galveston Bay may not be safe for contact recreational activities like swimming, wade-fishing, and sail-boarding due to the risk of bacterial infection. Potential risks associated with contact recreation in the open bay are considered to be relatively low. However, no routine sampling program currently exists within the estuary to monitor fecal coliform or other potentially harmful pollutants in the tributary areas frequently used for contact recreation.

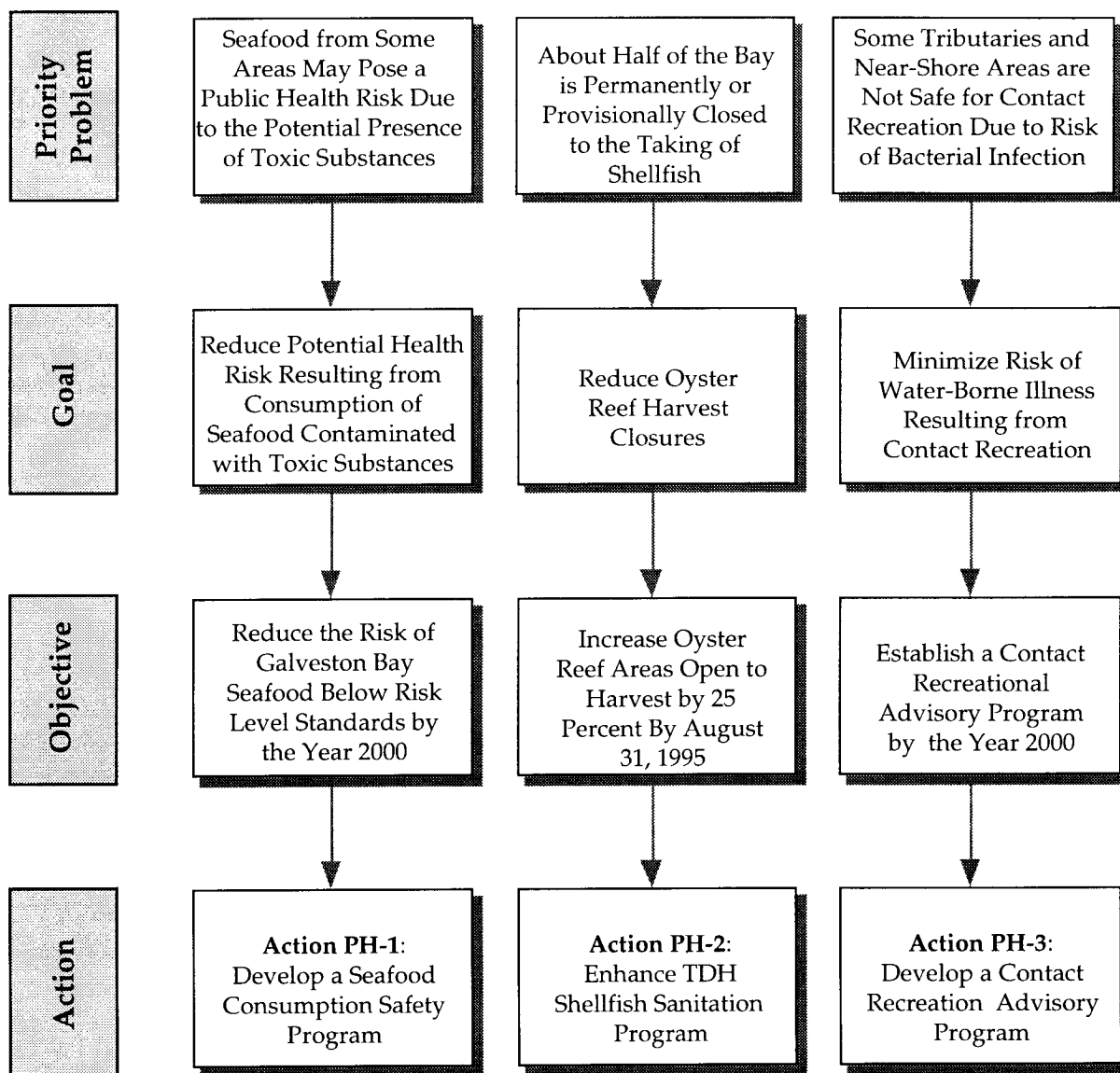
Goal

Minimize risk of water-borne illness resulting from contact recreation.

Objective

By the year 2000, establish a contact recreational advisory program in all areas of the estuary commonly used for contact recreation.

Action PH 3: Develop a contact recreation advisory program.

**Public Health Protection Action Flowchart**

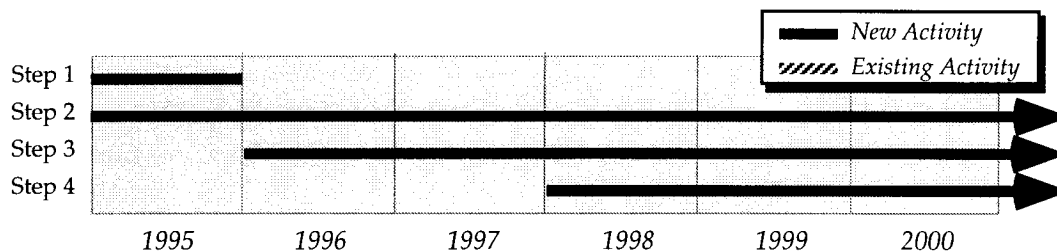
ACTION PH-1: Develop a Seafood Consumption Safety Program

What Develop a seafood consumption safety program to characterize and monitor any potential health risks to consumers of Galveston Bay seafood and inform the public of identified risks.

How

- Step 1** TDH will establish applicable standards, a risk assessment methodology, and a risk management process. Standards will be established for selected metals and organic compounds, including PCBs, PAHs, heavy metals, pesticides, and dioxins. These standards will apply to seafood, including molluscan shellfish, harvested from the Galveston Bay Estuary.
- Step 2** TDH will pursue federal funding sources as well as funding through the Texas Legislature.
- Step 3** TDH will, provided adequate funding is made available, begin a seafood monitoring program, utilizing the standards, risk assessment methodology, and risk management procedures developed in Step 1. The monitoring program will consist of periodic sampling and analysis of seafood from various locations within the estuary. The monitoring program will also include a public education program, involving the regular distribution of information regarding the seafood safety program, public forums, public meetings, news releases, the distribution of advisory pamphlets, and the installation and maintenance of signs. The seafood monitoring program will be coordinated with the Regional Monitoring Plan for the Galveston Bay Estuary (see Regional Monitoring Plan).
- Step 4** If the monitoring program identifies elevated concentrations of toxic substances, TDH will coordinate with the TNRCC, local governments, and other management agencies to incorporate measures to identify and eliminate the contaminant sources. The TNRCC will have primary responsibility for enforcing effective control of the source(s) of contamination. (Several actions under Water and Sediment Quality, Point Source Pollution, and Non-point Source Pollution address reducing contaminant sources to the estuary).

When



Where Galveston Bay Program Area.

Who Lead entity: TDH. Other participants: TNRCC, EPA, and local governments will be involved with reducing contamination that might be identified by the monitoring program. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 11,250
• TDH	\$ 2,400,000
TOTAL	\$ 2,411,250

Potential Sources of Funding: NOAA and Texas Legislature.

Regulatory Issues None.

Related Actions: NPS-4, NPS-6, NPS-11, NPS-13, NPS-16, and PPE-3.

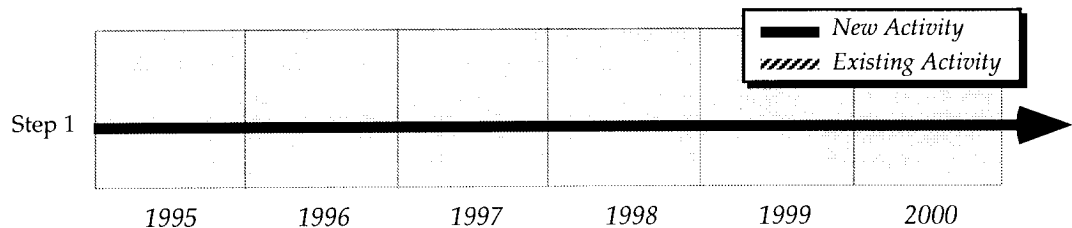
ACTION PH-2: Enhance the TDH Shellfish Sanitation Program

What Conduct more frequent water sampling in shellfish harvesting areas of Galveston Bay. With increased sampling, it is believed that unnecessary closures could be significantly reduced, opening more of the bay to commercial oyster harvest.

How

Step 1 TDH will increase the frequency of water sampling to more precisely determine the area and period of required molluscan shellfish closures. TDH will conduct public education and disseminate information regarding the closure process. TDH will pursue additional funding to implement this program.

When



Where Primarily in Conditionally Approved oyster harvest areas (see Figure PH-1).

Who Lead entity: TDH. Other participants: TPWD and USGS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 11,250
• TDH	\$ 217,000
TOTAL	\$ 228,250

Potential Sources of Funding: NOAA, USFWS, and Texas Legislature.

Regulatory Issues Continue coordination with emerging federal actions and the NSSP program. Support the completion of the National Indicator Study and the development of an improved indicator parameter for the determination of molluscan shellfish closures.

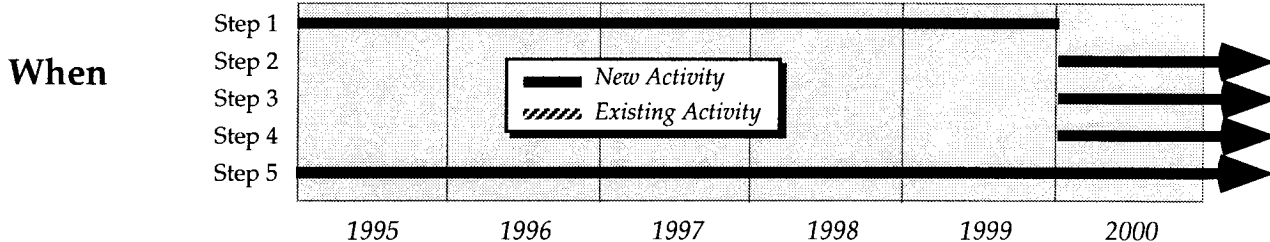
Related Actions: PS-1, PS-2, PS-5, NPS-3, NPS-4, NPS-6, NPS-14, NPS-15, and PPE-3.

ACTION PH-3: Develop a Contact Recreation Advisory Program

What Develop an effective contact recreation public health program to reduce the potential risk of bacterial infection.

How

- Step 1** TDH will, utilizing the current TNRCC fecal coliform standard for contact recreation (or other indicators, if developed), develop a methodology for determining if high-use areas are safe for contact recreation. This step will require research to investigate the relationship between waterborne illness, contact recreation and indicator organism concentration.
- Step 2** TDH will increase the frequency of monitoring in high-use areas to determine potential public health problems with contact recreation.
- Step 3** TDH will analyze the results of the monitoring, identify sources of contaminants, and link with pollution abatement and enforcement programs of state management agencies and local governments. These local governments and state and federal agencies (primarily the EPA and the TNRCC) will be responsible for enforcing effective control of the source(s) of contamination.
- Step 4** Local governments will coordinate with TDH to close unsafe areas to contact recreation. TDH will inform the public of potential health risks associated with contact recreation in contaminated areas, possibly by including the use of electronic bulletin boards that are accessible to the public.
- Step 5** In order to improve the long-term effectiveness of the contact recreation program, TDH will support the completion of the National Indicator Study and the development of an improved indicator parameter for contact recreation.



Where High-use contact recreation areas of the estuary (primarily west-side tributaries and side-bays).

Who Lead entity: TDH. Other participants: County and local health agencies, EPA, TNRCC, and USGS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TDH.....	\$ 810,000
• Program.....	\$ 11,250
TOTAL.....	\$ 821,250

Note: Operation of this program, currently scheduled to begin in the year 2000, will require an estimated \$578,530 per year, in addition to the costs included in the above table.

Potential Sources of Funding: NOAA.

Regulatory Issues None.

Related Actions: PS-1, PS-2, PS-5, NPS-3, NPS-4, NPS-6, NPS-14, NPS-15, and PPE-3.

Freshwater Inflow and Bay Circulation

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
FW-1	High	Complete current studies to determine freshwater inflow needs for the bay	102
FW-2	High	Expand streamflow, sediment loading, and rainfall monitoring.....	103
FW-3	High	Establish management strategies for meeting freshwater inflow needs.....	104
FW-4	High	Establish inflow regulations to protect the ecological needs of the estuary	105
FW-5	High	Explore means of providing sediment to the estuary.....	106
FW-6	High	Reduce water consumption.....	107
FW-7	Medium	Evaluate the effects of channels and structures on bay circulation, habitats, and species....	108

THE ISSUES

Among the most important factors governing the health of an estuary are the volume, timing, and quality of freshwater inflows to the estuary and the circulation and mixing of water within the estuary. The mix of river and sea water in Galveston Bay, in addition to the presence of key habitats like salt marshes, is responsible for the bay's high biological productivity. Alterations to the natural volume and timing of freshwater inflow and bay circulation patterns are important ecological concerns. Despite this fact, no statutory assurance exists to provide for freshwater resources and circulation necessary to maintain estuarine health and productivity. Rather, inflow to Galveston Bay is now dealt with on a case-by-case advocacy process presided over by the Texas Natural Resource Conservation Commission (TNRCC). To protect the health of the estuary, the management of freshwater inflow and circulation by monitoring freshwater inflow on a watershed basis is recommended in this action plan.

Tools for determining the amount, quality, location, and timing of inflow required to maintain biological productivity and diversity in the Galveston Bay Estuary are being developed as a part of studies mandated by the Texas legislature. This effort is scheduled for completion in 1994. Pending completion of these ongoing studies (including studies related to the Trans-

Texas Water Program), it is recommended that flexible management targets for freshwater inflow be established, and that Galveston Bay inflow requirements be given appropriate consideration in the watershed water allocation process. Further improvement of freshwater inflow management can be achieved by optimal routing of return flows and the conservation of water on a Galveston Bay watershed basis.

Due to their dependence on natural rainfall patterns and bay geography, freshwater inflow and circulation can only be managed to a limited extent. The results of ongoing and future research will provide additional information about how freshwater inflow to the estuary and circulation patterns within the estuary can best be managed. This action plan therefore supports a phased approach to the management of freshwater inflow, beginning with increased understanding of the issues and building towards improved management of the volume, timing, location, and quality of freshwater inflows to the estuary. The problems addressed by this action plan include:

- An incomplete understanding of the freshwater inflow needs of the estuary
- The lack of adequate monitoring data needed to accurately measure the volume and timing of freshwater inflow at different locations
- The absence of regulations and fully realized management strategies for ensuring adequate inflows to the estuary
- The role of impoundments, dikes, and levees in restricting the transport of sediment and nutrients to the bay, and their effects on bay circulation patterns
- A lack of public recognition of how water consumption can have an environmental impact on the estuary

Seven actions are proposed in *The Galveston Bay Plan* to address freshwater inflow and circulation problems:

- **Freshwater Inflow Management:** Six actions address the management of freshwater inflow adequate to maintain the productivity of economically important and ecologically characteristic species. Studies are needed to determine freshwater inflow and sediment requirements for the bay and to evaluate potential water conservation strategies. Monitoring of streamflow, sediment loading, and rainfall will provide data for the development of inflow regulations to protect the ecological needs of the estuary.
- **Ecosystem Protection:** An evaluation of the potential effects of bay circulation patterns on ecosystems is proposed in this action. Manmade structures and navigation channels will be studied to determine their impact on sediment and nutrient transport as well as circulation patterns within the bay.

ENVIRONMENTAL STATUS

Status and Trends

Freshwater Inflow

The characteristic natural community living in and around Galveston Bay is largely defined by the volume, timing, location, and quality of freshwater inflows into the bay from surrounding drainage basins. Freshwater inflows affect circulation and water quality within the estuary, and many species of fish, wildlife, aquatic plants, and shellfish depend on adequate freshwater inflows for survival. The continued high productivity of the Galveston Bay Estuary as we know it today is due to a great degree on the maintenance of adequate, high-quality freshwater inflow.

The 33,000-square-mile Galveston Bay watershed can be broken into three main elements: the Trinity River, the San Jacinto River, and the local watershed. From 1941 to 1987, freshwater inflows into the estuary averaged approximately 10.1 million acre-feet per year, the equivalent of 4.6 total "flushes" of the bay during an average year. Of the contributing basins, the Trinity River contributed the largest volume of freshwater (54 percent of the total), followed by the San Jacinto River basin (28 percent), and the local watershed (18 percent). Both the Trinity River and San Jacinto river flow through large reservoirs located close to the bay which have reduced sediment and nutrients entering the bay. This reduction of sediments and nutrients entering the bay should be monitored but does not imply that a negative condition exists. The 4500-square-mile local watershed is comprised of roughly equal portions of urban areas, agricultural lands, open/pasture lands, and forests. Within the local watershed, urbanized regions contribute the largest amounts of runoff reaching the bay as a result of impervious cover, such as parking lots, buildings, and roads. The runoff from urban areas greatly increases in wet years; a 30 percent increase in average annual rainfall results in about a 60 percent increase in runoff. Urban runoff is also much more polluted than rural runoff in this area, contributing to the bay's non-point source pollution problems.

The increased demands for freshwater by a growing population along with the construction of surface impoundments and diversions are widely perceived as having reduced freshwater inflow to the bay over time. Significant year-to-year variability in freshwater inflow is apparent, in conjunction with periods of drought and periods of heavy precipitation. However, an analysis of freshwater inflow trends for the period from 1968 to 1987 does not identify statistically significant trends which would indicate an overall reduction of freshwater inflow volume from the Trinity River, or within the estuary basin as a whole. However, some localized changes are apparent. Four of the most urbanized streams which discharge into the bay (White Oak Bayou, Brays Bayou, Sims Bayou, and Greens Bayou) all exhibit increasing flow since the 1960s (< five years) (1 to 3 percent per year on average), likely due to increases in impervious cover and increased return flows of wastewater from both groundwater and surface water.

On a seasonal basis, freshwater inflow to the estuary is normally characterized by peak springtime inflows in May followed by minimum inflows in August. Comparison of monthly mean flows before dam construction (1941-1969) and after dam construction (1972-1987)

indicates that peak flows have been cropped and low flows have been increased and that the timing of peak flows have been delayed slightly. Increasing return flows to the Trinity River and other watersheds have had the effect of elevating base flow during critical low-flow periods. Without the management of water resources, the remaining natural flows, return flows, and inter-basin transfer of water could further alter seasonal flow patterns and annual total quantities of water received by the bay, to the extent that the population dynamics for some estuarine species would likely be adversely affected.

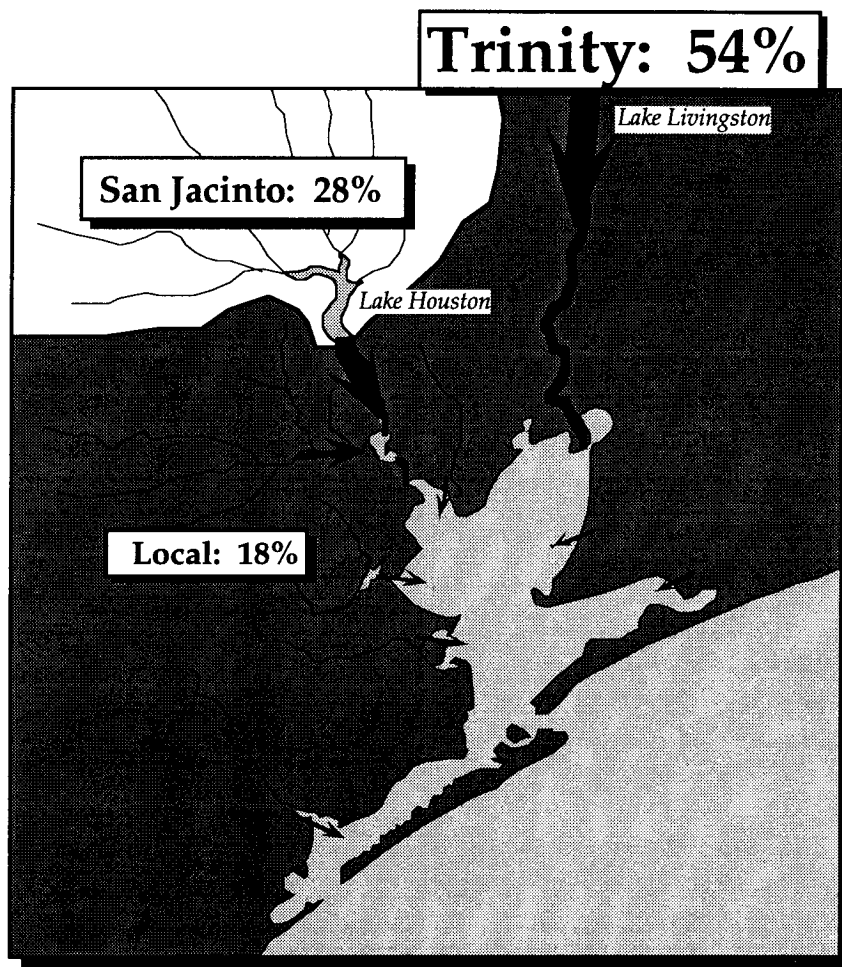


FIGURE FW-1: Average Freshwater Inflow Contributions

Two proposed water supply projects have the potential to alter freshwater inflow patterns to Galveston Bay. The Wallisville Project is a proposed reservoir on the lower Trinity River near Interstate Highway 10, now designed as a barrier to saltwater intrusion. This project would be a part of a larger effort to divert Trinity River water westward to the Houston metropolitan region for water supply purposes. Some diverted water would be lost through lawn watering, process use, and distribution losses, while some would be returned to the bay via wastewater treatment plants. A second project, the Texas Water Development Board's "Trans-Texas Project," would divert water westward from the Sabine River basin. This would result in

additional freshwater brought to Galveston Bay from outside the watershed, for a net increase in inflow.

Bay Circulation

The circulation of water in Galveston Bay is influenced by many bay features, including depth patterns, winds, tides, and freshwater inflow. In turn, circulation is a major force affecting the distribution of sediments, the location of oyster reefs, salinity gradients, and other habitat elements. When compared to other estuaries, Galveston Bay is affected much more by winds and less by tides than east and west coast bays.

The shallow nature of Galveston Bay has resulted in channel dredging for navigation, dike construction, and island creation, with corresponding significant influences on circulation. The Houston Ship Channel, the most prominent dredged feature in the bay, provides the primary mechanism for salt water intrusion, allowing higher salinity water to intrude farther into the bay. Dredged material areas on the margins of the Ship Channel form a barrier between the eastern and western portions of the bay. The Texas City Dike, originally constructed in 1915 to facilitate maintenance on the Texas City Ship Channel, has fundamentally altered the currents in the lower bay and has reduced circulation to West Bay. Some scientists have postulated that restricted circulation caused by the dike is responsible for reduced oyster reef productivity near Pelican Island and in central West Bay.

Cooling water intakes are another significant influence on circulation patterns within the bay. The combined annual volume of flow through two large power generating stations is equal to about half of the annual freshwater inflow to the bay.

Probable Causes

Freshwater inflows to the estuary are affected by year-to-year variability in precipitation, by impoundments, increases in return flows from wastewater treatment, urban development and the associated increase in impervious cover, and the import of water across watershed boundaries.

Circulation patterns are affected by a combination of natural factors and human activities. Primary natural factors included wind, bay geometry, tides, and rainfall patterns. Man-made structures and activities which affect bay circulation patterns include dredged channels, the Texas City Dike, and cooling water intakes.

MANAGEMENT STATUS

Freshwater inflow is regulated largely by the water rights provisions of the Texas Water Code administered by the Texas Natural Resource Conservation Commission (TNRCC). Permit applicants, such as municipalities, periodically apply for water allocation from state rivers and lakes based upon their projections of water usage. Planning and enforcement of the water allocation permitting process is based upon self-reporting by the permit holders. On a state-wide basis, the TNRCC annually processes 500 permits with a staff consisting of five members.

As a result, due to staffing and time restrictions, detailed evaluation of the environmental impacts of individual permits is generally not possible.

Management of freshwater inflow is handled on a watershed basis; however estuary needs for freshwater are often given the lowest priority. Current statutes for the prioritization of competing uses of state waters do not specifically identify the ecological needs of bays and estuaries. However, when issuing permits for surface water usage, the TNRCC must consider 1) studies by the Texas Parks and Wildlife Department (TPWD) and the Texas Water Development Board (TWDB) that determine inflow conditions necessary to maintain bays and estuaries and 2) effects on fish, wildlife, instream usage, and water quality.

Under the Texas Clean Rivers Program, the TNRCC contracts with regional councils of governments or river authorities to perform comprehensive water quality assessments of certain river basins or watersheds. The information is used by the TNRCC to develop regional water quality management plans for each basin or watershed.

Several agencies manage water development projects that may affect freshwater inflow. The U.S. Army Corps of Engineers (Corps) approves construction of dams and dikes across navigable waters. The TNRCC issues permits for the impoundment or diversion of state waters. The TWDB finances water storage projects subject to TNRCC permits. Special districts (e.g., drainage and storm water control) and river authorities also manage water development projects.

The TWDB is responsible for the establishment of a Texas Water Plan to conserve and develop the state's water resources. The first plan was prepared in 1969 and has been periodically revised since then to meet current and projected water needs. The plan currently emphasizes water supply, treatment, distribution, and conservation; and the collection and treatment of wastewater.

Management of freshwater inflow is generally handled on a watershed basis, with estuary inflow requirements are now evaluated a lower priority than other water use requirements in the water allocation process. There appears to be no documented evidence that indicates that the health of the estuary is suffering from current freshwater inflows. As estuary inflow targets are developed over the next several years, the permit allocation process will require modification if future monitoring of inflows in relation to the health of the estuary indicates a decline in the bay's biological activity.

Alterations to circulation changes are handled on a case-by-case basis. Deepening of the Houston Ship Channel, for, example, is predicted to increase the salinity of the Upper Bay to some degree. Currently issues like this are handled as part of each individual project's environmental impact statement.

FRESHWATER INFLOW AND BAY CIRCULATION ACTION PLAN

To ensure beneficial freshwater inflows necessary for a salinity, nutrient, and sediment loading regime adequate to maintain productivity of economically important and ecologically characteristic species in Galveston Bay.

OVERVIEW

Priority Problem

Future demands for freshwater and alterations to circulation may seriously affect productivity and overall ecosystem health. Freshwater inflows affect circulation and water quality within the estuary, and many species of fish, wildlife, aquatic plants, and shellfish depend on adequate freshwater inflows for survival. The continued high productivity of the Galveston Bay Estuary is due to a great degree on the maintenance of adequate, high-quality freshwater inflow.

Goal

Ensure beneficial freshwater inflows necessary for a salinity, nutrient, and sediment loading regime adequate to maintain productivity of economically important and ecologically characteristic species.

Objective

Determine annual and seasonal inflow needs to the bay by 1995.

- Action FW-1: Complete current studies to determine freshwater inflow needs for the bay.
- Action FW-2: Expand streamflow, sediment loading, and rainfall monitoring.

Objective

Incorporate inflow needs in regulatory authority and planning processes by the year 2000.

- Action FW-3: Establish management strategies for meeting freshwater inflow needs.
- Action FW-4: Establish inflow regulations to protect ecological needs of the estuary.
- Action FW-5: Explore means of providing sediment to the estuary.

Objective

Increase water use efficiency within the Galveston Bay Program area by 10 percent by 2005.

- Action FW-6: Reduce water consumption.

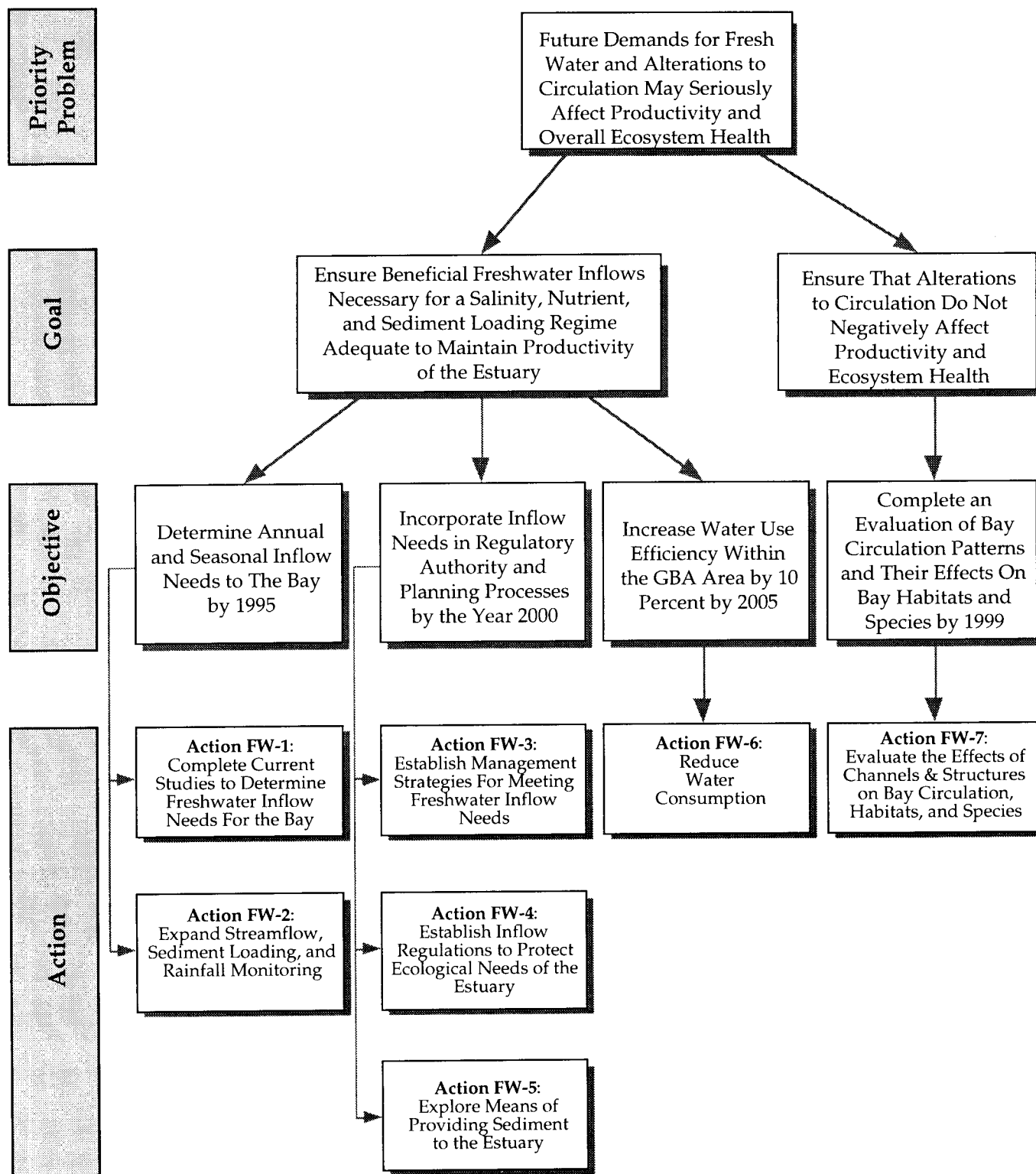
Goal

Ensure that alterations to circulation do not negatively affect productivity and ecosystem health.

Objective

Complete an evaluation of bay circulation patterns and their effects on bay habitats and species by 1999.

Action FW-7: Evaluate the effects of channels and structures on bay circulation, habitats, and species.



Freshwater Inflow and Bay Circulation Action Flowchart

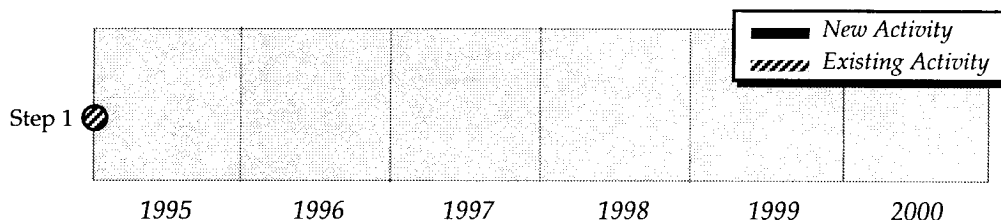
ACTION FW-1: Complete Current Studies to Determine Freshwater Inflow Needs for the Bay

What Complete current studies to better determine freshwater inflow needs for the bay to maintain the desired level of biological productivity and diversity. The Texas Water Development Board (TWDB) and Texas Parks and Wildlife Department (TPWD) is currently conducting an evaluation of the freshwater inflow needs for Galveston Bay, utilizing the State of Texas modeling methodology. This evaluation, scheduled for completion during 1994, will provide target inflow numbers for use in future management of freshwater inflow to the bay.

How

Step 1 TWDB will complete its current studies during 1994.

When



Where Entire Galveston Bay watershed.

Who Lead entity: TWDB and TPWD. Other participants: TNRCC and Universities. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

None
TOTAL..... \$ -0-

Regulatory Issues These studies have been mandated by Texas statute.

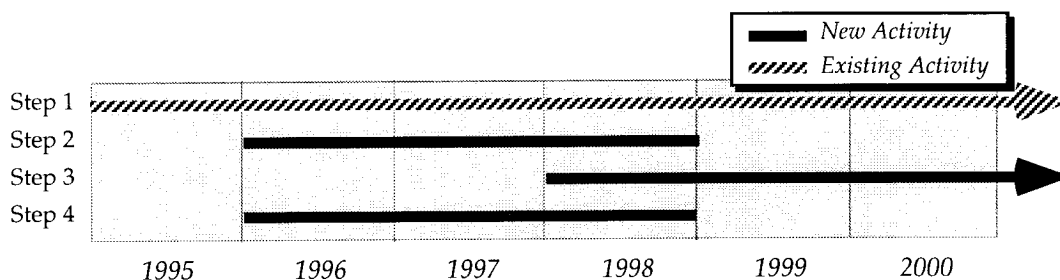
Related Actions: FW-3 and FW-4.

ACTION FW-2:**Expand Streamflow, Sediment Loading, and Rainfall Monitoring**

What Expand monitoring of streamflows, sediment loading, and rainfall to provide adequate data for management of freshwater inflow. During the past several years, reduced funding has lead to the dismantling and/or discontinued operation of approximately 50 percent of the stream monitoring stations within the Galveston Bay watershed. As a result, the accuracy of estuary freshwater inflow and sediment loading measurements has been significantly reduced. Sufficient data is no longer available for research and management needs.

How

- Step 1 All participants will maintain their existing inflow guages.
- Step 2 TWDB will initiate a cooperative effort to finance the re-establishment of sediment measuring stations, using state and local funds to match USGS funds.
- Step 3 USGS will install 2-3 additional sediment measuring stations, and begin operation of these new stations. Other participants will add rainfall stations to supplement existing network and/or explore with the National Weather Service the feasibility of using advance radar signature to eventually replace rain guages.
- Step 4 The City of Houston will conduct a survey of the Lake Houston dam to accurately measure flow over the dam spillway and will coordinate monitoring of spillway flow with the Galveston Bay Regional Monitoring Program.

When

Where All contributing river and coastal drainage basins.

Who Lead entities: USGS and TWDB. Other participants: Trinity River Authority, San Jacinto River Authority, City of Houston, Corps, Harris County Flood Control District, National Weather Service, BEG, and local governments. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• USGS	\$ 450,000	• TWDB	\$ 81,555
• Program	\$ 11,250	• Others	\$ 87,165
TOTAL		\$ 629,970	

Potential Sources of Funding: USDA, Corps of Engineers, USGS, and TWDB.

Regulatory Issues None.

Related Actions: NPS-1, NPS-11, and HP-9.

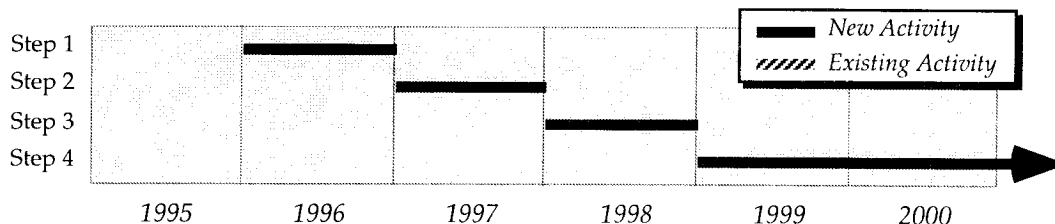
ACTION FW-3: Establish Management Strategies for Meeting Freshwater Inflow Needs

What Through a public and interagency process, establish management alternatives and strategies for meeting freshwater inflow needs.

How

- Step 1 The TNRCC will evaluate results of TWDB/TPWD freshwater inflow studies, working through the Clean Rivers Program (CRP) to set up a planning group.
- Step 2 The TNRCC will fund the multi-agency planning effort as a CRP pilot study. Quantity, seasonal, salinity and circulation effects, sediment and detrital transport, routing of return flows, and nutrient factors will all be considered in the development of management alternatives, leading to the development of a flexible management plan which provides for drought contingency. Development of the management plan will involve coordination of the findings of joint agency inflow studies, Clean Rivers Act programs, Trans-Texas Water Program, the Texas Coastal Management Program, and instream flow needs for rivers.
- Step 3 The results of the completed plan will be adopted by the following entities
- Galveston Bay Program (*Galveston Bay Plan*)
 - TWDB (*Texas Water Plan*)
 - TPWD
 - TNRCC
 - The CCC may review the freshwater inflow plan and after public comment may incorporate it into the CMP.
- Step 4 Galveston Bay Program and/or CCC, TNRCC and TWDB will review water impoundments and diversion projects for consistency with *The Plan*.

When



Where All contributing river and coastal drainage basins.

Who Lead entity: TNRCC. Other participants: TPWD, TWDB, GLO, CCC, City of Houston, Trinity River Authority, San Jacinto River Authority, and other water consumers. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TNRCC.....	\$ 116,250	• TWDB.....	\$ 37,500
• Others.....	\$ 150,000	• Program....	\$ 11,250
TOTAL.....		\$ 315,000	

Potential Sources of Funding: SCS, Corps of Engineers, USGS, and EPA.

Regulatory Issues Implementation of the strategies developed by this action may require additional regulations and/or statutes. See Action FW-4.

Related Actions: FW-1, FW-4, and FW-7.

ACTION FW-4: Establish Inflow Regulations to Protect the Ecological Needs of the Estuary

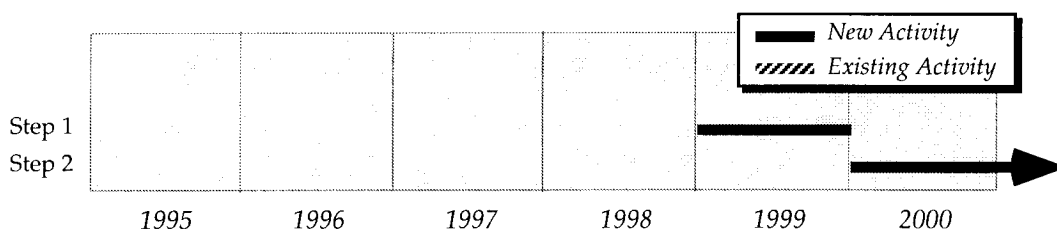
What Establish statutes and/or regulations to ensure more comprehensive watershed-based processes for management of inflow which recognizes the ecological needs of the estuary.

How

Step 1 In addition to consistency review provisions established through Action FW-3, TNRCC will promulgate rules, as necessary, to implement a basin or watershed-based approach to link individual water allocation permits to the ecological needs of the estuary.

Step 2 The TNRCC will pursue additional authority through the legislature, if necessary.

When



Where All contributing river and coastal drainage basins.

Who Lead entities: TNRCC. Other participants: TPWD, TWDB, GLO, CCC, USGS, Corps, EPA, USFWS, NMFS, City of Houston, and other water consumers. Role of Galveston Bay Program: Coordination.

Public Costs of New Actions (5 years)

• TNRCC	\$ 30,000
• Program.....	\$ 4,500
TOTAL.....	\$ 34,500

Potential Sources of Funding:

Regulatory Issues At the state level, Sec. 11.147 of the Texas Water Code requires that the TNRCC include in the conditions for a permit to store, take or divert state water, specific requirements to maintain beneficial inflows to any affected bays and estuary systems. If necessary, the TNRCC could expand the scope of this authority and could, by a legislative change, include all of a watershed in the area in which conditions could be imposed in permits.

Related Actions: FW-1, FW-3, FW-6, and FW-7.

ACTION FW-5: Explore Means of Providing Sediment to the Estuary

What Explore means of providing sediment to the estuary. The establishment of reservoirs near the coastline within the Galveston Bay watershed has had the effect of depriving the estuary of sediment. The net amount of sediment lost to the estuary is not known, and feasibility of remobilizing this sediment has not been extensively studied.

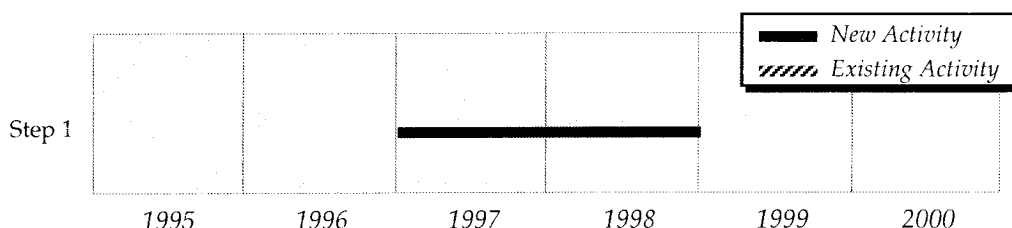
How

Step 1 TNRCC will pursue and/or provide funding for USGS and the Corps of Engineers to conduct a study to:

- Determine the net quantity of sediment which has been prevented from reaching the estuary
- Explore the feasibility of remobilizing sediment impounded behind watershed dams and transporting it to the estuary (including a generalized balancing of the costs and benefit and the impact on maintenance dredging).

Other participants and potential sponsors of this study are the GLO, Bureau of Reclamation, the Trinity River Authority, and the San Jacinto River Authority. This action will be coordinated with Action HP-9.

When



Where Trinity River delta and other areas within the estuary where additional sediment transport to the estuary is determined to be beneficial.

Who Lead entity: TNRCC. Other participants: TWDB, TPWD, USGS, Corps of Engineers, GLO, Bureau of Reclamation, Trinity River Authority, and San Jacinto River Authority. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TNRCC	\$ 22,500
• Program	\$ 2,250
TOTAL.....	\$ 24,750

Potential Sources of Funding: Rural Development Administration, SCS, NOAA, and USGS.

Regulatory Issues None.

Related Actions: HP-9.

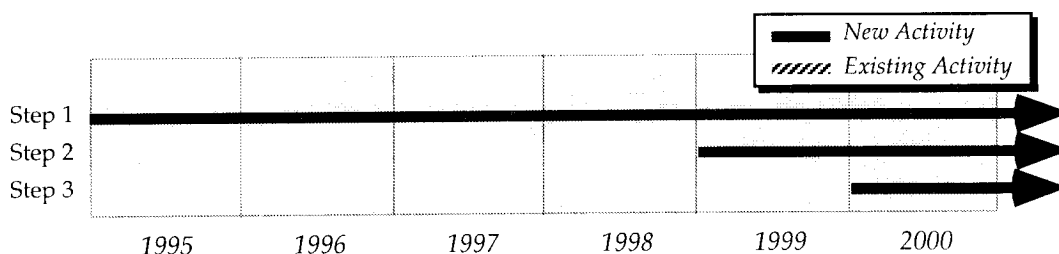
ACTION FW-6: Reduce Water Consumption

What Reduce water consumption. Future development within the watershed may put additional pressure on available water supplies, resulting in reduced freshwater inflows to the estuary. A long-term strategy of water conservation can help ensure that adequate freshwater inflows are provided to the bay.

How

- Step 1** Galveston Bay Program will work with the Subsidence District, municipalities and other local water utilities to encourage the use of existing surface-impounded water supplies instead of the development of new surface sources of water. This will include pursuing the Trans-Texas project. TWDB will incorporate this policy into the state water plan.
- Step 2** Galveston Bay Program and the TWDB will work with municipalities and other local water utilities to implement the state plumbing code and other codes that require low water use devices (e.g. low-flow faucets) on new or replacement fixtures and the adoption of strategies for reducing per capita water usage (e.g. educational programs, rate structure changes). TWDB will provide funding for pilot programs. Other possible long-term strategies: using recycled water for irrigation, watering, and cooling; develop water markets; and consumer water collection. Note that while per-capita reduction in water consumption is feasible, an overall net reduction is probably not practical as long as the area maintains its current growth rates.
- Step 3** Galveston Bay Program will seek funding from the TWDB to develop a regional water conservation plan. Once completed, TWDB will adopt the regional conservation plan into *The Texas Water Plan*.

When



Where Galveston Bay Program Area.

Who Lead entities: Galveston Bay Program, TWDB, and the Subsidence District. Other participants: TNRCC, municipalities including City of Houston, Trinity River Authority, San Jacinto River Authority, and water utilities. Role of Galveston Bay Program: Conduct/Coordinate Action.

Public Costs of New Actions (5 years)

• TWDB	\$ 37,500	• Others	\$ 55,000
• Program	\$ 48,750		
TOTAL		\$ 141,250	

Note: The above costs do not include costs associated with the Trans-Texas project. Potential Sources of Funding: USDA, EPA, and NSF.

Regulatory Issues None

Related Actions: HP-9.

ACTION FW-7: Evaluate the Effects of Channels and Structures on Bay Circulation, Habitats, and Species

What Evaluate the effects of channels and structures on bay circulation, habitats, and species. Conduct a study to evaluate the effects of current structures and practices, such as navigation channels, the Texas City Dike, and cooling water intake. Ensure that freshwater inflow needs are taken into account in the proposed construction of tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc. These structures can potentially alter sediment and nutrient transport to the estuary, as well as circulation patterns within the bay.

How

Step 1 TNRCC will pursue and/or provide funding for a study to:

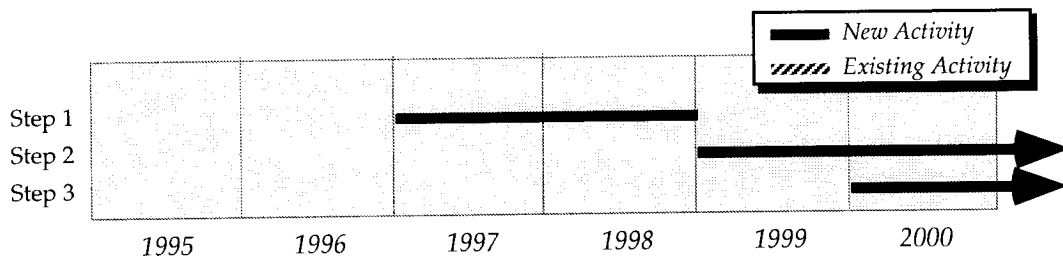
- Evaluate the effect of existing bay structures (such as navigation channels and the Texas City Dike) and practices (such as water extraction) on circulation, and the effect of circulation alterations on bay habitats and species.
- Develop a methodology to evaluate the effect of proposed structures (such as tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc.) on bay circulation patterns, habitats, and species.
- Evaluate the feasibility and cost effectiveness of making alterations to existing structures and practices which have harmful effects on bay circulation.

This study will be coordinated with the study proposed by Action FW-5.

Step 2 The TNRCC will institute a review process for proposed structures (such as tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc.) to help ensure that the freshwater inflow and circulation needs of the estuary are protected.

Step 3 If determined to be feasible and cost-effective, alter existing structures or practices which are identified in the study as being harmful to bay circulation, habitats, and/or species.

When



Where Throughout the Galveston Bay Estuary.

Who Lead entity: TNRCC. Other participants: TWDB, TPWD, USGS, and Corps. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• TNRCC.....	\$ 187,500
• Program.....	\$ 6,750
TOTAL.....	\$ 194,250

Potential Sources of Funding: NOAA, Corps of Engineers, and USGS.

Regulatory Issues None.

Related Actions: FW-1, FW-3, FW-4, FW-5, SM-4, HP-2, and HP-8.

Spills/Dumping

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
SD-1	Medium	Promote planning to facilitate natural resource damage assessments	119
SD-2	Medium	Identify simplified procedures for damage assessment for small oil spills	120
SD-3	Medium	Facilitate effective restoration of Galveston Bay's natural resources damaged by spills	121
SD-4	Medium	Facilitate spill cleanup by advance shoreline characterization	122
SD-5	Low	Improve trash management near the shoreline	123
SD-6	Low	Remove trash from storm water discharges	124
SD-7	Low	Publicize environmental harm caused by illegal dumping.....	125

THE ISSUES

The Management Conference of the Galveston Bay National Estuary Program (GBNEP) identified two issues of importance relating to spills and dumping in the Galveston Bay system:

- Bay habitats and living resources are impacted by spills of toxic and hazardous materials during storage, handling, and transport: Accidental spills or deliberate dumping affect both the aesthetic, economic and the ecological aspects of Galveston Bay. Intensive petrochemical and refining industries, shipping operations, and the highly urbanized local watershed place the bay at risk from these major sources of pollution.
- Illegal dumping and water-borne and shoreline debris degrade water quality and aesthetics of Galveston Bay: Estuarine debris represents a serious aesthetic concern in Galveston Bay, particularly to citizens who live along the shoreline or who use the bay for recreational activities such as fishing or sailing.

This action plan provides strong support for major ongoing developments in spill contingency planning and response preparedness. In order to avoid duplication of the work already proceeding, spill contingency planning and response are not the main focus of this action plan.

Instead, the problems primarily addressed by this action plan are those identified above which have not received the attention they deserve. In general, this action plan focuses on the following targets:

- **Natural Resource Damage Assessments:** Three actions are favored to obtain the maximum benefits available for environmental restoration from the natural resource damage assessment process. *The Galveston Bay Plan* supports the efforts of natural resource trustee agencies to obtain compensation from responsible parties for restoration of Galveston Bay ecosystems damaged by spills. The development of plans to streamline the natural resource damage assessment process and the identification of bay-wide restoration needs are also promoted by *The Plan*.
- **Spill Management:** An action is proposed to conduct an advance shoreline characterization of bay features (e.g., access points, sensitive habitats, shoreline modifications, etc.) that potentially affect the spill cleanup process. The deployment of spill response equipment, construction of boom anchor points for critical areas, and other preparedness strategies are also encouraged in this action.
- **Trash Control:** Three initiatives to reduce debris and illegal dumping into the bay are recommended by *The Galveston Bay Plan*. Reductions in the amount of shoreline and water-borne debris can be achieved by improved trash management practices for shoreline areas and storm water discharge points. *The Plan* also fosters the development of educational programs publicizing the environmental harm caused by illegal dumping.

ENVIRONMENTAL STATUS

Status and Trends

Spills

Several factors must be considered to evaluate the effect of spills on the bay. In general, the more material released, the greater the repercussions on natural resources. However, even a small amount of a very toxic or concentrated substance has the capacity to affect large volumes of water. Most spills that occur in the Galveston Bay area on a regular basis are relatively small and involve constituents for which the ecosystem has a natural assimilative capacity. Although spills of all sizes cannot always be prevented, compensation for environmental damages can be provided by the responsible party.

Oil spill response records maintained by the U.S. Coast Guard Marine Safety Office in Galveston, Texas (USCG MSO), indicate that, on average, two small spills of toxic contaminants, oil, fuel, or other pollutants occur daily. Totals for oil alone show over a quarter of a million gallons of oil spilled into the channel area in 1989. However, usually no cleanup action is required for the smallest spills, because natural forces have a capacity to minimize their effect. Frequently, responsible parties or sources of these spills are unknown. However, heavy vessel traffic to and from on-shore facilities, and frequent transfer and lightering activities put Galveston Bay in the high risk category for catastrophic spills as well. Significant

spills are generally related to human error and require cleanup actions. Water commerce statistics issued by the Army Corps of Engineers (Corps) showed an increase in crude petroleum transport at the Port of Houston from 28.2 million tons in 1988 to 30.3 million tons in 1989.

Over Water Transfers: More oil is transferred over water in the Galveston Bay complex, Port of Houston, Port of Texas City, Port of Galveston, and the offshore lightering zone than in any other area of the country. Large volumes of oil are lightered from large oil carriers to smaller tankers able to navigate the width and draft restrictions of the Houston Ship Channel. This large number of over-water transfers between tankers in the Galveston offshore lightering zone and between bulk cargo vessels and waterfront facilities in Galveston Bay's major ports poses increased risk for spills. Southeasterly prevailing winds and the tidal influences through San Luis Pass, Rollover Pass, and the Galveston-Houston jetties force spills in the lightering zone to move into Galveston Bay where spilled materials may present high risks to Galveston Bay's ecology.

Collisions: The major petrochemical complex along the Houston Ship Channel presents the continuing possibility for a collision-caused spill of oil or hazardous materials. Significant oil spills may be caused by collisions. According to 1990 import and export statistics, the Port of Houston ranked third and Port of Texas City sixth in the country for the volume of oil transported (New York and New Orleans ranked first and second, respectively.) In the past several years three major incidents have resulted in spilled cargoes in the Houston Ship Channel inside of Galveston Bay Estuary:

- In 1989, the Tank Barge Coastal 2514 spilled 6,000 barrels of oil slurry.
- In 1990, the Tank Barge Apex Marine 3417 spilled 16, 667 barrels of number six oil.
- In 1992, the Bottle Barge Duval II spilled 2,800 tons of molten sulfur.

Dumping

Waterborne trash such as cans, bottles, ropes, packing materials, plastic bags, or medical waste are pollutants classified as bay debris. Particular sources of debris, although difficult to locate with precision, may include 1) material dumped in rivers or offshore that becomes trapped in the shallow, enclosed waters of the bay, 2) debris from city streets that travels to the bay via storm water discharge, and 3) spillage of plastic pellets from loading docks.

Debris dumped in and around the bay degrades aesthetics, harms wildlife, clogs water intakes, and damages boat propellers. Birds may ingest plastic pellets, which can cause malnutrition and starvation in some cases. Plastic bags have been mistaken for food by sea turtles, causing malnutrition or starvation resulting from blockage of the digestive tract. Other types of debris have caused entanglement of wildlife, divers, and boat propellers; and have blocked cooling-water intake systems. The economy is also adversely affected by costly cleanup efforts and declines in tourism from bay debris.

A study was conducted recently to investigate the occurrence, magnitude, distribution, and effect of water-borne debris in the waters and along the shores of Galveston Bay. Samples of collected debris and trash from open water areas and the near-shore environment indicated

that plastic products composed over 50 percent of the items collected in open water areas, and metal made up most of the remainder. Near shore debris comprised a more diverse collection of materials: plastics, metals, construction debris, and rubber. Debris was most concentrated along the shoreline itself, where it tends to accumulate with the actions of winds, currents, and waves.

Analysis of samples taken from the Houston Ship Channel in a recent study indicated most debris to be storm water, rather than sewage, related. Items collected during the study included plastic pellets, bags, cups, fast food containers, toys, bottles, jugs, and general street litter. In comparison to other U.S. harbors, this study showed the Houston Ship Channel to have the highest incidence of plastic pellets.

Probable Causes

The causes of spills are generally evident. Spills may be caused by tanker collisions, rammings, groundings, and sinkings; human error during transfer operations; and natural catastrophes such as hurricanes, tornadoes or general flooding as seen in the San Jacinto River flood in the Fall of 1994. Dumping may be caused by lack of adequate collection facilities and trash pickup. A lack of education and public outreach coupled with inadequate enforcement of existing regulations leads people to consider only the convenience of dumping while ignoring the negative impacts on the bay.

MANAGEMENT STATUS

Regulatory Basis

Clearly the first priority in dealing effectively with spills and dumping should be prevention. Secondary activities should focus efforts on effective cleanup and compensation for environmental harm. Indeed, much progress has been made toward these goals as a result of federal and state legislation in the last several years. Further information regarding the role of various federal and state agencies in the management of spills and dumping is provided below.

Spills

Several federal and state laws govern spill prevention and response for discharges of oil and hazardous substances into surface waters. These statutes include the Clean Water Act (CWA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), and the Texas Hazardous Substances Spill Prevention and Control Act. Following the Exxon *Valdez* accident in Prince William Sound, the Oil Pollution Act of 1990 (OPA) and the Texas Oil Spill Prevention and Response Act (OSPRA) of 1991 were passed to protect coastal waters and adjacent shorelines from oil spills.

Spill Prevention and Response: Responsibility for spill response is divided up among no fewer than five federal and state entities. Federal spill response and cleanup is the responsibility of

the United States Coast Guard (USCG) for marine spills, or the Environmental Protection Agency (EPA) for inland spills of hazardous substances and of oil into water. Except for spills associated with oil and gas exploration, development, and production, including transport by pipelines, and oil spills in excess of 240 barrels into or that threaten coastal waters, the Texas Natural Resource Conservation Commission (TNRCC) is the lead state agency for oil and hazardous substance spill response and cleanup coordination on land and for hazardous substances spills in navigable waters of the state. The Texas Railroad Commission (RRC) has jurisdiction and spill response authority for all spills from oil and gas exploration, development, and production facilities, including crude oil and natural gas pipelines. The General Land Office (GLO) is the lead spill response agency for oil spills into coastal waters or that threaten coastal waters and exceed 240 barrels. For coastal oil spills of 240 bbls or less, the RRC acts as the state on-scene coordinator for abandonment, containment, removal, and cleanup.

Facility contingency plans describe the procedures to prevent spills of oil and hazardous substances and the methods to be followed to remove spills without undue delay. Current oil spill response plans are guided by rules issued pursuant to the CWA, the National Oil and Hazardous Substances Contingency Plan (NCP), and OSPRA. In accordance with provisions of OPA, state and federal agencies, private industry, and public organizations are currently developing and implementing local oil spill response contingency plans. OPA and OSPRA also require the state and federal agencies to certify facility and vessel spill contingency response plans. GLO is required to certify the spill prevention and response capabilities of coastal facilities managing oil. In conjunction with USCG, GLO also reviews vessel spill prevention and response plans, which include audits, drills, inspections and denial of port entry for noncompliant vessels.

When properly prepared and implemented, spill response contingency plans will facilitate a more rapid and efficient multi-agency response to oil and hazardous substance spill events. Key elements of these plans are detailed databases of spill response capabilities which include: 1) trained personnel; 2) equipment type and location; 3) communication capabilities. Spill response contingency plans should also address notification procedures, interagency coordination, and ability to respond to a "worst-case" spill event. In general, these elements are quickly developing in the Galveston Bay area and based on the response to the October 1994 pipeline break, response capability has improved.

Certain preparations may be made in advance of a spill so that cleanup may be accomplished quickly and effectively. These preparatory actions include identifying shorelines at risk, pre-constructing boom anchor points in sensitive areas, and amassing detailed information about shoreline features that may either help or hinder cleanup activities. However, little information is currently available about these factors. This means that last minute efforts must be made to acquire necessary information after the spill occurs, and many times cleanup is delayed.

Compensation for Environmental Injuries: Although spills of all sizes cannot always be prevented, in some cases state and federal laws may require the one responsible for the spill to provide compensation for injuries to public resources. The United States, states, and Indian

tribes are entitled to receive compensations from responsible parties for injury to, destruction of, or loss of public natural resources. The award of compensation for injured natural resources, however, has not been used extensively in Galveston Bay. Of the numerous spills, fewer than five have proceeded through the damage assessment process to final payment.

To help remedy this situation, the state of Texas passed Senate Bill 1049 (SB 1049) in June 1993. This legislation applies to coastal oil spills and includes provisions for the development of natural resource damage assessment methodologies, and requires parties responsible for coastal oil spills to take actions as soon as possible to restore, rehabilitate and/or replace injured natural resources. SB 1049 also requires the natural resource trustees for the state of Texas to formulate a baseline inventory of natural resources in several areas including Galveston Bay.

Natural resource damage assessments (NRDAs) are required under provisions of the CWA, CERCLA, OPA, and SB 1049. Five agencies act as "natural resource trustees," and are responsible for damage assessment in the Galveston Bay area. Federal natural resource trustees include the Department of the Interior and the National Oceanic and Atmospheric Administration. State trustees are the Texas Natural Resource Conservation Commission, the Texas Parks and Wildlife Department, and the Texas General Land Office.

Proposed Regulations: Several federal and state agencies are currently developing additional regulations to address recognized gaps in the statutes and rules discussed above. These additional efforts are as follows:

- **Areas of Special Importance:** EPA has recently proposed regulations under OPA, CWA, and CERCLA addressing facility and vessel planning and preparation for potential spills in areas of special economic or environmental importance. Plans are to be developed which provide for the immediate and effective protection, rescue, and rehabilitation of fish and wildlife resources (including habitat) that are harmed or jeopardized by a spill.
- **Contingency Plans for Additional Sources of Pollution:** TNRCC is in the process of developing Spill Prevention and Control rules under the provisions of the Hazardous Substances Spill Prevention and Control Act to prevent, control and manage discharges or spills. The new rules will require owners and operators of facilities and vessels to prepare spill contingency plans for any material capable of causing pollution. These rules have the goal of improving the timeliness, adequacy, coordination, efficiency, and effectiveness of responses to discharges or spills.

Dumping

Confusion over agency responsibilities has contributed to inadequate enforcement against deliberate dumping. A proliferation of deliberate dumping also results from lack of dockside garbage/sewage reception facilities. Individuals engaging in surreptitious and unauthorized disposal or discharge of litter or waste face little risk of apprehension.

Several federal and state laws regulate the dumping of refuse into surface waters. The disposal of marine solid waste is regulated by ports and navigation districts. Annex V of the

International Convention for the Prevention of Pollution from Ships and the Marine Plastics Pollution Research and Control Act (MARPOL) prohibit vessels and offshore platforms from dumping waste materials into U.S. lakes, rivers, bays, and sounds within three miles from shore. Marinas, marine terminals and ports are also required to maintain waste reception facilities.

Section 13 of the Rivers and Harbor Act of 1899 also prohibits depositing of refuse into any navigable water, and Section 10 of the Act deals with obstructions to navigation. Enforcement under this is cumbersome as criminal, rather than civil, sanctions are called for. Primary administration of the Refuse Act of 1899 rests with the Corps of Engineers.

As provided by the Texas Water Code and the Health and Safety Code, the TNRCC has jurisdiction over incidents involving the unauthorized disposal or discharge of litter or municipal solid waste into waters of the state. This type of discharge may be considered a violation of either the Texas Water Code, Chapter 26, or the Texas Health and Safety Code, Section 361.012, and both state and county governments have the authority to pursue and enforce violations of these state codes. The TNRCC may elect to delegate the incident to the county health department for investigation and enforcement or choose to investigate or conduct enforcement themselves. Often times the size or volume of the discharge is the discerning factor for determining whether the state or county will pursue the incident. The Harris County Pollution Control Department and the Galveston County Health Department can respond to reports of illegal dumping within their respective county areas.

SPILLS/DUMPING ACTION PLAN

To support a comprehensive natural resource damage assessment program by working in close coordination with federal, state, local, and private entities; enhance spill prevention and response by coordinating all involved parties; and eliminate dumping and accumulation of debris.

OVERVIEW

Priority Problem

Spills Impact Bay Habitats. Bay habitats and living resources are impacted by spills of toxic and hazardous materials during storage, handling, and transport.

Goal

Obtain Compensation for Environmental Injuries. Designated state and federal natural resource trustee agencies are authorized to seek compensation from responsible parties for injuries to natural resources resulting from spills of oil and hazardous substances. Compensation must be used by the trustees to restore the injured resources. *The Galveston Bay Plan* will facilitate the damage assessment and restoration process by providing a coordinating framework.

Objective

Support trustee actions to obtain compensation for environmental injuries and ensure that restoration funds are used effectively to benefit the Galveston Bay ecosystem to the maximum extent possible under the existing statutes and regulations.

- Action SD-1: Promote planning to facilitate natural resource damage assessments.
- Action SD-2: Identify simplified damage assessment procedures for small oil spills.
- Action SD-3: Facilitate effective restoration of Galveston Bay's natural resources injured by spills.

Goal

Reduce the impact from spills on the natural environment. Streamline spill response and cleanup procedures to reduce the impact of spills on bay resources.

Objective

Improve advance planning measures and on-the-ground readiness.

- Action SD-4: Facilitate spill cleanup by advance shoreline characterization.

Priority Problem

Debris and Illegal Dumping. Illegal dumping and water-borne and shoreline debris degrade water quality and aesthetics of Galveston Bay.

Goal

Eliminate water-borne debris. In addition to improving the general appearance of the bay, limiting the amount of water-borne debris will reduce harm and damage to wildlife, water intakes, and vessels.

Objective

Reduce the amount of shoreline and water-borne debris by half within five years.

Action SD-5: Improve trash management near the shoreline.

Action SD-6: Remove trash from storm water discharge.

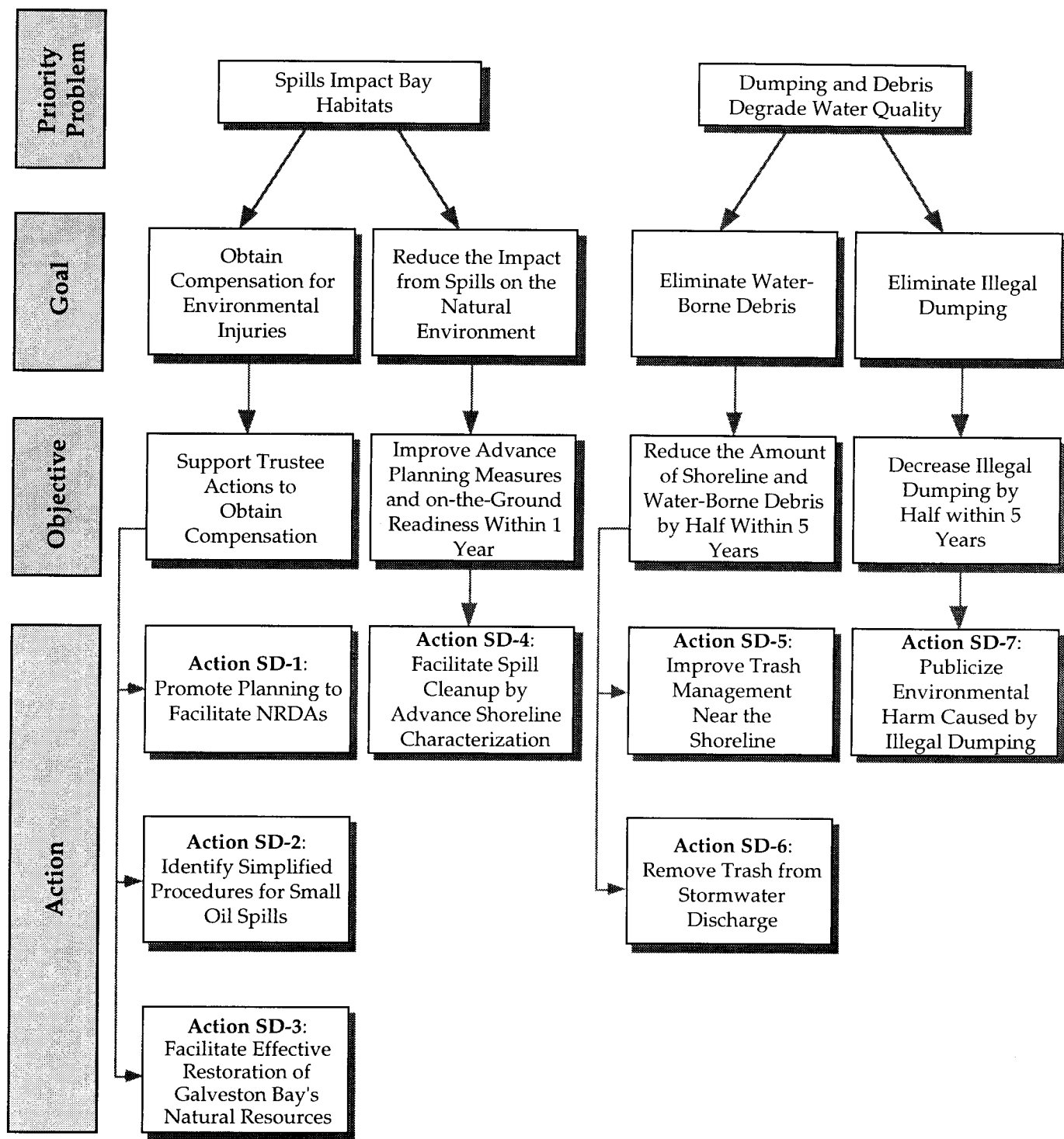
Goal

Eliminate illegal dumping. Reduce illegal dumping of trash into the bay to improve water quality and provide a more pleasant recreational environment.

Objective

Decrease illegal dumping by half within five years.

Action SD-7: Publicize environmental harm caused by illegal dumping.



Spills/Dumping Action Flowchart

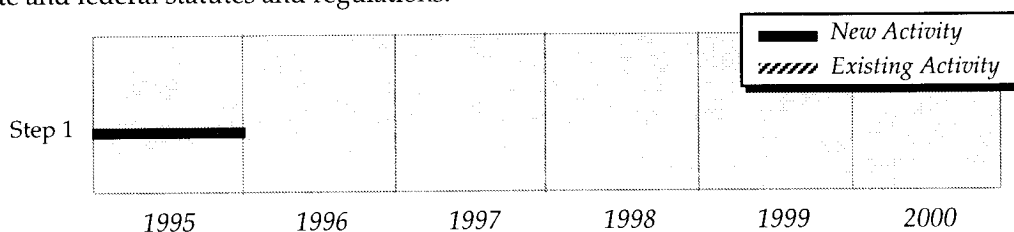
ACTION SD-1: Promote Planning to Facilitate Natural Resource Damage Assessments

What Facilitate the Natural Resource Damage Assessment (NRDA) process by advance pre-spill planning that includes the following elements: 1) agreement among natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) on the methodologies available to assess damages for various size spills of contaminants affecting different environments; 2) assignment of responsibility for collecting perishable data during the early stages of a spill; 3) procedures to be used in selecting a lead administrative trustee at the time of the spill; and 4) other administrative and procedural matters to facilitate timely initiation of natural resource damage assessments.

How

Step 1 Natural resource trustees will establish an MOU to delineate the roles of the trustees during a spill and detail procedures for coordinating joint assessments. All provisions of the MOU will be compatible with applicable state and federal statutes and regulations.

When



Where Waters of the State in the Galveston Bay Program area.

Who Natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD). Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 2,250
TOTAL.....	\$ 2,250

Potential Sources of Funding: USFWS, EPA, NOAA, GLO, TNRCC, and TPWD.

Regulatory Issues Procedures for conducting damage assessments for spills of oil and hazardous substances are provided in federal regulations issued subsequent to the CWA and CERCLA. NOAA is in the process of developing regulations to address damage assessments for oil spills as directed by the OPA. Additionally, Texas Senate Bill 1049, effective September 1, 1993, requires the state to develop a damage assessment process for oil spills in coastal waters, and Galveston Bay is specifically named to be surveyed for the Natural Resource Inventory.

Related Actions: SD-2.

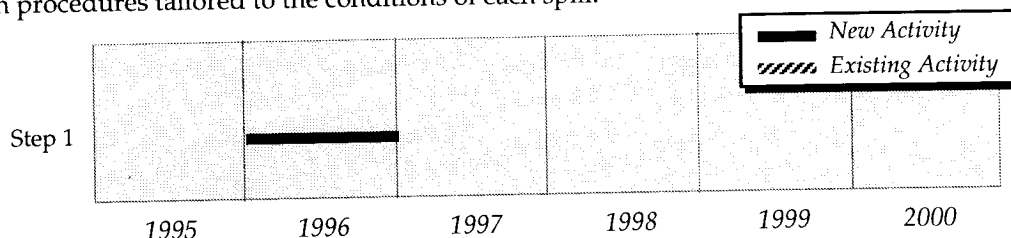
ACTION SD-2: Identify Simplified Damage Assessment Procedures for Small Oil Spills

What Develop simplified procedures, such as a compensation table, to assess natural resource damages from small oil spills within Galveston Bay. Establish a restoration framework to guide natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) in applying damage recoveries in an efficient and effective manner.

How

Step 1 Galveston Bay Program will assist natural resource trustees in developing a compensation table for oil spills in Galveston Bay based on the size, type, and location of a spill. Design of the table will be consistent with applicable state and federal statutes and regulations, and will describe special data collection procedures tailored to the conditions of each spill.

When



Where Galveston Bay Program area.

Who Lead entity: Galveston Bay Program; Other participants: natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD). Role of Galveston Bay Program: conduct action.

Public Costs of New Actions (5 years)

• Program	\$ 2,250
TOTAL	\$ 2,250

Expenditures for spill-related activities are generally managed through the Coastal Protection Fund established by industry fees and administered by the GLO. Potential Sources of Funding: EPA.

Regulatory Issues Procedures for conducting damage assessments for spills of oil and hazardous substances are provided in federal regulations issued subsequent to the Clean Water Act and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund). NOAA is in the process of developing regulations to address damages assessments for oil spills as directed by OPA. Additionally, Texas Senate Bill 1049/HB 2188, effective September 1, 1993, requires the state to develop a damage assessment process for oil spills in coastal waters, and Galveston Bay is specifically named to be surveyed for the Natural Resource Inventory.

Related Actions: SD-1.

ACTION SD-3:

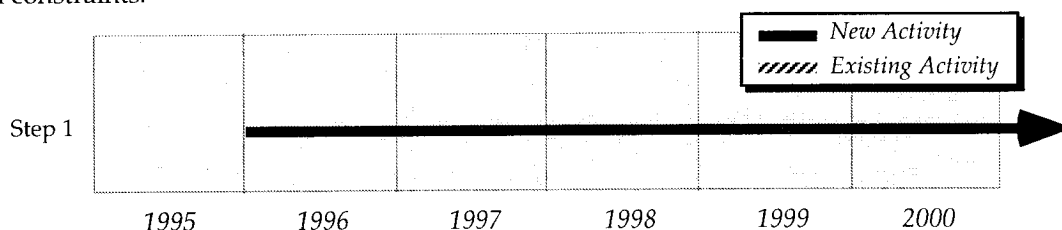
Facilitate Effective Restoration of Galveston Bay's Natural Resources Damaged by Spills

What Identify bay-wide restoration needs to be considered by the natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) during planning for and restoration of natural resources injured by releases of oil or hazardous substances. The actual restoration of such resources will be accomplished by the natural resource trustees using recovered damages.

How

Step 1 Galveston Bay Program will contribute to an effective and coordinated restoration program 1) by providing available baseline data on pre-release conditions in affected areas of the bay, and 2) by facilitating public review of the restoration plan and approval of related permits. In turn, the natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD) will provide Galveston Bay Program with data regarding the fate and effects of spilled oil and hazardous substances on Galveston Bay resources. Providing data gathered through the damage assessment process will be subject to applicable litigation constraints.

When



Where Galveston Bay Program jurisdictional area.

Who Lead entity: Galveston Bay Program; Other participants: natural resource trustees (i.e., USFWS, NOAA, GLO, TNRCC, and TPWD). Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program	\$ 30,000
TOTAL.....	\$ 30,000

Expenditures for spill-related activities are generally managed through the Coastal Protection Fund established by industry fees and administered by the GLO, and these costs are not included in the above table. NRDA regulations provide for cost effective assessments that avoid double counting of damages. Recovered damages must be used by the trustees on behalf of the public to restore the injured resources. Potential Sources of Funding: NOAA and EPA.

Regulatory Issues Existing legislation has established sufficient authority for these actions.

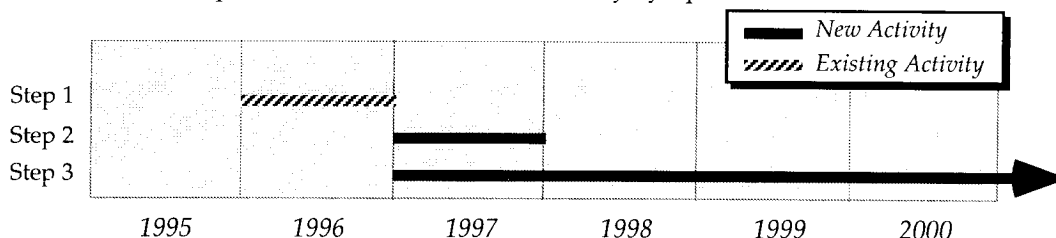
Related Actions: SD-1, SD-2.

ACTION SD-4:**Facilitate Spill Cleanup by Advance Shoreline Characterization**

What Facilitate a more timely and efficient spill response while minimizing injury to sensitive habitats by conducting an advance shoreline characterization of bay features that could help or hinder the cleanup process. The survey would inventory such features as access points, sensitive habitats, and shoreline modifications. Where practicable, deploy equipment and construct boom anchor points for critical areas based on advance survey information.

How

- Step 1 GLO will complete an initial geographic information system-based (GIS) survey of Galveston Bay shoreline features which could help or hinder response and cleanup activities in accordance with existing authority and legislative mandates for state spill response planning.
- Step 2 GLO will complete an assessment of existing state and federal response planning and equipment siting activities to determine if adjustments are needed in spill response preparedness strategies. This activity will be carried out in cooperation with the natural resource trustees (i.e., USFWS, NOAA, TNRCC, and TPWD), the USCG, and other private entities involved in spill response planning.
- Step 3 GLO will begin to publish updated GIS characterization information every five years and report on activities under this action plan in the biennial State of the Bay Symposia.

When

Where Galveston Bay shoreline and other features at risk from spills or influencing spill cleanup actions.

Who Lead entity: GLO; Other Participants: other natural resource trustees (i.e., USFWS, NOAA, TNRCC, and TPWD), monitoring agencies such as USGS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 11,250
TOTAL.....	\$ 11,250

Expenditures for spill-related activities are generally managed through the Coastal Protection Fund established by industry fees and administered by the GLO. Potential Sources of Funding: NOAA, EPA, and TWDB.

Regulatory Issues SB 1059/HB 2188, effective September 1, 1993, generally authorizes the use of a GIS to identify bay features helpful to cleanup activities, and the expenditure of Coastal Protection Fund moneys for such activities.

Related Actions: SD-3.

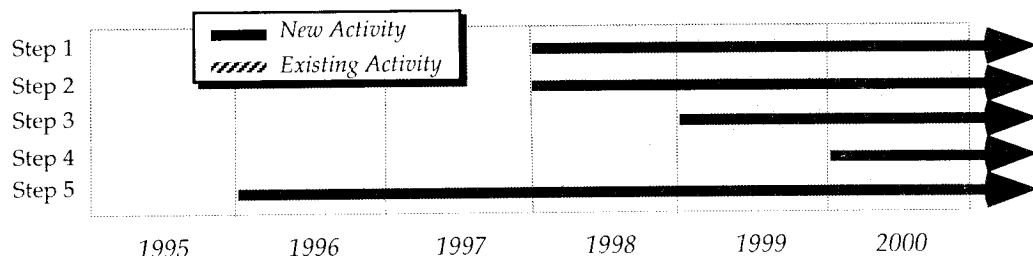
ACTION SD-5: Improve Trash Management Near the Shoreline

What Require placement and pickup of waste receptacles at commercial boating and fishing establishments, recreational boat marinas, and boat launch ramp facilities, shoreline parks, and other high-use shoreline locations around the bay.

How

- Step 1 GLO will continue to implement its requirement that marinas have adequate waste receptacles. Local governments will establish requirements ensuring adequate pickup of waste through ordinances.
- Step 2 Galveston Bay Program will coordinate with existing public/private litter abatement programs to encourage voluntary placement and maintenance of waste receptacles at other shoreline sites.
- Step 3 Galveston Bay Program will target an anti-litter/dumping public education effort at Galveston Bay in coordination with similar educational efforts (e.g., "Clean Texas 2000," "Don't Mess with Texas," "Keep Texas Beautiful," and "Adopt a Beach"). Galveston Bay Program will encourage greater coordination of anti-litter/dumping enforcement among federal, state and local law enforcement agencies and will consider advocating increased fines for littering. Sponsor bay shoreline cleanups by volunteers on a regular basis. Consider expanding TPWD "Don't Mess with Texas" program to "Don't Mess with Texas Bays."
- Step 4 Galveston Bay Program will oversee a new debris survey similar to one conducted previously under GBNEP and will update this survey every three years, and report on activities under this action plan in the biennial State of the Bay Symposia.
- Step 5 Galveston Bay Program will work with local industries to eliminate the release of plastic pellets to the Bay by 1) Encouraging adoption of the SPI 1991 Pellet Retention Environmental Code and the 1992 Processor's Pledge; 2) train employees to minimize pellet spillage; 3) encourage adoption of other measures listed in EPA guidance document "Plastic Pellets in the Aquatic Environment: Sources and Recommendations."

When



Where Galveston Bay Program area, emphasizing public use areas on the bay shoreline and on tributaries below Lakes Livingston and Houston.

Who Lead entity: Galveston Bay Program; Other participants: GLO, Corps, local governments for appropriate jurisdictions and commercial venture operators for private facilities. Role of GBC: Conduct Action.

Public Costs of New Actions (5 years)

• Munis	\$ 27,000	• TPWD	\$ 15,750
• Program	\$ 66,000	• Others	\$ 28,500
TOTAL		\$ 137,250	

Potential Sources of Funding: USDA, EPA, DOT, and TNRCC.

Regulatory Issues MARPOL Annex V establishes that facilities with more than 10 vessels supply shoreside trash handling facilities, and this addresses most marinas in the Galveston Bay system. A model ordinance is needed for incorporated areas encompassing shoreline parks and boat ramps, etc. Authority to require these actions is problematic for unincorporated areas such as county parks, where implementation would be voluntary and coordinated through county commissions and anti-littering campaigns.

Related Actions: PPE-2, PPE-4, PPE-5, NPS-3, RSC-3, SD-7, and WSQ-5.

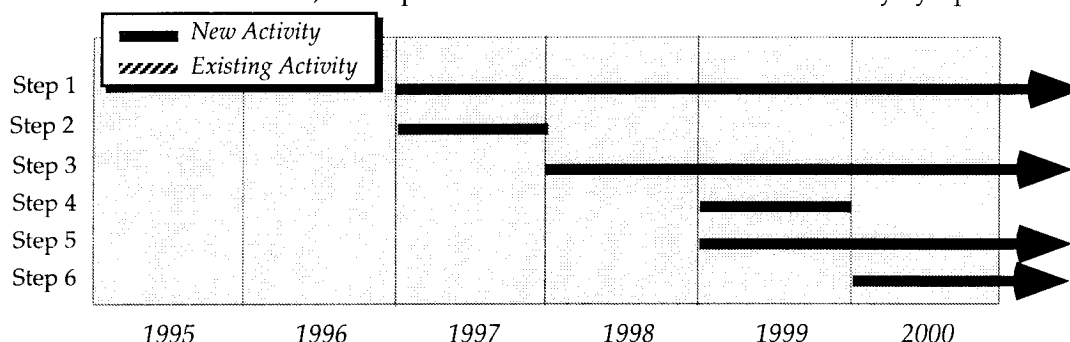
ACTION SD-6: Remove Trash from Storm Water Discharges

What Where technically feasible, require methods to remove floating trash and debris from significant storm water discharges into the bay or tributaries.

How

- Step 1 Local governments already subject to federal storm water permits will begin removing floatable debris (where applicable) from storm water discharges.
- Step 2 Local governments involved in trash screening will conduct pilot projects and sponsor technical reviews to evaluate the flooding potential of EPA-mandated trash removal methods. These investigations will address concerns regarding adverse impacts of captured floatable debris on the efficiency of storm water drainage during intense storm events common in the bay area.
- Step 3 Galveston Bay Program will incorporate appropriate methods determined from trash removal evaluations into the Galveston Bay BMP Performance Document in order to provide local governments with information regarding screening techniques.
- Step 4 EPA or TNRCC will extend trash removal requirements to smaller cities under the federal storm water permit program. Public comment periods are established for NPDES permits.
- Step 5 Galveston Bay Program will insure that adequate assistance is provided to local governments on effective implementation of trash removal as part of the overall technical assistance recommended for local governments.
- Step 6 Galveston Bay Program will conduct and periodically update a Galveston Bay debris survey to help the gauge the effectiveness of this action, and report results in the biennial State of the Bay Symposia.

When



Where Principle storm water outfalls throughout the immediate Galveston Bay watershed.

Who Local governments would implement this action under the authority of EPA, and TNRCC,. Role of Galveston Bay Program: Coordinate.

Public Costs of New Actions (5 years)

• Program	\$ 15,000
TOTAL	\$ 15,000

A substantial fraction of local governments costs associated with this action can be attributed to federal National Pollutant Discharge Elimination System (NPDES) regulations. Potential Sources of Funding: NOAA, HUD, and EPA.

Regulatory Issues This action would be implemented under NPDES storm water permits and provisions of the EPA/NOAA agreement for non-point source pollution control in coastal areas.

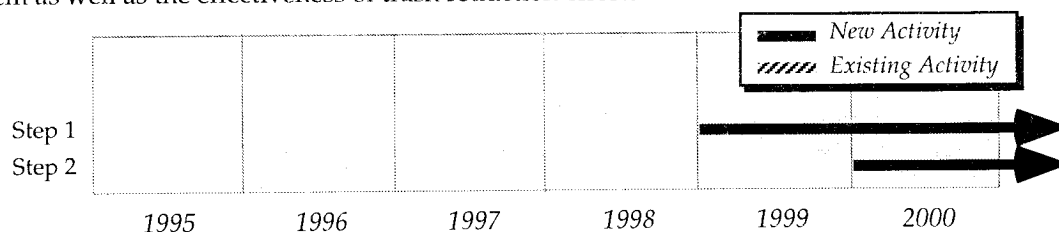
Related Actions: NPS-2, NPS-3, NPS-4, NPS-6, NPS-7, PPE-2, RSC-3, SD-5, and SD-7.

ACTION SD-7:**Publicize Environmental Harm Caused by Illegal Dumping**

What Establish improved public education addressing harm to the estuarine environment caused by dumping trash and hazardous materials. Highlight associated fines for dumping, and improve the awareness in the enforcement community concerning the implications of dumping.

How

- Step 1 Galveston Bay Program will focus public attention on the harm to the bay environment resulting from illegal dumping as part of an overall effort to reduce littering and dumping in the vicinity of Galveston Bay. Galveston Bay Program will conduct annual bay shore cleanup campaigns staffed by volunteers.
- Step 2 Galveston Bay Program will conduct and periodically update a Galveston Bay debris survey. Through the results of this survey, the Authority also will be able to publicize evidence of the magnitude of the trash problem as well as the effectiveness of trash reduction efforts.

When

Where Waters of the State in the Galveston Bay Program area.

Who Lead entity: Galveston Bay Program; Other participants: GLO, TNRCC, local media, "Keep Texas Beautiful," HGAC, and similar campaigns. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 30,000
TOTAL.....	\$ 30,000

Costs for conducting a debris survey are included in Action SD-5. Potential Sources of Funding: USDA, NOAA, EPA, TNRCC.

Regulatory Issues This action can be accomplished under existing programs, and requires no new regulations.

Related Actions: NPS-4, PPE-3, PPE-4, SD-5, and SD-6.

Shoreline Management

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
SM-1	Medium	Establish a planning program for shoreline development.....	135
SM-2	Medium	Identify appropriate residential shoreline development guidelines	136
SM-3	Medium	Identify appropriate commercial and industrial shoreline development guidelines	137
SM-4	Medium	Minimize negative effects of structures and dredging on publicly owned lands	138
SM-5	Medium	Improve access to publicly owned shorelines.....	139

THE ISSUES

The Galveston Bay system is a dynamic environment continuously shaped by natural processes (e.g., tides, currents, wind, waves, subsidence, periodic violent storms, etc.) that redistribute sediments and alter habitats. The system has a natural recuperative ability to sustain itself. Damaged vegetation redevelops and marshes submerged by erosion or subsidence are reestablished further inland.

Galveston Bay is also shaped by human processes as the bay is a resource greatly enjoyed by many people. People are naturally attracted to the bay area by the mild climate, the benefits of living in waterfront locations, and exploitable natural resources such as fish and wildlife; oil, gas, and other minerals; and agricultural land. Human activities can upset the natural balance of the shoreline ecosystem and often inhibit or prohibit natural recuperative abilities of the shoreline. Disturbances in the natural flows of freshwater, sediment, and nutrients and activities such as tilling, paving, dredging, draining, excavating, and filling can alter habitat quality and quantity.

Continued development of the shoreline contributes to shore erosion, loss of wetlands, increased point and non-point source pollution, and reduced public access to the shore. The environmental impact of activities such as bulkhead, dock, and revetment construction may be larger than the actual physical modifications would suggest. About 70 miles of the bay

shoreline has been either bulkheaded or converted to docks or revetments; by one estimate, this corresponds to 10 percent of the entire bay shoreline.

In Texas, primary management of development and related activities occurs on a local level and shoreline management practices often do not address negative environmental impacts on the bay's resources. Along the Galveston Bay shoreline, many regulatory and governmental entities engage in shoreline management activities related to economic and energy development, facility siting and shoreline access. The main hindrance to effective management of shoreline resources is that no comprehensive system is in place to guide local planning and decision-making processes that affect the bay. Major initiatives proposed by *The Galveston Bay Plan* for shoreline management include the following:

- **Shoreline Development Plans:** Three actions are recommended to establish plans and guidelines that address the environmental impacts of shoreline development activities. Studies of land use patterns in relation to shorelines processes of erosion and accretion are recommended. The establishment of guidelines for residential, commercial, and industrial construction activities in shoreline areas is encouraged to prevent flooding, erosion, habitat loss, and accidental releases of hazardous materials during severe weather.
- **Consideration of Environmental Impacts:** An action is proposed to minimize the negative environmental effects posed by manmade structures located on publicly-owned lands. These structures include bulkheads, docks, pipelines, barges, abandoned petroleum structures and other shoreline fabrications that potentially alter bay circulation, impair existing aquatic habitat, threaten water quality and navigation and degrade aesthetics. An inventory of derelict structures to determine removal priorities is advocated. The consideration of environmental impacts and the development of alternatives to mitigate unavoidable impacts are encouraged for shoreline structure and dredge/fill disposal activities.
- **Access to Galveston Bay:** An action to improve access to publicly-owned shorelines in a manner protective to the bay ecosystem is endorsed by *The Galveston Bay Plan*. An inventory of existing public recreational facilities and an assessment of public use needs will aid in the development of a Galveston Bay public facility plan. Environmental impacts resulting from shoreline recreational uses will be investigated. *The Plan* also encourages the creation of educational programs designed to enhance public awareness of litter, sensitive habitats, and pollution prevention.

ENVIRONMENTAL STATUS

As an aesthetic and economic resource to society, shoreline property along Galveston Bay is exposed to significant development pressure. Use of these resources in a thoughtless manner may compromise the natural functions and ultimately strain the resilience of the bay as a healthy dynamic ecosystem.

Status and Trends

The sprawling city of Houston and associated urban communities occupies the western side of the bay, and the eastern side remains largely agricultural and undeveloped. Urban development contributes polluted rainfall runoff from parking lots, streets, highways, roofs, and yards, while the eastern shore remains largely grassland, marshes and rice fields, with the potential to contribute herbicides and pesticides to receiving waters.

Information is scarce on detailed historical patterns of population growth along the Galveston Bay shoreline. No research has been completed to date that summarizes construction data such as number of permits, type of structures, and building locations. However, the effects of population growth on the natural resources of the bay have begun to appear. Currently, up to 50 percent by area (corresponding to 20 percent by reef) of oyster harvesting areas in the bay are closed at any time due to elevated fecal coliform levels resulting from non-point source pollution. Increasing development of the shoreline contributes to shore erosion, loss of wetlands, increased point and non-point source pollution, and reduced public access to beaches and the shore. More detailed discussion of these issues is provided in other action plans included in this document.

Probable Causes

Galveston Bay shares many problems with other estuaries of a similar stature chiefly in the rapidly escalating demands placed upon its resources because of an expanding population and associated development. It is estimated that by 1996, the Houston-Galveston area will have a population exceeding 3.6 million, an 11 percent increase from 1990. The year 2010 population is expected to reach 4.5 million residents. These projected increases in population and the associated increasing use of the bay resources pose a significant resource management challenge.

Human use and development activities can produce unintended results, such as habitat alteration and destruction, eutrophication, pollution, loss of biodiversity and extinction of species. Ecological knowledge can be applied in the management of these activities to reduce the incidence of negative, unintended results.

The 4,238-sq.-mile coastal basins are comprised of roughly equal portions of urban Houston, agricultural lands, open/pasture lands, and forests. Events occurring in this local watershed have much more immediate and direct effects on Galveston Bay than do events in the upper watershed. For example, contributions from non-point source pollution are dominated by the local watershed due to the high volume of contaminated runoff from the urban region.

The natural aspects of the bay discussed above are subject to major influences from human activity. Since the 1850s, man-made modifications to the physical structure of the bay include the dredging of navigation channels, subsidence due to groundwater withdrawal, and isolation of secondary bays and marshes by erection of dikes. Approximately 10 percent of the bay shoreline has been bulkheaded or converted to docks or revetments.

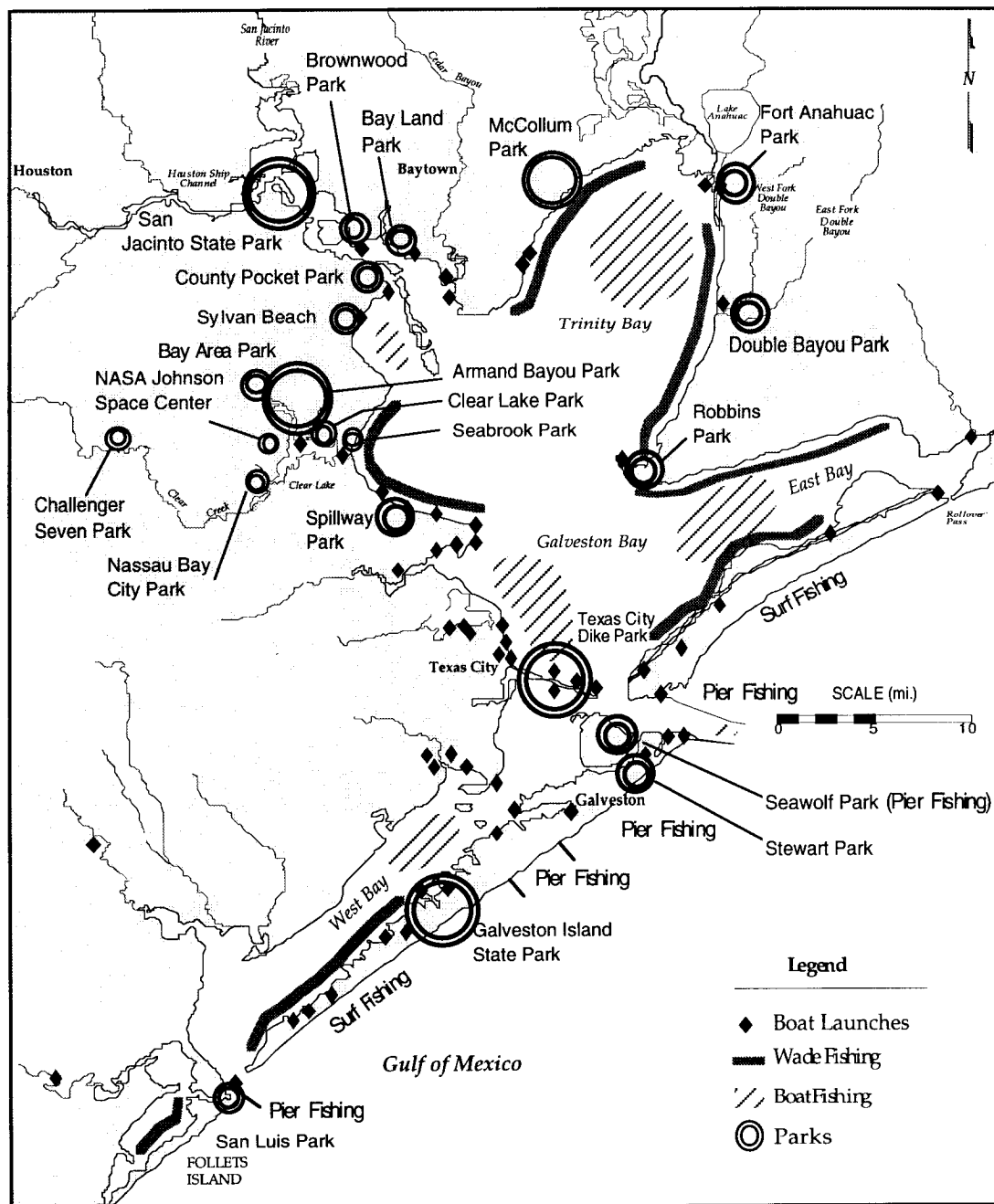


FIGURE SM-1. Access to Galveston Bay Shoreline

Steady growth has intensified competition for limited coastal resources. Uses that could easily coexist in the sparsely populated coastal area of a few decades ago are now in direct confrontation. Residential development is overtaking land formerly devoted to agriculture. Shoreline development raises issues of beach and marsh protection and preservation of open space as views are changed and avenues of easy access to the bay are closed. Coastal fisheries compete for freshwater with upstream users and suffer the effects of wetland loss and contamination of fishery habitat caused by human activities. Dredging, essential to many uses of the bay is a direct cause of habitat change and the disposal of dredged material is controversial in many areas.

As bayshore population and development increase, so do waste generation and the pollution of air, land, and water; so does the exposure of lives and property to hurricanes, flooding, and other hazards; so does the risk of irrevocable damage to the natural environment. Alteration of natural systems can bring damage to human systems; it can jeopardize our economy as well as our health and safety.

REGULATORY BASIS FOR MANAGEMENT STATUS

Development of shoreline areas is under the jurisdiction of local governments most of which have only basic land use planning authority. Municipal governments through ordinances or zoning power are authorized to affect development decisions, except for the Dune rules (see below). Counties in Texas do not have general ordinance making power (except for certain counties with powers granted under the Dune Protection Act). Land use regulation in Texas cities and counties has not made significant progress over the last several decades in comparison with other U.S. cities.

The state has passed legislation for managing shoreline development. Under the Open Beaches Act and the Dune Protection Act, local governments are required to adopt beach access and dune protection plans in accordance with regulations developed by the Texas General Land Office (GLO). The plans will control development within 1000 feet of mean high tide on the Gulf of Mexico shoreline. The GLO regulations require compliance with the standards established by the National Flood Insurance Program for construction in floodplains.

The GLO is the lead state agency for coordinating and planning erosion response measures in the coastal area. The state policy is to favor nonstructural erosion response techniques over structural methods.

The Coastal Coordination Act created the Coastal Coordination Council (CCC) to adopt and enforce a Coastal Management Program (CMP) for Texas based on the authority of existing laws and regulations. The CCC has no independent staff or budget and is composed of representatives of other state agencies and officials: the Commissioner of the General Land Office, the Attorney General, the chair of the Texas Parks and Wildlife Commission, the chairman of the Texas Natural Resource Conservation Commission, a member of the Railroad Commission of Texas, and one city or county elected official and one resident from the Coastal

area appointed by the governor for two-year terms. The goals of the Texas Coastal Management Program include the following: "(a) to protect, preserve, restore, and enhance the diversity, quality, quantity, functions and values of coastal natural resource areas; and (b) to ensure sound management of all coastal resources by allowing for compatible economic development and multiple human uses of the coastal area. Through uniform goals and policies, the CMP will be able to establish a unified state position on coastal resources management. The consistency review process will give the state the authority to require state and federal actions and projects in the Texas coastal area to comply with the CMP. Individual estuary management plans such as *The Galveston Bay Plan* maybe incorporated within the CMP in accordance with the proposed Special Area Management Planning Rule 31 TAC §§ SO4.1-8.

SHORELINE MANAGEMENT ACTION PLAN

To enhance long range conservation of living and non-living bay resources and improve aesthetic appeal and public access to Galveston Bay by managing human use of the shoreline and adjacent lands from a system-wide perspective.

OVERVIEW

Priority Problem:

Failure to reconcile use of bay resources with negative environmental consequences. Shoreline management practices frequently fail to balance the need for public access to bay resources with environmentally compatible development. Specific negative environmental consequences resulting from use of the bay shoreline include the following: 1) human-induced erosion; 2) water usage, point source, and non-point source impacts; 3) increased water-borne debris; 4) increased heavy metals, fecal coliforms, nutrients, and decreased dissolved oxygen concentrations.

For the purposes of this plan, the shoreline management boundary will be the same as the "coastal shore areas" established by the CMP within Brazoria, Chambers, Galveston, Harris, and Liberty, counties. In particular, activities within that area that are within 100 feet of the mean high tide are of concern.

Goal:

Reduce negative environmental consequences to the bay. Develop management plans and practices that minimize degradation of bay resources.

Objective:

Adopt a coordinated ecosystem approach to plan and permit shoreline development by 1996.

- Action SM-1: Establish a planning program for shoreline development.
- Action SM-2: Identify appropriate residential shoreline development guidelines.
- Action SM-3: Identify appropriate commercial and industrial shoreline development guidelines.
- Action SM-4: Minimize negative effects of structures and dredging on publicly owned lands.

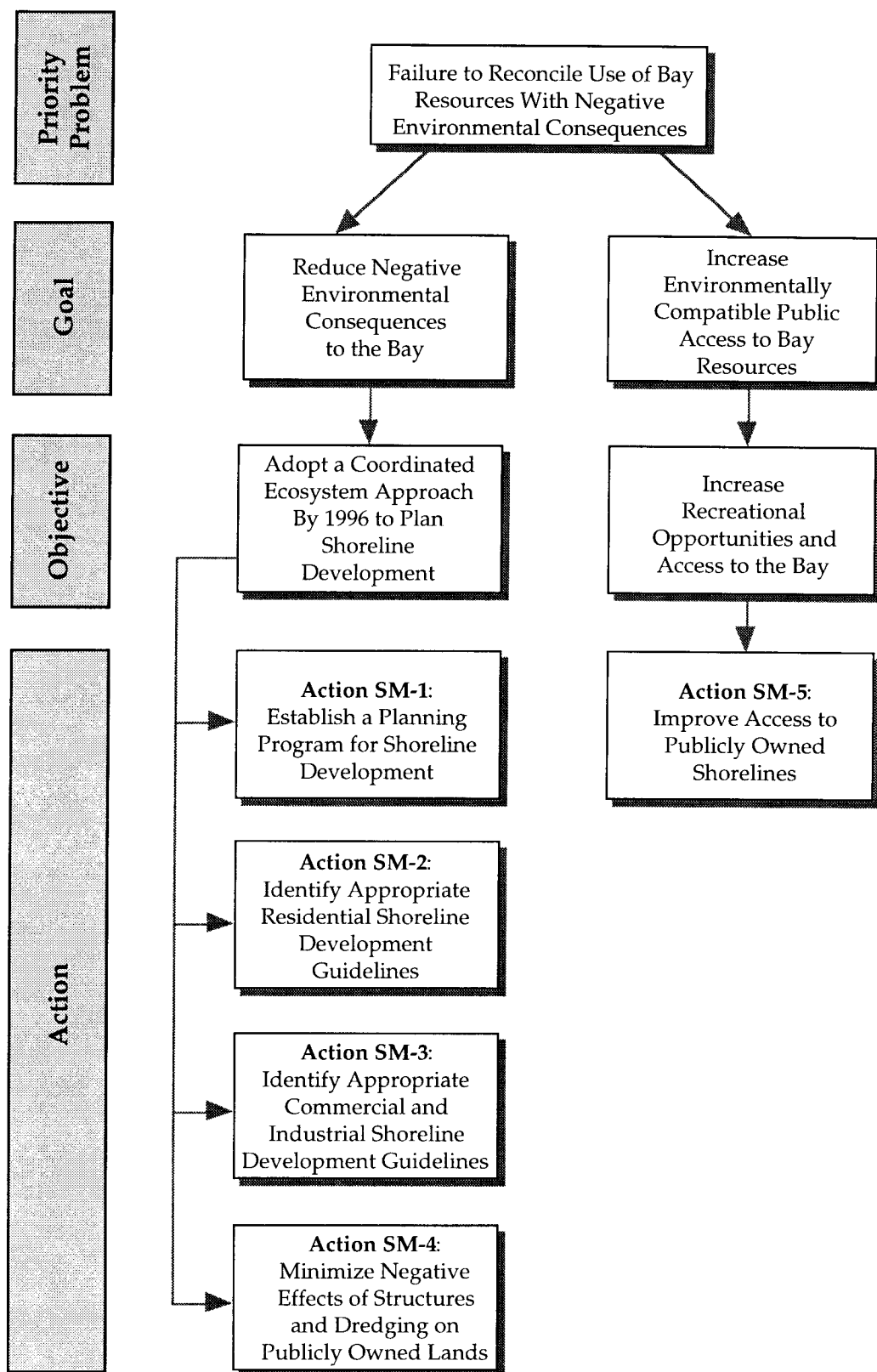
Goal:

Increase environmentally compatible public access to bay resources.

Objective:

Increase recreational opportunities and access to the bay by providing facilities such as parks, boat ramps, piers, trails, etc., that do not damage the bay.

- Action SM-5: Improve access to publicly owned shorelines.



Shoreline Management Action Plan Flowchart

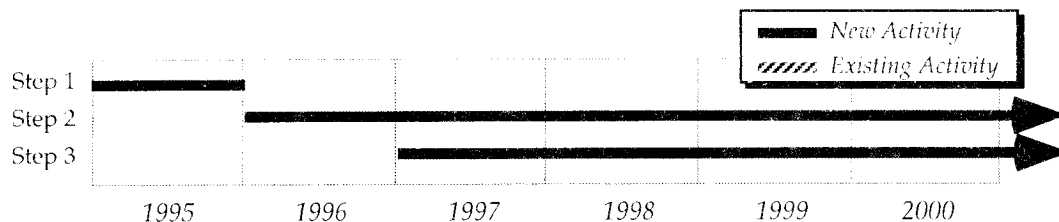
ACTION SM-1: Establish a Planning Program for Shoreline Development

What Implement through legislation an integrated shoreline development planning program for the Galveston Bay shoreline in close coordination with local governments and the CMP initiatives.

How

- Step 1 CCC will designate Galveston Bay as a Special Management Area under the CMP.
- Step 2 Galveston Bay Program will coordinate with the CCC and HGAC to insure that adequate technical assistance is available to local governments as they work to bring local development regulations and standards into conformance with CMP and *The Galveston Bay Plan* guidelines. Limited shoreline powers will be strengthened for counties which do not currently regulate land use. Development of greenways will be encouraged.
- Step 3 Galveston Bay Program will begin to track shoreline development and land use trends on Galveston Bay and will coordinate tracking of cropland and wetland acreage, shoreline erosion/accretion patterns, oil and gas development patterns, and similar shoreline processes with agencies and researchers already involved in this type of monitoring. A detailed land use map will be constructed for baseline conditions in order to track development in addition to the yearly aerial photography cropland studies done by the SCS. USFWS will continue working on wetlands update by aerial photography to be used to monitor shoreline loss due to erosion.

When



Where Shoreline management area.

Who Lead entity: Local governments, HGAC. Other participants: Regulatory agencies; industry, and public and private sector developments. Role of Galveston Bay Program: Coordination.

Public Costs of New Actions (5 years)

• GLO.....	\$ 96,000	• Counties	\$ 37,500
• Program	\$ 53,250	• HGAC.....	\$ 15,000
TOTAL.....		\$ 201,750	

This program will have an economic impact on developers, local governments, etc. depending upon voluntary development of plans by local governments. Potential Sources of Funding: NOAA, DoD, Corps, USGS, and EPA. The CCC should earmark CZMA funds for shoreline development planning.

Regulatory Issues County ordinance-making power would facilitate local participation in shoreline planning and attaining consistency with the developing CMP. Otherwise, planning would fall under existing local authorities.

Related Actions: HP-9, PPE-7, SM-2, and SM-3.

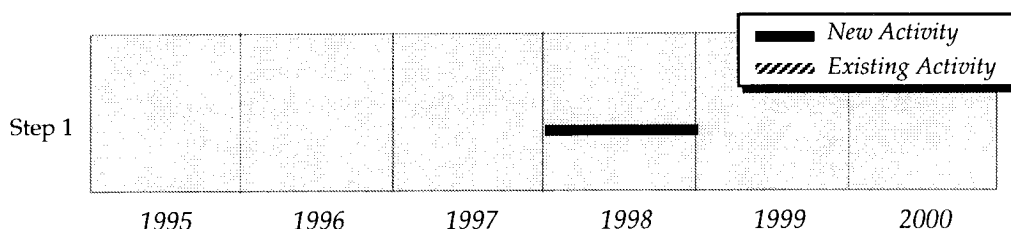
ACTION SM-2: Identify Appropriate Residential Shoreline Development Guidelines

What Incorporate cumulative impact elements and site-specific concerns during the permitting process for residential projects. Look at individual projects in the context of development of the bay as a whole and over time when considering environmental impacts.

How

Step 1 Galveston Bay Program, HGAC, and local governments will identify appropriate standards and establish regional residential development guidelines (on an advisory basis only) for shoreline areas that will be implemented by local municipalities. Development of guidelines will include public hearings during an adequate comment period for public review of proposed measures. CCC will consider funding to local entities to prepare plans based on bay-wide shoreline development planning.

When



Where Shoreline management area.

Who Lead entity: Galveston Bay Program and HGAC; Other Participants: Local governments and CCC. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• GLO.....	\$ 15,000	• Counties.....	\$ 187,500
• Munis	\$ 132,000	• Program	\$ 37,500
TOTAL.....		\$ 372,000	

Cost effective measures should be implemented to reap maximum benefit for minimum incremental costs to developers, land owners, and municipalities. Potential Sources of Funding: NOAA, DoD, Corps, EPA.

Regulatory Issues County ordinance-making power would enable more local participation in shoreline planning.

Related Actions: NPS-6, NPS-7, NPS-12, PPE-7, and SM-1.

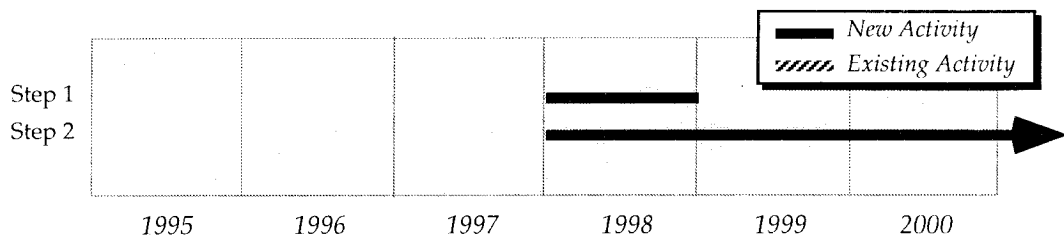
ACTION SM-3: Identify Appropriate Commercial and Industrial Shoreline Development Guidelines

What Incorporate cumulative impact elements and site-specific concerns for various shoreline types during the permitting process for individual projects. Implement controls over solid waste and sludge management facilities that may face inundation due to storm surge or general flooding.

How

- Step 1** Galveston Bay Program, HGAC, and local governments working with industry representatives and members of the public will identify appropriate commercial and industrial development and contingency planning guidelines for shoreline areas (on an advisory basis only). Development of guidelines will include ongoing hearings during an adequate comment period for public review. Close coordination will be required with the TNRCC to prevent accidental releases of hazardous materials during severe weather, and to modify the facility siting process for new industrial and commercial facilities to account for both flooding and hurricane threats in low-lying areas. Support contingency plans for existing facilities having hazardous or other wastes located in areas susceptible to hurricane washouts, storm surges, or erosion damage, as currently required under RCRA solid and hazardous waste regulations and SPCC requirements. Compile a list of appropriate actions (e.g., dike specifications, alternative waste storage locations) to prevent existing facilities and abandoned pits from adversely affecting the bay during severe weather conditions.
- Step 2** TNRCC and DPS will lead an interagency effort to inventory all existing solid/hazardous and sludge management facilities in the Galveston Bay Special Management Area and assess their hurricane damage potential.

When



Where Shoreline management area.

Who Lead entity: Galveston Bay Program, HGAC, TNRCC, and DPS; Other Participants: Local governments, GLO, industry, and the public. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• GLO.....	\$ 60,750
• Munis	\$ 132,000
TOTAL	\$ 192,750

Costs for Program are included in Action SM-2. Potential Sources of Funding: NOAA, DoD, Corps, and EPA.

Regulatory Issues County ordinance-making power would enable more local participation in shoreline planning. Standards are already a part of the RCRA facility siting process.

Related Actions: NPS-1, NPS-4, NPS-6, PPE-7, and SM-1.

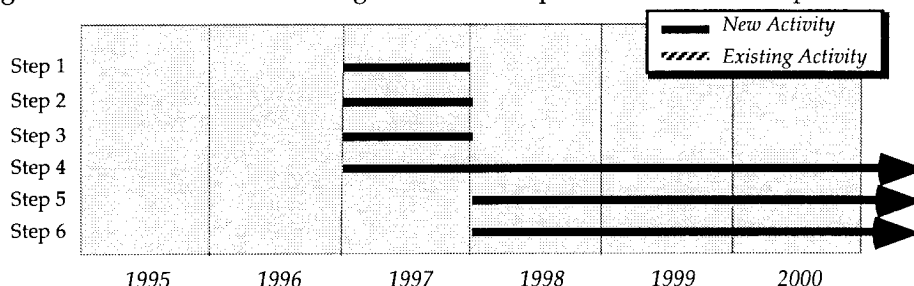
ACTION SM-4: Minimize Negative Effects of Structures and Dredging on Publicly Owned Lands

What Minimize negative effects of structures on submerged and emergent publicly owned lands. Any project on public lands is defined as a "structure;" including dredging (defined by GLO), docks, pipelines, and piers. This program will not include structures built for environmental benefits, such as artificial reefs, however.

How

- Step 1** GLO will inventory and assign removal priority to all derelict structures and pipelines on state-owned lands based on aesthetics, submerged habitat value, threat to shorelines, habitats, water quality, or safety. Structures determined to have positive environ. value (e.g., artificial reefs) are not subject to this action.
- Step 2** GLO will consider adopting rules to require, at the time of permit application, where practical, the deposit of funds into escrow or the posting of bond to cover future removal of the permitted structure if it is ever abandoned. GLO also will adopt rules to increase fines for abandonment of structures.
- Step 3** GLO and Corps will review rules for shoreline structure permitting and dredge/fill disposal activities to require consideration of specific & cumulative impacts and to require mitigation for unavoidable impacts.
- Step 4** USCG, TPWD, TDH and GLO will work to establish authority to expand enforcement against raw sewage discharges from cabins & houseboats.
- Step 5** GLO will begin removal of ownerless derelict structures based on priority ranking, and GLO will order the removal of structures where the owner is known.
- Step 6** GLO will begin the phase out of cabins on state-owned lands through a ban on lease transfers and renewals and by adopting rules to prohibit any new cabins or the rebuilding of damaged cabins according to criteria in the rules. Sewage containment procedures will be implemented for cabins.

When



Where Publicly owned shorelines and waters of the State in the Galveston Bay Program Area.

Who Lead entity: GLO; Other Participants: TNRCC, TDH, EPA, County health departments, Corps, private leaseholders, local governments, TPWD, USFWS, and USCG. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• GLO	\$ 153,500
• Program	\$ 37,500
TOTAL.....	\$ 191,000

Efforts should be made to ensure that expenses are incurred by those responsible for derelict structures. Potential Sources of Funding: NOAA and EPA.

Regulatory Issues GLO will consider adopting rules related to the following: 1) Escrow funds at time of construction permit application; 2) increase fines for abandonment; 3) provide for specific and cumulative impact assessment and mitigation against unavoidable impacts when permitting; 4) prohibit future cabin lease transfers; application renewals, new cabins on state lands; or rebuilding after damage to greater than half the cabin value; 4) obtain state authority to regulate placement of houseboats. RRC will revise rules to address oil and gas structures on submerged lands.

Related Actions: FW-7, NPS-1, NPS-8, and SM-1.

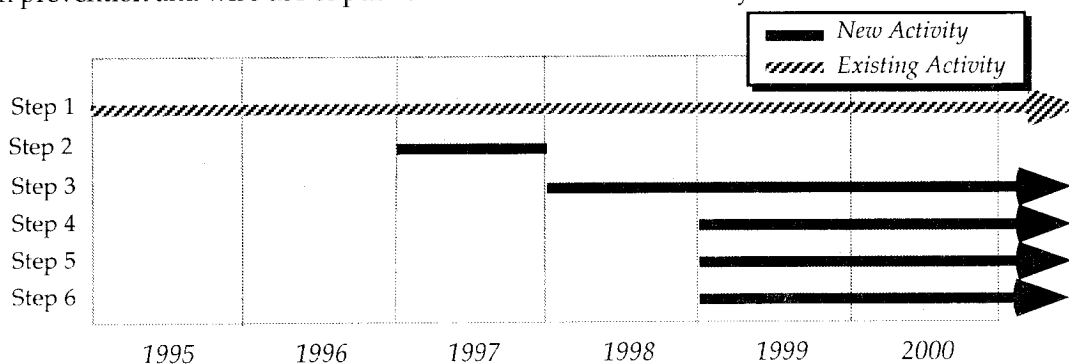
ACTION SM-5: Improve Access to Publicly Owned Shorelines

What Improve recreational opportunities and access to public shorelines in a manner consistent with protection of the ecosystem. Provide a sense of public ownership of the bay by providing facilities such as parks, boat ramps, piers, trails, roads, and walkways.

How

- Step 1 Federal, state and local agencies/entities will continue to increase resources available for acquisition of land and public recreational facilities on bay shoreline by coordinated funding and construction of public use facilities to improve bay access. Emphasize maintenance/improvement of existing facilities.
- Step 2 Galveston Bay Program will inventory and map existing public recreational facilities and access points and assess needs as the first step in development of a Galveston Bay public facility plan (see Action PPE-3). Investigate environmental impacts resulting from recreational uses of the shoreline, especially near submerged aquatic vegetation.
- Step 3 Galveston Bay Program will develop passive recreational opportunities around the bay and support for development of GBF Galveston Bay loop of Texas Coastal Trail.
- Step 4 Public entities such as TPWD and private entities will begin land acquisition based on public facility plan.
- Step 5 GLO and local governments will encourage voluntary land dedication in major new shoreline developments to provide for public access points based on public facility plan.
- Step 6 Maintenance costs and ecosystem damage may be reduced by informing the public about benefits (i.e., minimizing litter, reduced impact on sensitive habitats, and additional income from tourism) of using shoreline facilities wisely. Galveston Bay Program will lead public education effort to encourage pollution prevention and wise use of public facilities near Galveston Bay.

When



Where Publicly owned shorelines and waters of the State in the Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program; Other Participants: TPWD, USFWS, HGAC, GLO, local governments, GBF, National Park Service, and landowners. Role of Galveston Bay Program: Conduct Action.

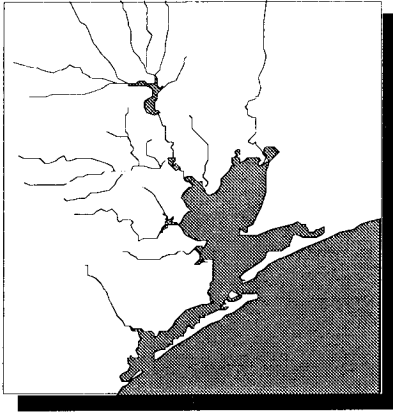
Public Costs of New Actions (5 years)

• GLO	\$ 15,750
• Program.....	\$ 40,000
TOTAL	\$ 55,750

Costs for Step 3 are included in Action PPE-3. Costs will be determined by the area and value of land purchased for additional park areas. Potential Sources of Funding: USDA, NOAA, DOD, Corps, DOI, NPS, TPWD. Consistency review of the real property acquisitions or dispositions by federal agencies can be a source of potential land for parks and public areas to enhance public access.

Regulatory Issues None.

Related Actions: PPE-3 and SM-1.



IV.

Water and Sediment Quality Improvement

This section of *The Galveston Bay Plan* deals with the relationship between water/sediment quality and pollutant loadings to the bay. Three action plans have been developed to address general water/sediment quality issues and problems with point source and non-point source pollutant loadings.

Water and Sediment Quality Two major water and sediment quality problems have been identified: certain toxic substances have contaminated water and sediment, and dissolved oxygen is reduced in certain tributaries and side bays, harming marine life. To address these concerns, actions plans were developed to determine the sources of ambient toxicity, set sediment quality standards, perform loading studies for toxics and oxygen-demanding pollutants, and to support the Clean Texas 2000 Pollution Prevention Program (see page 163).

Non-Point Sources of Pollution Urban runoff has been ranked as the second-most important priority problem to the bay. A series of actions, many coordinating and strengthening existing and proposed programs, have been developed for *The Galveston Bay Plan*. A total of 15 different actions target non-point sources of pollution from existing urban development, new urban development, roadways, agriculture, industry, and marinas (see page 179).

Point Sources of Pollution While there has been a dramatic reduction in point source loadings since the 1960s, there are still some areas of concern. Many municipal systems still have bypass, overflow problems, and connection problems, allowing raw or partially treated sewage to enter Galveston Bay. The City of Houston is currently undertaking a \$1.2 billion program to correct some of these problems, and other municipalities may need to implement similar programs. A second major problem is that produced water discharges from oil production platforms have a negative effect on aquatic life in the tidal zone. *The Galveston Bay Plan* includes an action to eliminate harm from these discharges (see page 199).

Water and Sediment Quality

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<i>Action</i>	<i>Priority</i>	<i>Description</i>	<i>Page</i>
WSQ-1	High	Reduce contaminant concentrations to meet standards and criteria.....	159
WSQ-2	High	Determine sources of ambient toxicity in water and sediment.....	160
WSQ-3	High	Establish and Adopt Sediment quality criteria.....	161
WSQ-4	High	Perform TMDL loading studies for toxics	162
WSQ-5	High	Support Clean Texas 2000 Pollution Prevention Program.....	163
WSQ-6	Medium	Reduce nutrient and BOD loadings to problem areas.....	164
WSQ-7	Medium	Perform TMDL loading studies for oxygen demand and nutrients	165

THE ISSUES

The Galveston Bay system is characterized as having relatively good water quality in open bay segments. Water quality problems, where they occur, are found in the western, urbanized tributaries. In general, the water quality problems in these locations have shown tremendous improvement over the past 20 years because of improved wastewater treatment. Although data in many cases is limited, localized problems remain. Isolated, localized areas of sediment toxicity exist, and certain Houston Ship Channel segments exceed water quality criteria for some selected contaminants such as PCBs, DDT, and heavy metals. Biomagnification and accumulation of toxicants occurs in tissues of certain estuarine organisms, and increases the potential risk associated with consuming contaminated seafood from local problem areas within the Galveston Bay Estuary. Although there has been dramatic improvement over the past 20 years, the upper Houston Ship Channel still has a problem with low dissolved oxygen (DO) concentrations compared to most other parts of the bay, impairing the full utilization of the channel by aquatic life. High levels of bacteria in open bay waters has closed over half of the bay to oystering, and some tributaries exceed the standards for safe contact recreation.

An action plan has been developed to improve the water and sediment quality in certain areas of the bay. This goal will be achieved by reducing the toxicity and contaminant concentrations

in the water and sediments and increasing the dissolved oxygen concentration in certain tributaries and side bays. These efforts should lend support to a healthy ecosystem and minimize risk to human health.

- **Contaminant Reduction:** Five actions are presented to address the elimination of ambient toxicity in Galveston Bay water and sediments. Several types of surveys are advocated to identify the sources of contaminants and toxicity found in the water and sediment. Efforts made by the Texas Natural Resource Conservation Commission (TNRCC) to establish and adopt sediment quality criteria are supported as well as the TNRCC Clean Texas 2000 Pollution Prevention Program.
- **Dissolved Oxygen Augmentation:** Two actions are promoted by *The Galveston Bay Plan* to address the lack of sufficient dissolved oxygen in certain areas of the bay. An increase in the dissolved oxygen concentration may promote aquatic life in areas of the bay system that have been historically unproductive. Studies to determine relative contributions of nutrients, oxygen-demanding materials, and hydrodynamic factors will aid in identifying problem areas and establishing biological oxygen demand (BOD) loading rates.

ENVIRONMENTAL STATUS

GBNEP Ambient Water and Sediment Quality Study

The authors of a GBNEP study that evaluated the existing monitoring data for the bay concluded that the water and sediment quality of the Galveston Bay system is "generally good, and where it is degraded it is showing a pattern of improvement." This conclusion was based on a detailed analysis of available water and sediment quality databases extending from 1965 to the present for most parameters. The task involved compiling a massive database from numerous separate sources, creating the most extensive and detailed long-term record of water and sediment quality ever assembled for the estuary. The study took an *ambient* or "in-the-bay" approach to complement other studies of potential pollution *sources* like point and non-point source pollution. The authors' conclusions regarding key water and sediment quality indicators are provided below.

Temperature

Water temperature has declined approximately 1° over 20 years, with the most prevalent decline occurring in the summer months. Since 1985, there have been violations of the 95°F (35°C) standard in two segments, both in the Houston Ship Channel. The frequency of violation is on the order of 5 percent for the two segments.

Salinity

Substantial gradients across the bay are a normal feature of salinity structure, declining on the average from values of about 30 parts per thousand (ppt) at the inlets to the Gulf to about three ppt near principal points of inflow, such as the Trinity River. Although many human activities (such as impoundment of rivers and sea water intrusion through dredged channels) were

thought to threaten the bay with a salinity increase, a four parts per thousand (ppt)*decline* in salinity has been observed in Galveston Bay over the past three decades. Salinity decreases are prominent in the lower bay (especially East Bay), and in areas influenced by intrusion from the Gulf of Mexico, particularly west of the Houston Ship Channel. Seasonally, the decline has been especially noticeable in late summer. An unexpected lack of direct linkage between freshwater inflow and bay salinity suggests the dynamics of Gulf interchange, return flows, and localized runoff may be much more important (and more complex) than previously suspected.

Geographically, the low salinities of the river-influenced upper bay normally grade to high salinities in the Gulf-dominated lower bay. Variability was shown to be high, however, with a standard deviation of 5-6 ppt throughout the bay. Salinities in the open bay reach of the Houston Ship Channel were some 2 ppt higher than those of adjacent waters. Variability with depth (stratification) was slight by estuarine standards, generally averaging less than 0.6 parts per thousand per meter (ppt/m) of which about half the bay area was less than 0.3 ppt/m, and showing no geographic correlation with total water depth. This was an expected condition in this shallow, wind-driven estuary.

Suspended Solids and Turbidity

Suspended solids, and the related parameter turbidity (cloudiness of the water), are associated with river inflows and dredging activities. Surprisingly, the GBNEP ambient water quality study indicated that there has been an approximate 50 percent decline in suspended solids and turbidity over the past 20 years. This has resulted in much clearer water in most portions of the bay compared to conditions in the early 1970s.

Dissolved Oxygen.

The oxygen dissolved in water (DO) is critically important to living organisms and to the overall health of the bay ecosystem. DO levels in the bay are generally determined by photosynthesis and wind action (which increase DO) and oxygen-demanding pollutants and plant and animal respiration (which reduce DO). DO is generally high throughout Galveston Bay, averaging near-saturation in large areas of the bay, with frequent occurrences of concentrations greater than the equilibrium concentration with air (supersaturation). Exceptions to this are in poorly flushed tributaries subjected to inflow and waste discharges, most significant of which is the Houston Ship Channel.

Traditionally, low DO has occurred in poorly flushed areas that receive nutrients and oxygen-demanding material from wastewater and runoff—that is, in the urbanized tributaries and the upper Houston Ship Channel. Twenty years ago, there was essentially no oxygen in the upper Houston Ship Channel, and therefore no fish. Critically low DO has not traditionally been a problem in open well-aerated portions of the bay, and this study confirms DO levels near (or even above) the saturation point in these areas, with little depth stratification.

Segment Number	Segment Name	<u>Designated Uses</u> ¹								<u>Standards</u> ¹	
		cr	hgh	sfw	iws	ncr	iqh	pdws	nav	DO	FC
2421	Upper Galveston Bay	•	•	•						4.0	14
2422	Trinity Bay	•	•	•						4.0	14
2423	East Bay	•	•	•						4.0	14
2424	West Bay	•	•	•						4.0	14
2425	Clear Lake	•	•							4.0	200
2426	Tabbs Bay	•	•							4.0	200
2427	San Jacinto Bay	•	•							4.0	200
2428	Black Duck Bay	•	•							4.0	200
2429	Scott Bay	•	•							4.0	200
2430	Burnett Bay	•	•							4.0	200
2431	Moses Lake	•	•							4.0	200
2432	Chocolate Bay	•	•	•						4.0	14
2433	Bastrop Bay/Oyster Lake	•	•	•						4.0	14
2434	Christmas Bay	•	•	•						4.0	14
2435	Drum Bay	•	•	•						4.0	14
2436	Barbours Cut	•	•							4.0	200
2437	Texas City Ship Channel		•			•				4.0	200
2438	Bayport Channel		•			•				4.0	200
2439	Lower Galveston Bay	•	•	•						4.0	14
Trinity River											
0801	Trinity River Tidal	•	•							4.0	200
0802	Trinity R. below L. Liv	•	•					•		5.0	200
Trinity-San Jacinto Coastal											
0901	Cedar Bayou Tidal	•	•							4.0	200
0902	Cedar Bayou Above Tidal	•	•					•		5.0	200
San Jacinto River											
1001	San Jacinto River Tidal	•	•							4.0	200
1005	HSC/San Jacinto River		•			•				4.0	200
1006	Houston Ship Channel				•				•	2.0	2000
1007	HSC/Bufalo Bayou				•					1.0	2000
1013	Buffalo Bayou Tidal	•					•			3.0	200
1014	Buffalo Bayou Above Tidal	•					•			—	—
San Jacinto-Brazos Coastal											
1101 ²	Clear Creek Tidal	•	•							4.0	200
1102 ²	Clear Creek Above Tidal	•	•							5.0	200
1103	Dickinson Bayou Tidal	•	•							4.0	200
1104	Dickinson Above Tidal	•	•					•		4.0	200
1105	Bastrop Bayou Tidal	•	•							4.0	200
1107	Chocolate Bayou Tidal	•	•							4.0	200
1108	Chocolate Above Tidal	•	•							5.0	200
1113	Armand Bayou Tidal	•	•							4.0	200

Note 1: cr = contact recreation, hgh = high quality habitat sfw = shellfish waters
iws = industrial water supply ncr = non contact recreation iqh = intermediate quality habitat
pdws = public domestic water supply nav = navigation
DO = dissolved oxygen, mg/L FC = fecal coliform, colonies/100 mL

Note 2: Segments 1101, 1113, and 2422 are subdivided, constituting a total of seven segments. HSC: Houston Ship Channel

FIGURE WSQ-2. Present Texas Natural Resource Conservation Commission Water Quality Segments, Designated Uses, and Standards in the Galveston Bay System

Within the upper Houston Ship Channel above the San Jacinto confluence, DO has *increased* by about 4 parts per million (ppm) in the past 20 years. (Other studies confirm that substantial numbers and kinds of fish and other organisms have returned to this area). However the level of oxygen demanding materials present measured as biological oxygen demand, (BOD) remains higher in the upper Ship Channel, in the upper Bay along the north and west shores, and in Clear Lake.

Nutrients

Prior to studies performed by the Galveston Bay National Estuary Program, there was a general concern that nutrients originating from agricultural runoff, urban runoff, and wastewater point sources were over-enriching Galveston Bay, leading to eutrophication. In many east coast estuaries, this produces widespread algae blooms from the fertilizing effect, loss of dissolved oxygen, and fish kills. But the overall view revealed by the GBNEP study (for the first time) shows a different picture. Phosphates, ammonia, and nitrates all show a substantial general *decline* bay-wide, with some localized exceptions (the urban bayous and Ship Channel remain problem areas).

The analysis also revealed an unexpected glimpse into possible effects of nutrient declines on bay productivity—the food chain process that begins with green plants like phytoplankton and ends with predators like game fish and human consumers. Although cause and effect are not yet linked, the bay apparently grows less algae and has clearer water than it did 20 years ago. A general decline in Chlorophyll *a* (a measure of phytoplankton) and a halving of total suspended solids (including both algae and inorganic particles) was noted over the last two decades. Suspended solids in the Trinity River have also declined by a factor of three since the closure of Lake Livingston in 1970, and suspended solids from waste discharges have declined by an estimated factor of 10. Reduced total organic carbon and turbidity in the bay reinforce this pattern.

A decline in primary productivity that is provided by phytoplankton could have serious food web implications. The root meaning of "eutrophication" is simply "the process of becoming well fed." What is a well-fed estuary, and when is it under- or over-fed? At what point does primary productivity reduction in phytoplankton affect higher levels in the food chain, and hence the bay's economy? Questions raised by the project will await further work.

What we do know is the relative contributions of nutrients from a variety of sources, such as industrial point sources, municipal point sources, urban runoff, agricultural runoff, and the upper watershed:

<u>Source</u>	<u>Percentage of Annual Loading to Bay (%)</u>	
	Total Nitrogen	Total Phosphorus
Industrial Point Sources	7 %	4 %
Municipal Point Sources	37 %	30 %
Local Urban Runoff	3 %	33 %
Local Agricultural Runoff	1 %	13 %

continued

Source	Percentage of Annual Loading to Bay (%)	
	Total Nitrogen	Total Phosphorus
Other Local Runoff	1 %	7 %
Upper Watersheds	51 %	13 %

As can be seen from these figures, municipal point sources and the upper watersheds are the largest contributors of nutrients to the bay. Agriculture is a surprisingly low source of nutrients, primarily because much of the agricultural lands are rice fields that lose relatively little nutrients during rain events.

Bacteria

Open-water portions of Galveston Bay generally conform to Texas water quality criteria for contact recreation. Areas where the long-term fecal coliform bacteria levels exceeded the state standards for contact recreation are in western, developed tributaries of the bay: Buffalo Bayou, White Oak Bayou, Clear Creek, Dickinson Bayou, and Chocolate Bayou. In some of these areas, contact recreation is common and unregulated. Bacteria data show no increasing trend that could be associated with human activities in the watershed.

While many regulatory changes have taken place over the years in shellfish harvesting regulation, the area of the bay subject to shellfish closure has remained about the same for four decades. Wet weather runoff appears to be the most significant source of bacteria, but concentrations in the open bay tend to be localized and of short duration. For example, many of the conditionally approved areas for oyster harvesting are reopened within a few days after heavy rain events. Many of the shellfish closures result from either a small portion of the data exceeding higher values, generally after rains, or a judgment made about the potential for upland facilities to introduce pathogens.

Toxics

Contaminants such as metals and trace organics (pesticides, PCBs) showed elevated levels in regions of runoff and waste discharge, with generally the highest values in the upper Ship Channel, and generally low values in the open bay waters. Using total metals data that will overestimate dissolved metals concentrations, the existing data show *potential* criteria violations for dissolved heavy metals along the Houston Ship Channel (both open-bay and landlocked reaches), along the Intracoastal Waterway, and in turning basins. Declines were noted for most of the toxic metals, both in water and sediment, in areas of maximal concentrations. This is especially true for the Upper Houston Ship Channel, where the rates of decline per decade for sediment concentrations of chromium, mercury and zinc are a factor of two; for copper and nickel a factor of three; and for arsenic, cadmium and lead a factor of ten. Although historical metals measurements may overestimate actual concentrations, metals in water appear to be at or below levels that would be satisfactory for an estuary (sediment standards do not yet exist). Isolated areas of elevated concentrations probably exist near specific sources of metals.

Most measurements of trace organics such as pesticides were below detection limits, precluding statistically reliable information on trends. Two out of 18 measurements in two

Houston Ship Channel segments exceeded the EPA's criterion for chronic DDT concentration. In three of the Ship Channel segments the EPA's PCB criteria for marine and freshwater environments were violated in 8 out of 16 measurements. Both these compounds are now highly regulated, but their high persistence is evident in the data.

Several monitoring programs have also focused on the accumulation of toxics in seafood and the associated health risks of these chemicals. Accumulation of PCBs and PAHs (polynuclear aromatic hydrocarbons, combustion byproducts and constituents of oil and creosote) in fish, oysters, and crabs has increased the risk of consuming seafood from Galveston Bay. Two seafood advisories caused by concern over toxics currently exist for the Galveston Bay system: the first is based upon dioxin contamination in a limited area of the upper bay, and the second is based on three industrial solvents found in fish from Clear Creek. See the Public Health Protection Action Plan for more information about these seafood studies.

Sediments

In Galveston Bay, commonly measured organic compounds and metals appear to follow the same general spatial distribution as most of the water quality parameters: elevated concentrations in regions of runoff, inflow and waste discharges, and lower, more-or-less uniform concentrations in the open bay, with the Houston Ship Channel generally the focus of maximal concentrations in the system. Where trends in metals are discernible, they tend to be declining, especially in the upper Houston Ship Channel. Over the past decade, these rates of decline have been sufficient to reduce sediment concentrations of chromium, mercury and zinc by a factor of two; copper and nickel by a factor of three; and arsenic, cadmium and lead by a factor of ten.

Other Studies

The Texas Water Commission compiled an annual overall ranking for 104 water quality segments in Texas which included 31 of the segments in and around Galveston Bay. The Houston Ship Channel had the lowest ranking (worst water quality) with identified problems in the area of toxics, known non-point sources, high point sources, fish kills, low dissolved oxygen, fecal coliforms, and nutrients. Upper Galveston Bay was ranked as 34th lowest out of the 104 segments and Trinity Bay was ranked 69th. East Bay, West Bay, and Chocolate Bay had high rankings (94th, 96th, and 102nd, respectively), indicating relatively good water quality in these areas. The Texas Department of Health (TDH), using data collected by the U.S. Environmental Protection Agency (EPA), has also issued advisories regarding dioxin pollution in certain upper portions of the Houston Ship Channel and Galveston Bay.

There is still considerable uncertainty in the Galveston Bay system about deposition of pollutants from the atmosphere. In other estuary systems, air deposition is a significant source of some parameters, such as nitrogen in Chesapeake Bay. A rough estimate, prepared for the Galveston Bay State of the Bay Report, indicates that air deposition may be responsible for around 12 percent of the annual nitrate/nitrite load, one percent of the annual lead loading, and nine percent of the annual cadmium loading. Note these estimates were developed using general deposition rates from other parts of the country. Additional work needs to be performed to make more accurate, site-specific loading estimates for Galveston Bay.

Probable Causes

General

Potential causes for the observed changes in water quality described previously were presented in the GBNEP ambient water and sediment quality report, and are summarized below:

Change in Parameter	Possible Causes of Change
Declining Temperature	Long-term changes in climatology Long-term changes in water temperature in Gulf Alterations in the intensity of interaction with Gulf
Declining Salinity	Decreased salinity in adjacent Gulf of Mexico Increased inflow from local watersheds Decreased interaction with Gulf
Increasing Dissolved Oxygen in Houston Ship Channel	20-fold reduction in industrial and municipal oxygen-demand loadings since 1970
Decreasing Suspended Solids and Turbidity	Reduced loadings from the main river system, probably due to reservoir construction and changes in upper watershed Reduced loadings from the local watershed Reduced loadings from treatment plants
Decreasing nutrients	Reduced loadings from the main river system, probably due to reservoir construction and changes in upper watershed Reduced loadings from treatment plants
Decreasing chlorophyll	Decreased nutrient supply Increased toxicity to phytoplankton Increased phytoplankton predation Altered species distribution

Problem areas in Galveston Bay for pollution of water and sediment are in areas of intense human activity, including urban areas, points of surface runoff, waste discharges, and shipping.

Toxics

The observed decline in concentrations of metals in the waters and sediments of the Galveston Bay system is probably related to improved wastewater treatment from industrial and municipal sources. Two compounds which have been shown to cause problems, DDT and PCBs, are now no longer manufactured and their use is highly regulated. These compounds are highly persistent in the environment, however, and are still found in the Galveston Bay system. Most of the PAHs that contribute to health risks in seafood are associated with combustion byproducts and not with releases of crude oil or creosote compounds, although some non-combustion PAHs contaminate sediments in localized areas around produced water discharges. Sources of the low levels of dioxin found in the upper bay are typically associated

with paper and pulp manufacturing, and three industrial chemicals found in fish from Clear Creek are also found at the former Brio Refining Company, a EPA Superfund site where a cleanup of toxic industrial compounds is now underway.

Oxygen Demand

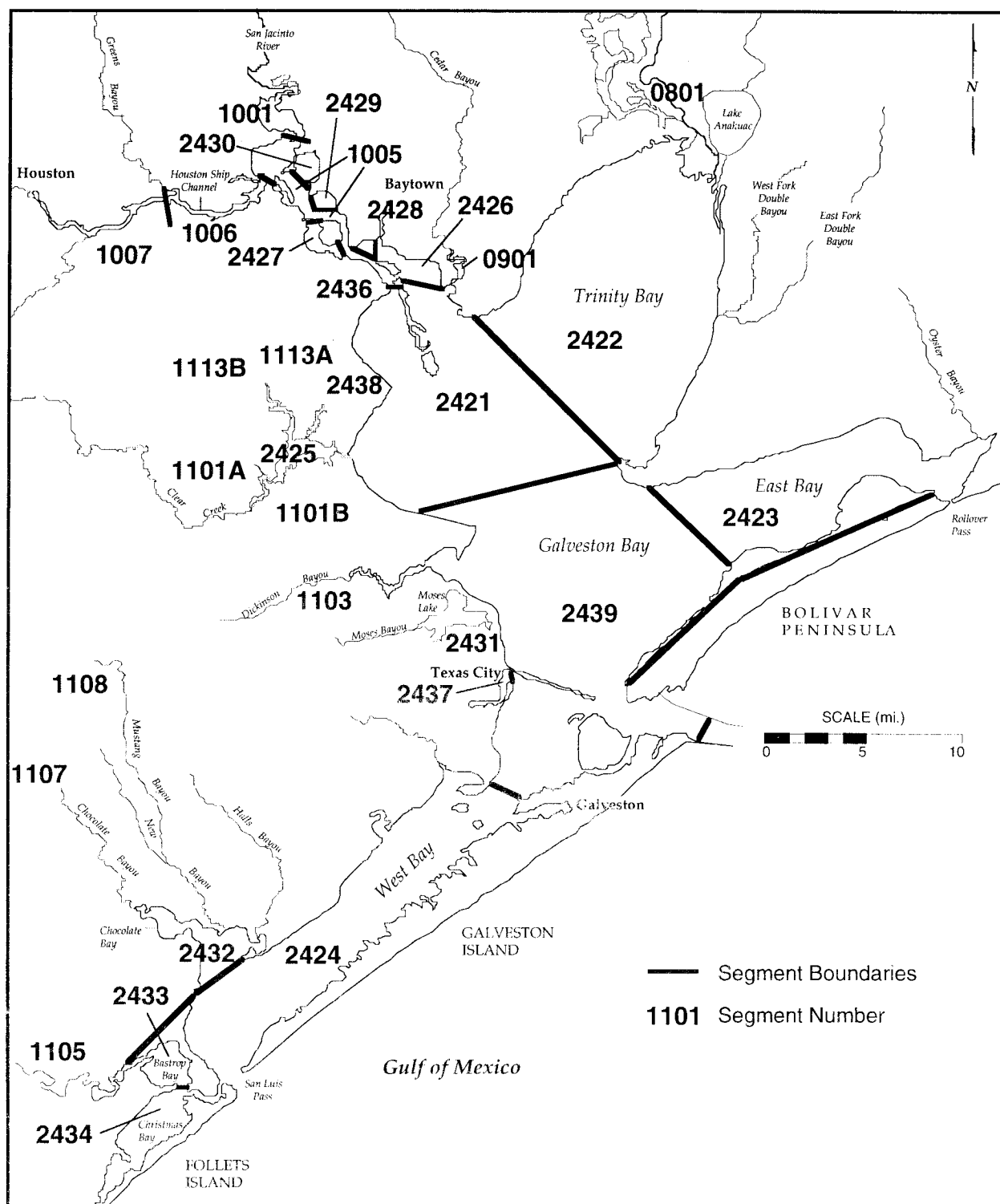
In most Galveston Bay waters, scattered violations of the dissolved oxygen standards (generally about two percent of the data show violations) indicate no serious or systematic water quality problems. Estuarine segments with some reported dissolved oxygen problems include Buffalo Bayou Tidal, Clear Creek Tidal, and Armand Bayou Tidal. Compared to the upper Houston Ship Channel, the other dissolved oxygen problems appear to be limited in scope and severity.

An evaluation of different oxygen demanding substances (Biochemical Oxygen Demand or BOD) indicates that most of the BOD loading to the bay originates from non-point sources in the local watershed (downstream of Lake Livingston and Lake Houston). On an annual basis, the overall BOD loading is distributed between these sources:

Source	% Contribution to Annual BOD Loading to Bay
Municipal Point Source	3 %
Industrial Point Sources	7 %
San Jacinto River	7 %
Trinity River	27 %
Local Urban Non-Point Sources	31 %
Local Agricultural Non-Point Sources	6 %
Local Forested and Open Non-Point Sources	14 %
Local Other Non-Point Sources	5 %

Note that the urban land uses reflect an incremental increase in non-point source loadings over pre-development conditions such as open pasture or forest. In other words, the average post development BOD loading from urban areas is about 30 kg of BOD per year per acre of land, compared to about 6 kg BOD per year per acre for forest or open land uses. Therefore even if all of BOD loads from urban development were reduced to pre-development conditions, the urban areas would still contribute about five percent of the total annual BOD load to the bay compared to the estimated amount of 31 percent shown above.

In the Houston Ship Channel above Morgans Point, however, there has been a historical problem with dissolved oxygen concentrations. In the 1960s and 1970s, excessive point source discharges eliminated dissolved oxygen in the upper Ship Channel, virtually wiping out all aquatic life. Since 1968, however, there has been a 95 percent reduction in municipal and industrial point source BOD loadings, and the upper Ship Channel now has enough dissolved oxygen to support an "extensive" utilization of the Channel by numerous aquatic species.



Note: Segments 0802, 0902, 1013, 1014, 1102, and 1104 not shown

FIGURE WSQ-1. TNRCC Water Quality Segments for Galveston Bay and the Houston Ship Channel

Despite the dramatic reduction in municipal and industrial pollution between 1968 and 1990, there are still some low dissolved oxygen concentrations and exceedances of standards in the upper Houston Ship Channel. In Segment 1006 (San Jacinto River to Greens Bayou) the frequency of exceedance of the 2.0 milligram per liter dissolved oxygen standard has ranged between one and 12 percent after 1985. In Segment 1007 (Greens Bayou to I-59, including the Turning Basin) the frequency of exceedance of the 1.0 milligram per liter dissolved oxygen standard has ranged between one and six percent after 1985. Note that these stream segments have not been designated by the state to maintain aquatic life, and therefore the dissolved oxygen standards have been set lower than any other Galveston Bay segments (most of which have a 4.0 or 5.0 milligram per liter standard).

An estimate of the sources of carbonaceous oxygen demand loadings to the Houston Ship Channel was performed during a 1986 TWC study. The sampling data from this study indicated that industrial point sources were responsible for about 7 percent of the annual carbonaceous oxygen demand, municipal discharges 10 percent, municipal bypasses and overflows 11 percent, and non-point sources 72 percent. Since this time a large collection system improvement project has been implemented by the City of Houston resulting in elimination of dry weather overflows and a large reduction in wet weather overflows (see Point Sources Action Plan).

The low-dissolved oxygen problems in the Galveston Bay system are caused by a combination of 1) low flushing rates, 2) oxygen demand from point, non-point, and benthic sources, and 3) possible oxygen demand from excessive algal growth. No detailed studies have been performed at any of the areas with low-dissolved oxygen areas to determine the relative contribution of these different sources, although further reductions in point source loadings alone will probably not result in greatly improved dissolved oxygen in the Houston Ship Channel.

MANAGEMENT STATUS

Section 303 of the Clean Water Act (CWA) and Title 40, Part 131 of the Code of Federal Regulations require states to establish surface water quality standards subject to EPA approval. The state standards must contain: 1) designated beneficial uses for which a water body is to be protected, (such as drinking water, contact recreation, etc.); 2) criteria necessary to protect these uses; and, 3) an antidegradation policy. The state standards may meet or be more stringent than EPA requirements. The standards must be reviewed by the states every three years. In the spring of 1991, the Texas Natural Resource Conservation Commission (TNRCC) completed a "triennial" review of the Texas surface water quality standards. TNRCC is currently scheduled to complete another triennial review in 1994.

Designated water body uses include water recreation, water supply, industrial and agricultural use, and support of fish and aquatic life. Water quality standards also establish water quality-based treatment controls and strategies. Water quality standards are composed of the following elements:

- Use designations for each water body
- Methods used and analyses conducted to support revisions to the standards
- Water quality criteria for the protection and maintenance of each designated use
- An anti-degradation policy to protect water quality
- An implementation and enforcement plan

The TNRCC has been delegated the responsibility for developing water quality standards for the state. The surface water quality standards promulgated in 30 Texas Administrative Code (TAC) Chapter 307 include regulations for general water quality criteria and site-specific uses and criteria. General criteria are applicable to all surface waters in the state and are particularly important for managing pollutants not addressed by specific numerical criteria. General criteria are composed of the following elements:

- Aesthetic parameters (e.g., taste, odor, floating debris, etc.)
- Radiological parameters
- Toxic parameters (e.g., PCBs, pesticides, metals, etc.)
- Nutrient parameters
- Temperature
- Salinity
- Dissolved oxygen

Major surface waters of the state are classified as segments for water quality management purposes and the designation of site-specific standards. Site-specific uses for classified segments include

- Recreation (contact and non-contact)
- Domestic water supply (public water supply and aquifer protection)
- Aquatic life (limited, intermediate, high and exceptional quality of aquatic habitat and oyster waters)
- Navigation
- Agricultural water supply
- Industrial water supply

Segment-specific standards also list upper and lower limits for common water quality criteria such as dissolved oxygen, temperature, pH, dissolved minerals, and fecal coliform bacteria.

The state standards are subject to review and approval by the EPA and must be updated every three years. New information on potential pollutants, additional data on water quality conditions in specific water bodies, and new state and federal regulatory requirements must be incorporated into the revised standards. Standards that are currently in effect were revised by the TNRCC in 1990/1991 and approved by the EPA on September 24, 1991.

TNRCC's antidegradation policy has been developed to prevent increases in pollutant loadings to state surface waters. Provisions of the policy include:

- Maintenance and protection of existing water quality
- Prohibited degradation of waters which exceed fishable/swimmable quality
- Protection of outstanding natural resource waters
- Compliance with federal and state water quality standards for any waste discharges
- Compliance with applicable wastewater treatment provisions and best management practices
- Establishment of modified thermal discharge limitations consistent with the CWA

The policy is applicable to permit actions, waste load evaluations and any other actions related to non-point sources of pollution which may impact the waters of the state.

It has been proposed that Christmas Bay be designated as an outstanding natural resource water body. Provisions for this designation would include prohibition of permitted discharges directly into the bay; prohibition of new channel construction within the bay; and, allowance for maintenance dredging for existing channels only.

In accordance with the provisions of Section 106 of the CWA and Section 26.023 of the Texas Water Code, the TNRCC must establish appropriate monitoring methods and procedures to compile and analyze data on the quality of waters within the states. The monitoring program must include the collection and analysis of physical, chemical and biological data and the development of a quality assurance and control program to validate the information. The collected data are to be used to:

- Establish baseline water quality
- Predict pollutant impacts
- Develop and review water quality standards
- Determine allowable pollutant loads
- Assess NPDES compliance by dischargers
- Report information to the public
- Review site-specific monitoring efforts to determine if standards are being maintained or are appropriate for the segment

The Clean Water Act also provided for the establishment of nationally acceptable technology-based effluent limitations to be promulgated by type of industry. The mechanism for implementing effluent limitations for point source discharges into surface waters is the National Pollutant Discharge Elimination System (NPDES) permit. These permits are issued by the EPA or a delegated state in accordance with the provisions of Section 402 of the CWA. Texas has not been granted this delegation and facilities in Texas must obtain a permit from both the TNRCC and the EPA.

Section 402 of the CWA added storm water runoff as a waste stream subject to NPDES permit requirements. Regulations promulgated by the EPA in 1990 established group and individual permit application requirements for storm water discharges associated with industrial activities and municipal separate storm sewer systems. Discharges of storm water from these sources must comply with water quality standards.

WATER AND SEDIMENT QUALITY ACTION PLAN

To maintain and improve the water and sediment quality of Galveston Bay in order to support a healthy ecosystem and minimize risk to human health.

OVERVIEW

Priority Problem

A few specific toxic substances have contaminated water and sediment in isolated, localized areas and may have a negative effect on aquatic life in contaminated areas. For example, a limited number of samples (less than 20) indicates that there have been exceedances in water quality criteria for PCBs (polychlorinated biphenyls, a banned chemical used mostly as a transformer oil) and DDT (also now banned) in the Houston Ship Channel/San Jacinto River segments. The GBNEP Ambient Water and Sediment Quality Study concluded that there have been some exceedances of criteria for arsenic, cadmium, chromium, and nickel, and that concentrations of these contaminants are at "the threshold of what would be satisfactory for an estuarine regime." (Note that in many cases the analytical results may have resulted in an overestimate of actual concentrations of metals in the water). In addition, the GBNEP toxicity study indicated some localized areas have water and sediment that exhibit some toxicity. The TDH, using data collected by the EPA, has also issued advisories regarding dioxin pollution in certain upper portions of the Houston Ship Channel and Galveston Bay. The EPA has included the Houston Ship Channel in a "short list" of waters exceeding priority pollutants criteria due to high concentrations of nickel. Finally, accumulation of PCBs and PAHs (polynuclear aromatic hydrocarbons, combustion byproducts and constituents of oil and creosote) in fish, oysters, and crabs has increased the risk of consuming seafood from Galveston Bay.

Goal

Reduce toxicity and contaminant concentrations in water and sediments. To accomplish this goal, additional studies are needed to determine current sources of these contaminants. PCBs and DDT production have been banned, for example, and additional studies are required to determine 1) if there are any continuing sources, and 2) how long it might take natural processes to eliminate these contaminants from the system. There have been some questions regarding the accuracy of heavy metals data from the bay, and more work is needed to determine if a serious metals problem does exist. In summary, the goal is to learn more about toxic materials in Galveston Bay, and then set appropriate standards (no standards are in place now) and acceptable loading rates from problem sources.

Objective

Eliminate ambient toxicity in Galveston Bay water and sediments by 2014.

- Action WSQ-1: Reduce contaminant concentrations to meet standards and criteria.
- Action WSQ-2: Determine sources of ambient toxicity in water and sediment.
- Action WSQ-3: Establish and adopt sediment quality criteria.

Action WSQ-4: Perform TMDL loading for toxics by watershed.

Action WSQ-5: Support Clean Texas 2000 Pollution Prevention Program.

Priority Problem

Dissolved oxygen is reduced in certain tributaries and side bays, harming marine life. In most Galveston Bay waters, scattered violations of the dissolved oxygen standards (generally about 2 percent of the data show violations) indicate no serious or systematic water quality problems. Estuarine segments with some reported dissolved oxygen problems include Buffalo Bayou Tidal, Clear Creek Tidal, and Armand Bayou Tidal. Compared to the upper Houston Ship Channel, the other dissolved oxygen problems appear to be limited in scope and severity.

In the Houston Ship Channel above Morgans Point, however, there has been a historical problem with dissolved oxygen concentrations. In the 1960s and early 1970s, excessive point source discharges eliminated dissolved oxygen in the upper Ship Channel, virtually wiping out all aquatic life. Since 1968, however, there has been a 95 percent reduction in municipal and industrial point source BOD loadings, and the upper Ship Channel now has enough dissolved oxygen to support an "extensive" utilization of the Channel by numerous aquatic species.

Despite the dramatic reduction in municipal and industrial pollution between 1968 and 1990, however, there are still periodic low dissolved oxygen concentrations and exceedances in standards in the upper Houston Ship Channel. In Segment 1006 (San Jacinto River to Greens Bayou) the frequency of exceedance of the 2.0 mg/l dissolved oxygen standard has ranged between one and 12 percent since 1985. In Segment 1007 (Greens Bayou to I-59, including the Turning Basin) the frequency of exceedance of the 1.0 mg/l dissolved oxygen standard has ranged between one and six percent since 1985. Note that these stream segments have not been designated by the state to maintain aquatic life, and therefore the dissolved oxygen standards have been set lower than any other Galveston Bay segments (most of which have a 4.0 or 5.0 mg/l standard).

Goal

Increase dissolved oxygen in problem areas. The return of aquatic life to the upper Houston Ship Channel, even though the state has not designated that this segment should support aquatic life, has prompted interest in increasing the dissolved oxygen in the upper Houston Ship Channel. The problem of low dissolved oxygen in other areas is generally associated with inflow and wasteloads.

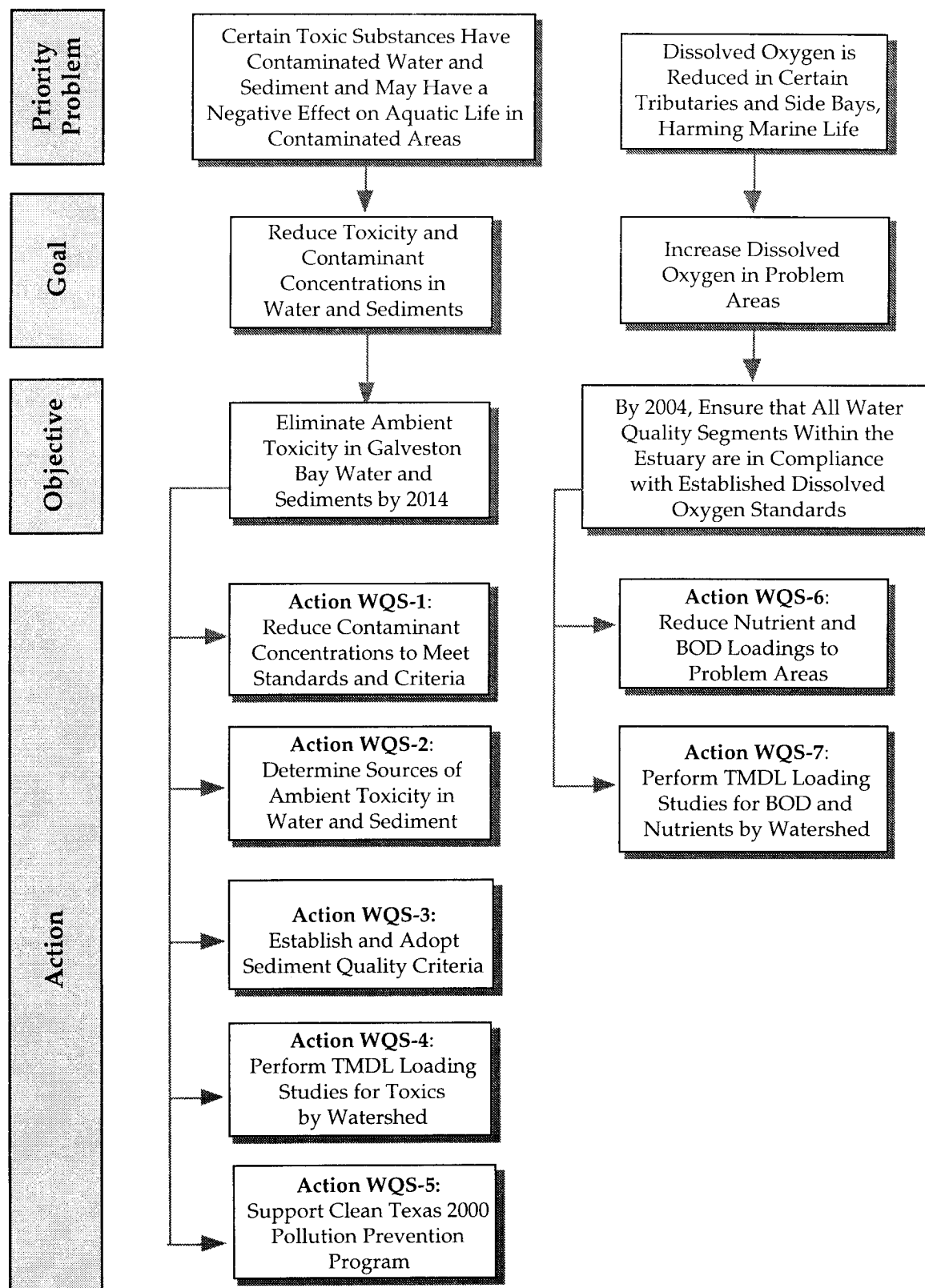
Objective

By 2004, ensure that all water quality segments within the estuary are in compliance with established dissolved oxygen standards.

Action WSQ-6: Reduce nutrient and BOD loadings to problem areas.

Action WSQ-7: Perform TMDL loading studies for oxygen-demand and nutrients by watershed.

Note: See Non-Point Source, Point Sources, and Public Health Action Plans for additional Water/Sediment Quality initiatives, including actions related to fecal coliform problems.



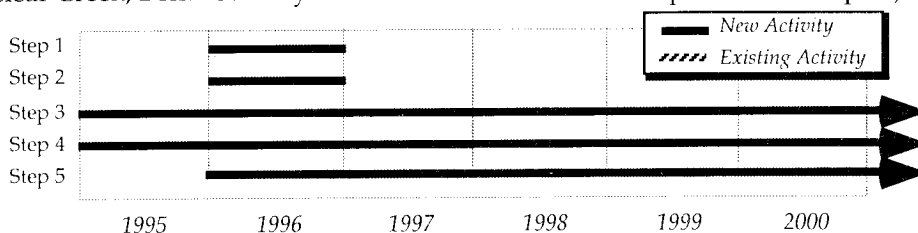
Water and Sediment Quality Action Plan Flowchart

ACTION WSQ-1:**Reduce Contaminant Concentrations to Meet Standards and Criteria**

What Perform special surveys to identify criteria violations and sources/sinks of priority pollutants, including PCBs, PAHs, pesticides, and selected heavy metals. Implement any needed source controls and/or remediation.

How

- Step 1 TNRCC and EPA will coordinate an analysis of NPDES permits and other pertinent data sources to identify potential sources of PCBs.
- Step 2 TNRCC and EPA will coordinate an analysis of pertinent data sources to identify potential sources of PAHs, focusing on urban non-point source runoff, air pollution, crankcase oil, diesel engines, outboard motors, and creosote in pilings. They will also encourage research in areas focusing on cycling, availability, and bioaccumulation, and consider PAHs not on the priority pollutant list, if necessary.
- Step 3 TNRCC will then expand NPDES monitoring of point and non-point sources of PCBs and PAHs in affected Houston Ship Channel (HSC) segments and other areas of Galveston Bay which existing data show to have elevated PCB, PAH, pesticides, or heavy metal concentrations. Appropriate ultra clean sampling techniques must be used for metals sample collection and analysis, especially in water column.
- Step 4 TNRCC will coordinate with TDH and TPWD to continue monitoring of PCBs and PAHs in seafood.
- Step 5 TNRCC and EPA will revise NPDES wastewater permits and develop storm water plans as necessary based on results of the TMDL studies (see Action WSQ-4). A synchronous schedule will be established for permit expirations on a watershed and subwatershed basis (subwatersheds such as Brays Bayou, Sims Bayou, Clear Creek, Dickinson Bayou as listed in the GBNEP non-point source report).

When

Where Affected HSC segments and other areas of Galveston Bay system with elevated PCB, PAH, pesticides, or heavy metals concentrations. Areas that have exhibited violations of water criteria are: Segment 1006 (HSC) for DDT; Segment 1007 (HSC/Buffalo Bayou) and Segment 1005 (HSC/San Jacinto) for water column PCBs. Using methods that overestimate actual concentrations, the existing data show potential criteria violations for dissolved heavy metals along the HSC (both open-bay and landlocked reaches), along the Intracoastal Waterway, and in turning basins. For areas with possible ambient sediment toxicity, see WSQ-3.

Who Lead entity: TNRCC. Other participants: EPA, NPDES permit holders (both municipal point source, industrial point source, and municipal non-point source), USGS, toxics researchers. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 126,000
• TNRCC	\$ 45,000
TOTAL.....	\$ 171,000

Private costs will probably be moderate to high because of increased NPDES monitoring costs. Potential Sources of Funding: NOAA, USGS, EPA, and TWDB.

Regulatory Issues Need to conduct enforcement based on results of monitoring. Consistency review of applications for NPDES and NPS implementation grants can be used to encourage TNRCC to implement.

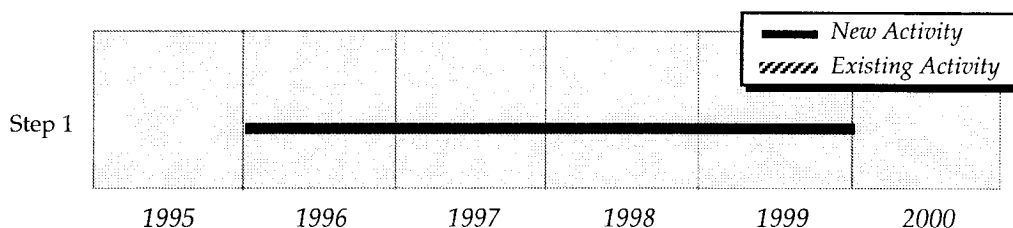
Related Actions: WSQ-1, 2, 3, 4, 5; NPS-1, 3, 5, 7, 8, 12, 15; PS-6, PH-1, HP-2, HP-8, and PPE-3.

ACTION WSQ-2:**Determine Sources of Ambient Toxicity in Water and Sediment**

What Determine the sources and pollutants which cause ambient toxicity in Galveston Bay. Perform correlation studies to determine if ambient toxicity is related to 1) sampling methods, 2) urban/industrial non-point runoff, 3) dredge material disposal, 4) point source discharges, including produced water discharge.

How

Step 1 TNRCC and USFWS will coordinate to design and perform loading studies on continuing sources of PCBs, DDT, PAHs, dioxins, selected heavy metals, and other toxics identified as part of Action WSQ-1 and identify potential sources of toxicity. The studies will 1) include detailed toxicity studies to resolve conflicting results from different methods; 2) include research to address the role of surface microlayer in ambient toxicity; 3) address the influence of pH, salinity, etc. on ambient toxicity; 4) determine the organisms and life stages affected by ambient toxicity focusing on the critical and most susceptible life stages; and 5) include assessment of biological community structure.

When

Where Begin with areas where ambient toxicity problems have been identified (see WSQ-1 and WSQ-3) and expand to areas where problems are suspected and/or where sufficient data has not been collected, as resources allow.

Who Lead entity: TNRCC and USFWS. Other participants: RRC, EPA, TPWD, USGS, Corps of Engineers, NPDES Storm Water permit groups, and industrial groups. Role of Galveston Bay Program: Coordination.

Public Costs of New Actions (5 years)

• Program.....	\$ 15,000	• USFWS	\$ 100,000
• TNRCC.....	\$ 60,000		
TOTAL.....	\$ 175,000		

Private costs will probably be low as public funds will be used to conduct these studies. Potential Sources of Funding: NOAA, USGS, EPA, and TWDB.

Regulatory Issues None identified.

Related Actions: WSQ-1, WSQ-2, WSQ-3 WSQ-4, WSQ-5, NPS-1, NPS-3, NPS-6, NPS-8, NPS-9, NPS-13, NPS-16, HP-2, and PH-1.

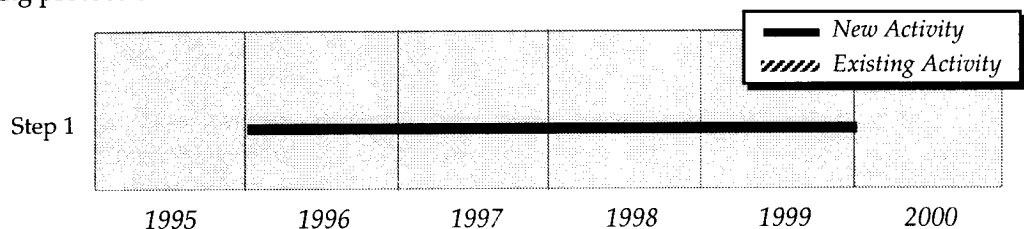
ACTION WSQ-3: Establish and Adopt Sediment Quality Criteria

What Establish or adopt appropriate sediment quality criteria for PCBs, PAHs, metals, DDT, and other pollutants identified by ambient toxicity studies and by public health concerns.

How

Step 1 TNRCC will adopt sediment quality criteria based on 1) results of the ambient toxicity studies; 2) a review of criteria development options; and 3) value of establishing state criteria now vs. adopting EPA criteria at a later time. TNRCC will coordinate with ongoing federal development of sediment standards, and determine appropriate action levels for Galveston Bay risk assessments based on state and federal guidelines (i.e., 10^{-4} vs. 10^{-6} risk level). Need to inform public of reason why sediment standards are needed, what benefits are, and what are the potential costs. Need to develop appropriate sediment monitoring protocols. TNRCC will coordinate with GLO and TPWD.

When



Where All of Galveston Bay bottom sediments and sediments in tributaries to the limit of tidal influence.

Who Lead entity: TNRCC. Other participants: TPWD, USFWS, USGS, and GLO. Role of Galveston Bay Program: Coordination.

Public Costs of New Actions (5 years)

• Program:	\$ 22,500
• TNRCC.....	\$ 171,750
TOTAL.....	\$ 194,250

Actions Tied to Other Programs: TNRCC may set sediment quality criteria regardless of implementation of *The Galveston Bay Plan*. Private Costs: Initially low. Future private costs to comply with sediment standards potentially high. Potential Sources of Funding: NOAA and EPA.

Regulatory Issues Need to add sediment criteria to state water quality standards.

Related Actions: WSQ-1, WSQ-2, WSQ-3 WSQ-4, WSQ-5, NPS-1, NPS-3, NPS-6, NPS-8, NPS-9, NPS-13, NPS-16, and HP-2.

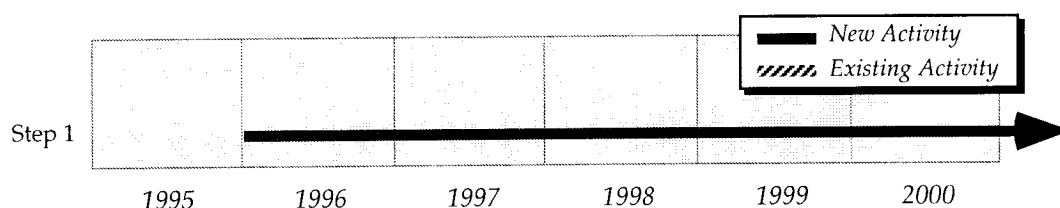
ACTION WSQ-4: Perform TMDL Loading Studies for Toxics

What For existing developed areas, implement controls to satisfy water quality criteria using a TMDL (total maximum daily load) allocation process accounting for 1) point source loadings, 2) non-point loadings, 3) existing in-place sources such as sediments, and 4) other factors.

How

Step 1 TNRCC will perform TMDL studies to estimate total maximum daily load (including some consideration of non-point sources) to maintain ambient standards and incorporate this process into NPDES wastewater permits and storm water permits. Methods will be developed to integrate both point source and non-point sources into TMDL process. Additional research will be performed to quantify transport and fate of toxics in the bay.

When



Where All water quality segments not meeting standards, or where one might expect standards to be violated in future due to increasing point and/or non-point source impacts. Areas that have exhibited violations of water criteria are: Segment 1006 (HSC) for DDT; Segment 1007 (HSC/Buffalo Bayou) and Segment 1005 (HSC/San Jacinto) for water column PCBs. Using methods that overestimate actual concentrations, the existing data show potential criteria violations for dissolved heavy metals along the HSC (both open-bay and landlocked reaches), along the Intracoastal Waterway, and in turning basins.

Who Lead entity: TNRCC. Other participants: EPA, USFWS, USGS, and NPDES storm water permit holders. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 81,050
• TNRCC.....	\$ 295,750
TOTAL.....	\$ 376,800

Private Costs: Initially low. Future private costs to comply with sediment standards potentially high. **Actions Tied to Other Programs:** TNRCC already performs some toxics loading studies for dry weather conditions. **Potential Sources of Funding:** NOAA, USGS, EPA.

Regulatory Issues TMDLs should be added to the state's Water Quality Management Plan. Permits need to be revised when they come up for renewal based on results of TMDLs. Local storm water management plans might be required to meet pollutant loading goals. TNRCC must modify the TMDL process to account for point and non-point sources.

Related Actions: WSQ-1, WSQ-2, WSQ-3 WSQ-4, WSQ-5, NPS-1, NPS-3, NPS-6, NPS-8, NPS-9, NPS-13, NPS-16, PS-6, and PH-1.

ACTION WSQ-5: Support Clean Texas 2000 Pollution Prevention Program

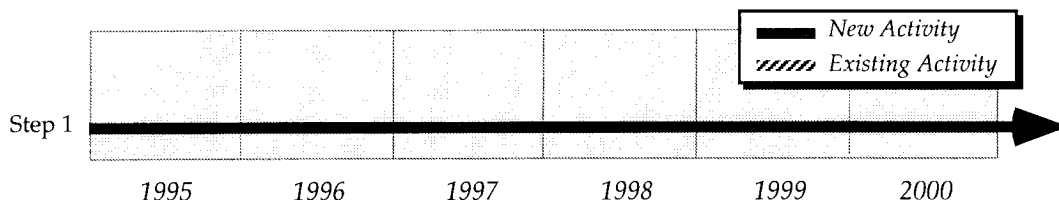
What Support the statewide pollution prevention program sponsored by the Governor and the TNRCC to reduce pollution across the state.

How

Step 1 Support the Clean Texas 2000 programs:

- a. *Clean Industries 2000*, where industries will reduce the amount of hazardous wastes and/or emissions tracked by the Toxic Release Inventory Program by at least 50 percent by the year 2000, implement an internal environmental review program, form citizens' communications programs, and support community environmental projects
- b. *Clean Cities 2000*, where cities will develop a comprehensive environmental program.
- c. *Operation Paper Chase*, where the TNRCC will streamline its permitting and enforcement process and eliminate unnecessary levels of bureaucracy
- d. *Texas Watch*, where citizens will be recruited and trained in water quality and environmental monitoring, local groundwater protection activities, and community collection of household hazardous waste
- e. *Public Education*, where the TNRCC will give Texans practical information about what they can do to improve the environment (see Action PPE-3)

When



Where The entire Galveston Bay Program area.

Who Lead entity: Industries, cities, TNRCC, and citizens. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 22,500
TOTAL.....	\$ 22,500

The TNRCC, several cities, and many private industries are currently participating in Clean Texas 2000 programs. No detailed cost expenditures are available.

Regulatory Issues None identified.

Related Actions: WSQ-1, WSQ-2, WSQ-3 WSQ-4, WSQ-5, NPS-1, NPS-3, NPS-6, NPS-8, NPS-9, NPS-13, SD-5, and PPE-3.

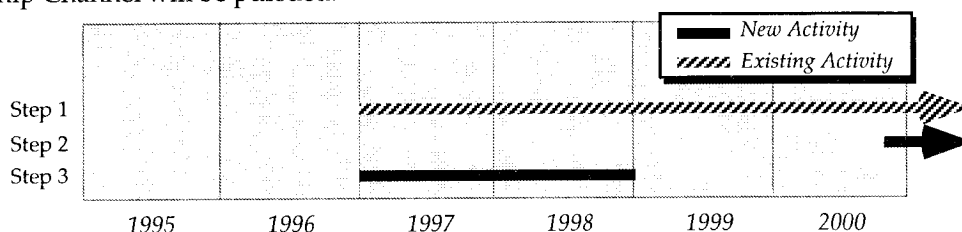
ACTION WSQ-6: Reduce Nutrient and BOD Loadings to Problem Areas

What Reduce nutrient and BOD loadings to problem areas.

How

- Step 1** TNRCC will coordinate with EPA to determine relative contributions of nutrients, oxygen-demanding materials, and hydrodynamic factors and identify most sensitive and most impacted areas, and then develop permissible nutrient and BOD loading rates based on the information.
- Step 2** TNRCC and EPA will achieve necessary reductions in nutrient and BOD loadings through state and NPDES point source and storm water permit discharge programs using a technology-based strategy for implementation of best management practices. A synchronous schedule will be established for permit expirations on a watershed and subwatershed basis (subwatersheds such as Brays Bayou, Sims Bayou, Clear Creek, and Dickinson Bayou as listed in the GBNEP non-point source report).
- Step 3** TNRCC will coordinate with EPA to conduct an engineering study (and/or attainability analysis) to determine if it is feasible to increase dissolved oxygen levels in the Houston Ship Channel. The study will use monitoring, engineering analysis, and computer modeling. The study will include 1) sediment demand monitoring to determine sink effects of sediment; 2) determine change in dissolved oxygen concentrations in the Ship Channel during and after storm events (using existing or expanded USGS network); 3) develop cost vs. dissolved oxygen/frequency relationships; 4) determine relative contributions of nutrients and oxygen-demanding materials to problem; 5) determine limitations caused by the existing hydrodynamic regime of the channel; and 6) estimate benefits to aquatic life in Channel and to the entire bay system from increased dissolved oxygen concentrations. Specific monitoring and research tasks may be required to meet the goals of the study. If feasible, an aquatic life use designation for the Ship Channel will be pursued.

When



Where Generally in urbanized tributaries and bayous. Specifically, the upper Houston Ship Channel above Morgans Point, Buffalo Bayou Tidal, Clear Creek Tidal, and Armand Bayou Tidal.

Who Lead entity: TNRCC, EPA, USGS. Other participants: municipalities. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 107,250	• Others	\$ 45,000
• TNRCC	\$ 897,500		

TOTAL..... \$ 1,049,750

Actions Tied to Other Programs: TNRCC already performs some loading studies for dry weather conditions. **Private Costs:** Initially low. Future private costs to comply with new standards potentially high. **Potential Sources of Funding:** NOAA, USGS, EPA, and TWDB.

Regulatory Issues No new legislation is required. Permit criteria may need to be revised based on results of this action. Thorough consistency reviews encourage reduction of discharge of nutrients by federally assisted or conducted actions. Consistency review of application for implementation grants from EPA can be used as a tool to encourage TNRCC to implement this action.

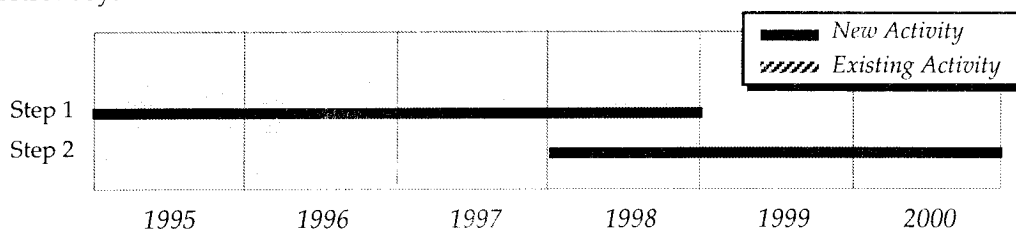
Related Actions: WSQ-7, NPS-1, NPS-2, NPS-3, NPS-4, NPS-6, NPS-7, NPS-8, NPS-9, NPS-10, NPS-11, NPS-12, NPS-13, PS-1, PS-2, PS-3, PS-4, and PS-5.

ACTION WSQ-7:**Perform TMDL Loading Studies for Oxygen Demand and Nutrients**

What For identified problem segments, implement controls to satisfy water quality criteria using a TMDL (total maximum daily load) allocation process accounting for both point and non-point loadings to the bay (see WSQ-4) for oxygen-demand and nutrients.

How

- Step 1 TNRCC will perform TMDL studies to estimate total maximum daily load (or NPS equivalent) to maintain ambient standards and incorporate this process into storm water permits as NPDES moves from monitoring to storm water cleanup. TNRCC will modify TMDL process to account for point and non-point source loadings.
- Step 2 TNRCC will require municipalities to perform engineering studies of existing drainage system to identify ways to retrofit system to reduce harmful effects from NPS.

When

Where Generally in urbanized tributaries and bayous. Specifically, the upper Houston Ship Channel above Morgans Point, Buffalo Bayou Tidal, Clear Creek Tidal, and Armand Bayou Tidal.

Who Lead entity: TNRCC. Other participants: EPA, USFWS, USGS, and NPDES storm water permit holders. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 99,750	• Munis	\$ 424,149
• TNRCC.....	\$ 1,437,500		
TOTAL.....		\$ 1,961,399	

Initially low. Future private costs to comply with new standards potentially high. Potential Sources of Funding: NOAA, USGS, EPA, and TWDB.

Regulatory Issues No new legislation is required. Permit criteria may need to be revised based on results of this action. TNRCC must modify the TMDL process to account for point and non-point sources.

Related Actions: WSQ-6, WSQ-7, NPS-1, NPS-2, NPS-3, NPS-4, NPS-6, NPS-7, NPS-8, NPS-9, NPS-10, NPS-11, NPS-12, NPS-13, PS-1, PS-2, PS-3, PS-4, and PS-5.

Non-Point Sources of Pollution

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
NPS-1	High	Implement storm water programs for local municipalities.....	183
NPS-2	High	Perform pilot projects to develop NPS Best Management Practices	184
NPS-3	High	Identify and correct priority watershed pollutant problems.....	185
NPS-4	High	Establish residential load reduction programs	186
NPS-5	High	Correct malfunctioning shoreline septic tanks	187
NPS-6	High	Implement NPS reduction plan program for new development.....	188
NPS-7	High	Establish roadway planning to minimize NPS effects	189
NPS-8	High	Implement NPDES Storm Water Program for area industries.....	190
NPS-9	High	Prevent degradation of bay waters by known industrial groundwater plumes.....	191
NPS-10	High	Develop inventory of agricultural non-point sources	192
NPS-11	High	Coordinate/implement existing agricultural NPS control programs.....	193
NPS-12	High	Adopt regional construction standards for NPS reduction.....	194
NPS-13	High	Implement toxics and nutrient control practices at construction sites	195
NPS-14	Low	Require sewage pumpout, storage, and provisions for treatment.....	196
NPS-15	Low	Require marine sanitary chemicals that can be treated in POTWs.....	197
NPS-16	Low	Implement washdown controls and containment measures	198

THE ISSUES

One of the most difficult areas of environmental management is control of pollution leached from thousands of filling stations, residential yards, septic tanks, driveways, parking lots, industries, farms, and other sites of every-day human activity. Residential gardening and lawn care, car washing, storm sewer dumping, dockside activities, construction practices, agricultural runoff, septic tank leaks, and use of a wide array of consumer and commercial products introduce potentially harmful materials into Galveston Bay. Degradation of the bay is influenced by the presence of toxicants, sediment, bacteria and nutrients in runoff water from both urban and rural areas. Land development which eliminates wetlands further reduces the ability of runoff water to naturally cleanse itself as it proceeds to the bay.

A comprehensive action plan has been developed in *The Galveston Bay Plan* to resolve the major problems caused by non-point source pollution in the Galveston Bay system. Two

categories of non-point source pollution have been identified: contaminated runoff and boat sewage and debris. The goals of the actions directed towards contaminated runoff are to reduce the non-point source pollutant loads from urban, industrial, agricultural, and construction sources. Similarly, the goals of the actions addressing boat sewage and debris are to reduce marine sewage and runoff from boat maintenance operations. Initiatives proposed by *The Galveston Bay Plan* to reduce the harm caused by non-point sources of pollution include the following:

- **Pollutant Load Reduction:** Twelve actions in *The Galveston Bay Plan* recommend reducing non-point source pollutant loads from urban, industrial, agricultural, and construction sources. To achieve these reductions, programs and plans for the management of storm water, erosion, construction and other activities will need to be developed. Demonstration projects to evaluate best management practices for non-point source pollutant control techniques are encouraged. In general, *The Plan* advocates use of technology-based Best Management Practices rather than performance-driven regulatory approaches.
- **Marine Sewage Reduction:** *The Galveston Bay Plan* offers two actions for the reduction of sewage discharges generated by vessels and marinas. Discharge activities and their subsequent deleterious effects on aquatic life can be thwarted by the implementation of toxic and nutrient control practices and the establishment of enforceable requirements for marine sewage treatment.
- **Management of Marina/Dockside Pollutants:** Implementation of washdown controls and containment measures are advocated to reduce the release of harmful materials (e.g., paints, solvents, etc.) from marinas and docks in the Galveston Bay area.

ENVIRONMENTAL STATUS

Status and Trends

Non-point source pollution is more difficult to define than point source pollution, but in general can be described by these general characteristics:

- Non-point source discharges enter surface waters in a diffuse manner and at intermittent intervals that are related mostly to the occurrence of rainfall events.
- Pollution arises over an extensive area of land and is in transit overland before it reaches surface waters.
- Non-point sources generally cannot be monitored at their point of origin, and their exact source is difficult or impossible to trace.
- Elimination or control of pollutants must be directed at specific sites.
- In general, the most effective and economical controls are land management techniques and conservation practices in rural zones and architectural controls in urban zones.
- Compliance monitoring for non-point sources is conducted on land rather than in water.
- Non-point source pollutants cannot be measured in terms of effluent limitations.

- The extent of non-point source pollution is related, at least in part, to certain uncontrollable climatic controls, as well as geographic and geologic conditions, and may differ greatly from place to place and year to year.
- Non-point sources are derived from operations on extensive units of land, as opposed to industrial activities that typically operate on intensive (small) units of land.

Pollutants found in urban and rural runoff include toxics, fecal coliform bacteria, biochemical oxygen demand, nutrients, and sediments. The precise sources of non-point source loads are relatively difficult to determine due to their widespread diffuse nature. The following table identifies major potential sources of NPS pollutants:

Water Quality Parameter	Major Potential Non-Point Sources
Total Suspended Solids	Eroding urban areas, cultivated fields, and stream banks
Total Nitrogen	Eroding soils, fertilizer application, leaking sanitary sewers, overflows, bypasses, and natural organic matter
Total Phosphorus	Eroding soils, fertilizer application, leaking sanitary sewers, overflows, bypasses, and natural organic matter
Biochemical Oxygen Demand	Natural decaying organic matter, leaking sanitary sewers, overflows, bypasses, oil and grease, and natural organic matter
Oil and Grease	Motor vehicles
Fecal Coliforms	Leaking sanitary sewers, bypasses, overflows, malfunctioning septic tanks, pets, cattle, and wildlife
Dissolved Copper	Corrosion of copper plumbing, electroplating wastes, algaecides, and eroding soils
Pesticides	Urban and rural pesticide application

Galveston Bay National Estuary Program (GBNEP) Non-Point Source Study

The GBNEP Non-Point Source Project was designed to be a "washoff" study, in other words, a study of non-point source loads originating from different types of land use. Land use has been recognized as one of the major variables in non-point sources of pollution, and has been the focus of most of the non-point source studies performed in the country to date. An original land use/land cover database for Galveston Bay was developed from interpreted satellite imagery that provided a high resolution snapshot of the basin land use as it existed in 1990. In addition, a relatively new technology, Geographical Information Systems (GIS), was used to map the geographic characteristics of the study area, analyze the land use data, complete the NPS calculations, and to graphically present the project results.

To calculate non-point source loads from the basin, typical concentrations of each water quality constituent in runoff were estimated from a variety of local and nationwide data sources. These water quality data, defined as event mean concentrations (EMCs), were derived for each land use type defined for the Galveston Bay project (see table above).

The Houston area EMC database indicated that sediment, nutrient, and oxygen demanding substances in local urban runoff are typical of urban runoff in other parts of the country. Although the rural EMC data were not as extensive as the urban database, they indicated that

NPS concentrations from Galveston Bay agricultural areas are lower than many other parts of the country. One possible explanation is the extensive rice cultivation in the watershed; flooded rice fields generate relatively low concentrations of sediments and nutrients compared to typical row crops such as corn and soybeans.

In general, high density urban land use areas, such as industrial, commercial, multi-family residential, and transportation areas, had higher NPS pollutant concentrations than most other non-urban land uses. Forest lands had the lowest concentrations of pollutants in runoff.

Using the land use and event mean concentration data, annual non-point source loads calculated for the local watershed (downstream of Lake Houston and Lake Livingston) and the entire drainage to the bay were calculated for a year with average rainfall:

Parameter	Annual Non-Point Source Loads Average Year (thousands kg/yr, except where noted)	
	Study Area Only	Entire Watershed
Runoff (ac-ft: acre-foot)	3,010 ac-ft/yr	9,050 ac-ft/yr
Total Suspended Solids	481,000	581,000
Total Nitrogen	6,420	23,128
Total Phosphorus	1,110	3,711
Biochemical Oxygen Demand	26,300	46,500
Oil and Grease	14,200	14,200
Fecal Coliforms (CFU: Colony Forming Unit)	355×10^{15} cfu/yr	355×10^{15} cfu/yr
Dissolved Copper	10.9	34.0
Pesticides	0.8	1.5

Non-Point Sources Impacts

Non-point sources are known or suspected to be responsible for water quality impairment in several bayou, stream, and bay segments in the immediate Galveston Bay watershed. In 1993, the Houston Galveston Area Council (HGAC) published non-point source assessment reports that identified the following bay and tidal segments as having reported known non-point source impacts or having ambient water quality below existing standards:

Segment	Parameters of Concern	Data Source
Clear Creek Above Tidal*	Fecal Coliform, DO, Chlorides	HGAC
Clear Creek Tidal*	Fecal Coliform, Nutrients	TWC, GBNEP-22
Clear Lake*	Nutrients, Fecal Coliform	305b, GBNEP-22
Armand Bayou	Fecal Coliform	305b, GBNEP-22
Dickinson Bayou Tidal	Fecal Coliforms	GBNEP-22
Dickinson Bayou Above Tidal	Nutrients, Fecal Coliforms	TWC, 305b, GBNEP-22
Moses Lake	Fecal Coliforms (Oyster Standard)	TDH, GBNEP-22
Chocolate Bayou Above Tidal	Fecal Coliforms	GBNEP-22
Chocolate Bay	Fecal Coliforms, Metals	GBNEP-22
Upper Galveston Bay	Fecal Coliforms	TDH
West Bay	Fecal Coliform (Oysters), pesticides	TDH, GBNEP-22
Bastrop Bay	Metals	GBNEP-22

Lower Galveston Bay	Fecal Coliform (Oysters), Metals	TDH, GBNEP-22
Houston Ship Channel	Fecals, DO, metals, nutrients, O&G	HGAC, GBNEP-15/22
Buffalo Bayou Tidal	Fecals, DO, metals, O&G	HGAC, Sierra, SWCD
Tabbs Bay	Fecal Coliform	GBNEP-22
San Jacinto Bay	Fecal Coliform	GBNEP-22
Black Duck Bay	Fecal Coliform	GBNEP-22
Scott Bay	Fecal Coliform	GBNEP-22
Burnett Bay	Fecal Coliform	GBNEP-22
Barbours Cut	Fecal Coliform	GBNEP-22
Cedar Bayou Tidal	Fecal Coliform	GBNEP-22

Notes: DO = Dissolved Oxygen. O&G: Oil and Grease

Data Sources identified in References Section of HGAC Report.

In terms of impacts on living resources, some non-point source effects have been observed on fish populations and on benthic organisms (primarily bottom dwelling crustaceans and insects) in Galveston Bay. For example, in a study of 220 Galveston Bay fish kills over the past 20 years, a total of 43 fish kill events were attributed to low dissolved oxygen or other impacts from non-point sources. Non-point source-related fish kills most often occurred after heavy rains from June through September with a peak in August.

GBNEP conducted a sediment quality triad study of Galveston Bay where sediment samples were analyzed for contaminants, toxicity, and benthic abundance and diversity. This study analyzed six stations directly associated with urban and/or industrial runoff: Burnett Bay in the Houston Ship Channel, Kemah Flats near the Clear Lake outfall, near Texas City, Black Duck Bay near local industrial treatment lagoons by Baytown, Swan Lake, and Dollar Bay. Two of these stations, Burnett Bay and Black Duck Bay, had significantly altered levels of benthic organisms from "contaminant-induced degradation." Both of these small, partially enclosed bays are located on the upper Houston Ship Channel near urbanized and industrial areas. The other four urban/industrial stations did not exhibit a significantly altered benthic community as a result of contamination. Therefore the immediate effects of non-point sources on benthos appear to be concentrated in small enclosed bays near highly urbanized areas; in more open areas of the bay the effects of non-point sources are less pronounced.

Probable Causes

Relationship to Land Use

Urban land use areas were the main contributor of NPS loads from the study area for all the parameters. For example, the GBNEP non-point source loading study estimated that the urban areas in the local watershed (primarily the Houston metropolitan region) contributed over 43 percent of the total NPS sediment loadings, 55-65 percent of the NPS nutrient loadings, and over 85 percent of all of the fecal coliform, pesticides, and oil and grease coming from local non-point sources of pollution. In addition, urban non-point sources are important contributors of several priority pollutants (toxics) such as polynuclear aromatic hydrocarbons (PAHs) and heavy metals which can increase the health risk associated with consuming seafood from Galveston Bay. Many toxics, such as the PAHs, probably originate mostly from automobile and truck traffic.

The load maps produced for this project identified the locations of highly concentrated non-point source load generation. In general, the highly urbanized areas in the Houston metropolitan area, Baytown, Texas City, and Galveston show the highest loads per unit area for all of the water quality constituents. As would be expected, fecal coliform and oil and grease NPS loads are almost entirely derived from the urban areas. Urban areas were also shown to be high source zones for pesticides as well.

The non-point source maps indicate that the highest erosion rates and, consequently greatest sources of sediment, occur in a wedge-shaped area, having a point at the mouth of the Houston Ship Channel and reaching through Houston to the watersheds upstream of the Barker/Addicks reservoirs. The high sediment loads were attributed to eroding urban land areas in the Houston area and barren land in the rural western watersheds.

Marinas

Marinas also serve as non-point source discharges into the bay system, but are generally unregulated. In the Galveston Bay system, approximately 40 marinas with 9,171 wet slips were documented in 1987. Until recently there were few locations to pump out boat sewage and consequently, much of the boat sewage was directly discharged into Galveston Bay and Clear Lake. Recent studies have indicated that the water quality impact of marinas is localized within the immediate vicinity of the marina, with low dissolved oxygen values being observed. Elevated concentrations of copper, lead, and arsenic were also associated with marina sites.

Groundwater

A variety of activities has resulted in contaminated groundwater, some of which may discharge to local surface water. These activities include: 1) leaking underground storage tanks such as those associated with service stations, 2) industrial waste management activities, such as leaking sewers at petrochemical plants, and 3) abandoned waste disposal sites such as sites now managed under the Superfund Program. One recent groundwater discharge of contaminated groundwater from the Brio Superfund Site has resulted in a public health advisory for portions of Clear Creek.

Pathogenic Microorganisms in Runoff

Loading estimates developed in a GBNEP study indicated that non-point source runoff was probably the largest contributor of fecal coliforms (which are used as an indicator organism for the presence of pathogenic microorganisms and unsafe water) to Galveston Bay. Their study indicated that storm water runoff contributed several times the annual loadings of fecal coliforms than sewage treatment plant bypasses/overflows, septic tanks and other sources. One notable effect of fecal coliforms in runoff is that several streams appear to exceed the state water quality standards for contact recreation due to high concentrations of fecal coliform bacteria. Areas where the long-term fecal coliform bacteria levels exceeded the state standards for contact recreation are in western, developed tributaries of the bay: Buffalo Bayou, White Oak Bayou, Clear Creek, Dickinson Bayou, and Chocolate Bayou. Other reported problem areas include Moses Lake, Highland Bayou, and the Diversion Canal. In addition, non-point sources are probably responsible for the fecal coliforms counts that prevent oyster harvesting in some parts of the open bay. Note that while septic tanks contribute only a small fraction of

the overall fecal coliform export to the bay, they may be important sources for smaller, more enclosed areas. More information on fecal coliforms and related effects on public health is given in the Public Health Protection Action Plan, particularly with regard to potential problems of overestimating the health risk when using fecal coliforms as an indicator of unsafe water conditions.

General Impacts

Actual impacts of local NPS pollutants on the bay are difficult to assess without analyzing the change in pollutant concentrations in Galveston Bay itself. For example, NPS loads are relatively brief slugs of pollutants that enter the bay intermittently from numerous entry points in the presence of large volumes of runoff. The amount, timing, and duration of these NPS events are determined by rainfall conditions. Discharges from Lake Livingston and Lake Houston complicate this assessment, as the reservoirs change the timing and water quality of the discharge from the Trinity and San Jacinto rivers to the bay.

MANAGEMENT STATUS

A number of federal and state regulatory programs have been developed to control point and non-point sources of pollution. Point source pollution has been controlled since the passage of the Federal Water Pollution Control Act of 1972. Non-point source pollution is a general category for pollution that does not originate from a single location and is a major problem for many estuaries. Non-point sources include urban runoff, construction sites, septic tanks, waste disposal sites, agriculture, silviculture, and marinas. A depiction of the major non-point management program applicable to Galveston Bay is shown in Figure NPS-1. These programs are described in more detail in the following text.

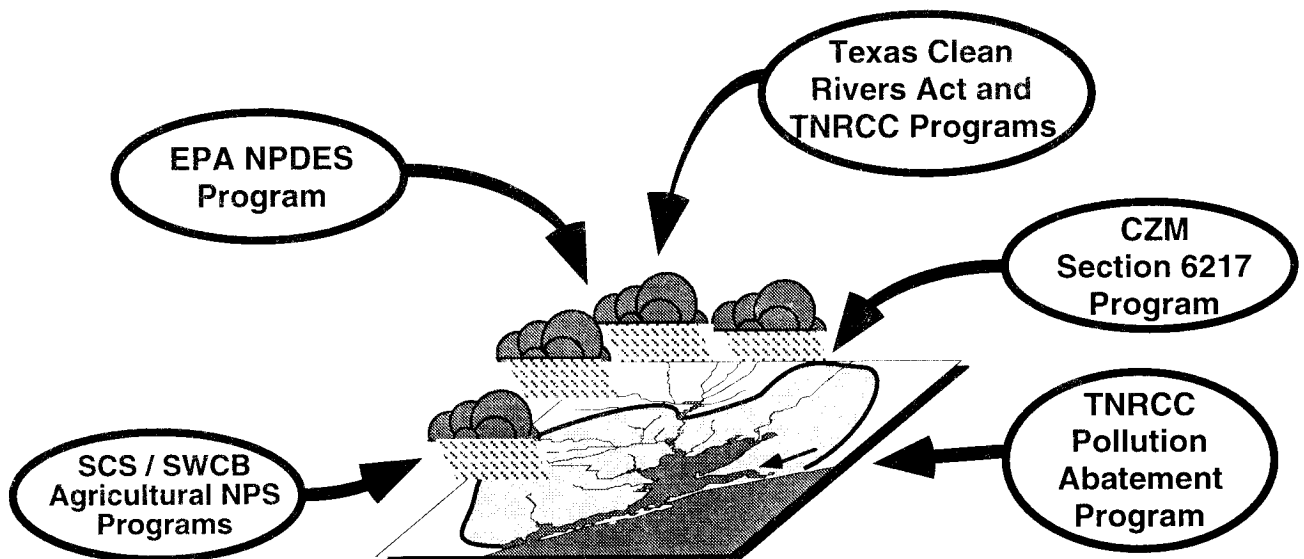


FIGURE NPS-1. Major Non-Point Source Management Programs That Are Applicable to Galveston Bay

Federal Programs

Clean Water Act Section 319

Section 319 of the Clean Water Act was the first national program to authorize federal funding for the control of non-point sources of water pollution and to support implementation of the states management programs. In order to be eligible for federal funding, states were required to:

- Assess water quality impacts due to non-point sources of pollution
- Develop a management program to address non-point source impacts

Section 319 authorizes the U.S. Environmental Protection Agency (EPA) to issue annual grants to assist states in implementing effective non-point source management activities that result in water quality improvements and other environmental benefits. The grants are offered on a 60 percent federal/40 percent local share matching basis to implement non-point source management programs and projects. The local share match requirement can be met in the form of "in-kind" services.

Clean Water Act Storm Water Permits

The storm water permits program was enacted by Congress under Section 402 of the Clean Water Act (CWA). The Phase I regulations require operators of municipal storm water systems with populations greater than 100,000 people and certain industrial operations (including large construction sites) to obtain a National Pollutant Discharge Elimination System (NPDES) permit from the EPA for their storm water outfalls. Permits are also to be issued, on a case-by-case basis, to storm water discharges contributing to a violation of a water quality standard or causing a significant amount of pollutants to enter surface waters.

In the Galveston Bay area, the following entities have submitted two-part applications to EPA for municipal storm water discharge permits: City of Houston, Harris County/Harris County Flood Control District, Texas Department of Transportation, and the City of Pasadena. The permit application was highlighted by the collection of storm water discharge characterization data and the development of a comprehensive Storm Water Management Plan (SWMP). The SWMP addresses the following: a comprehensive storm water monitoring program, a program to reduce pollutants in storm water runoff from commercial and residential areas, a program to detect and remove illicit connections to the storm sewer system, a program to monitor runoff from municipal landfills and certain industrial facilities, and a program to reduce pollutants in runoff from construction sites.

Coastal Zone Management Act

The federal Coastal Zone Management (CZM) Act of 1972 established a program for states and territories to voluntarily develop comprehensive programs to protect and manage coastal resources. Texas is presently developing the Texas Coastal Management Program which will be submitted to NOAA for approval of participation in the federal CZM program. States applying for acceptance into the federal program are required to develop programs that include enforceable policies to manage coastal land and water uses, that may adversely affect coastal natural resources. State programs are also required to include methods for resolving

conflicts among competing uses. Each program must protect and manage important coastal resources, including wetlands, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife habitats.

The Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) added Section 6217, a provision jointly administered by NOAA and EPA, which requires states with federally approved CZM programs to develop coastal non-point programs to address coastal non-point source pollution. The central purpose of Section 6217 is to strengthen links between federal and state coastal zone management and water quality programs. Section 6217 allows states to secure additional federal funding by participating in the federal CZM program to implement non-point source management measures in areas of the coast that significantly affect coastal waters. Participating states will be required to expand their non-point source programs that had been approved by EPA under Section 319 of the CWA and previously approved by National Oceanic and Atmospheric Administration (NOAA) under Section 306 of the CZM Act.

The coastal zone program requires EPA and NOAA to identify non-point source management measures and provide guidance on these measures to the states. Management measures are economically achievable measures for controlling non-point source pollution. The measures reflect the greatest degree of pollutant reduction achievable through the application of best available technology, siting criteria, operating methods, or alternatives. These measures are described in the *Guidance Specifying Management Measures for Sources of Non-point Source Pollution in Coastal Waters*. Participating states may select from a wide range of practices or a combination of practices that will achieve the level of control specified in the management measures.

The guidance addresses five categories of non-point source pollution: 1) agriculture, 2) forestry, 3) urban, 4) marinas, and 5) hydromodification. Example management measures include infiltration basins and trenches, vegetated filter strips, grassed swales, porous pavement, concrete grid pavement, water quality inlets, extended detention ponds, wet ponds, and constructed storm water wetlands.

This program is technology based, as opposed to water quality or performance based. In other words, unless the state can show that a category or subcategory does not individually or cumulatively, impact coastal waters, the measures *must* be implemented. The state must identify additional management measures for waterbodies that are impaired or threatened even after the prescribed management measures are implemented. Also, as with the CZM program, states must also have enforceable policies and mechanisms to ensure implementation.

The states also have the option of proposing alternative management measures. The measures prescribed in the guidance may not be feasible in all areas of the country. Therefore, states have the option of proposing alternative management measures. These measures must be shown to be as effective or better than those prescribed.

An issue for Galveston Bay is the applicability of Section 6217 guidance under the region's particular conditions of rainfall, topography, and soil types. Some of the management measures are not necessarily economical or technically feasible to implement in the local area. The state's current plans for the CZM do not include requirements for implementing the Section 6217 technical guidance, as other measures that achieve the same effect are to be developed. BMPs proven to be effective in the local area are summarized in the *Storm Water Quality Management Guidance Manual*, prepared by the Storm Water Joint Task Force comprised of Houston, Harris County, Harris County Flood Control District, and the Texas Department of Transportation. The Joint Task Force is using this manual as a basis for managing urban runoff in the Houston/Harris County NPDES permit area.

NOAA is authorized under Section 6217 to provide funds to state coastal management agencies to develop coastal non-point programs and funds may also be available from EPA under Section 319 of the CWA for implementation. In areas that are determined to be threatened or impaired by non-point source pollution despite the implementation of management measures, additional measures may be used. The state agencies with responsibility to abate non-point source pollution will identify the additional measures necessary to meet the state's water quality standards.

Agricultural Programs

Pollutants from agriculture may include sediments, nutrients, chemicals, salts, organic matter, and bacteria that can enter the Galveston Bay estuary suspended or dissolved in runoff, or attached to sediment particles. Agricultural sources of non-point source pollution include crop production, pastureland, rangeland, feed lots, aquaculture, and livestock management areas. The Agriculture Stabilization and Conservation Service (ASCS) and the Soil Conservation Service (SCS) of the U.S. Department of Agriculture administer a number of programs related to non-point source pollution from agricultural production. The ASCS administers two programs for ranchers and farmers, the Agricultural Conservation Program and the Conservation Reserve Program.

The Agricultural Conservation Program provides cost-share funds to farmers and ranchers to adopt conservation practices. These conservation practices are

- Conserve soil and water
- Improve water quality
- Protect and maintain productive farm and ranch land
- Preserve and develop wildlife habitat

The Conservation Reserve Program is designed to protect land that is easily eroded by retiring these areas from production for a period of 10 years. Decreased sediment loading to water occurs because of reduced soil erosion. The Conservation Reserve Program is also intended to protect and improve water quality by taking cropland out of production. Nonproductive cropland requires fewer fertilizers and pesticides; therefore, fewer of these pollutants are available for runoff.

The SCS provides technical assistance to conservation districts throughout the U.S. for water quality. The objectives of the SCS are to

- Increase technical assistance to areas with concerns about water quality
- Demonstrate available technology that will improve or protect water quality
- Help state agencies develop and implement programs for non-point source pollution
- Evaluate pollutant loads to determine the amount originated from agricultural sources
- Plan and implement a program of conservation practices to improve water quality affected by agricultural operations
- Evaluate the effects of conservation practices in reducing or preventing non-point source pollution

Other Federal Programs

The U.S. Geological Survey (USGS) and EPA have a Memorandum Of Understanding (MOU) pledging cooperation and collaboration on water quality monitoring and assessment activities. Both agencies conduct monitoring and assessment activities and the MOU coordinates their efforts.

The Forest Service also has a non-point source pollution management program that is coordinated with individual states to ensure compliance with state water quality requirements. Non-point source pollution that may result from land management activities is controlled by the following:

- Designing practices that are expected to meet water quality objectives
- Monitoring to ensure such practices are implemented and effective
- Mitigation to correct for unexpected problems
- Adjustment in land management design criteria where necessary

State Programs

Texas Clean Rivers Act

The Clean Rivers program was established by the Texas Natural Resource Conservation Commission (TNRCC) under provisions of the Texas Clean Rivers Act. The Act provides for a basin-wide comprehensive water quality management approach to evaluate cumulative impacts of point and non-point source pollution. The objectives of the Clean River program are to develop inventories of wastewater discharges, assess water quality status and trends, and evaluate cumulative impacts of point and non-point source pollution. Note that the Clean Rivers Program focuses on watersheds, but does not include an assessment of the Galveston Bay estuary.

TNRCC contracts with councils of governments or river authorities to perform comprehensive water quality assessments of river basins or watersheds. The assessments provide definitive technical information on non-point sources of pollution, nutrient loadings, and toxic materials, and the impacts and significance of this pollution on the health of aquatic life. Biennial reports will be prepared summarizing the results of the assessments, actions taken to address water quality, and recommendations on TNRCC's regional water quality management plans for each

basin or watershed. The program is funded by a state fee on wastewater discharge and water rights permits.

Texas Water Code Section 26.177

Section 26.177 of the Texas Water Code authorizes the TNRCC to develop rules requiring municipalities with populations of over 5,000 to develop and implement comprehensive water pollution control and non-point source pollution abatement plans. Promulgation of these rules is still pending.

Texas Agricultural Programs

Non-point source pollution from agricultural and silvicultural activities is managed by the Texas State Soil and Water Conservation Board (SWCB). The SWCB is in the process of establishing a certification program for non-point source pollution abatement plans developed for agricultural and silvicultural practices. The plans must comply with state surface water quality standards. The SWCB also works with the TNRCC to coordinate data collection and analysis for river basin and watershed assessments under the Texas Clean Rivers program.

The Texas Department of Agriculture (TDA) and the TNRCC have regulatory authority over the storage and disposal of pesticide wastes. TDA administers the state's pesticide and herbicide regulations developed under the Texas Pesticide Control Act and the Texas Herbicide Law. TNRCC has promulgated rules under the Texas Solid Waste Disposal Act prohibiting the storage, processing or disposal of any pesticide waste that may endanger human health or the environment. In addition, the Texas Department of Health regulates the labeling of pesticides and herbicides.

NON-POINT SOURCES ACTION PLAN

To reduce and eventually eliminate harm from non-point sources of pollution entering Galveston Bay, including toxic contaminants, nutrients, pathogens, sediment, and oxygen-demanding materials.

OVERVIEW

Priority Problem:

Contaminated runoff from non-point sources degrades the water and sediments of the bay tributaries and some near-shore areas. For example, over half of the sediment, phosphorus, fecal coliform bacteria, and oxygen demanding substances originate from non-point sources found in the local watershed. Although these NPS loads do not appear to be creating serious problems in the open bay (except for fecal coliforms), there are notable problems in urbanized bayous and enclosed areas with poor circulation. Specific problem areas include low dissolved oxygen in portions of the Houston Ship Channel, high fecal coliform concentrations that exceed contact recreation standards in Clear Creek and Dickinson Bayou, high nutrient concentrations in many of the urbanized bayous, and pollutants discharged from local marinas. These and other patterns were revealed in a comprehensive water/sediment quality study conducted by the University of Texas. General problems associated with non-point sources include closure of about half the bay to oystering due to high fecal coliform counts and polynuclear aromatic hydrocarbons (PAHs) from combustion sources that bioaccumulate in seafood.

Goal:

Reduce urban NPS pollutant loads. Urban non-point sources have been identified as the land use generating the highest NPS pollutant loadings to the bay. For example, the GBNEP non-point source loading study estimated that the urban areas in the local watershed (primarily the Houston metropolitan region) contributed over 43 percent of the total NPS sediment loadings, 55-65 percent of the NPS nutrient loadings, and over 85 percent of all of the fecal coliform, pesticides, and oil and grease coming from local non-point sources of pollution. In addition, urban non-point sources are important contributors of several priority pollutants (toxics) such as PAHs and PCBs which can increase the health risk associated with consuming seafood from Galveston Bay.

Objective:

Establish the regulatory framework for NPS control throughout the entire immediate Galveston Bay watershed within five years.

- Action NPS-1: Implement storm water programs for local municipalities.
- Action NPS-2: Perform pilot projects to develop NPS Best Management Practices.

Objective:

Reduce NPS loads from existing development. In particular, reduce PAH loadings from non-point combustion sources by 10 percent by 2004. If possible, reduce fecal coliform loadings (or appropriate indicators of pathogens) to 1) levels acceptable for contact recreation in Buffalo

Bayou, White Oak Bayou, Clear Creek, Dickinson Bayou, and Chocolate Bayou; and 2) levels that will permit opening of some or all of the open bay waters currently closed to oyster harvesting (see Public Health Protection Action Plan) by 2014.

- Action NPS-3: Identify and correct priority watershed pollutant problems.
- Action NPS-4: Establish residential load reduction programs.
- Action NPS-5: Correct malfunctioning shoreline septic tanks.

Objective:

Reduce urban NPS loading from new development using technology-based best management practices. Pollutants of particular interest for open Galveston Bay waters are fecal coliforms. Other areas, such as watersheds draining into the Houston Ship Channel may require reductions in other parameters such as BOD, TSS, and nutrients as well (see Water Quality Action Plan).

- Action NPS-6: Implement NPS Reduction Plan Program for New Development.
- Action NPS-7: Establish Roadway Planning to Minimize NPS Effects.

Goal:

Reduce industrial NPS pollutant loads. Industrial non-point sources include runoff from some non-process areas, storage areas and other industrial land uses. Although there are no data regarding the percentage contribution of industrial non-point sources at this time, there is information that industrial NPS have had some impact to the bay over the past 40 years.

Objective:

Ensure implementation of existing NPS programs for industrial areas within five years.

- Action NPS-8: Implement NPDES Storm Water Program for area industries.
- Action NPS-9: Prevent degradation of bay waters by known industrial groundwater plumes.

Goal:

Reduce agricultural NPS pollutant loads. Although agricultural NPS loadings are thought to cause more limited problems to Galveston Bay than other watersheds, it is suspected that there are localized problems caused by agricultural land uses. Existing programs need to be implemented to meet existing water quality standards.

Objective:

Manage agricultural runoff to satisfy water quality standards within five years.

- Action NPS-10: Develop inventory of agricultural non-point sources.
- Action NPS-11: Coordinate and implement existing agricultural NPS control programs.

Goal:

Reduce construction NPS pollutant loads. Construction NPS loadings have been shown to cause localized deterioration of water quality in the Galveston Bay watershed and create aesthetic problems with regards to water clarity. Erosion control programs for construction sites are an accepted practice in many of the large metropolitan regions and several states. For Galveston Bay, erosion control practices now being implemented in Houston and Harris County and by the Texas

Highway Department need to be implemented in other construction sites in the local watershed. In addition, toxics and nutrients control programs for construction sites need to be established.

Objective:

Reduce erosion from construction sites to the maximum extent practicable within five years.

Action NPS-12: Adopt regional construction standards for NPS reduction.

Objective:

Limit migration of toxics and nutrients from construction sites within 10 years.

Action NPS-13: Implement toxics and nutrient control practices at construction sites.

Priority Problem:

Water and sediments are degraded in and around marinas from boat sewage and introduction of dockside wastes from non-point sources. One study has indicated that the combination of poor circulation and discharge from boaters and boat maintenance operations create serious localized water quality problems.

Goal:

Reduce marina water quality degradation associated with sewage. Currently many boaters discharge raw sewage from marine heads directly in the waters of Galveston Bay, causing potential problems with nutrients and bacteria. By eliminating sewage discharge, poor areas of water quality near the marinas and near discharge points will be eliminated.

Objective:

Achieve zero sewage discharge from marinas to surface water within 10 years.

Action NPS-14: Require sewage pumpout, storage, and provisions for treatment.

Action NPS-15: Require use of marine sanitary chemicals that can be treated in POTWs.

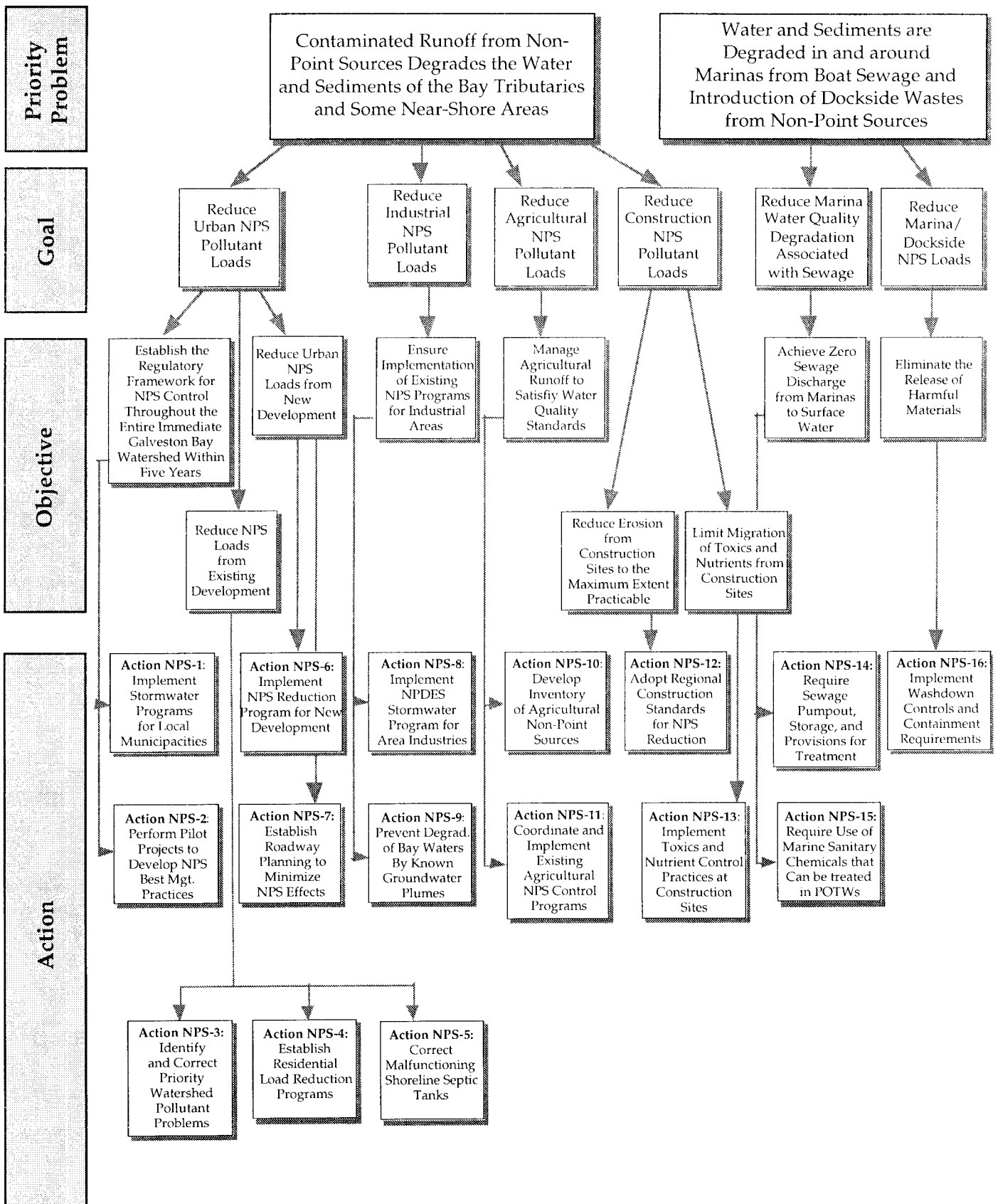
Goal:

Reduce marina/dockside NPS loads. Current boat maintenance operations create waste materials (some toxic) that wash off maintenance areas into the waters of Galveston Bay. Some of these materials, such as tributyl tin (TBT) have been observed to accumulate in sediments of Galveston Bay. These discharges need to be eliminated to improve the water quality of the bay and protect marine life in the bay.

Objective:

Eliminate the release of harmful materials (paints, solvents, etc.) from marinas and docksides within 10 years.

Action NPS-16: Implement washdown controls and containment measures.



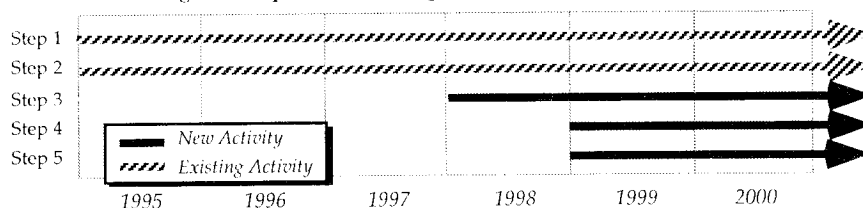
Non-Point Sources Action Plan Flowchart

ACTION NPS-1:**Implement Storm Water Programs for Local Municipalities**

What Implement municipal NPDES Storm Water Program in Houston/Harris county (note that administratively, stormwater is regulated as a point source, although runoff is conceptually a non-point source issue). For municipalities not in this program, encourage development of storm water management plans to control non-point sources.

How

- Step 1 Galveston Bay Program will monitor the efforts of the Joint Storm Water Task Force (Houston, Harris County, Harris County Flood Control District and the Texas Department of Transportation) to meet the requirements of the federal storm water permit program and implement effective storm water management plans in Harris County. The program is currently focusing a comprehensive storm water monitoring program, a program to reduce pollutants in storm water runoff from commercial and residential areas, a program to detect and remove illicit connections to the storm sewer system, a program to monitor runoff from municipal landfills and certain industrial facilities, and a program to reduce pollutants in runoff from construction sites. The Galveston Bay Program will provide input as needed based on scientific and public policy studies completed for *The Galveston Bay Plan* and will ensure that the resulting storm water management strategies are consistent with *The Plan*.
- Step 2 Galveston Bay Program will monitor new requirements proposed for smaller cities under the federal storm water permit program, the state Municipal Water Pollution Control and Abatement Program, and the Texas Coastal Mgt. Plan (see NPS-6). Entities listed in Step 1 will not be subject to these requirements under *The Galveston Bay Plan*.
- Step 3 Galveston Bay Program will determine status of smaller cities under NPDES Phase II, the state Municipal Water Pollution Control and Abatement Program, and the Coastal Management Program (NPS-6).
- Step 4 Galveston Bay Program and HGAC will coordinate the establishment of a Technical Assistance Group to assist local governments in developing storm water management plans for their jurisdictions. The Group will meet during the first half of Year 3 to agree on strategies for approaching local governments, to work out logistics, and to start technical assistance activities during the second half of Year 3.
- Step 5 Galveston Bay Program will begin to approach targeted local governments about the possibility of developing local storm water management plans with support from the Technical Assistance Group.

When

Where NPDES Storm Water Program: Houston, unincorporated portions of Harris County, and Pasadena. Storm Water Management Plans: Smaller municipalities and MUDs in local Galveston Bay watershed.

Who Lead entities: Joint Storm Water Task Force, Pasadena, and municipalities in local Galveston Bay watershed. Others: HGAC, USGS, EPA, TNRCC and local developers. Role of Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 11,250	• GLO	\$ 37,500
• TNRCC	\$ 97,500		
TOTAL		\$ 146,250	

Private Costs: Initially low. Future private costs are potentially high to developers and existing land owners if non-point source BMPs are required. Potential Sources of Funding: USDA, NOAA, EPA, and TWDB.

Regulatory Issues Implementation of non-point source control measures may require significant changes in local drainage regulations, building codes, zoning plans, etc.

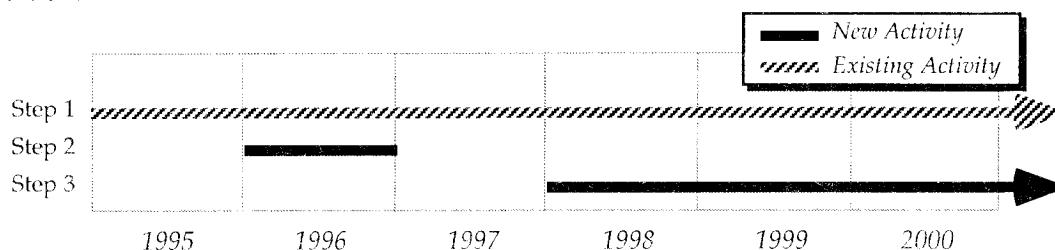
Related Actions: NPS-2 to NPS-7, NPS-12, NPS-13, WSQ-1 to WSQ-5, WSQ-6, WSQ-7, SM-2, SM-3, HP-9, PPE-7, FW-2.

ACTION NPS-2:**Perform Pilot Projects to Develop NPS Best Management Practices for the Galveston Bay Watershed**

What To support the bay-wide regulatory program, perform specific pilot projects to demonstrate viability of various best management practices for new development in Galveston Bay area. For example, some engineering practices related to detention and particularly infiltration technology are inappropriate for local topography, rainfall regimes, and soil types. Compile a single bay-wide BMP performance document based on performance data from the area and data that is transferable from other areas.

How

- Step 1 TNRCC will establish Galveston Bay as a demonstration area for coastal urban NPS pollution abatement by adding newly-identified problem areas in the Galveston Bay watershed (NPS-3) to its Section 319 NPS Assessment Report to EPA. TNRCC will publicize this action so potential pilot project sponsors are aware of funding eligibility for Galveston Bay demonstration projects.
- Step 2 Various entities will continue ongoing NPS projects and initiate new demonstration projects that include evaluation of BMPs in the Galveston Bay watershed.
- Step 3 The Galveston Bay Program will compile a *Galveston Bay BMP Performance Document* to inventory NPS control techniques which have been evaluated and, if necessary, adjusted to make them appropriate for local conditions and needs.

When

Where Selected urban watersheds and subwatersheds in local Galveston Bay watershed.

Who Lead entities: Galveston Bay Program, TNRCC, and Houston/Harris County. Participants: HGAC, EPA, universities, USGS, GLO, consulting firms, and local municipalities. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 37,500	• GLO, HGAC	\$ 30,000
• TNRCC	\$ 1,328,750	• Munis	\$ 90,000
TOTAL		\$ 1,486,250	

Private costs: low. Actions Tied to Other Programs: Some funding is currently committed to performing NPS pilot projects. Potential Sources of Funding: USDA, NOAA, HUD, USGS, EPA, and TWDB.

Regulatory Issues None identified.

Related Actions: NPS-1, NPS-3, NPS-4, NPS-6, NPS-7, NPS-12, NPS-13, WSQ-6, WSQ-7, SD-6, HP-4, HP-9, and PPE-7.

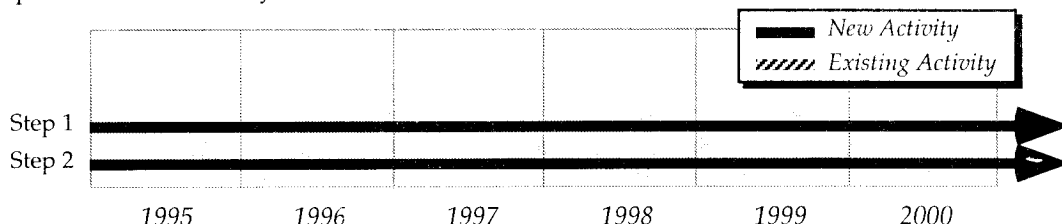
ACTION NPS-3: Identify and Correct Priority Watershed Pollutant Problems

What Determine major source areas that cause excessive non-point source pollution to Galveston Bay. These zones of concern would include areas with bad erosion problems (such as eroding stream channels), areas with septic tank problems, and other bad management practices.

How

- Step 1** The Galveston Bay Program will maintain and publish its own inventory of NPS concerns in the bay watershed. Various entities and researchers, through ongoing and new water quality initiatives, will continue to identify NPS source areas in the Galveston Bay watershed. Possible sources of information include 1) biennial basin assessment reports prepared under the Texas Clean Rivers Program will include a comprehensive inventory of NPS concerns in the watershed (not in the bay, however); 2) the GBNEP non-point source study's loading maps and land use maps; 3) 305b reports; 4) monitoring data showing areas with stream erosion problems, problem areas identified from agricultural non-point source programs, sources of continual PCB and PAH releases (if any); and the Galveston Bay Regional Monitoring Program. If necessary, special studies will be performed to locate and confirm the presence of non-point source areas and to perform in-stream ambient studies that will link loadings to real problems.
- Step 2** Various entities, through ongoing and new water quality programs, will recommend the application of BMPs (NPS-2) or other appropriate NPS control measures (NPS-1, NPS-6) to respond to NPS source areas identified in the Galveston Bay watershed. The Galveston Bay Program could help to disseminate information on BMPs and other NPS control measures and recommend appropriate measures as needed. Galveston Bay Program also could report on NPS concerns and impacts in the Galveston Bay watershed through its publications and during State of the Bay Symposia. In addition, the Galveston Bay Council will evaluate the effectiveness of technology-based BMPs, and if insufficient water quality improvements have been observed after a five year period, it will work with local municipalities and the CCC to set up a workable performance-based system for the area.

When



Where Local Galveston Bay watershed. Areas with known non-point source impacts or ambient water quality exceeding water quality standards include: Clear Creek Above Tidal, Clear Creek Tidal, Clear Lake, Armand Bayou, Dickinson Bayou Tidal, Dickinson Bayou Above Tidal, Moses Lake, Chocolate Bayou Above Tidal, Chocolate Bay, Upper Galveston Bay, West Bay, Bastrop Bay, Lower Galveston Bay, Houston Ship Channel, Buffalo Bayou Tidal, Tabbs Bay, San Jacinto Bay, Black Duck Bay, Scott Bay, Burnett Bay, Barbours Cut, Cedar Bayou Tidal.

Who Lead entity: Galveston Bay Program. Other participants: HGAC, EPA, universities, USGS, SWCB, SCS, GLO, consulting firms, and local municipalities. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program.....	\$ 50,000
• Munis.....	\$ 775,000
TOTAL.....	\$ 825,000

Private Costs: Initially low. Some landowners may have high costs if non-point source control measures are required to eliminate problems identified by this action. **Potential Sources of Funding:** USDA, SCS, NOAA, DoD, Corps, EPA, and TWDB.

Regulatory Issues None identified.

Related Actions: NPS-1 to NPS-13, WSQ-1 to WSQ-7, PS-3, PS-4, PPE-6, PPE-8, HP-3, HP-9, SD-6, PH-2, and PH-3.

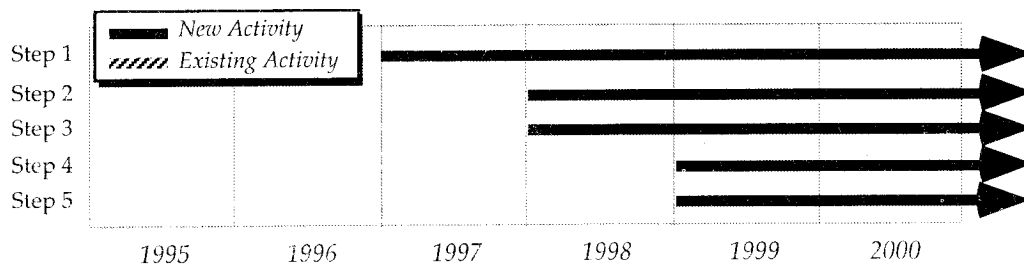
ACTION NPS-4: Establish Residential Load Reduction Programs

What Reduce NPS loadings from residential activities, including lawn and garden activities, household hazardous wastes, automotive fluids, pets, and storm sewer dumping.

How

- Step 1 Galveston Bay Program will implement a Galveston Bay public education program aimed at NPS pollution reduction from residential areas in coordination with similar NPS educational efforts.
- Step 2 Galveston Bay Program will complete an inventory of existing local government initiatives to reduce NPS pollution within their jurisdictions and assess technical assistance needs.
- Step 3 TNRCC will complete an internal review of requirements it imposes on and associated funds it targets toward local governments for implementation of NPS pollution prevention measures to determine the need for program adjustments.
- Step 4 The results of steps 2 and 3 will contribute to the development of local NPS management strategies under Action NPS-3.
- Step 5 Galveston Bay Council will evaluate the effectiveness of its NPS Residential Load Reduction Program. If insufficient water quality improvements have been observed after a five year period, the Galveston Bay Program will work with local municipalities and the GLO to set up a workable performance-based system for the area.

When



Where Residential areas that drain into bay tributaries that show proven detrimental effects from non-point sources based on in-stream data during storm events. Potential problem areas include the following subwatersheds in the GBNEP non-point source report (GBNEP-15, Table III. 2) with over 20 percent residential areas: Addicks Reservoir AD02; Armand/Taylor Bayou AT04; Buffalo Bayou BF02, BF03, BF04, and BF05; Brays Bayou BR03, BR04, BR05, BR06, BR07; Cedar Bayou CE04; Greens Bayou GR02, GR03, GR05, GR06, GR07; Ship Channel SC01, SC02, SC03, SC05; and Sims Bayou SM03, SM04, SM05.

Who Lead entities: TNRCC and Galveston Bay Program. Other participants: EPA, GLO, local municipalities, local school districts, and environmental organizations. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 93,750	• HGAC	\$ 24,000
• Munis	\$ 132,000	• Counties.....	\$ 582,600
TOTAL		\$ 832,350	

Private Costs: Initially low. Some landowners may have high costs if non-point source control measures are required to eliminate problems identified by this action. Actions tied to other programs are for programs proposed by the TNRCC. Potential Sources of Funding: USDA, SCS, NOAA, DoD, Corps, EPA, and TWDB.

Regulatory Issues May lead to new local ordinances aimed at curbing non-point source pollutants from various residential sources, such as fertilizer application, herbicide application, and pet waste. Through consistency review of implementation grants for TNRCC programs, the enhancement of existing or development of new TNRCC ordinances and education programs can be encouraged.

Related Actions: NPS-1, NPS-2, NPS-3, NPS-6, NPS-7, WSQ-6, WSQ-7, SD-6, and SD-7.

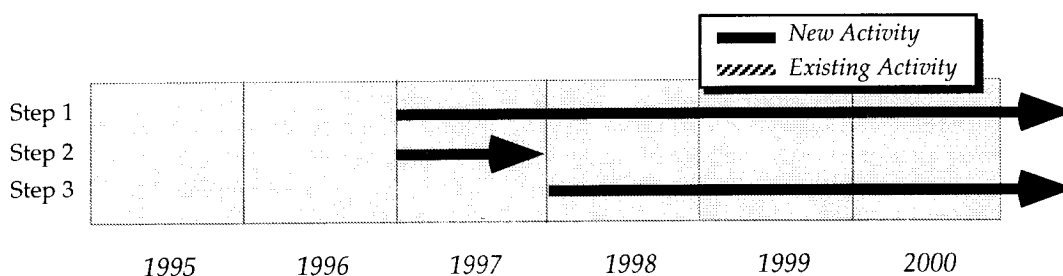
ACTION NPS-5: Correct Malfunctioning Shoreline Septic Tanks

What Implement measures to reduce fecal coliform pollution to the bay from malfunctioning septic tanks.

How

- Step 1 Local counties will work with the Corps and the GLO to develop ordinances that require all shoreline septic tank systems meet statewide suggested septic system and lot size standards. Included in these ordinances will be education requirements for septic tank installers.
- Step 2 Galveston Bay Program will work with the five counties and conduct a bay-wide septic system and geologic survey for use in regulations and management. The survey will also identify problem areas where septic tanks are degrading water quality through bacterial pollution.
- Step 3 Local counties will require septic system certification and upgrades (if necessary) upon sale or transfer of property in problem areas identified in Step 2.

When



Where Areas affected by fecal coliform pollution from septic tank systems, primarily tributaries and areas with low circulation.

Who Lead entities: County health departments, Corps, GLO, and Galveston Bay Program. Other participants: EPA, TDH, TPWD. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 25,000
• Munis, Counties.....	\$ 75,000
TOTAL	\$ 100,000

Private Costs: High for some septic tank owners and some developers.

Regulatory Issues Stronger local ordinances will be required to curb fecal coliform pollution from septic tanks. These ordinances will require some type of certification and upgrades upon sale or transfer of property in problem areas.

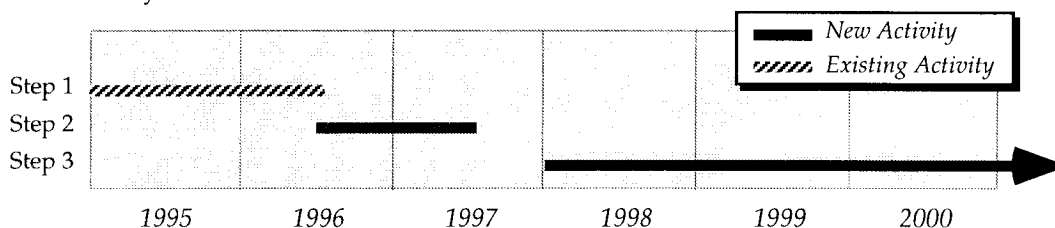
RELATED ACTIONS: NPS-1, NPS-2, NPS-3, NPS-4, NPS-6, NPS-7, NPS-14, NPS-15, PS-1, PS-2, PS-5, PH-1, PH-2, AND PPE-3.

ACTION NPS-6:**Implement NPS Reduction Plan Program for New Development**

What States with CZM programs that have received federal approval must develop a Coastal Non-Point Source Pollution Control Program. This program is designed to bring together the current patchwork of regulatory agencies to jointly address the problems of coastal non-point source pollution.

How

- Step 1 CCC will oversee development of the Texas Coastal NPS Reduction Plan required under the CMP.
- Step 2 The CCC will submit the proposed Texas Coastal NPS Reduction Plan to EPA and NOAA approximately two years after the CZMA, upon approval of the state's coastal management program for acceptance into the federal CZM program.
- Step 3 The CCC will oversee implementation of the approved Texas Coastal NPS Reduction Plan (if adopted). State agencies and local governments will exercise their existing authorities to implement the Coastal NPS reduction plan. Note that Phase I storm water cities (such as Houston) are exempt under *The Galveston Bay Plan*, as they are developing similar programs under the NPDES Storm Water permitting process. A possible resource for the Texas program in the Galveston Bay area may be the best management practices included in the *Storm Water Quality Management Guidance Manual* prepared by the Storm Water Joint Task Force. These management measures are technology-based procedures and practices for controlling non-point source pollution that are effective with the area's combination of flat topography, heavy soils, and wet climate. Some research monitoring may be needed for to ensure that the various best management practices are effective in the Houston area. Galveston Bay Council will evaluate the effectiveness of the management measures. If insufficient water quality improvements have been observed after a five year period, the Galveston Bay Program will work with local municipalities and the GLO to set up a workable performance-based system for the area.

When

Where Entire local Galveston Bay watershed.

Who Lead entities: CCC, TNRCC, and SSWCB. Other participants: EPA, USGS, NOAA, GLO, TSDOT, local municipalities, marina owners, construction companies and developers, and industries. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

No new Costs
TOTAL..... \$ -0-

Private Costs: Initially low. Implementation may involve high costs for developers and landowners. No new public costs were identified, as existing or planned programs are already in place for this action. Potential Sources of Funding: USDA, NOAA, EPA, DOT, ISTE, and TWDB.

Regulatory Issues Texas NPS Reduction Plan Program will need to be approved by EPA and NOAA.

Related Actions: NPS-1, NPS-2, NPS-3, NPS-4, NPS-7, WSQ-1, WSQ-2, WSQ-3, WSQ-4, WSQ-5, WSQ-6, WSQ-7, SD-6, SD-9, SM-2, PH-2, PH-3, PPE-3, PPE-4, and PPE-7.

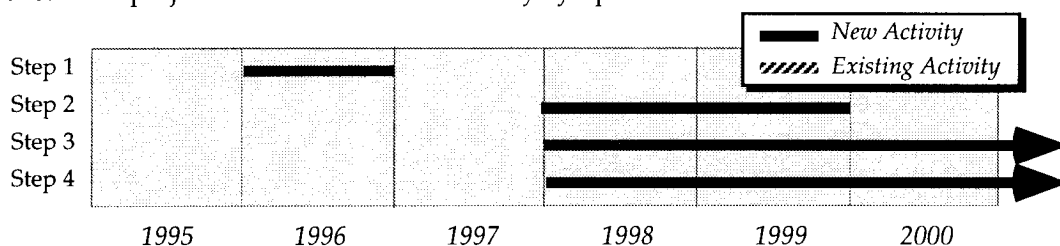
ACTION NPS-7: Establish Roadway Planning to Minimize NPS Effects

What Establish roadway planning to minimize NPS effects, including non-federal projects. This includes planning measures to protect areas that are susceptible to erosion, limit the disturbance of natural drainage features, etc.

How

- Step 1 Galveston Bay Program and the TXDOT will work together to incorporate into the 1996 State of the Bay Symposium any research findings and activities on NPS management issues related to roadway planning and design. Management measures in the *Storm Water Quality Management Guidance Manual* prepared by the Storm Water Joint Task Force may be used as a resource for appropriate best management practices.
- Step 2 Galveston Bay Program and the TXDOT will work together to organize educational workshops for county highway agencies, municipal public works departments, and private transportation engineering consultants in the Galveston Bay area regarding NPS control and prevention in roadway planning, design, construction, operation and maintenance.
- Step 3 Galveston Bay Program and the TXDOT will work together to promote demonstration projects and case studies of successful incorporation of NPS control and prevention measures into roadway planning and design.
- Step 4 TXDOT and other roadway planning interests will continue to present results of NPS control research and demonstration projects at biennial State of the Bay Symposia.

When



Where Entire local Galveston Bay watershed.

Who Lead entities: Galveston Bay Program and TXDOT. Other participants: USDOT, county highway departments, local municipalities, and TNRCC. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program.....	\$ 7,500	• Counties.....	\$ 47,250
• TXDOT	\$ 111,250		
TOTAL.....		\$ 166,000	

Private Costs: Initially low. Potential Sources of Funding: EPA, DOT, ISTEA, and TWDB.

Regulatory Issues Need to change management priorities within roadway planning agencies. Consistency review of highway research, planning, and construction grants provided by DOT can encourage use of best available technology and practices to reduce TSS, non-point source loading from new highway developments.

Related Actions: NPS-1, NPS-2, NPS-3, NPS-4, NPS-6, WSQ-6, WSQ-7, SD-6, PPE-7, SM-1, SM-2, PH-1, PH-2, and PH-3.

ACTION NPS-8:

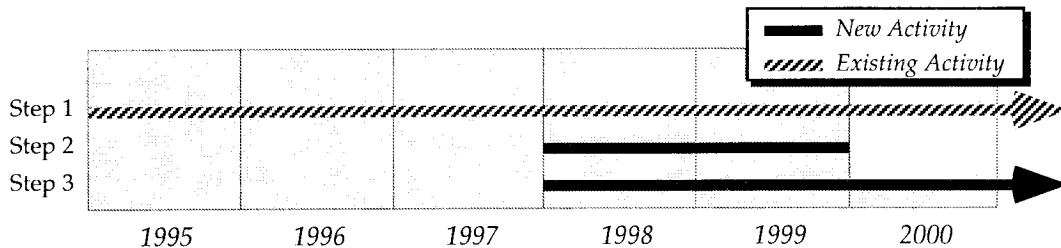
Implement NPDES Storm Water Program for Area Industries

What Continue to implement NPDES storm water program for area industries identified by federal regulations. During Phase II of the program additional industries will be identified. The industrial storm water permitting program is an EPA pollution control initiative that consists of the following elements: monitoring plans, pollution prevention plans, and spill prevention plans. Subsequent portions of the program will aim at managing problem non-point sources from industrial sites.

How

- Step 1 Galveston Bay Program will monitor the efforts of industries within the Galveston Bay watershed to meet the requirements of the federal storm water permit program and implement effective storm water management and pollution prevention plans. Galveston Bay Program will provide input as needed based on scientific and public policy studies completed for *The Galveston Bay Plan*.
- Step 2 Galveston Bay Program will work with the EPA to compile industrial non-point source monitoring data to update Galveston Bay NPS loading estimates and to assess industrial contributions to overall loadings.
- Step 3 Galveston Bay Program will incorporate industrial Best Management Practices into the Galveston Bay BMP Performance Document to be prepared under Action NPS-3.

When



Where All industries in the local Galveston Bay watershed subject to the EPA's NPDES requirements.

Who Lead entity: EPA or TNRCC and regulated industries identified by federal regulations in NPDES industrial storm water permit program. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program.....	\$ 21,750
TOTAL.....	\$ 21,750

Private Costs: Existing compliance costs are moderate to high. Potential Sources of Funding: EPA, and TWDB.

Regulatory Issues Consistency review of application for NPDES implementation grants can be used to encourage efforts toward goals of *The Plan* once TNRCC has NPDES delegation.

Related Actions: NPS-3, WSQ-1, WSQ-2, WSQ-3, WSQ-4, WSQ-5, WSQ-6, WSQ-7, SM-1, SM-3, and HP-4.

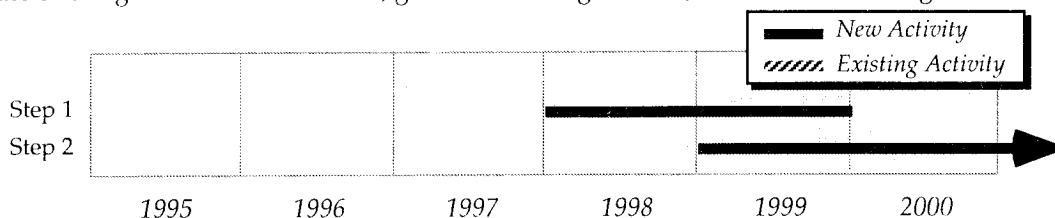
ACTION NPS-9: Prevent Degradation of Bay Waters by Known Industrial Groundwater Plumes

What Prepare inventory of known groundwater problems from active and abandoned industrial sites that could impact the bay. Note that this effort will not focus on septic tanks, as characterization studies have indicated that septic tanks are not a significant contributor to the annual bacterial loading to the bay.

How

- Step 1** The TNRCC will lead an interagency effort to inventory groundwater impacts to the bay from industrial sources (active and inactive) and potential impacts on surface water via groundwater. This inventory will include all existing sites regulated under CERCLA, RCRA, the Leaking Petroleum Storage Tank Program, the Oil Pollution Act and the Clean Water Act which currently have confirmed groundwater plumes that may discharge into surface waters of the Galveston Bay watershed. The inventory will be based on data and reports from existing groundwater monitoring programs; no new monitoring programs will be mandated. The inventory will include an evaluation of the overall pollutant loading from groundwater sources to Galveston Bay.
- Step 2** Based on the results from the inventory, TNRCC will require immediate remediation measures at sites that violate existing risk assessment rules, groundwater regulations, or surface water regulations.

When



Where All active and abandoned industrial sites with known groundwater contaminants that may impact Galveston Bay.

Who Lead entities: TNRCC and local industries with known groundwater problems. Other participants: HGAC, River Authorities, and USGS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 4,500	• River Au.....	\$ 30,000
• TNRCC	\$ 315,000	• HGAC.....	\$ 15,000
TOTAL		\$ 364,500	

Private Costs: Initially low. Some industries may have high costs to correct groundwater problems that are currently impacting the bay. Actions tied to other programs are proposed studies to be conducted as part of the Texas Clean Rivers Act. **Potential Sources of Funding:** USGS, EPA, and TWDB.

Regulatory Issues Change TNRCC's management emphasis to increase resources devoted to identifying groundwater plumes with substantial discharges to surface water. Consistency review of application for NPS implementation grants can be used to encourage TNRCC to move toward implementation of such programs.

Related Actions: NPS-3, WSQ-1, WSQ-2, WSQ-3, WSQ-4, WSQ-5, WSQ-6, WSQ-7, and SM-3.

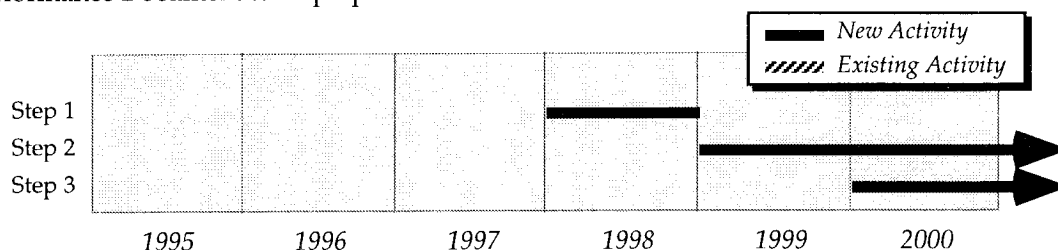
ACTION NPS-10: Develop Inventory of Agricultural Non-Point Sources

What Develop more accurate estimates of agricultural non-point source pollution to Galveston Bay.

How

- Step 1** The Texas State Soil & Water Conservation Board (SWCB) will lead an interagency effort to assess agricultural non-point source loadings to and impacts on Galveston Bay. Special studies will be performed to 1) refine current pesticide loadings from agricultural areas; 2) develop detailed loading estimates from the upper San Jacinto watershed (upstream of Lake Houston dam) and the upper Trinity watershed (upstream of Lake Livingston dam); 3) determine overall contribution of rice farming vs. low-till vs. conventional farming techniques; 4) assess seasonal effects to identify periods when high pollutant loads would be expected, such as when rice fields overflow or are drained, tilling periods, and periods when pesticide and fertilizer applications are heavy; 5) evaluate effectiveness of agricultural BMPs to reduce non-point source erosion loadings; 6) determine contribution of agricultural activities on fecal coliform levels in waters of Galveston Bay.
- Step 2** SWCB will lead an interagency effort to evaluate the effectiveness of existing agricultural Best Management Practices in the Galveston Bay vicinity and recommend improvements based on local conditions and practices.
- Step 3** Galveston Bay Program will incorporate agricultural Best Management Practices into the Galveston Bay BMP Performance Document to be prepared under Action NPS-3.

When



Where Agricultural areas in local Galveston Bay watershed.

Who Lead entities: SWCB, SCS, and HGAC. Other participants: River Authorities, local farming organizations, EPA, TNRCC, USGS, and GLO. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 42,500	• Counties	\$ 33,750
• TNRCC.....	\$ 312,500	• SWCB	\$ 75,000
TOTAL.....		\$ 463,750	

Private Costs: Low to moderate. Actions Tied to Other Programs: Includes funding for Clean Rivers Act. Potential Sources of Funding: USDA, SCS, EPA, and TWDB.

Regulatory Issues Consistency review of application for implementation grants for NPS program can be used to encourage TNRCC to develop this inventory.

Related Actions: NPS-3, NPS-11, WSQ-6, and WSQ-7.

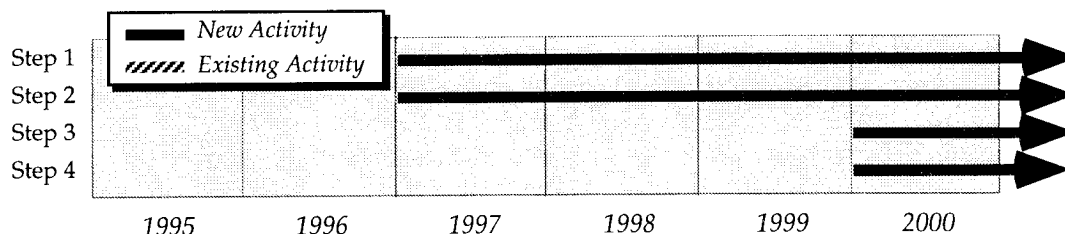
ACTION NPS-11: Coordinate and Implement Existing Agricultural NPS Control Programs

What Coordinate with USDA water quality initiatives, State Soil and Water Conservation Board programs, SCS activities and programs, the Farm Assist Program, the Rural Clean Water Program, the Conservation Reserve Program, the Wetlands Reserve Program, EPA 319 funding, and other activities directed at agricultural sources of contaminated runoff.

How

- Step 1** The GBP will establish an Agricultural NPS Coordination Committee. This committee will include representatives of the SCS, the SWCB, the Texas Department of Agriculture, TNRCC, and other appropriate federal, state, local and private entities.
- Step 2** The Agricultural NPS Coordination Committee will discuss and recommend priorities for 1) implementation of NPS-10; 2) coordination needs among agricultural NPS agencies and programs; and 3) possible joint projects between agencies/programs. The committee will consider other topics and coordination projects as needed, such as the need for increasing funding for agricultural NPS programs.
- Step 3** GBP and the Agricultural NPS Coordination Committee will conduct educational workshops in the Galveston Bay watershed on agricultural NPS pollution and best management measures for the area (based on the results of the agricultural BMP evaluation to be completed under Action NPS-10). Educational programs may be coordinated with chemical supply stores, garden shops, schools, etc.
- Step 4** The Agricultural NPS Coordination Committee will assist the GBP to incorporate agricultural Best Management Practices into the Galveston Bay BMP Performance Document to be prepared under Action NPS-2.

When



Where The local Galveston Bay watershed

Who Lead entity GBP. Other Participants: SWCB districts, USDA, SCS, Clean Rivers Act Studies, Farm Assist, Rural Clean Water Program, Conservation Reserve Program, Wetlands Reserve Program, EPA, TDA, TNRCC Ag program (under MOU negotiation between SWCB and TNRCC), Clean Rivers, and GLO. Role of GBP: Coordinating.

Public Costs of New Actions (5 years)

• Program.....	\$ 22,500
• SWCB.....	\$ 36,000
TOTAL.....	\$ 58,500

Private Costs: Initially low. Actions tied to other programs are existing programs that include coordination activities by SWCB, GLO, and TNRCC. **Potential Sources of Funding:** USDA, EPA, EPA, and TWDB.

Regulatory Issues Some change in management decision-making process needed to increase coordination between various programs in different agencies.

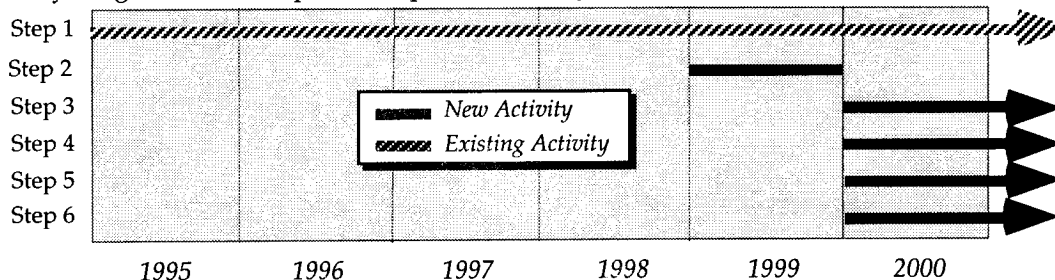
Related Actions: NPS-3, NPS-10, WSQ-6, WSQ-7, HP-4, HP-9, FW-2, and PH-1.

ACTION NPS-12:**Adopt Regional Construction Standards for NPS Reduction**

What On a regional basis by regulation, adopt and support the *Storm Water Management Handbook for Construction Activities* prepared by the Houston/Harris County Joint Storm Water Management Task Force for construction activities disturbing five or more acres or projects which are part of a master planned development.

How

- Step 1 HGAC will continue to encourage implementation of NPS control measures during construction through its educational and outreach efforts to local governments and builder/contractor groups, through ongoing distribution of H-GAC's *Action Guide for Erosion and Sediment Control During Construction Activities*, and through its comments on projects evaluated through the review process.
- Step 2 HGAC will encourage coordination among agencies with NPS programs to establish regional NPS control requirements or guidelines for construction activities in the Galveston Bay watershed. These requirements will be based, where appropriate, on the *Storm Water Management Handbook for Construction Activities* prepared for the Houston/Harris County/HCFCD/TXDOT Joint Storm Water Management Task Force. This will establish uniform construction NPS management practices for the entire region based on local conditions and practices. Note that since TXDOT is now a member of the Joint Task Force, the Handbook will be revised to reflect their guidance.
- Step 3 Galveston Bay Program will work with other agencies to provide technical assistance to local governments on appropriate NPS controls and model guidance for construction activities.
- Step 4 Galveston Bay Program will work with other agencies and builder/contractor groups to develop a regional education initiative for developers and contractors on construction BMPs.
- Step 5 Galveston Bay Program will lead an interagency effort to conduct a comprehensive review of regional NPS control practices for construction activities. This review will incorporate the results of any BMP evaluation projects completed under Action NPS-2 which involve construction.
- Step 6 Galveston Bay Program will incorporate Step 5 into the Bay BMP Performance Document (Action NPS-2).

When

Where Local Galveston Bay watershed.

Who Lead entities: HGAC, TNRCC, local municipalities, and Galveston Bay Program. Others: GLO (CMP), EPA/TNRCC (NPDES), and Joint Storm Water Management Task Force. Role of Program: Conduct Action.

**Public Costs of
New Actions (5 years)**

• Program.....	\$ 37,500	• HGAC.....	\$ 37,500
• TNRCC	\$ 15,000		
TOTAL.....		\$ 90,000	

Private Costs: moderate costs to developers, contractors. Potential funding sources: USDA, EPA, DOT, TWDB.

Regulatory Issues No new regulatory authority needed for existing NPDES storm water programs. Other municipalities need to adopt ordinances to implement these measures. Counties have no ordinance-making powers. Regulation would have to occur based on local ordinance-making powers. This action may require changes in local drainage regulations, codes, and zoning plans.

Related Actions: NPS-1, NPS-2, NPS-3, NPS-13, WSQ-6, WSQ-7, PPE-8, and SM-1.

ACTION NPS-13: Implement Toxics and Nutrient Control Practices at Construction Sites

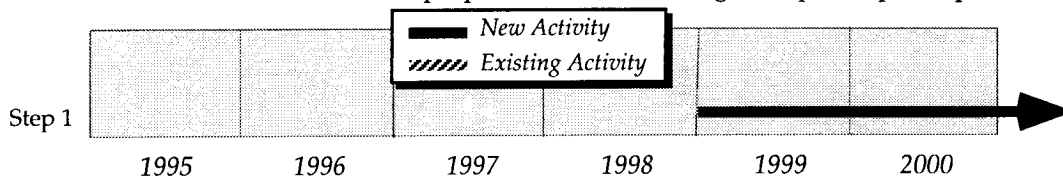
What Implement construction site chemical control measures as described in the CZM Non-Point Source Reduction Program (see Section 6217 *Guidance Specifying Management Measures for Sources of Non-Point Source Pollution in Coastal Waters*) that are appropriate to the Galveston Bay area. Note that Phase I storm water entities (such as Houston) are exempt, as they are developing their own NPS control program under NPDES.

How

Step 1 CCC will encourage coordination among agencies with NPS programs to establish regional requirements or guidelines for the control of nutrients and toxic materials during construction activities in the Galveston Bay watershed. The remaining implementation steps on this Action are the same as steps 3 - 6 on Action NPS-12, with the focus in this case on the control of toxics and nutrients during construction. If CZM is not implemented, then the Galveston Bay Program and the HGAC will work with local municipalities to implement some or all of the measures in the CZM guidance that are practical here:

- Properly store, handle, apply, and dispose of pesticides
- Properly store, handle, apply, and dispose of petroleum products
- Establish fuel and vehicle maintenance staging areas away from drainage courses
- Provide sanitary facilities for construction workers
- Store, cover, and isolate construction materials
- Develop and implement a spill prevention and control plan
- Maintain and wash equipment and machinery in confined areas to control runoff
- Develop and implement nutrient management plans
- Provide adequate disposal facilities for solid waste, including asphalt
- Educate construction workers about proper materials handling and spill response procedures

When



Where All of local Galveston Bay watershed.

Who Lead entities: HGAC, TNRCC, local municipalities, and Galveston Bay Program. Other participants: GLO, EPA, local developers and construction companies, and Houston/Harris County Joint Storm Water Management Task Force. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program.....	\$ 7,500
TOTAL.....	\$ 7,500

Private Costs: moderate costs to developers, contractors. Potential Funding Sources: USDA, NOAA, EPA, TWDB.

Regulatory Issues No new regulatory authority needed under existing NPDES permits (including Houston/Pasadena/unincorporated areas of Harris County). Other municipalities need to adopt ordinances to implement these measures at construction sites. At county level, however, adoption of construction practice regulation is problematic, since no ordinance-making powers exist at the county level. Regulation would have to occur based on local ordinance-making powers.

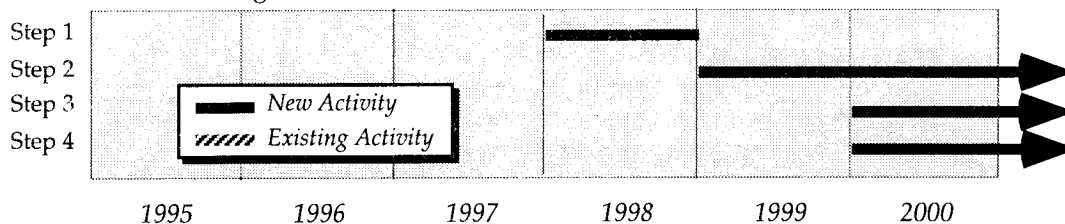
Related Actions: NPS-1, NPS-2, NPS-3, NPS-12, WSQ-1, WSQ-2, WSQ-3, WSQ-4, WSQ-5, WSQ-6, WSQ-7, PPE-8, PH-1.

ACTION NPS-14:**Require Sewage Pumpout, Storage, and Provisions for Treatment**

What Require sewage pumpout, storage, and provisions for treatment for all marinas greater than 10 boat slips in Galveston Bay waters. Achieve zero sewage discharge from marinas by linking enforcement to marina construction and designate, through state or federal authority, key areas (such as Clear Lake) as no discharge zones. Note that this action is primarily directed at recreational boating, as commercial vessels are already regulated by the Coast Guard.

How

- Step 1 GLO will require, via its permits, that marinas with capacity for long-term anchorage of more than 10 vessels shall provide pump-out facilities for marine toilets, or other such measures that provide an equal or better level of water quality protection.
- Step 2 Galveston Bay Program will work with other agencies and private organizations to establish an educational effort for marina users and to provide technical assistance to marinas to comply with the new state requirements.
- Step 3 TNRCC will designate sensitive areas of Galveston Bay as no-discharge zones.
- Step 4 TPWD will manage new boat registrations and the GLO will limit permits for marina construction in the vicinity of no-discharge zones based on evidence that violations of boat/marina sewage management requirements are still occurring.

When

Where All marinas in sensitive areas of Galveston Bay and tributary waters that are impacted by discharge of marine sewage.

Who Lead entity: GLO, TPWD, and TNRCC. Other participants: Galveston Bay Program, local marinas, and local municipalities. Role of Galveston Bay Program: Coordination.

Public Costs of New Actions (5 years)

• Program.....	\$ 30,000	• TPWD.....	\$ 28,750
• GLO	\$ 42,500		
TOTAL.....		\$ 101,250	

Private Costs: Potentially high to marina and boat owners. Potential Sources of Funding: USDA, NOAA, EPA, and TPWD.

Regulatory Issues May need new local or state regulations to implement, or can be accomplished via CMP consistency.

Related Actions: NPS-15, NPS-16, PPE-8, PH-2, and PH-3.

ACTION NPS-15: Require Use of Marine Sanitary Chemicals That Can Be Treated in POTWs

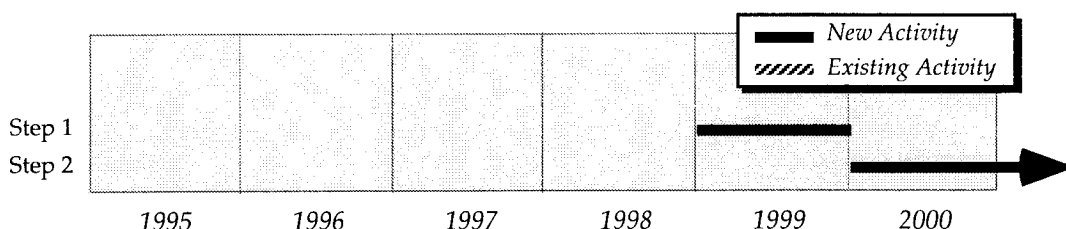
What Restrict use of marine sanitary chemicals to those that are compatible with the wastewater treatment plant processes.

How

Step 1 TNRCC will adopt rules to ban marine sanitary chemicals that are incompatible with wastewater treatment plant processes. Implementation of this Action also will depend on the educational efforts to be implemented under Action NPS-14, with the focus in this case on sewage-management alternatives for boaters and marinas.

Step 2 Galveston Bay Program will work with other agencies to promote marina demonstration projects which illustrate alternatives for effective sewage management.

When



Where All marinas on Galveston Bay and tributary waters to the bay.

Who Lead entity: TNRCC. Other participants: Galveston Bay Program, GLO, local boat supply retailers, and boat owners. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 7,500	• GLO	\$ 7,500
• TNRCC	\$ 90,750		
TOTAL.....		\$ 105,750	

Private Costs: Overall low cost to boat owners. Potential Sources of Funding: NOAA, and EPA.

Regulatory Issues Will need new local or state regulations to implement product bans.

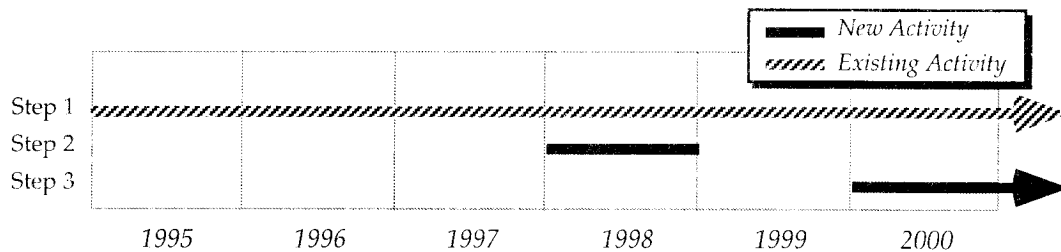
Related Actions: NPS-15, NPS-16, PPE-8, and PH-1.

ACTION NPS-16:**Implement Washdown Controls and Containment Measures**

What Implement washdown controls and containment requirements for all marinas (i.e., all marinas greater than 10 boat slips with a SIC code of 4493: marinas where vehicle (boat) rehabilitation, mechanical repairs, painting, fueling, and lubrication or equipment cleaning operations are conducted).

How

- Step 1 Marinas covered by the federal storm water permit program (if any) will continue to implement required pollution prevention measures.
- Step 2 GLO will adopt rules based on the Texas Coastal NPS Reduction Plan (Action NPS-6) to establish pollution prevention requirements for marinas, marine gas stations and related activities in the Galveston Bay vicinity.
- Step 3 Galveston Bay Program will incorporate marina and boating Best Management Practices into the *Galveston Bay BMP Performance Document* to be prepared under Action NPS-2. Implementation of this Action also will depend on the educational efforts to be implemented under Action NPS-14

When

Where All marinas on Galveston Bay and tributary waters to the bay.

Who Lead entities: Marina owners with NPDES permits. Other participants: Local municipalities, TNRCC, GLO, Coast Guard, and EPA. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program	\$ 24,000
• TNRCC	\$ 63,000
TOTAL	\$ 87,000

Private Costs: moderate to high for marina owners. Potential Sources of Funding: NOAA and EPA.

Regulatory Issues May need new local or state regulations to implement and enforce.

Related Actions: NPS-14, NPS-16, WSQ-1, WSQ-2, WSQ-3 WSQ-4, and PPE-8.

Point Sources of Pollution

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Priority</u>	<u>Description</u>	<u>Page</u>
PS-1	High	Determine location and extent of bypass and overflow problems	212
PS-2	High	Eliminate or reduce bypass and overflow problems	213
PS-3	High	Regionalize small wastewater treatment systems	214
PS-4	High	Improve compliance monitoring and enforcement for small dischargers	215
PS-5	Medium	Implement a dry-weather illegal connection program	216
PS-6	Medium	Issue NPDES Coastal General Permit or eliminate harm from oil field discharge	217

THE ISSUES

The impacts of point source discharges on water and sediment quality in Galveston Bay have been studied for many years. Point source discharges originate from municipal and industrial facilities, bypasses and overflows from municipal sewage systems, unpermitted and illegal discharges, and produced water from oil and gas operations. In the past, discharges of pollutants from municipal and industrial wastewater treatment plants have upset the healthy balance of marine life in portions of the Galveston Bay estuary system. However, since the 1970's, the pollutant loadings from large municipal and industrial discharges have been closely regulated through several management actions established under federal and state water pollution control laws. The permitting process established under these laws has been successful in reducing the concentration of pollutants entering the Galveston Bay system from these sources. Federal and state permitting rules also regulate the discharge of produced water from oil and gas operations and some progress is being made in reducing the concentration of pollutants entering the bay from these activities.

This action plan focuses on improving the control of toxicants, nutrients, and other pollutants discharged into the Galveston Bay system from sewage bypasses and overflows, illegal connections to storm sewers, and oil and gas field operations. Sewage bypasses and overflows occur during periods of heavy rainfall when the capacity of the sewer system to manage the

wastewater flow is exceeded and untreated sewage flows directly into the bay. The high concentrations of fecal coliform bacteria, nutrients, and suspended solids in the untreated wastewater can adversely affect aquatic life in the bay and cause areas of the bay to become unsafe for contact recreation activities such as swimming. Illegal storm sewer connections also result in the introduction of untreated wastes directly into bay tributaries. Oil and gas produced water discharges can also have deleterious effects on water quality and aquatic life in the bay as the brine contains high concentrations of salts and hydrocarbons. *The Galveston Bay Plan* recommends the following initiatives for remedying environmental problems in the bay area related to point sources of pollution:

- **Sewage Bypass and Overflow Elimination:** Two actions are proposed to address the problem of untreated wastes entering the Galveston Bay system from sewage bypasses and overflows during storm events. Studies are needed to identify sewage bypass or overflow problems in wastewater collection systems. *The Plan* also supports the efforts of the Texas Natural Resource Conservation Commission (TNRCC) to issue administrative orders to publicly owned treatment works (POTWs) requiring the POTWs to improve their sewage systems by increasing collection and storage capacity, and eliminating infiltration into the sewage systems.
- **Small Wastewater Treatment Plant Operations Improvement:** *The Galveston Bay Plan* offers two actions for improving operations at small wastewater treatment plants. The Gulf Coast Waste Disposal Authority (GCWDA) and other agencies will identify small wastewater treatment plants within the Galveston Bay watershed that may be adversely impacting water quality. These will also evaluate potential management options for more effective oversight of these small systems including consolidation of these small treatment plants into larger regional systems and providing improved compliance monitoring and enforcement.
- **Elimination of Illegal Storm Sewer Connections:** An action is presented to initiate a dry-weather illicit connection program in segments of the Galveston Bay tributaries that exhibit water quality problems. Accidental and intentional connections of sanitary sewage lines to storm sewers causes elevated concentrations in fecal coliform bacteria. Municipalities and POTWs will be encouraged by this action to implement voluntary detection programs for illicit connections to their storm sewer systems.
- **Produced Water Management:** *The Plan* supports the efforts of the U.S. Environmental Protection Agency (EPA) and the Texas Railroad Commission (RRC) to eliminate significant harm from produced water discharges by issuance of NPDES general permit or by implementation of a Texas Railroad Commission program. This action will protect plant and animal life in tidal areas from the toxic lethal and sublethal impacts of hydrocarbons and salts.

ENVIRONMENTAL STATUS

Status and Trends

Industrial and Municipal Discharges to the Houston Ship Channel

In the 1960s and early 1970s point source pollution from industrial and municipal discharges had virtually wiped out all aquatic life in the Houston Ship Channel above the confluence of the San Jacinto River and was identified by some as a potential threat to the health of the entire Galveston Bay system. The annual Biochemical Oxygen Demand (BOD, a measure of the amount of oxygen-robbing pollutants in water) pollutant loading increased after the turn of the century, because 1) rapid municipal and industrial growth increased the amount of raw wastewater being generated, and 2) most of the wastewater was being discharged with inadequate treatment or no treatment at all. The increase in loadings over time is shown in the following figure.

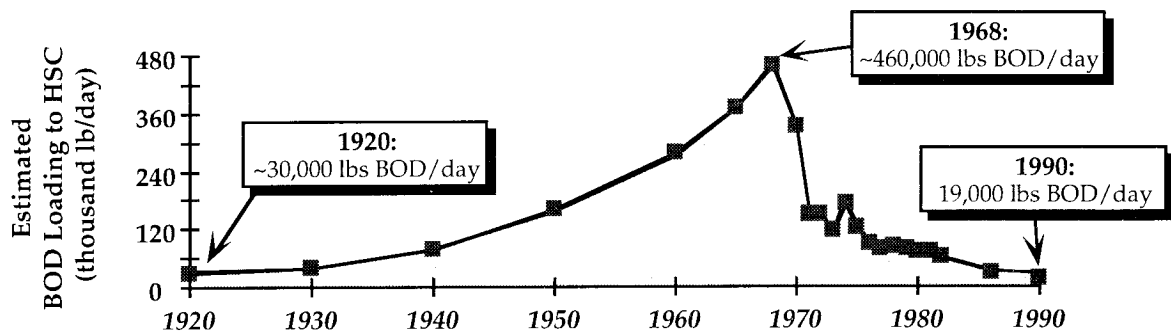


FIGURE PS-1. Changes Over Time in the Biochemical Oxygen Demand (BOD) Loadings to the Upper Houston Ship Channel (HSC) from Municipal and Industrial Point Sources

The Federal Water Quality Act of 1965 required each state to develop water quality standards for all navigable waters in their jurisdictions by 1967. To comply with this mandate, the Texas Water Quality Board divided the state into 23 basins with several zones per basin and developed standards based on the desired water use. For example, West Bay was designated for recreational swimming while the Houston Ship Channel was designated commercial-industrial. The Ship Channel was to be of "an aesthetically acceptable quality, that it be aerobic, and that the main portion of it be suitable for non-contact recreation."

The state embarked on a low-profile approach to reducing wastewater pollutant loads to the channel, and in 1968 began reducing permitted BOD loads for some dischargers. Operation Clean Sweep was initiated in late 1968 to evaluate the compliance of every discharger in the state. Primarily because of the state-led reductions from industrial permit holders, the total BOD loads to the channel declined from approximately 460,000 pounds per day in 1968 to 152,000 pounds per day in 1971.

Despite these reductions, there were still tremendous water quality problems in the Houston Ship Channel in the early 1970s. The upper sixteen miles of the Channel still did not support any aquatic life, and the pollutants discharged to the channel were associated with massive

fish kills in the upper part of Galveston Bay. The lack of visible progress resulted in a federal attempt at intervention, as summarized below from information in a 1972 Conservation Foundation publication "The Decline of Galveston Bay" by James Noel Smith.

Federal Shellfish Conferences

According to the 1972 Water Quality Act, the newly-formed U.S. Environmental Protection Agency (EPA) could only intervene for water quality reasons in three ways. The first two approaches, a federal lawsuit and a standard-enforcement conference, required the consent of the governor. Because the governor of Texas was not likely to concur, the third avenue – a federal shellfish conference – was used. Shellfish were tied into interstate commerce, and therefore were indirectly included as part of EPA's regulatory authority. The EPA had to prove that shellfish industry had suffered substantial economic harm from pollution in order to force water quality improvements in state waters.

The first Shellfish Conference, held on June 7, 1971, in Houston's Rice Hotel, resulted in a somewhat confrontational discussion between state and federal officials regarding the status of the oyster harvest and the progress towards reaching water quality goals for the Ship Channel and the bay. Despite the acrimony at the first conference, the state and EPA embarked on a joint program to evaluate water pollution problems in the bay. A second Shellfish Conference was convened in November 1971 and was conducted in a much less confrontational manner than the first conference held five months before. Eleven specific cleanup actions were agreed on by the state and federal conferees including several recommendations on sampling and research needs. It was agreed, for example, to begin dechlorination of all sewage discharges, and that waste load allocations for the entire bay would be performed by June 1972.

Most importantly, the conferees also agreed to limit BOD discharges to the Houston Ship Channel to 35,000 pounds per day, a drastic reduction from the state's permitted limit of 180,000 pounds per day. The scientific basis of the 35,000 pound per day limit was a "back of an envelope" calculation performed by Art Busch, a professor at Rice University and future Regional Director of EPA. He estimated that 35,000 pounds of BOD per day was the maximum load that would still result in dissolved oxygen concentrations of 1 milligram per liter, making the upper part of the Ship Channel aerobic.

Era of Point Source Reductions

The new BOD limit was a dramatic change in overall policy towards water quality in the Ship Channel and Galveston Bay. The Texas Water Quality Board estimated that *The Plan* would cost \$800 million and would require 20 years to complete the required improvements to existing treatment plants and build new plants. Nevertheless, new discharge limits were issued, and industrial and municipal discharges began reducing their pollutant loadings. By 1990 less than 19,000 pounds per day of BOD were discharged into the Houston Ship Channel by municipal and industrial dischargers, less than the estimated discharge in the 1920s (see Figure PS-1).

Although there are still problems, these management actions in the 1970s resulted in a dramatic improvement in the Houston Ship Channel. There has been an increasing trend in dissolved oxygen concentrations with recent Texas Water Commission (TWC) sampling of the

upper channel and turning basin (Segment 1007) showing an average concentration of 3.2 milligram per liter. There is now "extensive" utilization of the channel by a variety of organisms. The lower channel supports a healthy and viable fish population year-round. In winter months, the upper channel has a species richness and abundance that exceeds the lower channel, and maintains a viable shoreline assemblage during the summer months. Although the Houston Ship Channel currently possesses a "no aquatic life" designation, the increased utilization by fish, shrimp, and crab may have implications on the future use designations of the channel.

Current Point Source Loadings

An estimate of the total contribution of various water quality pollutants from point sources (both municipal and industrial), local watershed non-point sources, the San Jacinto River, and the Trinity River was developed using information from a series of GBNEP reports. The preliminary analysis indicates that municipal and industrial point discharges are no longer the primary source of most pollutants to Galveston Bay:

Parameter	Percentage of Annual Pollutant Loading to:			
	Entire Galveston Bay System		Houston Ship Channel	
	<i>From Municipal Point Sources</i>	<i>From Industrial Point Sources</i>	<i>From Municipal Point Sources</i>	<i>From Industrial Point Sources</i>
Flow	3 %	1 %	22 %	5 %
BOD	3	7	7	16
Total Suspended Solids	<1	1	1	3
Total Phosphorous	30	4	79	10
Total Nitrogen	37	7	64	11
Oil and Grease	28	3	38	4
Total Cadmium	20	3	68	9
Total Copper	7	3	41	20

Probable Causes

Bypasses and Overflows

During heavy rains large quantities of groundwater and/or stormwater may enter the wastewater collection system through manholes, broken or defective lines, and other openings in the collection system, greatly increasing the flow in the collection lines. These excess flows may cause the capacity of the collection system and/or treatment plant to be exceeded. Raw or partially treated sewage can be discharged into Galveston Bay waters through these bypasses or overflows from municipal wastewater collection systems. Wastewater collection systems were not designed to convey storm water, which is intended to be conveyed in storm drains or via surface drainage in the streets. During rains, water enters the collection system through cracks in pipes (public and private) and manhole leaks that have developed over the years from soil settlement, corrosion of concrete pipe, and in some cases, poor construction practices. Sufficient rainwater can enter the collection system to cause an overload, resulting

in overflows of diluted sewage from manholes or overflow structures specifically installed to provide system relief.

A 1986 study estimated the relative contribution of different wet-weather pollutant sources to the Houston Ship Channel by collecting over 500 samples of storm data from numerous streams, land use areas, wastewater treatment plants, and other parts of the collection system. This effort indicated that the total BOD loading from bypasses and overflows to the Houston Ship Channel was 3.1 million kilograms per year (equivalent to an average value of 18,900 pounds per day). By comparing all of the loading sources (including non-point sources), the authors concluded that bypasses and overflows contributed approximately 11 percent of the annual BOD load, seven percent of the annual TSS load, and seven percent of the annual ammonia load to the Ship Channel in 1986.

In response to an EPA initiative, the City of Houston is now undertaking a \$1.2 billion construction project to improve and expand the city's underground wastewater collection system. A series of deep tunnels are being constructed in combination with rehabilitation of existing lines, construction of relief lines, etc. to control bypasses and overflows for the 2-5 year frequency storm, that is all but the largest rainfall events. So far this program has resulted in complete elimination of dry-weather overflows, and a 60-90 percent reduction in the volume of wet weather overflows.

Unpermitted and Illegal Discharges

Because improvements in the point source discharges and the collection system did not improve dry-weather water quality in the Buffalo Bayou watershed, a special survey of illegal (illicit) discharges to the storm drainage system was conducted by the City of Houston. This survey indicated that accidental and intentional connections of sanitary sewage lines to the storm sewers was responsible for elevated concentrations of fecal coliforms to Buffalo Bayou. By eliminating these discharges, there was a marked improvement in dry-weather water quality.

Along the bay shoreline, however, illegal discharges did not appear to be as prevalent. As part of a GBNEP study, a detailed visual search was conducted for discharge pipes in nine shoreline segments around Galveston Bay: Cedar Bayou, Galveston Bay, Double Bayou, East Bay, Chocolate Bayou, Armand Bayou, Dickinson Bayou, Carancahua Bayou and Carancahua Lake. The authors identified a total of 69 permitted discharges and 117 "unpermitted" discharge pipes along the shoreline in these segments. Most of these pipes were storm drains, dredge material disposal, oil field related, lawn drainage, or apparent sewage discharges. A subsequent evaluation of some of these unpermitted discharges by the Texas Natural Resource Conservation Commission (TNRCC) concluded that there appeared to be no illegal sanitary sewer connections or illegal point source discharges along the shoreline, however. The Texas Railroad Commission investigation of 17 discharges identified as oil field related showed that 12 were actually related to oil field operations. Of these, seven were permitted and five did not require a permit; however three violation letters were issued.

Regionalization of Small Municipal Treatment Systems

Lack of coordination, insufficient use of new technologies, and inadequacies within existing systems enables excessive quantities of pollutants to enter Galveston Bay via approved discharge networks. Individual utility districts, industries, and municipalities operate separate wastewater treatment systems, resulting in lost efficiency, consistency, and economies of scale. These problems are mainly focused in the unincorporated portions of the counties around Galveston Bay.

Oil and Gas Production

In the process of recovering oil and gas, or produced water is also withdrawn from underground formations. A common method of produced water disposal along the Texas coast is discharge to surface waters, either directly or by overland flow. Substantial negative impacts have been documented from such discharges, and are especially acute where large discharges occur in low energy and nearshore environments. Some observed effects are:

- Formation of density gradients (circulation of dense produced water) in low-energy systems such as bayous
- Incorporation of oil and chloride into sediments near discharges, severely depressing the abundance and richness of benthic (bottom-dwelling) organisms
- Elevation of salinities which inhibit aquatic life
- Ingestion and incorporation of petroleum hydrocarbons into the tissues of various aquatic organisms
- Toxic lethal and sublethal impacts to plant and animal life

Texas Railroad Commission (RRC) data indicates that some 93 discharges were permitted in 1991 to release up to 15.2 million gallons of produced water per day to Galveston Bay and its tributaries. Of these, some 62 discharges were active in early 1993, for an estimate of 5.8 million gallons per day actual discharge into the Galveston Bay system. Of this amount, however, approximately 3.4 million gallons per day were from one source, which voluntarily began deep-well injection in early 1993. Actual discharges into the bay vary greatly, depending upon the economic feasibility of oil production and the length of reservoir production (i.e., older fields yield proportionally more water).

MANAGEMENT STATUS

Regulatory Basis

Generators of point source discharges are regulated under a dual permitting system. They must obtain permits both from the TNRCC or from the RRC for oil and gas activities and from the EPA. The statutory and regulatory framework for reducing point source pollution is generally strong and consistent with the two decades of experience in implementing the program.

Because of increased public interest in toxic substances, the TWC substantially revised water quality standards in 1987 to include numerical criteria for several toxic substances and

required whole effluent toxicity testing by most point source dischargers. In 1991 the TWC again revised the standards to regulate 30 toxics affecting aquatic life and 66 affecting human health either through drinking water or contaminated fish and shellfish; these criteria are imposed depending on the designated use of the segment. Most observers are convinced that implementation of these standards will continue to reduce the amount of these substances discharged to water.

The standards are revised periodically. Some of the current issues TNRCC will be addressing are:

- Minimum presumptions for unclassified waters
- Procedures for site-specific standards revisions
- Wetlands standards
- Outstanding natural resource waters
- Toxic criteria to protect aquatic life
- Toxic criteria to protect human health
- Salinity
- Endangered species
- Site-specific standards

The RRC regulates all oil and gas exploration and production activities in the state through regulatory and permitting requirements. Because the RRC has not received federal authorization from the EPA for its oil and gas discharge permitting program, permits are required from both agencies for wastewater discharges. The RRC issues tidal disposal permits in accordance with the applicable surface water quality standards (less than 25 milligram per liter of oil and grease). The RRC prohibits produced water discharges into freshwater but still permits these discharges into tidal reaches. A recently proposed National Pollutant Discharge Elimination System (NPDES) general permit for produced water and sand discharges to coastal waters in Louisiana and Texas would ban tidal discharges in favor of reinjection.

Management Problems

Although TNRCC's resources for permitting seem adequate, an over-emphasis on facilities consistently in compliance reduces resources for enforcement of smaller systems. Most compliance problems seem to be generally associated with smaller dischargers rather than the large high-volume industrial and municipal dischargers. These problems are likely to increase as state resources committed to compliance are being reduced due to other federal mandates, and local agencies cannot fill this gap due to conflict-of-interest issues.

Data gaps in point source monitoring programs have made it difficult to accurately quantify some pollutant loads from point sources. Bay-wide loading estimates for nutrients are incomplete for two reasons: 1) nutrient concentrations are not reported by all dischargers, and 2) chemical forms analyzed in tributaries are inconsistent between many NPDES dischargers and those measured by the U.S. Geological Survey (USGS) in tributaries. Loading estimates for metals are incomplete because they are not reported by all dischargers and because the chemical forms (mainly total recoverable versus dissolved forms) analyzed are inconsistent

between dischargers and USGS data. Loading estimates for complex organics are the most incomplete of all those reported because of the great inconsistency of reporting among dischargers.

POINT SOURCES OF POLLUTION ACTION PLAN

To improve the control of toxicants, nutrients, and other pollutants discharged into the Galveston Bay system by industrial, municipal, and petroleum dischargers, reducing and eventually eliminating harm from such contaminants entering or accumulating in the Galveston Bay ecosystem.

OVERVIEW

Priority Problem:

Raw or partially treated sewage enters Galveston Bay from Publicly Owned Treatment Systems (POTWs) due to design and operational problems, especially during rainfall runoff. These discharges contribute to eutrophication, bacterial contamination, shellfish harvest closures, and other water quality problems. A 1986 study indicated that bypasses and overflows contributed approximately eleven percent of the annual BOD load, seven percent of the annual TSS load, and seven percent of the annual ammonia load to the Ship Channel. Although the City of Houston has undertaken a 1.2 billion-dollar project to correct their problems, many smaller municipalities still have serious overflow and bypass problems that reduce the quality of Galveston Bay water. Texas City, for example, is now starting a \$23 million program to address bypass and overflow problems in the Texas City area.

Goal:

Eliminate wet weather sewage bypasses/overflows. To meet this goal, the wastewater collection piping associated with many of the area's wastewater systems will have to be improved, expanded, or reconstructed. The City of Houston is currently rehabilitating existing lines and constructing relief lines and wet-weather primary treatment facilities to expand the capacity of their collection system and is trying to eliminate sources of wet-weather infiltration.

Objective:

By 2004, develop sufficient overflow and bypass capacity to control a storm of up to five-year frequency. (The TNRCC, EPA, and the City of Houston are working to determine the critical storm frequency with no significant impact on water quality, with two-year and five-year being the leading candidates).

- | | |
|--------------|--|
| Action PS-1: | Determine location and extent of bypass and overflow problems. |
| Action PS-2: | Eliminate or reduce bypass and overflow problems. |

Goal:

Eliminate pollution problems from poorly operated small wastewater treatment plants. Some urban and suburban areas of the watershed are served by numerous small "package plants," many of which do not receive adequate maintenance to meet current discharge standards. Regionalization would consolidate the numerous smaller plants into a small number of larger better operated, wastewater treatment plants.

Objective:

By 2004, ensure that all wastewater treatment plants operate in accordance with permit requirements, including consolidation of small plants where feasible.

Action PS-3: Regionalize small wastewater treatment systems.

Action PS-4: Improve compliance monitoring/enforcement for small discharges.

Priority Problem:

Illegal connections to storm sewers introduce untreated wastes directly into bay tributaries. A study performed by the City of Houston indicated that illegal discharges to the storm sewer system (both inadvertent and intentional) had a significant effect on dry-weather fecal coliform concentrations in Buffalo Bayou.

Goal:

Eliminate illegal connections to storm sewers, which result in introduction of untreated wastes directly into bay tributaries. By eliminating these discharges, the dry-weather concentrations of fecal coliforms in the urbanized stream segments can be reduced and these segments made safer for contact recreation.

Objective:

By 1997, eliminate all identified illicit connections to storm sewers.

Action PS-5: Implement a dry-weather illegal connection program.

Priority Problem:

Certain toxic substances from produced water discharges related to oil production have contaminated sediment and may have a negative effect on aquatic life in contaminated areas. The Railroad Commission permits the discharge of oil field produced water directly into tidal waters and there are approximately 60 of these permitted produced water discharges in the Galveston Bay system. Several water quality and biologic studies have determined that produced water discharges can create oil sheens, clog and contaminate sediments with oil and grease, elevate and chemically alter salinity, introduce low-level radioactive compounds, and result in toxic lethal and sublethal impacts to benthic organisms at substantial distances from the discharge point. EPA does not yet permit coastal produced waters under the mandated NPDES permits.

Goal:

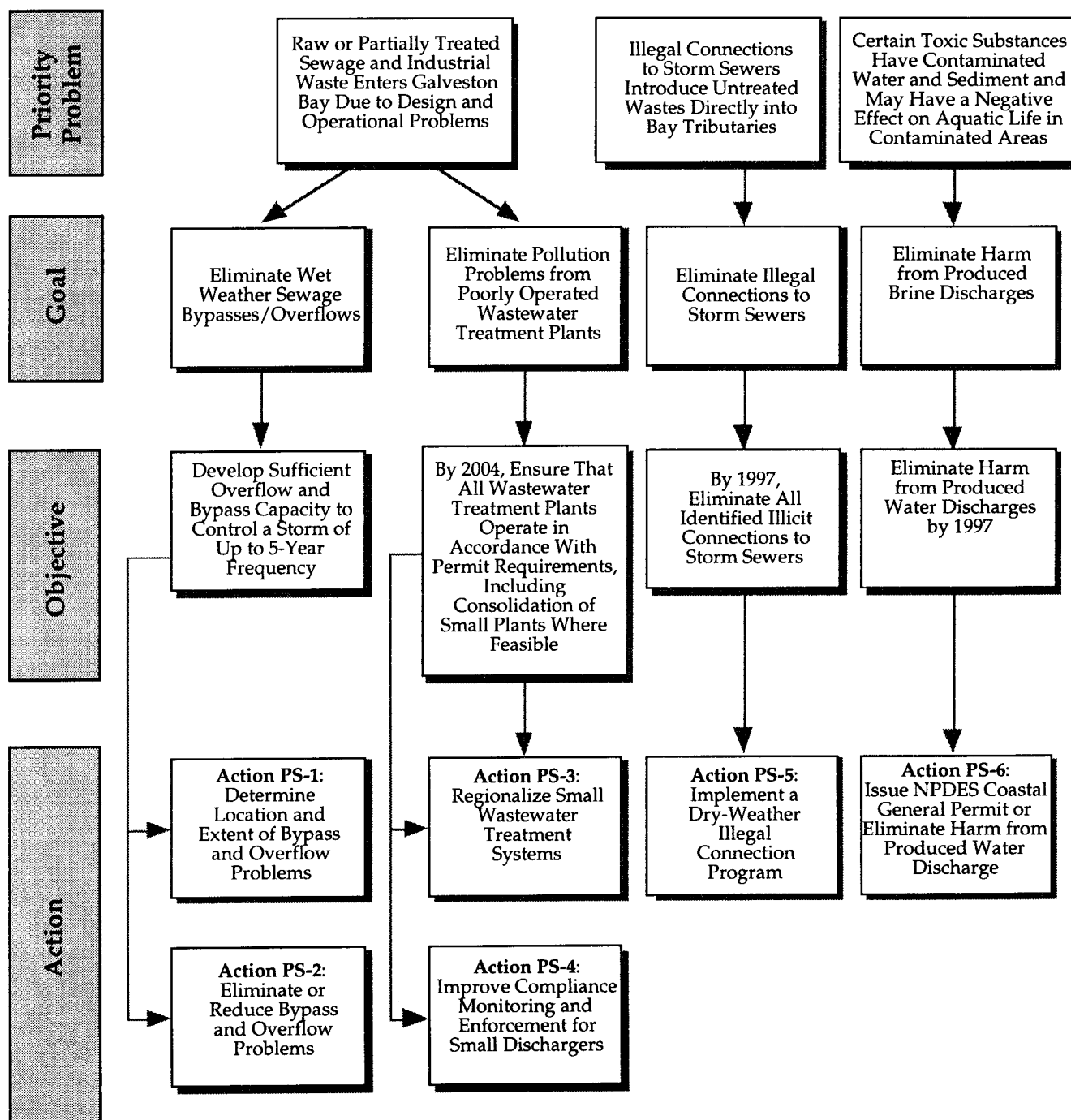
Eliminate harm from produced water discharges. The first approach is to have EPA issue a final NPDES Coastal General Permit. If this final permit is the same as the December 12, 1992 proposed

permit, all produced water discharges into Texas Coastal waters would be prohibited. If EPA does not issue this final general permit, then action by the RRC would be required to reduce harm from produced water.

Objective:

Eliminate harm from produced water discharges to Galveston Bay by 1997.

Action PS-6: Issue NPDES Coastal General Permit or eliminate harm from oil field produced water discharge.



Point Sources of Pollution Action Plan Flowchart

ACTION PS-1:

Determine Location and Extent of Bypass and Overflow Problems

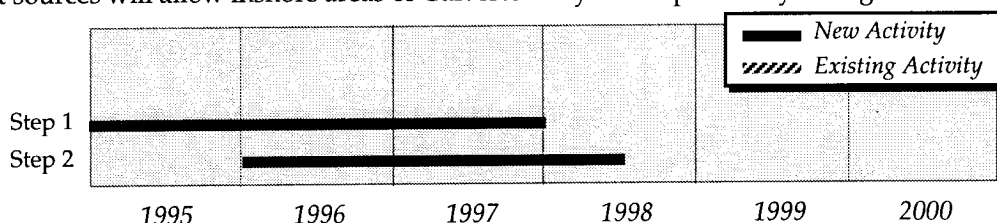
What Conduct a study to identify collection systems in Publicly Owned Treatment Works (POTWs) with bypass or overflow problems.

How

Step 1 The TNRCC and EPA will require all wastewater discharge permit holders for POTWs to conduct studies of their collection and treatment systems to identify and evaluate any bypass or overflow problems. If necessary, the TNRCC will issue administrative orders requiring dischargers to conduct the necessary studies. These studies will include a review of records, existing water quality data, and a hydraulic analysis. Studies for large POTWs must be completed during 1996 so that any corrective action plans may be completed by mid-1997. Studies for small POTWs must be completed during 1997 so that any corrective action plans may be completed by mid-1998. (The City of Houston is already implementing a comprehensive bypass/overflow elimination program.)

Step 2 Permit holders for large POTWs will develop corrective action plans to address bypass and overflow problems by mid-1997 for submission to TNRCC. Permit holders for small POTWs must develop their plans by mid-1998. TNRCC will issue administrative orders as needed to require plan preparation. Some research may be needed to 1) determine the costs and environmental benefits associated with different levels of control (what return frequency to design controls for) and 2) determine if elimination of these pollutant sources will allow inshore areas of Galveston Bay to be open for oystering.

When



Where All municipalities and other governmental entities operating wastewater treatment plants in local Galveston Bay watershed (below Lake Houston and Lake Livingston) that are not currently undertaking a bypass/overflow control program. Note that Galveston is currently under an order to do so.

Who Lead entities: TNRCC, EPA, and local municipalities. Other participants: MUDs, GCWDA, TWDB, GLO, Galveston County, Harris County, Chambers County, Brazoria County, and Liberty County. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program.....	\$ 37,500
TOTAL.....	\$ 37,500

Private Costs: Low. Actions Tied to Other Programs: Existing costs are for on-going City of Houston program (see text); proposed costs are estimated by applying similar program to all other municipalities in watershed. The existing costs have already been committed by the City of Houston, while the proposed costs will probably be mandated by EPA with or without *The Galveston Bay Plan*. Potential Sources of Funding: NOAA, EPA, and TWDB.

Regulatory Issues EPA and TNRCC will need to issue administrative orders as needed.

Related Actions: PS-2, WSQ-6, WSQ-7, PH-2, PH-3, and NPS-3.

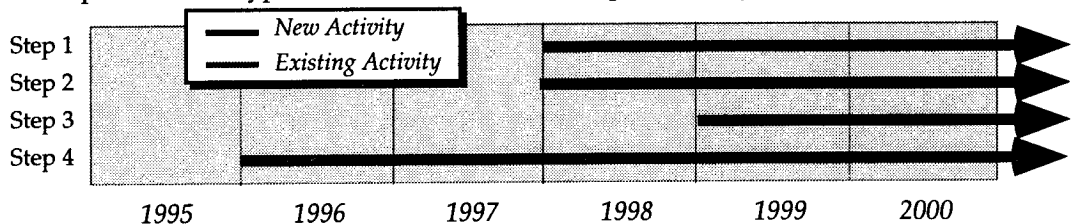
ACTION PS-2: Eliminate or Reduce Bypass and Overflow Problems

What Publicly Owned Treatment Works (POTWs) will design and build improvements to collection systems and treatment plants to eliminate or reduce bypass and overflow problems. This includes but is not limited to 1) increasing the capacity of the collection system, 2) eliminating infiltration sources, and 3) increasing storage capacity. Note that this action will be directed at POTWs outside of the City of Houston, as Houston is currently undertaking a 1.2 billion dollar project to reduce bypass and overflow problems.

How

- Step 1 The TNRCC and EPA will issue administrative orders to wastewater discharge permit holders for POTWs to require implementation of their corrective actions plans to address bypass and overflow problems.
- Step 2 Permit holders for large POTWs will begin implementing their corrective action plans in Fiscal Year 1998 according to a schedule negotiated individually with TNRCC.
- Step 3 Permit holders for small POTWs will begin implementing their corrective action plans in Fiscal Year 1998 according to a schedule negotiated individually with TNRCC.
- Step 4 TNRCC and the EPA will monitor progress and review their existing regulations regarding POTW operations and penalties for bypasses/overflows and will implement any needed regulatory changes.

When



Where All municipalities and other governmental entities in local Galveston Bay watershed with bypass or overflow problems. The City of Houston has an extensive on-going program to deal with overflow and bypass problems.

Who Lead entities: TNRCC, EPA and local municipalities. Other participants: MUDs, GCWDA, and GLO. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program.....	\$ 11,250
TOTAL.....	\$ 11,250

Private Costs: Low. Actions Tied to Other Programs: Existing costs are for on-going City of Houston program (see text); proposed costs are estimated by applying similar program to all other municipalities in watershed. The existing costs have already been committed by the City of Houston, while the proposed costs will probably be mandated by EPA with or without *The Galveston Bay Plan*. Potential Sources of Funding: USDA, NOAA, EPA, and TWDB.

Regulatory Issues EPA and the TNRCC will need to issue administrative orders to implement this action.

Related Actions: PS-1, WSQ-6, WSQ-7, PH-2, PH-3, and NPS-3.

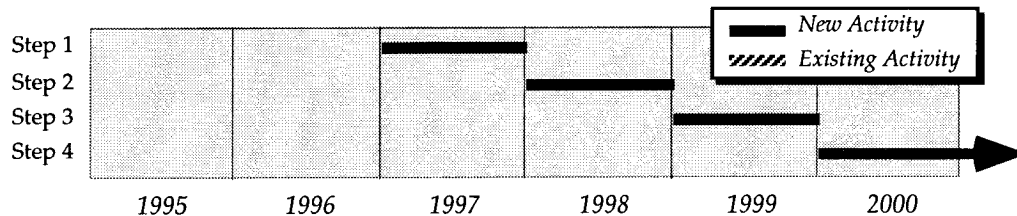
ACTION PS-3: Regionalize Small Wastewater Treatment Systems

What Consolidate small treatment systems into larger regional systems so that it will be easier to properly operate and monitor the performance of point source dischargers.

How

- Step 1** The Gulf Coast Waste Disposal Authority (GCWDA) will lead an interagency effort to identify all small wastewater treatment plants in the Galveston Bay watershed. The Galveston Bay Program and GCWDA recognizes that many technical aspects need to be addressed regarding the scope, organization, project management, and implementation of such an effort.
- Step 2** GCWDA will lead an interagency effort to evaluate the permit compliance record of small wastewater treatment plants identified in the bay watershed and evaluate adverse impacts on water quality of permit violations.
- Step 3** GCWDA will lead an interagency effort in coordination with the City of Houston Regionalization Plan to identify potential management options for more effective oversight of small treatment systems. These options could include a variety of operators and approaches. (One option for consideration is to require under all new permits for small systems that a fee be paid or a bond posted prior to construction to ensure that funds are available for ongoing system maintenance and operation. These funds also might be earmarked for potential future regionalization costs.)
- Step 4** Based on the results of previous steps, GCWDA will lead an interagency effort to develop proposals to the TNRCC for specific treatment system consolidations and/or system management consolidations. Consolidation plans will be implemented following TNRCC approval. TNRCC and GCWDA will monitor the effectiveness of the consolidation actions.

When



Where Areas served by small treatment systems that cause in-stream water quality problems. Example areas might be parts of Ft. Bend County, Cypress Creek area, and other suburban areas served by a number of small MUDs.

Who Lead entity: GCWDA and TNRCC. Other participants: Local municipalities, MUDs, GLO, and USGS. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 11,250
• GCWDA.....	\$ 315,000
TOTAL.....	\$ 326,250

Private Costs: Low. Ultimate public Costs: Potentially very high to fund required construction projects. Potential Sources of Funding: USDA, HUD, USGS, EPA, and TWDB.

Regulatory Issues May require local and state legislation to give GCWDA the authority to implement regional treatment if GCWDA is identified as the preferred operator. A possible approach to encouraging regionalization is to require that new permit holders with small systems pay a fee or post a bond prior to construction to ensure that funds are available for system maintenance and operation, or to ensure funding for potential future regionalization effort. Consistency review of any federal assistance to these small systems can be used as a tool to encourage regionalization.

Related Actions: PS-1, WSQ-6, and NPS-3.

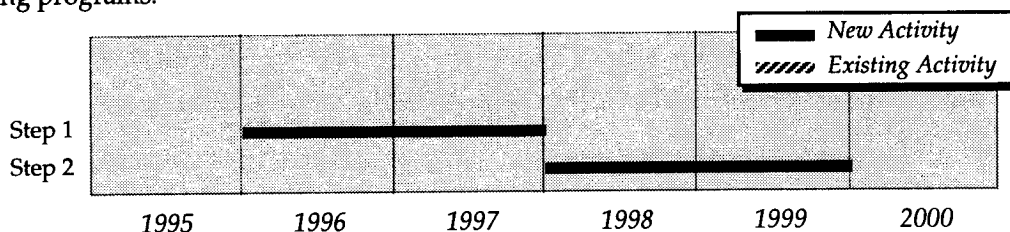
ACTION PS-4: Improve Compliance Monitoring and Enforcement for Small Dischargers

What Improve compliance monitoring and enforcement of small permitted wastewater dischargers to 1) ensure that current reporting system is functioning as planned, 2) identify violators of permit requirements, 3) determine which plants are operating adequately and which plants have operational problems.

How

- Step 1** The EPA and the TNRCC will jointly conduct internal evaluations of their existing compliance monitoring and enforcement programs and develop recommendations for improvement. Priorities for this evaluation are to ensure reliable reporting by permitted dischargers and effective identification of permit violations and problem plants. Items for consideration include 1) increased agency commitment and funding for these programs, and 2) stronger focus on smaller treatment systems because they now represent a bigger compliance problem than well-funded and established larger dischargers. Other potential activities include 1) support transfer of NPDES authority to the TNRCC, develop a map of NPDES discharge points for TNRCC/EPA enforcement personnel, 2) establish a synchronous schedule for permit expirations on a watershed and subwatershed basis (subwatersheds such as Brays Bayou, Sims Bayou, Clear Creek, Dickinson Bayou etc.), and 3) expand pretreatment requirements to include small plants which receive industrial wastes.
- Step 2** EPA and TNRCC will implement improvements to their compliance monitoring and enforcement programs (including potential new funding requests based on internal evaluations). Where appropriate, TNRCC will utilize county compliance monitoring data to augment existing TNRCC compliance monitoring programs.

When



Where Small permitted wastewater treatment systems in the Galveston Bay watershed.

Who Lead entity: TNRCC and EPA. Other participants: EPA, GCWDA, POTW operators, and USGS. Role of Galveston Bay Program: Tracking.

Public Costs of New Actions (5 years)

• Program.....	\$ 68,500
• TNRCC	\$ 75,000
TOTAL	\$ 143,500

Private Costs: Potentially high for small private discharges because of increased monitoring and operational costs. **Potential Sources of Funding:** EPA, TWDB.

Regulatory Issues May require additional funding from state or the collection of inspection fees.

Related Actions: WSQ-4, WSQ-5, and WSQ-7.

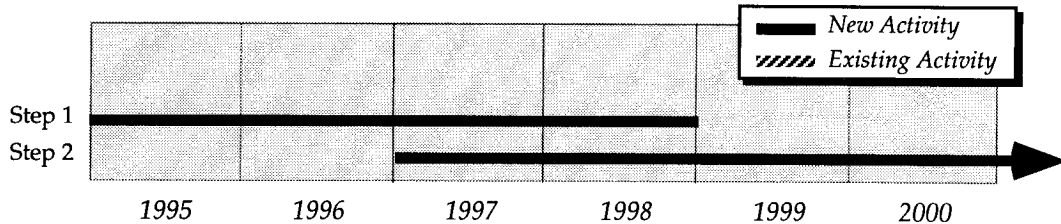
ACTION PS-5: Implement a Dry-Weather Illegal Connection Program

What Initiate a dry-weather illicit connection program by 1997 in segments draining into Galveston Bay that exhibit water quality problems.

How

- Step 1** The TNRCC will lead in encouraging municipalities and permit holders for Publicly-Owned Treatment Works (POTWs) to implement voluntarily detection programs for dry-weather illicit connections to their storm sewer systems. Based on results from Houston's program, breaks in the wastewater collection piping has been responsible for over 90 percent of the problem. Improper tie-ins (typically plumbing mistakes) constitute less than 10 percent of the problems.
- Step 2** TNRCC will determine whether detection programs should be made mandatory for municipalities under its implementing rules for the state Municipal Water Pollution Control and Abatement Program. The Galveston Bay Program will use ambient monitoring data to determine the effectiveness of dry-weather connection programs.

When



Where Example streams subject to this program with storm sewers that drain heavily urbanized areas include the Houston Ship Channel, Buffalo Bayou, Brays Bayou, White Oak Bayou, Greens Bayou, Halls Bayou, Armand Bayou, lower Clear Creek, lower Dickinson Bayou, lower Cedar Bayou, Goose Creek, etc.

Who Lead entities: Local municipalities and POTW operators. Other participants: TNRCC and EPA. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 37,500	• GLO	\$ 15,000
• TNRCC.....	\$ 1,552,500		
TOTAL.....		\$ 1,605,000	

Private Costs: Probably low. Potential Sources of Funding: EPA and TWDB.

Regulatory Issues Initially the program will be voluntary. Rule making by the TNRCC under the Pollution Abatement for Municipalities rules might be required in two years if voluntary implementation is insufficient.

Related Actions: PS-1, PS-2, PH-2, and PH-3.

ACTION PS-6: Issue NPDES Coastal General Permit or Eliminate Harm From Oil Field Produced Water Discharge

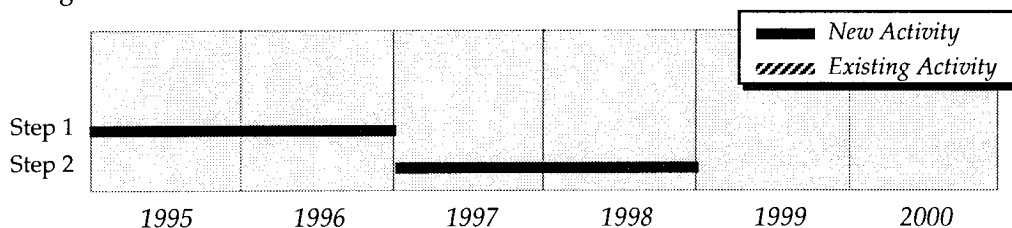
What Eliminate significant harm from produced water discharges by issuance of NPDES general permit or by implementation of a Texas Railroad Commission program.

How

Step 1 EPA may issue NPDES permit that will eliminate harm from produced water discharges.

Step 2 If EPA does not issue the permit, the RRC commission will take action to eliminate harm from produced water discharges.

When



Where All produced water discharges to bay waters and bay tributaries.

Who Lead entities: EPA and RRC. Other participants: Oil producers with produced water discharges. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• Program	\$ 59,000	• GLO	\$ 22,500
• TNRCC	\$ 37,500	• RRC.....	\$ 33,750
TOTAL.....		\$ 152,750	

Note the RRC cost above is exclusive of costs of plugging abandoned wells or cleanup of abandoned sites. Private costs may be high as cost of new injection wells or the cost of plugging the ~600 producing wells can be significant. Potential Sources of Funding: NOAA, EPA and TWDB.

Regulatory Issues Need to issue NPDES permit or implement new RRC program.

Related Actions: WSQ-1, WSQ-2, WSQ-3, and WSQ-4.



V. Support Action Plans

This section of *The Galveston Bay Plan* presents two actions plans that are intended to support the implementation of all nine of the previous action plans.

Research Current research efforts for Galveston Bay suffer from several problems that reduce their effectiveness. For example, much of the research is administered by state and federal agencies that focus on specific parts of the ecosystem or on specific environmental programs. None of these agencies have responsibility for the Galveston Bay Estuary as a whole and are often driven to provide information that will support an agency's ability to carry out its mission. To address this problem, *The Galveston Bay Plan* includes actions to convene a research coordination board, to identify important research needs, continue the State of the Bay Symposium, and to increase funding for Galveston Bay research (see page 221).

Public Participation Public participation and education are critical elements for the long-term successful management of the Galveston Bay Estuary. To ensure greater public interest in issues affecting the estuary, strong and sustained support of the ongoing citizens monitoring program, the citizens pollution reporting system, and other existing volunteer opportunities is encouraged. The development of additional volunteer opportunities and the improvement of environmental education programs for both youth and adults are also vital in securing the long-term commitment of an informed public to the protection of the estuary (see page 231).

Research

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

<u>Action</u>	<u>Description</u>	<u>Page</u>
RSC-1:	Establish a research coordination board	226
RSC-2:	Identify research needs from an ecosystem perspective	227
RSC-3:	Continue State of the Bay process	228
RSC-4:	Increase funding for Galveston Bay research	229

THE ISSUES

Scientific research plays an important role in environmental management. It forms the basis for models that predict or describe ecosystem functioning, justifies standards, and supports every aspect of the regulatory process. Although science alone cannot determine regulatory policy, without it there is no reasonable basis for regulation. An important strategy in *The Galveston Bay Plan* is to focus current research programs and increase research funding that will help the managers of the bay (i.e., the regulators) solve critical environmental problems. To manage the bay as an entire ecosystem, common research goals are needed to:

- Develop basic information on ecosystem structure, function, and productivity
- Focus scientific attention on management concerns of the bay
- Establish research priorities
- Coordinate and target funding
- Assure that research results are available to agencies and individuals who can utilize the findings and to the public at large

Current Research Environment

Most research on Galveston Bay is conducted by independent researchers and university scientists funded by various agencies, although agencies also frequently give each other research grants. Among the major research funding groups for Galveston Bay projects are Texas Sea Grant, National Science Foundation, and NOAA, with additional research funding

from the U.S. Fish and Wildlife Service, Texas Water Development Board, Texas Parks and Wildlife Department, Texas Natural Resource Conservation Commission, and the U.S. Army Corps of Engineers. Other groups not traditionally associated with research that have recently funded Galveston Bay research projects are environmental groups and industrial/commercial associations.

Current research efforts for Galveston Bay suffer from several problems that reduce their effectiveness. For example, much of the research is administered by state and federal agencies that focus on specific parts of the ecosystem or on specific environmental programs. None of these agencies have responsibility for the Galveston Bay estuary as a whole and are often driven to provide information that will support an agency's ability to carry out its mission. Therefore relatively little research is conducted that looks at the cumulative effects.

Scientific information is dispersed within the research community, and important research results are often not transferred effectively to the people who need the information the most: resource managers and policy makers. In addition, the other members of the environmental decision making process, such as different stakeholders and the general public, do not get research results.

Scientists and Managers in a Cooperative Approach

To change the current system to a ecosystem-based research approach, the difference between environmental scientists and environmental managers must be recognized. Generally speaking, scientists are interested in all of the infinite information that can be gathered about an estuary, so long as it contributes to new knowledge. Managers, by contrast, expect concise answers to certain short-term questions that help solve bay problems. Clearly, some sort of agreed-upon communications are necessary for these diverging views about information to be reconciled. Certain conceptual boundaries therefore apply to scientific activity aimed at providing information to managers:

- Managers must address the right questions, so that scientists have a role in identifying and ranking research projects.
- Selected projects must be undertaken in the context of a perturbed ecosystem, allowing that projects focus on impact dynamics rather than traditional ecology alone.
- Projects must provide data at a scale of resolution defined by management, including generalized geographic ordering of projects and sampling within projects.
- Results must be made available to managers in an accessible, useful format, requiring that data be converted to synoptic information.
- Ongoing work must fulfill a sensory feedback function to managers, requiring a monitoring program with a direct link to management objectives.

Within these conceptual boundaries, a practical mechanism must then be agreed upon to tailor research to the particular ecosystem issues of concern. To prepare *The Galveston Bay Plan*, a process established by the National Estuary Program guidance was employed. A *Priority Problems List* identified and ranked estuarine management issues, serving as a focal point for consensus about where to begin. Generally, issues were advanced if they had a system-wide impact, impaired designated uses, or (more practically) if they could be quickly or cheaply fixed. The key feature of the *Priority Problems List* was that it be adopted by the consensus of managers, scientists, and bay stakeholders represented on the Management Conference. In the event of disagreement, managers carried the day, in observance of the first conceptual constraint listed above.

To managers, the best use of the *Priority Problems List* was to prevent distractions from scientists seeking to fund projects which did not help managers. To scientists, the list became a set of broadly-stated hypotheses to be strengthened or refuted. The GBNEP characterization studies were part of the process to test these hypotheses, and several surprising conclusions resulted in refuting of some long-held conventional wisdom about the Galveston Bay. The *State of the Bay Report* summarizes some of the conclusions resulting from the GBNEP characterization process.

The Galveston Bay Plan

Creation of *The Galveston Bay Plan* resulted in the identification of numerous research needs tied to the various action plans (summarized in Appendix E). Without a coordinated program to review, rank, and carry out this research in an ecosystem management context, the information base available to bay managers will not match the actions to address the bays problems.

Research is therefore an important part of *The Galveston Bay Plan*, and *The Plan* lays out an ecosystem-based approach that links scientists and managers. It employs a similar philosophy to the one used in the GBNEP process described above for short term research: lay out a general mechanism where managers and researchers can work together. The following actions describe such a process for focusing research, improving communication between scientists and resource managers, and effective dissemination of results that will answer more immediate questions about the bay in such a way that bay managers benefit.

For research with maximum value to the community of the Galveston Bay System, the Galveston Bay Program can be an effective interlocuter. They can assist bay managers to find the scientists who provide the scientific answers on which immediate decisions are needed, the bottom line short term questions. They can assist scientists who research natural processes in the estuary to locate supportive funding from managers cognizant that fundamental questions will continue to thwart management, the basic questions of longer range problems. Beyond identifying the critical questions, Galveston Bay Program should assist both parties in the realities of available research monies and of the terribly expensive price of comprehensive ecosystem and process research. Hopefully scientists will be proceeding to find answers even before managers know the question.

RESEARCH ACTION PLAN

To support and focus Galveston Bay research to improve our knowledge of the bay and its relation to human uses, including: 1) stimulation of creativity and excellence in research; 2) encouragement of research related to decision-making activities under The Galveston Bay Plan by regulatory and management agencies; 3) support of timely implementation of the goals and objectives of The Galveston Bay Plan for the Galveston Bay system; and 4) dissemination of findings to regulatory and scientific communities and the public.

OVERVIEW

Goal:

To ensure that the basic and applied research that is required for Galveston Bay management decisions is available to managers.

- Action RSC-1: Establish a research coordination board.
- Action RSC-2: Identify research needs from an ecosystem perspective.
- Action RSC-3: Continue *State of the Bay* process.
- Action RSC-4: Increase funding for Galveston Bay research.

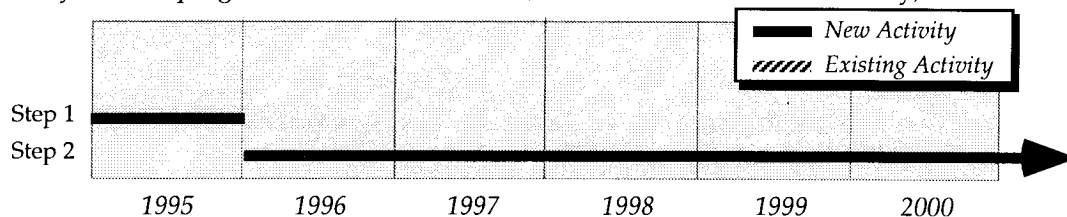
ACTION RSC-1: Establish a Research Coordination Board

What Establish a committee or coordination body of technical experts comprised of research organizations, environmental management agencies, environmental research funding agencies, foundations, and other entities that either 1) direct and fund bay research, 2) manage the bay under existing or proposed regulatory programs, or 3) are important stakeholders involved in bay research.

How

- Step 1** Galveston Bay Program staff will work with the Galveston Bay Council to determine appropriate structure and representation for the RCB. This process should include input from management agencies, potential funding sources and research institutions.
- Step 2** Galveston Bay Program will convene the RCB. Its principal activity during its first year will be to conduct the State of the Bay Symposium (RSC-3) and begin ranking research initiatives (RSC-2). The RCB will meet quarterly until its programs are well-established, and not less than semi-annually, thereafter.

When



Where The RCB will convene in the Galveston Bay area.

Who Lead entity: Galveston Bay Program. Other participants: UT, TAMU, UH, Rice; WEF; SeaGrant, TWRI, TNRCC, GLO, TDH, RRC, TWDB, Galveston Bay Foundation, TPWD, EPA, Corps, USFWS, NMFS, USGS, TCC, SWCB, River Authorities, environmental groups, and industrial research groups. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program.....	\$ 50,000
• Others.....	\$ 487,500
TOTAL.....	\$ 537,500

This action only includes costs for developing new funding sources. The actual cost of new research has not been determined.

Related Actions: RSC-2, RSC-3, and RSC-4.

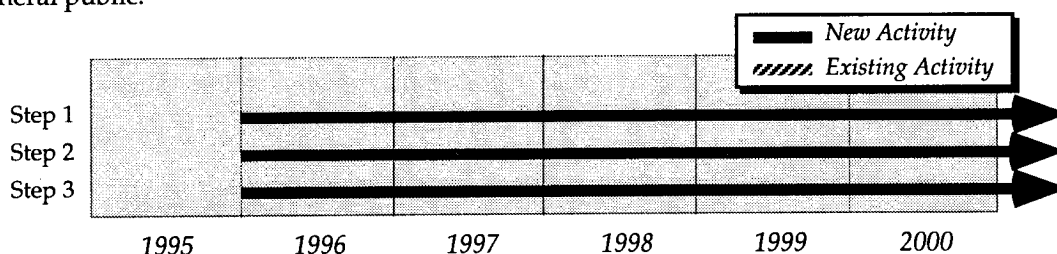
ACTION RSC-2: Identify Research Needs From an Ecosystem Perspective

What Establish a process to rank research needs, correlate to available research, identify gaps, and encourage redirection of research as needed. Establish a mechanism to link ranking of research topics, involvement of both scientists and managers, and directing of funds.

How

- Step 1 Galveston Bay Program and the RCB will develop a survey of scientists (agency, university, and other researchers), bay managers and users, private industry and the general public to identify research needs. These will be compared with symposium findings to identify gaps in basic and applied research. The RCB and the Galveston Bay Program staff will design a ranking method for research projects to be clearly prioritized. This priority list will be updated biennially, following each State of the Bay Symposium.
- Step 2 Galveston Bay Program and the RCB will match prioritized research needs with existing and potential funding sources. From this analysis, a funding plan will be prepared (RSC-4).
- Step 3 Galveston Bay Program and the RCB will develop research dissemination strategy, including provisions for the following:
- publication of Galveston Bay research in scientific and technical journals.
 - maintaining a research clearinghouse within the Galveston Bay Program, including a library, computer database and bibliography.
 - preparation and distribution of summaries of key research findings to bay users, managers and the general public.

When



Where The Galveston Bay area.

Who Lead entity: Galveston Bay Program. Other participants: UT, TAMU, UH, Rice; WEF; SeaGrant, TNRCC, GLO, TDH, RRC, TWDB, Galveston Bay Foundation, TPWD, EPA, Corps, USFWS, NMFS, USGS, TCC, River Authorities, environmental groups, and industrial/commercial research groups. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

(Costs Included in RSC-1)	
TOTAL.....	See RSC-1

This action only includes costs for developing new funding sources. The actual cost of new research has not been determined.

Related Actions: RSC-1, RSC-3, RSC-4, and SP-4 (see Table of Research Needs).

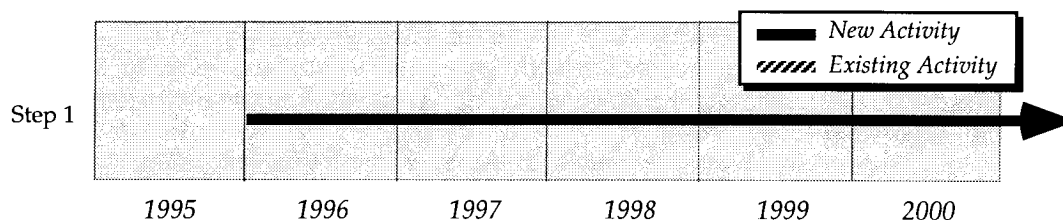
ACTION RSC-3: Continue State of the Bay Process

What Continue the State of the Bay Symposium on a regular basis to discuss important management and technical issues related to Galveston Bay. More specifically, the Symposium will provide a forum for dissemination of research results; develop consensus for actions; encourage interaction among researchers, managers, and the public; and improve opportunities and visibility relevant to funding needs.

How

Step 1 Galveston Bay Program will convene State of the Bay Symposium. Findings will be utilized by Galveston Bay Program and its RCB to maintain current research priorities, and should also be summarized for broad public distribution. The Symposium will be conducted biennially to help keep the public involved in the process.

When



Where The Galveston Bay area.

Who Lead entity: Galveston Bay Program. Other participants: UT, TAMU, UH, Rice; WEF, SeaGrant, TNRCC, GLO, TDH, RRC, TWDB, Galveston Bay Foundation, TPWD, EPA, Corps, USFWS, NMFS, USGS, TCC, River Authorities, environmental groups, and industrial/commercial research groups. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 30,000
TOTAL.....	\$ 30,000

This action only includes costs for developing new funding sources. The actual cost of new research has not been determined.

Related Actions: RSC-1, RSC-2, RSC-4, and PPE-3.

ACTION RSC-4: Increase Funding for Galveston Bay Research

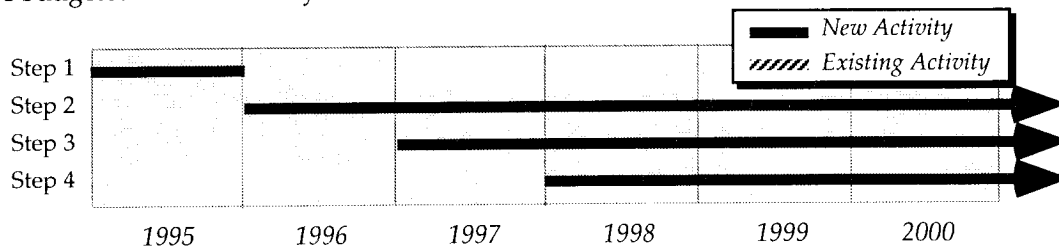
Objective To establish and maintain a system of priorities and funding for dissemination of research.

What Identify, establish, redirect, and leverage funding sources to increase funding for Galveston Bay research programs. Include federal, state, local, and private sources. Track research programs of other agencies and pending legislation that could increase funds available for coastal research (e.g., various Gulf of Mexico initiatives)

How

- Step 1** Galveston Bay Program and the TSC should identify any short term "windows of opportunity" for funding, such as the GOMP, federal or state legislative initiatives and/or grants, or foundation funds. *The Galveston Bay Plan* research needs list, divided into basic and applied research, will serve as a guide.
- Step 2** Galveston Bay Program/RCB will continue to track funding opportunities and match them with research needs, as updated at State of the Bay.
- Step 3** Galveston Bay Program/RCB will link the prioritized list of research needs (RSC-2) with funding sources. These research needs should be incorporated into *The Galveston Bay Plan* so priorities can impact federal and state funding decisions. Funding gaps should be identified and included as federal and state legislative priorities for the Galveston Bay Program.
- Step 4** Galveston Bay Program/RCB will develop a strategy to expand foundation and private sector funding sources for Galveston Bay research. A proposal and presentation should be developed, and staff time should be budgeted for this activity.

When



Where The Galveston Bay area.

Who Lead entity: Galveston Bay Program. Other participants: UT, TAMU, UH, Rice; WEF; SeaGrant, TNRCC, GLO, TDH, RRC, TWDB, Galveston Bay Foundation, TPWD, EPA, Corps, USFWS, NMFS, USGS, TCC, river authorities, environmental groups, and industrial/commercial research groups. Role of Galveston Bay Program: Conduct Action.

Public Costs of New Actions (5 years)

• Program	\$ 37,500
TOTAL.....	\$ 37,500

This action only includes costs for developing new funding sources. The actual cost of new research has not been determined.

Related Actions: RSC-1, RSC-2, and RSC-3.

Public Participation and Education

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF THE ACTIONS

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Action PPE-1:	Establish citizen involvement as an integral part of the Galveston Bay Program.....	237
Action PPE-2:	Continue and expand the State of the Bay Symposia	238
Action PPE-3:	Develop and implement a long-range adult education and outreach program.	239
Action PPE-4:	Develop specific curricula for use in Galveston Bay watershed school districts	240
Action PPE-5:	Continue to develop effective volunteer opportunities for citizens.....	241
Action PPE-6:	Maintain a citizen pollution reporting system.	242
Action PPE-7:	Develop and implement a strategy for informing, educating, and providing support for local government involvement	243
Action PPE-8:	Provide assistance for user groups affected by implementation of The Galveston Bay Plan	244

THE ISSUES

Public participation and education are critical elements for the long-term successful management of the Galveston Bay Estuary. As a public resource, the bay should be managed to ensure its productivity and ecological diversity on a long-term, sustainable basis. In an era of severe constraints on both governmental and private sector funding, an educated and motivated public can provide much of the needed expertise, time, effort, and leadership to protect and monitor the bay. To this end, increased public involvement in bay management is strongly encouraged.

As the Galveston Bay Program begins implementing *The Galveston Bay Plan*, it is important that the public play a large role in determining the direction and focus of the Galveston Bay Program. For this reason, this action plan recommends that the Galveston Bay Program take a lead role in encouraging public participation in bay-related activities, providing educational materials about the bay to both youth and adults, providing information to the media concerning the status of the bay, continuing the State of the Bay Symposium, and stimulating the creation of new volunteer opportunities.

To ensure greater public interest in issues affecting the estuary, strong and sustained support of the ongoing citizens monitoring program, the citizens pollution reporting system, and other existing volunteer opportunities is encouraged. The development of additional volunteer opportunities and the improvement of environmental education programs for both youth and adults are also vital in securing the long-term commitment of an informed public to the protection of the estuary. *The Galveston Bay Plan* supports public involvement from all of the groups involved with this important estuary; urban and rural; residents from all parts of the watershed; and people of diverse socioeconomic and racial backgrounds.

CURRENT STATUS

The participation of an educated public is critical for effective implementation of *The Plan*. Citizens need an understanding of the extent to which the Galveston Bay Estuary contributes to the quality of life of this area of Texas. The bay lacks the geographic or visual grandeur of San Francisco or Chesapeake Bays, and many Houston-area residents may go several years without actually seeing the bay. Yet Galveston Bay is extraordinarily important and productive from an economic standpoint, and the estuary exhibits ecological diversity unequaled by many better known or more scenic estuaries. It has been estimated that approximately 9 percent of households within Brazoria, Chambers, Galveston, Harris, and Liberty Counties earn income from activities directly associated with the bay, and the bay represents an important recreational resource for thousands of additional households.

Public involvement in issues which concern the bay is growing rapidly. Increasing numbers of citizens are active participants in such groups as the Gulf Coast Conservation Association (GCCA), the Galveston Bay Foundation (GBF), and the Audubon Society, and several of these organizations administer programs which directly involve volunteers with bay management issues.

A few examples of the many ongoing volunteer or public outreach programs are:

- A boater education program and pilot-marina pumpout project, carried out by GBF, aimed at reducing the discharge of untreated sewage to the bay from boats and marinas
- The citizens' monitoring program administered by GBF. As part of this program, trained volunteers sample and analyze bay waters for a suite of basic indicator parameters. The resultant data can be utilized in making management decisions concerning the bay.
- Bay Day, sponsored by GBNEP and GBF. Over 20,000 people attended the 1993 event, held at Sylvan Beach, in LaPorte, and more than 70 exhibitors, representing business, government, nature, heritage, and recreation, demonstrated how their activities are tied to preservation of a healthy estuary.
- Annual bird counts, sponsored by the Audubon Society

- The Galveston Bay Ambassadors Program, sponsored by GBF and SCS, which provides environmental education concerning the bay to students in the counties surrounding the bay
- Cord grass replanting, organized by the Marine Extension Service

Building upon the increase in public involvement and interest in the bay, GBNEP has reached out to the public as participants in development of *The Plan*. The public has volunteered numerous hours to participate in task force meetings, and attendance was excellent at a series of public meetings held during November 1992 at various locations in the bay area. To reach additional members of the public, GBNEP has sponsored the production of seven videos about the estuary, and has issued greater than 50 publications concerning various aspects of the estuary ecosystem.

In addition, GBNEP has initiated a Citizens Pollution Reporting System pilot project which has been well received. By calling the system (1-800-3-OUR BAY), members of the public can ensure that their complaint or incident report relating to air, land, or water will receive the attention and follow-up of the proper government agency.

THE ROLE OF GALVESTON BAY PROGRAM

Education is a vital component of any long-term strategy to increase public participation in bay management issues. Currently, however, classroom education concerning local environmental issues is inadequate, and many schoolchildren lack even a fundamental grasp of the bay's location or role in commerce and the environment. Media reports concerning the bay often tend towards the sensational, and do not provide the foundation for a true understanding of bay-related issues. Much of the news regarding the estuary is good news, such as the dramatic water quality improvements which have been achieved in the Houston Ship Channel during the last two decades. Improved and sustained environmental education and reporting are needed to improve public understanding and participation in bay management issues. To raise the level of the discussion concerning the future of the bay, the Galveston Bay Program will act as a focal point for providing high quality information concerning the bay to youth, adults, and the media.

Current public outreach efforts carried out by state and federal environmental agencies, while valuable, tends to focus on general environmental concerns. Galveston Bay Program will have the ability to focus existing environmental outreach programs on an issue that affects everyone in this area of Texas: the future of the Galveston Bay Estuary.

PUBLIC PARTICIPATION AND EDUCATION ACTION PLAN

To establish effective, ongoing public involvement with Galveston Bay resource management efforts at all levels; to improve future stewardship through education of students and the adult public concerning the bay ecosystem; and to invoke the public commitment and political will necessary to achieve effective comprehensive management.

OVERVIEW

Goal:

Facilitate Public Involvement in Bay Policy and Management.

- Action PPE-1: Establish citizen involvement as an integral part of the Galveston Bay Program.
- Action PPE-2: Continue and expand the State of the Bay Symposia.

Goal:

Increase education and outreach regarding issues affecting the estuary.

- Action PPE-3: Develop and implement a long-range adult education and outreach program.
- Action PPE-4: Develop specific curricula for use in Galveston Bay watershed school districts.

Goal

Increase volunteer involvement in the ongoing stewardship of the estuary.

- Action PPE-5: Continue to develop effective volunteer opportunities for citizens.

Goal:

Increase the ability of citizens to effectively report pollution events.

- Action PPE-6: Maintain a citizen pollution reporting system.

Goal:

Expand and sustain local government involvement and support.

- Action PPE-7: Develop and implement a strategy for informing, educating, and providing support for local government involvement.

Goal:

Assure effective communication with and outreach to specific bay users groups.

Action PPE-8: Provide assistance for user groups affected by implementation of *The Galveston Bay Plan*.

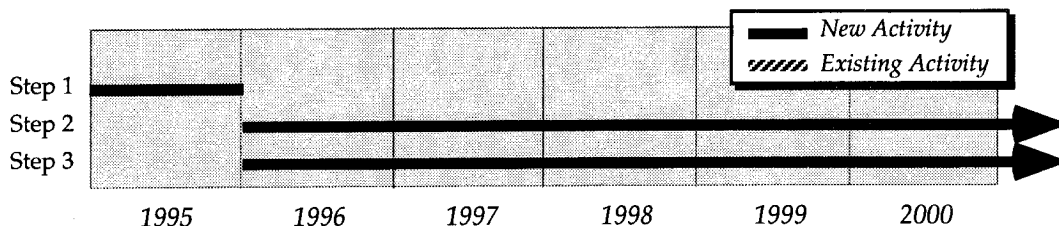
ACTION PPE-1: Establish Citizen Involvement as an Integral Part of the Galveston Bay Program

What Establish citizen involvement as an integral part of the Galveston Bay Program, including the addition of permanent staff on the Galveston Bay Program with public participation responsibilities. Develop public involvement guidelines for implementing *The Galveston Bay Plan*.

How

- Step 1 Galveston Bay Program will hire a full time Public Participation Coordinator to direct the public participation effort.
- Step 2 Galveston Bay Program will work with the existing GBNEP Citizen Advisory Steering Committee to include citizen representatives as members of the GBC.
- Step 3: Galveston Bay Program will initiate a public attitudes survey and present findings at the State of the Bay Symposium (coordinate with Actions PPE-2 and RSC-3). This survey should be conducted biennially to coincide with the State of the Bay Symposium. The Program will also ensure that there is adequate public participation in the development and implementation of any new regulatory programs (if any) required to implement *The Galveston Bay Plan*.
- Step 4 Galveston Bay Program will conduct a public involvement evaluation, assessing the effectiveness of public information and education efforts over the first two years of *The Galveston Bay Plan* implementation. This evaluation will be a part of the overall *Galveston Bay Plan* evaluation report, which the Program will develop biennially.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program. Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program.....	\$ 580,250
TOTAL.....	\$ 580,250

Potential Sources of Funding: EPA

Regulatory Issues None.

Related Actions: PPE-2 and RSC-3.

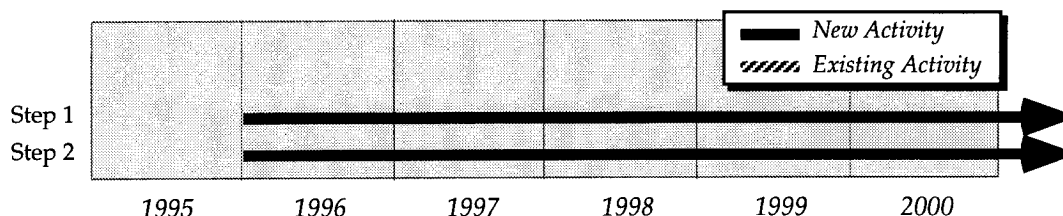
ACTION PPE-2: Continue and Expand the State of the Bay Symposia

What Continue and Expand the State of the Bay Symposia.

How

- Step 1** Galveston Bay Program will expand the State of the Bay Symposium to include: a local governments section, a students section, and a citizens monitoring section. Galveston Bay Program staff will also present its biennial evaluation of implementation efforts. Galveston Bay Program public information staff will work to generate expanded media coverage and will coordinate with other public agencies so that the State of the Bay Symposium is promoted in their publications.
- Step 2** Galveston Bay Program will publish the proceedings of the Symposia, and make the Proceedings available to the legislature, the public, scientists, and governmental agencies.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program. Other participants: GBF, Sea Grant, government agencies, universities, public and private schools, etc. Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program.....	\$ 45,000
TOTAL.....	\$ 45,000

Potential Sources of Funding: EPA, NOAA, Department of Education, NSF, and private foundations.

Regulatory Issues None.

Related Actions: SD-5, SD-6, SD-7, and RSC-3.

ACTION PPE-3: Develop and Implement a Long-Range Adult Education and Outreach Program

What Support the development and implementation of a long-range adult education and outreach strategy, focusing on effective utilization of the media.

How

Step 1 Public Communication: Building on existing education materials, Galveston Bay Program will develop materials which clearly and accurately communicate information concerning the estuary to the public:

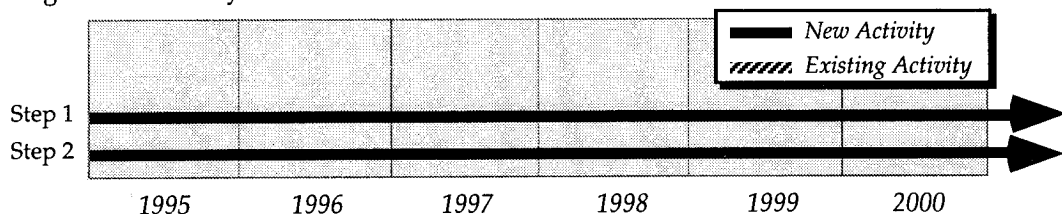
- A packet concerning the need for household hazardous waste disposal programs, and identifying existing programs (such as the City of Houston program)
- Information regarding risks associated with seafood consumption and contact recreation
- Environmental trends within the estuary. Develop a general environmental index for the bay to track its environmental status (for example, a "bay barometer", which is regularly published in local newspapers).
- Information on point source and non-point source reductions.
- A map which identifies all public access points and provides information on bay recreational activities, the ecology of the bay, and guidelines for preservation of bay habitat
- Press releases regarding key bay issues.

Galveston Bay Program will emphasize urban and upper watershed communities not traditionally concerned with bay issues; pursue an educational strategy which emphasizes a multi-cultural approach, and targets materials and efforts towards the entire spectrum of economic and ethnic groups.

The Galveston Bay Information Center will establish a Galveston Bay Estuary section under the Texas Armadillo electronic bulletin board, which can be accessed via Internet.

Step 2: Media Relations: Gal. Bay Program will hire a full-time public information officer (PIO) reporting to the Public Participation Coordinator to work towards more in-depth coverage of bay issues. The PIO will maintain regular contact with bay area reporters with news releases, press conferences, and news items. Galveston Bay Program will develop, publish, distribute, and regularly update a media guide which will assist the media to locate and receive information from individuals and groups which are involved in and are knowledgeable of the bay.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program. Other participants: GBF, governmental agencies with a role in bay management, and the media. Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program	\$ 835,000
TOTAL.....	\$ 835,000

Potential Sources of Funding: EPA, USDA, NOAA, NSF, and private foundations.

Regulatory Issues None.

Related Actions: WSQ-1, WSQ-2, WSQ-5, NPS-4, SM-5, and SD-7.

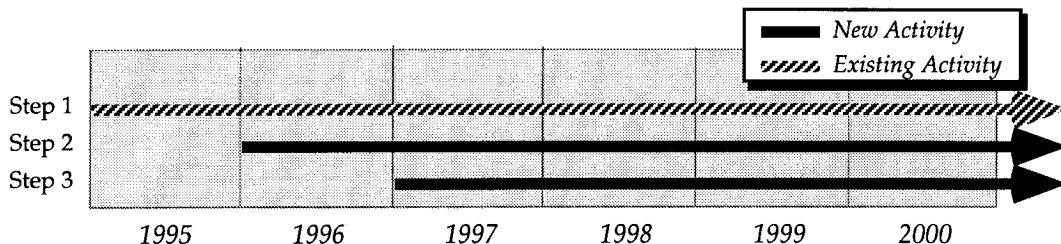
ACTION PPE-4: Develop Specific Curricula for Use in Galveston Bay Watershed School Districts

What Support the development of specific curricula for use in Galveston Bay watershed school districts.

How

- Step 1** GBF and SCS will continue to pursue funding and volunteer support to expand the Galveston Bay Ambassador Program, and advance achievement training programs for teachers in the region.
- Step 2** Galveston Bay Program will work with GBF and others to pursue additional sources of grant funding to develop Galveston Bay curriculum to teach essential environmental elements across all grade levels; and will support legislation to fund the environmental education mandates in SB 1340.
- Step 3** Galveston Bay Program will work with TNRCC, GBF, area school districts and Texas Education Agency (TEA) to develop a strategy for "marketing" bay-oriented lessons to area teachers. Elements of this strategy may include in-service training, TEA's Annual Science Summit, and after-school voluntary forums. This effort will be coordinated where possible with TNRCC's environmental education program.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program and GBF. Other participants: local schools and universities, TPWD, USFWS, SCS, State coordinating committee on environmental education, and the agricultural extension service. Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program	\$ 99,750
TOTAL	\$ 99,750

Potential Sources of Funding: EPA, NOAA, Department of Education, and NSF. Funds other than Section 320 funds will be used for potential school education programs.

Regulatory Issues Legislative note: Chapter 361, Section 11.53 of the Texas Health and Safety Code, as established by S.B. 1340, mandates environmental education programs in Texas' public schools. However, this mandate has not been funded to date. A bill to fund this measure through a license plate fee was introduced in the 1993 Texas Legislature, but failed.

Related Actions: SD-7, SD-5, and NPS-4.

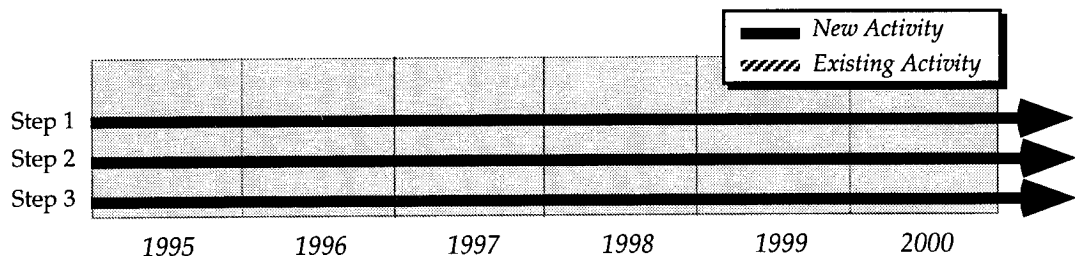
ACTION PPE-5: Continue to Develop Effective Volunteer Opportunities for Citizens

What Continue to support the development of effective, attractive, and organized volunteer opportunities for citizens. Currently available volunteer opportunities include citizen monitoring, discharge permit review, cord grass replanting, volunteer teacher programs, debris pickup, storm drain painting, and the Bay Day Festival. To further involve the public, additional opportunities will be identified, funded, and implemented.

How

- Step 1 Galveston Bay Program and the GBF will work together to ensure the effective continuation of the ongoing citizen monitoring program by conducting activities such as
- Secure long-term GBF funding for the ongoing citizen monitoring program.
 - Improve the link between citizen monitoring data and data collected by agencies for management purposes. Ensure that data for the citizen monitoring program is incorporated into the regional monitoring database.
 - A report documenting the results of the monitoring program will be published annually, with a summary report being presented at the State of the Bay Symposium.
 - Support expansion of the ongoing monitoring program to include additional parameters (e.g., fecal coliform) and ensure that critical geographic areas not being monitored by agencies are included.
 - Support continued participation of the citizen monitoring program in the Bay Day Festival.
- Step 2 The Galveston Bay Program Office should participate in and support Bay Day as a means of publicizing volunteer opportunities.
- Step 3. Galveston Bay Program will monitor *Galveston Bay Plan* implementation efforts and recommend to the GBC opportunities for citizen volunteer implementation.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program and GBF. Other participants: TNRCC, TDH, TPWD, all other governmental agencies with a role in bay management, other private volunteer groups, and the public. Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• GBF	\$ 398,750
• Program	\$ 37,500
TOTAL.....	\$ 436,250

Potential Sources of Funding: EPA, NOAA, and NSF.

Regulatory Issues None.

Related Actions: PPE-3, SD-5, and HP-4.

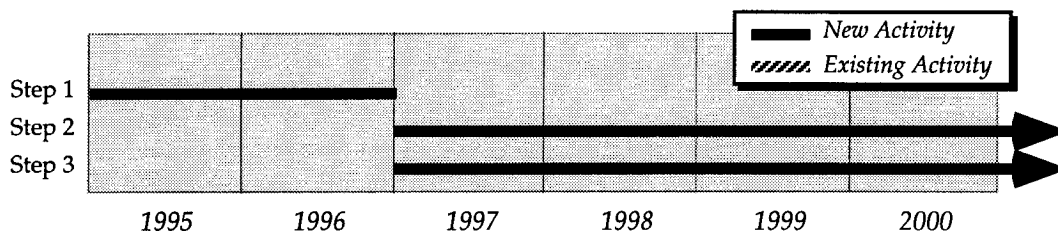
ACTION PPE-6: Maintain a Citizen Pollution Reporting System

What Maintain a Citizen Pollution Reporting System for the bay region for all environmental media and secure long-term increased funding and staffing for the current pollution reporting system program. Currently, 21 various federal, state, and local-level agencies share responsibility for responding to environmental complaints reported by citizens in the five-county area surrounding the bay. The relative responsibility of each of these agencies is not always clear. The current one-call system reduces confusion involved in reporting pollution events, and should be continued.

How

- Step 1** TNRCC will provide full-time staff support to maintain the Citizen's Pollution and Reporting Response System in its Houston office. The Galveston Bay Program will serve in an oversight capacity. As soon as feasible, TNRCC will transfer the Citizen Pollution Reporting and Response System from the region to the Program Office, and will seek funds to hire sufficient staff to maintain the hotline.
- Step 2** Galveston Bay Program will develop an expanded marketing campaign, will publicize the multi-media (i.e., soil, surface water, groundwater, air, etc.) objectives of the system, and will commence a fund-raising effort to add staff to this function.
- Step 3** Galveston Bay Program will work with other environmental agency managers to develop a standard computerized Incident Report Form and develop a multi-agency database. Galveston Bay Program and local environmental agencies will develop a memorandum of understanding to clearly define the responsibilities of the agencies regarding pollution reports.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program and TNRCC. Other participants: local environmental agencies.
Role of Galveston Bay Program: Conduct action.

Public Costs of New Actions (5 years)

• Program.....	\$ 471,750
TOTAL.....	\$ 471,750

Potential Sources of Funding: EPA, USDA, and NOAA.

Regulatory Issues None.

Related Actions: NPS-3.

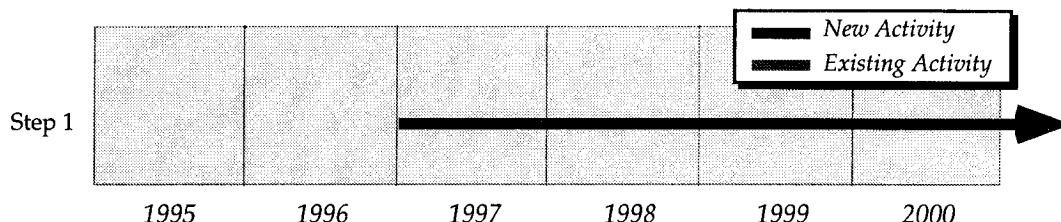
ACTION PPE-7:**Develop and Implement a Strategy for Informing, Educating, and Providing Support for Local Government Involvement**

What Develop and implement a strategy for informing, educating, and providing support for local government involvement. Local governments frequently have difficulty keeping abreast of new environmental regulations and existing programs through which local environmental projects might potentially receive funding. Develop and implement a strategy for informing, educating, and providing support for local governments. Establish a program which acts as a clearinghouse of information.

How

Step 1 Building on established programs conducted by HGAC, HGAC will implement a program which 1) acts as a clearinghouse of information for local government; 2) identifies available technical expertise and currently available assistance programs (such as the Municipal Assistance Program); 3) provides regulatory information; and 4) encourages the use of intergovernmental agreements to jointly utilize technical personnel.

Also see Action NPS-1 ; this action should be coordinated with NPS-1 beginning in FY 98.

When

Where Galveston Bay Program Area.

Who Lead entity: HGAC Other participants: Local governments, EPA and TNRCC. Role of Galveston Bay Program: Coordinating.

Public Costs of New Actions (5 years)

• HGAC.....	\$ 100,000
• Program.....	\$ 37,500
TOTAL.....	\$ 137,500

Potential Sources of Funding: EPA.

Regulatory Issues None.

Related Actions: NPS-1, NPS-2, NPS-4, NPS-7, SM-1, SM-2, and SM-3.

ACTION PPE-8: Provide Assistance for User Groups Affected by Implementation of *The Galveston Bay Plan*

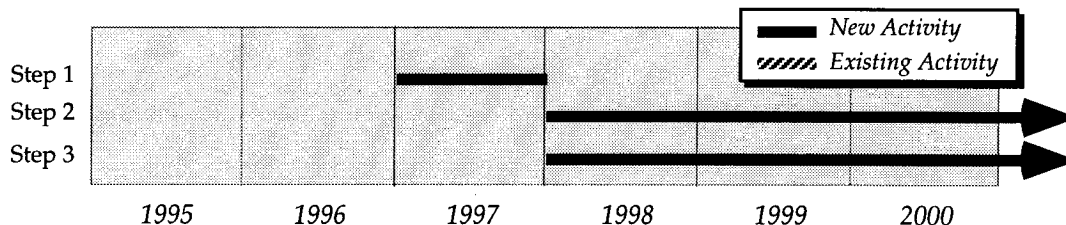
What Provide assistance for user groups affected by implementation of *The Galveston Bay Plan*. Emphasize an understanding of the link between user economic activity and the need for effective management by directly involving the publics that use the bay.

How

- Step 1. The Galveston Bay Program will develop and update bay user's guides.
- Step 2. The Galveston Bay Program will distribute the guides through retail outlets, agencies, and user groups. Other participants include GBF (combine with educational and general programs) and TPWD (maritime sanitation programs, licenses and passes).
- Step 3. The Galveston Bay Program and resources agencies will conduct periodic workshops with user groups as new regulations or programs are implemented.

This action should be coordinated with Actions NPS-14, 14, and 15, beginning in FY 99, and with other new regulatory programs as they are developed.

When



Where Galveston Bay Program Area.

Who Lead entity: Galveston Bay Program. Other participants: GBF, TPWD (maritime sanitation program), and TPWD (distribution of information with licenses). Role of Galveston Bay Program: Conduct action.

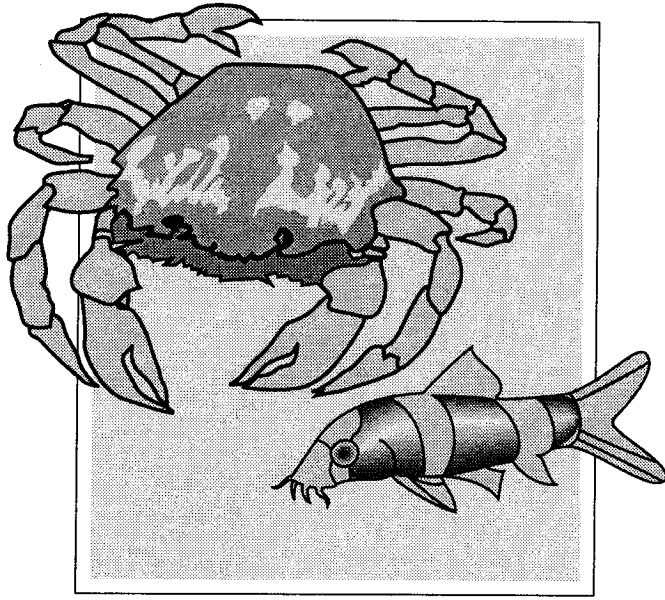
Public Costs of New Actions (5 years)

• Program	\$ 68,000
TOTAL.....	\$ 68,000

Potential Sources of Funding: EPA, NOAA, USDA, Department of Education, NSF, and private foundations.

Regulatory Issues None.

Related Actions: NPS-4, NPS-12, NPS-13, NPS-14, NPS-15, and NPS-16.



VI.

The Galveston Bay Regional Monitoring Program

The Galveston Bay Regional Monitoring Program

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF CHAPTER

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The Regional Monitoring Program is designed to answer two different types of questions about Galveston Bay. The first type of question asks, "are the goals and objectives set forth in *The Galveston Bay Plan* being met?" Are the regulatory agencies and the regulated community fulfilling their commitments to *The Plan*? Are actions in *The Plan* having the desired impact? Does *The Plan* need to be changed? If the monitoring results indicate that *The Plan's* objectives are not being met, then the actions can be modified or the objectives can be changed to reflect a better scientific understanding about the bay.

The second type of question, which is much broader, asks, "is the health of the ecosystem changing, either for the better or the worse?" To answer this type of question, information from the monitoring program may be used to:

- Improve our understanding of the Galveston Bay system
- Assist in setting environmental standards
- Support the development of predictive tools

Two monitoring elements are needed to provide the information to answer these questions. These elements, programmatic and environmental monitoring, each provide information needed to evaluate *The Plan* at various levels. There are three identifiable levels at which we make use of monitoring information to assess *Plan* progress. These levels are administrative, symptomatic, and ecosystem (Figure RM-1) Programmatic monitoring can be accomplished at both administrative and symptomatic levels. Administrative monitoring establishes accountability of designated lead agencies for carrying out specific actions outlined in *The Plan*.

It is also necessary to measure non-environmental outcomes such as changes in opinion, knowledge, or behavior concerning a specific *Plan* action. These are examples of programmatic monitoring conducted at a symptomatic level. Examples of symptomatic level, programmatic monitoring would be a survey to determine if an educational outreach program has had the desired effect on a target community or monitoring changes in bay loadings from point or non-point sources. Environmental monitoring can also be thought of in terms of levels of information.

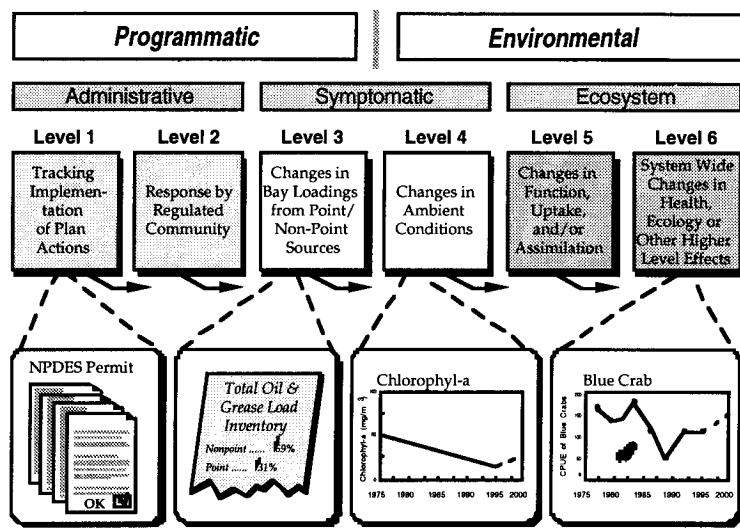


FIGURE RM-1. Hierarchy of Monitoring

While it can be argued that environmental monitoring measures outcomes, there are two different levels at which we can evaluate environmental monitoring. At one level, we measure certain parameters as an indicator of whether *Plan* actions are having an observable environmental impact. This we will call symptomatic monitoring. This level of measurement looks for such things as reductions in ambient conditions, changes in nutrient concentrations, or increased bird nesting habitat. At a higher level we want to be able to assess the impact of change in these indicators on the health of the ecosystem. Such indicators are measured as increases in nesting bird populations, changes in primary productivity, or reduced human health risk from bay fish and shellfish consumption. This hierarchy of indicators, shown in Figure RM-1, has been modified from the Chesapeake Bay program. Figure RM-2 shows how each component of *The Plan* fits into this hierarchy and how the levels of monitoring are integrated with the implementation strategies. We can see that all *Plan* actions contribute to the common goal of maintaining the ecosystem at an optimal health level.

Programmatic Monitoring

To effectively and completely measure the success of the program, it is necessary to establish a monitoring program which measures the success of the program in programmatic as well as environmental measures. *Plan* actions are usually specific activities designed to contribute to a

broader environmental objective and as such lend themselves to programmatic monitoring. As Figure RM-2 illustrates, it is the implementation of *Plan* actions which is the stimulus for anticipated changes in environmental health. Programmatic monitoring will have two goals. First is to monitor those activities which are established in *The Plan*. This is intended to keep managers informed on the implementation status of various programs. Secondly, the monitoring program must help identify which programs are or are not achieving their intended outcomes. Such monitoring improves the accountability of the program to the public and local governments. With this information, management can redirect resources or make necessary modifications to the actions to achieve the desired result.

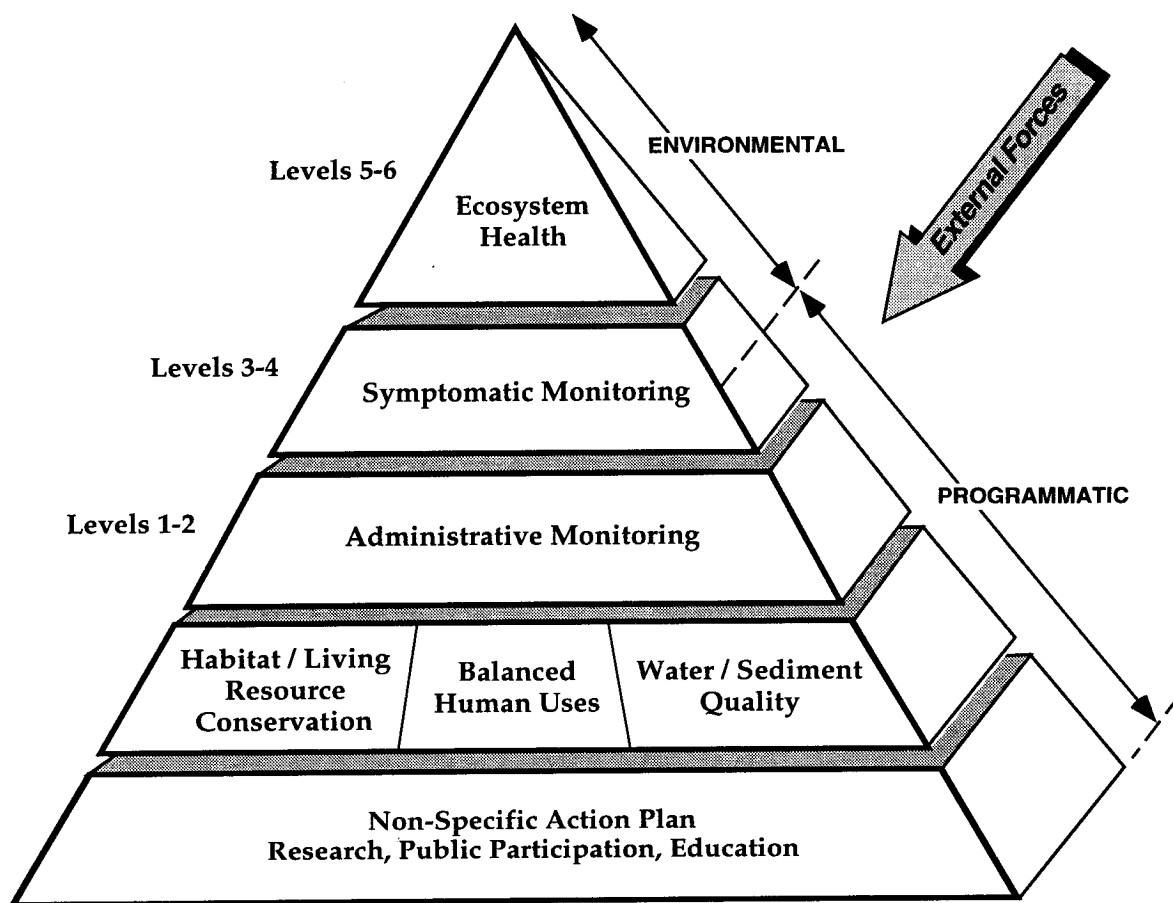


FIGURE RM-2. Integration of *Plan* Actions, Monitoring and Ecosystem Health

The programmatic element of the monitoring process will include an annual review of agency and local government implementation efforts. The Program will prepare an annual report outlining the specific actions taken toward achieving implementation goals. Biennial progress reports will be submitted to the Governor, the Texas Legislature and the public.

Environmental Monitoring

Generally, environmental monitoring lends itself to assessment of *Plan* objectives rather than specific *Plan* actions. The environmental monitoring element of the Galveston Bay Regional Monitoring Program has been developed to provide these higher level assessments of *Plan* success. The Regional Monitoring Program is a statistically sound, holistic monitoring effort designed to provide environmental data of known quality and confidence. The Regional Monitoring Program is designed to collect data that can be compared to the quantifiable objectives in each action plan. It also has a larger goal of providing knowledge of bay-wide ecosystems, their variability, and societal impacts both environmental and ecological.

A lack of fundamental, long-term ambient information was identified by characterization reports and Task Force members as a critical concern (GBNEP-22). These and other concerns will be addressed by building on existing monitoring programs, coordinating them to eliminate duplication of effort, increasing their scope and resolution, improving timeliness of data analyses, eliminating information of dubious value, and making the results available to a diverse set of users in a timely fashion.

Understanding that no agency's mandate is broad enough for this undertaking, the Regional Monitoring Program seeks to promote a cooperative effort by all agencies who participate in bay monitoring activities. The Program attempts, wherever possible, to integrate and expand current monitoring activities into a comprehensive and unified monitoring plan. The plan was developed with full participation of all interested agencies to encourage cooperation, communication, and to maximize the potential for successful implementation. This chapter is a summary of a separate, more detailed report entitled "The Galveston Bay Regional Monitoring Program."

PRINCIPLES FOR BUILDING A REGIONAL MONITORING PROGRAM

One of the early commitments of the Galveston Bay National Estuary Program (GBNEP) was the development of a sound regional monitoring program. The need for such a program was formalized at the GBNEP Regional Monitoring Conference held in Galveston, Texas, on July 8-9, 1992. The conference was widely attended by technical experts and managers of local, state, and federal programs administering monitoring activities in Galveston Bay. From this conference came the conceptual framework for the development of the regional monitoring program. Recommendations from this conference included the following points (Tetra Tech, 1994):

- A regional monitoring program is needed to improve our ability to effectively manage resources in the estuary
- Establishment and management of a technically sound regional monitoring program is feasible
- The details of the monitoring program should be designed by technical experts working with managers and decision makers

The Regional Monitoring Program is centered around five primary management topics:

- Water and sediment quality
- Species population protection
- Habitat protection
- Freshwater inflow
- Public health protection

A Task Force was established for each of the five management topics. Six rounds of meetings were held over a period of months. Each task force was charged with developing action plan items to address perceived threats and concerns. Once these action plans were incorporated into *The Plan*, monitoring objectives and information needs were developed by the Task Force.

Key Elements in Development of the Regional Monitoring Program:

- GBNEP Regional Monitoring Conference
- Management Topic Task Forces
- State of the Bay Symposia
- GBNEP Characterization Studies
- Monitoring Database Inventory
- Tetra Tech Monitoring Strategy Document
- Regional Monitoring Program Work Group Formation
- Final Regional Monitoring Program

The Regional Monitoring Program has been designed to incorporate existing programs as its foundation. Goals were to reduce duplication of effort, expand the scope of the monitoring, and leverage resources by judicious selection of monitoring parameters. This was accomplished through the formation of the Galveston Bay Regional Monitoring Work Group. The Work Group membership was comprised of senior monitoring technical experts representing all agencies with ongoing monitoring activities in the bay area. The steps involved in development of the monitoring program are shown in Figure RM-3. The principles upon which the program was conceived are described below.

Measuring the Status and Effectiveness of *Plan* Actions

First and foremost, Galveston Bay's Regional Monitoring Program will provide information to measure the progress and effectiveness of implemented *Plan* actions. This will be accomplished through three types of monitoring efforts. These are programmatic monitoring, symptomatic monitoring, and environmental monitoring. Programmatic monitoring includes the tracking of *Plan* implementation. An important Galveston Bay Program staff function will be to coordinate and communicate regularly with agencies identified as lead agencies for specific initiatives. Symptomatic monitoring measures the effectiveness of *The Plan* actions in achieving the intermediate goals and objectives of *The Plan*. Environmental monitoring measures outcomes to determine improvements in environmental conditions relative to identified bay problems.

Characterization of the Status and Trends of Conditions in the Bay

Galveston Bay's Regional Monitoring Program will provide information describing the status and long-term trends of specific biotic and abiotic resources to be managed. The monitoring effort will incorporate the regular and long-term collection of measurements of fundamental parameters. For each parameter, the measurements will be specifically defined and will relate directly to management objectives. Sampling efforts will be coordinated to facilitate testing for meaningful correlation among several parameters as well as trends in parameters measured over time. The Regional Monitoring Program will monitor parameters that will allow a direct comparison to the goals and objectives specified in *The Plan*. With this information, Bay managers, stakeholders, and the public can easily track the progress of *The Plan*.

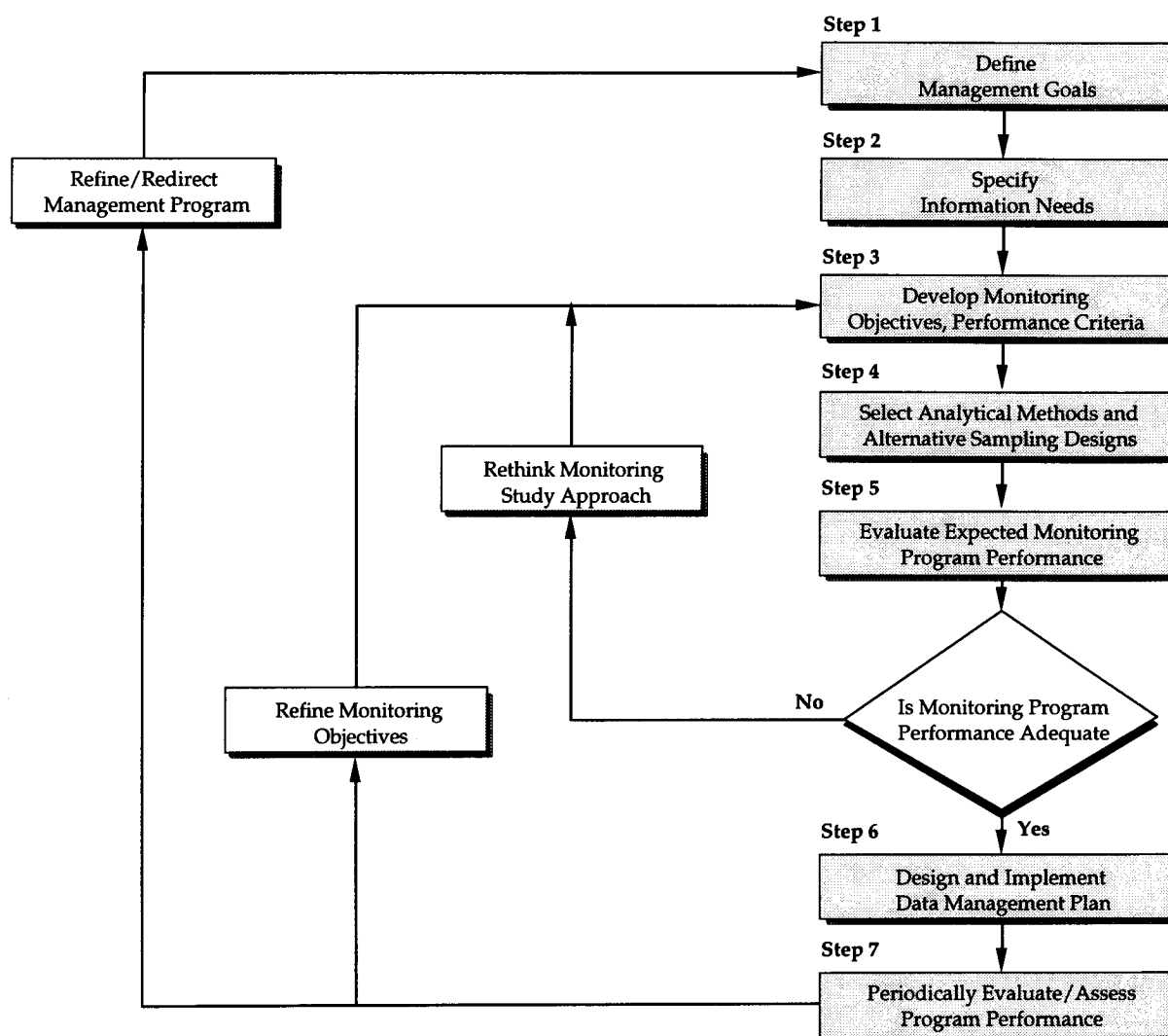


FIGURE RM-3. Galveston Bay Regional Monitoring Program Design

Integration of Existing Monitoring Efforts

Galveston Bay's Regional Monitoring Program will incorporate existing and planned monitoring efforts or elements from these programs to minimize duplication of effort, maximize the development of essential information, and reduce the cost of the monitoring effort. Where information gaps have been identified in existing monitoring programs, the appropriate agencies have been approached to supplement their existing monitoring or encouraged to develop the missing monitoring effort.

A key element in achieving this goal was the adoption of standard parameter sets and comparable protocols for field sampling, analytical, and Quality Assurance/Quality Control (QA/QC) methods. Performance-based standardized sampling, analytical, and QA/QC protocols will be employed to ensure that the data collected by different groups participating in the Regional Monitoring Program are directly comparable. Standardization and coordination of existing sampling efforts among local, state, and federal agencies will allow long-term sharing and use of all data collected as part of the Regional Monitoring Program.

An integral part of the Regional Monitoring Program is the development of a strong Quality Assurance program. This will be accomplished with the Galveston Bay Program office acting as a central figure in developing joint training programs and participation in laboratory quality assurance programs. An example of this is the Water Pollution Performance Evaluation Study available through the EPA. All laboratories in the program will participate in this nationwide quality assurance program.

Assessment of the Status and Trends of the Bay's Resources

Measurement of all the variables of all the resources and all processes in the ecosystem is not feasible. The use of measurements that indicate the condition of valued habitats and resources, and the exposure to human stresses within habitats, will significantly reduce the cost of the monitoring effort. Galveston Bay's Regional Monitoring Program will measure indicator parameters to characterize:

- Condition
- Biological response
- Stress exposure
- Sources of stress

Analyses of these parameters will be used to assess the current status and trends in the condition of key estuarine habitats and resources.

Oversight and Coordination of the Regional Monitoring Program

Participants in the Regional Monitoring Workshop held in June 1992, unanimously called for the formation of a multi-agency committee to coordinate regional monitoring and research efforts. The Regional Monitoring Work Group was formed in response to this call. The Work Group is comprised of senior technical representatives from each of the agencies currently

doing monitoring in the bay. In addition there is representation of agencies whose responsibilities for managing bay resources may be impacted by the Regional Monitoring Program. In the implementation phase, the work of the Monitoring Work Group will be continued through formation of the Monitoring Steering Committee. It is highly recommended that the institutional membership of the current Work Group be included in this Committee.

It was responsibility of the Work Group to develop and recommend to the Management Committee, a final comprehensive environmental monitoring plan. This has been accomplished wherever possible through coordination of current monitoring activities. To accomplish this, task focus groups were formed for each of the major monitoring components of *The Plan*. Actions included in this effort are adoption of spatial and temporal sampling schemes, development of monitoring objectives, and performance criteria directed at obtaining monitoring information required to evaluate the action plans. This included development of standard suites of parameters, sampling protocols, analytical methods and QA/QC procedures that will become the core of the monitoring program.

Access to Essential Monitoring Information

Monitoring data for the Galveston Bay estuary are often not readily available and essential quality assurance information necessary to evaluate the comparability of data sets is frequently not preserved. A centralized data and information management system will be developed to ensure access to monitoring data. Current monitoring programs will continue to manage data for their specific mandates and purposes and agencies will maintain their own database systems. The focus of the Galveston Bay Data Information Management System (DIMS) will be to help make this data useful beyond these purposes. The system will have the following features:

- Centralized storage of data and information
- Standardized quality assurance reports for each data set
- Easy access and use
- Long term availability and flexibility
- System documentation and technical support

The data management system will be in place and operational prior to initiation of the monitoring program, and will provide the primary source of information for graphical and written summaries of the environmental data. These summaries will serve as tools to communicate information on the effectiveness of *The Plan* management actions and to build public awareness of monitoring program results.

Galveston Bay's Regional Monitoring Program will be composed of numerous major monitoring components ranging from hydrology to public health. A summary of the parameters associated with each major component and a discussion of which existing programs will be incorporated into the Regional Monitoring Program is provided below. For summary purposes only, broad based monitoring objectives have been given. Specific monitoring objectives driven by management objectives and actions listed in *The Plan* have

been developed and are included in the Galveston Bay Regional Monitoring Program document.

EXISTING MONITORING PROGRAMS

Currently, there are at least 19 different entities that monitor the water, biota, or habitat of the bay for some environmental purpose. A listing and brief summary of the major monitoring groups and their activities are provided below.

Federal Agencies

U. S. Environmental Protection Agency

EPA Environmental Monitoring and Assessment Program (EMAP) conducts routine monitoring at stations in Galveston Bay through its EMAP-Estuaries Louisianian Province program. Galveston Bay falls in the Western Region of the Louisianian Province. Sampling stations are systematically distributed throughout the estuary according to hexagonally gridded areas with approximately 18 km between each station designation. A quarter of these gridded areas, approximately seven in Galveston Bay, are sampled annually. During each sampling event, a random station is selected from within those grids to be sampled. These stations are sampled for analyses which include limited water quality parameters, detailed sediment chemistry, sediment toxicology, and benthic community structure. All samples are collected during summer months.

United States Geological Survey

The USGS operates a total of 16 stations which monitor either water quality in tidally affected sections of Galveston Bay or freshwater inflow to the bay. These stations include four continuous water monitoring stations for the City of Houston that record specific conductance, temperature, dissolved oxygen (DO), and water surface elevation on an hourly basis. These data are available on a near real-time basis through access via the GOES satellite system.

The twelve other stations are located to help define freshwater inflow to the bay. These sites are paired with USGS flow stations and are equipped with automatic samplers. In addition to hourly water surface elevation and flow data, a wide selection of water quality parameters are monitored. Sample collection varies on the order of four to six times per year.

U. S. Army Corps of Engineers

The Corps currently conducts two sampling programs in Galveston Bay. The first is the Dredged Material Monitoring Program. Six core stations in the Houston Ship Channel are monitored for dredging activities. Other estuarine stations are also monitored for specific projects. All dredged channels are sampled prior to dredging and six times after dredging. Maintained channels are monitored every three years. Samples are collected by bottom grab and analyzed for metals, oil and grease, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), pesticides, grain size, toxicity, and bioaccumulation.

The second sampling program conducted by the Corps in Galveston Bay is the Open Bay Disposal Dredged Material Program. This is a three-year program now in its third year. Thirty stations were monitored two to four times per year. The monitoring is conducted by box corer and utilizes a sediment profiler for sediment profile imagery, benthos characterization, grain size, sediment carbon, redox potential, surface relief, and benthic succession. While not a true long-term monitoring effort, it will provide information on sediment characteristics which will be useful in assessment of our sediment data.

U. S. Fish and Wildlife Service

USFWS activities are generally limited to short-term special studies designed to address particular issues. USFWS does conduct the National Wetlands Inventory, which is a program of mapping wetlands nationwide using stereoscopic analysis of high altitude aerial photography. Areal changes in open-water, wetlands, and developed land are assessed and future changes projected. This survey is performed on a roughly 10-year interval. The USFWS also has plans for a larger monitoring effort focusing on wildlife refuges. This effort is expected to fall under the responsibility of the recently created National Biological Survey. At this time, no specific plans or schedules have been developed for Galveston Bay.

USFWS has also been involved in several bird surveys. The North American Breeding Bird Survey has been conducted continuously from 1986-1990 with intermittent coverage dating back to 1968. Another more significant study, the Mid-Winter Waterfowl Survey, is carried out in cooperation with the Texas Parks and Wildlife Department. This survey consists of a systematic scheme of sampling along transects and another less systematic scheme of counting birds in general locations. These data provide information on abundance of waterfowl by species and by transect, or by general location within the surrounding waters of the Galveston Bay System (GBNEP-19).

National Oceanic and Atmospheric Administration

NOAA has two programs that involve monitoring activities in Galveston Bay. NOAA's Mussel Watch Program monitors six stations in Galveston Bay. At each of these stations, oysters are sampled annually for trace elements, chlorinated pesticides, PCBs, PAHs, and tributyl tin (TBT). Sediments were also sampled during the period from 1986 to 1988.

The second NOAA monitoring program is the Benthic Surveillance Project which monitors nine sites in Galveston Bay. Fish livers are sampled from the sites every two years and are analyzed for chlorinated pesticides, PCBs, PAHs, TBT and pathology.

National Marine Fisheries Service

NMFS has two monitoring activities in Galveston Bay. The first is designed to monitor baseline production of fish and shellfish in West Bay marshes. This program includes a number of variable stations in the marshes. Fish, shrimp, and crab are sampled for the measurement of densities of target species and biomass. There are plans to expand the program to 30 sites covering the entire Galveston Bay. No cost or data management information is available at this time.

The second activity is the Brown Shrimp Catch program. During April-June each year, NMFS monitors sizes of brown shrimp and catch per unit effort (i.e., pounds per hour) using information provided by bait dealers and fishermen. A third activity, the Post Larval Shrimp program was discontinued in 1993.

State Agencies

Texas Natural Resource Conservation Commission

The TNRCC conducts routine sampling at 68 stations in the Galveston Bay watershed to maintain a central database for monitoring water and sediment conditions. The stations are divided into groups of 55, 10, and 3 stations; the groups are sampled four, two, and one times per year, respectively, yielding a total of 243 sample collection events per year. Conventional water quality measurements including DO, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), pH, conductivity and salinity are conducted at all stations. Other water quality measurements include nutrients, fecal coliforms, chlorophyll *a* and pheophytin *a*, Total Organic Carbon (TOC), Total Dissolved Solids (TDS), and VSS. Additional parameters are monitored at selected stations and lower frequencies. These include benthos, plankton, metals, pesticides, other priority pollutants and toxicity in both water and sediment. Data are stored in the Surface Water Quality Monitoring database.

Texas Water Development Board

The objective of TWDB's monitoring program in Galveston Bay is to collect data to support calibration of TWDB's models of circulation and salinity, and to support analyses of the relationship between salinity and freshwater inflow. TWDB routinely samples five stations in Galveston Bay for water temperature, pH, DO, conductivity, and salinity. The measurements are conducted by probes fixed at the sites and are automatically recorded every 90 minutes.

Texas Department of Health

The TDH's monitoring program in Galveston Bay is designed to ensure compliance with the National Shellfish Sanitation Program (NSSP). NSSP requires use of bacteriological monitoring along with pollution source surveys to classify shellfish producing waters. TDH routinely monitors 104 stations in Galveston Bay at infrequent and variable intervals. These stations are located adjacent to actual or potential sources of fecal coliform pollution. Sample collections are timed to represent worst case conditions. The measurements conducted include air and water temperature, tide condition, rainfall, weather conditions, wind direction, velocity, DO, salinity, and fecal coliform (FC).

Texas Parks and Wildlife Department

The TPWD has three monitoring programs in Galveston Bay. The Resource Monitoring Program collects gill net samples at 45 sites twice annually during the spring and fall. On a monthly basis 20 trawl, 30 oyster dredge, and 20 bag seine samples are collected from Galveston Bay. Weather conditions, tide conditions, temperature, salinity, DO, and turbidity are measured when collecting samples. The collected samples are analyzed for species identification, number of specimens, size, weight (occasional), sex, and maturity. Large, live fishes are tagged to allow growth, mortality and movement estimates.

The second monitoring program is the Coastal Resource Harvest Commercial Landings Program. Ninety-five seafood dealers are interviewed monthly for information about all commercial finfish, shrimp, crab, oyster, and other marine life. Licensed dealers are required to report all edible saltwater products purchased from commercial fishermen through the submission of a "Monthly Aquatic Products Report" to TPWD or NMFS.

The Coastal Resource Harvest Recreational Landings Program involves conducting on-site, trip-end interviews on 125 boat access survey sites. A total of 133 surveys are conducted per year to gather information such as trip length, number and residence of people in the party, area fished, the type and amount of gear and bait that were used, fish landed by species, total lengths of fish (six per species), grade for trip success, species sought, and methods of obtaining bait (caught or bought).

In addition to the fisheries programs, the TPWD participates annually in several bird survey programs including the Mid-Winter Waterfowl Survey and the Texas Colonial Waterbird Survey. The TPWD also conducts helicopter surveys of American alligator nests along established transects in the marshes adjacent to East Bay and Trinity Bay.

Texas General Land Office

The GLO has recently initiated a coastal environmental monitoring program called the Texas Coastal Ocean Observation Network (TCOON). This program consists of managing eight of the National Oceanic Service's tide gauges (referred to as the Next Generation Water Level Measurement System) that are located in the Galveston Bay system. The eight locations are: Christmas Bay, Alligator Point (near the mouth of Chocolate Bayou), Galveston Pier 21 (in Galveston Channel), Galveston Pleasure Pier (in the Gulf of Mexico), Eagle Point, Clear Lake, Morgans Point, and Round Point (in east Trinity Bay).

Local Agencies

City of Houston

Two departments in the City of Houston conduct routine monitoring of tidal tributaries to Galveston Bay. The first is the Department of Public Works and Engineering (DPW&E), Division of Wastewater Operations, which monitors the major bayous within the city. The objectives of the monitoring program are to resolve concerns over water quality conditions in the bayous and to aid in locating and correcting sewer leaks. DPW&E monitors 45 stations in the tidal and non-tidal portions of major bayous. Most are sampled weekly for parameters including DO, temperature, pH, ammonia-N, nitrate-N, BOD, TSS, conductivity and fecal coliforms.

The Health and Human Services Department (HHSD), Bureau of Public Health Engineering, has two groups which conduct monitoring. The Field Operations Unit monitors 54 stream stations in the Houston area as well as all permitted wastewater discharges. The stream stations are monitored on a monthly basis for conventional parameters and nutrients. The Quality Assurance Group of the Bureau of Public Health Engineering of HHSD also monitors a number of stations. Although most of its stations are in Lake Houston and its watershed, part

of the monitoring effort is in six major Houston bayous.

Harris County Pollution Control Department

The Harris County Pollution Control Department (HCPCD) monitors nine stations on the Houston Ship Channel (HSC) and six stations on the San Jacinto River below Lake Houston. Monitoring parameters include field measurements of pH, DO, temperature and conventional parameters including TSS, TOC, phosphorous, ammonia-N and trace metals.

Galveston County Health District

The Pollution Control Department of the Galveston County Health District (GCHD) monitors 92 stations including the beach and bay sides of Galveston Island and most of its bayous. Monitoring parameters include conventional pollutants, nutrients, and weather conditions. Most GCHD stations are monitored monthly, and permitted discharges are monitored one to three times per year.

Citizens' Monitoring Programs

The TNRCC has supported environmental monitoring by local citizens' groups to supplement existing monitoring programs. For example, the Galveston Bay Foundation coordinates a volunteer monitoring network called The Estuarine Sampling Team (TEST). There are currently 34 stations in the TEST network. These volunteers are trained to collect key water quality data, such as DO, pH, temperature, and other parameters and take measurements at several locations in the local area on a regular basis. The interest in citizens' monitoring programs has increased significantly over the past several years and is one of the actions detailed in *The Galveston Bay Plan* (Action PPE-5).

Participation by volunteer monitoring groups is also evident in several surveys conducted to evaluate Galveston Bay bird populations. The Texas Colonial Waterbird Society and the TPWD jointly participate in the Texas Colonial Waterbird Survey (TCWS). Results of this survey have been compiled and published from 1973 to the present. Surveys are conducted annually during a two-week period beginning the last of May, corresponding to the incubation period of most colonial nesting waterbirds. The Christmas Bird Count (CBC) is sponsored by the National Audubon Society. This is a less rigorous survey of day-long tallies of birds seen within four 24-km diameter areas.

MONITORING PROGRAM ELEMENTS FOR HABITAT AND LIVING RESOURCE CONSERVATION

Habitat Protection

The availability and quality of habitats is one of the most important factors determining the abundance and distribution of aquatic and terrestrial organisms. Estuarine habitats provide areas for spawning, rearing, feeding, and sheltering organisms from predators and physical stresses. Estuarine habitats also perform valuable functions for humans including erosion and flood protection, water quality control, and provision of habitats for commercial and

recreational waterfowl and wildlife. Habitat quality monitoring will provide information to characterize the condition of bay habitats, evaluate potential stresses to resident organisms, and track habitat recovery following adverse environmental impacts.

Programmatic Monitoring

There are numerous specific *Plan* actions for which progress must be tracked and evaluated. Programmatic monitoring generally includes monitoring for implementation of key actions or milestones leading to such action and a broader evaluation of *Plan* objectives.

Acquiring and Protecting Quality Wetlands Habitat

Actions HP-4, 5, and 6 address the objectives directed at acquisition and protection of wetland habitats. Wetland accounting systems will be implemented to monitor acquisitions of wetland habitat, habitat in public ownership, and to document wetland conversion. Effectiveness of tax incentives to discourage wetland development can be monitored through applications for special tax status. These will be tracked as administrative functions. Informational input will come from environmental wetland characterization monitoring and other ancillary data such as the Corps Section 404 permit program.

Another objective of the habitat protection action plan is directed at selectively moderating erosional impacts. To achieve this objective, a rating system will be implemented to identify areas of high erosion impact. These areas will be monitored for erosion rates and effectiveness of management practices implemented to reduce erosion.

Additional milestone events to track action implementation will include:

- Status and actions related to obtaining funding for habitat acquisition (HP-5)
- Prioritizing of wetland tracts for acquisition (HP-5)
- Status of state and local government efforts to create tax incentives for wetland protection (HP-6)
- Monitoring progress in beneficial use of dredged material for restoration and creation of wetland areas (HP-2 and 8)

Coordinating Wetland Regulatory Strategy

Key elements for programmatic follow-up for this action are:

- Implementation of Memorandum of Understanding (MOU) to standardize mitigation criteria, policies and requirements (HP-4 and 9)
- Development of wetland water quality standards by TNRCC (HP-4)

Environmental Monitoring

Task Force members adopted the following broad environmental monitoring objectives to be used in design of the Galveston Bay Regional Monitoring Program:

- Determine trends in the areal extent, quality, and distribution of selected habitats of concern (Actions HP-1, 3, 4, 5, and 6)
- Determine the extent of habitat quality, continuity, and fragmentation (Actions HP-1, 2, and 3)

- Determine trends in the abundance and distribution of species whose existence depends on wetland habitats (Actions HP-7,8)

Based on recommendations from Habitat Protection Task Force members, ecologically important and potentially threatened habitats within the estuary include:

- Submerged aquatic vegetation
- Freshwater, brackish, and salt marshes
- Colonial bird nesting habitat

Submerged vegetation and marshes were identified because they:

- Are important sources of nutrients and organic matter
- Furnish key nursery and adult habitat for bay biota
- Provide flood peak reduction, attenuation of storm water flows, and sediment and shoreline stabilization

Colonial bird nesting habitat was identified because bird populations have significant ecological and aesthetic value to users of the bay.

Based on *Plan* objectives and recommendations from Habitat Protection Task Force members, habitat indicators were developed and are given in Table RM-1. Because these habitat types differ significantly in their physical characteristics and location, different monitoring methods will be required for each.

Extent, Change and Distribution

Long-term measurements of area and location will be used to provide data on gains or losses of specific habitat types within the estuary as required by Actions HP-1, 3, 4, 5, and 6. Areal and distribution data will also be used to assess whether habitats are of sufficient size to perform hydrodynamic and water quality functions. Remote sensing techniques combined with ground truthing will be utilized to provide this information. Data on areal extent and change for the identified habitats and others will be obtained through the TPWD Resource Protection Division Coastal Habitat Group. This program utilizes satellite Landsat Thematic Mapper (TM), multi-spectral imagery from which land cover classifications are done. The program utilizes the NOAA Coast Watch-Change Analysis Program (C-CAP) classification protocols. In addition to development of baseline mapping, the program has a goal of monitoring changes in wetland and submerged habitat every 2-5 years. Mapping of the Galveston Bay system has been completed so baseline data are available. As reported by the TPWD, the primary advantages of landcover mapping with satellite imagery using C-CAP protocols are: 1) standardized mapping classification with other major wetland classification systems, 2) extensive coverage within a single satellite scene, 3) classification and mapping can be done over a relatively short period of time, and 4) the classified landcover information is in a format readily integrated into a Geographic Information System (GIS).

TABLE RM-1. Candidate Indicators and Measurements for Habitat Protection

Candidate Indicators	Candidate Measurement
Marsh	
• All marsh types	Areal extent and distribution % emergent vegetation % open water dominated by aquatic vegetation Marsh edge and interspersions Water duration Open water depth Salinity
• Brackish marsh	Aquatic organism access
• Salt marsh	Change in relative sea level - subsidence/erosion % <i>Spartina alterniflora</i>
Submerged Vegetation	
• Seagrasses	Areal extent and distribution Biomass Vegetation composition PAR Salinity
Oyster Reefs	
	Areal extent and distribution
Colonial Waterbird Nesting Habitat	
	Number of colonies and distribution Abundance of predators (e.g., fire ants) Elevation above sea level Accessible feeding habitat Connectivity to mainland Indications of human disturbance

Habitat Quality and Function

This monitoring element is directed at the goal of expanding areas and restoring quality of wetland habitat (HP-1, 2, and 3). In addition to monitoring habitat change using previously described methodology, various wetland habitat modification activities will be monitored to prioritize and target areas where potentially degraded wetlands may occur. Such activities would include humanly-induced subsidence, draining and filling, and isolation activities. Once targeted, assessments of wetland quality and function will be conducted using the Wetland Value Assessment (WVA) methodology. This methodology was developed by the US. Fish and Wildlife Service in Lafayette, LA. It was developed as a quantitative assessment tool intended for use in ranking projects for the Coastal Wetlands Planning, Protection, and

Restoration Act. It is a modification of the USFWS Habitat Evaluation Procedure (HEP). WVA utilizes a community-based approach in metric development as opposed to the species approach utilized by HEP. The assessment tool will be field tested for applicability to Galveston Bay wetland habitats and if necessary, appropriate modifications to the metrics will be made. Wetland restoration projects will be prioritized and evaluated utilizing WVA rankings.

Colonial Waterbird Nesting Habitat

The Texas Colonial Waterbird Census (TCWC) is a program for monitoring colonial waterbird nesting sites conducted in the Galveston Bay estuary. This program gives nesting site utilization data required to address Actions HP-7 and 8. This program does not include evaluation of habitat extent or condition so information from the project as currently conducted can not directly address the issue of the Habitat Objective. However, analyses of colony attributes can be made. Numerous possible factors may influence waterbird nesting habitats and each nesting habitat will be evaluated to determine the primary factor for abandonment as a nesting habitat. Some possible causes of nesting habitat loss are human disturbance, predation, loss of island area through subsidence or erosion and access to feeding habitats. Once specific factors can be identified, remediation measures can be recommended and implemented.

Implementation

As previously discussed, the information on habitat areal extent and distribution will be obtained from the TPWD Habitat Assessment Branch classification program. Assessment of the WVA approach for habitat quality will be headed by the USFWS along with members of the EPA, Corps and TPWD.

Species Population Distribution and Condition

Galveston Bay's fish and wildlife provide some of the bay's greatest economic, recreational, and aesthetic values. Less recognized organisms play key roles in maintaining the diversity of the bay's biological resources. To protect and preserve Galveston Bay's biological resources, information on the condition of the bay's plants and animals is necessary. Species population monitoring will provide information to characterize the condition of bay biota, evaluate potential stresses to bay organisms, and track population responses following environmental interventions.

Programmatic Monitoring

The following are general programmatic areas for which progress will be tracked and evaluated:

- Creation of the Galveston Bay Species Advisory Committee (SP-1)
- Development and implementation of TPWD program for returning oyster shell to designated locations (SP-2)
- Progress in streamlining the current leasing process to encourage reef creation (SP-3)
- Legislative activity for creation of oyster reef research areas or preserves (SP-4)

- Identification of changes in gear and devices to reduce by-catch. Commercial fleets will be monitored for implementation of new devices as they are developed (SP-5)
- Educational programs for recreational fishermen will be developed by TPWD; effectiveness of these programs can be monitored through the TPWD Creel Surveys and surveys targeted at recreational fishermen to assess awareness of the program and its importance (SP-6)
- Adoption by TPWD of management plans for endangered species found in Galveston Bay (SP-8)
- Monitoring development of new legislative actions directed at the prohibition of introducing exotic species (SP-9)
- Progress in identification and implementation of effective means of controlling exotic species (SP-10)

Data information needs for the programmatic monitoring effort include:

- Numbers and locations of alternative material oyster reefs created (SP-3)
- Amounts of reef area designated as research or preserve areas (SP-4)
- Results of TPWD Coastal Resource Recreational Landings Program (SP-6)

Environmental Monitoring

The stated goals of *The Plan* are to maintain and enhance populations of economically important species, ecologically important species, and threatened and endangered species, while reducing populations of introduced exotic species. Economically important species are ecological components having an economic or recreational value. Threatened and endangered species are listed by the US Fish and Wildlife Service. Of specific importance to Galveston Bay are the brown pelican, piping plover, and five species of sea turtles. Introduced exotic species include nutria, grass carp, and fire ants. Species of ecological importance are defined as ecological components mediating processes or interactions that affect the structure and function of existing bay habitats and communities. Because it is not feasible to measure all economic, threatened and endangered, introduced, and ecologically important species, a limited set of indicator species were identified based on recommendations by Species Population Protection Task Force members. The Regional Monitoring Program will determine the status and trends in the following.

- Abundance and distribution of dominant phytoplankton (SP-1).
- Abundance and distribution of dominant species of benthic invertebrates (SP-1).
- Relative abundance (i.e., catch per unit effort) and distribution of selected species of fin- and shellfish (SP-1,2).
- Abundance and distribution of selected species of birds and reptiles (SP-1).
- Abundance and distribution of endangered and threatened species (SP-8).
- Abundance and distribution of certain introduced exotic species (SP-9, 10).
- Impingement and entrainment and mortality of impinged organisms (SP-7).
- By-catch in commercial fisheries industry (SP-5).

From these broad objectives and a review of the data required to assess effectiveness of the defined action plans, a list of indicator species for environmental monitoring was developed. These species are outlined in Table RM-2.

TABLE RM-2. Candidate Indicators and Measurements for Species Protection

Candidate Indicator	Candidate Measurement
Ecologically Important Species/Communities	
• Plankton community	Chlorophyll-a (see Water Quality)
• Benthos	Community structure (see Sediment Quality)
• Invertebrates	
- white shrimp	Abundance and distribution
- brown shrimp	Abundance and distribution
- blue crabs	Abundance and distribution
• Finfish	
- Atlantic croaker	Abundance and distribution
- gulf menhaden	Abundance and distribution
- anchovy	Abundance and distribution
• Birds	
- Colonial waterbirds	Abundance and distribution
- Shorebirds	Abundance and distribution
- Wintering waterfowl	Abundance and distribution
• Alligator	Abundance and distribution; # nests
Commercially and Recreationally Important Species	
• Shellfish	
- eastern oyster	Areal extent of reefs; distribution; density; size
- white shrimp	Abundance and distribution; size; weight
- brown shrimp	Abundance and distribution; size; weight
- blue crabs	Abundance and distribution; size; weight
• Finfish	
- Atlantic croaker	Abundance and distribution; size; weight
- black drum	Abundance and distribution; size; weight
- red drum	Abundance and distribution; size; weight
- gulf menhaden	Abundance and distribution; size; weight
- sand seatrout	Abundance and distribution; size; weight
- spotted seatrout	Abundance and distribution; size; weight
- sheepshead	Abundance and distribution; size; weight
- southern flounder	Abundance and distribution; size; weight
Commercial By-Catch	CPUE # and biomass; by-catch/shrimp biomass ratios
Impingement/Entrainment	Abundance
Introduced Exotic Species	
• grass carp	Abundance and distribution
• nutria	Abundance and distribution

continued

continued

Candidate Indicator

Candidate Measurement

Threatened and Endangered Species

- brown pelican
- piping plover
- Kemps Ridley sea turtle
- Southeastern snowy plover
- Texas diamondback terrapin

Abundance and distribution
Abundance and distribution
Sightings

Finfish and Shellfish

Selected finfish and shellfish represent commercially important species, key intermediate consumers, and forage species in the estuary. Information describing the status and trends of economic species will be used to (1) characterize standing stocks of economic species, (2) provide early warning of potential impacts to bay fisheries, and (3) assist in identifying appropriate resource management actions. Information on abundance and distribution of ecologically important species will be used to assess the structure and function of the Galveston Bay System. Catch Per Unit Effort (CPUE), size, weight, and location of indicator finfish, shrimp, and crabs will be used to characterize abundance and distribution of fish and shellfish populations. The abundance of oysters will be determined from the areal extent, density, and distribution of oyster reefs as monitored through the TPWD Coastal Fisheries Program.

Birds

Several programs directed at the evaluation of bird populations are conducted in the Galveston Bay area. These include the previously discussed Texas Colonial Waterbird Survey, Mid-winter Waterfowl Survey and the Bolivar Shorebird Survey. The Regional Monitoring Program will work to promote, improve and increase utility of these programs.

Reptiles

Among locally important ecological species is the American alligator. TPWD conducts an helicopter survey of American alligator nests along established transects in the marshes adjacent to East Bay and Trinity Bay. This survey was conducted annually from 1980-1984 and on three-year intervals since 1985. In addition to nest counts, TPWD conducts night-count surveys on three selected navigable waterways within the Galveston Bay System. The Galveston Bay Program will work with TPWD to continue these surveys and to improve the quality of the data through improvements in standardized methods.

Endangered and Threatened Species

Listed threatened and endangered species will be directly and indirectly monitored. Long-term measurements of sightings and location data will be used to assess population levels and trend data will be used to identify potential population declines. In addition, it is recommended that the areal extent and distribution of required or preferred habitats of threatened and endangered species be used to assist in characterizing population abundance and providing early warnings of potential population declines.

Introduced Exotic Species

Monitoring for introduced exotic species will be required to assess the effectiveness of techniques for controlling populations of these species. Species specifically named in *The Plan* are grass carp and nutria. Current monitoring efforts are not adequate to provide information needed to assess this plan objective. The Galveston Bay Program office will work with the appropriate agencies in developing methods for monitoring the effect of population management controls. An informal task force has met to discuss possible monitoring and control strategies for grass carp. A similar group will be convened to address the issue of nutria populations. Proposed population estimates include abundance and spatial distribution data.

Impingement/Entrainment

One objective of *The Plan* is the reduction of impingement and entrainment and increased survival of impinged and entrained organisms at power generating stations. The TNRCC has collected impingement data for several years at one power plant location. This data collection effort will be continued to document any reductions seen in impingement from actions taken at the plant. In addition Houston Lighting and Power (HL&P) will be conducting mortality studies beginning in the fall of 1994 to measure the effectiveness in reducing mortality of recently installed pumping systems. Through these studies estimates of reductions that may be achieved through implementation of best available technology can be established.

Commercial By-Catch

The NMFS works toward the development and implementation of gear and devices to reduce commercial by-catch. TPWD is currently conducting by-catch surveys in several Texas bays. The sampling protocols being used are comparable to those used in the GBNEP by-catch studies conducted by NMFS (GBNEP-25). Using the NMFS data as a baseline and implementing future by-catch studies in Galveston Bay, TPWD and NMFS will monitor trends in by-catch reductions.

Implementation

As previously discussed most monitoring information on commercially important species will be provided from the TPWD Coastal Fisheries Program. The TNRCC also does limited collections in shallow water areas not generally sampled by the TPWD program. The Galveston Bay Program will work with volunteer, state, and federal agencies in the continuation and expansion of the bird surveys currently conducted within the Galveston Bay System. TPWD will be the lead agency for by-catch and endangered species monitoring

MONITORING ELEMENTS FOR BALANCED HUMAN USES

Public Health

The presence of contaminants in bay biota and pathogens in bay waters can have adverse human health effects. Concentrations of contaminants in bay fish and shellfish are used to assess risks to human health from the consumption of seafood. Levels of human pathogen indicators (fecal coliforms) in bay waters are used to regulate areas for shellfish harvesting and

may be used to develop a contact recreation advisory program. Maintenance of adequate public health standards within the estuary is critical for the protection of the general public and important for the long-term stability of the fishing and water recreation industries.

Programmatic Monitoring

Each of the public health plans are primarily environmental in nature. However, accomplishment of certain milestone activities can be administratively monitored. These are:

- Establishment of standards for selected toxics in tissue (PH-1)
- Adoption of an approved Risk Assessment Methodology for human consumption of seafood (PH-1)
- Increases in sampling frequency, in the Shellfish Sanitation Program (PH-3)
- Track trends in closures of oyster harvest areas (PH-3)
- Development of indicator organisms for the contact recreation program (PH-2)
- Tracking incidence of waterborne diseases resulting from contact recreation in Galveston Bay waters (PH-2)

Environmental Monitoring

The following broad monitoring objectives were used in developing the public health component of the regional monitoring program:

- Characterize the distribution and trends of selected toxics in fish and shellfish (PH-1)
- Characterize the distribution and trends of selected bacteriological indicators in estuarine waters and sediments (PH-3)

From these broad objectives and a review of the data required to assess effectiveness of the defined action plans, a list of indicator species for environmental monitoring for public health were developed. These species are outlined in Table RM-3.

Concentrations of Contaminants in Tissues of Indicator Organisms.

Concentrations of contaminants in edible portions of selected commercial fish and shellfish will be used to estimate contaminant exposures to humans through the consumption of seafood. Contaminant exposure levels will be used in health risk assessments to determine if seafood consumption poses unacceptable risks to human populations. Current tissue monitoring efforts are not adequate for development of human health risk assessments. Data are of an episodic nature, are many times single sampling events, and are generally limited to areas with known sources of contamination. Development of a seafood consumption safety program falls under the auspices of the TDH. Such a program will include establishing applicable standards, developing a periodic sampling and analysis program, and a public education program. The seafood monitoring program will be coordinated with the Regional Monitoring Program.

Bacteriological Indicators

Fecal coliform monitoring will be a Tier One element in the ambient water quality monitoring program. *The Plan* recommends development of a Contact Recreation Advisory program and designates the TDH as the lead agency. TDH is directed to utilize state TNRCC fecal coliform

standards for contact recreation, or other indicators if developed to create the advisory program. The ambient water quality program will collect fecal coliform samples according to TNRCC protocols. Development of an advisory program will require research to establish the relationship between water-borne illness, contact recreation and indicator organisms. Increased monitoring frequencies are scheduled to begin in 1999. The Monitoring Steering Committee will reassess monitoring frequencies and indicators for the purposes of this program once TDH has established the bacteriological indicator and monitoring needs.

Shellfish Sanitation Program

The TDH is the State Shellfish Control Authority responsible for administering the National Shellfish Sanitation Program (NSSP). Under this regulatory program TDH monitors 112 stations 12-30 times per year. From this monitoring data the Shellfish classification status of Texas estuarine areas is determined by TDH. Plan Action PH-3 addresses the need for increased sampling frequency.

Implementation

Current fecal coliform monitoring programs within the TNRCC, TDH, and GCHD will be coordinated through the Monitoring Steering Committee. The Galveston Bay Program will work with the TDH through the Monitoring Steering Committee, to implement a tissue monitoring program to meet the goals outlined by the Public Health Task Force. Upon development of the Contact Recreational Advisory Program by TDH, the Monitoring Steering Committee will assess current monitoring programs and make recommendations for modifications which meet the established monitoring needs.

**TABLE RM-3. Candidate Indicators and Measurements
for Public Health Protection**

<u>Candidate Indicators</u>	<u>Candidate Measurements</u>
Bacteriological Indicators:	
• Fecal coliforms	Colony counts
• Enterococcus	Colony counts
• Escherichia coli	Colony counts
Weather:	
• Precipitation	Amount and timing
Fish and Shellfish Tissue Contaminant Sampling:	
<i>Shellfish</i>	
• Blue crab	Edible tissue COC concentrations
• Oyster	Edible tissue COC concentrations

Fish

- | | |
|---------------------|----------------------------------|
| • Black drum | Edible tissue COC concentrations |
| • Southern flounder | Edible tissue COC concentrations |
| • Atlantic croaker | Edible tissue COC concentrations |
| • Seatrout | Edible tissue COC concentrations |
| • Redfish | Edible tissue COC concentrations |
-

Freshwater Inflow/Bay Hydrodynamics

Information describing the quantity and timing of freshwater inflow is needed to determine annual and seasonal inflow needs to the bay and estimate contaminant and nutrient loadings to the bay. Information describing bay hydrodynamics is needed to determine circulation patterns in the bay and assist in determining the fate and transport of contaminants and weak-swimming or passively transported biological resources. Baseline information for these parameters is needed so that future projects which may impact circulation and salinity gradients can be assessed for their impact.

Programmatic Monitoring

Activities to be monitored for achievement of programmatic objectives are:

- Completion of TWDB/TPWD inflow study (FW-1)
- The development of freshwater inflow management plans (FW-3)
- Monitor changes in state legislation, Section 11.147, to expand water use permitting authority for TNRCC (FW-4)
- Track trends in water consumption rates (FW-6)
- Survey municipalities and local water utilities for implementation of programs to utilize low water-use devices (FW-6)

Environmental Monitoring

The Freshwater Inflow Task Force members adopted the following broad monitoring objectives to be used in development of the Regional Monitoring Program.

- Characterize the status and trends in the quantity and timing of freshwater inflows to the bay (FW-1)
- Characterize the water quality of freshwater inflows (FW-1)
- Characterize the distribution and trends of selected water quality parameters in the bay (FW-2)
- Determine bay-wide, as well as habitat-specific, circulation patterns (FW-7)

Data that will be collected and analyzed as part of the freshwater inflow/hydrodynamics component of the regional monitoring program are listed in Table RM-4.

Timing, Volume, and Rates of Freshwater Inflow.

Freshwater inflow data are needed to gain a fundamental understanding of what levels and timing of freshwater flow are necessary to maintain the productivity of the bay. The goals of

long-term measurements of freshwater inflow volumes are to:

- Estimate contaminant, nutrient, and sediment loadings
- Identify potential causes for observed changes in salinity regimes
- Calibrate and validate hydrodynamic models describing Bay circulation patterns
- Explain and identify potential causes for observed changes in the abundance and distribution of Bay biota

**TABLE RM-4. Parameters used as Indicators of
Freshwater Inflow Quantity and Quality**

Candidate Parameters

Inflows - In areas with gauging stations

- Tidal flow
- Freshwater flow

Inflows - In areas without gauging stations

- Precipitation
- Runoff coefficients

Inflow Water Quality

In situ Measures

- Temperature
- Conductance
- pH
- Dissolved Oxygen
- Turbidity

Analytical Samples:

- Oxygen demand, BOD (5-day)
- TSS, VSS
- Nutrients:
 - Nitrogen - NH₃-N, nitrate, nitrite,
 - Phosphorous - Total and ortho-
- Carbon - TOC
- Fecal coliform
- Total/dissolved metal COCs
- Organic toxic COCs
- Pesticide COCs
- Ambient toxicity

Timing, volume, and rates of freshwater inflow may be directly measured at stream gauging stations. However, in areas without gauging stations, freshwater inflow must be estimated from measurements of precipitation and watershed area. Run-off estimates will be made from tables relating runoff coefficients to land use or from watershed ratios. Efforts will be made to

establish flow gauging stations where feasible.

Water Density.

Descriptions of water density are needed to identify distinct water masses and predict circulation patterns. Water density will not be measured directly, but determined from measurements of salinity (conductance), temperature, and pressure (depth). Vertical measurements of salinity (conductance) and temperature can be collected by passing a CTD (Conductivity-Temperature-Depth) unit through the water column. Information for this indicator will be routinely collected as part of the water quality monitoring element.

Current Speed and Direction

Long-term measurements of current speed and direction will be used to:

- Characterize and predict circulation patterns in the bay
- Describe the transport of contaminants, sediments, and larvae in the bay
- Calibrate and validate Bay hydrodynamic models

Circulation and transport information will be used to assist in identifying and predicting potential causes for observed changes in the abundance and distribution of Bay habitats and biota. This monitoring element will be conducted to establish a baseline understanding of these systems in the bay.

Implementation

Existing and projected monitoring efforts of the TWDB, TNRCC and USGS will provide information for this element of the monitoring plan.

Spills and Dumping

Programmatic Monitoring

Administrative tracking of action implementations is essential to the assessment of program success in this element. Most plan actions are administrative in nature. Examples of information to be used in tracking this element are:

- Establishment of MOU to delineate the roles of natural resource trustees (SD-1)
- Development of a compensation table for oil spills in Galveston Bay (SD-2)
- Identification of oil spill natural resource restoration needs (SD-3)
- Monitor local governments for ordinances requiring waste receptacles at shoreline facilities (SD-5)
- Surveys to track implementation of stormwater debris removal programs (SD-6)
- Maintain public hotline for reporting incidence of illegal dumping (SD-7)

Programmatic data needs for monitoring success of program objectives are:

- Records of environmental compensation
- Miles of shoreline evaluated under advanced shoreline characterizations
- Monitor numbers of shoreline waste receptacles put into service
- Conduct Galveston Bay debris survey every three years to monitor trends in debris characterization

Environmental Monitoring

Monitoring for this element in *The Plan* is primarily programmatic in nature. There are no specific environmental monitoring actions for this element. However, several monitoring initiatives are linked to this element. For example, habitat identification procedures can provide baseline information for identification of sensitive wetland habitats in the advance shoreline characterization action (SD-4). Other such indirect involvement includes baseline information on habitat quality.

Shoreline Management

Most actions under this plan element are programmatic in nature. Milestone achievements to be monitored under this element include:

- Designation of Galveston Bay as a Special Management Area under the CMP (SM-1)
- Create system to track development of local regulations consistent with CMP (SM-2, 3)
- Establish standards and guidelines for shoreline development (SM-2, 3)

Data information needs for assessing plan objectives include:

- Numbers of new recreational opportunities and access opportunities established around the bay (SM-5)
- Documentation of activities resulting in reduced negative environmental impacts to the bay (SM-4)
- Land use maps with adequate detail for shoreline planning (SM-1)

MONITORING ELEMENTS FOR WATER AND SEDIMENT QUALITY IMPROVEMENT

Programmatic Monitoring

The ultimate measure of success in this element will be measured in environmental terms. However, there are programmatic measures important to success of the Water Quality element. Examples of these measures are:

- Establishment of sediment quality criteria (WQS-3)
- Development of Total Maximum Daily Loads (TMDL) for toxics in Galveston Bay watersheds, (WQS-4)
- Incorporation of TMDLs for toxics into NPDES permit process (WQS-4)
- Monitor activities in support of Clean Texas 2000 (WQS-5)
- Track NPDES permit issuance (WQS-4, 6, & 7)
- Monitor TMDL studies for oxygen demand and nutrients (WQS-6 & 7)

Data information needs for programmatic monitoring include:

- Point and non-point nutrient and BOD loadings to Galveston Bay

Environmental Monitoring

Integration of information from multiple sources on the various resources of Galveston Bay, especially water and sediment quality, was determined to be a critical function for successful system-wide sampling. The adoption of a common sampling design agreed to by all participants in the regional monitoring effort will greatly contribute to this integration effort. Several potential spatial strategies were evaluated by the Monitoring Work Group. These included randomized sampling, stratified random designs and a probabilistic sampling model such as the one used in the EPA Environmental Monitoring and Assessment Program (EMAP).

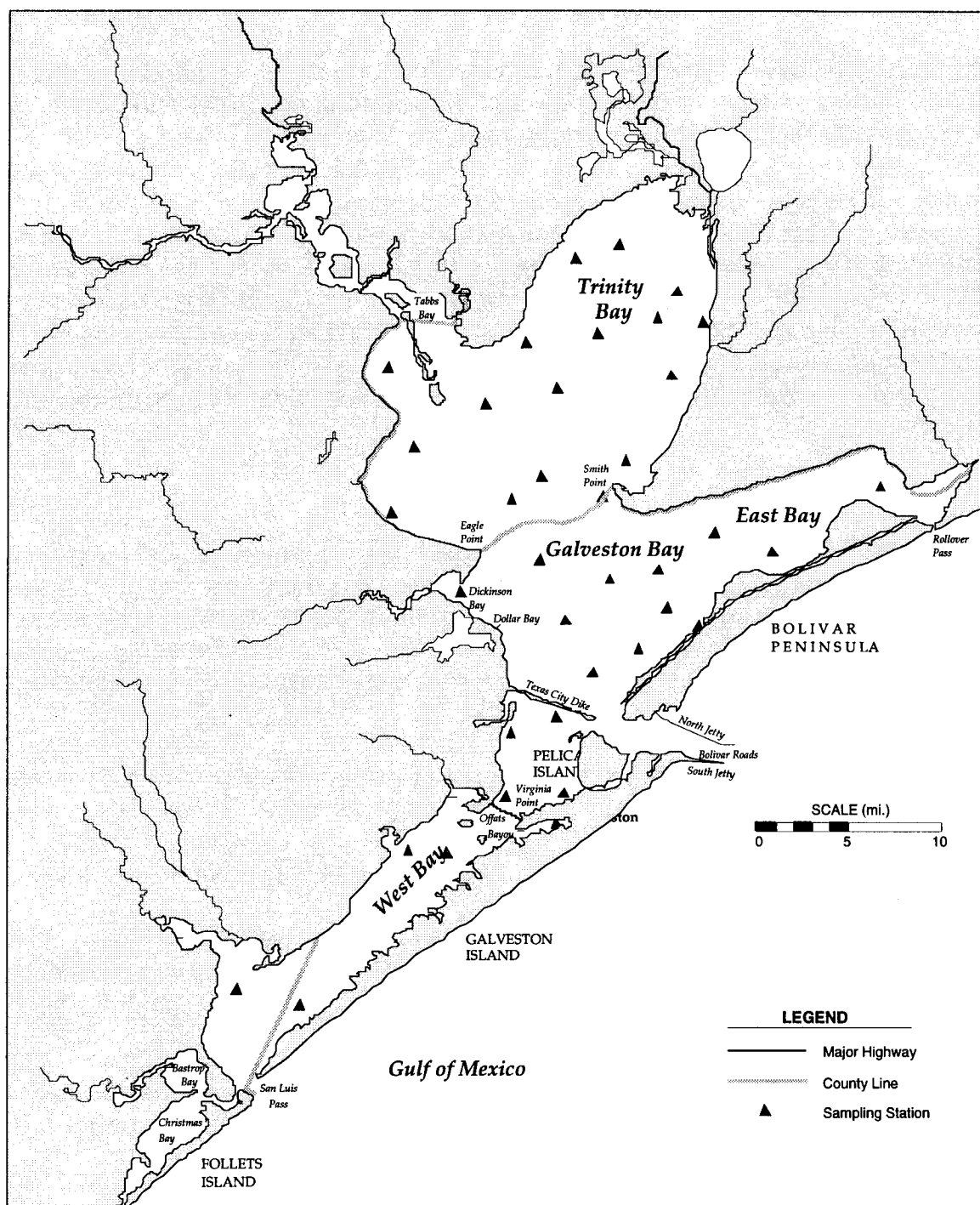
The spatial design model adopted for the open-bay water portions of the Regional Monitoring Program is the probability-based, hierarchical grid design utilized by EMAP. The design uses probability sampling theory to provide rigorous, unbiased estimates of environmental conditions. EMAP stated goals and objectives were determined to be consistent with our own:

- Estimate the current status and trends in the condition of ecological resources within a defined spatial scale, with known statistical confidence
- Seek associations among anthropocentric stress and ecological conditions
- Provide periodic statistical summaries and interpretive reports on ecological status and trends to resource managers and the public

Recently conducted R-EMAP projects, including one in Galveston Bay in 1993, have demonstrated the utility of the grid structure in addressing any spatially distributed and well defined ecological resource. In addition, this approach has been successfully applied to several estuary monitoring programs including the Delaware Bay, Tampa Bay and Sarasota Bay National Estuary Programs. In the opinion of the Work Group this design had numerous advantages over other considered designs.

Monitoring tidal stream segments is a second element in the Regional Monitoring Program. Tidal stream sampling design will coordinate current sampling efforts of monitoring entities. Adoption of comparable sampling and analytical methods will allow creation of a regional database incorporating data from all local and state agencies. This effort will be closely coordinated with the Texas Clean Rivers Program. Clean Rivers is a state program administered locally by the Houston-Galveston Area Council. Its goals are to provide coordinated river basin monitoring information utilizing a watershed management approach. Two major river basin watersheds for the Galveston Bay system are the San Jacinto and lower Trinity systems. The Monitoring Work Group is working closely with the regional Clean Rivers Program to ensure comparability with Galveston Bay Regional Monitoring Program sampling efforts. Close coordination with the Clean Rivers Program will assure a truly regional monitoring program which will include the entire Galveston Bay watershed.

The Monitoring Work Group adopted water and sediment quality assessment goals that would allow bay-wide determinations of estuarine conditions on an areal basis within ten percent annually. Sample site selection was made by randomly placing a 4-fold enhancement of the EMAP grid structure over the Galveston Bay area. The result is approximately 30-40 hexagons of approximately 70 km² with a 7.5 km distance between the grid centers. From these hexagons, random site selection procedures produced 34 sampling sites (Figure RM-4).



SOURCE: EPA, 1994

**FIGURE RM-4. Galveston Bay Regional Monitoring Program
Ambient Water and Sediment Quality Sampling Stations**

The Regional Monitoring Work Group acknowledges Dr. Kevin Summers of the EMAP-Estuaries program in Gulf Breeze, Florida, who provided the technical assistance for enhancement of the EMAP sampling grid system.

In addition to the goal of determining trends within 10 percent on an areal basis, biennial assessments of the statistical resolving power of the sampling plan, for trend detection, will be conducted by the Galveston Bay Program staff. This will be accomplished using the Macintosh based JMP[®] statistical package developed by the SAS Institute Inc. Power analysis evaluations of selected parameters from the historical data set, compiled during the characterization phase of the program, have demonstrated that sample sizes required to meet recommended power criteria of 80 percent are highly variable. For example, sample sizes designed to detect a 25 percent change from the historical mean for NH₃ - N, at a power level of 0.8 would require approximately 25 samples. In contrast, similar evaluations for TOC and total zinc would require only 4 and 17 samples respectively. Based on these estimates, the chosen sampling scheme will enable program staff to make reliable estimations of trends in Galveston Bay.

Water Quality

Estuarine waters represent an important habitat for many commercially, recreationally, and ecologically important organisms. These waters also represent a medium in which food, larvae, nutrients, and contaminants may be transported throughout the estuary. Water quality monitoring will provide information to characterize the condition of the aquatic environment, evaluate potential stresses to aquatic organisms, and track habitat recovery following adverse environmental impacts.

Broad water quality monitoring objectives aimed at providing information to assess action items were outlined by the Water and Sediment Quality Task Force. These are:

- Characterize the concentration and trends of selected toxics in Bay waters and sediments (WSQ-1)
- Characterize the magnitude and trends of toxicity in waters and sediments (WSQ-2)
- Characterize the magnitude, extent and trends of selected conventional water and sediment quality parameters (WSQ-1)

Based on these objectives and recommendations from Water and Sediment Quality Task Force members, the indicator parameters for water quality were selected and are outlined in Table RM-5. Tier One Water Quality parameters will be collected quarterly at a minimum and Tier Two parameters will be collected on an annual basis.

Contaminants of Concern

Not all chemicals in the environment warrant equal attention. Contaminants of concern (COCs) are a limited set of chemicals that may adversely affect bay biota and human populations. Concentrations of COCs are needed to characterize the condition of aquatic habitats and evaluate effectiveness of management actions. A primary objective of the Regional Monitoring Program is to measure attainment with state water quality standards for

chemical toxics. COCs will be established from state Surface Water Quality Standards Criteria which establish numerical levels for both aquatic life and human health protection.

TABLE RM-5. Parameters and Performance Criteria for Water and Sediment Quality

Ambient Water Column Tier One Monitoring:

Parameter

In s itu Measures

- Temperature
- Salinity
- Conductivity
- pH
- Dissolved Oxygen
- Turbidity, as Secchi depth
- Sample depth

Analytical Samples:

- TSS, VSS
- Oxygen demand, 5-day BOD (tributary monitoring only)
- Nutrients: Nitrogen - NH₃-N, nitrate, nitrite, Phosphorous - Total and ortho-Carbon - TOC
- Chlorophyll-a
- Fecal coliforms

Parameters for Ambient Water Column Tier Two Monitoring:

- Water Hardness (for salinity < 2 ppt)
- Dissolved Metal COCs
- Organic toxic COCs
- Pesticide COCs
- Ambient toxicity

Parameters for Sediment Quality Monitoring:

- Grain size (to be developed)
- Sediment bound metals
- Sediment bound organics
- Benthic community assessments
- Sediment toxicity tests
- Acid Volatile Sulfides (to be developed)

Continuous Monitoring for Dissolved Oxygen

Areas within the bay system, sensitive to variations in DO will be monitored with continuously recording instrumentation to supplement the DO measurements collected as part of Tier One sampling. This data will be used to evaluate diurnal patterns of DO and compliance with state water quality criteria. These probes will also provide data for conductivity, salinity, temperature and pH.

Concentration of Nutrients

Nutrients in bay waters can affect plant growth and, in certain instances, can result in algal blooms and eutrophication of bay waters. Conversely, low levels of nutrients can become limiting factors in the bay's overall productivity. Ward and Armstrong (GBNEP-22) performed a quantitative assessment of water and sediment quality over time. This characterization report highlighted significant reductions in suspended solids and nutrient loadings to the bay over the last two decades. These trends are of concern as a potentially limiting factor of productivity in the bay. This study emphasizes the importance and provides the foundation for further scientific study of nutrients in Galveston Bay. To address this concern, nutrient evaluations have been included as a major component of the water quality program. Monitoring nutrients in bay waters and inflows will provide information needed to 1) characterize ambient nutrient levels, 2) help explain and identify potential causes for observed changes in plant species composition, growth and/or distribution, and 3) help in assessing the status of nutrient loadings to the bay.

Phytoplankton

Phytoplankton provide a major direct food source for both the pelagic and benthic food chains in estuaries. Phytoplankton biomass is most frequently estimated through the measurement of chlorophyll-a concentration. As a potential enhancement to this program, evaluation of high-performance liquid chromatography (HPLC) methods of chlorophyll determination are recommended. HPLC provides the most accurate measurement of chlorophyll a, b, c and their degradation products. It can also provide information on relative proportions of pigments from which estimations of phytoplankton distributions can be made based .

Ambient Toxicity

Toxicity of bay waters will be evaluated using tests adopted from EPA toxicity methods. Both vertebrate and invertebrate species will be evaluated for their response to exposure to bay waters. Candidate freshwater tests are the seven-day chronic tests for *Ceriodaphnia dubia* and fathead minnow, *Pimephales promelas*, embryo larval and teratogenicity test. Candidate marine tests are the nine-day embryo-larval and teratogenicity chronic test for sheepshead minnow, *Cyprinodon variegatus*, and the 96-hour acute test for mysids, *Mysidopsis bahia*.

Physical Attributes

Salinity and temperature data will be used to identify distinct water masses, determine the areal extent of the influence of freshwater and Gulf of Mexico water inflow, and assist in explaining and identifying potential causes for changes in the abundance and distribution of salinity and temperature dependent biota. Contaminants tend to sorb to particulates in the water column. Measurement of total and volatile suspended solids will be used to estimate

bioavailable COC concentrations in bay waters. Suspended substances increase both the scattering and absorption of photosynthetically active radiation (PAR). A reduction in the depth to which light penetrates can result in reduced growth of phytoplankton and submerged vegetation. Turbidity, as Secchi depth, will be used to estimate light penetration in water. In areas of submerged aquatic vegetation direct measurement of light (PAR) will be made.

Implementation

Numerous agencies including the TNRCC, GCHD, HCPCD, City of Houston, USGS and TPWD have ongoing monitoring programs which supply information for evaluation water quality. A well coordinated effort of station location and parameter selection will allow integration of data collected from all agencies for inclusion in the Regional Monitoring database. Volunteer monitoring data will also be incorporated into the regional database.

Sediment Quality

Estuarine sediments represent an important habitat for many commercially, recreationally, and ecologically important organisms. Sediments also represent the ultimate sink for many chemical toxics in the estuarine environment. Sediment quality monitoring will provide information to characterize the condition of the aquatic environment, evaluate potential stresses to aquatic and sediment-dwelling organisms, and track habitat recovery following environmental interventions.

Based on *Plan* objectives and recommendations from Water and Sediment Quality Task Force members, the parameters listed in Table RM-5 will be collected as part of the sediment quality component of the regional monitoring program.

Contaminants of Concern

Concentrations of COCs are needed to characterize the condition of benthic habitats, provide early warnings of potential impacts to estuarine biota, and evaluate the effectiveness of management actions. Research strongly suggests that measurements of total organic carbon (TOC) and acid volatile sulfides (AVS) are needed to estimate bioavailable concentrations of selected organic compounds and metals, respectively. Development of these analytical capabilities by the TNRCC laboratory will be pursued. These parameters will be evaluated on a limited basis upon establishing analytical capabilities. Sampling and analysis of these parameters on a regular basis will be implemented upon adoption of sediment criteria requiring their use.

Benthic Invertebrates

The identification and enumeration of infaunal and epibenthic invertebrates will be used to characterize benthic communities, assess sediment quality, and assist in predicting potential impacts to bottom-feeding fish and birds. Number of species and dominance will be some of the metrics used to characterize the structure of the benthic communities. Functional characterizations of benthic communities will be based on dominant feeding types. Sediment quality will be assessed based on relative abundance of pollutant-resistant species, species richness, and dominance.

Depth of Aerobic Sediments

The depth of aerobic sediments provides a direct measurement of the biologically active zone. This will be used to determine the depth to which sediment samples will be taken. It is also important in the evaluation of the presence of particular benthic assemblages. Shallow aerobic sediments are often dominated by small polychaetes; whereas deep aerobic sediments typically support more diverse benthic communities.

Grain Size

The bioavailability of sediment contaminants are often correlated to sediment grain size. Grain size data are also needed to explain and identify potential causes for temporal and spatial variability in benthic communities: changes in grain size often affect an infaunal organism's ability to build tubes, capture food and escape predation.

Sediment Toxicity

Toxicity of bay sediments will be evaluated using sediment elutriate tests adopted from EPA toxicity methods. Both a vertebrate and invertebrate species will be evaluated for their response to exposure to bay sediments. Candidate freshwater tests are the seven-day chronic tests for *Ceriodaphnia dubia* and fathead minnow, *Pimephales promelas*, embryo larval and teratogenicity test. Candidate marine tests are the nine-day embryo-larval and teratogenicity chronic test for sheepshead minnow, *Cyprinodon variegatus*, and the 96-hour acute test for mysids, *Mysidopsis bahia*. These tests, as conducted by the US EPA Regional Laboratory for the TNRCC, have been shown to produce valuable information on bay-area sediment quality, especially in tributary sediments. These methods will be assessed over a two year period to determine if valuable sediment information is being obtained. Tests will be evaluated for appropriate modifications or elimination as indicated from a review of the data.

Implementation

The only current broad-based, long-term monitoring of bay sediments is conducted by the TNRCC. The Corps has a program which emphasizes sediment deposition in navigation channels. With sampling assistance to be provided by other monitoring agencies and increased resources within the TNRCC an expanded sediment monitoring effort will be implemented. This program will collect sediment samples from half of the water/sediment quality sites each year. Collections will be done during late summer months. Analyses will cover a wide range of organic and inorganic toxics and sediment toxicity testing.

Non-Point Sources of Pollution

Control of non-point sources of pollution is one of the most difficult areas of environmental management. The bay is impacted by urban and rural area runoff carrying toxics, sediment, bacteria and nutrients. This problem is compounded by the fact that losses in wetland habitats reduce the natural cleansing ability provided by these habitats. The plan to reduce the harm caused by non-point sources (NPS) is addressed through both regulation and public education actions.

Programmatic Monitoring

In response to *Plan* actions the following administrative monitoring actions will be implemented by the program office.

- The Program Office will develop a Galveston Bay Best Management Practices Performance Document for NPS control techniques (NPS-2)
- Success of public education programs directed at reducing NPS pollution will be evaluated (NPS-4 & 5)
- Submittal of the CMP Texas Coastal NPS Reduction Plan by CCC and GLO will be tracked (NPS-6)
- An NPDES stormwater permitting tracking programs will be implemented (NPS-8)

To properly assess these management program objectives data information needs:

- Local municipalities will be surveyed for progress in development of stormwater programs, shoreline septic tank ordinances, construction standards for NPS reductions (NPS-1, 4, 5, 6, 7, 12, & 13)
- Galveston Bay marinas will be monitored for implementation of sewage pumpout and storage facilities, and washdown activities at targeted marinas (NPS-14)
- Surveys targeted at boats will evaluate compliance with use of approved marine sanitary chemicals (NPS-15 & 16)

The first three goals (Actions NPS-1-13) of the NPS action plan call for reductions in NPS pollutant loads. Because of the diverse nature of NPS pollution it is not feasible to monitor every source of discharge. To address these objectives monitoring will focus on implementation of BMPs rather than onsite monitoring. Monitoring will be limited to BMP pilot studies from which projected loading reductions from implementation of BMPs will be determined.

Point Sources of Pollution

This action plan outlines means of improving the control of point source discharges into Galveston Bay. The routine operations of larger point sources are heavily regulated and have shown considerable improvement over the last 20 years. For this reason, this action plan focus on non-routine operations such as elimination of wet-weather bypasses and overflows at larger facilities and elimination of operational problems smaller discharges.

Programmatic Monitoring

The Program Office will implement tracking of the following activities related to point source action goals. These activities will include:

- Issuance of TNRCC administrative orders requiring studies to identify overflow and bypass problems (PS-1 & 2)
- Tracking submittals of corrective action plans of larger POTWs to address identified bypass and overflow problems (PS- 1 & 2)

- The Steering Committee will have responsibility for 1) review and modifications to monitoring elements, 2) creating new monitoring program elements, as appropriate; 2) developing new protocols; and 3) managing, interpreting, and reporting regional monitoring data.
- The Steering Committee will work to involve all parties (federal, state, and local agencies, research institutes, and academic institutions) engaged in monitoring and research in the estuary to maximize the usefulness and efficiency of public moneys spent on monitoring, but it will not dictate changes in ongoing agency monitoring programs.
- The Steering Committee will not make policy recommendations on regulatory or management issues. The Steering Committee will, however, seek to provide relevant information to policymakers and bring identified problems to the attention of policymakers and the public. It will establish policy on monitoring and recommend research needs related to monitoring efforts.
- The Steering Committee will be responsible for effective translation of scientific data (its own and that of others) in terms that policymakers and the public can readily understand. A periodic report on conditions in the estuary will be produced and distributed.
- The Steering Committee will be accountable to the Galveston Bay Council.

Galveston Bay Program Office

The Galveston Bay Program Office will have full-time staff responsible for monitoring action implementation and outcomes. The Galveston Bay Program Organization Plan will be structured to mirror initiatives found in *The Plan*. Every *Plan* Action will be managed by one of four organizational groups. These groups are Water/Sediment Quality, Natural Resources Uses, Monitoring and Research, and Public Participation. The Program will track implementation of *Plan* Actions, submit annual reports of these activities, implement any actions which *The Plan* delegates to the Program Office, and work with other lead agencies to develop assessment tools to measure the effectiveness of *Plan* actions.

COMMUNICATING RESULTS: DATA AND INFORMATION MANAGEMENT

One of the limitations of estuary monitoring systems across the country, including Galveston Bay, is that results from different monitoring programs are not easy to compile for ecosystem analyses. Agencies maintain different data bases and report formats, acquisition of data can be time-consuming, and no centralized data management system is currently available to report on overall trends. To alleviate these problems, a Data and Information Management System (DIMS) for Galveston Bay has been developed as an integral part of the Regional Monitoring Program.

DIMS Objectives

The Galveston Bay DIMS has been structured to meet the following objectives:

- Ensure the long-term integrity, storage, and accessibility of high-quality data collected by Galveston Bay's Regional Monitoring Program.
- Ensure data quality.
- Improve the access to information at various decision-making levels.
- Facilitate the integration and analysis of existing physical, chemical, and biological data to generate information useful to resource managers.
- Support statistical, graphical, spatial analysis and mapping of monitoring data, (e.g. power analyses, computer-compatible geographic information system (GIS) format).

Summary of Agency Data Management Systems

There are 19 programs presently conducting monitoring in Galveston Bay. In most cases the data are stored 1) on in-house computers under a variety of formats, or 2) on paper. Although most data are made available to the public, access is often difficult. There is no central data storage system that would allow easier access for the public or the agencies presently concerned with monitoring Galveston Bay. Some duplication of effort is noted, particularly for point source monitoring. Most efforts are directed at fulfilling specific agency mandates and have not been geared to ecosystem scale assessments. Ward (GBNEP-22) cites numerous challenges encountered in compiling 26 data sets for such an analysis. Publications GBNEP-7 and 8 also document monitoring deficiencies encountered in obtaining and compiling historical data sets. To address some of these problems during the development of *The Plan*, several GBNEP projects were conducted to compile data sets from diverse sources and to allow easy exchange of existing bay information. For example, the Galveston Bay Information Center was developed to serve as a clearinghouse for all types of literature about the bay.

There are several existing database management systems (DBMS) and GIS systems running on various platforms at the local, state, and federal agency level. The diversity of existing and planned DBMS applications, GIS applications, and hardware platforms at the agency level reveals a determined use of best available technology. However, these conditions have made it difficult for agencies to access, query, transmit, and analyze resource data in an efficient and timely manner. Getting different DBMS on different hardware platforms to communicate is technically challenging. Currently, no statewide computer network system exists to quickly and easily share data among state and federal resource agencies.

In 1989 the Texas Legislature enacted legislation which requires that state agencies share information and information resources. In the same year, the Department of Information Resources (DIR) was established to provide the leadership role in this area. From this effort two planning groups important to the Galveston Bay DIMS have been formed. The GIS Planning Council was formed to make recommendations to DIR concerning GIS coordination. The GIS Standards Committee was formed to develop and/or recommend GIS technical standards to DIR. Statewide efforts have not specified the use of specific DBMS software or networking hardware products to agencies. Because no single existing system or network of systems currently exists to accommodate Galveston Bay's regional monitoring data, GBNEP has planned a regional DIM system that conforms to existing and planned statewide agency and information management plans wherever possible.

Design of Galveston Bay DIMS

The Galveston Bay DIM system will be implemented in phases. In the first phase, Galveston Bay's DIM will emphasize standardized data file structures and implementing data storage and retrieval from a centralized system. Centralizing data to one database server will simplify the tasks of storing, maintaining, locating, querying, and retrieving regional monitoring data. Later phases will include modifying the system to include linking all participating agency database servers on a Wide Area Network (WAN).

Participating federal, state, and local agencies will be assigned primary responsibility for adapting standardized formats for data collected by their program. All water and sediment quality data collected will be submitted to the Houston-Galveston Area Council (HGAC). Additional roles to be performed by the HGAC include data quality assurance and handling data requests for regional monitoring data. A direct link will be established between the Galveston Bay Program Office and the HGAC. HGAC will serve as custodian and repository for all Galveston Bay regional monitoring data. HGAC has been named as a regional provider in the state data information system and is responsible for data management of the Texas Clean Rivers Program in the Galveston Bay area. Once this system is established the Program Office will be able to access all information through their HGAC link.

Future planning will allow all contributing agencies wide-area LAN access to this system for data input and on a read only basis through the HGAC Office. Base maps of interest to many agencies will be stored, managed, and accessed at a centralized location within the Galveston Bay Program Office as well as HGAC. Particular emphasis will be placed on keeping all agencies in the information management loop through establishment of a committee to help define data formats and data structure.

Network Architecture

HGAC currently maintains a UNIX network with Hewlett-Packard workstations. This network is linked to a Novell network with approximately 100 personal computers (PCs). The UNIX workstations run Arc/Info GIS software and the PC's run in Windows environment.

In the future a WAN will connect database servers located at participating agencies. A network design that is inexpensively maintained and that allows individual users (i.e., workstations or dumb terminals) and local area networks (LANs) to be easily and inexpensively added to the system will be selected.

Data Types

The DIMS system will support the following data types:

- Discrete and continuous numeric monitoring data
- Nonparametric monitoring data (e.g., presence/absence data)
- Text or memo formats
- Maps and charts, i.e., geographically referenced data

Galveston Bay's DIMS system will store core base maps in a central location in accordance with the state GIS Planning Council's recommendation. Participating agencies may request copies of specific core base maps and have them mailed on magnetic disks or optical CDs.

A standard file structure will be established for each data type (e.g., water quality data, population abundance data, toxicity testing data). The standard file structures will link QA/QC information and other data to their parametric and geographically referenced data. Directly linking meta- and monitoring data will ensure that information needed to assess the quality of monitoring data will not be lost.

Data Quality Assurance / Quality Control (QA/QC)

Maintaining the integrity of data stored in the system is critical to ensuring user confidence in the system. Data stored in the central database can be queried, read, copied, and downloaded initially only through requests to HGAC or the Program Office. As direct access to the system is established users of the system will have read only access. Additions and updates to the data will only be made through standard quality control protocols.

Standardized procedures for checking submitted data will include: computerized code and range checking, technical data review, and preparation of a data QA abstract. The data abstract is for describing sampling and analytical methods, QA/QC information, and any other pertinent metadata information needed to assess data quality.

GIS

GIS capabilities are viewed as an important tool for this program to complete and achieve its mission. However, it is not necessary that the Galveston Bay Program develop comprehensive GIS analytical capabilities at this time. Personnel and budgetary requirements to maintain such a system would be prohibitory. For this reason an ARC-INFO ARCVIEW system electronically linked to the main server at HGAC will be the level of entry into GIS. ARCVIEW allows the integration of intermediate and final GIS products needed for this program. Core GIS data sets will be kept and maintained at the Program Office or accessed through the direct link with HGAC. Most of these data are readily available from sources such as state and federal agencies. This system would allow GBNEP to integrate and maintain all of its data sets geographically.

DIMS Systems Administration

Galveston Bay's DIMS Steering Committee will be responsible for overseeing the implementation of the DIMS, approving all DIMS system modifications, and securing future funding sources. The HGAC will be responsible for administration of the Regional Monitoring Data system. These responsibilities will include:

- Providing DBMS technical support to agency database managers and system users
- Designing and implementing user interfaces and/or other system applications

- Securing sources of financial support for the system

Additional specific responsibilities will include supervision of system quality assurance and implementation of system upgrades.

Communicating Monitoring Results

The system will support the following user groups:

- Galveston Bay Council
- Technical and scientific staff of participating agencies
- Technical and scientific staff of non-participating agencies
- Private industry
- Public interest groups
- Schools
- General public

Technical staff of non-participating agencies, private industry, public interest groups, schools, and the public will have access to raw monitoring data. In addition there will exist the ability to retrieve selected summary statistics and display these data on core base maps. Requests for data will be handled through HGAC or the Program Office. In the future the Program Office will support evaluation programs for development of direct link data service centers at strategic locations. These would be established to support direct access to the system for non-participating agencies, private industry, public interest groups, schools, and the general public. Selected bay-wide summary statistics will be available to the public for downloading at the service centers. Requests for raw regional monitoring data will continue to be made through the HGAC or the Galveston Bay Program Office.

Information from The Galveston Bay Regional Monitoring Program will be available in two formats: technical reports for the scientific community and non-technical briefs for the lay public. Programs will be written to automatically conduct the appropriate data queries, data retrievals, data analyses, and data presentations (e.g., graphs, maps). Ad hoc analyses may be used, as needed, to supplement these fundamental data analyses. A set of most requested bay information may be published in an annual report as well as made available on-line in the system.

The Galveston Bay Program Office will be responsible for comparing the results from the monitoring program with the objectives listed in *The Plan*. The comparison will be conducted for both environmental objectives and management objectives in *The Plan*. The comparisons will be conducted on an annual basis and summarized in the DIMS system. In addition a more robust bay-wide analysis of the data will be conducted every two years, with Galveston Bay Program staff presenting evaluations of implementation findings through the State of the Bay Symposium.

Bay Barometer

A potential tool for communicating the status of the health of the ecosystem is the development of a Galveston Bay barometer similar in approach to the one used in the Chesapeake Bay Program. For example, such a barometer could include several easily measured components of the Galveston Bay system, such as:

- Trends in species abundance (key species sampled by TPWD)
- Water quality (index of key TNRCC parameters, such as DO and FC)
- Seafood consumption safety (based on planned risk assessments of seafood)
- Habitat (planned studies showing the change in wetland and reef areas)
- Areas opened to oyster harvest

Using these types of data, a simple index could be developed for each component, and a total number that indicates the general health of the ecosystem could be provided. This number could then be used as a simple, general yardstick to tell the public how the bay is doing. The Bay Barometer concept will be developed by the Galveston Bay Program Office.

Sources of Financial Support

Several candidate sources of financial support for the implementation and maintenance of the DIMS system were identified by the Data and Information Management Task Force, including

- Corporate sponsors
- Other state-wide or gulf-wide data sharing projects
- Line-item support from the State

Private sector corporations and software/hardware vendors will be sought out to sponsor, in part, the cost of hardware and software needed to implement the DIMS system. Candidate corporate and vendor sponsors will be aggressively pursued by the chair of the Regional Data Management Steering Committee and the DIMS systems administrator.

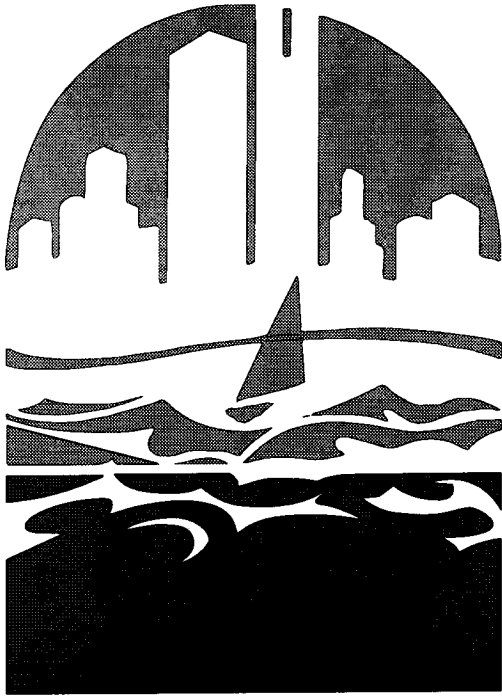
Furthermore, the implementation of Galveston Bay's DIMS system may be partially supported through other statewide or gulfwide data management projects including the Coastal GIS Initiative, the Natural Resources Inventory, the Texas Clean Rivers Program , and the Gulf of Mexico Program (GMP).

The Chair of the Regional Data Management Steering Committee and the DIMS systems administrator will pursue all statewide and Gulf Coast financial sources. The Chair of the Regional Data Management Steering Committee and the DIMS Systems Administrator will aggressively approach the legislature to seek line-item status for Galveston Bay's DIMS system.

TIMETABLE

A detailed timetable for analyzing the data and assessing program performance will be developed at a later date.

This chapter was based on material provided in the Regional Monitoring Program report prepared by Tetra Tech, Inc.



VII.

The Public Role in Drafting *The Galveston Bay Plan*

The Public Role in Drafting *The Galveston Bay Plan*

***The Galveston Bay Plan* Galveston Bay National Estuary Program**

Strong involvement by the public has been indispensable to the development of *The Galveston Bay Plan* and will be critical to *Plan* implementation. Public review and comment on *The Plan* are key elements of the Clean Water Act and U.S. Environmental Protection Agency (EPA) guidance for National Estuary Programs. The Galveston Bay National Estuary Program (GBNEP) recognized a need for public involvement with *The Plan* beyond the level required by EPA guidance. Consequently the public began to have a strong role early in the development of *The Plan*.

The Management Conference recognized early in the program that the success of the GBNEP would be directly related to the public support and enthusiasm generated by the program to ultimately lead to public support and funding for implementation of *The Galveston Bay Plan*. In the final analysis, creation of public policies in *The Galveston Bay Plan* depends upon a high degree of awareness and involvement of citizens, particularly those whom the policy affects.

Public Participation Activities

Since its inception, GBNEP has conducted an intensive public outreach/education program. When the GBNEP began in 1989, a Citizen's Advisory Steering Committee (CASC) was established. Appointments to this committee included a variety of stakeholder interests: industry, shipping, recreational boating, commercial and recreational fishing, development, agriculture, and environmental groups. The committee has been instrumental in assuring that citizen/stakeholder perspectives are at the forefront of planning. The Public Participation program has been supported by three full-time staff for most of the program and about 25 percent of the GBNEP budget has been dedicated to Public Participation activities. CASC undertook several projects that were aimed at fostering public awareness and involvement with the GBNEP and the development of *The Galveston Bay Plan*. A discussion of the major outreach efforts is presented below.

Speaker's Bureau. Public Participation staff coordinated hundreds of outside speaking engagements by volunteer Management Conference members and staff. Invitations were solicited from diverse organizations for programs involving slide presentations and speeches.

Efforts were made to find new groups to involve in *The Galveston Bay Plan*, and to revisit groups reached in previous years to update on the progress of *Plan* development.

Citizen's Monitoring. This initiative of the GBNEP provided for establishment of a bay-wide citizen monitoring program in conjunction with both the TNRCC and the Galveston Bay Foundation. Through this project, citizens from the bay area have been given the opportunity to directly support Galveston Bay management through "hands-on" activity. Volunteers collect water quality data in the field. This data is intended supplement the existing data collected by agencies, expanding the amount of information available to managers. Citizen monitoring is seen as a significant component of community involvement in the welfare of the estuary. Volunteers develop an enhanced interest in Galveston Bay and *The Galveston Bay Plan*.

BayLine. Since the beginning of the GBNEP, the program has published a quarterly newsletter. *BayLine* has been produced by staff, with articles contributed by a variety of organizations and individuals in the bay area. Content of the newsletter included: updates on the development of *The Galveston Bay Plan*, summaries of the published GBNEP reports, requests for public involvement with volunteer projects, and requests for information and input on specific issues that affect the development of *The Plan*. With a current circulation exceeding 10,000, *BayLine* has been an excellent line of communication with the general public regarding *Plan* development.

Portable Information Display. During the first year of the program a portable information display was designed. Since that time, the exhibit has been taken to dozens of events ranging from boat shows to the annual Bay Day event. The information display alone has reached hundreds of thousands of individuals. Promotional items and educational giveaways designed to help build recognition of the GBNEP and its goals in bay protection were distributed at these events. Exhibiting has provided an opportunity for the GBNEP to "meet the public" and discuss the developing *Galveston Bay Plan*.

Publication Series. The GBNEP has published some 50 documents over the life of the program. Most GBNEP projects conceived to identify status, trends, and probable causes of priority problems were published in a "Green Cover Series" to communicate findings to members of the public involved in review of *The Galveston Bay Plan*. Findings of these technical projects justify and shape *Plan* initiatives and therefore contribute to informed public participation and review. Two Galveston Bay Handbooks were also published. *The Recreational User's Guide* identifies fishing habitat, boating rules, birding areas, and general recreational information about the bay. *The Bay Area Residents' Guide* describes actions residents in the area can take to minimize and prevent non-point source pollution, including recycling information, native plants, and proper fertilizer/pesticide use. Each publication is distributed to all Management Conference members for use within their own agency or organization. Distribution of materials to the general public in the Houston-Galveston area has relied heavily on regional and local libraries - with over 60 libraries on the distribution list - to develop the maximum participation in *Plan* development and general awareness of the need for management of this ecosystem. The documents have also been made available to the public upon request throughout the program.

Galveston Bay Information Center. The GBIC is a bay area center to house the special reference collection of Galveston Bay literature and media for use by the scientific community and general public. This project included two major components. First was creation of a five-year strategic plan for the GBIC, providing a clear vision for the future of the Center. Second is to develop User's Guides describing all aspects and features available for public use.

Videos. Throughout the program, the GBNEP has produced several educational and persuasive videos and public service announcements on comprehensive management of the bay and the ecosystem. These videos have been distributed for educational purposes to various organizations. The videos have been used by the public, for group meetings, in the classroom and in conjunction with the informational booth.

Bay Day. The purpose of Bay Day, a joint effort of the Galveston Bay Foundation and the GBNEP, is to call attention to and celebrate Galveston Bay by providing bay-oriented family activities for all ages, thereby increasing public awareness of the bay's value and diversity of uses. The event is volunteer-intensive with heavy involvement by the GBNEP Public Forum and volunteers from outside organizations. Many activities are education-oriented, with numerous booths and educational activities. The GBNEP Management Conference has determined that this festival is useful for increasing public awareness of the bay and its competing uses and has provided planning funds each year to help assure the event becomes a permanent, self-sustaining endeavor.

Citizen's Pollution Reporting and Response System. This project was operated out of the GBNEP program office and served as an excellent vehicle for making citizens aware of the program and *The Galveston Bay Plan* development process. The project was implemented in 1992 to address some long-standing problems: (1) the inability of many average citizens to report pollution, due to an elaborate mosaic of more than 20 government jurisdictions involved in pollution response; and (2) the lack of any centralized database describing pollution incidents for the bay and its watersheds, to help focus pollution management. The "Hotline" was designed to offer citizens the opportunity to report pollution incidents involving air, land or water, with a single toll free phone call—regardless of which government agency is involved in the response process.

Two user polls involving 240 different citizen callers revealed a highly positive public response to the CPRRS. Following an evaluation by the GBNEP Management Conference of the demonstration phase, the Policy Committee voted unanimously in March, 1993, to permanently implement the program in the Texas Natural Resource Conservation Commission, Houston Region Office. On September 1, 1993, the Citizen's Pollution Reporting and Response System was successfully relocated to that office.

The Role of Public Review in the Development of *The Galveston Bay Plan*

When the GBNEP was getting started, public meetings were held to obtain citizen input on program goals and priority problems in Galveston Bay. Citizens were also brought together to discuss Christmas Bay and Armand Bayou Coastal Preserves, citizens monitoring, and oil spill response. A total of 20 meetings were conducted between April 10, 1989, and April 24, 1991.

The resulting priority problems list included the input of bay area citizens and was used to guide studies aimed at determining the status and trends of the conditions in the bay. Characterization of these priority problems was the first step in developing *The Galveston Bay Plan*.

Between November 9 and 19, 1992, six public meetings were held in the Galveston Bay area to collect public comments about issues affecting management of Galveston Bay and to inform the general public about the developing *Galveston Bay Plan*. (see Table PR-1) These meetings were located in Anahuac, Baytown, Clear Lake, Galveston, Houston, and Lake Jackson. Cumulative registered attendance at the meetings was 337 persons. In a few cases, particularly the Houston and Clear Lake meetings, more people attended than registered. There was a total of 42 speakers at the meetings, 19 of whom submitted written text of their comments, with 11 written comments submitted by mail to the GBNEP office. Verbal comments were from citizens representing themselves, representatives of industry, non-profit organizations, commercial and recreational fishing interests, and local governments. Written comments reflected the same distribution.

TABLE PR-1. Summary of Public Meeting Attendance

Date	Location	Attendance	Comments
November 9	Houston	86	11
November 10	Baytown	58	9
November 12	Clear Lake	90	6
November 16	Galveston	64	9
November 17	Lake Jackson	22	3
November 19	Anahuac	22	3
All		337	42

To prompt comments, the GBNEP issued a 26 page document (plus glossary and appendices) entitled *Managing Galveston Bay: Issues and Alternatives—Public Discussion Summary*. This document was a brief summary of topics discussed by the sixteen GBNEP Action Plan Task Forces charged with developing *The Galveston Bay Plan*. Citizens interested in more technical details were given the opportunity to obtain a larger, more detailed version, entitled *Draft Discussion Items and Possible Management Strategies*. In addition, *BayLine* issue #13 was dedicated entirely to summarizing the Issues and Alternatives Document. This was mailed to approximately 7,000 readers in late November, allowing them time to obtain a public discussion document and submit comments.

The public was made aware of the availability of the summary document and encouraged to attend the public meetings through a variety of forms: news releases to area media; paid display and legal notice advertising ran in *The Houston Chronicle* and *The Houston Post* as well as seven other local papers; articles and notices in environmental group and civic association newsletters; postcards mailed to all *BayLine* subscribers; speeches by staff and volunteers to targeted groups and organizations; and, flyers distributed by conference members and word-of-mouth. One-page "news advisories," or reminders of the meetings, were faxed to radio stations and newspapers in the locale of the meetings one to two days in advance of each meeting. The news releases resulted in several newspaper articles before the meetings, one

television story during the meetings, and numerous radio announcements. An informal verbal survey of meeting attendees indicated that all of these efforts paid off—in other words, each promotion vehicle prompted people to attend a meeting or send in a written comments.

The issues and alternatives document was distributed to the Management Conference members, at meetings of interested groups requesting GBNEP speakers, and to anyone who requested one as a result of advertising and promotion of the public meetings. Numerous Management Conference members assisted in distribution by sharing the document with their colleagues and the entities they represent.

GBNEP staff and volunteers gave presentations at the meetings and answered questions from the audience. Citizens were given time to speak formally to the audience and informally discuss their concerns about the bay with GBNEP staff and Management Conference members. Both GBNEP staff and the citizens in attendance expressed the feeling that the meetings were productive.

Concerns raised by attendees at the meetings included the following issues.

- Reduce toxics and solids discharges to the bay (Baytown, Galveston, and Houston participants).
- Protect wetlands and preserve wildlife habitats (Anahuac, Baytown, Clear Lake, and Houston participants).
- Evaluate dredging and filling impacts on oyster reefs (Anahuac, Clear Lake and Houston participants).
- Enhance freshwater inflow into the bay (Baytown, Clear Lake, Galveston, and Houston participants).
- Encourage public participation and support (Anahuac, Baytown, Galveston, Houston, and Lake Jackson participants).

In addition to the comments received at the meetings, written comments were submitted to the GBNEP office during an open comment period that ended December 31, 1992. Spoken and written comments reflected wide-ranging support for the concept of a comprehensive management plan for Galveston Bay (Table PR-2).

TABLE PR-2. Distribution of Verbal and Written Comments

Participant Affiliation	Verbal Comments		Written Comments	
	Number	Percent	Number	Percent
Unaffiliated Citizens	18	43	12	48
Environmental/Nature Groups	13	31	6	24
Commercial Fishermen	5	12	1	4
Petroleum/Chemical Corporations	3	7	1	4
Industrial Organizations	1	2	1	4
Commercial Fishermen's Organizations	1	2	1	4
Local Government Agency	1	2	1	4
Marina-related	-	-	1	4
Engineering/Consulting	-	-	1	4

Following public review of the Issues and Alternatives document and based on the comments and suggestions received during those meetings, a pre-draft *Galveston Bay Plan* was developed. The pre-draft *Plan* was reviewed and revised by the GBNEP Management Conference and Task Forces numerous times. The pre-draft *Plan* was also reviewed by numerous "focus groups" through an active outreach program sponsored by the GBNEP. These focus groups included industry, environmental groups, local governments, and others. Fifty-six focus group meetings were held between June 1993, and May 1994 (see Table PR-3). The direct involvement of these parties helped shape the draft *Galveston Bay Plan* that was unanimously approved by the GBNEP Policy Committee for release for public review on April 18, 1994.

TABLE PR-3. Schedule of Focus Group Meetings to Present *The Galveston Bay Plan*

DATE	FOCUS GROUP MEETING
June 30, 1993	Greater Houston Partnership/Clean Water Coordinating Council
July 9, 1993	Local Government <i>Galveston Bay Plan</i> Workshop
August 27, 1993	Texas Chemical Council
October 11, 1993	Clear Lake Marina Operators Association
October 13, 1993	Houston Canoe Club
October 15, 1993	Speaker of the House and key staff
October 15, 1993	Lieutenant Governor and key staff
October 21, 1993	Coast Guard Auxiliary
October 26, 1993	City of LaPorte City Manager and key staff
October 27, 1993	East Harris County Manufacturer's Association
October 28, 1993	Governor's key staff
November 9, 1993	Texas Waterway Operators Association
November 19, 1993	Galveston Bay Cruising Association
December 17, 1993	Coastal Coordination Council
January 5, 1994	Soil Conservation Service District Conservationists and Chambers County Landowners
January 6, 1994	Coastal Management Program/ <i>Galveston Bay Plan</i> coordinating session
January 11, 1994	Baytown Advisory Committee
January 12, 1994	General Land Office special area planning session
January 15, 1994	Environmental Defense Fund
January 24, 1994	Liberty County Judge and Commissioners
January 24, 1994	City Council and Mayor of LaPorte
January 25, 1994	City Council and Mayor of Pasadena
January 26, 1994	Galveston County Mayors and Council Members Association
January 27, 1994	City Council and Mayor of League City
January 27, 1994	Houston-Galveston Navigation Safety Advisory Committee
February 1, 1994	City Council and Mayor of Deer Park
February 10, 1994	City Council and Mayor of Galveston
February 10, 1994	City Council and Mayor of Baytown

Schedule Continued

DATE	FOCUS GROUP MEETING
February 14, 1994	Galveston County Mayor and Council members and State Reps. Mike Martin and Patricia Grey
February 2, 1994	City Council and Mayor of Texas City
February 3, 1994	City Council and Mayor of Alvin
February 9, 1994	Clear Lake Council of Mayors
February 15, 1994	Houston Galveston Area Council Board
February 15, 1994	Galveston Bay Foundation Board
February 17, 1994	Houston Yacht Club
February 17, 1994	Harris County Mayors and Council Members Association
February 21, 1994	Harris County/City of Houston key staff
February 24, 1994	Solid and Hazardous Waste Symposium
February 25, 1994	Houston-Galveston Area Council/Texas Clean Rivers Basin Advisory Group
February 25, 1994	City of Houston key staff
February 28, 1994	Brazoria County Judge and Commissioners
February 28, 1994	Chambers County Judge and Commissioners
March 3, 1994	Houston-Galveston Area Council - Natural Resource Advisory Committee
March 8, 1994	Brazoria County Flood Control District
March 9, 1994	Houston Audubon Society
March 21, 1994	Bayou Preservation Association
March 29, 1994	City of Houston Director of Public Works and key staff
March 29, 1994	Governor's Environmental Staff
April 13, 1994	Galveston Bay Conservation and Preservation Association
April 15, 1994	Environmental Trade Fair - Austin
April 21, 1994	Clear Creek Sierra Club
April 27, 1994	Greater Houston Partnership
May 11, 1994	East Harris County Manufacturer's Association
May 20, 1994	Texas Chemical Council
May 24, 1994	Planner's Association Meeting

Between May 18, and June 7, 1994 another round of public meetings was conducted in the Galveston Bay area to offer citizens an opportunity to comment on the draft *Galveston Bay Plan* and to have questions answered. The nine meetings were located in Anahuac, Baytown, Clear Lake, Galveston, Houston, Lake Jackson, LaPorte, and Texas City (see Table PR-4). Cumulative registered attendance at the meetings was 322 persons. There was a total of 77 speakers at the meetings.

TABLE PR-4 Summary of Public Meeting Attendance

Date	Location	Attendance	Comments
May 18	Anahuac	60	15
May 19	Texas City	29	9
May 24	Houston	33	9
May 25	Lake Jackson	13	4
May 26	Galveston	53	6
May 31	Houston	15	3
June 1	LaPorte	25	10
June 2	Clear Lake	56	12
June 7	Baytown	38	9
All		322	77

To facilitate public review of *The Plan*, a summary was produced. This document was a brief synopsis of the problems facing Galveston Bay and the proposed solutions. Persons interested in the details of *The Plan* were invited to request a copy of the larger document from the Program Office. Both *The Galveston Bay Plan* and the summary were made available for review at approximately 60 public libraries in the five-county area. In addition, *BayLine* Issue #18, mailed to approximately 10,000 readers in early May, summarized *The Plan* and encouraged public comment.

Example Public Meeting Notice
Galveston Bay National Estuary Program

Public review and comment is invited on the draft of the *Galveston Bay Plan*, to be submitted in final form to Governor Ann Richards and EPA Administrator, Carol Browner in the Fall of 1994. *The Galveston Bay Plan* addresses public health, living resources, habitat, water quality and physical conditions in order to manage Galveston Bay as a single integrated ecosystem. The Galveston Bay National Estuary Program is seeking your comments on this comprehensive plan to help shape the future management of the Bay. Citizens, industry, shipping, business, development and government entities have been working for five years to develop the Comprehensive Conservation and Management Plan.

Wednesday, May 18, 7:00 p.m.

American Legion Hall
Fort Anahuac Park, Anahuac

Thursday, May 19, 7:00 p.m.

College of the Mainland, Room L131,
Auditorium of Library
1200 Amburn Road, Texas City

Tuesday, May 24, 10:00 a.m.

Houston Garden Center, Auditorium
Hermann Park
Museum of Natural Science, Houston

Wednesday, May 25, 6:30 p.m.

Brazosport Center for Arts & Sciences,
Art Gallery
400 College Drive, Lake Jackson

Thursday, May 26, 6:30 p.m.

Rosenberg Library,
Auditorium
2310 Sealy Avenue, Galveston

Tuesday, May 31, 6:30 p.m.

Tracy Gee Center,
Meeting Rooms A, B, and C
3599 Westcenter Drive, Houston

Wednesday, June 1, 7:00 p.m.

Sylvan Beach Park, Pavilion
1 Sylvan Beach Drive, La Porte

Thursday June 2, 7:00 p.m.

Nassau Bay Hilton
3000 Nasa Road 1, Nassau Bay

Tuesday, June 7, 7:00 p.m.

Baytown Community Center,
Meeting Room
2407 Market Street, Baytown

Please Note: The Deadline for written comments is July 1, 1994.

Galveston Bay National Estuary Program
711 W. Bay Area Boulevard, Suite 210
Webster, Texas 77598

(713) 332-9937
Fax (713) 332-8590

Citizens were informed of the opportunity to receive a copy of the draft *Galveston Bay Plan* and notified of the nine public meetings being held in the five counties surrounding Galveston Bay through a variety of mechanisms. An official notice for each meeting was sent to the *TexasRegister* and legal notices of the meetings were printed in both the *Houston Post* and the *Houston Chronicle* as well as many of the local papers (see box example). A postcard invitation was sent to all *BayLine* subscribers and the schedule of upcoming public meetings was placed on TNRCC OnLine, an electronic bulletin board.

A public education and information campaign (GALVESTON BAY: IT'S NOT JUST WATER, IT'S A WAY OF LIFE!) was also developed in conjunction with the release of *The Galveston Bay Plan* for public review. It was designed to create awareness of the relationship between lifestyles and bay pollution, to inform citizens of the availability of *The Plan*, the opportunity to comment on *The Plan*, and the schedule of public meetings. The campaign included both print and radio media. Two hundred and eighty four radio spots were aired on major Houston-Galveston area stations during drive time and prime time. A total of 37 print advertisements were placed in the *Houston Post*, the *Houston Chronicle*, four local daily papers and twelve area weekly papers, reaching a combined circulation of 2,004,644 people.

In addition to paid advertising, the GBNEP also initiated numerous press contacts. A press conference for major Houston media was held on April 18, 1994 to unveil *The Plan*. Six television stations were represented with reporters and camera crews, and all key print media were present. Media packets were mailed to 355 outlets, both print and electronic in early May. The packet included a news release, a schedule of public meeting dates and locations, recent news clippings, a fact sheet, and the summary of *The Plan*. Regional news releases were sent out just prior to each public meeting. Public Service Announcements were also drafted and distributed to radio stations. This activity generated some 40 requests for interviews, all accommodated by the GBNEP Program Director, and nearly all resulting in a published article about *The Plan*.

A four-minute video about the problems facing Galveston Bay and solutions proposed in *The Plan* was shown at the beginning of each meeting. The Program Director provided an overview of *The Plan* and invited citizens to comment and ask questions. Various members of the GBNEP Policy, Management, Scientific/Technical, and Citizen's Advisory committees participated as members of a panel to discuss various aspects of *The Plan*, and to answer questions.

Response to Public Comments

Public testimony was heard at each of the nine meetings. In addition, participants were provided with forms for written comments, copies of either *The Plan* or the summary, and other background materials produced by the TNRCC, the GBNEP and the Galveston Bay Foundation. Citizens were encouraged to submit written comments to the GBNEP office during an open comment period that ended July 1, 1994. Verbal and written comments were received from a wide range of bay stakeholders (Table PR-5).

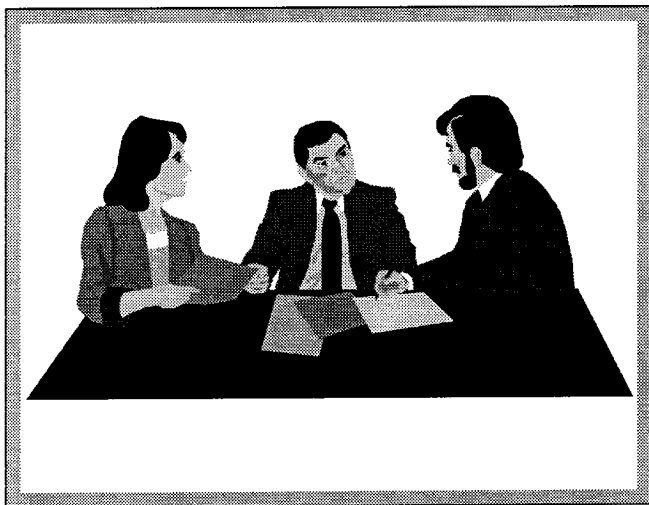
TABLE PR- 5. Distribution of Verbal and Written Comments

Participant Affiliation	Verbal Comments		Written Comments	
	Number	Percent	Number	Percent
Unaffiliated Citizens	45	62	18	29
Environmental/Nature Groups	15	19	6	10
Industry	0	0	3	5
Industrial Organizations	0	0	5	8
Marina Related	1	2	0	0
Engineering/Consulting	0	0	3	5
Federal Government	0	0	6	10
State Government	2	3	6	10
Local Government	12	16	15	24

To facilitate response to public comments, staff compiled a summary of all verbal and written comments by action plan. This summary was distributed to the Management Conference and used to guide deliberation. The majority of the comments received by the GBNEP resulted in minor revisions to *The Plan* that served to clarify the intent of the Conference. The major revisions to *The Plan*, as a result of public review of the document, are summarized below:

- Individual actions in *The Plan* (except the support actions) were ranked based on previously ranked goals and objectives. The Habitat section of *The Plan* was reordered to reflect the ranking.
- The Non-Point Sources of Pollution action plan was re-focused to reflect that the Coastal Coordinating Council has no intention of broadening the scope of the Coastal Management Program from the currently proposed rules.
- References to the regulatory use of CZARA Section 6217 Guidance, for any purpose other than a technical resource, were deleted from the Non-Point Sources of Pollution action plan.
- *The Plan* recommends utilization of the Draft Storm Water Quality Management Guidance Manual prepared by the Storm Water Management Joint Task Force as a key aspect of non-point source management.
- *The Plan* does not recommend use of performance based standards for Non-point sources. *The Plan* emphasizes the use of technology based best management practices.
- *The Plan* includes a description of how the major coastal programs (the Galveston Bay Program, the Texas Coastal Management Program, the Clean Rivers Program and the Gulf of Mexico Program) relate to each other.
- *The Plan* recognizes the need to comply with State and Federal historic preservation laws.
- *The Plan* includes a discussion of the Action Plan Demonstration Projects conducted by the program and how the results of the those projects influenced the content of *The Plan*.

Appendix J provides a summary of the major comments received from the public.



VIII.

Implementing and Funding *The Galveston Bay Plan*

Implementing and Funding *The Galveston Bay Plan*

The Galveston Bay Plan Galveston Bay National Estuary Program

OVERVIEW OF IMPLEMENTATION AND FUNDING

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This chapter describes implementation of *The Galveston Bay Plan* under a newly-created Galveston Bay Program (GBP) of the Texas Natural Resource Conservation Commission (TNRCC). The GBP office of the TNRCC will be located in the bay area. *The Galveston Bay Council* (GBC) comprised of natural resource agencies, stakeholders, and citizens involved in bay use and management will provide advice to the GBP on issues related to *Plan* implementation.

THE GALVESTON BAY PROGRAM OF THE TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Several management strategies were considered for implementation of *The Galveston Bay Plan*. The Galveston Bay National Estuary Program (GBNEP) Management Conference evaluated three such strategies: the Texas Natural Resource Conservation Commission (TNRCC), the Texas General Land Office (GLO), and the creation of a new independent management organization created by the Texas Legislature.

During development of *The Galveston Bay Plan*, creation of a new, independent entity (first called the “Galveston Bay Authority,” and later the “Galveston Bay Council”) was initially identified as the preferred alternative. Subsequently, numerous focus group discussions with local government officials revealed little support for any approach that would: 1) create a totally new government structure with any sort of authority over local actions; or 2) involve funding or collection of funds by local governments, (e.g. taxes or fees). In general, local officials did not find fault with *The Plan’s* initiatives; rather they were concerned with funding and the management structure for implementation. Funding of the program is closely tied to the management structure of the implementing organization. Funding of an independent entity would require passage of enabling legislation which identifies a funding source such as general revenue, a fee, or tax. In contrast, funding of an agency program would occur through that agency.

As a result of the involvement by local officials and further deliberation by the GBNEP Management Conference, the TNRCC was identified as the preferred implementing organization. Several factors were considered in the Management Conference decision:

- Most state initiatives in *The Plan* fall under the jurisdiction of the TNRCC. TNRCC is the regulatory authority for the majority of the state-initiated actions and will provide a major share of the funds for implementation of *The Plan*. Initiatives estimated to cost about \$7.5 million over the first five years will be incurred by the TNRCC, compared to some \$4.5 million for Texas Parks and Wildlife Department (TPWD), and \$1.5 million for GLO. The costs incurred by other state agencies were comparatively smaller amounts.
- The National Estuary Program is a Water Quality Act program, and all other programs under the Act are under TNRCC and SWCB jurisdiction at the state level.
- The recent consolidation of several natural resource management programs under the TNRCC by the Texas Legislature has given this agency a broad role for management of aquatic and marine ecosystems – compatible with the ecosystem approach of *The Plan*. It promotes balanced use of the state's natural resources while avoiding unnecessary adverse harm to the resources.

THE TNRCC GALVESTON BAY PROGRAM

Geographic Coverage of the Galveston Bay Program

Geographically, the GBP will concern itself with the lower Galveston Bay watershed within the following five counties: Brazoria, Chambers, Galveston, Harris, and Liberty. While Galveston Bay’s watershed extends north nearly to Oklahoma (including Dallas and Fort Worth), scientific work has shown that influences from the upper watershed are minor in comparison to influences in the lower watershed downstream from Lake Livingston (on the Trinity River) and Lake Houston (on the San Jacinto River) as shown in Figure I-1.

Funding the Galveston Bay Program

Funding needs for the GBP will be \$2.0 million per year, of which half is ear-marked as seed money to match funds from outside the bay region for *Plan* implementation. Of the \$2.0 million base program funding, \$1.5 million will be state funds and \$0.5 million federal. Beyond the base program, overall implementation of *The Galveston Bay Plan* is expected to cost some \$36.5 million over a five-year period, with annual costs dependent upon the specific implementation schedule outlined in this document. A five-year cycle of plan evaluation and re-direction will assure implementation continues to effectively address problems in Galveston Bay. Although funding from many of the regulatory agencies involved in the GBP cannot be formally committed over long time periods, there has been an informal commitment from these agencies to support the Program on a long-term basis.

Staffing and Duties of the Galveston Bay Program

A Galveston Bay Program Director and staff of up to 15 TNRCC employees will oversee Plan implementation. The Program Director will be appropriately positioned within the TNRCC to have access to policy makers and top level managers in outside agencies and may report directly to the Executive Director of the TNRCC.

In addition to coordinating implementation activities among the many natural resource and public agencies, the GBP will also provide technical assistance and will be directly responsible for the implementation of certain *Plan* actions. The composition of the staff will reflect *The Plan's* initiatives, with expertise in wetlands and estuarine habitats, coastal resource conservation, non-point source pollution issues, water quality, public health, and public education. Work of the staff will also include support actions such as regional monitoring initiatives, research, and fostering continued public participation in establishing bay management policy.

The duties of the GBP staff will include the following :

- Acquire, manage and disperse funds to implement *The Plan*
- Review federal, state and local projects in an open process for consistency with *The Plan*
- Provide for coordination with the Texas Coastal Management Program (CMP) and the Coastal Coordination Council (CCC)
- Provide for coordination and communication among state and federal resource agencies for the many cross-jurisdictional issues
- Monitor implementation of specific actions by *The Plan's* partners
- Identify and communicate bay improvements to agencies, stakeholders, and the public, and redirect *The Galveston Bay Plan* where improvements lag
- Conduct public outreach and education to increase public awareness of Galveston Bay, and to advocate conservation of the estuary
- Evaluate the impacts of proposed actions on cultural resources and areas of historical significance

Focusing Agency Efforts

A key aspect of the GBP's work will involve guiding the efforts of federal, state, and local natural resource agencies, organizations and the public. These activities will include:

- Informing federal, state, and local agencies and private interests of their responsibilities under *The Plan*
- Maintaining implementation commitments from policy officials and agencies
- Promoting interagency cooperation through Memoranda of Understanding
- Maintaining communication among all involved with or affected by implementation actions
- Staffing the Galveston Bay Council

Securing Funds for Implementation

The GBP will acquire, manage, and disperse public and private funds for *Plan* implementation. Methods for obtaining funds will include:

- Applying directly for federal and state grants to implement specific projects
- Assisting agencies, local governments, and others in securing grant funds for implementation
- Working with appropriate funding agencies and non-profit foundations to consider *The Galveston Bay Plan* priorities in their funding decisions, through delineation of "hard" funding for existing core programs, as well as leveraging outside funds
- Working to secure private sponsorships, donations, and in-kind services to support *Plan* implementation

Consistency Review

Federal, and potentially state, and local projects will be reviewed for consistency with *The Plan* by the GBP. The GBP will review federal assistance and development projects for consistency with *The Plan* in accordance with the provisions of Section 320 of the Clean Water Act (CWA). This is a "review and comment" function delegated to the Program by the GBNEP Management Conference upon approval of *The Plan* by the EPA. GBP policies and procedures for federal consistency review are described in detail in The Federal Consistency Report for the Galveston Bay Estuary.

The GBP may also provide input to the Coastal Coordination Council (CCC) in determining consistency of certain state and local projects on the Texas Coastal Management Program (CMP). The CCC plans may adopt all or portions of the enforceable policies of *The Plan* as a Special Area Management Plan (SAMP) within the CMP. If *The Plan* is adopted as a SAMP, applicable state actions will also be reviewed for consistency with the provisions of *The Plan*. The GBP would participate in the CMP state consistency review process by providing comments to the CCC on actions subject to the CMP that occur within the Program's geographic coverage. The CCC will make the final consistency determination. Note that implementation of *The Galveston Bay Plan* will still occur even if *The Plan* is not adopted as a SAMP.

The Galveston Bay Council may appoint a committee to provide input on consistency reviews. GBP staff will work closely with the GLO to "pre-review" projects for *Plan* consistency whenever possible. This "pre-review" will enable applicants to address potential impacts on

the bay early in the applicant's planning process, therefore minimizing inconsistencies with *The Plan*.

If federal CZM status is granted to the State of Texas, consistency review would also apply to federal permits and licenses (under CWA consistency, it only applies to federal agency actions and funding assistance programs). This designation would add a powerful implementation tool, since federal permits for discharges of wastewater, stormwater, and dredged materials, among others, would need to be consistent with *The Plan*. However, consistency review for federal permits under CZM is not the sole implementation strategy for any of *The Plan's* actions.

Monitoring and Evaluation

Activities conducted by the GBP will also include tracking implementation efforts of other agencies, monitoring the progress of *Plan* implementation, and compiling the results. Ambient environmental monitoring will be the primary method of determining the effectiveness of *Plan* implementation actions. The Galveston Bay Monitoring Plan provides the basis for a long-term coordinated strategy for monitoring key environmental conditions in the bay and lays out the approach that will be used to collect this data.

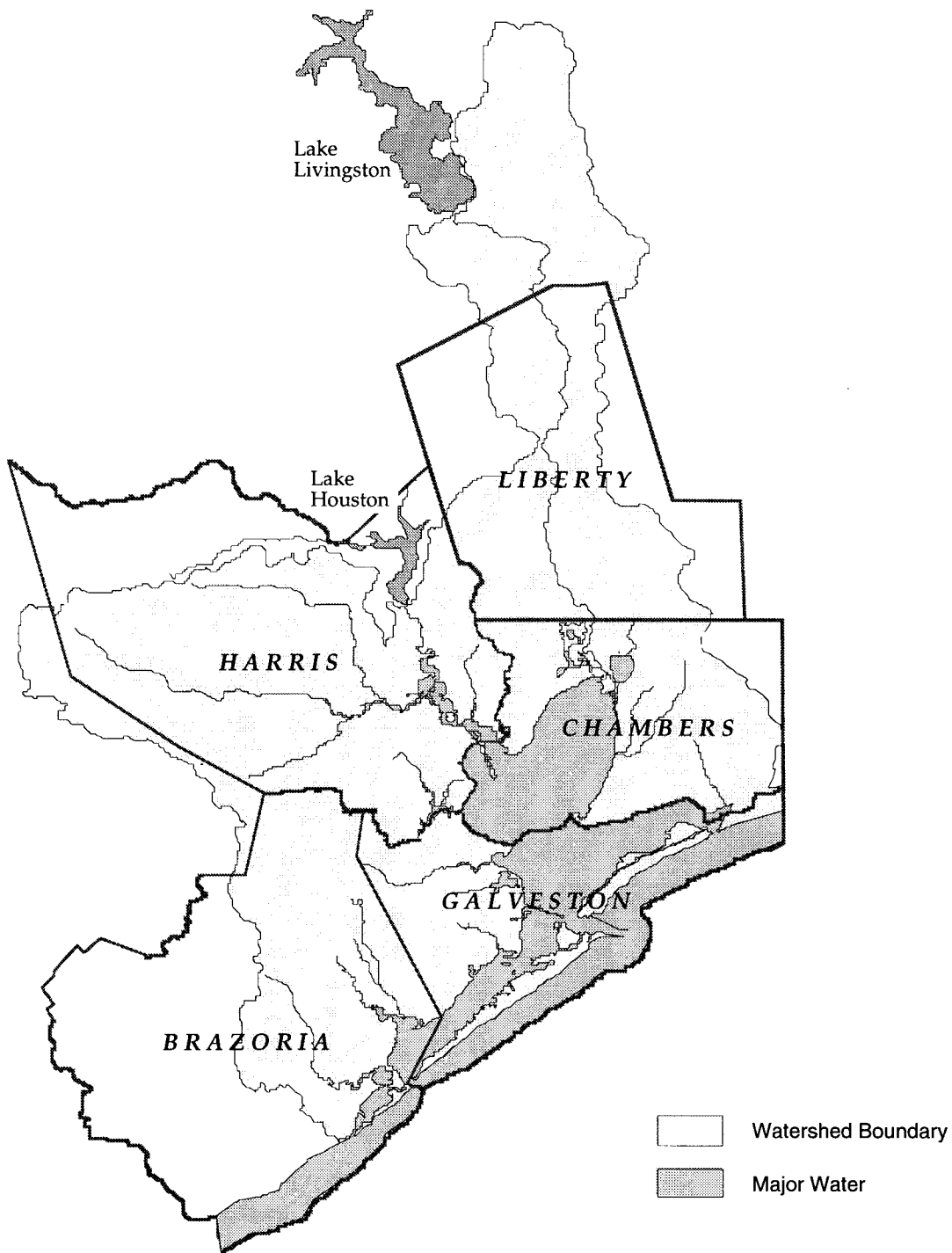
Completed actions described in *The Plan* will be evaluated with respect to monitored data to determine the effectiveness of these initiatives in achieving the goals and objectives of *The Plan*. The GBP will review all implementation actions initiated, underway, or completed, and assess their effectiveness in improving identified bay problems. On a biennial basis, an overall GBP progress report, including a summary of actions and monitored results, will be submitted to the Governor, the Texas Legislature, and to the public.

Plan Revision

The results of the evaluation to determine *The Plan's* effectiveness will be used to modify *The Plan*, or re-direct resources, if necessary, to ensure that action initiatives are producing the intended benefits and represent an effective use of funding. The Galveston Bay Council will approve any revisions to *The Plan*. Input for revisions of *The Plan* will also be received from scientists, resource managers, and the public at each biennial State of the Bay Symposium. The Symposium will be convened every other year prior to the biennial report to the Governor and the Texas Legislature. Based on all these sources of information, *The Plan* will be formally revised every five years.

Public Education and Outreach

Public outreach and education activities will be conducted by the TNRCC GBP to increase public awareness of *The Plan* and the Galveston Bay Estuary system. The GBP will serve as the regional information clearinghouse for the Galveston Bay ecosystem, and will conduct public meetings to discuss important issues related to management of the Bay.



Adapted from HGAC

FIGURE I-1. Geographic Coverage of the Galveston Bay Program.

Education and outreach activities of *The Plan* will occur within the bay's watershed downstream from Lakes Houston and Livingston. Outreach efforts may include publications, educational events, electronic media, a speaker's bureau, and response to information calls. Information made available to the public will include:

- Results of basic and applied research
- Monitoring findings
- Public health and safety information
- Action plan progress reports and agency performance evaluations
- Regulatory and funding information
- Public education materials

The biennial State of the Bay Symposium will an important opportunity for public participation. The targeted audience of the Symposium will include elected officials, natural resource and funding agency managers, local governments, the scientific community, industry, small businesses, non-profit and volunteer organizations, and the general public.

Advocacy

The GBP and the Galveston Bay Council will play a major role in advocating Galveston Bay management initiatives at the federal, state, and local government levels, as well as in the private sector. This advocacy role will be to promote legislation, regulations, and funding necessary to support the implementation of *The Plan* and to enhance conservation efforts for the Galveston Bay Estuary system.

THE GALVESTON BAY COUNCIL

Diverse concerns for habitat and wildlife, competing resource uses, water quality, and human health cannot be adequately addressed without the involvement of multiple natural resource agencies and bay stakeholders. To achieve success, problems of a regional nature - those affecting the entire ecosystem - will require regionally coordinated actions. This need for cross-jurisdictional coordination was emphasized in a recent evaluation of current bay governance entitled *Framework for Action: Galveston Bay Management Evaluation*. Because of the comprehensive nature of *The Plan*, the creation of a *Galveston Bay Council* to advise the GBP is an important part of implementation. The Galveston Bay Council (GBC) will help the GBP provide a continuing focus on Galveston Bay issues and coordination among the implementing organizations. The GBC will have a strong advisory role; not merely perfunctory. Figure I-2 presents examples of existing environmental programs that will be focused towards achieving the goals and objectives of *The Plan*.

The GBC will consist of representatives of federal, state and local natural resource agencies, the research community, local governments, citizens groups including representatives from low-income and minority communities, and other Galveston Bay stakeholders (see Table I-1). One representative of each interest listed in Table I-1 will serve on the GBC. The GBC will select its own Chair on an annual basis, meet at least quarterly, and perform the following functions:

- Provide a forum for technical and stakeholder review and input during *Plan* implementation
- Maintain agency commitments to implement *The Galveston Bay Plan*
- Advise TNRCC staff during preparation of progress reports, evaluations and *Plan* updates
- Authorize and make appointments to advisory committees as necessary
- Assess the success of the action plans and initiate revisions
- Address legislative issues and make recommendations to the legislature
- Set annual priorities for the implementation of the action plans by advising the TNRCC

The GBC, as the implementation committee for *The Plan*, will serve in a similar capacity to the current Management Conference of the Galveston Bay National Estuary Program. The GBC will assume the purposes of the Management Conference with respect to monitoring the effectiveness of actions taken pursuant to *The Plan* and review all federal financial assistance programs and federal development projects in accordance with the provisions of Section 320 of the Clean Water Act.

The Galveston Bay Plan

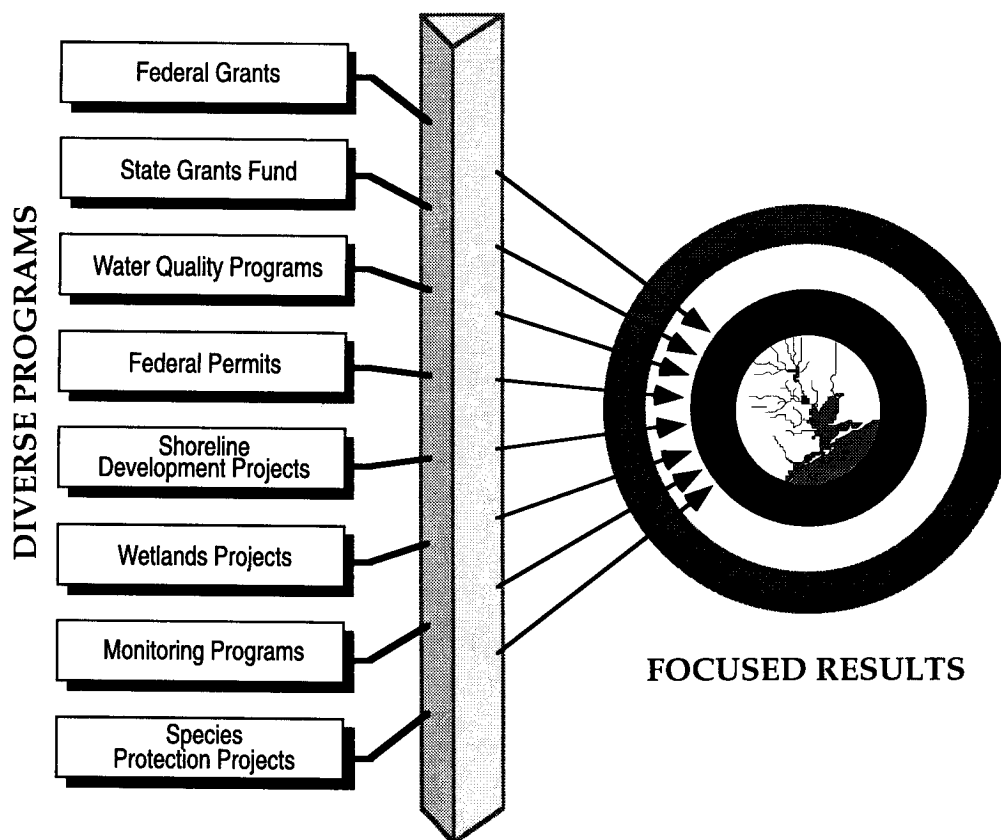


FIGURE I-2. *The Galveston Bay Plan* will Focus Existing Environmental Programs

Subcommittees of the Galveston Bay Council

The GBC will have the ability to form subcommittees or work groups as necessary to accomplish its advisory duties to the GBP. These subcommittees will be established on an as-needed basis. For example, a Technical Advisory Committee may be formed to advise the GBC on technical and scientific issues such as monitoring and research. A Consistency Review Committee may be established to participate in both federal and state consistency reviews or CMP pre-review activities involving state agencies. Temporary special-purpose committees may also be established, for example, to help manage the State of the Bay Symposia.

WHO WILL DO WHAT?

Because of the comprehensive nature of *The Plan*, successful implementation will depend on coordinated actions by local, state, and federal agencies and other organizations responsible for implementing specific initiatives. The Galveston Bay Program (GBP) is responsible for this coordination, utilizing the advice of the Galveston Bay Council (GBC). The roles of the major partners in bay management under *The Plan* are summarized below.

The Federal Role

Many of the actions described in *The Galveston Bay Plan* involve federal activities that have been previously planned or are currently in progress. *The Plan* has included these activities to reaffirm their importance to Galveston Bay and will provide a framework for coordinating actions among federal agencies. Federal natural resource agencies can use *The Plan* in making budget decisions by aiding prioritization of new management initiatives. Implementation actions among federal agencies participating in *Plan* activities include:

- Provide adequate staff for the federal regulatory, enforcement, monitoring, and research activities identified in *The Plan*
- Develop or tailor regulations, standards, and policies to meet the management needs identified in *The Plan*
- Provide funding for *Plan* implementation activities
- Prioritize *Galveston Bay Plan* actions for agency operating budgets and grant programs
- Develop Memoranda of Understanding between federal and state natural resource agencies to better coordinate environmental protection efforts

Federal agencies will also play specific roles in a number of *The Plan's* actions. In Habitat Protection, for example, the U.S. Army Corps of Engineers (Corps) will lead efforts to implement a coordinated regulatory strategy through a Memorandum of Understanding between federal and state agencies now involved in the review of wetlands-related permits. The Corps will promote the beneficial use of dredged materials to restore and create wetlands in the Galveston Bay Estuary. The U.S. Fish and Wildlife Service (USFWS) will play a leading role in the acquisition and restoration of wetlands called for in *The Plan*.

The U.S. Environmental Protection Agency (EPA) will also play a very important role in implementing *The Plan's* actions. EPA will be at the forefront of many of *The Plan's* water quality initiatives, such as issuing NPDES stormwater permits. EPA will also issue administrative orders, as needed to require cities to correct by-pass and overflow problems associated with municipal wastewater collection and treatment systems.

TABLE I-1. Galveston Bay Council Representatives

Type of Organization	Interest Represented
Federal Agencies:	U.S. Coast Guard U.S. Army Corps of Engineers Environmental Protection Agency U.S. Fish and Wildlife Service U.S. Geological Survey National Marine Fisheries Service Soil Conservation Service
State Agencies:	Texas Department of Agriculture Texas General Land Office Texas Railroad Commission Texas Department of Health Texas Department of Transportation Texas Natural Resource Conservation Commission Texas Parks & Wildlife Department Texas Soil and Water Conservation Board Texas Water Development Board
Regional/Local Governments:	Gulf Coast Waste Disposal Authority Houston-Galveston Area Council Port of Houston Authority City of Houston Large Local Governments (populations >500,000) Medium Local Governments (populations 25,000-500,000) Small Local Governments (populations < 25,000) Trinity River Authority San Jacinto River Authority
Environmental/Citizen's Groups:	Galveston Bay Foundation Gulf Coast Conservation Association Citizens-at-Large League of Women Voters Low-income Community Representatives Minority Representatives Other Conservation Organizations
Private Sector:	Greater Houston Partnership Utilities Galveston County Council of Chambers Industry East Harris County Manufacturer's Association Marinas Commercial Fisheries
Research/Academia:	Major Universities Sea Grant Program

Adapted from HGAC

The primary tool for ensuring federal compliance with *The Plan* will be consistency reviews conducted in an open process by the GBP with input from the Galveston Bay Council. Federal grant programs and development projects with the potential to affect the Galveston Bay Estuary will be reviewed by the GBP under the provisions of Section 320 of the Clean Water Act to determine whether the programs or projects are consistent with the goals and objectives of *The Plan*.

The State Role

Texas Natural Resource Conservation Commission (TNRCC)

The success of *The Plan* will depend directly upon both active state agency participation in the GBC and upon fulfillment of commitments concerning *The Plan's* specific initiatives. The TNRCC's role will be somewhat unique by virtue of the predominance of TNRCC initiatives in *The Plan*, and because the GBP will be sponsored by the TNRCC. The TNRCC will have the leading role in implementation of *The Plan* through the establishment and funding of the GBP. Key implementation steps for the TNRCC include:

- Establish and fund the Galveston Bay Program
- Working with the guidance of the Galveston Bay Council, submit *The Plan* to the Coastal Coordination Council (CCC) for designation of *The Plan* as a SAMP
- Pursue assumption of the NPDES program from EPA
- Develop appropriate water quality standards for Galveston Bay management initiatives
- Adopt a watershed approach to water quality management
- Develop non-point source pollution management programs for smaller cities

Coastal Coordination Council

Many of the state environmental programs operating in the Galveston Bay Estuary will be coordinated through the Texas Coastal Management Program (CMP). The Coastal Coordination Council (CCC) has recently proposed rules for the CMP that will be implemented in 1995. After the rules are in effect, state agency grants, permits and development activities must be consistent with the applicable goals, objectives, and policies of the CMP.

The CMP recognizes that specific coastal areas have unique values of ecological, commercial, recreational, industrial, and aesthetic importance. These specific areas require special policies for environmental protection established in the form of a Special Area Management Plans (SAMPS). The CCC may adopt as a rule, all or a portion of the enforceable policies of *The Plan* into the CMP as a SAMP. The CCC will review state actions for consistency with those adopted enforceable policies. For the purposes of the CMP, enforceable policies are those elements of *The Plan* which are: 1) agreed upon by consensus as being appropriate benchmarks for consistency review, and 2) are enforceable under existing laws and regulations. Under state law, the CCC will make the final consistency determination, although the GBP and GBC will provide input. Implementation of *The Galveston Bay Plan* will still occur regardless of its adoption as a SAMP.

In conjunction with approval and implementation of the CMP, Texas is also seeking acceptance into the federal Coastal Zone Management (CZM) program. If Texas is accepted into the federal CZM program, the range of programs covered under consistency review could be further expanded to include federally-issued permits. The GBP would have the opportunity to review the federal permits and provide comments to the CCC. The final decision regarding consistency of federal programs would be made by the CCC.

Other State Agencies:

In addition to the TNRCC and the CCC, other state agencies will also be actively involved in *Plan* implementation. Their roles will be to:

- Participate in the Galveston Bay Council
- Help develop (through the Galveston Bay Council) any enforceable policies for adoption of *The Galveston Bay Plan* as a SAMP
- Establish new funding sources for habitat and species protection, and public health and safety programs
- Provide adequate staff for the regulatory, enforcement, monitoring, and research activities identified in *The Plan*
- Tailor regulations and policies to fit the management needs identified in *The Plan*
- Develop Memoranda of Understanding among federal and state natural resource agencies to better coordinate environmental protection efforts
- Assist in the education of bay users and the public on stewardship of the bay ecosystem

The Local Government Role

There are five counties, 97 cities, and hundreds of special districts, authorities, and other units of government in the bay's lower watershed in the area covered by *The Plan*. While local governments are listed as lead agencies on relatively few of *The Plan's* actions, their participation will be critical to its success. *Plan* implementation will also require a significant expenditure of local government resources and changes in certain areas of their operations. Major local government implementation roles will include:

- Compliance with federal and state orders to improve wastewater collection and treatment systems
- Compliance with federal and state requirements to manage NPS pollution from stormwater runoff
- Voluntary incorporation of NPS management practices into development guidelines, regulations and building codes
- Incorporation of habitat protection provisions into development guidelines and regulations and tax abatement programs
- Participation in shoreline management planning and development of land use guidelines and regulations
- Education of the public on methods to reduce residential pollutant loadings and reduce water consumption

Many of *The Plan's* initiatives can only be effectively implemented through local plans, ordinances, and policies affecting construction and development. This is particularly true in

the management of non-point sources of pollution. Lessons learned from the Houston/Harris County stormwater management program under federal NPDES permit requirements, along with the results of state-funded pilot studies will be closely evaluated by EPA, TNRCC, and GBP in the design of cost-effective local stormwater management programs. The GBP will also encourage local governments to voluntarily adopt NPS management practices which may forestall the need for additional regulatory programs in the future. Results of local program evaluations will be incorporated into a manual of NPS Best Management Practices (BMPs) specifically tailored for the Galveston Bay Estuary.

Habitat protection, erosion, and public access to the bay in shoreline development projects are other issues affecting local governments. Shoreline development plans are increasingly being established by shoreline communities in the region; however, much of the area surrounding the bay is unincorporated. The GBP will offer assistance to local governments in the development of shoreline management programs beneficial to local economies. Unincorporated areas generally do not have ordinance-making authority at the county level. A legislative change may be required to give certain counties ordinance-making authority for the unincorporated areas of the bay.

The Role of Stakeholders

There are many *stakeholders* in *The Plan* as depicted in Figure I-3. This term applies to civic, conservation and environmental organizations, industry, small businesses, commercial and sport fishermen, developers, boaters, and the public. All of these stakeholders will be affected by *The Plan* and will share responsibility for implementation. The partnership approach to natural resource protection has been emphasized throughout *The Galveston Bay Plan*, and will be even more important in its implementation. Difficult policy and resource allocation decisions will need to be made to move implementation forward. These will require broad support from all stakeholder groups to be successful. The benefits of these efforts will be a cleaner, healthier, more productive bay. Involvement of stakeholders will include:

- Serving on the Galveston Bay Council and providing a voice for ongoing bay management
- Participating in public forums advocating the goals and objectives of *The Galveston Bay Plan*
- Providing input and comments on environmental policies affecting the bay
- Assisting with public outreach and educational efforts
- Contributing funding, volunteer, and in-kind services to support implementation
- Supporting legislative efforts at the federal, state, and local level

The Role of the Public

Public involvement is indispensable to the implementation of *The Galveston Bay Plan* and public support is critical to long-term success. Representatives from environmental and recreational groups, locally-elected officials and industry can help educate the general public and advocate the goals of *The Galveston Bay Plan*. Representatives from local stakeholder groups will be chosen to serve on the Galveston Bay Council. Representation will come from all facets of the populations surrounding Galveston Bay, including low-income and minority communities. This will allow the entire community to participate in the decision-making

process and ensure that the goals, objectives, and actions of *The Galveston Bay Plan* are achieved. Elements of public involvement in implementation include:

- Encouraging federal, state, and local agencies, as well as bay user groups to implement *The Galveston Bay Plan*
- Contributing funds, land, and in-kind services and encouraging receipt of funds from "soft" sources such as grants
- Advocating the regional importance of Galveston Bay and working for passage of necessary state laws and local ordinances to implement *The Plan*
- Working for appropriation of required funds at the federal, state, and local level
- Supporting State-of-the-Bay Symposia as a forum for reporting ongoing research, and for educating and involving the public in the state of the bay
- Creating educational and outreach programs which also involve the media
- Participating in a school educational program that targets children residing in the Galveston Bay watershed
- Providing volunteer opportunities for education and other "Protect-the-Bay" events
- Encouraging pollution reporting through the Citizens Pollution Awareness and Reporting System hotline
- Implementing citizen actions such as improved management of household hazardous wastes, reducing the amount of pesticides and fertilizers used, recycling used motor oil, etc.

HOW MUCH WILL THE GALVESTON BAY PLAN COST?

Limitations on Cost Estimates

Cost estimates were prepared for the action plans described in *The Galveston Bay Plan* based on available information and actual costs may be more or less than projected estimates. Estimates are five-year costs. Some future programs are difficult to predict, making cost assessment problematic. Future federal non-point source mandates are likely, for example, and could greatly benefit Galveston Bay. Such programs will benefit from regional coordination by the GBP, but are not included in *Plan* cost estimation. Revision of *The Plan* after five years will result in re-direction of initiatives based on new scientific findings and progress made to resolve bay problems.

Numerous existing programs now address problems or can be re-directed to address significant problems in Galveston Bay—this is an important element of *The Plan*. These programs are identified throughout this document in the specific initiatives. However, the costs of these programs are not paid through *The Plan*, and therefore were not included in the cost estimates. For example, the costs of storm water management programs within the City of Houston currently being undertaken are not included; City of Houston costs for these programs exceed the entire cost of *The Plan*.

Some other bay issues are likely to be addressed in future programs being proposed or developed apart from *The Plan*. If such issues were included in *Plan* costs, controls recommended in the Point Sources of Pollution Action Plan would be responsible for over 95

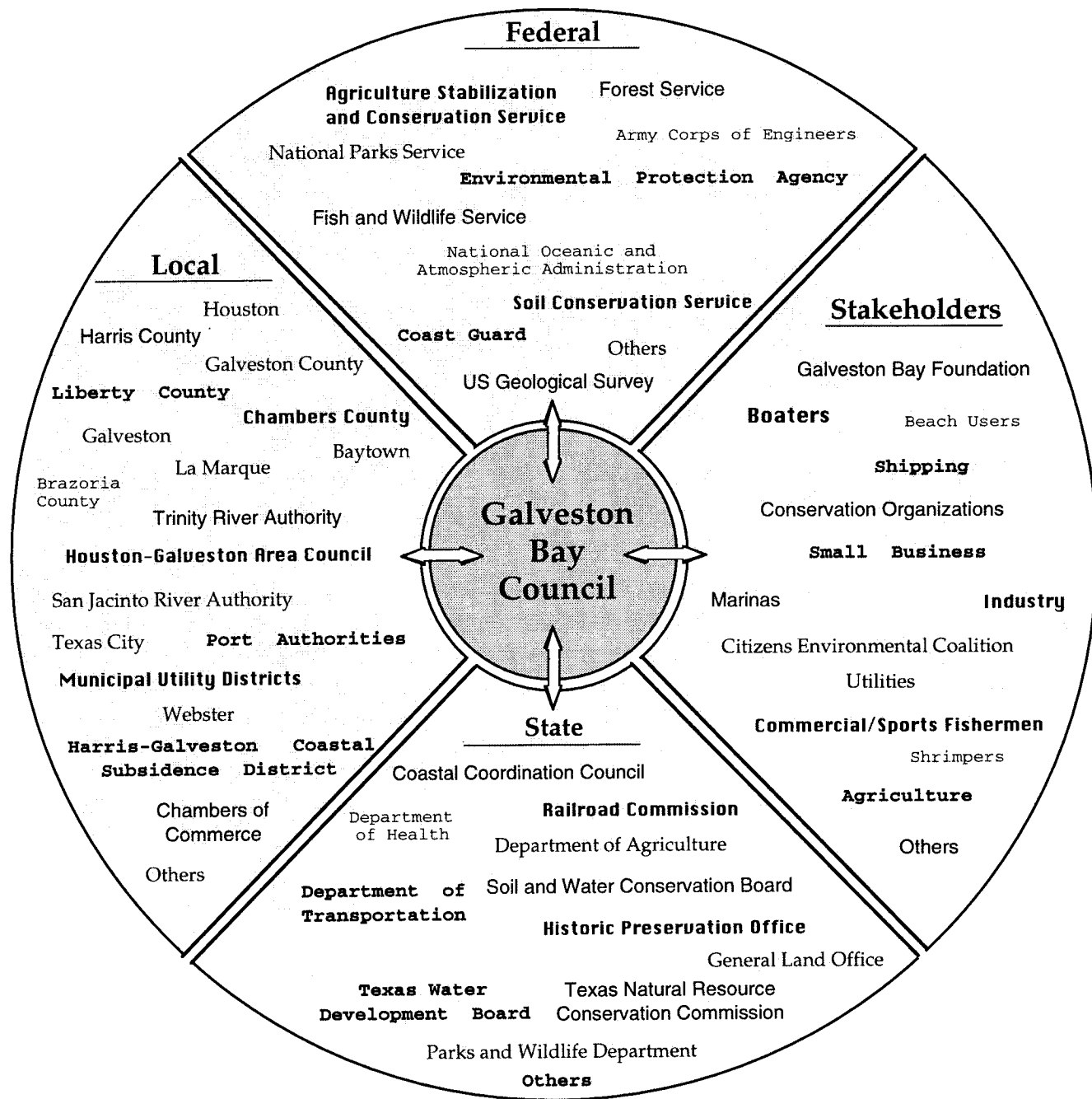


FIGURE I-3. Partners for Implementing *The Galveston Bay Plan*

percent of the total costs of *The Galveston Bay Plan*. The two actions that address municipal overflow and bypass problems (PS-1 and PS-2) are estimated to cost approximately \$1.6 billion. In the City of Houston, these capital projects are already being developed in conjunction with the TNRCC and are not included in the costs of implementing *The Plan*.

Costs associated with the Regional Monitoring Plan and the Data and Information Management Strategy are also not included in the cost estimates. Where monitoring and information management activities have been identified in action plans, cost estimates for those activities have been included in the corresponding action plan. Once *The Plan* becomes final, costs for the overall monitoring and data management strategy can be estimated.

In summary, estimates reported here do *not* include costs associated with the following:

- City of Houston storm water management projects
- Regional Monitoring Plan and Data and Information Management (the nature of these programs can only be determined by the final contents of *The Plan*)
- Bypass/overflow initiatives already ongoing or likely extensions of ongoing work
- Inflation
- Forecast elements for future circumstances

How Costs Were Estimated

In general, costs were developed using information supplied by the agencies identified with implementation responsibilities. Unit costs were developed by using estimates of the average level of effort required to implement particular activities in each action and are based on "best professional judgment." Information was provided by Texas natural resource agencies for labor requirements needed to perform each selected task. For those activities that could not be estimated using unit costs, information was obtained from the following sources:

- Interviews with agency staff and other individuals familiar with the recommended action
- Analogous projects and programs for which cost data or budget information was available
- Published cost estimates from other similar programs, engineering journals, construction manuals, and other documents

The costs for *The Plan* are of two types. First is the cost of the Galveston Bay Program—including the TNRCC Program Office and Staff, and costs associated with the Galveston Bay Council and other advisory committees. This cost includes match money to attract funds from outside the region for implementation of specific initiatives. The second type of cost is for implementation of *The Plan's* actions which are above and beyond the costs of existing programs that contribute to these initiatives.

Both types of costs represent "new costs" of implementing *The Plan* and are discussed below. A detailed report providing specific limitations and assumptions for determining the estimated costs of implementing *The Galveston Bay Plan* has been developed in a separate publication.

Estimated Costs for the Galveston Bay Program

Total Galveston Bay Program (GBP) costs are estimated at \$2.0 million annually. Approximately \$1.0 million per year will be needed for GBP operating expenses. These funds will be used by the GBP to undertake actions identified in *The Plan* as program functions. Included in these costs are establishing and staffing the GBP Office and supporting the Galveston Bay Council (GBC) and other advisory committees. An additional \$1.0 million per year will be needed as match money for grants. This "seed money" can be used to leverage outside funding, for example federal grants, to fund specific initiatives. A funding strategy to acquire the estimated total \$2.0 million per year for the GBP is presented in the "Funding the Galveston Bay Program" section of this document.

Estimated Costs for Implementing The Galveston Bay Plan Actions

Costs to implement actions in *The Plan* are estimated at \$36.5 million over five years, with variable annual costs averaging \$7.3 million per year (Figures I-4 and I-5). These costs include those to be incurred by federal, state, and local entities as well as the GBP for implementing new actions recommended by *The Plan*. Figure I-5 indicates the proportion of these costs accruing to federal, state, and local entities, and to the GBP (TNRCC costs for The GBP are state costs, but are given their own category for planning purposes). A detailed categorization

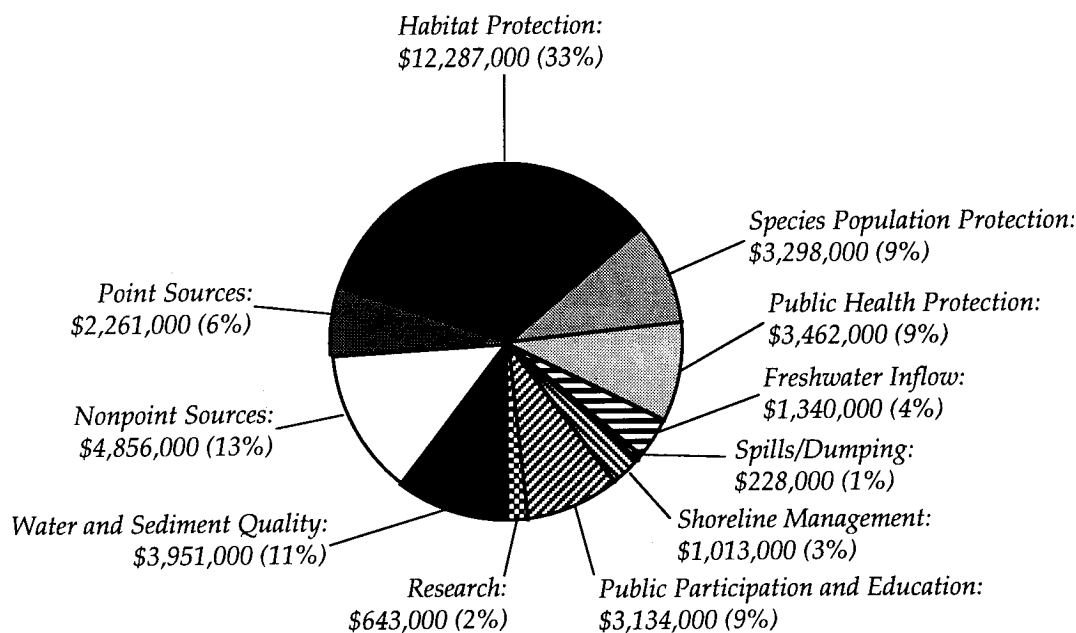


FIGURE I-4. Estimated Five-Year Costs of New Actions Recommended by *The Galveston Bay Plan*, Classified by Type of Action

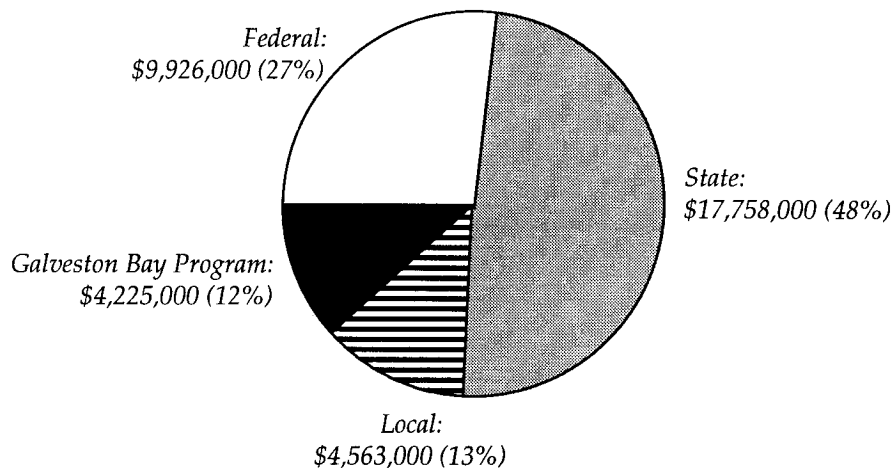


FIGURE I-5. Estimated Five-Year Costs of New Actions Recommended by *The Galveston Bay Plan*, Classified by Who Bears the Cost

of these costs by implementing organization is presented in Appendix B. How these needs will be funded is considered below in the "Funding New Actions" section of this chapter.

How Other Programs Lower the Cost of The Galveston Bay Plan

Numerous existing and proposed programs will expend funds to benefit Galveston Bay; therefore, these costs do not add to the cost of *The Plan*. In fact, *Plan* costs are small in comparison to the total expenditures in the region on water quality improvement programs. These "Existing and Proposed Programs" are an important part of *The Plan's* bay-wide strategy for stewardship, but are not funded through *The Plan* by virtue of their separate mandates (i.e., they would occur regardless of *The Plan*). An important role of *The Plan* is in coordinating these programs to assure the bay's true most significant problems are addressed. The costs which are included in *The Plan* reflect the fact that water quality improvements funded under these other programs have benefited Galveston Bay. New initiatives can focus on problems such as habitat protection that do not have a successful management history.

Because the work being funded under Existing and Proposed Programs is so important to overall bay management, estimates of their costs were also compiled during drafting of *The Plan*, even though these costs do not contribute to the cost of *The Plan*. Figure I-6 indicates that the estimated five-year costs of these programs total approximately \$1.7 billion, or about fifty times the five-year cost of all new initiatives proposed in *The Plan*.

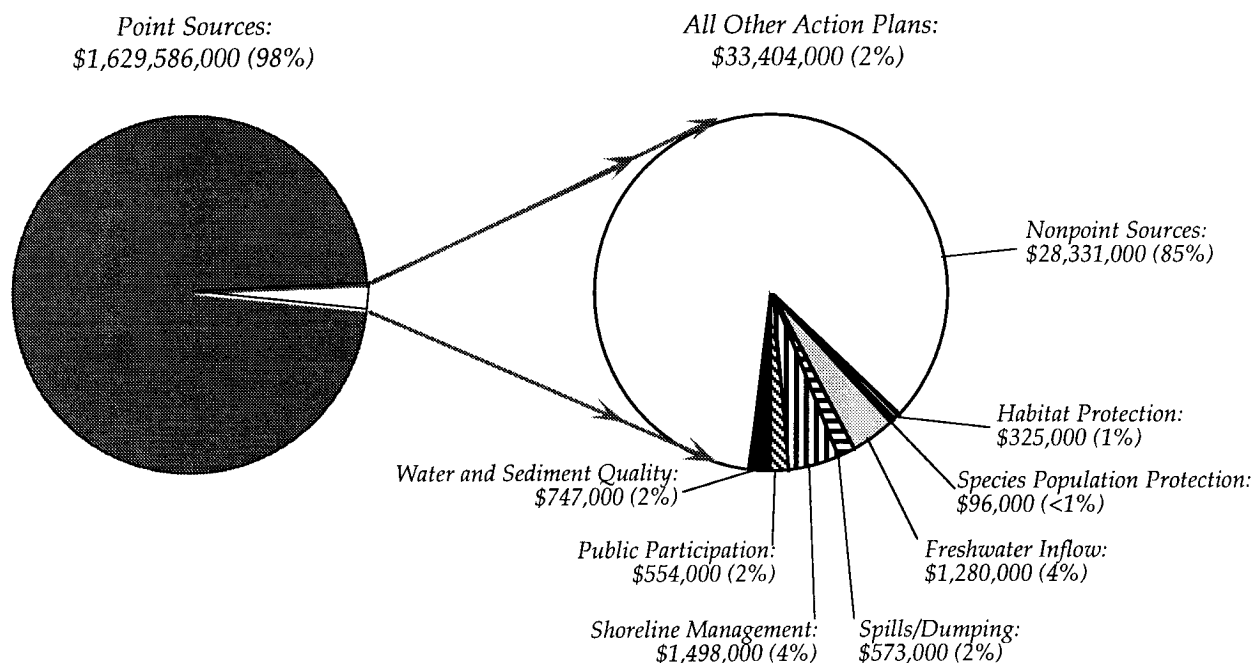


FIGURE I-6. Estimated Five-Year Costs for Existing and Proposed Programs Not Funded Under *The Galveston Bay Plan*.

FINANCING THE GALVESTON BAY PLAN

As described previously, costs associated with *The Plan* are of two types: maintaining a Galveston Bay Program (TNRCC Program Office, Galveston Bay Council, and related committees); and implementing the actions in *The Plan*. The financing strategy to meet each of these needs is discussed below. Additional information on funding *The Galveston Bay Plan* is provided in *The Galveston Bay Plan* Funding Strategy report.

Funding The Galveston Bay Program

Section 320 of the Water Quality Act of 1987 authorizes the use of federal funds for a five-year planning process leading to completion of a Comprehensive Conservation and Management Plan (CCMP), here *The Galveston Bay Plan*. These funds are limited to 75 percent of costs; in Texas, the 25 percent required match was supplied as Texas general revenue, appropriated to the TNRCC and expended through that agency to match Section 320 federal funds to carry out the Management Conference activities resulting in this document. Upon completion of a CCMP, the Water Quality Act calls for implementation to be funded by states, but intends for existing federal programs (for example under other sections of the Water Quality Act) to be adopted for coordinated actions under the CCMP.

Funding the GBP will occur primarily with state funds. Of the \$2.0 million annually required for the GBP (\$1.0 million for the Program itself and \$1.0 million seed money to leverage grants and other sources), funding is to consist of \$1.5 million state funds and \$0.5 million federal

funds. State funds are to be appropriated by the Texas Legislature to the TNRCC for establishment of the GBP to implement *The Plan*. Federal funds will be sought as a line item in the federal budget. Alternatively, federal funds could be derived from re-authorization of the Water Quality Act (which could provide for some limited implementation funds) or through an existing federal program such as watershed management activities under Section 104 of the Water Quality Act.

The state-federal funding partnership proved to be advantageous during creation of *The Plan* due to the involvement of programs at many levels of government. The continued partnership of both TNRCC and EPA is equally vital during the coming implementation phase of the program. The continued participation of EPA in the GBP is critical since numerous initiatives in *The Plan* involve federal actions under EPA jurisdiction.

Funding Galveston Bay Plan Actions

The available funding options for implementation of new actions recommended by *The Plan* include federal, state, and private grants and assistance programs. Many of these programs already provide assistance to natural resource agencies in the Galveston Bay region. The GBP will seek funds from a variety of sources to avoid creating a disproportionate financial burden on any one group. Potential sources of revenue for implementation of new actions recommended by *The Plan* are described below. A detailed financial strategy providing specific options for funding the new actions described in *The Galveston Bay Plan* has been developed in a separate publication, *The Galveston Bay Plan Funding Strategy Report*.

Grants

Grants will be obtained from major federal assistance programs administered by the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture (USDA), and the U.S. Army Corps of Engineers. The GBP will also "pass through" grant funds to entities responsible for implementing *The Plan's* actions. A survey of grant programs has been completed, indicating this approach is feasible. Generally, these grant programs call for a local funding match ranging from five to 25 percent of the total. The seed money to be allocated for grant matching will allow the GBP to leverage these funds.

Contract Operations

The GBP may conduct activities under interlocal contract with other units of government. Contract services for non-profit and private sector entities may be provided by the GBP if the activities are identified in or consistent with *The Plan*. This will allow the GBP to adopt existing agency programs to accomplish the initiatives in *The Plan*.

Donations of Property

The GBP may receive donated property from public and private sources for the purposes of habitat preservation, providing public access, or implementing other programs of *The Plan*. The GBP may also transfer such property to appropriate management entities (e.g., state or federal natural resource agencies).

Private and Non-Profit Sources

Revenue from non-profit foundations that support projects related to environmental conservation may be obtained by the GBP.

COMMON GOALS FOR THE BAY: CONSISTENCY

Consistency serves as an important tool for the implementation of *The Plan*. Consistency assures that agencies carrying out activities which affect Galveston Bay do not act at cross-purposes to the goals of *The Plan*. Consistency provides a level of authority intermediate between assessments or planning (no authority) and statute (complete authority). The various levels of authority which apply to coastal management are shown in Figure I-7 which shows several current programs for comparison.

The first level of authority, that of undertaking environmental assessments or planning (a critical activity for effective management), requires little or no authority. The Galveston Bay National Estuary Program (GBNEP) as a five-year planning program, was in this category.

Two types of consistency review provide the second and third levels of authority. Federal consistency review under an executive order is the second level. This type of consistency review is prescribed for National Estuary Programs under the Water Quality Act, and applies to federal assistance and other projects. Review of permits is excluded from this process. The third level of authority results from consistency review granted by statute.

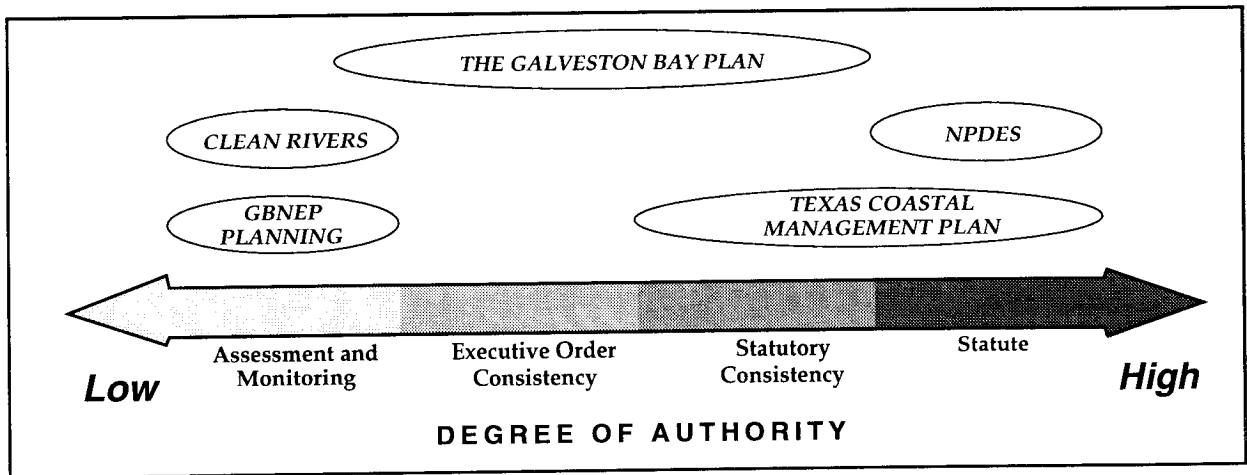


FIGURE I-7. Levels of Authority Applicable to Coastal Management in Texas

At the federal level, the Coastal Zone Management (CZM) Act sets out statutory consistency review for approved CZM programs. At the state level, the 1991 Texas Legislature established similar state agency consistency review for the Coastal Coordination Council and Texas Coastal Management Program (CMP).

Finally, the fourth and highest level of authority is direct regulatory power granted by statute. For example, the Clean Water Act provides this authority to programs such as the National Pollutant Discharge Elimination System (NPDES) for wastewater and stormwater discharge permits. This approach works well for certain well-defined issues such as point source pollution, but does not lend itself as well to complex ecosystem actions affecting many parties.

The Galveston Bay Plan will utilize federal and potentially state consistency for an intermediate level of authority. The Galveston Bay Program (GBP) will have no regulatory, rule-making, or taxing powers apart from existing TNRCC authority; neither is it powerless or confined to merely studying the problems. The GBP will conduct consistency reviews of projects to ensure efficient, coordinated implementation of *Plan* actions. Three types of consistency are potentially available for implementing *The Plan*:

- Federal Consistency for National Estuary Programs
- State Consistency under the Texas Coastal Management Program
- Federal Consistency under the Coastal Zone Management Act

The relationships between the types of consistency reviews available to the GBP are presented below.

TABLE I-2. Consistency Provisions Potentially Applicable to *The Galveston Bay Plan*

Type of Consistency	Authority	Scope
Federal Consistency for National Estuary Programs	Executive Order of the President cited in Section 320 of The Water Quality Act (EPA)	Applies to federal actions affecting NEP initiatives. Is limited to federal financial assistance and development programs; does not apply to permits
State Consistency under the Texas Coastal Management Program	State Statute; final determination by the Coastal Coordination Council	Applies to state agency actions within the coastal area. Is based on enforceable policies, agency rule-making, and "thresholds;" includes state permits
Federal Consistency under the Coastal Zone Management Act	Federal Statute under NOAA; depends upon federal approval of the Texas Coastal Management Program	Applies to federal actions in the coastal zone, including permits; gives states control over federal actions under state coastal management programs

Federal Consistency for National Estuary Programs

Federal consistency review under Section 320 of the Water Quality Act will be carried out by the GBP. Section 320 contains provisions for reviewing all federal financial assistance and development programs to determine whether such programs are consistent with the goals and objectives of *The Galveston Bay Plan*. The GBP will review and comment on federal actions and grants using delegated authority from the GBNEP Management Conference upon approval of *The Plan* by the EPA. The GBP will suggest modifications to those federal programs with activities that are inconsistent with or may jeopardize the effectiveness of *The Plan* (see Figure

I-8). GBP policies and procedures for federal consistency review are described in detail in *The Galveston Bay Plan* Federal Consistency Report.

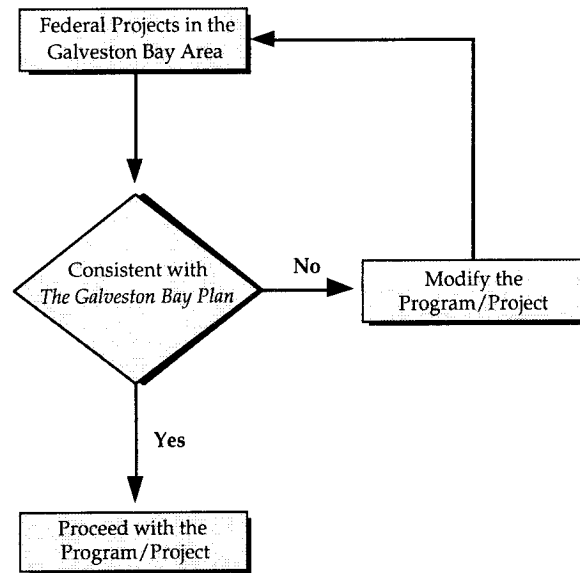


FIGURE I-8. Federal Consistency Review Process Under the National Estuary Program

State Consistency Under the Texas Coastal Management Program (CMP)

Development of *The Galveston Bay Plan* has been closely coordinated with the emerging, coast-wide Coastal Management Program (CMP). *The Galveston Bay Plan* could be adopted by the Coastal Coordination Council (CCC) as a Special Area Management Plan (SAMP) under the Coastal Management Program. This would strengthen the CMP for the Galveston Bay region, and could help provide a model for implementation of the CMP in a way that accounts for particular needs of the Galveston Bay region. The GBP could participate in the CMP state consistency review process by providing comments to the CCC on actions subject to the CMP that occur within the GBP's geographic coverage (those actions subject to enforceable policies developed for *The Galveston Bay Plan*). The GBP will receive guidance in the consistency review process by the Galveston Bay Council. The CCC will make the final consistency determination. Note that implementation of *The Galveston Bay Plan* will still occur even if *The Plan* is not adopted as a SAMP.

Final rules have now been approved for the CMP, for implementation in 1995. These rules allow the CCC to adopt enforceable policies for Galveston Bay as a SAMP. Enforceable policies would be: 1) agreed upon by consensus as being appropriate benchmarks for consistency review, and 2) enforceable under existing laws and regulations. Identifying enforceable policies would involve the same public discussion and open deliberation that characterized creation of *The Plan*. Subsequently, the GBP would have three points of influence in the state consistency process:

- Through agency rules. Under the policies of the CCC, state agencies will adopt rules to assure state actions are consistent with the CMP. Such rules could be adopted to assure consistency with elements of *The Galveston Bay Plan*. Most initiatives in *The Galveston Bay Plan* have an identified lead agency.
- Through consistency pre-review. Rules of the CCC establish a pre-review process, whereby the CCC can hear and comment on agency actions in the context of non-binding discussion, in essence to provide an opinion in advance of actual consistency review. Pre-review is triggered only by the request of the state agency undertaking the action at hand.
- Through written/oral comments. When the CCC undertakes consistency review, their meeting for this purpose includes elements similar to a public hearing. Any party can provide comments at such a meeting, including, potentially, a representative of the Galveston Bay Council. The CCC then weighs public testimony prior to their consistency decisions.

Federal Consistency Under the Coastal Zone Management Act

Another mechanism for consistency review by the GBP is provided by the Coastal Zone Management (CZM) Act. Once the CMP has been approved and implemented, Texas may be designated as a federal Coastal Zone Management (CZM) program. If federal CZM status is granted, consistency review would also apply to federal permits and licenses (under CWA consistency, it only applies to federal agency actions and funding assistance programs). This designation would add a powerful implementation tool, since federal permits for discharges of wastewater, stormwater, and dredged materials, among others, would need to be consistent with *The Plan*. However, consistency review for federal permits under CZM is not the sole implementation strategy for any of *The Plan's* actions.

Other Program Coordination

Consultations required by Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas are important implementation activities designed to ensure that actions taken under *The Galveston Bay Plan* do not adversely affect cultural, historical, or archeological resources. In addition, if Texas' Coastal Management Plan is submitted to the National Oceanic and Atmospheric Administration, and approved, then reviews for consistency of *The Galveston Bay Plan* in general, and specific implementation actions in *The Galveston Bay Plan*, with the goals and policies of the Texas Coastal Management Plan, will be necessary to ensure that implementation of *The Galveston Bay Plan* does not adversely affect Coastal Natural Resource Areas.

Under Section 106 of the National Historic Preservation Act, Federal agencies which fund, permit, license, approve, or carry out certain actions in *The Galveston Bay Plan* may be required

to consult the State Historic Preservation Office (in this case the Texas Historical Commission) to determine if a site is listed in, or is eligible for listing in, the National Register of Historic Places (NRHP). If a site is listed, or is eligible for listing, then the action agency must determine, in consultation with the State Historic Preservation Office (Texas Historical Commission), if there is a potential for adverse effects to the site as a result of the proposed action. If the action agency determines that the action will affect sites listed or eligible for listing in the NRHP, the agency will consult with the Texas Historical Commission. Similarly, the Texas Antiquities Code protects State Archeological Landmarks (SALs), through comments and requirements issued by the Texas Historical Commission to State agencies and political subdivisions on the effects of their actions on areas that may contain SALs as well as designated SALs. Because of these requirements, it is the policy of *The Galveston Bay Plan* that Agencies approving, funding, or carrying out actions under *The Plan* consult with the Texas Historical Commission as lawfully required.

As a matter of policy, CCMPs developed under the NEP are to be voluntarily submitted for review under the Federal consistency provisions of Section 307 (c) (1) of the Coastal Zone Management Act of 1972, as amended. However, since Texas does not yet have a federally-approved Coastal Zone Management program, it is not possible to accomplish this at this time. When a federally-approved Coastal Zone Management program is established in Texas, *The Galveston Bay Plan* will be submitted for such review.

EPA Region 6 has also voluntarily initiated informal consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service under Section 7 of the Endangered Species Act, for EPA's approval of *The Galveston Bay Plan* Under Section 320 of the Clean Water Act. Further, EPA has encouraged the participation of both the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, in the development of *The Galveston Bay Plan*. The Galveston Bay National Estuary Program has benefited from the active participation of both these agencies throughout the development of *The Galveston Bay Plan*.

TRANSITION FROM PLANNING TO IMPLEMENTATION

The initial GBNEP planning phase ends with final revision of *The Galveston Bay Plan* based on public comments, final approval by the Policy Committee of the GBNEP, and subsequent submittal of *The Plan* to the Governor of Texas and the EPA. EPA has a 180-day review period to evaluate *The Plan* for applicability to the Water Quality Act and consistency with National Estuary Program guidance. When *The Plan* is agreed upon by the Governor of Texas and signed by the Administrator of EPA, implementation can begin. Due to the schedule of the Texas Legislature, however, the GBP will not be fully funded until September, 1995. Fiscal Year 1995 (September 1994 through August 1995) therefore represents a transitional period for the GBP during which the final structure of the Program will be established.

Funding for the transitional period has been requested from the TNRCC and EPA. During the transitional year, GBNEP staffing will remain at approximately its current level. State revenue (\$1.5 million) and federal revenue (\$0.5 million) will be sought by the TNRCC to fund the GBP beginning in September, 1995. At that time, additional staff will be hired and implementation

of *The Plan* will begin, following the implementation schedule put forth in the initiatives. Figure I-9 below illustrates the overall implementation schedule.

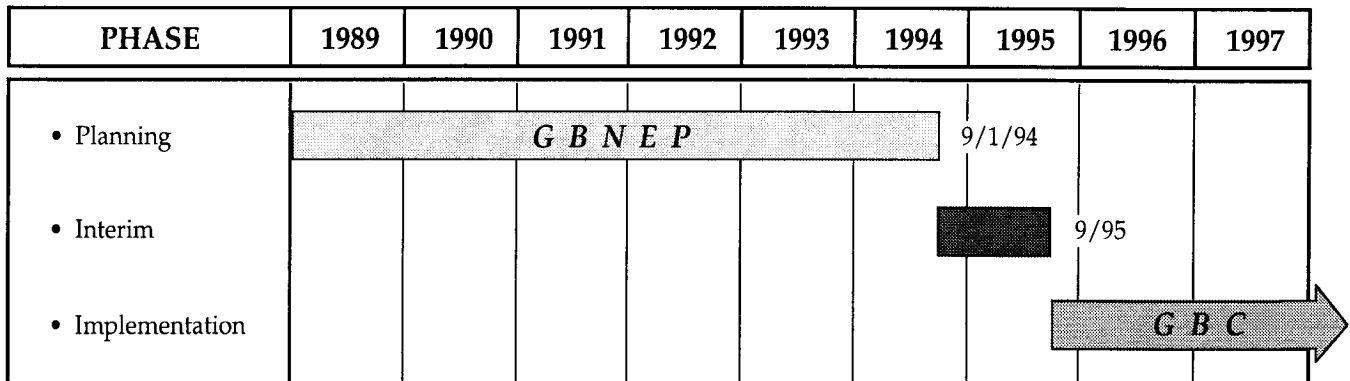


FIGURE I-9. Transition from Planning to Implementation

Within *The Plan* individual actions have been assigned a priority rank of "High," "Medium," or "Low" based on deliberation by the Management Conference. In assigning these ranks, the Management Conference considered both the costs and probable outcomes of the actions, and made judgments about which were most significant in relation to the bay's documented problems. The assigned rankings will provide a guideline for expenditure of funds during implementation of *The Plan*,

Appendices

The Galveston Bay Plan Galveston Bay National Estuary Program

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APPENDIX A:
Ranked Problems and Goals for Galveston Bay

Appendix A: Ranked Problems and Goals for Galveston Bay

The Galveston Bay Plan was drafted by the Galveston Bay National Estuary Program (GBNEP). GBNEP, established as a State of Texas/U.S. Environmental Protection Agency (EPA) cooperative program, is administered under the auspices of the Texas Natural Resource Conservation Commission (TNRCC). The Management Conference of the GBNEP consists of approximately 100 individuals appointed by agreement between the Governor of Texas and the EPA Region 6 Administrator.

Environmental Impacts on the Galveston Bay Ecosystem

Development of *The Plan* involved Galveston Bay user groups, government agencies, stakeholder organizations, and the public. This appendix describes GBNEP's tasks to define the major problems facing Galveston Bay. By examining existing scientific data, consulting with experts, and talking with bay users, several important cause-and-effect relationships were identified. Some of the causes-and-effects were similar to those found in other bays around the country. Others appeared to be unique to the Galveston Bay system.

The result of this process was the Environmental Impact Matrix shown in Figure A-1. It shows GBNEP's original view of the effect different perturbations (natural and man-made disturbances) had on different parts of the bay ecosystem (labeled "valued ecosystem components"). The stars indicate the degree of influence and the shaded areas denote a possible management priority.

For example, non-point source pollution was considered a major influence on water quality to the extent that this process posed a possible management priority (see Figure A-1). On the other hand, recreational fishing has only a slight influence on oysters; therefore, this linkage was not identified for possible management.

Based on this matrix, it became apparent that Galveston Bay is a complex system that is affected by numerous human activities and natural processes. The process of developing the matrix focused attention on several key cause-and-effect relationships, such as:

- The impacts of sea level rise, shoreline modification, and dredging on important habitats such as wetlands and submerged aquatic vegetation
- The effect of runoff (non-point sources), wastewater discharges (point sources), marinas, and petroleum activity on water and sediment quality

Appendix A: Ranked Problems and Goals for Galveston Bay

Valued Ecosystem Components																	
Sources of Perturbation	Water Quality	Circulation	Sediment	Phytoplankton	Zooplankton	Oysters	Shellfish	Other Benthos	Finfish	Birds	Marine Mammals	Sea Turtles	Human Health	Wetlands	Submerged Plants	Shoreline	Aesthetic Appeal
Northers		**		?	?	*			**	*							
Hurricanes		**	*	?	?	*	*	**		*			?	?	***	***	
Inflow Modification	***	***	*	?	?	****	***	***	**			?		***	**		
Subsidence/Sea Level		**				*	**		*	*				****	***	****	
Shoreline Development	**	*	*	*			**		**	**				****	**	****	***
Dredging	***	****	****	?		**	*	**	**	***	?	?	?	***	**	***	**
Shipping	**		*								?			**		**	
Point Sources	****		****	***	**	***	**	**	**	**	?	?	****	*	**		**
Non-Point Sources	****		****	***	?	***	**	**	**	**	?	?	***	**	**		**
Commercial Fishing	?		?			**	****	?	***		?	?			**		
Recreational Fishing						*	*		***					?	*		
Boating/Marinas	***		***	?	?			**	*					*	*	*	?
Petroleum Activity	***		***	?	?	*	**	**	*	*	?	?	*	**	*		?
Oil/Chemical Spills	***		***	?	?	**	?	?	?	**	?	?	**	***	?		***
Marine Debris									?	*	*	**					***

NOTE:

* = Slight influence

** = Moderate influence

*** = Significant influence

**** = Major influence

? = Unknown relationship

= Possible management priority

SOURCE: GBNEP Program Office

FIGURE A-1. Environmental Impact Matrix for Galveston Bay

Appendix A: Ranked Problems and Goals for Galveston Bay

Problems Addressed in *The Galveston Bay Plan*

During the process of drafting *The Galveston Bay Plan*, 17 compelling problems were distilled from the hundreds of issues affecting the bay system. The four years of scientific work carried out by the program established the importance of these issues to Galveston Bay. Once identified, these problems served as the starting point for the drafting of *Galveston Bay Plan* initiatives. These problems are presented below in order of their management importance to the bay based upon consensus reached by the Management Conference. Problems deemed most important by consensus of the GBNEP Management Conference are listed first.

1. Vital Galveston Bay habitats like wetlands have been lost or reduced in value by a range of human activities, threatening the bay's future sustained productivity.
2. Contaminated runoff from non-point sources degrades the water and sediments of bay tributaries and some near-shore areas.
3. Raw or partially treated sewage and industrial waste enters Galveston Bay due to design and operational problems, especially during rainfall runoff.
4. Future demands for freshwater and alterations to circulation may seriously affect productivity and overall ecosystem health.
5. Certain toxic substances have contaminated water and sediment and may have a negative effect on aquatic life in contaminated areas.
6. Certain species of marine organisms and birds have shown a declining population trend.
7. Shoreline management practices frequently do not address negative environmental consequences to the bay, or the need for environmentally compatible public access to bay resources.
8. Bay habitats and living resources are impacted by spills of toxic and hazardous materials during storage, handling, and transport.
9. Seafood from some areas in Galveston Bay may pose a public health risk to subsistence or recreational catch seafood consumers as a result of the potential presence of toxic chemicals.
10. Illegal connections to storm sewers introduce untreated wastes directly into bay tributaries.
11. Dissolved oxygen is reduced in certain tributaries and side bays, harming marine life.

Appendix A: Ranked Problems and Goals for Galveston Bay

12. About half of the bay is permanently or provisionally closed to the taking of shellfish because of high fecal coliform bacterial levels that may indicate risk to shellfish consumers.
13. Water and sediments are degraded in and around marinas from boat sewage and introduction of dockside wastes from non-point sources.
14. Some bay shorelines are subject to high rates of erosion and loss of stabilizing vegetation due to past subsidence/sea level rise and current human impacts.
15. Illegal dumping and water-borne and shoreline debris degrade water quality and aesthetics of Galveston Bay.
16. Some tributaries and near-shore areas of Galveston Bay are not safe for contact recreational activities such as swimming, wade-fishing, and sail-boarding due to risk of bacterial infection.
17. Some exotic/opportunistic species (e.g. nutria and grass carp) threaten desirable native species, habitats, and ecological relationships.

Goal Priorities in *The Galveston Bay Plan*

In *The Galveston Bay Plan*, goals are established to address each problem listed above. These goals are then the basis for more specific objectives and actions which are the heart of *The Plan*. Table A-1 describes the relative importance of *The Plan's* goals. The table subdivides the goals into three major bay management categories: 1) Water and Sediment Quality Improvement; 2) Habitat/Living Resource Conservation; and 3) Balanced Human Uses. Goals in each of these categories are classified by their priority level—that is their relative importance in comprehensive planning to solve the problems. Within each priority level in the table, individual goals are also listed in order of their priority.

Appendix A: Ranked Problems and Goals for Galveston Bay

Table A-1. Goal Priorities in *The Galveston Bay Plan*.

Priority Level	Water/Sediment Quality Improvement	Habitat/Living Resource Conservation	Balanced Human Uses
Very High	<p>Reduce urban NPS pollutant loads.</p> <p>Reduce toxicity and contaminant concentrations in water and sediments.</p> <p>Eliminate wet weather sewage bypasses/overflows.</p>	<p>Increase the quantity and improve the quality of wetlands for fish and wildlife.</p> <p>Eliminate or mitigate the conversion of wetlands to other uses caused by human activities.</p>	<p>Ensure beneficial freshwater inflows necessary for a salinity, nutrient, and sediment loading regime adequate to maintain productivity of economically important and ecologically characteristic species in Galveston Bay.</p>
High	<p>Eliminate pollution problems from poorly operated wastewater treatment plants.</p> <p>Restore and/or compensate for environmental damage (injury) resulting from discharges of oil or the release of hazardous substances.</p> <p>Eliminate illegal connections to storm sewers, which result in introduction of untreated wastes directly to bay tributaries.</p> <p>Increase dissolved oxygen in problem areas.</p>	<p>Acquire existing wetland habitats and provide economic incentives for conservation.</p> <p>Reverse the declining population trend for affected species of marine organisms and birds, and maintain the populations of other economic and ecologically important species.</p>	<p>Reduce potential health risk resulting from consumption of seafood contaminated with toxic substances.</p> <p>Reduce negative environmental consequences to the bay (i. e., human-induced erosion) from shoreline development.</p>

Appendix A: Ranked Problems and Goals for Galveston Bay

Priority Level	Water/Sediment Quality Improvement	Habitat/Living Resource Conservation	Balanced Human Uses
Moderate	<p>Reduce agricultural NPS pollutant loads.</p> <p>Reduce industrial NPS pollutant loads.</p> <p>Reduce marina water quality degradation associated with sewage.</p> <p>Reduce marina/dockside NPS loads.</p>	<p>Selectively moderate erosional impacts to the bay and associated shorelines.</p> <p>Increase productivity of oyster reefs in West Bay.</p> <p>Restore deteriorated colonial bird nesting islands to usefulness and create new islands for birds where nesting habitat is inadequate.</p>	<p>Reduce oyster reef harvest closures.</p> <p>Ensure that alterations to circulation do not negatively affect productivity and overall ecosystem health.</p>
Low	<p>Reduce construction NPS pollutant loads.</p> <p>Reduce the impact from spills on the natural environment.</p> <p>Eliminate illegal dumping.</p> <p>Eliminate waterborne debris.</p>	<p>Eradicate or reduce the populations of exotic/opportunistic species which threaten desirable native species, habitats, and ecological relationships. Prevent the introduction of additional exotic species.</p>	<p>Reduce risk of water-borne illness resulting from contact recreation.</p> <p>Increase environmentally compatible public access to bay resources.</p>



APPENDIX B:
Summary of Federal, State, and Local Costs

Appendix B: Summary of Federal, State, and Local Costs

Estimated cost figures obtained as described in the “How Much Will It Cost?” section of this document were summarized for federal, state, and local entities likely to be responsible for implementing various actions described in *The Galveston Bay Plan*. In addition, a summary of estimated costs for the new Galveston Bay Program are presented. Federal, state, and local costs are presented on Tables B-1, B-2, and B-3, respectively. Program costs are shown on Table B-4. Costs associated with the lead entities for each action are underlined.

New 5-Year Costs

Appendix B-1: Estimated FEDERAL Costs (Page 1 of 4)

ACTION		DESCRIPTION	USFWS	Corps	NMFS	National Park Serv.	SCS	USGS
HABITAT PROTECTION								
HP-1	Restore, create, and enhance wetlands		<u>\$750,000</u>	\$750,000	\$750,000		\$750,000	
HP-2	Beneficial uses of dredged material							
HP-3	Inventory/remediate degraded wetlands		<u>\$45,750</u>		\$45,750		\$45,750	
HP-4	Coordinate System-Wide reg. program		<u>\$11,250</u>	<u>\$11,250</u>				
HP-5	Acquire quality wetlands		<u>\$1,537,500</u>	\$1,500,000		\$1,500,000		
HP-6	Develop a tax incentive program							
HP-7	Facilitate bird nesting on existing islands		<u>\$37,500</u>					
HP-8	Build nesting islands			<u>\$37,500</u>				
HP-9	Coordinate erosion/subsidence program						\$100,000	
SUBTOTAL			\$2,382,000	\$2,298,750	\$795,750	\$1,500,000	\$895,750	
SPECIES POPULATION PROTECTION								
SP-1	Strengthen species management		\$84,375		\$37,500		\$37,500	
SP-2	Return oyster shell to bay							
SP-3	Develop oyster reefs		<u>\$36,000</u>	\$6,750				
SP-4	Set aside reef habitat for research		\$6,750		\$6,750			
SP-5	Reduce commercial bycatch		\$11,250		<u>\$875,000</u>			
SP-6	Catch and release programs							
SP-7	Investigate reducing impingement		\$22,500					
SP-8	Develop plans for endangered species		\$6,750		\$6,750			
SP-9	Enforce prohibitions- exotic species		<u>\$252,250</u>		\$4,500			
SP-10	Implement controls-exotic species		\$4,500		\$4,500		\$4,500	
SUBTOTAL			\$424,375	\$6,750	\$935,000		\$42,000	
PUBLIC HEALTH PROTECTION								
PH-1	Seafood Consumption Safety Program							
PH-2	Enhance TDH Shellfish Program							
PH-3	Contact Recreation Advisory Program							
SUBTOTAL								
FRESHWATER INFLOW								
FW-1	Determine freshwater inflow needs							
FW-2	Expand monitoring							<u>\$450,000</u>
FW-3	Meet freshwater inflow needs							
FW-4	Establish inflow regulations							
FW-5	Provide sediment to the bay							
FW-6	Reduce water consumption							
FW-7	Evaluate freshwater inflow needs							
SUBTOTAL								\$450,000
SPILLS/DUMPING								
SD-1	Damage assessment pre-screening							
SD-2	Establish compensation for small oil spills							
SD-3	Coordinate Restoration							
SD-4	Spill cleanup-shoreline characterization							
SD-5	Improve trash management			\$6,750				
SD-6	Screen trash from stormwater discharge							
SD-7	Publicize harm caused by illegal dumping							
SUBTOTAL				\$6,750				
SHORELINE MANAGEMENT								
SM-1	Establish shoreline development planning							
SM-2	Establish residential shoreline standards							
SM-3	Establish industrial shoreline standards							
SM-4	Minimize negative effects of structures							
SM-5	Improve shoreline access							
SUBTOTAL								

Notes: Lead entity is underlined. More actions are included on following page.

New 5-Year Costs

Appendix B-1: Estimated FEDERAL Costs (Page 2 of 4)

ACTION	DESCRIPTION	USFWS	Corps	NMFS	National Park Serv.	SCS	USGS
WATER/SEDIMENT QUALITY STANDARDS							
WSQ-1	Reduce contaminant concentrations						
WSQ-2	Determine sources of ambient toxicity	\$100,000					
WSQ-3	Establish sediment quality criteria						
WSQ-4	Perform TMDL loading studies-toxics						
WSQ-5	Support Clean Texas 2000						
WSQ-6	Reduce Nutrient and BOD Loadings						
WSQ-7	Perform TMDL loading studies-BOD						
SUBTOTAL		\$100,000					
NONPOINT SOURCES OF POLLUTION							
NPS-1	Implement NPDES Stormwater						
NPS-2	Perform pilot projects for BMPs						
NPS-3	Identify pollutant reduction						
NPS-4	Establish residential NPS programs						
NPS-5	Correct malfunctioning septic tanks						
NPS-6	Implement CZM NPS Reduction Plan						
NPS-7	Establish roadway planning for NPS						
NPS-8	NPDES Stormwater-industries						
NPS-9	Implement groundwater plume control						
NPS-10	Develop inventory of agricultural NPS						
NPS-11	Implement ag. NPS programs						
NPS-12	Adopt NPS construction standards						
NPS-13	Construction toxics/ nutrient control						
NPS-14	Require sewage pumpout, storage, tmt.						
NPS-15	Use of WWTP-treatable marine chemicals						
NPS-16	Implement wash down controls						
SUBTOTAL							
POINT SOURCES OF POLLUTION							
PS-1	Locate and delineate bypass/overflows						
PS-2	Eliminate/reduce bypasses-overflows						
PS-3	Regionalize small wastewater systems						
PS-4	Improve compliance monitoring						
PS-5	Implement illegal connection program						
PS-6	Issue NPDES Coastal General Permit						
SUBTOTAL							
RESEARCH ACTION PLAN							
RSC-1	Establish research coordination board						
RSC-2	Identify research needs						
RSC-3	Continue State of the Bay process						
RSC-4	Increase funding for Bay research						
SUBTOTAL							
PUBLIC PARTICIPATION/EDUCATION							
PPE-1	Establish a Citizen Advisory Committee						
PPE-2	Continue State of the Bay Symposia						
PPE-3	Adult education and outreach program						
PPE-4	Curricula for school districts						
PPE-5	Develop volunteer opportunities						
PPE-6	Citizen Pollution Reporting System						
PPE-7	Support for local governments						
PPE-8	Assist user groups affected by Plan						
SUBTOTAL							
5-YEAR TOTAL BY ORGANIZATION		\$2,906,375	\$2,312,250	\$1,730,750	\$1,500,000	\$937,750	\$450,000

ACTION	DESCRIPTION	NBS	EPA	NOAA	USCG	TOTAL FEDERAL
HABITAT PROTECTION						
HP-1	Restore, create, and enhance wetlands					\$3,000,000
HP-2	Beneficial uses of dredged material					
HP-3	Inventory/remediate degraded wetlands	<u>\$45,750</u>				\$183,000
HP-4	Coordinate System-Wide reg. program		<u>\$27,000</u>	\$11,250		\$60,750
HP-5	Acquire quality wetlands					\$4,537,500
HP-6	Develop a tax incentive program					
HP-7	Facilitate bird nesting on existing islands					\$37,500
HP-8	Build nesting islands					\$37,500
HP-9	Coordinate erosion/subsidence program					\$100,000
SUBTOTAL		\$45,750	\$27,000	\$11,250		\$7,956,250
SPECIES POPULATION PROTECTION						
SP-1	Strengthen species management					\$159,375
SP-2	Return oyster shell to bay					
SP-3	Develop oyster reefs					\$42,750
SP-4	Set aside reef habitat for research					\$13,500
SP-5	Reduce commercial bycatch					\$886,250
SP-6	Catch and release programs					
SP-7	Investigate reducing impingement					\$22,500
SP-8	Develop plans for endangered species					\$13,500
SP-9	Enforce prohibitions- exotic species				\$4,500	\$261,250
SP-10	Implement controls-exotic species					\$13,500
SUBTOTAL					\$4,500	\$1,412,625
PUBLIC HEALTH PROTECTION						
PH-1	Seafood Consumption Safety Program					
PH-2	Enhance TDH Shellfish Program					
PH-3	Contact Recreation Advisory Program					
SUBTOTAL						
FRESHWATER INFLOW						
FW-1	Determine freshwater inflow needs					
FW-2	Expand monitoring					\$450,000
FW-3	Meet freshwater inflow needs					
FW-4	Establish inflow regulations					
FW-5	Provide sediment to the bay					
FW-6	Reduce water consumption					
FW-7	Evaluate freshwater inflow needs					
SUBTOTAL						\$450,000
SPILLS/DUMPING						
SD-1	Damage assessment pre-screening					
SD-2	Establish compensation for small oil spills					
SD-3	Coordinate Restoration					
SD-4	Spill cleanup-shoreline characterization					
SD-5	Improve trash management					\$6,750
SD-6	Screen trash from stormwater discharge					
SD-7	Publicize harm caused by illegal dumping					
SUBTOTAL						\$6,750
SHORELINE MANAGEMENT						
SM-1	Establish shoreline development planning					
SM-2	Establish residential shoreline standards					
SM-3	Establish industrial shoreline standards					
SM-4	Minimize negative effects of structures					
SM-5	Improve shoreline access					
SUBTOTAL						

Notes: Lead entity is underlined. More actions
are included on following page.

ACTION	DESCRIPTION	NBS	EPA	NOAA	USCG	TOTAL FEDERAL
WATER/SEDIMENT QUALITY STANDARDS						
WSQ-1	Reduce contaminant concentrations					
WSQ-2	Determine sources of ambient toxicity					\$100,000
WSQ-3	Establish sediment quality criteria					
WSQ-4	Perform TMDL loading studies-toxics					
WSQ-5	Support Clean Texas 2000					
WSQ-6	Reduce Nutrient and BOD Loadings					
WSQ-7	Perform TMDL loading studies-BOD					
SUBTOTAL						\$100,000
NONPOINT SOURCES OF POLLUTION						
NPS-1	Implement NPDES Stormwater					
NPS-2	Perform pilot projects for BMPs					
NPS-3	Identify pollutant reduction					
NPS-4	Establish residential NPS programs					
NPS-5	Correct malfunctioning septic tanks					
NPS-6	Implement CZM NPS Reduction Plan					
NPS-7	Establish roadway planning for NPS					
NPS-8	NPDES Stormwater-industries					
NPS-9	Implement groundwater plume control					
NPS-10	Develop inventory of agricultural NPS					
NPS-11	Implement ag. NPS programs					
NPS-12	Adopt NPS construction standards					
NPS-13	Construction toxics/ nutrient control					
NPS-14	Require sewage pumpout, storage, tmt.					
NPS-15	Use of WWTP-treatable marine chemicals					
NPS-16	Implement wash down controls					
SUBTOTAL						
POINT SOURCES OF POLLUTION						
PS-1	Locate and delineate bypass/overflows					
PS-2	Eliminate/reduce bypasses-overflows					
PS-3	Regionalize small wastewater systems					
PS-4	Improve compliance monitoring					
PS-5	Implement illegal connection program					
PS-6	Issue NPDES Coastal General Permit					
SUBTOTAL						
RESEARCH ACTION PLAN						
RSC-1	Establish research coordination board					
RSC-2	Identify research needs					
RSC-3	Continue State of the Bay process					
RSC-4	Increase funding for Bay research					
SUBTOTAL						
PUBLIC PARTICIPATION/EDUCATION						
PPE-1	Establish a Citizen Advisory Committee					
PPE-2	Continue State of the Bay Symposia					
PPE-3	Adult education and outreach program					
PPE-4	Curricula for school districts					
PPE-5	Develop volunteer opportunities					
PPE-6	Citizen Pollution Reporting System					
PPE-7	Support for local governments					
PPE-8	Assist user groups affected by Plan					
SUBTOTAL						
5-YEAR TOTAL BY ORGANIZATION		\$45,750	\$27,000	\$11,250	\$4,500	\$9,925,625

ACTION	DESCRIPTION	TNRCC	TPWD	TXDOT	GLO	TDH
HABITAT PROTECTION						
HP-1	Restore, create, and enhance wetlands		<u>\$1,133,750</u>		\$125,000	
HP-2	Beneficial uses of dredged material	\$37,500	\$37,500		\$37,500	
HP-3	Inventory/remediate degraded wetlands		\$45,750		\$45,750	
HP-4	Coordinate System-Wide reg. program	<u>\$123,750</u>	<u>\$11,250</u>		<u>\$86,250</u>	
HP-5	Acquire quality wetlands		<u>\$1,584,375</u>		\$46,875	
HP-6	Develop a tax incentive program		<u>\$50,000</u>		<u>\$30,000</u>	
HP-7	Facilitate bird nesting on existing islands		<u>\$143,500</u>			
HP-8	Build nesting islands		\$17,500			
HP-9	Coordinate erosion/subsidence program		\$25,250		<u>\$200,250</u>	
SUBTOTAL		\$161,250	\$3,048,875		\$571,625	
SPECIES POPULATION PROTECTION						
SP-1	Strengthen species management		<u>\$294,000</u>		\$46,875	\$46,875
SP-2	Return oyster shell to bay		<u>\$423,000</u>			
SP-3	Develop oyster reefs		<u>\$73,500</u>		\$6,750	\$6,750
SP-4	Set aside reef habitat for research		<u>\$30,000</u>		\$6,750	\$6,750
SP-5	Reduce commercial bycatch		\$11,250			
SP-6	Catch and release programs		<u>\$90,000</u>			
SP-7	Investigate reducing impingement		\$22,500			
SP-8	Develop plans for endangered species		<u>\$182,250</u>			
SP-9	Enforce prohibitions- exotic species		\$4,500			
SP-10	Implement controls-exotic species		<u>\$150,000</u>			
SUBTOTAL			\$1,281,000		\$60,375	\$60,375
PUBLIC HEALTH PROTECTION						
PH-1	Seafood Consumption Safety Program					\$2,400,000
PH-2	Enhance TDH Shellfish Program					\$217,500
PH-3	Contact Recreation Advisory Program					<u>\$810,000</u>
SUBTOTAL						\$3,427,500
FRESHWATER INFLOW						
FW-1	Determine freshwater inflow needs					
FW-2	Expand monitoring					
FW-3	Meet freshwater inflow needs	<u>\$116,250</u>	\$30,000		\$22,500	
FW-4	Establish inflow regulations	<u>\$30,000</u>				
FW-5	Provide sediment to the bay	<u>\$22,500</u>				
FW-6	Reduce water consumption					
FW-7	Evaluate freshwater inflow needs	<u>\$187,500</u>				
SUBTOTAL		\$356,250	\$30,000		\$22,500	
SPILLS/DUMPING						
SD-1	Damage assessment pre-screening					
SD-2	Establish compensation for small oil spills					
SD-3	Coordinate Restoration					
SD-4	Spill cleanup-shoreline characterization					
SD-5	Improve trash management		\$15,750		\$6,750	
SD-6	Screen trash from stormwater discharge					
SD-7	Publicize harm caused by illegal dumping					
SUBTOTAL			\$15,750		\$6,750	
SHORELINE MANAGEMENT						
SM-1	Establish shoreline development planning				<u>\$96,000</u>	
SM-2	Establish residential shoreline standards				\$15,000	
SM-3	Establish industrial shoreline standards				\$60,750	
SM-4	Minimize negative effects of structures				<u>\$153,500</u>	
SM-5	Improve shoreline access				\$15,750	
SUBTOTAL					\$341,000	

Notes: Lead entity is underlined. More actions are included on following page.

New 5-Year Costs

Appendix B-2: Estimated STATE Costs (Page 2 of 6)

ACTION	DESCRIPTION	TNRCC	TPWD	TXDOT	GLO	TDH
WATER/SEDIMENT QUALITY STANDARDS						
WSQ-1	Reduce contaminant concentrations	<u>\$45,000</u>				
WSQ-2	Determine sources of ambient toxicity	<u>\$60,000</u>				
WSQ-3	Establish sediment quality criteria	<u>\$126,750</u>	\$22,500		\$22,500	
WSQ-4	Perform TMDL loading studies-toxics	<u>\$295,750</u>				
WSQ-5	Support Clean Texas 2000					
WSQ-6	Reduce Nutrient and BOD Loadings	<u>\$897,500</u>	\$22,500			
WSQ-7	Perform TMDL loading studies-BOD	<u>\$1,437,500</u>				
SUBTOTAL		\$2,862,500	\$45,000		\$22,500	
NONPOINT SOURCES OF POLLUTION						
NPS-1	Implement NPDES Stormwater	<u>\$97,500</u>			\$37,500	
NPS-2	Perform pilot projects for BMPs	<u>\$1,328,750</u>			\$15,000	
NPS-3	Identify pollutant reduction					
NPS-4	Establish residential NPS programs					
NPS-5	Correct malfunctioning septic tanks					
NPS-6	Implement CZM NPS Reduction Plan					
NPS-7	Establish roadway planning for NPS			<u>\$111,250</u>		
NPS-8	NPDES Stormwater-industries					
NPS-9	Implement groundwater plume control	<u>\$315,000</u>				
NPS-10	Develop inventory of agricultural NPS	\$312,500				
NPS-11	Implement ag. NPS programs					
NPS-12	Adopt NPS construction standards	\$15,000				
NPS-13	Construction toxics/ nutrient control					
NPS-14	Require sewage pumpout, storage, tmt.		\$28,750		\$42,500	
NPS-15	Use of WWTP-treatable marine chemicals	<u>\$90,750</u>			\$7,500	
NPS-16	Implement wash down controls	<u>\$63,000</u>				
SUBTOTAL		\$2,222,500	\$28,750	\$111,250	\$102,500	
POINT SOURCES OF POLLUTION						
PS-1	Locate and delineate bypass/overflows					
PS-2	Eliminate/reduce bypasses-overflows					
PS-3	Regionalize small wastewater systems					
PS-4	Improve compliance monitoring	<u>\$75,000</u>				
PS-5	Implement illegal connection program	<u>\$1,537,500</u>			\$15,000	
PS-6	Issue NPDES Coastal General Permit	<u>\$37,500</u>			\$22,500	
SUBTOTAL		\$1,650,000			\$37,500	
RESEARCH ACTION PLAN						
RSC-1	Establish research coordination board	\$37,500	\$37,500		\$37,500	
RSC-2	Identify research needs					
RSC-3	Continue State of the Bay process					
RSC-4	Increase funding for Bay research					
SUBTOTAL		\$37,500	\$37,500		\$37,500	
PUBLIC PARTICIPATION/EDUCATION						
PPE-1	Establish a Citizen Advisory Committee					
PPE-2	Continue State of the Bay Symposia					
PPE-3	Adult education and outreach program					
PPE-4	Curricula for school districts					
PPE-5	Develop volunteer opportunities					
PPE-6	Citizen Pollution Reporting System	<u>\$240,000</u>			\$220,500	
PPE-7	Support for local governments					
PPE-8	Assist user groups affected by Plan					
SUBTOTAL		\$240,000			\$220,500	
5-YEAR TOTAL BY ORGANIZATION		\$7,530,000	\$4,486,875	\$111,250	\$1,422,750	\$3,487,875

ACTION	DESCRIPTION	TWDB	TSSWCB	Shellfish Committee	CCC	RRC
HABITAT PROTECTION						
HP-1	Restore, create, and enhance wetlands					
HP-2	Beneficial uses of dredged material	\$37,500				
HP-3	Inventory/remediate degraded wetlands					
HP-4	Coordinate System-Wide reg. program					
HP-5	Acquire quality wetlands					
HP-6	Develop a tax incentive program					
HP-7	Facilitate bird nesting on existing islands					
HP-8	Build nesting islands					
HP-9	Coordinate erosion/subsidence program					
SUBTOTAL		\$37,500				
SPECIES POPULATION PROTECTION						
SP-1	Strengthen species management	\$46,875		\$50,000	\$37,500	
SP-2	Return oyster shell to bay			\$30,000		
SP-3	Develop oyster reefs					
SP-4	Set aside reef habitat for research					
SP-5	Reduce commercial bycatch					
SP-6	Catch and release programs					
SP-7	Investigate reducing impingement					
SP-8	Develop plans for endangered species					
SP-9	Enforce prohibitions- exotic species					
SP-10	Implement controls-exotic species					
SUBTOTAL		\$46,875		\$80,000	\$37,500	
PUBLIC HEALTH PROTECTION						
PH-1	Seafood Consumption Safety Program					
PH-2	Enhance TDH Shellfish Program					
PH-3	Contact Recreation Advisory Program					
SUBTOTAL						
FRESHWATER INFLOW						
FW-1	Determine freshwater inflow needs					
FW-2	Expand monitoring	<u>\$81,555</u>				
FW-3	Meet freshwater inflow needs	\$37,500			\$30,000	
FW-4	Establish inflow regulations					
FW-5	Provide sediment to the bay					
FW-6	Reduce water consumption	<u>\$37,500</u>				
FW-7	Evaluate freshwater inflow needs					
SUBTOTAL		\$156,555			\$30,000	
SPILLS/DUMPING						
SD-1	Damage assessment pre-screening					
SD-2	Establish compensation for small oil spills					
SD-3	Coordinate Restoration					
SD-4	Spill cleanup-shoreline characterization					
SD-5	Improve trash management					
SD-6	Screen trash from stormwater discharge					
SD-7	Publicize harm caused by illegal dumping					
SUBTOTAL						
SHORELINE MANAGEMENT						
SM-1	Establish shoreline development planning					
SM-2	Establish residential shoreline standards					
SM-3	Establish industrial shoreline standards					
SM-4	Minimize negative effects of structures					
SM-5	Improve shoreline access					
SUBTOTAL						

Notes: Lead entity is underlined. More actions
are included on following page.

ACTION	DESCRIPTION	TWDB	TSSWCB	Shellfish Committee	CCC	RRC
WATER/SEDIMENT QUALITY STANDARDS						
WSQ-1	Reduce contaminant concentrations					
WSQ-2	Determine sources of ambient toxicity					
WSQ-3	Establish sediment quality criteria					
WSQ-4	Perform TMDL loading studies-toxics					
WSQ-5	Support Clean Texas 2000					
WSQ-6	Reduce Nutrient and BOD Loadings					\$22,500
WSQ-7	Perform TMDL loading studies-BOD					
SUBTOTAL						\$22,500
NONPOINT SOURCES OF POLLUTION						
NPS-1	Implement NPDES Stormwater					
NPS-2	Perform pilot projects for BMPs					
NPS-3	Identify pollutant reduction					
NPS-4	Establish residential NPS programs					
NPS-5	Correct malfunctioning septic tanks					
NPS-6	Implement CZM NPS Reduction Plan					
NPS-7	Establish roadway planning for NPS					
NPS-8	NPDES Stormwater-industries					
NPS-9	Implement groundwater plume control					
NPS-10	Develop inventory of agricultural NPS		\$75,000			
NPS-11	Implement ag. NPS programs		\$36,000			
NPS-12	Adopt NPS construction standards					
NPS-13	Construction toxics/ nutrient control					
NPS-14	Require sewage pumpout, storage, tmt.					
NPS-15	Use of WWTP-treatable marine chemicals					
NPS-16	Implement wash down controls					
SUBTOTAL						\$111,000
POINT SOURCES OF POLLUTION						
PS-1	Locate and delineate bypass/overflows					
PS-2	Eliminate/reduce bypasses-overflows					
PS-3	Regionalize small wastewater systems					
PS-4	Improve compliance monitoring					
PS-5	Implement illegal connection program					
PS-6	Issue NPDES Coastal General Permit					\$33,750
SUBTOTAL						\$33,750
RESEARCH ACTION PLAN						
RSC-1	Establish research coordination board					
RSC-2	Identify research needs					
RSC-3	Continue State of the Bay process					
RSC-4	Increase funding for Bay research					
SUBTOTAL						
PUBLIC PARTICIPATION/EDUCATION						
PPE-1	Establish a Citizen Advisory Committee					
PPE-2	Continue State of the Bay Symposia					
PPE-3	Adult education and outreach program					
PPE-4	Curricula for school districts					
PPE-5	Develop volunteer opportunities					
PPE-6	Citizen Pollution Reporting System					
PPE-7	Support for local governments					
PPE-8	Assist user groups affected by Plan					
SUBTOTAL						
5-YEAR TOTAL BY ORGANIZATION		\$240,930	\$111,000	\$80,000	\$67,500	\$56,250

ACTION	DESCRIPTION	Texas A&M	Seagrant	Texas A&M Galveston	TIO	TOTAL STATE
HABITAT PROTECTION						
HP-1	Restore, create, and enhance wetlands					\$1,258,750
HP-2	Beneficial uses of dredged material					\$150,000
HP-3	Inventory/remediate degraded wetlands					\$91,500
HP-4	Coordinate System-Wide reg. program					\$221,250
HP-5	Acquire quality wetlands					\$1,631,250
HP-6	Develop a tax incentive program					\$80,000
HP-7	Facilitate bird nesting on existing islands					\$143,500
HP-8	Build nesting islands					\$17,500
HP-9	Coordinate erosion/subsidence program					\$225,500
SUBTOTAL						\$3,819,250
SPECIES POPULATION PROTECTION						
SP-1	Strengthen species management					\$522,125
SP-2	Return oyster shell to bay					\$453,000
SP-3	Develop oyster reefs	\$6,750				\$93,750
SP-4	Set aside reef habitat for research					\$43,500
SP-5	Reduce commercial bycatch					\$11,250
SP-6	Catch and release programs					\$90,000
SP-7	Investigate reducing impingement	\$6,750				\$29,250
SP-8	Develop plans for endangered species					\$182,250
SP-9	Enforce prohibitions- exotic species					\$4,500
SP-10	Implement controls-exotic species					\$150,000
SUBTOTAL						\$1,579,625
PUBLIC HEALTH PROTECTION						
PH-1	Seafood Consumption Safety Program					\$2,400,000
PH-2	Enhance TDH Shellfish Program					\$217,500
PH-3	Contact Recreation Advisory Program					\$810,000
SUBTOTAL						\$3,427,500
FRESHWATER INFLOW						
FW-1	Determine freshwater inflow needs					\$81,555
FW-2	Expand monitoring					\$236,250
FW-3	Meet freshwater inflow needs					\$30,000
FW-4	Establish inflow regulations					\$22,500
FW-5	Provide sediment to the bay					\$37,500
FW-6	Reduce water consumption					\$187,500
FW-7	Evaluate freshwater inflow needs					\$595,305
SUBTOTAL						\$595,305
SPILLS/DUMPING						
SD-1	Damage assessment pre-screening					
SD-2	Establish compensation for small oil spills					
SD-3	Coordinate Restoration					
SD-4	Spill cleanup-shoreline characterization					
SD-5	Improve trash management					\$22,500
SD-6	Screen trash from stormwater discharge					
SD-7	Publicize harm caused by illegal dumping					
SUBTOTAL						\$22,500
SHORELINE MANAGEMENT						
SM-1	Establish shoreline development planning					\$96,000
SM-2	Establish residential shoreline standards					\$15,000
SM-3	Establish industrial shoreline standards					\$60,750
SM-4	Minimize negative effects of structures					\$153,500
SM-5	Improve shoreline access					\$15,750
SUBTOTAL						\$341,000

Notes: Lead entity is underlined. More actions
are included on following page.

New 5-Year Costs

Appendix B-2: Estimated STATE Costs (Page 6 of 6)

ACTION		Texas A&M	Seagrant	Texas A&M Galveston	TIO	TOTAL STATE
WATER/SEDIMENT QUALITY STANDARDS						
WSQ-1	Reduce contaminant concentrations					\$45,000
WSQ-2	Determine sources of ambient toxicity					\$60,000
WSQ-3	Establish sediment quality criteria					\$171,750
WSQ-4	Perform TMDL loading studies-toxics					\$295,750
WSQ-5	Support Clean Texas 2000					
WSQ-6	Reduce Nutrient and BOD Loadings					\$942,500
WSQ-7	Perform TMDL loading studies-BOD					\$1,437,500
SUBTOTAL						\$2,952,500
NONPOINT SOURCES OF POLLUTION						
NPS-1	Implement NPDES Stormwater					\$135,000
NPS-2	Perform pilot projects for BMPs					\$1,343,750
NPS-3	Identify pollutant reduction					
NPS-4	Establish residential NPS programs					
NPS-5	Correct malfunctioning septic tanks					
NPS-6	Implement CZM NPS Reduction Plan					
NPS-7	Establish roadway planning for NPS					\$111,250
NPS-8	NPDES Stormwater-industries					
NPS-9	Implement groundwater plume control					\$315,000
NPS-10	Develop inventory of agricultural NPS					\$387,500
NPS-11	Implement ag. NPS programs					\$36,000
NPS-12	Adopt NPS construction standards					\$15,000
NPS-13	Construction toxics/ nutrient control					
NPS-14	Require sewage pumpout, storage, tmt.					\$71,250
NPS-15	Use of WWTP-treatable marine chemicals					\$98,250
NPS-16	Implement wash down controls					\$63,000
SUBTOTAL						\$2,576,000
POINT SOURCES OF POLLUTION						
PS-1	Locate and delineate bypass/overflows					
PS-2	Eliminate/reduce bypasses-overflows					
PS-3	Regionalize small wastewater systems					
PS-4	Improve compliance monitoring					\$75,000
PS-5	Implement illegal connection program					\$1,552,500
PS-6	Issue NPDES Coastal General Permit					\$93,750
SUBTOTAL						\$1,721,250
RESEARCH ACTION PLAN						
RSC-1	Establish research coordination board	\$37,500	\$37,500	\$37,500	\$37,500	\$262,500
RSC-2	Identify research needs					
RSC-3	Continue State of the Bay process					
RSC-4	Increase funding for Bay research					
SUBTOTAL						\$262,500
PUBLIC PARTICIPATION/EDUCATION						
PPE-1	Establish a Citizen Advisory Committee					
PPE-2	Continue State of the Bay Symposia					
PPE-3	Adult education and outreach program					
PPE-4	Curricula for school districts					
PPE-5	Develop volunteer opportunities					
PPE-6	Citizen Pollution Reporting System					\$460,500
PPE-7	Support for local governments					
PPE-8	Assist user groups affected by Plan					
SUBTOTAL						\$460,500
5-YEAR TOTAL BY ORGANIZATION		\$51,000	\$37,500	\$37,500	\$37,500	\$17,757,930

ACTION	DESCRIPTION	Municipalities (other than Houston)	Five Counties	GBF	GCWDA	HGAC	ICC
HABITAT PROTECTION							
HP-1	Restore, create, and enhance wetlands						
HP-2	Beneficial uses of dredged material					\$37,500	<u>\$150,000</u>
HP-3	Inventory/remediate degraded wetlands						
HP-4	Coordinate System-Wide reg. program						
HP-5	Acquire quality wetlands						
HP-6	Develop a tax incentive program						
HP-7	Facilitate bird nesting on existing islands						
HP-8	Build nesting islands						
HP-9	Coordinate erosion/subsidence program						
SUBTOTAL						\$37,500	\$150,000
SPECIES POPULATION PROTECTION							
SP-1	Strengthen species management		\$150,000				
SP-2	Return oyster shell to bay						
SP-3	Develop oyster reefs						
SP-4	Set aside reef habitat for research						
SP-5	Reduce commercial bycatch						
SP-6	Catch and release programs						
SP-7	Investigate reducing impingement						
SP-8	Develop plans for endangered species						
SP-9	Enforce prohibitions- exotic species						
SP-10	Implement controls-exotic species						
SUBTOTAL			\$150,000				
PUBLIC HEALTH PROTECTION							
PH-1	Seafood Consumption Safety Program						
PH-2	Enhance TDH Shellfish Program						
PH-3	Contact Recreation Advisory Program						
SUBTOTAL							
FRESHWATER INFLOW							
FW-1	Determine freshwater inflow needs						
FW-2	Expand monitoring		\$14,055				
FW-3	Meet freshwater inflow needs						
FW-4	Establish inflow regulations						
FW-5	Provide sediment to the bay						
FW-6	Reduce water consumption						
FW-7	Evaluate freshwater inflow needs						
SUBTOTAL			\$14,055				
SPILLS/DUMPING							
SD-1	Damage assessment pre-screening						
SD-2	Establish compensation for small oil spills						
SD-3	Coordinate Restoration						
SD-4	Spill cleanup-shoreline characterization						
SD-5	Improve trash management	\$27,000				\$15,000	
SD-6	Screen trash from stormwater discharge						
SD-7	Publicize harm caused by illegal dumping						
SUBTOTAL		\$27,000				\$15,000	
SHORELINE MANAGEMENT							
SM-1	Establish shoreline development planning		\$37,500			\$15,000	
SM-2	Establish residential shoreline standards	\$132,000	\$187,500				
SM-3	Establish industrial shoreline standards	\$132,000					
SM-4	Minimize negative effects of structures						
SM-5	Improve shoreline access						
SUBTOTAL		\$264,000	\$225,000			\$15,000	

Notes: Lead entity is underlined. More actions
are included on following page.

New 5-Year Costs

Appendix B-3: Estimated LOCAL Costs (Page 2 of 6)

ACTION	DESCRIPTION	Munis	Five Counties	GBF	GCWDA	HGAC	ICC
WATER/SEDIMENT QUALITY STANDARDS							
WSQ-1	Reduce contaminant concentrations						
WSQ-2	Determine sources of ambient toxicity						
WSQ-3	Establish sediment quality criteria						
WSQ-4	Perform TMDL loading studies-toxics						
WSQ-5	Support Clean Texas 2000						
WSQ-6	Reduce Nutrient and BOD Loadings						
WSQ-7	Perform TMDL loading studies-BOD	\$424,149					
SUBTOTAL		\$424,149					
NONPOINT SOURCES OF POLLUTION							
NPS-1	Implement NPDES Stormwater						
NPS-2	Perform pilot projects for BMPs		\$75,000			\$15,000	
NPS-3	Identify pollutant reduction	\$775,000					
NPS-4	Establish residential NPS programs	\$132,000	\$582,600			\$24,000	
NPS-5	Correct malfunctioning septic tanks	\$75,000					
NPS-6	Implement CZM NPS Reduction Plan						
NPS-7	Establish roadway planning for NPS		\$47,250				
NPS-8	NPDES Stormwater-industries						
NPS-9	Implement groundwater plume control					\$15,000	
NPS-10	Develop inventory of agricultural NPS		\$33,750				
NPS-11	Implement ag. NPS programs						
NPS-12	Adopt NPS construction standards					\$37,500	
NPS-13	Construction toxics/ nutrient control						
NPS-14	Require sewage pumpout, storage, tmt.						
NPS-15	Use of WWTP-treatable marine chemicals						
NPS-16	Implement wash down controls						
SUBTOTAL		\$982,000	\$738,600			\$91,500	
POINT SOURCES OF POLLUTION							
PS-1	Locate and delineate bypass/overflows						
PS-2	Eliminate/reduce bypasses-overflows						
PS-3	Regionalize small wastewater systems				\$315,000		
PS-4	Improve compliance monitoring						
PS-5	Implement illegal connection program						
PS-6	Issue NPDES Coastal General Permit						
SUBTOTAL					\$315,000		
RESEARCH ACTION PLAN							
RSC-1	Establish research coordination board						
RSC-2	Identify research needs						
RSC-3	Continue State of the Bay process						
RSC-4	Increase funding for Bay research						
SUBTOTAL							
PUBLIC PARTICIPATION/EDUCATION							
PPE-1	Establish a Citizen Advisory Committee						
PPE-2	Continue State of the Bay Symposia						
PPE-3	Adult education and outreach program						
PPE-4	Curricula for school districts						
PPE-5	Develop volunteer opportunities			\$398,750			
PPE-6	Citizen Pollution Reporting System						
PPE-7	Support for local governments					\$100,000	
PPE-8	Assist user groups affected by Plan						
SUBTOTAL				\$398,750		\$100,000	
5-YEAR TOTAL BY ORGANIZATION		\$1,697,149	\$1,127,655	\$398,750	\$315,000	\$259,000	\$150,000

New 5-Year Costs

Appendix B-3: Estimated LOCAL Costs (Page 3 of 6)

ACTION	DESCRIPTION	City of Houston	SJRA	TRA	Port of Galveston	Port of Houston	Rice
HABITAT PROTECTION							
HP-1	Restore, create, and enhance wetlands						
HP-2	Beneficial uses of dredged material				\$37,500	\$37,500	
HP-3	Inventory/remediate degraded wetlands						
HP-4	Coordinate System-Wide reg. program						
HP-5	Acquire quality wetlands						
HP-6	Develop a tax incentive program						
HP-7	Facilitate bird nesting on existing islands						
HP-8	Build nesting islands						
HP-9	Coordinate erosion/subsidence program						
SUBTOTAL					\$37,500	\$37,500	
SPECIES POPULATION PROTECTION							
SP-1	Strengthen species management	\$37,500					
SP-2	Return oyster shell to bay						
SP-3	Develop oyster reefs						
SP-4	Set aside reef habitat for research						
SP-5	Reduce commercial bycatch						
SP-6	Catch and release programs						
SP-7	Investigate reducing impingement						
SP-8	Develop plans for endangered species						
SP-9	Enforce prohibitions- exotic species						
SP-10	Implement controls-exotic species						
SUBTOTAL		\$37,500					
PUBLIC HEALTH PROTECTION							
PH-1	Seafood Consumption Safety Program						
PH-2	Enhance TDH Shellfish Program						
PH-3	Contact Recreation Advisory Program						
SUBTOTAL							
FRESHWATER INFLOW							
FW-1	Determine freshwater inflow needs						
FW-2	Expand monitoring	\$45,000	\$14,055	\$14,055			
FW-3	Meet freshwater inflow needs	\$22,500	\$22,500	\$22,500			
FW-4	Establish inflow regulations						
FW-5	Provide sediment to the bay						
FW-6	Reduce water consumption	\$13,750	\$13,750	\$13,750			
FW-7	Evaluate freshwater inflow needs						
SUBTOTAL		\$81,250	\$50,305	\$50,305			
SPILLS/DUMPING							
SD-1	Damage assessment pre-screening						
SD-2	Establish compensation for small oil spills						
SD-3	Coordinate Restoration						
SD-4	Spill cleanup-shoreline characterization						
SD-5	Improve trash management						
SD-6	Screen trash from stormwater discharge						
SD-7	Publicize harm caused by illegal dumping						
SUBTOTAL							
SHORELINE MANAGEMENT							
SM-1	Establish shoreline development planning						
SM-2	Establish residential shoreline standards						
SM-3	Establish industrial shoreline standards						
SM-4	Minimize negative effects of structures						
SM-5	Improve shoreline access						
SUBTOTAL							

Notes: Lead entity is underlined. More actions are included on following page.

New 5-Year Costs

Appendix B-3: Estimated LOCAL Costs (Page 4 of 6)

ACTION	DESCRIPTION	City of Houston	SJRA	TRA	Port of Galveston	Port of Houston	Rice
WATER/SEDIMENT QUALITY STANDARDS							
WSQ-1	Reduce contaminant concentrations						
WSQ-2	Determine sources of ambient toxicity						
WSQ-3	Establish sediment quality criteria						
WSQ-4	Perform TMDL loading studies-toxics						
WSQ-5	Support Clean Texas 2000						
WSQ-6	Reduce Nutrient and BOD Loadings						
WSQ-7	Perform TMDL loading studies-BOD						
SUBTOTAL							
NONPOINT SOURCES OF POLLUTION							
NPS-1	Implement NPDES Stormwater						
NPS-2	Perform pilot projects for BMPs	\$15,000					
NPS-3	Identify pollutant reduction						
NPS-4	Establish residential NPS programs						
NPS-5	Correct malfunctioning septic tanks						
NPS-6	Implement CZM NPS Reduction Plan						
NPS-7	Establish roadway planning for NPS						
NPS-8	NPDES Stormwater-industries						
NPS-9	Implement groundwater plume control		\$15,000	\$15,000			
NPS-10	Develop inventory of agricultural NPS						
NPS-11	Implement ag. NPS programs						
NPS-12	Adopt NPS construction standards						
NPS-13	Construction toxics/ nutrient control						
NPS-14	Require sewage pumpout, storage, tmt.						
NPS-15	Use of WWTP-treatable marine chemicals						
NPS-16	Implement wash down controls						
SUBTOTAL		\$15,000	\$15,000	\$15,000			
POINT SOURCES OF POLLUTION							
PS-1	Locate and delineate bypass/overflows						
PS-2	Eliminate/reduce bypasses-overflows						
PS-3	Regionalize small wastewater systems						
PS-4	Improve compliance monitoring						
PS-5	Implement illegal connection program						
PS-6	Issue NPDES Coastal General Permit						
SUBTOTAL							
RESEARCH ACTION PLAN							
RSC-1	Establish research coordination board		\$37,500	\$37,500			\$37,500
RSC-2	Identify research needs						
RSC-3	Continue State of the Bay process						
RSC-4	Increase funding for Bay research						
SUBTOTAL			\$37,500	\$37,500			\$37,500
PUBLIC PARTICIPATION/EDUCATION							
PPE-1	Establish a Citizen Advisory Committee						
PPE-2	Continue State of the Bay Symposia						
PPE-3	Adult education and outreach program						
PPE-4	Curricula for school districts						
PPE-5	Develop volunteer opportunities						
PPE-6	Citizen Pollution Reporting System						
PPE-7	Support for local governments						
PPE-8	Assist user groups affected by Plan						
SUBTOTAL							
5-YEAR TOTAL BY ORGANIZATION		\$133,750	\$102,805	\$102,805	\$37,500	\$37,500	\$37,500

ACTION	DESCRIPTION	TCC	UH	UH CEI	WEF	HGCSD	TOTAL LOCAL
HABITAT PROTECTION							
HP-1	Restore, create, and enhance wetlands						\$262,500
HP-2	Beneficial uses of dredged material						
HP-3	Inventory/remediate degraded wetlands						
HP-4	Coordinate System-Wide reg. program						
HP-5	Acquire quality wetlands						
HP-6	Develop a tax incentive program						
HP-7	Facilitate bird nesting on existing islands						
HP-8	Build nesting islands						
HP-9	Coordinate erosion/subsidence program						
SUBTOTAL							\$262,500
SPECIES POPULATION PROTECTION							
SP-1	Strengthen species management						\$187,500
SP-2	Return oyster shell to bay						
SP-3	Develop oyster reefs						
SP-4	Set aside reef habitat for research						
SP-5	Reduce commercial bycatch						
SP-6	Catch and release programs						
SP-7	Investigate reducing impingement						
SP-8	Develop plans for endangered species						
SP-9	Enforce prohibitions- exotic species						
SP-10	Implement controls-exotic species						
SUBTOTAL							\$187,500
PUBLIC HEALTH PROTECTION							
PH-1	Seafood Consumption Safety Program						
PH-2	Enhance TDH Shellfish Program						
PH-3	Contact Recreation Advisory Program						
SUBTOTAL							
FRESHWATER INFLOW							
FW-1	Determine freshwater inflow needs						\$87,165
FW-2	Expand monitoring						
FW-3	Meet freshwater inflow needs						\$67,500
FW-4	Establish inflow regulations						
FW-5	Provide sediment to the bay						
FW-6	Reduce water consumption					\$13,750	\$55,000
FW-7	Evaluate freshwater inflow needs						
SUBTOTAL							\$209,665
SPILLS/DUMPING							
SD-1	Damage assessment pre-screening						\$42,000
SD-2	Establish compensation for small oil spills						
SD-3	Coordinate Restoration						
SD-4	Spill cleanup-shoreline characterization						
SD-5	Improve trash management						
SD-6	Screen trash from stormwater discharge						
SD-7	Publicize harm caused by illegal dumping						
SUBTOTAL							\$42,000
SHORELINE MANAGEMENT							
SM-1	Establish shoreline development planning						\$52,500
SM-2	Establish residential shoreline standards						\$319,500
SM-3	Establish industrial shoreline standards						\$132,000
SM-4	Minimize negative effects of structures						
SM-5	Improve shoreline access						
SUBTOTAL							\$504,000

Notes: Lead entity is underlined. More actions are included on following page.

ACTION	DESCRIPTION	TCC	UH	UH CEI	WEF	HGCSD	TOTAL LOCAL
WATER/SEDIMENT QUALITY STANDARDS							
WSQ-1	Reduce contaminant concentrations						
WSQ-2	Determine sources of ambient toxicity						
WSQ-3	Establish sediment quality criteria						
WSQ-4	Perform TMDL loading studies-toxics						
WSQ-5	Support Clean Texas 2000						
WSQ-6	Reduce Nutrient and BOD Loadings						
WSQ-7	Perform TMDL loading studies-BOD						\$424,149
SUBTOTAL							\$424,149
NONPOINT SOURCES OF POLLUTION							
NPS-1	Implement NPDES Stormwater						
NPS-2	Perform pilot projects for BMPs						\$105,000
NPS-3	Identify pollutant reduction						\$775,000
NPS-4	Establish residential NPS programs						\$738,600
NPS-5	Correct malfunctioning septic tanks						\$75,000
NPS-6	Implement CZM NPS Reduction Plan						
NPS-7	Establish roadway planning for NPS						\$47,250
NPS-8	NPDES Stormwater-industries						
NPS-9	Implement groundwater plume control						\$45,000
NPS-10	Develop inventory of agricultural NPS						\$33,750
NPS-11	Implement ag. NPS programs						
NPS-12	Adopt NPS construction standards						\$37,500
NPS-13	Construction toxics/ nutrient control						
NPS-14	Require sewage pumpout, storage, tmt.						
NPS-15	Use of WWTP-treatable marine chemicals						
NPS-16	Implement wash down controls						
SUBTOTAL							\$1,857,100
POINT SOURCES OF POLLUTION							
PS-1	Locate and delineate bypass/overflows						
PS-2	Eliminate/reduce bypasses-overflows						
PS-3	Regionalize small wastewater systems						\$315,000
PS-4	Improve compliance monitoring						
PS-5	Implement illegal connection program						
PS-6	Issue NPDES Coastal General Permit						
SUBTOTAL							\$315,000
RESEARCH ACTION PLAN							
RSC-1	Establish research coordination board	\$37,500	\$37,500	\$37,500	\$37,500		\$262,500
RSC-2	Identify research needs						
RSC-3	Continue State of the Bay process						
RSC-4	Increase funding for Bay research						
SUBTOTAL		\$37,500	\$37,500	\$37,500	\$37,500		\$262,500
PUBLIC PARTICIPATION/EDUCATION							
PPE-1	Establish a Citizen Advisory Committee						
PPE-2	Continue State of the Bay Symposia						
PPE-3	Adult education and outreach program						
PPE-4	Curricula for school districts						
PPE-5	Develop volunteer opportunities						\$398,750
PPE-6	Citizen Pollution Reporting System						
PPE-7	Support for local governments						\$100,000
PPE-8	Assist user groups affected by Plan						
SUBTOTAL							\$498,750
5-YEAR TOTAL BY ORGANIZATION		\$37,500	\$37,500	\$37,500	\$37,500	\$13,750	\$4,563,164

ACTION	DESCRIPTION	
HABITAT PROTECTION		
HP-1	Restore, create, and enhance wetlands	\$37,500
HP-2	Beneficial uses of dredged material	\$6,750
HP-3	Inventory/remediate degraded wetlands	\$11,250
HP-4	Coordinate System-Wide reg. program	\$37,500
HP-5	Acquire quality wetlands	\$99,750
HP-6	Develop a tax incentive program	\$22,500
HP-7	Facilitate bird nesting on existing islands	\$11,250
HP-8	Build nesting islands	\$11,250
HP-9	Coordinate erosion/subsidence program	\$11,250
SUBTOTAL		\$249,000
SPECIES POPULATION PROTECTION		
SP-1	Strengthen species management	\$48,750
SP-2	Return oyster shell to bay	\$9,000
SP-3	Develop oyster reefs	\$11,250
SP-4	Set aside reef habitat for research	\$6,750
SP-5	Reduce commercial bycatch	\$11,250
SP-6	Catch and release programs	\$6,750
SP-7	Investigate reducing impingement	\$6,750
SP-8	Develop plans for endangered species	\$6,750
SP-9	Enforce prohibitions- exotic species	\$6,750
SP-10	Implement controls-exotic species	\$4,500
SUBTOTAL		\$118,500
PUBLIC HEALTH PROTECTION		
PH-1	Seafood Consumption Safety Program	\$11,250
PH-2	Enhance TDH Shellfish Program	\$11,250
PH-3	Contact Recreation Advisory Program	\$11,250
SUBTOTAL		\$33,750
FRESHWATER INFLOW		
FW-1	Determine freshwater inflow needs	
FW-2	Expand monitoring	\$11,250
FW-3	Meet freshwater inflow needs	\$11,250
FW-4	Establish inflow regulations	\$4,500
FW-5	Provide sediment to the bay	\$2,250
FW-6	Reduce water consumption	<u>\$48,750</u>
FW-7	Evaluate freshwater inflow needs	\$6,750
SUBTOTAL		\$84,750
SPILLS/DUMPING		
SD-1	Damage assessment pre-screening	\$2,250
SD-2	Establish compensation for small oil spills	<u>\$2,250</u>
SD-3	Coordinate Restoration	<u>\$30,000</u>
SD-4	Spill cleanup-shoreline characterization	\$11,250
SD-5	Improve trash management	\$66,000
SD-6	Screen trash from stormwater discharge	\$15,000
SD-7	Publicize harm caused by illegal dumping	<u>\$30,000</u>
SUBTOTAL		\$156,750
SHORELINE MANAGEMENT		
SM-1	Establish shoreline development planning	\$53,250
SM-2	Establish residential shoreline standards	<u>\$37,500</u>
SM-3	Establish industrial shoreline standards	
SM-4	Minimize negative effects of structures	\$37,500
SM-5	Improve shoreline access	<u>\$40,000</u>
SUBTOTAL		\$168,250

Notes: Lead entity is underlined. More actions are included on following page.

ACTION		DESCRIPTION
WATER/SEDIMENT QUALITY STANDARDS		
WSQ-1	Reduce contaminant concentrations	\$126,000
WSQ-2	Determine sources of ambient toxicity	\$15,000
WSQ-3	Establish sediment quality criteria	\$22,500
WSQ-4	Perform TMDL loading studies-toxics	\$81,000
WSQ-5	Support Clean Texas 2000	\$22,500
WSQ-6	Reduce Nutrient and BOD Loadings	\$107,250
WSQ-7	Perform TMDL loading studies-BOD	\$99,750
SUBTOTAL		\$474,000
NONPOINT SOURCES OF POLLUTION		
NPS-1	Implement NPDES Stormwater	\$11,250
NPS-2	Perform pilot projects for BMPs	\$37,500
NPS-3	Identify pollutant reduction	\$50,000
NPS-4	Establish residential NPS programs	\$93,750
NPS-5	Correct malfunctioning septic tanks	\$25,000
NPS-6	Implement CZM NPS Reduction Plan	
NPS-7	Establish roadway planning for NPS	\$7,500
NPS-8	NPDES Stormwater-industries	\$21,750
NPS-9	Implement groundwater plume control	\$4,500
NPS-10	Develop inventory of agricultural NPS	\$42,500
NPS-11	Implement ag. NPS programs	\$22,500
NPS-12	Adopt NPS construction standards	\$37,500
NPS-13	Construction toxics/ nutrient control	\$7,500
NPS-14	Require sewage pumpout, storage, tmt.	\$30,000
NPS-15	Use of WWTP-treatable marine chemicals	\$7,500
NPS-16	Implement wash down controls	\$24,000
SUBTOTAL		\$422,750
POINT SOURCES OF POLLUTION		
PS-1	Locate and delineate bypass/overflows	\$37,500
PS-2	Eliminate/reduce bypasses-overflows	\$11,250
PS-3	Regionalize small wastewater systems	\$11,250
PS-4	Improve compliance monitoring	\$68,500
PS-5	Implement illegal connection program	\$37,500
PS-6	Issue NPDES Coastal General Permit	\$59,000
SUBTOTAL		\$225,000
RESEARCH ACTION PLAN		
RSC-1	Establish research coordination board	\$50,000
RSC-2	Identify research needs	
RSC-3	Continue State of the Bay process	\$30,000
RSC-4	Increase funding for Bay research	\$37,500
SUBTOTAL		\$117,500
PUBLIC PARTICIPATION/EDUCATION		
PPE-1	Establish a Citizen Advisory Committee	\$580,250
PPE-2	Continue State of the Bay Symposia	\$45,000
PPE-3	Adult education and outreach program	\$835,000
PPE-4	Curricula for school districts	\$99,750
PPE-5	Develop volunteer opportunities	\$37,500
PPE-6	Citizen Pollution Reporting System	\$471,750
PPE-7	Support for local governments	\$37,500
PPE-8	Assist user groups affected by Plan	\$68,000
SUBTOTAL		\$2,174,750
5-YEAR TOTAL BY ORGANIZATION		\$4,225,000

APPENDIX C:

Estimated Costs of Galveston Bay Plan Compared to Costs of Other Programs

Appendix C: Estimated Costs of Galveston Bay Plan Compared to Costs of Other Programs (Page 1 of 2)

		TOTAL 5-YEAR	5-YEAR COSTS ASSOCIATED WITH OTHER PROGRAMS			
		COSTS OF	EXISTING PROGRAMS		PROPOSED PROGRAMS	
ACTION	DESCRIPTION	NEW ACTIONS IN GBP	IMPLEMENTING AGENCIES	COST	IMPLEMENTING AGENCIES	COST
HABITAT PROTECTION						
HP-1	Restore, create, and enhance wetlands	\$4,296,250				
HP-2	Beneficial uses of dredged material	\$419,250				
HP-3	Inventory/remediate degraded wetlands	\$285,750				
HP-4	Coordinate System-Wide reg. program	\$319,500				
HP-5	Acquire quality wetlands	\$6,268,500				
HP-6	Develop a tax incentive program	\$102,500				
HP-7	Facilitate bird nesting on existing islands	\$192,250	USFWS, TPWD	\$225,000		
HP-8	Build nesting islands	\$66,250				
HP-9	Coordinate erosion/subsidence program	\$336,750			GLO, SCS	\$100,000
SUBTOTAL		\$12,287,000		\$225,000		\$100,000
SPECIES POPULATION PROTECTION						
SP-1	Strengthen species management	\$917,750				
SP-2	Return oyster shell to bay	\$462,000				
SP-3	Develop oyster reefs	\$147,750	USFWS, TPWD	\$48,000		
SP-4	Set aside reef habitat forresearch	\$63,750				
SP-5	Reduce commercial bycatch	\$908,750				
SP-6	Catch and release programs	\$96,750	TPWD	\$33,000		
SP-7	Investigate reducing impingement	\$58,500				
SP-8	Develop plans for endangered species	\$202,500				
SP-9	Enforce prohibitions- exotic species	\$272,500			USFWS	\$15,000
SP-10	Implement controls-exotic species	\$168,000				
SUBTOTAL		\$3,298,250		\$81,000		\$15,000
PUBLIC HEALTH PROTECTION						
PH-1	Seafood Consumption Safety Program	\$2,411,250			TDH	\$2,400,000
PH-2	Enhance TDH Shellfish Program	\$228,750			TDH	\$217,500
PH-3	Contact Recreation Advisory Program	\$821,250				
SUBTOTAL		\$3,461,250				\$2,617,500
FRESHWATER INFLOW						
FW-1	Determine freshwater inflow needs	\$0				
FW-2	Expand monitoring	\$629,970	TWDB River Authorities Harris County	\$1,280,000		
FW-3	Meet freshwater inflow needs	\$315,000				
FW-4	Establish inflow regulations	\$34,500				
FW-5	Provide sediment to the bay	\$24,750				
FW-6	Reduce water consumption	\$141,250				
FW-7	Evaluate freshwater inflow needs	\$194,250				
SUBTOTAL		\$1,339,720		\$1,280,000		
SPILLS/DUMPING						
SD-1	Damage assessment pre-screening	\$2,250			Nat'l Res. Trustees	\$56,250
SD-2	Establish compensation for small oil spills	\$2,250			Nat'l Res. Trustees	\$56,250
SD-3	Coordinate Restoration	\$30,000			GLO, TNRCC, TPWD	\$47,250
SD-4	Spill cleanup-shoreline characterization	\$11,250			Nat'l Res. Trustees, USCG	\$210,500
SD-5	Improve trash management	\$137,250				
SD-6	Screen trash from stormwater discharge	\$15,000			EPA, Munis	\$202,500
SD-7	Publicize harm caused by illegal dumping	\$30,000				
SUBTOTAL		\$228,000				\$572,750
SHORELINE MANAGEMENT						
SM-1	Establish shoreline development planning	\$201,750			SCS	\$1,385,250
SM-2	Establish residential shoreline standards	\$372,000				
SM-3	Establish industrial shoreline standards	\$192,750				
SM-4	Minimize negative effects of structures	\$191,000	USCG, TDH, TPWD	\$112,500		
SM-5	Improve shoreline access	\$55,750				
SUBTOTAL		\$1,013,250		\$112,500		\$1,385,250

Note: More actions are included on the following page.

Appendix C: Estimated Costs of Galveston Bay Plan Compared to Costs of Other Programs (Page 2 of 2)

		TOTAL 5-YEAR	5-YEAR COSTS ASSOCIATED WITH OTHER PROGRAMS			
		COSTS OF	EXISTING PROGRAMS		PROPOSED PROGRAMS	
ACTION	DESCRIPTION	NEW ACTIONS IN GBP	IMPLEMENTING AGENCIES	COST	IMPLEMENTING AGENCIES	COST
WATER/SEDIMENT QUALITY STANDARDS						
WSQ-1	Reduce contaminant concentrations	\$171,000				
WSQ-2	Determine sources of ambient toxicity	\$175,000				
WSQ-3	Establish sediment quality criteria	\$194,250			TNRCC	\$32,250
WSQ-4	Perform TMDL loading studies-toxics	\$376,750	TNRCC	\$600,000		
WSQ-5	Support Clean Texas 2000	\$22,500				
WSQ-6	Reduce Nutrient and BOD Loadings	\$1,049,750	TNRCC	\$115,000		
WSQ-7	Perform TMDL loading studies-BOD	\$1,961,399				
SUBTOTAL		\$3,950,649		\$715,000		\$32,250
NONPOINT SOURCES OF POLLUTION						
NPS-1	Implement NPDES Stormwater	\$146,250	Houston	\$27,803,750		
NPS-2	Perform pilot projects for BMPs	\$1,486,250	Harris County			
NPS-3	Identify pollutant reduction	\$825,000				
NPS-4	Establish residential NPS programs	\$832,350			TNRCC	\$60,000
NPS-5	Correct malfunctioning septic tanks	\$100,000			GLO	
NPS-6	Implement CZM NPS Reduction Plan	\$0				
NPS-7	Establish roadway planning for NPS	\$166,000				
NPS-8	NPDES Stormwater-industries	\$21,750				
NPS-9	Implement groundwater plume control	\$364,500			TNRCC, HGAC	\$100,000
NPS-10	Develop inventory of agricultural NPS	\$463,750			HGAC	\$300,000
NPS-11	Implement ag. NPS programs	\$58,500	TSSWCB GLO TNRCC	\$67,500	River Authorities	
NPS-12	Adopt NPS construction standards	\$90,000				
NPS-13	Construction toxics/ nutrient control	\$7,500				
NPS-14	Require sewage pumpout, storage, tmt.	\$101,250				
NPS-15	Use of WWTP-treatable marine chemicals	\$105,750				
NPS-16	Implement wash down controls	\$87,000				
SUBTOTAL		\$4,855,850		\$27,871,250		\$460,000
POINT SOURCES OF POLLUTION						
PS-1	Locate and delineate bypass /overflows	\$37,500	Houston	\$250,000,000	Other Munis	\$266,400,000
PS-2	Eliminate/reduce bypasses-overflows	\$11,250	Houston	\$950,000,000	Other Munis	\$163,185,976
PS-3	Regionalize small wastewater systems	\$326,250				
PS-4	Improve compliance monitoring	\$143,500				
PS-5	Implement illegal connection program	\$1,590,000				
PS-6	Issue NPDES Coastal General Permit	\$152,750				
SUBTOTAL		\$2,261,250		\$1,200,000,000		\$429,585,976
RESEARCH ACTION PLAN						
RSC-1	Establish research coordination board	\$575,000				
RSC-2	Identify research needs	\$0				
RSC-3	Continue State of the Bay process	\$30,000				
RSC-4	Increase funding for Bay research	\$37,500				
SUBTOTAL		\$642,500				
PUBLIC PARTICIPATION/EDUCATION						
PPE-1	Establish a Citizen Advisory Committee	\$580,250				
PPE-2	Continue State of the Bay Symposia	\$45,000				
PPE-3	Adult education and outreach program	\$835,000				
PPE-4	Curricula for school districts	\$99,750				
PPE-5	Develop volunteer opportunities	\$436,250	GBF	\$141,250	GBF	\$37,500
PPE-6	Citizen Pollution Reporting System	\$932,250	GBF	\$375,000		
PPE-7	Support for local governments	\$137,500				
PPE-8	Assist user groups affected by Plan	\$68,000				
SUBTOTAL		\$3,134,000		\$516,250		\$37,500
5-YEAR TOTAL		\$36,471,719		\$1,230,801,000		\$434,806,226

APPENDIX D:
Summary of Regulatory Needs

Appendix D: Summary of Regulatory Needs

A summary of the needs for new legislation and regulations that may be required to implement the actions recommended by *The Galveston Bay Plan* is presented in Table I-7. Each action proposed by *The Plan* is listed in the table along with a corresponding regulatory need. Some actions do not require additional regulatory measures beyond those already in place and are described in Table I-7 as “none” or “none identified.”

Appendix D: Summary of Regulatory Needs

Action	Regulatory Needs
HP-1: Restore, Create, and Protect Wetlands	Review and change existing federal, state, and local regulations which discourage habitat creation and restoration initiatives (e.g., liabilities).
HP-2: Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands	Dredging activities of Corps will be subject to the consistency review process.
HP-3: Inventory Degraded Wetlands and Fund Remedial Measures	Review and change existing state, and local regulations which discourage habitat creation and restoration initiatives.
HP-4: Implement a Coordinated System-Wide Wetland Regulatory Strategy	Generate an MOU as described .
HP-5: Acquire and Protect Quality Wetlands	Congressional authorization and appropriation will be required for federal funding appropriations to acquire wetlands.
HP-6: Develop Economic and Tax Incentive Programs to Protect Wetlands	New tax incentives may require legislation or regulation. The Federal Assistance Program (Water Bank Program) will reward the property owner for preserving wetlands.
HP-7: Facilitate Bird Nesting on Existing Sites	No new regulatory needs were identified for this action.
HP-8: Build Nesting Islands Using Dredged Material	Appropriate permits will be necessary for dredging activities necessary to complete this action. Houston Ship Channel project requires congressional authorization and appropriation.
HP-9: Reduce Erosional Impacts on Wetlands and Habitats	Standards for erosion may be appropriate for inclusion in General Permits.
SP-1: Implement a Bay-Wide Effort to Strengthen Species Management	Potential establishment of additional management plans or regulatory action by TPWD or other entities. No current legislation needed.
SP-2: Return Oyster Shell to Designated Locations Within the Bay	Funding for this program will require an appropriation from the Texas Legislature.
SP-3: Promote the Development of Oyster Reefs Using Alternate Materials	The current leasing process required for the placement of reef substrate needs to be streamlined.

Appendix D: Summary of Regulatory Needs

Action	Regulatory Needs
SP-4: Set Aside a Portion of Reef Habitat as Scientific Research Areas or Preserves	May require action by the Texas Legislature or other entities in addition to TPWD.
SP-5: Encourage Continued Development of Gear to Reduce Commercial By-Catch	NMFS has already mandated the use of Turtle Excluder Devices (TEDs).
SP-6: Conduct Educational Programs About Catch and Release	None.
SP-7: Investigate Potential Measures to Reduce Impingement and Entrainment	None.
SP-8: Develop Management Plans for Endangered or Threatened Species	None.
SP-9: Improve Enforcement of Prohibitions Against the Introduction of Exotic Species	Clarification of the scope of enforcement authority will be required.
SP-10: Identify and Implement Techniques for the Control of Problem Exotic Species	None.
PH-1: Develop a Seafood Consumption Safety Program	None.
PH-2: Enhance the TDH Shellfish Sanitation Program	Continue coordination with emerging federal actions and the NSSP program. Support the completion of the National Indicator Study and the development of an improved indicator parameter for the determination of molluscan shell fish closures.
PH-3: Develop a Contact Recreation Advisory Program	None.
FW-1: Complete Current Studies to Determine Freshwater Inflow Needs for the Bay	These studies have been mandated by Texas statute.
FW-2: Expand Streamflow, Sediment Loading, and Rainfall Monitoring	None.
FW-3: Establish Management Strategies for Meeting Freshwater Inflow Needs	Implementation of the strategies developed by this action may require additional regulations and/or statutes. See Action FW-4.
FW-4: Establish Inflow Regulations to Protect the Ecological Needs of the Estuary	At the state level, Sec. 11.147 of the Texas Water Code requires that the TNRCC include in the conditions for a permit to store, take or divert state water, specific requirements to maintain beneficial inflows to any affected bays and estuary systems. If necessary, the TNRCC could expand the scope of this authority and could, by a legislative change, include all of a watershed in the area in which conditions could be imposed in permits.

Appendix D: Summary of Regulatory Needs

Action	Regulatory Needs
FW-5: Explore Means of Providing Sediment to the Estuary	None.
FW-6: Reduce Water Consumption	None.
FW-7: Evaluate the Effects of Channels and Structures on Bay Circulation, Habitats, and Species	None.
SD-1: Promote Planning to Facilitate Natural Resource Damage Assessments	Damage assessments for spills of oil and hazardous substances should be conducted in accordance with provisions of applicable federal regulations issued subsequent to the CWA and CERCLA. NOAA is in the process of developing regulations to address damage assessments for oil spills as directed by the OPA. Additionally, Texas Senate Bill 1049, effective September 1, 1993, requires the state to develop a damage assessment process for oil spills in coastal waters, and Galveston Bay is specifically named to be surveyed for the Natural Resource Inventory.
SD-2: Identify Simplified Damage Assessment Procedures for Small Oil Spills	Damage assessments for spills of oil and hazardous substances should be conducted in accordance with provisions of applicable federal regulations issued subsequent to the Clean Water Act and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund). NOAA is in the process of developing regulations to address damages assessments for oil spills as directed by OPA. Additionally, Texas SB 1049/HB 2188, effective September 1, 1993, requires the state to develop a damage assessment process for oil spills in coastal waters, and Galveston Bay is specifically named to be surveyed for the Natural Resource Inventory.
SD-3: Facilitate Effective Restoration of Natural Resources Damaged by Spills	Existing legislation has established sufficient authority for these actions.
SD-4: Facilitate Spill Cleanup by Advance Shoreline Characterization	SB 1059/HB 2188, effective September 1, 1993, generally authorizes the use of a GIS to identify bay features helpful to cleanup activities, and the expenditure of Coastal Protection Fund moneys for such activities.
SD-5: Improve Trash Management Near the Shoreline	MARPOL Annex V establishes that facilities with more than 10 vessels supply shoreside trash handling facilities, and this addresses most marinas in the Galveston Bay system. A model ordinance is needed for incorporated areas encompassing shoreline parks and boat ramps, etc. Authority to require these actions is problematic for unincorporated areas such as county parks, where implementation would be voluntary and coordinated through county commissions and anti-littering campaigns.
SD-6: Remove Trash from Storm Water Discharges	This action would be implemented under NPDES storm water permits and provisions of the EPA/NOAA agreement for non-point source pollution control in coastal areas.

Appendix D: Summary of Regulatory Needs

Action	Regulatory Needs
SD-7: Publicize Environmental Harm Caused by Illegal Dumping	This action can be accomplished under existing programs, and requires no new regulations.
SM-1: Establish a Planning Program for Shoreline Development	County ordinance-making power would facilitate local participation in shoreline planning and attaining consistency with the developing CMP.
SM-2: Identify Appropriate Residential Shoreline Development Guidelines	County ordinance-making power would enable more local participation in shoreline planning.
SM-3: Identify Appropriate Commercial and Industrial Shoreline Development Guidelines	County ordinance-making power would enable more local participation in shoreline planning. Standards are already a part of the RCRA facility siting process.
SM-4: Minimize Negative Effects of Structures and Dredging on Publicly Owned Lands	1) Escrow funds at time of construction permit application; 2) increase fines for abandonment; 3) provide for specific and cumulative impact assessment and mitigation against unavoidable impacts when permitting; 4) prohibit future cabin lease transfers; application renewals, new cabins on state lands; or rebuilding after damage to greater than half the cabin value; 5) obtain state authority to regulate houseboats.
SM-5: Improve Access to Publicly Owned Shorelines	None.
WSQ-1: Reduce Contaminant Concentrations to Meet Standards and Criteria	Need to conduct enforcement based on results of monitoring. Consistency review of applications for NPDES and NPS implementation grants can be used to encourage TNRCC to implement.
WSQ-2: Determine Sources of Ambient Toxicity in Water and Sediment	None identified.
WSQ-3: Establish and Adopt Sediment Quality Criteria	Need to add sediment criteria to state water quality standards.
WSQ-4: Perform TMDL Loading Studies for Toxics	TMDLs should be added to the state's Water Quality Management Plan. Permits need to be revised when they come up for renewal based on results of TMDLs. Local storm water management plans might be required to meet pollutant loading goals. TNRCC must modify the TMDL process to account for point and non-point sources.
WSQ-5: Support Clean Texas 2000 Pollution Prevention Program	None identified.
WSQ-6: Reduce Nutrient and BOD Loadings to Problem Areas	No new legislation is required. Permit criteria may need to be revised based on results of this action. Thorough consistency reviews encourage reduction of discharge of nutrients by federally assisted or conducted actions. Consistency review of application for implementation grants from EPA can be used as a tool to encourage TNRCC to implement this action.

Appendix D: Summary of Regulatory Needs

Action

Regulatory Needs

WSQ-7: Perform TMDL Loading Studies for Oxygen Demand and Nutrients

No new legislation is required. Permit criteria may need to be revised based on results of this action. TNRCC must modify the TMDL process to account for point and non-point sources.

NPS-1: Implement Storm Water Programs for Local Municipalities

Implementation of non-point source control measures may require significant changes in local drainage regulations, building codes, zoning plans, etc.

NPS-2: Perform Pilot Projects to Develop NPS Best Management Practices for the Galveston Bay Watershed

None identified.

NPS-3: Identify and Correct Priority Watershed Pollutant Problems

None identified.

NPS-4: Establish Residential Load Reduction Programs

May lead to new local ordinances aimed at curbing non-point source pollutants from various residential sources, such as fertilizer application, herbicide application, and pet waste. Through consistency review of implementation grants for TNRCC programs, the enhancement of existing or development of new TNRCC ordinances and education programs can be encouraged.

NPS-5: Correct Malfunctioning Shoreline Septic Tanks

Stronger local ordinances will be required to curb fecal coliform pollution from septic tanks. These ordinances will require some type of certification and upgrades upon sale or transfer of property in problem areas.

NPS-6: Implement NPS Reduction Plan Program for New Development

Texas NPS Reduction Plan Program will need to be approved by EPA and NOAA.

NPS-7: Establish Roadway Planning to Minimize NPS Effects

Need to change management priorities within roadway planning agencies. Consistency review of highway research, planning, and construction grants provided by DOT can encourage use of best available technology and practices to reduce TSS, non-point source loading from new highway developments.

NPS-8: Implement NPDES Storm Water Program for Area Industries

Consistency review of application for NPDES implementation grants can be used to encourage efforts toward goals of *The Plan* once TNRCC has NPDES delegation.

NPS-9: Prevent Degradation of Bay Waters by Known Industrial Groundwater Plumes

Change TNRCC's management emphasis to increase resources devoted to identifying groundwater plumes with substantial discharges to surface water. Consistency review of application for NPS implementation grants can be used to encourage TNRCC to move toward implementation of such programs.

NPS-10: Develop Inventory of Agricultural Non-Point Sources

Consistency review of application for implementation grants for NPS program can be used to encourage TNRCC to develop this inventory.

Appendix D: Summary of Regulatory Needs

Action

NPS-11: Coordinate and Implement Existing Agricultural NPS Control Programs

NPS-12: Adopt Regional Construction Standards for NPS Reduction

NPS-13: Implement Toxics, Nutrient Control Practices at Construction Sites

NPS-14: Require Sewage Pumpout, Storage, and Provisions for Treatment

NPS-15: Require Use of Marine Sanitary Chemicals That Can Be Treated in POTWs

NPS-16: Implement Washdown Controls and Containment Measures

PS-1: Determine Location and Extent of Bypass and Overflow Problems

PS-2: Eliminate or Reduce Bypass or Overflow Problems

PS-3: Regionalize Small Wastewater Treatment Systems

PS-4: Improve Compliance Monitoring and Enforcement for Small Dischargers

PS-5: Implement a Dry-Weather Illegal Connection Program

Regulatory Needs

Some change in management decision-making process needed to increase coordination between various programs in different agencies.

No new regulatory authority needed for existing NPDES storm water programs. Other municipalities need to adopt ordinances to implement these measures. Counties have no ordinance-making powers. Regulation would have to occur based on local ordinance-making powers. This action may require changes in local drainage regulations, codes, and zoning plans.

No new regulatory authority needed under existing NPDES permits (including Houston/Pasadena/unincorporated areas of Harris County). Other municipalities need to adopt ordinances to implement these measures at construction sites. At county level, however, adoption of construction practice regulation is problematic, since no ordinance-making powers exist at the county level. Regulation would have to occur based on local ordinance-making powers.

May need new local or state regulations to implement.

Will need new local or state regulations to implement product bans.

May need new local or state regulations to implement and enforce.

EPA and TNRCC will need to issue administrative orders as needed.

The TNRCC will need to issue administrative orders to implement this action.

May require local and state legislation to give GCWDA the authority to implement regional treatment. A possible approach to encouraging regionalization is to require that new permit holders with small systems pay a fee or post a bond prior to construction to ensure that funds are available for system maintenance and operation, or to ensure funding for potential future regionalization effort. Consistency review of any federal assistance to these small systems can be used as a tool to encourage these systems to regionalize.

May require additional funding from state or the collection of inspection fees.

Initially the program will be voluntary. Rulemaking by the TNRCC under the Pollution Abatement for Municipalities rules might be required in two years if voluntary implementation is insufficient.

Appendix D: Summary of Regulatory Needs

Action	Regulatory Needs
PS-6: Issue NPDES Coastal General Permit or Reduce Oil Field Brine Discharge	Need to issue NPDES permit or implement new RRC program.
RSC-1: Establish a Research Coordination Board	None.
RSC-2: Identify Research Needs From an Ecosystem Perspective	None.
RSC-3: Continue State of the Bay Process	None.
RSC-4: Increase Funding for Galveston Bay Research	None.
PPE-1: Establish Citizen Involvement as an Integral Part of the Program	None.
PPE-2: Continue and Expand the State of the Bay Symposia	None.
PPE-3: Develop and Implement a Long-Range Adult Education and Outreach Program	None.
PPE-4: Develop Specific Curricula for Use in Galveston Bay Watershed School Districts	Legislative note: Chapter 361, Section 11.53 of the Texas Health and Safety Code, as established by SB. 1340, mandates environmental education programs in Texas public schools. However, this mandate has not been funded to date. A bill to fund this measure through a licenses plate fee was introduced in the 1993 Texas Legislature, but failed.
PPE-5: Continue to Develop Effective Volunteer Opportunities for Citizens	None.
PPE-6: Maintain a Citizen Pollution Reporting System	None.
PPE-7: Develop and Implement a Strategy for Informing, Educating, and Providing Support for Local Government Involvement	None.
PPE-8: Provide Assistance for User Groups Affected by Implementation of <i>The Galveston Bay Plan</i>	None.

APPENDIX E:
Summary of Research Needs

Appendix E: Summary of Research Needs

This appendix describes additional information required for some actions prior to effective implementation as part of *The Galveston Bay Plan*. The table below presents those actions for which further research or study is needed along with a summary of appropriate projects to provide the desired information. The Research Action Plan provides further details for using the tools of basic and applied research to make informed management decisions concerning Galveston Bay.

Appendix E: Summary of Research Needs

No.	Research Need	Who	Research or Technical Study
HP-1	Restore, Create, and Protect Wetlands	TPWD NMFS Nat'l Biol. Survey	Research causes of seagrass loss and techniques to restore submerged aquatics. Evaluate effectiveness of various marsh creation and enhancement techniques, such as thin layer disposal on subsiding marshes.
HP-2	Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands	ICC	Conduct comprehensive bay-wide beneficial uses inventory.
HP-2	Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands	ICC	Develop and verify predictive models to assess impacts of circulation and salinity changes (e.g. effects of Texas City Dike).
HP-2	Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands	ICC	Develop advanced testing program to determine existence of geographic distribution of contaminants for project-by-project dredging/filling in order to manage contaminated sediments safely.
HP-3	Inventory Degraded Wetlands and Fund Remedial Measures	USFWS	Develop a definition of a degraded wetland for use in inventory and ranking.
HP-3	Inventory Degraded Wetlands and Fund Remedial Measures	USFWS TPWD NMFS	Complete estuary-wide inventory of habitat, and rank degraded habitats in order of increasing need for remediation.
HP-3	Inventory Degraded Wetlands and Fund Remedial Measures	USFWS SCS NBS, NMFS TPWD GLO	Evaluate the effectiveness of various marsh creation and enhancement techniques and prepare a descriptive list of the relative effectiveness of each.
HP-5	Acquire and Protect Quality Wetlands	USFWS TPWD	Complete detailed inventory and ranking of habitats and an accompanying quality assessment
HP-6	Develop Economic and Tax Incentive Programs to Protect Wetlands	TPWD	Study to explore use of ad valorem tax incentive and other existing economic incentives that would encourage habitat protection.
HP-9	Reduce Erosional Impacts on Wetlands and Habitats	GLO TPWD	Research effects of reservoir or surface impoundment construction on erosion.
HP-9	Reduce Erosional Impacts on Wetlands and Habitats	GLO TPWD	Study effects of sand and gravel mining on erosion.

Appendix E: Summary of Research Needs

No.	Research Need	Who	Research or Technical Study
HP-9	Reduce Erosional Impacts on Wetlands and Habitats	GLO	Study means to reduce erosion and restore eroded fringing marsh in sensitive areas of the bay such as Christmas Bay where the width of the GIWW has been increased by erosion. Research the correlation between magnitude and rate of shoreline erosion to hull configuration, draft, speed, and other appropriate factors for vessels commonly using the bay. Perform a wind wave analysis to distinguish between a ship wake and wind wave erosion problem.
SP-1	Implement a Bay-Wide Effort to Strengthen Species Management	TPWD, Advisory Com.	Research causes of identified declines in species populations. Investigate possible reintroduction of reduced/extirpated species, with appropriate species/habitat management plans. Identify areas where additional research is required, including time/trend analysis on factors affecting blue crab population and population of other affected species.
SP-3	Promote the Development of Oyster Reefs Using Alternate Materials	HL&P, USFWS, TPWD	Continue current HL&P experimental project to create five acres of reef substrate using coal combustion by-products.
SP-4	Set Aside a Portion of Reef Habitat as Scientific Research Areas or Preserves	TPWD	Designate areas of reef habitat as preserves or research areas by the TPWD. Select sites based on input from scientists, commercial oyster harvesters, and the general public. Investigate reef ecology and compare natural and new oyster reefs established using alternate materials.
SP-5	Encourage Continued Development of Gear to Reduce Commercial By-Catch	NMFS	Research to optimize design of gear and devices, and assess practicality of implementation under existing conditions. Study the survival rates of by-catch organisms.
SP-7	Investigate Potential Measures to Reduce Impingement and Entrainment	HL&P	Conduct research and pilot projects on feasible impingement reduction methods to measure changes in quantity, total biomass, and distribution of impinged and entrained organisms.
SP-10	Identify and Implement Techniques for the Control of Problem Exotic Species	TPWD	Identify effective techniques for the control of problem exotic species (i.e., nutria, grass carp, and fire ants). Conduct pilot test to determine effectiveness of species control techniques.
PH-1	Develop a Seafood Consumption Safety Program	TDH	Establish applicable standards, a risk assessment methodology, and a risk management process for seafood advisories. Establish standards for selected metals and organic compounds, including PCBs, PAHs, heavy metals, pesticides, and dioxins. Apply standards to seafood harvested from the Galveston Bay Estuary, including molluscan shellfish.

Appendix E: Summary of Research Needs

No.	Research Need	Who	Research or Technical Study
PH-2	Enhance the TDH Shellfish Sanitation Program	TDH	Increase the frequency of water sampling to more precisely determine the area and period of required molluscan shellfish closures.
FW-1	Complete Current Studies to Determine Freshwater Inflow Needs for the Bay	TWDB	Continue TWDB evaluation of the freshwater inflow needs for Galveston Bay utilizing the State of Texas modeling methodology. This evaluation, scheduled for completion during 1994, will provide target inflow numbers for use in future management of freshwater inflow to the bay.
FW-5	Explore Means of Providing Sediment to the Estuary	TNRCC USGS Corps GLO, BR Riv. Auth.	Determine the net quantity of sediment which has been prevented from reaching the estuary, and explore the feasibility of remobilizing sediment impounded behind watershed dams and transporting it to the estuary.
FW-7	Evaluate the Effects of Channels and Structures on Bay Circulation, Habitats, and Species	TNRCC	Perform a study to 1) evaluate the effect of existing bay structures (such as navigation channels and the Texas City Dike) and practices (such as cooling water intake) on circulation, and the effect of circulation alterations on bay habitats and species, 2) develop a methodology to evaluate the effect of proposed structures (such as tidal and near-tidal dikes, levees, impoundments, channels, disposal sites, etc.) on bay circulation patterns, habitats, and species, and 3) evaluate the feasibility and cost effectiveness of making alterations to existing structures and practices which have harmful effects on bay circulation.
SD-4	Facilitate Spill Cleanup by Advance Shoreline Characterization	GLO	Complete an initial GIS-based survey of Galveston Bay shoreline features which could help or hinder spill response and cleanup activities.
SD-4	Facilitate Spill Cleanup by Advance Shoreline Characterization	GLO	Assess existing state and federal response planning and equipment siting activities to determine if adjustments are needed in spill response preparedness strategies.
SD-6	Remove Trash from Storm Water Discharges	Local gov.	Conduct pilot projects and technical reviews to evaluate the flooding potential of EPA-mandated storm water screening methods. Address concerns regarding adverse impacts of captured floatables on the efficiency of storm water drainage during intense storm events common in the bay area.
SM-3	Identify Appropriate Commercial and Industrial Shoreline Development Guidelines	CCC	Compile a list of appropriate actions (e.g., dike specifications, alternative waste storage locations) to prevent existing facilities and abandoned pits from adversely affecting the bay during severe weather conditions.

Appendix E: Summary of Research Needs

No.	Research Need	Who	Research or Technical Study
SM-3	Identify Appropriate Commercial and Industrial Shoreline Development Guidelines	GLO	Inventory all existing hazardous material/waste facilities in the Galveston Bay Special Management Area and assess their hurricane damage potential.
SM-4	Minimize Negative Effects of Structures and Dredging on Publicly Owned Lands	GLO	Inventory and assign removal priority to all derelict structures and pipelines on state-owned lands based on aesthetics, submerged habitat value, threat to shorelines, habitats, water quality, or safety.
SM-5	Improve Access to Publicly Owned Shorelines	Program	Inventory and map existing public recreational facilities and assess public use needs. Research environmental impacts resulting from recreational uses of the shoreline, especially near submerged aquatic vegetation.
WSQ-2	Determine Sources of Ambient Toxicity in Water and Sediment	TNRCC, USFWS	Perform loading studies on continuing sources of PCBs and DDT (if any) and identify potential sources of toxicity. The studies will 1) include detailed toxicity studies to resolve conflicting results from different methods; 2) include research to address the role of surface microlayer in ambient toxicity; 3) address the influence of pH, salinity, etc. on ambient toxicity; 4) determine the organisms and life stages affected by ambient toxicity focusing on the critical and most susceptible life stages; and 5) include assessment of biological community structure.
WSQ-4	Perform TMDL Loading Studies for Toxics	TNRCC	Develop methods to integrate both point source and non-point sources into TMDL process. Perform additional research to quantify transport and fate of toxics in bay.
WSQ-6	Reduce Nutrient and BOD Loadings to Problem Areas	TNRCC	Conduct an engineering study (and/or attainability analysis) to determine if it is feasible to increase dissolved oxygen levels in the Houston Ship Channel. The study will use monitoring, engineering analysis, and computer modeling. The study will include 1) sediment demand monitoring to determine sink effects of sediment; 2) determine change in dissolved oxygen concentrations in the Ship Channel during and after storm events (using existing or expanded USGS network); 3) develop cost vs. dissolved oxygen/frequency relationships; 4) determine relative contributions of nutrients and oxygen-demanding materials to problem; 5) determine limitations caused by the existing hydrodynamic regime of the channel; and 6) estimate benefits to aquatic life in channel and to the entire bay system from increased dissolved oxygen concentrations.

Appendix E: Summary of Research Needs

No.	Research Need	Who	Research or Technical Study
NPS-2	Perform Pilot Projects to Develop NPS Best Management Practices for the Galveston Bay Watershed	Program, TNRCC, Houston/Harris County	Conduct specific pilot projects to demonstrate viability of various best management practices for new development in Galveston Bay area. For example, some engineering practices related to detention and particularly infiltration technology are inappropriate for local topography, rainfall regimes, and soil types. Compile a single bay-wide BMP performance document based on performance data from the area and data that is transferable from other areas.
NPS-3	Identify and Correct Priority Watershed Pollutant Problems	Program	Publish an inventory of NPS concerns in the bay watershed. Various entities and researchers, through ongoing and new water quality initiatives, will continue to identify NPS source areas in the Galveston Bay watershed. Possible sources of information include 1) biennial basin assessment reports prepared under the Texas Clean Rivers Program will include a comprehensive inventory of NPS concerns in the watershed; 2) the GBNEP non-point source study's loading maps and land use maps; 3) 305b reports; and 4) monitoring data showing areas with stream erosion problems, problem areas identified from agricultural non-point source programs, sources of continual PCB and PAH releases (if any). If necessary, perform special studies to locate and confirm the presence of non-point source areas. Carry out research to determine the extent and severity of atmospheric deposition of air pollutants and subsequent runoff to Galveston Bay and its tributaries.
NPS-5	Correct Malfunctioning Septic Tanks	Program, Counties	Conduct a bay-wide septic system and geologic survey for use in regulation and management. Identify problem areas where septic tanks are degrading water quality through bacterial pollution.
NPS-7	Establish Roadway Planning to Minimize NPS Effects	Program TXDOT	Incorporate into the 1996 State of the Bay Symposium any research findings and activities on NPS management issues related to roadway planning and design. Continue to present results of NPS control research and demonstration projects at biennial State of the bay symposia.
NPS-8	Implement NPDES Storm Water Program for Area Industries	Program EPA Industry	Compile industrial non-point source monitoring data to update Galveston Bay NPS loading estimates and to assess industrial contributions to overall loadings.

Appendix E: Summary of Research Needs

No.	Research Need	Who	Research or Technical Study
NPS-9	Prevent Degradation of Bay Waters by Known Industrial Groundwater Plumes	TNRCC Industry	Use existing groundwater monitoring data to inventory potential impacts on the estuarine ecosystem from affected groundwater associated with industrial sources. Include existing sites regulated under CERCLA, RCRA, the Petroleum Storage Tank Program, the Texas Risk Reduction Rules, OPA, and CWA which currently have confirmed groundwater plumes that may discharge into surface waters of the Galveston Bay watershed. Estimate the overall pollutant loading from groundwater sources to Galveston Bay.
NPS-10	Develop Inventory of Agricultural Non-Point Sources.	SWCB SCS HGAC	Assess agricultural non-point source loadings to and impacts on Galveston Bay. Special studies will be performed to 1) refine current pesticide loadings from agricultural areas; 2) develop detailed loading estimates from the upper San Jacinto watershed (upstream of Lake Houston dam) and the upper Trinity watershed (upstream of Lake Livingston dam); 3) determine overall contribution of rice farming vs. low-till vs. conventional farming techniques; 4) assess seasonal effects to identify periods when high pollutant loads would be expected, such as when rice fields overflow or are drained, tilling periods, and periods when pesticide and fertilizer applications are heavy; 5) evaluate effectiveness of agricultural BMPs to reduce non-point source erosion loadings, 6) determine contribution of agricultural activities on fecal coliform levels in waters of Galveston Bay.
PS-1	Determine Location and Extent of Bypass and Overflow Problems	TNRCC Munis	Conduct research to support bypass and overflow corrective action plans prepared by POTWs for submission to the TNRCC. Determine the costs and environmental benefits associated with different levels of control, such as what return frequency to design controls for. Determine if elimination of these pollutant sources will allow inshore areas of Galveston Bay to be open for oystering.
PS-3	Regionalize Small Wastewater Treatment Systems	GCWDA	Identify potential management options for more effective oversight of small treatment systems.

APPENDIX F:
Priority Ranking of Management Actions
for *The Galveston Bay Plan*

Appendix F: Priority Ranking of Management Actions for *The Galveston Bay Plan*

Action		Overall Priority Ranking
1	HP-1: Restore, Create, and Protect Wetlands	2.0
2	HP-2: Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands	2.0
3	HP-3: Inventory Degraded Wetlands and Fund Remedial Measures	2.0
4	HP-4: Implement a Coordinated System-Wide Wetland Regulatory Strategy	2.5
5	HP-5: Acquire and Protect Quality Wetlands	3.0
6	HP-6: Develop Economic and Tax Incentive Programs to Protect Wetlands	3.0
7	NPS-1: Implement Stormwater Programs for Local Municipalities	3.0
8	NPS-2: Perform Pilot Projects to Develop NPS Best Management Practices for the Galveston Bay Watershed	3.0
9	NPS-3: Identify and Correct Priority Watershed Pollutant Problems	3.0
10	NPS-4: Establish Residential Load Reduction Programs	3.0
11	NPS-5: Correct Malfunctioning Shoreline Septic Tanks	3.0
12	NPS-6: Implement NPS Reduction Plan Program for New Development	3.0
13	NPS-7: Establish Roadway Planning to Minimize NPS Effects	3.0
14	HP-7: Facilitate Bird Nesting on Existing Sites	4.7
15	HP-8: Build Nesting Islands Using Dredged Material	4.7
16	PS-1: Determine Location and Extent of Bypass and Overflow Problems	4.7
17	PS-2: Eliminate or Reduce Bypass and Overflow Problems	4.7
18	FW-1: Complete Current Studies to Determine Freshwater Inflow Needs for the Bay	5.0
19	FW-2: Expand Streamflow, Sediment Loading, and Rainfall Monitoring	5.0
20	FW-3: Establish Management Strategies for Meeting Freshwater Inflow Needs	5.0
21	FW-4: Establish Inflow Regulations to Protect the Ecological Needs of the Estuary	5.0
22	FW-5: Explore Means of Providing Sediment to the Estuary	5.0
23	FW-6: Reduce Water Consumption	5.0
24	NPS-10: Develop Inventory of Agricultural Non-Point Sources	5.0
25	NPS-11: Coordinate and Implement Existing Agricultural NPS Control Programs	5.0
26	PS-3: Regionalize Small Wastewater Treatment Systems	5.0
27	PS-4: Improve Compliance Monitoring and Enforcement	5.0
28	NPS-8: Implement NPDES Stormwater Program for Area Industries	5.3
29	NPS-9: Prevent Degradation of Bay Waters by Groundwater Plumes	5.3
30	NPS-12: Adopt Regional Construction Standards for NPS Reduction	6.0
31	NPS-13: Implement Toxics and Nutrient Control Practices at Construction Sites	6.0
32	WSQ-1: Reduce Contaminant Concentrations to Meet Standards and Criteria	6.3
33	WSQ-2: Determine Sources of Ambient Toxicity in Water and Sediment	6.3
34	WSQ-3: Establish Sediment Quality Criteria	6.3
35	WSQ-4: Perform TMDL Loading Studies for Toxics	6.3
36	WSQ-5: Support Clean Texas 2000 Pollution Prevention Program	6.3
37	PS-6: Issue NPDES Coastal General Permit or Eliminate Harm From Oil Field Produced Water Discharge	7.3
38	FW-7: Evaluate the Effects of Channels and Structures on Bay Circulation, Habitats, and Species	7.5
39	SP-1: Implement a Bay-Wide Effort to Strengthen Species Management	8.5
40	SP-2: Return Oyster Shell to Designated Locations Within the Bay	8.5
41	SP-3: Promote the Development of Oyster Reefs Using Alternate Materials	8.5
42	SP-4: Set Aside a Portion of Reef Habitat as Scientific Research Areas or Preserves	8.5
43	SP-5: Encourage Continued Development of Gear to Reduce Commercial By-Catch	8.5
44	SP-6: Conduct Educational Programs About Catch and Release	8.5
45	SP-7: Investigate Potential Measures to Reduce Impingement and Entrainment	8.5
46	SP-8: Develop Management Plans for Endangered or Threatened Species	8.5
47	SM-1: Establish a Planning Program for Shoreline Development	9.5
48	SM-2: Identify Appropriate Residential Shoreline Development Guidelines	9.5
49	SM-3: Identify Appropriate Commercial and Industrial Shoreline Development Guidelines	9.5

Appendix F: Priority Ranking of Management Actions for *The Galveston Bay Plan*

Action		Overall Priority Ranking
50	SM-4: Minimize Negative Effects of Structures on Publicly Owned Lands	9.5
51	SD-1: Promote Planning to Facilitate Natural Resource Damage Assessments	10.3
52	SD-2: Identify Simplified Damage Assessment Procedures for Small Oil Spills	10.3
53	SD-3: Facilitate Effective Restoration of Galveston Bay's Natural Resources Damaged by Spills	10.3
54	PH-1: Develop a Seafood Consumption Safety Program	11.0
55	SM-5: Improve Access to Publicly Owned Shorelines	11.5
56	SD-4: Facilitate Spill Cleanup by Advance Shoreline Characterization	12.3
57	PS-5: Implement a Dry-Weather Illegal Connection Program	12.5
58	WSQ-6: Reduce Nutrient and BOD Loadings to Problem Areas	13.8
59	WSQ-7: Perform TMDL Loading Studies for Oxygen Demand and Nutrients	13.8
60	PH-2: Enhance the TDH Shellfish Sanitation Program	15.0
61	NPS-14: Require Sewage Pumpout, Storage, and Provisions for Treatment	16.5
62	NPS-15: Require Use of Marine Sanitary Chemicals That Can Be Treated in POTWs	16.5
63	NPS-16: Implement Washdown Controls and Containment Measures	16.8
64	HP-9: Reduce Erosional Impacts on Wetlands and Habitats	17.0
65	SD-7: Publicize Environmental Harm Caused by Illegal Dumping	19.5
66	SD-5: Improve Trash Management Near the Shoreline	19.8
67	SD-6: Screen Trash from Stormwater Discharges	19.8
68	PH-3: Develop a Contact Recreation Advisory Program	20.0
69	SP-10: Identify and Implement Techniques for the Control of Problem Exotic Species	21.0
70	SP-9: Improve Enforcement of Prohibitions Against the Introduction of Exotic Species	21.0

Note: The above actions are listed according to their overall priority ranking. The highest priority actions are listed first.

Key: FW = Freshwater Inflow and Bay Circulation SD = Spills/Dumping
 HP = Habitat Protection SM = Shoreline Management
 NPS = Non-Point Sources of Pollution SP = Species Population Protection
 PH = Public Health Protection WSQ = Water and Sediment Quality Improvement
 PS = Point Sources of Pollution

Ranking Procedure:

The priority problem and goals associated with each action, excluding the support actions, were used to develop the overall priority ranking system. For each action, a number between 1 and 17 was assigned, representing the importance of the **priority problem**. For example, for Action NPS-1, the **priority problem** was contaminated runoff from nonpoint sources (see page 182). This priority ranking received a value of "2" based on the ranking developed by GBNEP (see page 337).

The goal of Action NPS-1 was to reduce urban nonpoint source loads (see page 182). As shown on page 339, this was ranked as a "very high" priority goal by GBNEP out of total of four possible rankings (very high, high, moderate, and low). Therefore this action received a goal ranking of "1".

The problem ranking and goal ranking were then added together to provide the overall priority ranking of "3.0", which in the table was ranked as the 7th highest priority action (note that lower numbers correspond to higher priority rankings). Ties were settled by using the priority problem as the first tie-breaker, and then the position of an action plan in each chapter.

APPENDIX G:
Galveston Bay National Estuary Program
Management Conference
Directory

Appendix G: GBNEP Management Conference Directory

POLICY COMMITTEE

The Honorable Rodney Ellis, Chair

Ms. Jane Saginaw, Vice-Chair

Mr. James Blackburn
Past Chairman, Galveston Bay Foundation
3131 Eastside, Suite 450
Houston, Texas 77098
(713) 524-1012
(713) 524-5165 fax

The Honorable Rodney Ellis
The Senate of Texas
P.O. Box 12068
Austin, Texas 78711-2068
(512) 463-0113
(512) 463-0006 fax

Mr. John Hall
Chairman, Texas Natural Resource Conservation
Commission
P.O. Box 13087
Capitol Station
Austin, Texas 78711-3087
(512) 239-5505
(512) 239-5533 fax

Ms. Teresa Hershey
Commissioner, Texas Parks and Wildlife Department
#1 Longbow Lane
Houston, Texas 77024
(713) 681-1816
(713) 681-3318 fax

Mr. Charles W. Jenness
Chairman, Texas Water Development Board
1111 Bagby, Suite 1600
Houston, Texas 77002
(512) 463-8176 (Austin Office)
(512) 475-2053 fax

Mr. Charles Miller
601 Jefferson, Suite 4000
Houston, Texas 77002-5098
(713) 651-2312
(713) 651-2390 fax

Ms. Jane Saginaw
Regional Administrator, U.S. Environmental
Protection Agency
Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 655-2100
(214) 655-6648 fax

Appendix G: GBNEP Management Conference Directory

LOCAL GOVERNMENT ADVISORY COMMITTEE

Mr. Ray Holbrook, Chair

Member

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Mr. Ray Holbrook, County Judge

Brazoria County

Mr. James W. Phillips, County Judge

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City of League City

Mr. James G. Knuth, Councilman

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Mr. Ronnie Broaddus, Commissioner

Mr. Charles Brack, County Attorney

Mr. El Franco Lee, Commissioner

Mr. Bobby Payne, Commissioner

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Captain Jack Smith, Councilman

Mr. William Clayton, Councilman

Mr. Guy Sutherland, Councilman

E.J. Ritchey, Councilman

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LOCAL GOVERNMENT ADVISORY COMMITTEE *continued*

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Member

City of Texas City
Charles Doyle, Mayor

Soil & Water Conservation District
W.S. Edwards, Chairman
Trinity Bay SWCD

General Law Cities
Ms. Sandra Cable, Alderwoman
City of Stafford

Alternate

Connie Jackson, Commissioner

Mr. Thomas A. Manison, Chairman
Waters Davis SWCD

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MANAGEMENT COMMITTEE

Mr. Myron O. Knudson, Chair

Mr. Thomas Remaley, Vice-Chair

Ms. Glenda Callaway
Galveston Bay Foundation
2400 Westheimer, No. 118-E
Houston, Texas 77098
(713) 520-9031
(713) 524-5165 fax

Mr. David Hankla, Field Supervisor
Division of Ecological Services
U.S. Fish & Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058
(713) 286-8282
(713) 488-5882 fax

Ms. Sally Davenport
Associate Deputy Commissioner
Texas General Land Office
Stephen F. Austin Building
1700 North Congress Avenue, Suite 620
Austin, Texas 78701-1495
(512) 463-5059
(512) 475-0680 fax

Mr. Mike Hightower, Deputy Director
Sea Grant College Program
Texas A&M University
1716 Briarcrest, Suite 702
Bryan, Texas 77802
(409) 845-3854
(409) 845-7525 fax

Mr. DeGraaf Adams
Gulf Coast Conservation Association
c/o Adams & Porter
510 Bering Drive
Houston, Texas 77057
(713) 953-8801
(713) 975-1172 fax

Mr. James W. Kachtick
Environmental Manager, Southern Region
Occidental Corporation
5 Greenway Plaza, Suite 2400
Houston, Texas 77046
(713) 623-7602
(713) 623-7686 fax

Dr. Bill Evans
Galveston Chamber of Commerce
Texas Institute of Oceanography
P.O. Box 1675 Pelican Island
Galveston, Texas 77553-1675
(409) 740-4504
(409) 740-4704 fax

Mr. Tommy Knowles
Directory of Planning
Texas Water Development Board
P.O. Box 13231
Austin, Texas 78711-3231
(512) 463-8407
(512) 463-9893 fax

Captain Richard E. Ford, Jr.
Commanding Officer, U.S. Coast Guard
Marine Safety Office
Room 301, P.O. Building
601 Rosenberg
Galveston, Texas 77550-1705
(409) 766-3687
(409) 766-3689 fax

Mr. Myron O. Knudson, P.E.
Director, Water Management Division
U.S. Environmental Protection Agency
1445 Ross Avenue
Dallas, Texas 75202-2733
(214) 655-7100
(214) 655-6490 fax

Appendix G: GBNEP Management Conference Directory**MANAGEMENT COMMITTEE *continued*****Mr. Myron O. Knudson, Chair****Mr. Thomas Remaley, Vice-Chair**

Dr. Fred Liscum
Hydrologist, Area Surface Water Specialist
U.S. Geological Survey
2320 LaBranch, Room 1112
Houston, Texas 77004
(713) 750-1662
(713) 750-1661 fax

Mr. Fred McGuire
General Manager, Technical Department
Houston Lighting & Power Company
P.O. Box 1700
Houston, Texas 77251-1700
(713) 945-8331
(713) 945-7697 fax

Dr. Larry McKinney, Division Director
Resource Protection Division
Texas Parks & Wildlife Department
4200 Smith School Road
Austin, Texas 78744
(512) 389-4864
(512) 389-4394 fax

Rick Medina
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229
(409) 766-3001
(409) 766-3049 fax

Mr. Donald Moore
Chief, Galveston Field Branch
National Oceanic & Atmospheric Administration
National Marine Fisheries Service
Habitat Conservation Division
4700 Avenue U, Building 308
Galveston, Texas 77551-5997
(409) 766-3699
(409) 766-3575 fax

Mr. Tom Remaley
Watershed Management Division
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087
(512) 239-4576
(512) 239-4420 fax

Mr. Don Reynolds
Commercial Fishing
Route 3, Box 353
Dickinson, Texas 77539
(713) 339-1506
(713) 339-1509 fax

Mr. Jack Steele, Executive Director
Houston-Galveston Area Council
P.O. Box 22777
Houston, Texas 77227-2777
(713) 627-3200
(713) 621-8129 fax

Mr. Windle Taylor, Hydrologist
Underground Injection Control Section
Texas Railroad Commission
P.O. Drawer 12967, Capitol Station
Austin, Texas 78711-2967
(512) 463-6803
(512) 463-6780 fax

Mr. Richard Thompson, Director
Shellfish Sanitation Division
Texas Department of Health
1100 West 49th Street
Austin, Texas 78756
(512) 719-0200, Ext. 229
(512) 719-0220 fax

Appendix G: GBNEP Management Conference Directory**MANAGEMENT COMMITTEE *continued*****Mr. Myron O. Knudson, Chair****Mr. Thomas Remaley, Vice-Chair**

Mr. W. Daniel Vaughn
McLeod, Alexander, Powel and Apffel
Attorneys at Law
P.O. Box 629
Galveston, Texas 77553
(713) 488-7150, Ext. 115
(409) 762-1155 fax

Standing Representative (*Member*)

Mr. Ed Feith (Fred McGuire)
Houston Lighting & Power Company
P.O. Box 1700
Houston, Texas 77251
(713) 945-8332
(713) 945-7697 fax

Mr. Carl Masterson (Jack Steele)
Houston-Galveston Area Council
P.O. Box 22777
Houston, Texas 77227-2777
(713) 627-3200
(713) 993-4503 fax

Mr. Bob Spain (Larry McKinney)
Resource Protection Division
Texas Parks & Wildlife Department
4200 Smith School Road
Austin, Texas 78744
(512) 389-4725
(512) 389-4394 fax

Lt. David Weimer (Capt. R.E. Ford, Jr.)
Marine Safety Office
601 Rosenberg, Room 301
Galveston, Texas 77550-1705
(409) 766-3687
(409) 766-3689 fax

Mr. Gary Westmoreland
Assistant State Conservationist- Water Quality &
Water Resources
Natural Resources Conservation Service
101 South Main
Temple, Texas 76501-7682
(817) 774-1255
(817) 774-1388 fax

Ex officio, Voting Members

(Advisory Committee Chairs)
The Honorable Ray Holbrook (LGAC)
Galveston County Judge
722 Moody
Galveston, Texas 77550
(409) 766-2244
(409) 765-2653 fax

Dr. Robert McFarlane (STAC)
McFarlane & Associates
9503 Sharpview Drive
Houston, Texas 77036
(713) 772-8294
(713) 772-6025 fax

Ms. Sharron Stewart (CASC)
Texas Environmental Coalition
P.O. Box 701
Lake Jackson, Texas 77566
(409) 297-6360
(409) 297-9432 fax

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SCIENTIFIC/TECHNICAL ADVISORY COMMITTEE

Dr. Robert McFarlane, Chair

Ms. Teresa Battenfield, Vice-Chair

Mr. James D. Abbott
Assistant State Conservationist-Programs & Strategic
Planning
USDA Natural Resources Conservation Service
101 South Main
Temple, Texas 76501-7682
(817) 774-1231
(817) 774-1388 fax

Dr. Richard C. Allison
Chair, Administrative Sciences
University of Houston - Clear Lake
2700 Bay Area Blvd., Box 003
Houston, Texas 77058
(713) 283-3251
(713) 283-3951 fax

Ms. Teresa Battenfield
Assistant Director
Department of Public Utilities
City of Houston
4545 Groveway
Houston, Texas 77087
(713) 643-9883
(713) 644-9854 fax

Mr. Ben Bickham
Manager, Water Resources
Barfield & Holmes, Inc.
1710 Seamist Drive
Houston, Texas 77008-3189
(713) 869-3433
(713) 869-6702 fax

Mr. Dick Brown, General Manager
Gulf Coast Waste Disposal Authority
901 Bay Area Blvd.
Houston, Texas 77058
(713) 488-4115
(713) 488-3331 fax

Dr. Richard M. Browning, Senior Manager
Planning and Environmental Management
Division
Trinity River Authority
P.O. Box 60
Arlington, Texas 76004
(817) 467-4343
(817) 465-0970 fax

Dr. Ernst Davis
Professor of Environmental Sciences
University of Texas at Houston
School of Public Health
P.O. Box 20186
Houston, Texas 77225-0186
(713) 792-4451
(713) 794-4877 fax

Mr. Ken DeMaet
President and General Manager
Texas City Terminal Railway Company
P.O. Box 591
Texas City, Texas 77592-0591
(409) 945-4461
(409) 945-8479 fax

Mr. Marty Entringer
Galveston County Environmental Consumer
Health
P.O. Box 939
La Marque, Texas 77568
(409) 938-2244
(409) 938-2321 fax

Dr. Frank M. Fisher, Jr.
Professor and Director of Wetlands Studies
Department of Ecology & Evolutionary Biology
Rice University
P.O. Box 1892
Houston, Texas 77251
(713) 527-4917
(713) 285-5232 fax

Appendix G: GBNEP Management Conference Directory**SCIENTIFIC/TECHNICAL ADVISORY COMMITTEE *continued*****Dr. Robert McFarlane, Chair****Ms. Teresa Battenfield, Vice-Chair**

Mr. Richard Gorini
Manager, Environmental Affairs
Port of Houston Authority
111 East Loop North
P.O. Box 2562
Houston, Texas 77252-2562
(713) 670-2948
(713) 670-2952 fax

Dr. Gary Gill
Texas A&M University at Galveston
Marine Science Department
P.O. Box 1675
Galveston, Texas 77553-1675
(409) 740-4710
(409) 740-4429 fax

Mr. Theo Glanton
City of Houston
7107 Renwick
Houston, Texas 77081
(713) 295-5539
(713) 295-5506 fax

Mr. Richard L. Goss
Supervisory Hydrologist
U.S. Geological Survey
Water Resources Division
2320 LaBranch Street, Room 1112
Houston, Texas 77004
(713) 750-1655
(713) 750-1661 fax

Mr. Albert W. Green
Chief, Aquatic Studies Branch
Texas Parks & Wildlife Department
Fountain Park Plaza 1
3000 South IH 35, Suite 320
Austin, Texas 78704
(512) 448-4313
(512) 440-8887 fax

Mr. Guy M. Grossman
Texas Railroad Commission, District 3
Oil and Gas Division
13201 Northwest Freeway, Suite 701
Houston, Texas 77040-6008
(713) 460-0631
(713) 707-1358 fax

Mr. George Guillen
Texas Natural Resource Conservation Commission
4150 Westheimer
Houston, Texas 77027
(713) 625-7900
(713) 625-7987

Mr. Joe Kolb
Supervisor, Environmental Compliance
Enron Corporation
P.O. Box 1188
Houston, Texas 77251-1188
(713) 853-3272
(713) 646-2511 fax

Dr. James Lawrence
University of Houston
Department of Geosciences
4800 Calhoun
Houston, Texas 77204-5503
(713) 743-3410
(713) 748-7906 fax

Dr. Robert McFarlane
McFarlane & Associates
9503 Sharpview Drive
Houston, Texas 77036
(713) 772-8294
(713) 772-6025 fax

Appendix G: GBNEP Management Conference Directory

SCIENTIFIC/TECHNICAL ADVISORY COMMITTEE *continued*

Dr. Robert McFarlane, Chair

Ms. Teresa Battenfield, Vice-Chair

Mr. Rick Medina
Chief, Environmental Resources Branch
U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, Texas 77553-1229
(409) 766-3044
(409) 766-3905 fax

Mr. Gary Powell
Chief, Environmental Systems Section
Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231
(512) 445-1463
(512) 445-1417 fax

Dr. Sammy M. Ray
Professor Emeritus
Marine Biology Department
Texas A&M University at Galveston
P.O. Box 1675
Galveston, Texas 77553-1675
(409) 740-4526
(409) 740-4887 fax

Mr. Will Roach
Staff Biologist
U.S. Fish & Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058
(713) 286-8282
(713) 488-5882 fax

Mr. C. Bruce Smith
Administrator, Technical Programs
Texas General Land Office
Stephen F. Austin Building
1700 North Congress, Suite 620
Austin, Texas 78701
(512) 463-5055
(512) 475-0680 fax

Texas State Soil and Water Conservation Board
P.O. Box 658
Temple, Texas 76503-0658
(817) 773-2250
(817) 773-3311 fax

Dr. Jerry Wermund
Research Scientist
Bureau of Economic Geology
University of Texas at Austin
Balcones Research Center
University Station Box X
Austin, Texas 78713-7508
(512) 471-1534
(512) 471-0140 fax

Dr. Terry Whitledge
University of Texas
Marine Sciences Institute
University of Texas at Austin
P.O. Box 1267
Port Aransas, Texas 78373-1267
(512) 749-6769
(512) 749-6777 fax

Mr. Kirk Wiles
Shellfish Sanitation Division
Texas Department of Health
1100 West 49th Street
Austin, Texas 78756
(512) 719-0200
(512) 719-0220 fax

Mr. Roger Zimmerman
Acting Director, Galveston Laboratory
National Marine Fisheries Service
4700 Avenue U
Galveston, Texas 77551
(409) 766-3500
(409) 766-3508 fax

Appendix G: GBNEP Management Conference Directory

SCIENTIFIC/TECHNICAL ADVISORY COMMITTEE *continued*

Dr. Robert McFarlane, Chair

Ms. Teresa Battenfield, Vice-Chair

Standing Representative (*Member*)

Mr. Mark Freeman (James D. Abbott)

Resource Conservationist

USDA - Soil Conservation Service

101 South Main

Temple, Texas 76501-7682

(817) 774-1231

(817) 774-1388 fax

Appendix G: GBNEP Management Conference Directory**CITIZEN'S ADVISORY STEERING COMMITTEE****Ms. Sharron Stewart, Chair****Mr. Ron Embry, Vice-Chair**

Dr. Dede Armentrout
National Audubon Society
2525 Wallingwood, Suite 1505
Austin, Texas 78746
(512) 327-1943
(512) 327-1264 fax

Mr. Craig Biddle
Recreational Fishing
1710 A McCall Road
Austin, Texas 78703
(512) 452-1776
(512) 452-1948 fax

Mr. Harry Brown
Galveston Area Citizen
523 24th Street, Suite 102
Galveston, Texas 77550
(409) 763-2212
(409) 763-2903 fax

Mr. Julio Bynum
Superintendent, Marine Operations
Amoco Oil Company
P.O. Box 401
Texas City, Texas 77592-0401
(409) 945-1345
(409) 945-1338 fax

Ms. Barbara A. Carroll
Exxon Chemical Americas
13501 Katy Freeway
Houston, Texas 77079
(713) 870-6933
(713) 588-2522

Mr. Ira Clarkson, III (deceased)
Gulf Coast Conservation Association
Ira Clarkson and Associates
P.O. Box 7826
Houston, Texas 77270
(713) 869-8168
(713) 869-8315 fax

Mr. Ron Embry
Coordinator, Public Relations
Baytown Refinery-Exxon USA
P.O. Box 3950
Baytown, Texas 77522
(713) 425-3333
(713) 425-4479 fax

Ms. Mary Gillette
League of Women Voters
1021 Omar Street
Houston, Texas 77009-6534
(713) 864-8184

Mr. Robert Heineman
Land Development
Vice President of Planning
The Woodlands Corporation
P.O. Box 4000
The Woodlands, Texas 77387
(713) 377-6396
(713) 377-7254 fax

Mr. Clifford Hillman
Commercial Fisherman
Rt. 3, Box 409
Dickinson, Texas 77539
(713) 339-1506
(713) 339-1509 fax

Appendix G: GBNEP Management Conference Directory**CITIZEN'S ADVISORY STEERING COMMITTEE *continued*****Ms. Sharron Stewart, Chair****Mr. Ron Embry, Vice-Chair**

Dr. Ken Kramer
Sierra Club
State Conservation Office
1104 Nueces Street, #2
Austin, Texas 78701-2106
(512) 477-1729
(512) 477-8526 fax

Mr. Charles Berdon Lawrence
President Hollywood Marine, Inc.
P.O. Box 1343
Houston, Texas 77251
(713) 868-1661
(713) 868-6422 fax

Mr. Kenneth Lovell
Executive Director, The Boating Trades Association of
Metropolitan Houston
2600 Southwest Freeway, Suite 1000
Houston, Texas 77098
(713) 526-6361
(713) 526-6454 fax

Ms. Julie Massey
Galveston Co. Marine Extension Agent
Texas Marine Advisory Service
5115 Hwy. 3
Dickinson, Texas 77539
(713) 996-5314 or (409) 948-2581
(713) 534-4053 fax

Ms. Ellyn Roof
Galveston Bay Foundation
1111 Pine Circle
Seabrook, Texas 77586
(713) 326-3217 (Fax same)

Mr. Frank Tuma
Galveston Bay Cruising Association
18619 Upper Bay Road
Houston, Texas 77058
(713) 280-5949
(713) 280-7502 fax

Mr. C.F. "Dick" Schendel
Chairman, Texas State Soil and Water
Conservation Board
Rt. 2, Box 49
Goliad, Texas 77963
(512) 645-2255

Mr. Waldo Smith
Past President
Texas Association of Soil & Water Conservation
Districts
Rt. 3, Box 160
Brenham, Texas 77833
(409) 836-5294
(409) 836-5320 fax

Ms. Sharron Stewart
Texas Environmental Coalition
P.O. Box 701
Lake Jackson, Texas 77566
(409) 297-6360
(409) 297-9432

Dr. Elbert B. Whorton, Jr.
Port of Galveston
P.O. Box 328
Galveston, Texas 77553
(409) 772-2335

Appendix G: GBNEP Management Conference Directory

CITIZEN'S ADVISORY STEERING COMMITTEE *continued*

Ms. Sharron Stewart, Chair

Mr. Ron Embry, Vice-Chair

Ex officio, Voting Member

Dr. Don Bass
College of the Mainland
1200 Auburn Rd.
Texas City, Texas 77591
(409) 938-1211
(409) 938-1306 fax

Standing Representative (Member)

Mr. John Baker (Charles Lawrence)
Hollywood Marine
P.O. Box 1343
Houston, Texas 77251
(713) 868-1661
(713) 868-6464 fax

Ms. Sandra B. Hoover (Dede Armentrout)
19 Crestwood, #2
Houston, Texas 77007
(713) 529-6443
(713) 529-6481 fax

Mr. Frederick LeBlanc (Robert Heineman)
Environmental Manager
The Woodlands Corporation
2201 Timberloch Place
The Woodlands, Texas 77380
(713) 377-5535
(713) 377-7254 fax

Mr. Dan McNamara (Ken Kramer)

Sierra Club
Lone Star Chapter
801 Scarbrough Bldg.
Austin, Texas 78701
(512) 477-1712
(512) 477-3316 fax

Mr. Thomas Manison (C.F. "Dick" Schendel)
Waters Davis SWCD
P.O. Box 148
Friendswood, Texas 77546
(712) 482-1251

A.N. "Boots" Nelson (Waldo Smith)
Box 1080
Mt. Belvieu, Texas 77580
(713) 383-2143

GALVESTON BAY PUBLIC FORUM

Dr. Don Bass, Chair

Dr. Don Bass
College of the Mainland
1200 Auburn Road
Texas City, Texas 77591
(409) 938-1211
(409) 938-1306 fax

Open membership, participants vary

Appendix G: GBNEP Management Conference Directory**FINANCIAL PLANNING COMMITTEE****Mr. Louis Pauls, Chair**

The Honorable Ronnie Broadus
P.O. Box 998
Clute, Texas 77531
(409) 265-3953
(409) 265-5409 fax

Ms. Tracy Eagle
Financial Analyst
Regional SRF Coordinator
U.S. EPA - Region 6
Municipal Facilities Branch (6W-MP)
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-2733
(214) 655-7158
(214) 655-6490 fax

Mr. Dick Brown
General Manager
Gulf Coast Waste Disposal Authority
910 Bay Area Boulevard
Houston, Texas 77058
(713) 488-4115
(713) 488-3331 fax

Mr. Jack Fickessen
Texas Water Partnership
P.O. Box 164341
Austin, Texas 78716
(512) 472-1022
(512) 472-0266 fax

Mr. Tom Brown
Deputy Executive Administrator
Water Resources Development
Texas Water Development Board
1700 North Congress
Austin, Texas 78711-3231
(512) 475-2081
(512) 475-2053 fax

Mr. Jody Jiles, Vice President
First Boston
3030 Texas Commerce Tower
600 Travis Street
Houston, Texas 77002
(713) 220-6700
(713) 236-0505

The Honorable Barbara Crews
Mayor of The City of Galveston
P.O. Box 779
Galveston, Texas 77550
(409) 766-2103
(409) 763-4847 fax

Mr. Guy C. Jackson, III
Attorney at Law
P.O. Box 308
Anahuac, Texas 77514
(713) 383-2841
(409) 267-6355 fax

Mr. David G. Cummins
GCCA
4801 Woodway, Suite 220 West
Houston, Texas 77056
(713) 626-4222
(713) 961-3801 fax

Ms. Fritz Pikes
Deputy Director, Administration
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087
(512) 463-7807
(512) 475-2454

Appendix G: GBNEP Management Conference Directory**FINANCIAL PLANNING COMMITTEE *continued*****Mr. Louis Pauls, Chair**

Mr. Richard Lewis, Acting Director
City of Houston
Finance and Administration
901 Bagby, Second Floor, Room 215
Houston, Texas 77002
(713) 247-2087
(713) 247-2148 fax

Mr. Walt Precourt (resigned)
Sterling Chemicals, Inc.
P.O. Box 1311
Texas City, Texas 77592-1131
(409) 942-3038
(409) 942-3448 fax

Mr. Paul Nutting, City Manager
City of League City
300 West Walker
League City, Texas 77573
(713) 332-3431
(713) 332-2938 fax

Mr. Richard Raycraft, Director
Harris County Budget Office
1001 Preston, Suite 938
Houston, Texas 77002
(713) 755-5113
(713) 755-8841 fax

Mr. Terrell Palmer
Masterson, Moreland, Sauer, Wiseman, Inc.
333 Clay Street, Suite 4000
Houston, Texas 77002
(713) 654-8664
(713) 651-9361 fax

Mr. Louis Pauls, Councilman
City of Galveston
2315 Strand
Galveston, Texas 77553
(409) 763-4678
(409) 763-4678 fax

APPENDIX H:
Projects Sponsored by GBNEP

Appendix H: Projects Sponsored by GBNEP

PROJECT TITLE	CONTRACTOR
Bay-Wide Management Survey	University of Texas at Austin
Bay-Wide Management Evaluation	University of Texas at Austin
Segmentation of Galveston Bay	Jones and Neuse, Inc.
History of Resource Utilization I	University of Houston-Clear Lake
History of Resource Utilization II	Margaret Henson
Socioeconomics of Bay Utilization	University of Houston-Clear Lake
Natural Resource Economics	University of North Carolina
Funding Source Inventory	University of Texas at Austin
<i>The Galveston Bay Plan</i> Action Plan Costing	Apogee Research, Inc.
<i>The Galveston Bay Plan</i> Federal Consistency Survey	Shiner, Moseley and Associates
<i>The Galveston Bay Plan</i> Funding Strategy	Resource Analytics, Inc.
<i>The Galveston Bay Plan</i> Implementation Strategy	Houston-Galveston Area Council
CCMP Participation by Local Governments	Houston-Galveston Area Council
Bay Characterization Support	Groundwater Services, Inc.
CCMP Support	Groundwater Services, Inc.
Point Source Loading Study	University of Texas at Austin
Shoreline Survey for Unpermitted Point Sources	Texas A&M University, GERG
Non-Point Source Loading Study	Groundwater Services, Inc.
Treated/Untreated Effluent Loadings	Texas Natural Resource Conservation Commission
Ambient Water/Sediment Quality	University of Texas at Austin
Dredge/Fill Impacts	University of Texas at Austin
Toxicants in Sediment and Benthos	U. S. Fish and Wildlife Service
Oyster Survey	Texas A&M University
Living Resources Status and Trends	Texas Parks and Wildlife Department
Trawling By-Catch	National Marine Fisheries Service
Recreational By-Catch	FTN Associates, LTD
Non-Fishing Incidental Mortality	Jones and Neuse, Inc.
Wetland Habitat Survey	Bureau of Economic Geology
Ecosystem Conceptual Model	McFarlane & Associates
Bay Debris Survey	Texas Parks and Wildlife Department
Toxicants in Seafood Organisms	Texas A&M University, GERG

Appendix H: Projects Sponsored by GBNEP

PROJECT TITLE	CONTRACTOR
Public Health Synopsis	Espey, Huston & Associates
Regional Monitoring/Data Management Strategy Development	Tetra Tech, Inc.
Regional Monitoring Methods Standardization	Tetra Tech, Inc.
Data Base Inventory	University of Texas at Austin
Galveston Bay Information Center	Texas A&M at Galveston; TIO
Galveston Bay Bibliography	Texas A&M at Galveston; TIO
Acquisition of 1930 Aerial Photo Set	TOBIN Research, Inc.
State of the Bay Symposia	GBNEP Program Office
Nomination for Preserve Status	Bureau of Economic Geology
Tide Gauge Recon/Purchase	Texas General Land Office
Tide Gauge Installation	Texas General Land Office
Environmental Inventory of Armand Bayou	Galveston Bay Foundation
Environmental Inventory of Christmas Bay	Galveston Bay Foundation
Regulatory Survey and Evaluation of Armand Bayou	Houston-Galveston Area Council
Regulatory Survey and Evaluation of Christmas Bay	Houston-Galveston Area Council
Phase I Management Plans and Implementation	Texas Parks and Wildlife Department
Phase II Management Plans and Implementation	Texas Parks and Wildlife Department
Public Participation for Preserves	GBNEP Program Office
Citizens' Monitoring I and II	Texas Water Commission
Citizens' Monitoring III	Galveston Bay Foundation
BayLine Newsletter	GBNEP Program Office
Portable Information Display	GBNEP Program Office
GBNEP Publication Series	GBNEP Program Office
Balancing Act Video (Armand Bayou and Christmas Bay Coastal Preserves)	SeaGrant
Oil Spills Video	Texas Water Commission
Public Service Announcement Video	Texas Water Commission
User Conflicts Video	University of Houston
Oyster Conservation Video	University of Houston
Galveston Bay Ecosystem Video	Texas Water Commission
3-4 Minute Promotional Video	Texas Water Commission

Appendix H: Projects Sponsored by GBNEP

PROJECT TITLE	CONTRACTOR
Bay Day	Galveston Bay Foundation
Public Education/Outreach	GBNEP Program Office
Pollution Awareness/Reporting	GBNEP Program Office
Media Relations	GBNEP Program Office
Special Kick-off Events	GBNEP Program Office
Consensus-Building Survey/Training	University of Houston-Clear Lake
Local Government Advisory Committee Support	GBNEP Program Office
Speakers Bureau/Public Meetings	GBNEP Program Office
Promotions	GBNEP Program Office
Management Conference Workshops	GBNEP Program Office
Shoreline Erosion/Habitat Creation	U.S. Soil Conservation Service
Houston Ship Channel Pollution Prevention	Texas Natural Resource Conservation Commission
Citizens' Pollution Reporting and Response System (Hotline) Development	Galveston Bay Foundation
Citizens' Pollution Reporting and Response System (Hotline) Promotions	Texas Water Commission
Citizens' Pollution Reporting and Response System (Hotline) Implementation	GBNEP Program Office
Oyster Reef Creation from Coal Combustion Byproducts	Port of Houston

APPENDIX I:
GBNEP Publications

Appendix I: GBNEP Publications

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- Brooks, J.M., T.L. Wade, M.C. Dennicutt II, D.A. Wiesenburg, D. Wilkinson, T.J. McDonald, and S.J. McDonald. 1992. Toxic Contaminant Characterization of Aquatic Organisms in Galveston Bay: A Pilot Study. Galveston Bay National Estuary Program publication GBNEP-20. Webster, Texas.
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- Green, A., M. Osborn, P. Chai, J. Lin, C. Loeffler, A. Morgan, P. Rubec, S. Spanyers, A. Walton, R.D. Slack, D. Gawlik, D. Harpole, J. Thomas, E. Buskey, K. Schmidt, R. Zimmerman, D. Harper, D. Hinkley, T. Sager, and A. Walton. 1992. Status and Trends of Selected Living Resources in the Galveston Bay System. Galveston Bay National Estuary Program publication GBNEP-19. Webster, Texas.
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- Hadden, S.G. 1992. Environmental Management Inventory of Galveston Bay. Galveston Bay National Estuary Program publication GBNEP-24. Webster, Texas.
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Appendix I: GBNEP Publications

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- McFarlane, R.W. 1991. An Environmental Inventory of the Armand Bayou Coastal Preserve. Galveston Bay National Estuary Program publication GBNEP-8. Webster, Texas.
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- Newell, C.J., H.S. Rifai, and P.B. Bedient. 1992. Characterization of Non-point Sources and Loadings to Galveston Bay. Volume I, Technical Report. Galveston Bay National Estuary Program publication GBNEP-15. Webster, Texas.
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Appendix I: GBNEP Publications

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- Walton, A.H., and A.W. Green. 1993. Probable Causes of Trends in Selected Living Resources in the Galveston Bay System. Galveston Bay National Estuary Program publication GBNEP-33. Webster, Texas.
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- White, W.A., and J.G. Paine. 1992. Wetland Plant Communities, Galveston Bay System. Galveston Bay National Estuary Program publication GBNEP-16. Webster, Texas.
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APPENDIX J:
Summary of Public Comments

Summary of Public Comments and Management Conference Responses Concerning the Draft *Galveston Bay Plan*

GENERAL COMMENTS

Summary of Comment	Summary of Response
(VERBAL) Who coordinated the development of <i>The Galveston Bay Plan</i> ?	The Management Conference of the Galveston Bay National Estuary Program (GBNEP), a group of approximately 100 individuals appointed by the Governor of Texas and the Regional Administrator of EPA Region 6 to represent state and federal resource agencies, local governments, stakeholder organizations, and citizens.
(VERBAL) States that there are numerous economic benefits associated with a clean bay.	The Management Conference concurs.
Recommends priority ranking of the many recommendations of <i>The Plan</i> , including a weighing of the costs and benefits.	Priorities are now established for Plan actions. These were determined by deliberations which included both cost and benefit elements.
(VERBAL) Recommends setting priority recommendations to address our most serious problems.	See above.
(VERBAL) Concerned that much of the effort in the plan will not have any positive effects due to the bay being in overall good health.	<i>The Plan</i> emphasizes those issues which jeopardize bay resources, and geographic regions with specific problems. <i>The Plan</i> de-emphasizes issues and regions already in good shape.
(VERBAL) States we need to move forward in our process of protecting the bay.	No revision necessary.
Requests that Management Conference members and other state leaders be cognizant of the various programs currently underway to protect Galveston Bay: Galveston Bay NEP, Coastal Coordination Council, Gulf of Mexico Program, and Texas Clean Rivers Program. Urges review of implications of these programs individually and collectively.	Revisions were made to improve the descriptions of inter-agency coordination. The Management Conference seeks to coordinate to the maximum degree possible with other programs, to avoid duplications, overlaps, or conflicting actions.
States that we are creating too many programs to accomplish the same ends. Need to assure that Galveston Bay Program, Coastal Management Plan, Clean Rivers Program, and Gulf of Mexico Program are not duplicative, and are channeled through one effort and program office.	See above.
(VERBAL) States that too many programs exist, trying to accomplish the same thing	See above.
Concerned that coordination and volunteerism supported in the Galveston Bay Plan will be affected by inclusion as Special Area Management Plan by Coastal Coordination Council; asks about public comment on enforceable policies, and rights of affected parties under a Special Area Management Plan.	Revisions have been made to improve and update the discussion of the possibility of adoption as a Special Area under the Texas Coastal Management Plan. By rule, only the Policy Committee of the Management Conference can nominate Galveston Bay for this purpose. Status as a special area of the Texas Coastal Management Plan would be based upon Coastal Coordination Council adoption of enforceable policies proposed by the Galveston Bay Council (not the entire plan). Development of enforceable policies (if any) for special area management of Galveston Bay will occur in an open public forum through the Galveston Bay Council. The Management Conference believes these policies should be considered by the body to be involved with consistency review (the Council) and that final decisions should await implementation of the Coastal Management Plan. The Management Conference intends that The Galveston Bay Plan be implemented with or without the Coastal Management Plan, as described in the Implementation and Funding chapter.

Request that <i>The Plan</i> rely less on the future Texas Coastal Management Plan, particularly the Special Area Management Plan Provision, and place greater emphasis on how the plan would function relying on existing regulations and authority.	See above.
States that <i>The Plan</i> should become Special Area Management Plan under the proposed Coastal Management Plan, but need to clarify differences and relationships between two programs.	See above.
States that <i>The Plan</i> needs to clearly and explicitly define the relationship between the Galveston Bay Program (and Plan) and the developing Coastal Management Plan, particularly for the definition and use of "enforceable policies."	See above.
Recommends that, as a Special Area Management Plan under the Texas Coastal Management Plan, enforceable policies should be developed by consensus under the Management Conference.	See above.
Recommends better definition of how <i>The Plan</i> will be adopted as a Special Area Management Plan of the Texas Coastal Management Plan; what if the statewide program is delayed?	See above.
States the program needs to add discussion of how the Plan implementation success will be affected if there is no adoption of the Plan as a Special Area Management Plan under a federally approved CZM Plan, thus eliminating federal permit consistency review. Address this topic on page xx, page 18, and in Chapter VIII.	See above.
(VERBAL) Will the findings of the Galveston Bay Plan be incorporated into or cross-referenced into the Coastal Management Plan?	See above.
(VERBAL) What is the relationship between <i>The Galveston Bay Plan</i> and the Coastal Management Plan?	See above.
(VERBAL) Can the Coastal Coordinating Council use part of <i>The Galveston Bay Plan</i> as a Special Area Management Plan or will they use the whole Plan?	See above.
(VERBAL) States that <i>The Plan</i> will jeopardize local autonomy, create micro-management of regional affairs by state, and could result in disrespect of private property rights	A previous proposal for greater local representation in implementing <i>The Plan</i> was turned down due to local opposition. The current version represents a consensus of entities with an interest in the bay.
(VERBAL) Is <i>The Plan</i> going to overpower every agency we have in this state?	<i>The Plan</i> has no power over state agencies; rather the state agencies and other entities drafted <i>The Plan</i> together to improve the effectiveness of their joint management of Galveston Bay.
States that important and non-renewable archeological and historical resources of the Galveston Bay system were largely overlooked in <i>The Plan</i> ; more than 350 archeological resources are known and likely many undiscovered. Some areas are identified by the Commission as Critical Resource Zones; therefore some federally-funded actions under <i>The Plan</i> will likely fall under the jurisdiction of the National Historic Preservation Act, under which federal funding or approving agency must consult with State Historic Preservation Office (Texas Historical Commission). Urges the program to consider impacts of proposed program actions on cultural resources, as well as address pertinent consultation needs under state and federal historic preservation laws for actions within bay.	<i>The Plan</i> now includes language to accomplish this recommendation. All activities of the Galveston Bay Program will be undertaken in compliance with cultural and archeological resource requirements. The Management Conference intends that no archeological or historical resources be needlessly impacted by human activity related to <i>The Plan</i> .
Requests <i>The Plan</i> include language acknowledging the values of non-renewable archeological and historical resources, and assurance of compliance with National Historic Preservation Act and Antiquities Code of Texas.	Done; see above.
States that <i>The Plan's</i> heavy emphasis on regulatory actions seems out of character with the project technical findings as well as what would seem to be good policy. Believes that reality is complex and necessary knowledge only obtained slowly over time. States that <i>The Plan</i> should recognize substantial uncertainty associated with proposed nutrient and stormwater control initiatives, and emphasize research.	While The Management Conference recognizes the high importance of research (and has drafted a research action plan), much of the information needed for better management of this ecosystem is already available. Many places in <i>The Plan</i> recommend improvements in the current regulatory system based on our understanding (in some cases for the first time) of issues at the ecosystem level.

Requests discussion of the role of demonstration projects in assisting in the choice of options in <i>The Plan</i> .	Done; discussion of demonstration projects was added to the Introduction.
States that time schedule for proposed actions is too long; all should be in full operation before year 2000.	The schedules in <i>The Plan</i> were based upon projected resources available and are geared for permanent, long-term change. However, the Management Conference intends that actions be undertaken ahead of schedules presented in <i>The Plan</i> , wherever possible. Some actions are already being accomplished ahead of schedule.
Requests a focus on programs and initiatives which can have a significant impact on Galveston bay at reasonable cost.	Actions have now been ranked for their importance to bay improvements, with these criteria in mind. In cases where management resources are limited, the Management Conference intends that the most important actions be undertaken first, with cost as an additional element in decision-making.
States that <i>The Plan</i> should take a position on important permits, such as Wallisville Reservoir, Houston Ship Channel deepening and widening, Gulf Intracoastal Waterway dredged material disposal, and finger canal projects.	<i>The Plan</i> establishes consistency review for future federal projects, to assure projects do not conflict with Plan recommendations for wise management of the bay system. During creation of <i>The Plan</i> , the Policy Committee determined that the Management Conference should not become involved in permit applications for individual projects, therefore, <i>The Plan</i> itself does not take positions on individual permits.
Points out apparent inconsistencies in <i>The Plan</i> : <ul style="list-style-type: none"> • Oyster reefs are closed due to fecal coliforms, but Plan proposes building bird islands, a source of fecals. • Reduced Phytoplankton from lower nutrient loadings may be causing species declines, but some elements of Plan propose further nutrient reductions. 	<ul style="list-style-type: none"> • Birds are not generally a source of human pathogens, but unfortunately, current technology does not distinguish between contamination from humans and from birds. <i>The Plan</i> recommends adoption of an improved bacterial indicator organism as technology improves. • Several decades of point source controls have reduced nutrients to a level closer to the natural condition of the bay, a management success causing no documented species declines.
States that the introductory sections of the action plans should better match and support the actions themselves.	<i>The Plan</i> was revised to improve the descriptions in the introductory sections.
Concerned that the overall flavor of <i>The Plan</i> is regulatory, while the basic findings of the studies reflected in The State of the Bay report revealed many unanswered questions.	The Management Conference acknowledges many unanswered questions about the bay, and proposes continued research. However, numerous clear problems were also revealed, which the Management Conference believes management actions can address. Throughout <i>The Plan</i> , the Management Conference has attempted to utilize existing regulatory programs, rather than creating new requirements.
States that The Plan has two major needs for success: local government involvement for implementation; and participation of all bay interests to continue the cooperative problem-solving process.	The Management Conference concurs and seeks to establish continued involvement of local governments and stakeholders as <i>The Plan</i> is implemented. <i>The Plan</i> establishes a Galveston Bay Council as one means of broad involvement in problem-solving.
States that there is a need to use ecotourism to generate more interest in conservation.	The Management Conference concurs. Ecotourism is the fastest-growing segment of the tourism industry and as bay management under <i>The Plan</i> proceeds, this issue will become increasingly important.
States that EPA is out of control; we don't need any more bureaucracies to rape our pocketbooks.	<i>The Galveston Bay Plan</i> was not drafted by the EPA, nor will it be implemented by the EPA.
Opposes <i>The Plan</i> ; states that stormwater treatment is expensive and will aggravate flooding; cost of identifying small point sources may exceed harm they are causing; better to spend \$ 35 million for police, better teacher salaries, transit; <i>Plan</i> is only tip of iceberg for costs.	<i>The Plan</i> reflects a strong consensus among the Stakeholders of Galveston Bay that proactive management is necessary to conserve valued resources, including water quality. The Management Conference seeks to accomplish management through existing programs to the maximum extent possible, and previously revised <i>The Plan</i> to avoid creation of any new agency or authority.

States that <i>The Plan</i> and the Coastal Management Plan will jeopardize local autonomy, create micro-management of regional affairs by state, and could result in disrespect of private property rights by Coastal Coordination Council or the Galveston Bay Authority, possibly resulting in taking of property. Object to unfunded mandates, new taxing authority, and any fees leveled on local governments. Request economic impact statement or cost-benefit analysis at the program's expense, and funding for any new treatment required by local governments. Remove southern and western Brazoria County from <i>The Plan</i> .	The Management Conference has carefully considered the issues of a regional authority and fee structure, and based upon communication with numerous groups, eliminated these from a previous draft. <i>The Plan</i> proposes no taxing authority, no fees, and no actions in disrespect of property rights. All guidelines for impact and other studies are being met, and regions outside the watershed, such as Western Brazoria County, are not subject to <i>The Plan</i> . By rule, only the Policy Committee can nominate <i>The Plan</i> for adoption as Special Area Management Plan under the Texas Coastal Management Plan.
(VERBAL) Remove southern and western Brazoria County from <i>The Plan</i> .	Revised to clarify that regions outside the watershed, such as Western Brazoria County, are not subject to <i>The Plan</i> .
States that there should be a separate Galveston Bay Authority established to implement <i>The Plan</i> ; there should be more hard-line mandates in <i>The Plan</i> , to give it teeth.	The Management Conference is appreciative of the need to take decisive action on bay problems, but seeks to do so utilizing existing mandates and a program under the TNRCC. This is a consensus reached in public deliberation involving numerous bay stakeholders, leading to a decision not to propose the Galveston Bay Authority.
(VERBAL) States that there should be a separate Galveston Bay Authority established to implement <i>The Plan</i> .	See above.
Opposed to plan because same people are behind it who have failed to address the McGinnis Facility. These people are under the control of the Chemical Council; I intend to sue the Army Corps of Engineers, EPA, and Texas State government.	The Management Conference has no authority to address the McGinnis Facility. The Management Conference consists of representatives from many, diverse organizations.
(VERBAL) Opposes <i>The Plan</i> because same people are behind it who have failed to address the McGinnis Facility.	See above.
Submitted 14-page letter generally urging actions be mandated through regulation instead of voluntary, done sooner than the time schedule proposes, and not represent a balanced approach among uses, but a strictly protective approach that puts the bay first. Objects to the description of progress in point source controls as too positive. Points out lack of action on atmospheric deposition. Plan should be explicitly against Wallisville Dam project or it is a farce.	The Management Conference seeks to address bay issues via voluntary, rather than mandatory approaches wherever possible. Improvements to the bay from point sources controls are fully documented by scientific studies. Atmospheric deposition is recognized in <i>The Plan</i> as an issue needing increased emphasis in the future. As a matter of policy, <i>The Plan</i> does not support or oppose any individual projects such as the Wallisville Dam Project.
(VERBAL) States that there should be more hard-line mandates in <i>The Plan</i>	While the Management Conference appreciates the need for improved environmental management, the program has sought to solve bay problems without additional mandates or layers of government wherever possible.
EPA Office of Water states that the program's <i>State of the Bay: A Characterization of the Galveston Bay Ecosystem</i> satisfies the plain English summary requirement for CCMPs, and may be included in the final federal submittal.	<i>The State of the Bay</i> will be submitted in the final package to fulfill this requirement.
States that a need exists to better describe "Why" actions are being undertaken.	New information has been added at the beginning of each action plan in a section entitled "The Issues" in order to clarify why proposed actions are being undertaken.
(VERBAL) Expresses approval for <i>The Plan</i> , and excitement about its implementation.	No revision necessary.
(VERBAL) Suggests it's time to quit studying and do something.	The Management Conference agrees on the need for action. <i>The Plan</i> describes numerous actions for protection of Galveston Bay's resources.
(VERBAL) States there is a lack of enforcement of environmental laws.	<i>The Plan</i> calls for improved enforcement in several action plans where enforcement has been traditionally weak.
(VERBAL) Impressed with the results of the GBNEP effort.	No revision necessary.
(VERBAL) States that if the Houston Chamber of Commerce, City of Houston, Houston Endowment, the Gulf Coast, if they like <i>The Plan</i> , the rest of us had better be leery of it	The Management Conference has sought consensus among all the agencies, organization, and stakeholders with concerns for Galveston Bay. Numerous environmental organizations support <i>The Plan</i> as well.
The large number of tasks will require large commitment.	The Management Conference concurs.

IMPLEMENTING AND FUNDING THE GALVESTON BAY PLAN

Summary of Comment	Summary of Response
Requests inclusion of more detailed funding information (could cite financial report and include by reference). Fund sources and key options could be better summarized.	Revised as suggested. The Galveston Bay NEP's Funding Strategy Report provides additional detail.
Requests clarification of the membership of the Galveston Bay Council (agencies represented, size of committee and roles and responsibilities).	Revised as suggested.
Requests clarification of the relationship between the Galveston Bay Council and the Galveston Bay Program. For example, the Galveston Bay Council, as the implementation committee, is serving a similar function to the current management conference, and has the authority to carry out purposes 6 and 7 of the Management Conference.	Revised as suggested. A refined description is provided in the introduction.
States that activities and functions of the Galveston Bay Program on page 267 should be tied together, perhaps in an outline format to show which activities follow under which functions.	The descriptions of activities and functions have now been improved.
Suggests that the Galveston Bay Program may want to consider reducing the number and frequency of post-CCMP reports, for example by consolidating reporting periods to several years.	The Management Conference intends to establish a "State of the Bay" symposium and report every two years, with major evaluation and redirection of <i>The Plan</i> every five years. This is a reduction in reporting in comparison to the five years of <i>Plan</i> development.
Suggests the need for a caveat to long-term financial commitments to this plan on the part of agencies; no one knows their budget five years in advance.	Revised as suggested.
Strongly urges involvement of all user groups during process of identifying enforceable policies for adoption of Galveston Bay Plan as Special Area Management Plan under Texas Coastal Management Plan.	The Galveston Bay Plan will be completed prior to implementation of the Coastal Management Plan, so all details are not yet worked out. However, identifying enforceable policies for consistency review is a key element. The Management Conference has determined that enforceable policies (if any) will be determined during full public deliberation by the stakeholder and agency members of the Galveston Bay Council.
Concerned about hidden powers of consistency review, that program is just the tip of the iceberg for future costs, and that non-elected people are put in positions of power.	Federal consistency is a statutory element of the Water Quality Act of 1987. The Management Conference seeks to establish an open and public consistency process. For all elements of <i>Plan</i> implementation, a Galveston Bay Council is established to assure balanced decision-making and sharing of power.
(VERBAL) Concerned about the hidden powers of consistency review.	See above.
States that <i>The Plan</i> needs more concise use of "consistency review" terminology to delineate among Water Quality Act, Coastal Zone Management Act, and state programs. For CZMA Section 307, note that states with federally approved coastal management programs may review direct federal activities, federally licensed or permitted activities, OCS permits, and federally supported projects, within or outside of the states coastal program that affect any land or water uses or natural resources of the coastal zone for consistency with the enforceable policies of the State management program.	Revised as suggested.
Suggests that CMP and Galveston Bay Program agree to review federal activities for consistency with enforceable policies only under the CZMA consistency review.	Adoption of a CZMA consistency review process depends upon adoption enforceable policies of <i>The Plan</i> as a Special Area Management Plan of the Coastal Management Plan. By statute, this adoption will be a decision of the Coastal Coordination Council, outside the purview of the Galveston Bay Management Conference, and will be considered following approval of <i>The Galveston Bay Plan</i> . Both the Coastal Coordination Council and the Policy Committee of the Management Conference are committed to use of a unified consistency process by both programs.
States that consistency is very important; suggests need for extra effort to assure rule/regulation consistency of implementing agencies.	See above.

(VERBAL) States that consistency is very important; suggests need for extra effort to assure rule/regulation consistency of implementing agencies.	See above.
Suggests enforceable policies be developed under existing state authorities which meet one of the acceptable management techniques pursuant to CZMA.	Enforceable policies (if any) will be considered by The Galveston Bay Council following approval of The Galveston Bay Plan. This process will be consistent with the rules of the Texas Coastal Management Plan, which has not yet been accepted into the federal Coastal Zone Management Program.
(VERBAL) What are the enforceable policies in <i>The Plan</i> ?	See above.
Resolution stating entity "supports the intent of the Draft Galveston Bay Plan; however, it does not endorse the establishment of a new taxing entity and oversight organization for Galveston Bay or the recommendations of the Draft Plan without a more comprehensive, systems approach to the issues addressed in the plan."	This comment resulted from focus group review of a previous draft by local governments, and has already been addressed in <i>The Plan</i> . No new taxing entity or authority is proposed.
Expresses opposition to the creation of a new taxing authority to implement The Galveston Bay Plan; recommends the program eliminate the creation of any new authority or governmental entity to implement this program; and eliminate any proposal for new taxes or fees to be collected by or imposed on local governments to fund the plan.	See above.
Expresses appreciation for removing the language calling for the creation of a separate authority and collection of fees by local governments.	This comment pertains to previous versions of <i>The Plan</i> .
Supports creation of TNRCC Galveston Bay Program and supports many specific actions. Urges director be appropriately placed in TNRCC to have access to policy makers and top level managers in outside agencies.	Language was added to the plan to emphasize the Management Conference intent that the Program Director be placed appropriately within the TNRCC as suggested.
States that the Galveston Bay Program Office should report directly to the Executive Director of TNRCC, not a lower office.	New wording has been added to assure the Program Director is appropriately placed within the TNRCC.
States the Galveston Bay Plan does not adequately address costs and realistic potential for funding; cumulative public cost is unrealistic. Recommends limiting new actions to only the most cost-effective and high priority projects, and better clarify the anticipated sources of funding. Recommends the number of proposals in <i>The Plan</i> be reduced to top priority projects with high benefits and funding potential.	The Management Conference estimated costs as an element of planning and anticipates that cost estimates will improve as steps to implement <i>The Plan</i> actually occur. More detailed description of various funding sources are now available in the Finance Strategy, a separate program report. As a means of assuring expenditures accomplish as much benefit to the bay as possible, priorities have now been established for Plan actions, and implementation is expected to proceed with both benefits and costs in mind.
Urges Galveston Bay Council be given a major role in guiding implementation; urges costs be kept minimal and resources be used for implementation, not administration. Urges that EPA/TNRCC improve existing regulations, rather than add new ones.	The Management Conference has proposed that the Galveston Bay Council be fully involved with all issues arising under <i>The Plan</i> and advise the TNRCC at every step of implementation. The administrative costs of maintaining a program office were established as the minimal costs possible for full implementation; fewer resources would necessitate fewer actions implemented.. The basis of <i>The Plan</i> is reliance on existing programs and regulations wherever possible.
Recommends the Galveston Bay Plan focus on habitat protection and balanced human uses actions, due to management gaps and low costs.	Habitat protection is identified in <i>The Plan</i> as the number one priority issue for the bay system. Many actions in the "Balanced Human Uses" sections are also high priority, based on the priority rankings now included in <i>The Plan</i> .
Expresses disappointment that the Galveston Bay Plan does not establish a free-standing organization to implement the Plan, but believes that having a local office which reports directly to the Executive Director of the TNRCC is a workable solution. Would like to see the League of Women Voters on Galveston Bay Council.	As noted in <i>The Plan</i> , a free-standing Galveston Bay Authority was not adopted since agreement on this concept among partners in <i>The Plan</i> was not possible. The Management Conference believes the TNRCC and Galveston Bay Council can assure effective implementation. The League of Women Voters is proposed as a representative on the Galveston Bay Council.

States that the Galveston Bay Council should report directly to the Commission of the TNRCC (and Regional Administrator of EPA if EPA funding for the program continues). Suggests development of a mechanism within the Council to encourage resolution of inter-agency disputes. Urges complete stakeholder representation, including citizens, and the means for anyone to make a nomination to the Council for approval by the Commission (and possibly EPA)	The Management Conference recommends that inter-agency disagreements occurring on the Galveston Bay Council during consistency review be elevated to the Executive Director of the TNRCC if necessary. Concerning representation, the Management Conference considers the membership on the Galveston Bay Council recommended in <i>The Plan</i> as a starting point, and future changes may need to occur to assure continuing complete stakeholder representation.
Recommends the program clearly establish that the Program Office and Galveston Bay Council will conduct consistency reviews. Better delineate the relationship between <i>The Plan</i> and the Texas CMP, with emphasis on enforceable policies.	Revised as suggested. Enforceable policies for consistency review will be determined through deliberation of the Galveston Bay Council. The description of these two programs in <i>The Plan</i> has been improved.
Avoid duplicative consistency review by both proposed GLO consistency review team and Galveston Bay Program.	See above.
Recommends that state funding be doubled to \$ 3 million.	While the Management Conference is sympathetic to the need for implementation funds, it seeks to keep public expenditures to a minimum, and believes an effective program can be attained with at a \$ 1.5 million per year expenditure for the Galveston Bay Program.
States that two needs exist for success: local government involvement for implementation, and participation of all bay interests to continue the cooperative problem-solving process	The Management Conference concurs.
Requests that <i>The Plan</i> not contain actions or enforceable policies that go beyond the current requirements of state and federal laws and rules. City of Houston costs should be reexamined to determine their accuracy, since they appear to be underestimated at a total of \$133,750. Requests Galveston Bay Council representatives for City of Houston water, wastewater, and stormwater departments.	By law, enforceable policies must be based on extant rules or statutes. Similarly, the Management Conference intends that actions in <i>The Plan</i> make full use of existing programs and rules, rather than proposing new authority. The City of Houston funding total may appear low because major programs which contribute to implementation, but which <i>are not incremental costs of the Plan, per se</i> , are not included. While the City of Houston is granted one slot on the Galveston Bay Council, both the Houston-Galveston Area Council, and "local governments over 500,000" are also recommended, increasing the presence of the City of Houston.
Suggests specifically referencing the Finance Plan and the Implementation Plan produced by the Galveston Bay NEP.	Revised as suggested.
Suggests: on page xxi under "Sources of Funds" include a statement that EPA supports implementation of the Plan, but does not commit any funds.	A statement related to agency commitments in general is now included (other agencies are in the same position as EPA)
Recommends that the Program acknowledge that the funds to implement are not in place and that funding all actions is not assured, nor essential, to the overall success of the Plan.	The Management Conference notes that Plan recommendations precede formal funding commitments on the part of partner organizations and agencies. The Management Conference believes that final agreement on <i>The Plan</i> is a positive step toward these commitments, but has also attached priorities to Plan actions to assure success even if funding falls short of 100 percent. Limitations on agency commitments are now noted in the Executive Summary.
States that inordinate funds appear allocated for wetlands acquisitions; would favor more expenditures on research.	The \$ 12.3 million allocated for wetlands protection is for all wetlands programs, not merely acquisition. Specifics are given in the cost appendix to <i>The Plan</i> .
States that costs appear to be underestimated and private sector costs should be included. Cost/Benefit analyses should be utilized to determine where and when the implementation of a management practice is cost effective.	In deliberating to draft The Galveston Bay Plan, private sector costs were considered by the action plan task forces. Priority ranking of actions now in the plan should also aid in decisions about future expenditures. Under the Clean Water Act, National Estuary Programs are directed to establish comprehensive plans on criteria other than cost-benefit ratios.
(VERBAL) States that the program is just the tip of the iceberg for future costs.	The costs in <i>The Plan</i> are calculated for a five-year period, with a review and re-direction of the plan to occur after five years. The Management Conference seeks to improve the effectiveness of existing expenditures by agencies involved in bay management, by guiding programs toward to issues identified by scientific studies.

Strongly urges involvement of the industry focus group through the Greater Houston Partnership in the process of identifying enforceable goals and policies for inclusion of the Galveston Bay Plan as a Special Area Management Plan under the Texas Coastal Management Plan.	The Management Conference concurs and anticipates full participation by the Greater Houston Partnership, a designated representative on the Galveston Bay Council.
Urges strong role for Galveston Bay Council with advisory role that is not merely perfunctory. Better define substance of their work; consistency review process; and best organizational structure.	The Management Conference intends that the Galveston Bay Council be fully involved in all steps of implementation, and has revised <i>The Plan</i> to provide a better description of the substance of their work. The Council's role in consistency review is detailed in the program's Federal Consistency Report, and its representation is defined in the Galveston Bay Plan itself.
Suggests: shorten and simplify implementation by starting small with a focus on major issues that can be readily implemented, demonstrate early results, and bring together the diverse interests. However, also select one or two tough issues as well. Get a program adopted and let it grow from there.	The Management Conference has now ranked Plan actions for priority, for use by the Galveston Bay Council in making implementation as effective as possible. Demonstration projects have been, and will continue to be an important element.
Recommends that the consensus process that proved so effective during Plan development continue under the Galveston Bay Council, with judicious use of any direct enforcement authority. TNRCC implementation is endorsed; Plan will succeed if the relationship between the TNRCC and the Galveston Bay council is comparable to that which has existed between the Galveston Bay Program Office and the Management Conference. The Galveston Bay Council should provide direction and advice, while TNRCC provides administration and empowerment. Redirection or significant revisions of the plan should be initiated by the Galveston Bay Council	The Management Conference generally concurs with these comments. It will be the Galveston Bay Council (essentially a continuation of the Management Conference) which takes up the issue of enforceable policies. Further details are provided in the Federal Consistency Report prepared by the Galveston Bay Program.
(VERBAL) What's the trade-off between having a local taxing authority and having funding from the Texas Natural Resources Conservation Commission?	A local authority would have created stronger local control, but was opposed due to the need for new locally-based revenue.
Recommends that, due to comprehensive nature of Plan, clarification should be given that funding realities may dictate that actions will be performed based on the identified priorities and that adjustment to some actions could be required in the future. Success in coordination and acquiring funding will be keys to successful implementation.	Revised as suggested.
(VERBAL) Conveys doubt the program will receive any funds to implement <i>The Plan</i> .	No revision necessary.
(VERBAL) Objects to unfunded mandates, new taxing authority, and any fees leveled on local governments.	These elements are not included in <i>The Plan</i> .
(VERBAL) Requests economic impact statement or cost-benefit analysis at the program's expense, and funding for any new wastewater treatment required by local governments.	The Management Conference has fulfilled all requirements of the Clean Water Act and EPA guidance in drafting <i>The Plan</i> . Included in this process was a ranking of priorities, in which costs were considered an important factor. <i>The Plan</i> mandates no new wastewater treatment.
States that there should be some regionally-based tax or other funding to increase the buy-in to the process.	Buy-in to The Galveston Bay Plan dramatically decreased when taxes or fees were considered as funding alternatives in previous versions. No revision was undertaken.
(VERBAL) States that there should be some regionally-based tax or other funding to increase the buy-in to the process.	See above.
Recommends utilization of tax abatements currently granted to big industry to fund program.	The Management Conference is appreciative of this idea, but based on substantial public deliberation, has elected not to utilize regionally-based taxes to implement <i>The Plan</i> .
(VERBAL) Recommends utilization of tax abatements currently granted to big industry to fund program.	See above.
(VERBAL) Expresses concern about funding for <i>The Plan</i> .	No revision necessary.

(VERBAL) States that non-elected people should not be put in positions of power.	The Management Conference appreciates the need for strong accountability, and has built into the design for the Galveston Bay Council slots for government entities with elected leaders. Equally significant is a continuation of the open, public process utilized in creation of <i>The Plan</i> .
(VERBAL) States that <i>The Plan</i> is not going to be successful if the board running it is appointed by the Governor	Under <i>The Plan</i> , the program will be carried out by the TNRCC.
Requests the Trinity Bay Soil and Water Conservation District have a slot on Galveston Bay Council.	The Management Conference invites conservation district participation on the Council through representation by the Texas Soil and Water Conservation Board.
(VERBAL) Requests that Trinity Bay Soil and Water Conservation District be represented on the Galveston Bay council.	See above.
States that the Galveston Bay Council should have equal representation for each interest (e.g. double representation from H-GAC and local governments) and TNRCC should not be represented, as the implementing agency.	The Management Conference has carefully considered representation on The Galveston Bay Council with respect to population base, bay impacts, the identity of implementing entities for action plans, and other factors. Each representative currently listed has a vital role in Plan implementation, and could not be eliminated without sacrificing implementation of one or more Plan elements.

EXECUTIVE SUMMARY AND INTRODUCTION

Page	Summary of Comment	Summary of Response
xix	Suggests the following additions to the Galveston Bay Council's responsibilities: to revise <i>The Plan</i> and redirect implementation strategies; to assess the success of the action plans; to address legislative issues and make recommendations to the legislature; and to set annual priorities for the implementation of the action plans.	Revised as suggested.
11	Points out that the 1986 figures for overflows were based on 1.7 billion gallons, compared to more recent estimates of 200-700 million gallons per year. Present this information appropriately.	Revised as suggested.
18	Recommends the program identify projects subject to consistency review.	This section now refers to the program's Federal Consistency report, which provides greater detail.

HABITAT PROTECTION

Note: The actions in this section have been reordered as a result of public comment to better reflect the priority ranking of actions and other revisions. The actions and page numbers reflect the public review draft organization, but new action numbers (for this document) are given in parentheses.

Action	Page	Summary of Comment	Summary of Response
		(VERBAL) Is pleased that habitat loss is given high priority in <i>The Plan</i>	No revision necessary.
		Recommends prohibition of dredging, except to maintain existing channels.	Under the Clean Water Act, federal dredging projects will be reviewed for consistency with <i>The Plan</i> on a case by case basis.
		States that damage to sea grasses from shrimp trawls should be evaluated and possibly regulated. Most pristine areas of bay should be set aside as refuges to protect them from future dredging, trawling, over harvesting, etc.	Most remaining seagrasses occur in Christmas Bay, now a Texas Coastal Preserve as a result of program actions. Trawls generally do not operate in Christmas Bay. Several actions in <i>The Plan</i> will enable additional protection in the future.
		Recommends evaluation of alternative shrimp and oyster harvesting practices which do not disrupt large areas of bay bottom ecosystem.	There is no scientific evidence to indicate oyster harvesting causes damage to reefs. Regulation of shrimping activity by the TPWD is considered by the Management Conference as appropriate for this industry.

		(VERBAL) areas of the Bay need to be protected from shrimp trawling	See above two responses.
		How does one rate wetlands for degradation (quality; function.)?	The Regional Monitoring Strategy identifies a particular methodology as a useful tool. The Management Conference has also identified this topic as a research need in <i>The Plan</i> .
		Recommends that the program address the need for water quality protection for submerged vegetation, for example adoption of protective water quality criteria.	The Management Conference has identified this topic as a research need in <i>The Plan</i> , since (unlike the eastern Gulf) water quality influences on seagrasses are not well established for Texas Seagrasses.
		Recommends inclusion of actions designed to avoid the future impoundment of wetlands.	The Management Conference agrees this is an important consideration. Review of any future impoundment projects for consistency with <i>The Plan</i> will be utilized to avoid wetland losses or degradation.
		(VERBAL) What do I have to look forward to as land owner?	The Management Conference recognizes the importance of private land ownership in wetlands protection. While <i>The Plan</i> sets out no new regulatory requirements for landowners, it encourages (through tax breaks and other means) the good management of wetlands in private ownership.
Intro	36	States that <i>The Plan</i> implies that all conversion of wetlands to agricultural land has contributed to decreased wildlife habitat. Urges consideration of habitat value of rice fields to waterfowl.	<i>The Plan</i> has been revised to reflect the benefits of rice fields to waterfowl.
Intro	29-42	Suggests modifying all uses of "habitat" by inserting "aquatic." States that, in an effort to potentially have future enforceable policies via the Texas Coastal Management Plan, <i>The Plan</i> should clarify its focus on aquatic systems only.	Habitats discussed are now generally qualified as "aquatic" or "estuarine."
HP-1 (Now HP-5)	44	Recommends <i>The Plan</i> not include acquisition of wetlands, since the government can't manage wetlands as well as private landowners.	The Management Conference recognizes that public ownership of wetlands (e.g. wildlife refuges) plays a key role in habitat conservation. Acquisition is just one tool available, and in some cases acquisition by a private group is preferable to action by the state or federal government. The Management Conference advocates improved stewardship of both public and private wetlands.
HP-1 (Now HP-5)	44	Recommends that the bay be sold in one mile blocks to private citizens for \$ 32,000 to \$ 40,000 in order to fund the program and improve the management that comes with private ownership of resources like oysters, etc. Set guidelines for the benefit of the bay. States that the only people who are going to do anything about the problems are the owners.	The Management Conference has neither the authority nor inclination to sell publicly-held resources. <i>The Plan</i> , however, does seek to set guidelines for the benefit of the bay; indeed that is its purpose.
HP-1 (Now HP-5)	44	(VERBAL) Recommends that the bay be sold in one mile by one mile blocks charging \$32,000 to \$40,000 a block, since private owners would take care of the bay better than the government.	See above.
HP-1 (Now HP-5)	44	Recommends inclusion of NMFS in any activities to acquire and protect wetlands, to help evaluate marine habitat values.	Revised as suggested.
HP-1 (Now HP-5)	44	States that <i>The Plan</i> implies that government acquisition of wetlands is the ultimate answer to all problems in Galveston Bay. Our view is that voluntary, economic incentive based programs will work far superior to government acquisition, and could be less expensive.	The Management Conference intends for <i>The Plan</i> to present a balanced approach to wetlands protection including economic incentives (HP-6), wetlands creation (HP-1,2), acquisitions (including by private entities) (HP-5) and other management tools.
HP-1 (Now HP-5)	44	(VERBAL) States opposition to acquiring wetlands.	See above.

HP-1	44	Recommends inclusion of additional upland and other coastal habitats in addition to wetlands. Recommends that Corps buy land in Trinity basin.	The scope of The Plan encompasses those wetlands which directly influence the bay system. Corps purchase of lands would be a decision of the Corps.
HP-1 (Now HP-5)	44	Suggests the program Plan to clarify the definition of wetlands; USFWS and CORPS classifications differ. Will those involved in wetlands inventory be certified (e.g. proposed CORPS certification)?	<i>The Plan</i> makes no recommendation concerning the <i>jurisdictional</i> definition of wetlands, since this is an issue being addressed at the federal level. However, a better means of defining wetland condition is addressed by <i>The Plan</i> .
HP-2 (Now HP-6)	45	Suggests that state agencies should not be lead entities for tax incentives; suggests replacement of TPWD and GLO as lead entities with local governments, with support from state agencies. Suggests deletion of reference to new regulation in Step 2; incentives and disincentives are not mandatory.	Revised to indicate that any new legislation would be local-government initiated.
HP-2 (Now HP-6)	45	Suggests <i>The Plan</i> indicate what types of wetlands are indicated for this action. How will a wetlands determination be made if data are not available?	This action was revised to reflect the need for development of a suitable definition of wetlands for purposes of providing economic or tax incentives.
HP-2 (Now HP-6)	45	Recommends the program mention Proposition 2, which is an <i>ad valorem</i> tax relief measure currently in regulation development. Wetlands are on current draft list of qualifying properties.	Revised as suggested.
HP-2 (Now HP-6)	45	Concerned about increases in tax assessments for private wetlands; appraisals to be based on average land values, resulting in doubling the appraisal for wetlands.	The Management Conference appreciates this concern and has proposed tax breaks to help maintain privately held wetlands, as opposed to increases in appraised value.
HP-2 (Now HP-6)	45	(VERBAL) Expresses concern that tax assessments for private wetlands could increase, providing a disincentive to landowners seeking to preserve wetlands.	See above.
HP-2 (Now HP-6)	45	How will local governments be reimbursed for tax losses from wetland tax breaks?	<i>The Plan</i> was revised to recognize local governments as the lead entity for this action (rather than state agencies). This would allow them flexibility to determine how to best implement this action.
HP-3 (Now HP-4)	46	States that we need uncertainty in the permit process to get developer and industry attention.	The Management Conference disagrees with this statement and no revision was made.
HP-3 (Now HP-4)	46	Strongly supports coordinated habitat management, but urges a go-slow approach to water quality standards for wetlands under the TNRCC.	The Management Conference and TNRCC agree on the need for a careful and measured approach to wetlands standards.
HP-3 (Now HP-4)	46	States that "Regulatory Needs" should include use of water quality standards and 401 certification to assure minimal protection of wetlands, including RRC as well as TNRCC. Suggests ranking of wetlands for their potential for restoration/enhancement. Favors protection of degraded or other wetlands from further conversion, until funds are available for restoration. Recommends a better definition of consistency review in this section.	<i>The Plan</i> is now revised to clarify use of water quality standards for wetlands protection. <i>The Plan</i> includes ranking of habitats in order of increasing need for remediation. Consistency review under CZRA is still being developed, since Texas does not yet have an approved coastal zone program.
HP-4 (Now HP-1)	47	Suggests the program consider including this step within HP-3. States that restoration and enhancement should apply to the full range of wetland functions: marine, estuarine, and shoreline species habitat values; flood protection; shoreline protection, water quality protection, etc.	The Management Conference concurs that habitats should be managed for their full range of values. The Habitat Protection section of <i>The Plan</i> was revised and reordered to better reflect this intent.
HP-4 (Now HP-1)	47	States that GLO should be lead entity for this action due to significant responsibility for wetland restoration, creation, and protection on state-owned land.	The Management Conference has revised the discussion of lead entity to provide for GLO lead with coordination by other appropriate agencies.
HP-4 (Now HP-1)	47	States that no new wetlands should be created if they are low quality replacements for better destroyed habitat.	The Management Conference intends to establish a bay-wide habitat management program that will better account for the condition of managed wetlands. <i>The Plan</i> proposes both monitoring of wetland quality and additional research to measure and define quality.

HP-4,5 (Now HP-1,2)	47-48	Recommends the use of inmates for labor-intensive work of replanting cordgrass.	Inmates, as well as those required or willing to perform community service, are considered by the Management Conference to be an excellent source for labor, and are now included in <i>The Plan</i> .
HP-4,6 (Now HP-1,3)	47,49	Questions investment of significant amounts of money in attempting to restore lost wetlands and remediate “degraded” wetlands, as high risk and poor investment. Encourages acquisitions, tax incentives, and beneficial uses of dredged material.	The Management Conference considers the wetlands problems to require a balanced approach using diverse management tools. For example, degraded (e.g. drowned) wetlands could represent some of the best locations for remediation involving beneficial use of dredged material.
HP-5 (Now HP-2)	48	States that the proposal to eliminate non-beneficial use of dredged material is not realistic. The words “encourage the beneficial use” should be substituted for “eliminate the non-beneficial use”.	This wording has been revised to reflect that <i>The Plan</i> does not propose complete elimination of non-beneficial uses of dredged material.
HP-5 (Now HP-2)	48	States that elimination of non-beneficial disposal of dredged material may not be desirable; suggest revising to: “eliminate non-beneficial disposal of dredged materials where test data show that contaminants are not a concern.”	See above.
HP-5 (Now HP-2)	48	States that the proposal to eliminate non-beneficial use of dredged material is not realistic. Do not extend ban to a complete ban on traditional disposal.	See above.
HP-5 (Now HP-2)	48	Suggests a need to consider all contributing factors, e.g. wind, waves, tide, depth, weather, vessel draft, etc., for created wetlands.	The Management Conference concurs on the need for valid engineering and biological design elements for created wetlands; these would be necessary elements of each individual project.
HP-5 (Now HP-2)	48	Recommends that all possible materials be used to rebuild reefs in shallow bay areas affected by shell dredging.	Creation of reefs using alternate material are elements of <i>The Plan</i> (see action SP-3). The range of materials used could be further expanded in the future if necessary.
HP-5 (Now HP-2)	48	Recommends expansion of wetlands dredge material restoration activities in <i>The Plan</i> .	Currently Wetlands protection is the most emphasized initiative in <i>The Plan</i> , and the Management Conference intends expanded activity for habitat protection.
HP-5 (Now HP-2)	48	Recommends adoption of a dredge management plan and develop enforceable policies for inclusion in CMP.	The Coastal Management Plan will not be implemented until after the Galveston Bay Plan must be submitted, therefore enforceable policies will not be considered until later deliberation by the Galveston Bay Council. Any enforceable policies pertaining to dredge material will be considered at that time.
HP-6 (Now HP-3)	49	How will the need for habitat remediation be determined?	<i>The Plan</i> calls for development of a definition of degraded wetlands for use in an overall bay-wide inventory and remediation strategy.
HP-6 (Now HP-3)	49	Suggests the program make the definitions for wetlands consistent and focus on higher-quality types like coastal marshes, as opposed to stormwater ditches and treatment impoundments with wetland vegetation.	<i>The Plan</i> was revised to clarify this point; <i>The Plan</i> makes no recommendation concerning the <i>jurisdictional</i> definition of wetlands, since this is an issue being addressed at the federal level. A better means of measuring wetlands condition is addressed by <i>The Plan</i> .
HP-7	50	States that GLO should be lead entity.	The Management Conference has revised the discussion of lead entity to provide for GLO lead with coordination by other appropriate agencies.
HP-7	50	Recommends policing of bird nesting islands and fines against those who harass birds. States that island creation is excuse to allow Corps to avoid disposing spoil in disposal area.	Improved protection of existing islands is an initiative of <i>The Plan</i> (HP-7). Under <i>The Plan</i> , the decision to construct a new island would not be the Corps alone, but would be based on biological information and deliberation by an Interagency Coordinating Committee.
HP-7	50	Recommends the undertaking of better efforts to post bird rookeries.	This initiative is included in <i>The Plan</i> .
HP-8	51	States that GLO should be lead entity.	The Management Conference has revised the discussion of lead entity to provide for GLO lead with coordination by other appropriate agencies.

HP-8	51	Recommends the program state who will fund transportation of dredged material for bird island construction.	<i>The Plan</i> makes no recommendation for changing the negotiation mechanism between the Corps and the local project sponsor concerning costs of dredge material disposal.
HP-9	52	Recommends that the Intracoastal Waterway be shut down due to its severe erosional impacts.	This suggestion was not adopted by the Management Conference.
HP-9	52	(VERBAL) States that bird habitat needs protection from boat wakes.	This would be an engineering element of any project to create or restore bird nesting islands.
HP-9	52	Recommends the program identify which "general permits" are appropriate to include erosion standards.	Identification of specific permits subject to erosion standards would necessarily await a definition of criteria and other elements of program development. <i>The Plan</i> indicates that such standards "may be" appropriate for inclusion.
HP-1 thru 9	44-52	Expresses support for all actions, and request that local governments be made an active partner in habitat programs.	The Management Conference concurs and actively seeks local government involvement as partners in the habitat initiatives.

SPECIES POPULATION PROTECTION

Action	Page	Summary of Comment	Summary of Response
		Recommends that <i>The Plan</i> include rebuilding the north jetty at Bolivar Roads to allow for movements of marine organisms moving along the shoreline, to improve their access to the bay and increase productivity.	The Management Conference appreciates this comment, however, the technical studies carried out by the program do not indicate biological access to the bay is a substantial issue affecting bay productivity.
		(VERBAL) Recommends that <i>The Plan</i> call for the rebuilding of the north jetty at Bolivar Roads to allow for movements of marine organisms moving along the shoreline.	See above.
		States that <i>The Plan</i> should contain actions for identifying and eliminating the factors causing the premature deaths of seals, dolphins, and other aquatic mammals in the bay area.	The Management Conference acknowledges marine mammal deaths are a concern, however seals do not utilize Galveston Bay, and dolphin strandings or deaths have been rare in this bay system.
		States that <i>The Plan</i> needs to include monitoring of bycatch reduction goal in monitoring strategy.	The monitoring strategy has been substantially revised, including monitoring of bycatch.
		Suggests inclusion of an action to raise and release Penaeid shrimp, similar to redfish releases.	The Management Conference appreciates this suggestion, however (for a number of years) Galveston Bay has been at the maximum sustainable yield for shrimp, with adjustment of harvest intensity the most cost-effective tool for shrimp population management.
		Proposes that, during extremely cold periods, shut down the Houston Ship Channel to allow fish to have a deep water refuge to escape being frozen in shallow areas.	The Management Conference has declined to adopt this suggestion.
		(VERBAL) Proposes that, during extremely cold periods, shut down the Houston Ship Channel to allow fish to have a deep water refuge to escape being frozen in shallow areas.	See above.
Intro	55	Suggests that: the fourth sentence inferring that survivorship may be significantly lower than the range of 10 to 90 percent should be deleted. The cited range characterizes the observed variability under various operating conditions.	Wording was revised to more accurately reflect the findings of the study cited.
SP-1	64	Suggests addition of language to promote multi-species and biodiversity protection, in additional to single species plans.	Revised as suggested.
SP-1	64	Proposes that <i>The Plan</i> reduce fishing pressure by limited access. Suggests working through and amending the Magnuson Act to extend control to nearshore fisheries. States that the Galveston Bay Council should introduce incentive-based system to price and distribute fishery rights, for example through individual transferable Quotas.	Nearshore fisheries, while posing substantial management challenges, are not within the scope of <i>The Plan</i> , which includes the Galveston Bay estuarine system and its lower watershed.

SP-1	64	Proposes that <i>The Plan</i> include an element to reintroduce species, e.g. Gulf Salt Marsh Snake.	This could be a possible recommendation of the species management plans called for in <i>The Plan</i> .
SP-2	65	Proposes protection of small shoreline oyster reefs, the cleaning up of pollution, and guarantees for fresh water inflows.	These are important issues supported by the Management Conference, with pollution and inflow addressed in separate sections of <i>The Plan</i> .
SP-3	66	Proposes that <i>The Plan</i> address the streamlining of state leasing procedures (e.g. for oyster reef creation) as an action step.	Revised as suggested.
SP-3	66	Suggests deletion of the reference to cumbersome process under Regulatory Needs. States that, if necessary, keep recommendation to streamline as an action step.	Wording was revised, and streamlining was added as an action step.
SP-3	66	Concerned about long-term contamination from fly ash reefs.	The Management Conference was also concerned about contamination, and raised this issue in its deliberations. A scientific work group was established to review all data and to design an ongoing monitoring program to assure safe implementation of artificial reef projects using this material. The Management Conference is now satisfied that project monitoring and state land lease provisions are protective.
SP-4	67	Suggests that the program consider National Estuarine Research Reserve System in connection with the action to set aside reef habitats.	Revised as suggested.
SP-5	68	(VERBAL) States that commercial bycatch is a big problem for the Bay.	The Management conference is also concerned about this issue, since the program's technical study showed that for each pound of shrimp caught, about three pounds of other fish and shellfish were included in the catch.
SP-5	68	Suggests that the program conduct an educational program for commercial fishermen (bycatch reduction).	Done; an educational initiative has already begun and is showing good success.
SP-5	68	(VERBAL) Suggests that the program conduct an educational program for commercial fishermen (bycatch reduction).	See above.
SP-5	68	States that The Program should not merely encourage, but instead require bycatch reductions.	The Management Conference seeks non-regulatory solutions for bay problems wherever possible. Because shrimpers themselves seek to avoid bycatch, improving bycatch reduction technology and coordination with commercial interests has been adopted in <i>The Plan</i> .
SP-6	69	States that catch and release needs more research so we know how many fish die and how to stop it.	More detailed information on this topic is available in publication GBNEP-25, which also addresses research needs.
SP-6	69	Suggests the program consider Sea Grant as a potential fund source for catch and release education programs.	Revised as suggested.
SP-7	70	Suggests that <i>The Plan</i> be revised to reflect that HL & P will investigate impingement/entrainment reduction methods and regulatory compliance rather than undertake research to characterize this problem or its effects on bay populations. Does not agree that FW-7 is a related action.	This action was revised to reflect compliance with forthcoming EPA regulatory requirements, and less emphasis on population impacts in the bay from impingement/entrainment. The Management Conference concludes that the volume of water pumped is germane to both this issue and FW-7 concerning freshwater inflow.
SP-7	70	Suggests that the program not merely investigate, but instead require reduction of impingement/entrainment.	EPA regulations are forthcoming, and <i>The Plan</i> was revised to include this requirement.
SP-8	71	States that <i>The Plan</i> needs specific population increase goals for each threatened/endangered species; make Chinese Tallow reduction 30 percent instead of 10.	Plans are already in place for endangered species, but <i>The Plan</i> calls for better emphasis on management actions to address these species. The Management Conference has adopted the recommendation of a task force of scientists and managers for Chinese Tallow.
SP-8	71	States that <i>The Plan</i> needs specific plans for each listed species.	See above. The creation of such specific plans is the next step called for by <i>The Plan</i> .
SP-9	72	Opposed to regulation of exotic species at Galveston Bay level; must be addressed by EPA and Coast Guard at national and international level.	Action was revised to reflect the appropriate level of regulation.

SP-9	72	States that there is a need for stronger enforcement and eradication programs for exotic species like grass carp and nutria.	The Management Conference concurs and has included such actions in <i>The Plan</i> , but has determined that this is a relatively low priority in comparison to some other issues addressed by <i>The Plan</i> .
SP-9	72	States that laws and regulations are needed to prohibit ridiculous introductions of exotics.	This need is addressed by <i>The Plan</i> for bilge water releases, which could introduce exotics. For some species, <i>The Plan</i> recognizes that regulations are present and enforcement needs improvement.
SP-10	73	(VERBAL) Suggests more enforcement and eradication programs for exotic species.	<i>The Plan</i> calls for a number of actions concerning exotics, some of which are regulatory in nature, and some of which are not.
SP-10	73	States that exotic species actions should be backed by strong new regulations.	See above.
SP-10	73	(VERBAL) States that the program should do something about the grass carp.	Grass carp are included in action SP-10; however, eradication may not be a biologically feasible goal.

PUBLIC HEALTH PROTECTION

Action	Page	Summary of Comment	Summary of Response
		Suggests <i>The Plan</i> should implement public health actions much sooner than indicated.	The implementation schedule set in <i>The Plan</i> in part reflects the need for additional revenue, dependent upon the schedule of the Texas Legislature.
Intro	80-81	Points out use of term "polluted areas" is a legislative definition and is technically incorrect.	This point has now been clarified.
PH-1	88	Suggests <i>The Plan</i> call for action to start now to analyze for organic chemicals and communicate to the public.	The Management Conference also recognizes the need for a seafood safety program, dependent upon additional funding to the Texas Department of Health. Toxic organic contaminants would be included.
PH-1	88	States that there should be regular, at least weekly columns to inform public of important monitoring details such as which areas are safe or unsafe for seafood harvest.	The Management Conference concurs with the need for a routine risk communication program for seafood. The frequency of reporting will be affected by the sampling frequency, which is in turn dependent upon funds available and logistical sampling constraints.
PH-1	88	Indicates there is a need to constantly monitor fish/shellfish pollutant levels using accredited labs, and make findings public in the form of advisories.	These elements are included in <i>The Plan</i> .
PH-1	88	(VERBAL) States that there is a need to communicate risks of seafood consumption more effectively.	The Management Conference concurs; this is an element of <i>The Plan</i> .
PH-1	88	States that a seafood safety program should be implemented in less than six months and that no part of the bay's seafood should be a health hazard after December, 1996.	The implementation schedule set in <i>The Plan</i> in part reflects the need for additional revenue, dependent upon the schedule of the Texas Legislature. Some contamination problems result from banned substances which have been in the Bay for years, and for which short-term solutions are difficult to achieve.
PH-1	88	(VERBAL) States that the few fish toxicity studies that have been done are too negative.	Studies carried out by the Management Conference do indicate some contamination of fish and shellfish in Galveston Bay, and the need for a seafood safety program to communicate risk to the public.
PH-1	88	States that there is no real concern for seafood safety, in light of the heavy level of regulation we already have. Recommends reduction in the level of effort for this action.	The Management Conference believes that decisions about eating seafood should be based upon individual personal assessment of risk. Currently no public information exists to determine and communicate these risks, therefore this initiative is proposed to provide enhanced information.

PH-2	89	Questions whether the opening of additional areas to shellfish harvesting as a result of increased monitoring would produce enough benefits to be worthwhile.	Currently, about half the bay is subject to shellfish closure due to bacterial loadings. The Texas Department of Health, under this action would seek additional funds to monitor and open new areas where possible. The Management Conference encourages the TDH to also consider the benefits of is work under this action.
PH-3	90	States that the western tributaries including Clear Creek and Dickinson Bayou will always have high fecal coliform levels, and points out that, for practical purposes, there is no contact recreation in urban bayous or upper Houston Ship Channel during wet weather conditions. Recommends low priority for this action.	In relation to contact recreation, the principal concern of the Management Conference was TNRCC data showing bacterial levels exceeding standards in areas heavily used for contact recreation, such as Dickinson Bayou and Clear Creek. Nevertheless, this action has a low priority.
PH-3	90	Suggests that, for the contact recreational advisory program, the program consider public access to a data terminal.	The data and information management system for the proposed Galveston Bay Regional Monitoring Program will provide for ready access to these and other data.

FRESHWATER INFLOW AND BAY CIRCULATION

Action	Page	Summary of Comment	Summary of Response
		States that program is living in another world by stating there is "no documented evidence that indicates that the health of the estuary is suffering from current freshwater inflows." Suggests the program take action sooner than shown.	The Management Conference is currently awaiting the results of freshwater inflow needs analyses being carried out by the TWDB, TPWD, and TNRCC. Findings of these analyses will, for the first time, provide an objective basis for management of freshwater inflow by indicating freshwater inflow needs for a series of key species. The Management Conference is committed to management improvements based on objective data.
		(VERBAL) What does controlling freshwater inflow entail?	This is an extremely complicated issue involving water rights, currently permitted withdrawals, return flows, and circulation factors in the bay itself (to list just a few of the issues). The first step, proposed in <i>The Plan</i> , is to better determine the freshwater needs of the estuary by considering several key estuarine species and habitats.
		States that <i>The Plan</i> should allow no new additional stream water withdrawals or obstructions, in order to maintain inflow.	See above. The Management Conference does not have the authority to prevent some additional withdrawals, for example for diversions which are already permitted but not fully utilized.
		States that <i>The Plan</i> should focus on findings and follow-up related to the joint agency study on inflow needs, instead of the actions now in <i>The Plan</i> , which are sidelights.	The Management Conference concurs that the joint TWDB, TPWD, TNRCC study is of central importance to this issue. The intent is to base the contained initiatives on the findings of that study.
		Indicates that <i>The Plan</i> should allow no actions which restrict "fan-type" water dispersal, and account for the benefits of river and low-area estuarine flooding.	The Management Conference appreciates the value of delta sedimentation and intends to address this issue through action FW-5.
		Suggests that, in light of the estuary's need for sediment, that non-point programs may end up removing pollutants like nutrients and sediment in conflict to this need. States that EPA should consider an EIS in the impact of their stormwater program.	The Management Conference notes that concerns about reduction of sediment is based mainly on the issue of delta nourishment, not the urban bayous most heavily impacted by non-point loadings. For nutrients, the open bay has no serious nutrient problems, while developed tributaries do.
		Suggests revision of <i>The Plan</i> to consider a breach in the Texas City Dike.	Consideration of alterations to existing structures such as the Texas City Dike is included in action FW-7.
		States that <i>The Plan</i> should discuss how alterations to circulation are currently addressed, under "Management Status" in the introduction.	Revised as suggested.

		States that <i>The Plan</i> should address the negative effects of salt water intrusion, for example with deepening the Houston Ship Channel.	The Management Conference concurs, and supports Corps studies overseen by the Interagency Coordinating Team to determine impacts of Houston Ship Channel enlargement. Additional information on this topic is contained in publication GBNEP-44.
		(VERBAL) States that <i>The Plan</i> should include a section that describes the effects of salt water intrusion on this bay.	A more detailed discussion of this topic is found in publications GBNEP-22, 28, and 44.
		(VERBAL) States that <i>The Plan</i> should initiate action to dredge the Trinity River to reduce flooding of flood plain lands.	The Management Conference did not adopt this recommendation.
FW-2	101	States that <i>The Plan</i> should identify source and amount of funds for sediment measuring stations, and cost to City of Houston to implement flow measurement as recommended.	Sediment measuring stations are identified as a USGS initiative, while flow measuring would be part of planned programs (e.g. reservoir monitoring). The Management Conference understands that agencies and cities are not able to commit or budget funds for future years as a part of The Galveston Bay Plan, and this is explained in the Plan's executive summary.
FW-2	101	Recommends less emphasis on this action since inflow is very well monitored now. Would rather see money spent on improved technology rather than more local stream gages.	Work by the TWDB, TPWD, and TNRCC to determine bay inflow needs, as well as GBNEP studies, have indicated a need for critical information concerning accurate inflow from Lake Houston and sediment inputs to the system. The threat of further cutbacks on existing gaging work also hampers the ability of agencies to accurately model and manage flow.
FW-2	101	Offers to coordinate needed monitoring (e.g. Lake Houston spillway flow) with upcoming City of Houston program to monitor reservoir systems.	Revised to include City of Houston participation.
FW-3	102	Suggests better coordination with Trans-Texas Water Program; proposal to work through Clean Rivers appears to be duplicative.	Revised to reflect improved coordination with other programs.
FW-3	102	Suggests the program delete the second bullet reference to Coastal Coordination Council adopting any new programs on freshwater inflow, and any other references to the Coastal Coordination Council adopting any new programs or policies.	Revised as suggested. The Management Conference recognizes that rules adopted by the Coastal Coordination Council since publication of the draft Galveston Bay Plan have established that the Coastal Coordination Council will not seek to impose additional regulatory programs beyond agency programs which currently exist.
FW-4	103	What is the cost to upstream water users as a result of protecting inflow to estuary?	This question cannot be addressed until estuarine inflow needs are determined, the first step in this action plan.
FW-4	103	Suggests the need for water conservation elements and protection of Buffalo Bayou from diversions (like golf course watering).	Action FW-6 provides for water conservation actions.
FW-5	104	States that costs of increasing the sediment load to the bay (if dredged material is used) should be balanced with the benefits; consider state, local, and private sponsors in case the federal funding is inadequate.	This action was revised to include these elements.
FW-5	104	States that, in researching sediment for the estuary, the program should not ignore potential impacts on maintenance dredging requirements.	The Management Conference intends for any future sediment management initiatives to be developed with the participation of all bay interests, including navigational.
FW-6	105	Suggests the need for significant industrial, agricultural, and municipal water conservation to result in saving at least 50 percent of water used in each of these categories.	The Management Conference appreciates the need for water conservation, and intends for any use reduction targets developed to be based on objective analyses of estuarine freshwater needs, currently underway.
FW-6	105	Suggests the need to make distinction between per capita water reduction (possible) and overall reduction (not likely due to economic/population projections). States that Step 3 to develop regional conservation plan seems duplicative of work by City of Houston and Trans Texas Project.	Revised to include suggested distinction and participation by and coordination with City of Houston.

FW-6	105	States that the regional water conservation plan should have stakeholder involvement and be consistent with City of Houston and Subsidence District plans.	The Management Conference concurs, and has now included both these entities where appropriate.
FW-6	105	States that <i>The Plan</i> should discourage use of existing surface water supplies, delete support for the Trans-Texas Project, and live within the bounds of local resources. Favors promotion of conservation through retrofits of plumbing fixtures, lining of water transfer and storage facilities, leveling of agricultural fields, and use of xeric plants. Suggests the program adopt municipal pricing strategies that promote conservation by allocation. Encourages consumer water collection and reuse by consumers via rainwater collection and gray water recycling. Suggests that <i>The Plan</i> should penalize peak time demand and reward off-peak use. Suggests use of recycled water for watering, irrigation, and cooling. States <i>The Plan</i> should enforce water right forfeiture law to discourage hoarding of rights, with positive incentives including tax deductions or payments for permanent dedication of rights to instream flow. Suggests an element to develop water markets.	The Management Conference supports water conservation in <i>The Plan</i> , but realizes that surface waters will continue to be utilized (for example to prevent subsidence through increased use of groundwater). The specific suggestions offered are all tools that the Management Conference recommends be considered when estuarine freshwater needs are better determined and conservation plans are formulated.
FW-7	106	States that <i>The Plan</i> should not treat circulation, habitat, and species protection together, since circulation is a physical parameter. Requests reference to "cooling water intake" be deleted.	The Management Conference recognizes that, through physical and biological ecosystem linkages, circulation, habitat, and species are all affected by human structures and navigation channels. <i>The Plan</i> was revised to refer to all water extractions, rather than specifying cooling water intakes.

SPILLS/DUMPING

Action	Page	Summary of Comment	Summary of Response
		States: instead of deepening/widening the Houston Ship Channel, build an alternative shallow draft (15 feet or so) channel to allow the barges and other shallow draft traffic to get off the main channel and decrease risk of collision.	This alternative has been evaluated previously by the Corps and rejected. Currently, the Corps has not yet sought congressional authorization to proceed with Houston Ship Channel enlargement.
		Recommends the program discuss the problem of underwater pipeline leaks, and if such discharges occur, prescribe actions.	This issue was addressed by the Spills and Dumping Task Force, which concluded that pressure monitoring technology and Railroad Commission rules were adequately protective, and such incidents were relatively rare.
		Proposes a mandate requiring double walls for tankers and barges; requirement for potential spillers to post performance bonds, redeemable upon satisfactory performance.	While appreciative of these suggestions, the Management Conference determined they exceeded the scope of <i>The Plan</i> . Tanker and barge design is addressed at the national/international level and spill response and cleanup are addressed by new programs resulting from recent federal and state statutes.
		States that the emphasis on compensation for environmental injuries seems targeted merely to make environmental lawyers richer. Supports only the trash management issue.	No revisions were made.
Intro	110-111	Recommends clarification of wording about spills, to clarify jurisdictions of various agencies.	Revised as suggested.
SD-3	119	Urges analysis of timing and weather conditions for spill cleanup and review of effectiveness of various methods and effects such as toxicity of dispersants. Suggests a requirement for analysis of low-risk transport alternatives such as trucks, ocean-going barges, or pipelines.	The review of response and cleanup technology was not included in <i>The Plan</i> in order to avoid duplication of recently initiated efforts in Galveston Bay by state and federal agencies and private spill response cooperatives. These efforts are the result of new federal and state laws concerning spills.

SD-5	121	Recommends adoption of actions outlined in EPA document "Plastic Pellets in the Aquatic Environment: Sources and Recommendations."	Revised as suggested.
SD-6	122	States that CMP does not grant any entity new authority, and local governments cannot therefore adopt trash screening under CMP authority. Recommends revision of "Who" section.	Revised as suggested. The Management Conference recognizes that rules adopted by the Coastal Coordination Council since publication of the draft Galveston Bay Plan have established that the Coastal Coordination Council will not seek to impose additional regulatory programs beyond agency programs which currently exist.
SD-6	122	Recommends this action be deleted; there are numerous other means to control floatables (e.g. trash pickup), and screening will pose a significant flooding potential.	Revised to indicate that screening is not the only method available. This action now takes the approach of developing best management practices for this problem.

SHORELINE MANAGEMENT

Action	Page	Summary of Comment	Summary of Response
		Points out limited staff and other resources to undertake major planning efforts, encourages program to seek commitment from Coastal Coordination Council to earmark CZMA funds for shoreline management initiatives. Against inclusion of additional local development standards (beyond dune/beach access) under CMP consistency review.	The Management Conference appreciates the limited funds currently available for shoreline planning and supports the possibility of CZMA funds being earmarked in the future (Texas does not at this time have a federally approved program). Enforceable policies for consistency review (including any development standards) will be addressed by the Galveston Bay Council in public deliberation at a later time.
		States that the planning in this action plan is premature and unsound, and that there should be more emphasis on understanding such issues as habitats, nutrients, and inflows (research) before we consider management.	The Management Conference, while recognizing the need for continued research, believes that some actions can be taken to prevent habitat loss and water quality degradation. These actions would entail management on a case-by-case basis at the local level.
		Suggests, in general, delete references to Coastal Coordination Council adopting new programs or policies and steps that state that the Coastal Coordination Council will require consistency of local actions with the CMP. States that enforceable policies of the CMP are all to be based on existing statutory authorities. States that the Coastal Coordination Council has no intention of broadening the scope of actions subject to the CMP. States that all shoreline management actions should have local government focus, not state-driven mandates.	Revised as suggested. The Management Conference recognizes that rules adopted by the Coastal Coordination Council since publication of the draft Galveston Bay Plan have established that the Coastal Coordination Council will not seek to impose additional regulatory programs beyond agency programs which currently exist. This resulted in some substantial changes to this section of <i>The Plan</i> .
		Proposes the program take action to eliminate subsidies to coastal development, e.g. federally subsidized flood insurance and disaster relief loans. States that if private property owners had to individually absorb the cost of damage, there would be much less construction and less non-point source pollution in coastal areas. Recommends the roll back of subsidies for existing structures, and elimination of subsidies for new construction.	The Management Conference appreciates these suggestions, but does not have authority to alter nationwide federal programs or policy. However, federal consistency review will allow the TNRCC and Galveston Bay Council to review federal assistance and development projects for consistency with <i>The Plan</i> , on a case-by-case basis. Details are provided in the program's Federal Consistency Report.
		(VERBAL) How does <i>The Plan</i> affect the process of obtaining a bulkhead permit?	The existing permit process will remain in effect.
		States that Gulf beach erosion is a terrible problem; when Bolivar Peninsula is gone, there will be no East Bay. Recommends the program look into this problem.	The Management Conference appreciates this concern, but does not address issues concerning beaches of the Gulf of Mexico, since they are not part of the estuary.
		Recommends control of land use and limitation of development. Recommends that subdivisions not be allowed to be established in upstream flood plains; the restriction of road construction, and the revocation of the authority of population centers to give tax abatements to entice new industry and development.	The Management Conference appreciates the need for improved land use planning adjacent to the bay, but seeks to accomplish the goals of <i>The Plan</i> without creating new regulatory mandates.

		(VERBAL) Opposed to habitat protection and shoreline development planning via the land use controls as the tool.	See above.
		Recommends action to impose speed limits in the Houston Ship Channel due to wake erosion of upper bay shores.	In investigating this issue, the Management Conference determined that human safety and spill prevention were also important considerations hinging on navigability and vessel speed. The Management Conference believes that, while existing limits should be enforced, no new limits in the Houston Ship Channel should be imposed.
		(VERBAL) Recommends a speed limit be imposed in the Houston Ship Channel.	See above.
		Voices a need to address wake damage by recreational vessels in enclosed areas like Clear Lake. States that large boats traveling fast in tributary waters are a danger to people, wildlife (e.g. broods of ducks), and create severe erosion.	In recreational areas such as Clear Lake, exceedance of vessel speed guidelines is a problem. <i>The Plan</i> calls for a better definition of resulting environmental impacts, better enforcement of existing speed limits, and improved education of boaters to address this issue (see action HP-9).
		(VERBAL) Voices concern about damage from high speed boating in the bayous.	See above.
		Recommends the program use boater education and enforcement to prevent the erosion of shorelines from irresponsible boaters.	See above.
		States that wake erosion from barge traffic on the Intracoastal Waterway is a serious problem. Need to have a vessel toll or some other way to address this issue.	The Management Conference recognizes wake erosion as a problem. <i>The Plan</i> calls for initiatives under HP-9 to better define and solve this problem. Additional actions will then be incorporated in the planning process as implementation of <i>The Plan</i> proceeds.
		(VERBAL) Concerned that wake erosion from barge traffic on the Intracoastal Waterway is a serious problem. Need to have a vessel toll or some other way to address this issue.	See above.
		(VERBAL) Concerned about shoreline erosional effects.	See above.
Intro		States that the program should better develop the concept of water dependency and non-water dependent uses, and state public trust responsibilities	The Management Conference notes that the concept of water dependency is more applicable for Coastal Zone Management planning than for NEPs, and is being addressed by the GLO in the developing Texas Coastal Management Plan.
SM-1	133	Consider using defined "water-dependent" activities for shoreline management, as done in the Coastal Management Plan.	See above.
Intro		States that the program should include RRC in its authority (along with TNRCC) for issuance of 401 certifications for oil and gas related activities.	Section 401 certifications are addressed as a management tool for wetlands management in the Habitat Protection chapter, where the RRC is included (this would address shoreline wetlands).
Intro		States that <i>The Plan</i> should more clearly identify the management objectives for shoreline development guidelines (suggestions provided).	Actions SM-1-3 will result in creation of more specific goals of the type suggested, and those suggested will be considered during this process.
Intro	131	Suggests shoreline management action area be defined as those areas within 100 feet of the mean high tide, called "coastal shore areas" in the CMP and designated as a Coastal Natural Resource Area. States that the currently-proposed "Coastal Wetlands Boundary" has no factual basis for this purpose, and would include inappropriate areas.	Revised as suggested.
SM-1	133	Suggests <i>The Plan</i> not include GLO as lead entity since it has no authority to govern local land use beyond dunes and beach access on the Gulf. States that lead entity should be Galveston Bay Program or Local Governments.	Revised as suggested.
SM-1	133	States that the program should consider development of greenways as a comprehensive management tool (suggestions provided).	The Management Conference appreciates the value of greenways as a management tool and has included this approach under action SM-1.

SM-1	133	States that the rationale for area within 100 ft of mean high tide needs better emphasis and definition. Recommends the program consider 100 ft from inland extent of coastal wetlands. Recommends <i>The Plan</i> include steps to adopt enabling legislation for local governments to address shoreline development, and develop shoreline development guidelines for adoption as CMP policies for Galveston Bay Special Area Management Plan.	The rationale is based on the state definition of “coastal shore areas” in the developing Coastal Management Plan and is being retained for the sake of effective coordination with that program. Enforceable policies for adoption by the Coastal Coordination Council as a Special Area Management Plan (if any) will be developed at a later time by the Galveston Bay Council.
SM-1	133	Suggests that this action needs regulations instead of just guidelines.	The Management Conference proposes non-regulatory approaches to achieving the goals of <i>The Plan</i> , wherever possible.
SM-1	133	States that the program should integrate into plan the requirement of formal permission by Port for any structure or pipeline at or below mean low tide in navigable streams.	While the Management Conference recognizes the validity of the permission requirement, the myriad of regulatory requirements at this level of detail (there are many other examples) are not generally mentioned in <i>The Plan</i> , which serves as a comprehensive planning document.
SM-1-3	133-135	States that <i>The Plan</i> needs definition of the shoreline to be affected by this action.	The Management Conference has determined that, because these actions are not being proposed as a regulatory program, the areas potentially considered by local municipalities for shoreline management should be determined by local definition. The Management Conference does not wish to be over-prescriptive.
SM-2	134	Recommends that H-GAC not be allowed to set standards, since they are handmaidens of industry, developers, transportation interests, and local government officials who want growth at any cost.	The Management Conference favors inclusion of industry, developers, and transportation interests in the planning process (among other interests), but has involved H-GAC in this action because of their local government representation.
SM-2	134	Suggests development of regional residential guidelines that local governments can use to develop their own specific guidelines. Recommends clarifying discussion of consistency review (suggestions provided).	This approach is now adopted in <i>The Plan</i> .
SM-2	134	Recommends that the program delete discussion of GLO authority under Regulatory Needs. Notes that CMP is based solely on existing authorities.	Revised as suggested.
SM-2,3	134-135	Recommends amending the description of residential and commercial shoreline management guideline projects to clarify the limits on state-level land use planning authority, by noting the advisory nature of the proposals and clarifying the references to Coastal Coordination Council requirements, which are now also better defined and largely advisory.	Revised as suggested.
SM-3	135	Recommends deletion of the GLO as lead entity in favor of TNRC or perhaps DPS. Recommends deleting discussion of GLO authority under Regulatory Needs. Notes that CMP is based solely on existing authorities.	Revised as suggested.
SM-3	135	Recommends that the program change Step 2 from “hazardous material/waste facilities” to “solid waste and sludge management facilities” to better define issue.	Revised as suggested.
SM-4	136	Recommends that the program clarify that dredging is addressed by inserting “and Dredging” after the word “Structures” in the title.	Revised as suggested.
SM-4	136	Recommends inserting “and Dredging” after the word “Structures” in the title.	See above.
SM-4	136	Proposes that rules against structure abandonment not apply to structures representing an environmental benefit (e.g. artificial reefs).	Revised as suggested.
SM-4	136	Recommends inclusion of the RRC as an agency to revise rules to address structures on submerged lands, to account for oil and gas structures.	Revised as suggested.

SM-4	136	Recommends removal of all cabins from the bay.	Action SM-4 proposes a phasing out of cabins on state-owned lands.
SM-4	136	States that the GLO does not have authority to impose fines for abandoned structures. Recommends revision of Step 2 to read: "GLO will consider adopting rules to require at the time of permit application, where practical, the deposit of funds..." Recommends revision of Regulatory Needs section appropriately.	Revised as suggested.
SM-5	137	States that first step to improve access should be inventory of existing public access sites. Recommends clarification of consistency review.	An access inventory is included in action SM-5.
SM-5	137	Recommends <i>The Plan</i> highlight the voluntary nature of land dedications for public access, to ensure they will not be challenged as unconstitutional takings.	Revised as suggested.
SM-5	137	Recommends that TPWD pursue purchase of park land around bay to improve access.	Revised as suggested.
SM-5	137	States that Step 1 should strongly emphasize acquisition of public lands for shoreline access.	Revised as suggested.

WATER AND SEDIMENT QUALITY

Action	Page	Summary of Comment	Summary of Response
		Recommends that the program establish a new goal with objectives and actions which address excessive fecal coliforms.	The Management Conference has added steps under existing actions in <i>The Plan</i> to emphasize reduction of bacterial loading.
		Recommends that the program establish subwatershed planning groups for ambient, non-point, and point source elements.	This suggestion was considered by the Management Conference, and rather than create any new organizations, this role will become a function of the Galveston Bay Council (which can establish planning groups if necessary).
		States the record shows no real concern with toxics. PAHs, PCBs, and DDT have no real sources, and any concern for metals is completely bogus.	The Management Conference, in response to data concerning human consumption risk levels, and natural community degradation based on toxicity testing and other approaches, believes toxicants are a concern in portions of Galveston Bay.
Intro	145	States that <i>The Plan</i> should clarify difference between point source and non-point source pollution and the effects each has on the bay.	Done; for additional information, see also publication GBNEP-44: <i>The State of the Bay, A Characterization of the Galveston Bay Ecosystem</i> .
Intro	149	States <i>The Plan</i> needs to qualify NPS loading comparison in table and text. States that the incremental non-point source loading difference (increase) from urban and agricultural sources vs. an undeveloped area provides better information than total NPS load. Revision language suggested.	Revised as suggested.
Intro		States that <i>The Plan</i> implies that non-point source pollution is as large a concern as point source pollution even though 60 percent of all permitted wastewater discharges occur into the Galveston Bay system.	Studies carried out by the GBNEP confirm that non-point source loadings for many parameters are greater than point source loadings. Point source discharges are treated, while non-point sources are not.
Goal	153	Recommends that, due to toxic contamination of only isolated areas, the program should change the goals statement to "Reduce Toxicity Areas".	The Management Conference agrees that much of Galveston Bay is not subject to toxic contamination. However, the current language accounts for the common situation in which unmeasurable (or less than toxic) concentrations of pollutants in water contribute to a toxic "hotspot" via transport and concentrating mechanisms in sediment or at the water-sediment interface.

Goal	153	States that <i>The Plan's</i> assertion that these toxic substances may have a negative impact on aquatic life is speculative, not supported by text, and should be eliminated.	A substantial number of scientific studies, including those of the program, have demonstrated negative toxic impacts on aquatic life. See <i>The State of the Bay, A Characterization of the Galveston Bay Ecosystem</i> for a summary and appropriate citations.
WQS-1	156	Questions why Step 5 is included. Believes that, with the possible exception of dioxin, these are not point source issues. Recommends renaming this action to reflect study only, with no management action.	The Management Conference concurs with the need for additional survey data, particularly related to defining the source of contaminants (step 5). Based on these findings, permit actions can then specifically address sources.
WSQ-3	158	Urges adoption of EPA sediment criteria only, with no independent development by the state. Appropriate revisions are suggested.	The Management Conference acknowledges the expertise and jurisdiction of the TNRCC concerning this issue, and proposes no criteria development apart from TNRCC action. It is anticipated that TNRCC will rely heavily or exclusively upon criteria development efforts by EPA. This action was revised to better reflect criteria adoption as opposed to criteria development.
WSQ-3	158	Urges adoption of EPA sediment criteria only, no independent development by state. Revise appropriately.	See above.
WSQ-3	158	Opposed to any sediment quality criteria approach not consistent with federal guidance and standards; urges utilization of effects-based testing included in EPA "Green Book" and "Gold Book".	See above.
WSQ-3	158	Questions cost-effectiveness of establishing sediment quality criteria when pollutant loadings are principally the function of past point source discharges currently being controlled. Should not try to address this issue when others have failed.	GBNEP scientific studies indicate that current non-point sources are a likely a source of some sediment contamination; particular areas continue to have contaminated sediments, some so severely that the benthic community is severely affected.
WSQ-3	158	Urges that <i>The Plan</i> be re-written to assure that sediment criteria will be established and put in place.	This is the intent of this action; some revisions have been made to clarify.
		States that if we don't even know if there is a problem with toxics, why would we want to spend time and almost \$200 K developing a regulatory conformation of our conclusion?	The Management Conference believes sufficient information about toxicity exists for Galveston Bay to warrant development of sediment criteria for use as a management tool. <i>The Plan</i> has been revised to encourage a careful approach by the TNRCC that accounts for all the EPA work in this area.
WSQ-3	158	States that reference to pesticides in the "What" statement should be dropped or changed to DDT, the only elevated compound in characterization studies.	Revised as suggested.
WSQ-4	159	States that non-point loadings should not be included in a Total Maximum Daily Load process, due to differences between point and non-point loading conditions. States that loading cannot be used as a sole indicator of ambient hotspots.	The Management Conference recognizes the technical challenge of addressing both wet and dry weather loading conditions in the Total Maximum Daily Loading process. However, studies show that toxicants from both sources are of concern. Transport and ambient conditions must also be considered to determine the true relationships of loadings to ambient impacts. The action was revised to better reflect these issues.
WSQ-4	159	Does not support the action and believes there is insufficient evidence to demonstrate a toxics problem. Has concerns about the TMDL methodology.	No revisions made; see above concerning methodology.
WSQ-5	160	States that Clean Cities 2000 goals concerning solid waste reduction and water conservation will not improve water/sediment quality of the bay; remove this from action.	Revised as suggested.

WSQ-5	160	Recommends mandating industry to reduce their pollution by 50 percent, rather than to merely encourage.	Technical studies indicate the greatest loading for many pollutants results from contaminated, non-treated runoff. Highly regulated and treated effluents from industry are at a point of diminishing returns in terms of load reduction per dollar spent. While supporting the ongoing point source regulatory system, <i>The Plan</i> emphasizes new initiatives in the areas where they can do the most good: non-point source reductions.
WSQ-6	161	Urges that no more studies be carried out; suggests a requirement that year-round dissolved oxygen in the Houston Ship Channel be greater than 4.0 mg/l.	The Management Conference appreciates the need to implement management actions, as opposed to merely studying problems. The proposed dissolved oxygen requirement might require stopping all discharges, and even then, there is no assurance that dissolved oxygen at depth would rise to a natural level above 4.0 mg/l. The Management Conference proposes that regulation of discharges to the Houston Ship Channel be based on objective data, and therefore supports the use of some additional loading studies, which include non-point sources, to acquire these data.
WSQ-6	161	Urges that all actions to limit both point and non-point sources be shelved until we study the questions more.	The Management Conference supports the need both for additional study and for reduction of pollution sources.
WSQ-6	161	States that the current EPA stormwater approach requires only implementation of BMPs. Does this program intend to go beyond this to performance-based management; if so, to what limit and upon what basis?	The Management Conference has adopted a technology-based approach to management initiative in <i>The Plan</i> , and has now made appropriate revisions.
WSQ-7	162	States that <i>The Plan</i> appears to go beyond EPA Stormwater regs. Shouldn't current program be implemented and monitored first?	The intent of this action is to address waters which violate standards in spite of years of point source controls. Work will be coordinated closely with developing EPA stormwater program elements to prevent duplication.

NON-POINT SOURCES OF POLLUTION

Action	Page	Summary of Comment	Summary of Response
		(VERBAL) States there is a need to control <i>non-point</i> source pollution in order to clean up the Bay.	The Management Conference concurs; this issue was ranked number two of 17 problems facing Galveston Bay.
		States that there is no need to control non-point sources until we conduct more research, especially for sediment and nutrients, which may be needed in greater amounts in the bay.	The Management Conference agrees with the need for additional research, but existing studies suggest actions to clean up the highly impacted tributaries which drain urbanized and developed areas.
		Expression of concern by local governments about the possibility of facing three different sets of stormwater regulations (NPDES, TNRCC, and Coastal NPS). Recommends that <i>The Plan</i> call for unified local government approach, taking into account our high rainfall and flat topography. Recommends emphasis on education and voluntary initiatives over burdensome regulatory programs.	The non-point source initiatives have been revised to clarify the coordination of the various programs (some of which are still evolving). The Management Conference agrees with the need for BMPs tailored to our flat topography and fine clays. Education and voluntary initiative are likewise important parts of <i>The Plan's</i> approach to reduction of polluted runoff.
		States that the various programs to control NPS should be streamlined and coordinated; control of the same sources by several different agencies is unnecessarily duplicative, time-consuming, and expensive.	See above, clarifications have been made.
		States that all the various programs addressing this issue should be coordinated and streamlined; control of the same sources by several different agencies is unnecessarily duplicative.	See above.

	States that <i>The Plan</i> should provide for close involvement of Galveston Bay Program with development of the state coastal non-point program.	During planning for all elements of the Texas CMP, close coordination has occurred with development of The Plan. Numerous recent revisions to the Non-Point Source Action Plan reflect this coordination. The nature of non-point initiatives under the states federal application (CZM) is not yet determined.
	States that <i>The Plan</i> should clearly state the intent for coordination with state CNP and Section 319 program.	Revisions have been made to better define the relationships among these programs. The nature of the Section 319 program in Texas is not yet fully defined.
	States that <i>The Plan</i> should include a requirement to retrofit all existing development to reduce NPS.	The Management Conference recognizes the value of retrofits in some situations. However, retrofits are in other cases the most expensive solution to a problem for which less expensive solutions exist. For example, <i>The Plan</i> emphasizes source reductions in residential areas, in order to improve the quality of runoff, as opposed to stormwater treatment. In general, retrofits, as the most burdensome sort of solution, would be considered only if other approaches are not available or viable.
	Recommends an increase in fines for littering and imposition of greater enforcement.	These suggestions have now been incorporated into action SD-5.
	States there is a lack of recognition or proposed actions to protect the bay from air pollution generated water pollution.	The Management Conference concurs concerning the likely high importance of atmospheric deposition of pollutants and subsequent runoff to the bay. Currently, very little information exists on this issue. In <i>The Plan</i> , atmospheric deposition is identified as a research priority, in order to acquire a basis for future management actions.
	Recommends that the program begin far up the tributaries, and work down to clean up the sources of NPS. Recommends setting strict enforcement of laws already on the books.	The Management Conference agrees with the geographical targeting of non-point sources in the watershed, and has the results of a watershed loading study to strengthen this approach.
	(VERBAL) Suggests increased fines for littering and better enforcement of existing laws.	The Management Conference concurs on the need for enforcement of existing laws.
	Requests incorporation of specific comments submitted by the Storm Water Management Joint Task Force and City of Houston Participants.	Revised as suggested.
	Requests <i>The Plan</i> not refer to NPDES Stormwater Program as non-point source; alternative language supplied by EPA.	This reference has now been qualified to acknowledge that the NPDES program is administratively a point source program.
	Concerned that <i>The Plan</i> proposes non-point source controls and other actions without knowing enough about the effects in the bay (science).	The Management Conference appreciates the lack of a true understanding of the effects of nutrient reductions and other human changes to the bay, but notes the substantial contribution of non-point loadings to the poor water quality in the bay's western and urban tributaries.
	Requests the program address nightmares like McGinnis Pits and industrial land farms that do not have permanent liners to contain leachate. Recommends testing of old injection wells for leakage. and use of polystyrene planks for bulkheading instead of treated wood.	Previously permitted facilities have generally not been individually reviewed by the program, since they are subject to existing regulatory programs. However, the Management Conference intends that future consistency review provide an improved evaluation for some projects in relation to elements of <i>The Plan</i> .
	States that <i>The Plan</i> should take actions to clean up McGinnis Pits and prohibit transporting and dumping of dangerous materials by requiring they be chemically altered to be harmless, within the smallest taxing jurisdiction where they were produced.	See above.
Intro	Requests correction of inaccuracies in Management Status section of introduction concerning Coastal Zone Management Act (wording supplied).	Revisions have now been made to clarify this section.
Intro	169 Recommends wording to clarify Coastal Zone Management Act and implications for states.	Revised as suggested.

Intro	170	Strongly recommends NPS management in Houston/Harris County should initially concentrate on technology-based measures, with performance-based action only after progress is evaluated.	Revised as suggested. This was an issue involving substantial discussions by the Management Conference with both stakeholders and regulators.
Intro	170	Strongly recommends deletion of all 6217 reference, except as a technical resource. Notes that Commissioner Mauro has expressed opposition to these requirements; they would also be strongly opposed in <i>The Plan</i> .	Revised as suggested. The Management Conference has considered this issue in detail and negotiated with the Joint Stormwater Task Force and representatives of Commissioner Mauro to arrive at acceptable language.
Intro	170	States that the use of 6217 NPS Guidance is not assured, and the management measures within that guidance should be construed as examples only, rather than mandates, since similar measures to achieve the same effect are allowed.	<i>The Plan</i> has been appropriately revised to reflect use of 6217 guidance as a technical resource only.
Intro	170	States that <i>The Plan</i> should delete any reference to the 80 percent TSS reduction from the 6217 guidance.	Revised as suggested. See above.
Intro	170	States that <i>The Plan</i> should refer to the program that states must develop pursuant to Section 6217 as “coastal non-point programs” (CNPs) and eliminate the current conflicting terminology.	Revised as suggested.
Intro	170	States that the focus of 6217 CNP is to implement minimum technology-based management measures for each non-point source identified as significantly affecting coastal waters, without making the link to specific water quality impacts. Suggests <i>The Plan</i> build on existing programs to include enforceable policies and authorities. Otherwise, risk loss of federal funds.	See above. <i>The Plan</i> , as well as the developing Texas CMP, relies on existing programs. Enforceable policies will be considered at a later date by the Galveston Bay Council.
Intro	170	Concerned that post-construction sediment load reduction of 80 percent is not in fact mandated by 6217 (is rather suggested), and should not be adopted in any case, in favor of a BMP approach without monitoring requirements. Urges adoption of Joint Task Force approach.	Revised to reflect use of 6217 guidance as a technical reference only.
Intro	170	Voices concerns that post-construction sediment load reduction of 80 percent is not in fact mandated by 6217 (is rather suggested), and should not be adopted in any case, in favor of a BMP approach without monitoring requirements.	Revised; see above.
Intro	170	Voices concerns about adoption of the EPA/NOAA 6217 guidance as a requirement, and points out that the CMP will not likely strongly emphasize 6217	Revised to reflect use of 6217 guidance as a technical reference only.
Intro	173	States that Special Area Management Planing results show that fecal coliforms from all types of land use areas including undeveloped are in similar ranges. States that there are no proven available measures to reduce fecal coliforms in runoff regardless of type of land use.	The Management Conference agrees that fecal coliforms are a difficult management issue requiring diverse actions, including initiatives related to septic systems, municipal bypasses and overflows, marinas, and other sources. However, bacteria in runoff is a substantial source to Galveston Bay, and from an engineering perspective, some control measures clearly reduce bacteria in runoff.
Intro	174	How do these goals fit in with the state's current agricultural NPS program administered by the State Soil and Water Conservation Board?	The Management Conference recognizes the SWCB as the lead entity for agricultural non-point source programs in Texas. Actions NPS-10 and NPS-11 therefore stipulate a SWCB lead, and the Management Conference supports full partnership with the SWCB and utilization of related agricultural programs that have application for Galveston Bay.
Objective	174	Recommends <i>The Plan</i> not include the 80 percent figure and that <i>The Plan</i> not attribute PCBs to new development. Rewording of objective proposed.	Revised as suggested.
Objective	174	Recommends re-working of the objective to eliminate reference to 80 percent TSS reduction (suggested wording provided).	Revised as suggested.

NPS-1	179	States that the title of NPS-1 should be changed to accurately read: Monitor/Implement Storm Water Programs for Local Municipalities. States that <i>The Plan</i> should take full advantage of the Joint Task Force Handbook (BMP approach).	Although monitoring is an element of this action, its ultimate result is implementation of programs in the region. Revisions have been made to take better advantage of the excellent management tools created by the Joint Task Force as a basis for future action..
NPS-1	179	States that the title of NPS-1 should be changed to accurately read: Monitor/Implement Storm Water Programs for Local Municipalities. <i>The Plan</i> should take full advantage of the Joint Task Force Handbook (BMP approach).	See above.
NPS-1	177	Recommend revision to reflect the level of work being accomplished by the NPDES stormwater program; clarify that duplication of effort will not be required for parties under NPDES.	See above.
NPS-1	177	Recommends changing the title to "Monitor/Implement Storm Water Programs for Local Municipalities.	See above.
NPS-1	177	Recommends <i>The Plan</i> require, rather than encourage municipalities to control stormwater pollution.	Federal mandates under the Clean Water Act are becoming increasingly stringent. The Management Conference seeks to help guide mandated programs to success under our specific local conditions, and to provide for improving voluntary efforts as well, without adding mandates which are duplicative with existing program.
NPS-1	177	Why wouldn't NPDES Stormwater actions be included in costs?	The Management Conference acknowledges the substantial costs of implementing NPDES stormwater controls. However, the costs included in <i>The Plan</i> are only those incremental costs beyond existing or future mandated programs external to <i>The Plan</i> .
NPS-1	177	States that the NPDES stormwater program is actually a point source program, and may be more appropriate if placed under the point source section.	Revisions were made to clarify this issue. While the Management Conference agrees that this program is administratively a point source program, it conceptually addresses polluted runoff, and has therefore been grouped with other initiatives for this issue.
NPS-3	179	States that loading/land use cannot be used alone to define hotspots. No verifiable data would confirm that NPS hotspots exist in the 29 subwatersheds listed.	<i>The Plan</i> is now revised to cite findings related to this issue. Substantial ambient water quality analyses by the University of Texas document regions of reduced water quality in areas of high urban runoff.
NPS-4	180	States that loading/land use cannot be used alone to define hotspots. No verifiable data would confirm that NPS hotspots exist in the 29 subwatersheds listed.	See above.
NPS-5	181	States that <i>The Plan</i> should include a ban on all septic systems on the coast in favor of composting or incinerator toilets.	<i>The Plan</i> identifies leaking septic systems as a problem, however many septic systems are legal, functional, and do not leak to the bay or its tributaries. The Management Conference does not seek to impose regulation in specific cases where there is no problem.
NPS-6	182	States that action should not rely on the development of the coastal non-point source plan. Rely only upon existing authority, e.g. TNRCC 319 program, Texas State Soil and Water Conservation Board authority, and local governments.	The Management Conference concurs and has made appropriate revisions.
NPS-6	182	Assumes new development actions reflect state's CMP. Recommends <i>The Plan</i> clarify why there are no costs shown and no regulatory needs. States that technology-based management measures must be ultimately ensured through adoption of enforceable policies or mechanisms, generally implying new regulatory authority.	This initiative does not constitute the State's approach to non-point sources under the CMP. <i>The Plan</i> is designed to be implemented whether or not Texas' CMP becomes federally approved, once it is developed. Because this initiative relies upon existing programs, there is no incremental cost due to <i>The Plan</i> .

NPS-6	182	Favors BMP approach to post-construction erosion control for TSS reductions, without requiring monitoring. Points out that 6217 does not apply anyway to municipalities under NPDES stormwater permits(City of Houston, Pasadena, Harris County). Proposes re-wording without the 80 percent reduction of TSS provision.	Revised as suggested.
NPS-6	182	Favors BMP approach to post-construction erosion control for TSS reductions, without requiring monitoring. Points out that 6217 does not apply anyway to municipalities under NPDES stormwater permits(City of Houston, Pasadena, Harris County). Proposes re-wording without the 80 percent reduction of TSS provision.	See above.
NPS-6	182	Recommends all references to Section 6217 (Coastal Zone NPS guidelines) be removed and replace with a more specific plan such as that of the Joint Task Force. Concerned about the costs of 6217 (e.g. within the municipal utility districts using public financing).	Revised to reflect use of 6217 guidance as a technical reference only.
NPS-6,7,13	183 183 189	Recommends deletion of reference to 6217 Guidance, except as a technical reference. States that reference to construction activities should be revised as "construction activities disturbing 5 or more acres or those projects which are part of a master planned development."	Revised as suggested.
NPS-7	183	Encourages program to work closely with TXDOT to be sure roadway runoff is not channeled directly to bayou or bay waters.	The Management Conference concurs and has now included TXDOT in several initiatives.
NPS-7	183	(VERBAL) Would like the Program to work with the Department of Transportation on current and future roadway plans.	See above.
NPS-7	183	Urges requirement of NPS control on all roads now; states that this is not difficult or expensive.	The Management Conference appreciates concern related to this issue and agrees on the need for improved management of roadway runoff. Some controls for polluted runoff from roadways are quite expensive.
NPS-9	185	States that the word "known" should be inserted before the word "Groundwater" in the title to better reflect the intent of this action.	Revised as suggested.
NPS-9	185	States that the program should consider incorporating information from the <i>State of the Bay</i> report (e.g. page 132) to show why this groundwater plume action does not address nutrients, bacteria, or other such issues typically addressed in some other estuaries.	Information has now been included in the introductory section describing environmental status.
NPS-10	186	States that the source of funding for the projected expenditures attributed to the State Soil and Water Conservation Board is unclear.	In spite of high level of agency involvement in creation of The Plan, partner agencies do not have the ability to commit their budgets over the planning period being considered. This fact is now recognized in the Executive Summary. Many agencies are utilizing <i>The Plan</i> as a means to increase budgets for programs related to Galveston Bay.
NPS-11	187	(VERBAL) States that agricultural non-point source pollution is ranked too high in the priority list.	The Management Conference has previously revised the priority of this issue downward. Currently, <i>The Plan</i> calls for utilization of existing and future voluntary programs of the State Soil and Water Conservation Board as lead entity to address this issue.
NPS-11	187	(VERBAL) States that agricultural runoff is not a pollution problem.	See above.
NPS-11	187	(VERBAL) States that agricultural runoff should not be considered a "moderate" source of pollution.	See above.
NPS-11	187	States that <i>The Plan</i> should seek to reduce agricultural chemicals in runoff, utilizing an education program coordinated with chemical supply stores, garden shops, churches, schools, and flower/botanical groups.	The Management Conference appreciates this suggestion and will coordinate with the implementing entities for this action to consider this approach.

NPS-12	188	States that all the controls for construction practices should be mandatory and not voluntary.	The Management Conference anticipates increasing federal mandatory requirements in this area, and seeks to coordinate with federal and local programs rather than create new mandates at the regional level.
NPS-12	188	States that <i>The Plan</i> should disengage proposals from reliance on Texas Coastal Management Plan for NPS control; rather urge granting of county land-use control authority by Texas Legislature.	Revisions have been made to significantly reduce the reliance on the Texas Coastal Management Plan for authority for implementation of non-point actions. <i>The Plan</i> does recommend increased authority for counties.
NPS-12	188	States that the Coastal Coordination Council has no intention of broadening scope of CMP from its currently proposed rules; recommends deletion of Step 2 from this action.	Revised; Step 2 no longer calls for rule-making by the CCC.
NPS-12	188	States that Step 1 implies that implementation of NPS control measures is voluntary; recommends that EPA regulations for construction sites greater than 5 acres be noted. States that <i>The Plan</i> should utilize the Joint Task Force Handbook.	Revised as suggested.
NPS-12	188	States that Step 1 implies that implementation of NPS control measures is voluntary; recommends that EPA regulations for construction sites greater than 5 acres be noted.	See above.
NPS-13	189	States that the Coastal Coordination Council has no intention of broadening scope of CMP from its currently proposed rules; recommends deletion of Step 1 from this action and add local governments to "Who."	Revised; Step 1 no longer calls for rule-making by the CCC.
NPS-14	190	States that requiring pumpouts for all new marinas and retrofitting of all existing marinas with more than 10 slips is excessive, and that the minimum size should be increased to 25 slips, with retrofitting of smaller facilities (10-25 slips) required only if facility expands.	The Management Conference considered this suggestion but favors the widespread availability of pumpouts to boaters, as an alternative to direct discharges to waters of the bay.
NPS-14	190	Recommends revision of the marina pumpout schedule to make use of Clean Vessel Act funding available before the currently planned installation schedule.	The Management Conference supports the current initiatives noted for marina pumpouts, and intends that the published schedule in no way limit early initiatives, for any action.
NPS-14,15	190-191	Recommends <i>The Plan</i> reduce commercial/recreational boat waste discharges.	Actions to address this issue are contained in <i>The Plan</i> .
NPS-14,15	190-191	(VERBAL) How does the plan address the dumping of human waste into the bay system?	Actions NPS-14 and 15 detail the approach.
NPS-14,15	190-191	(VERBAL) States that marinas are educating their people about pumping out their holding tanks	The Management Conference appreciates the efforts of marina operators to address this issue.
NPS-16	192	(VERBAL) how does the Plan address educating marina operators about toxic runoff from boat maintenance operations?	This action will be coordinated with Step 2 of NPS-14.
NPS-16	192	Recommends the program explore different, non-toxic hull coatings for boats.	Hull coatings are effective only because they are toxic to marine fouling organisms. The Management Conference has directed its effort to ensure that coatings do not become introduced into the general environment, particularly as a result of maintenance activities.

POINT SOURCES OF POLLUTION

Action	Page	Summary of Comment	Summary of Response
		Recommends requiring greater compliance for sewage treatment plants, to a tertiary level.	The Management Conference, while appreciative of the need to continue point source regulatory programs, has emphasized more cost-effective means of pollutant reductions.

		States that text gives impression that point sources are no longer a major influence on water/sediment quality; this conflicts with matrix in Appendix A.	Water quality studies indicate that for some parameters, point source loadings are greater than non-point sources, but in general, non-point sources are emphasized in the plan because runoff is not treated nor yet adequately regulated, while point sources have well established regulatory programs which have greatly improved the quality of discharges. Specific information is presented in the program's publication: <i>The State of the Bay, A Characterization of the Galveston Bay Ecosystem</i> .
		Recommends elimination of mixing-zone exemptions in public receiving waters, which result in long-term build-up of highly contaminated sediments around the outfall.	Discharge zones of initial dilution are governed by state-wide regulations of the TNRCC, which are designed to be protective of surface waters in relation to water quality standards. An exception is oil and gas production-related discharges regulated by the Railroad Commission. Produced waters fall in this category and are addressed in <i>The Plan</i> partly for reasons cited.
		(VERBAL) Suggests that constructed wetlands be used for wastewater treatment.	This is a technique applicable to both point and non-point management, and would be supported by the Management Conference for consideration under a number of actions in <i>The Plan</i> .
		Recommends that local heavy industries have zero discharge in 10-15 years, cities somewhat longer.	No revisions made based on this comment.
Intro	200	Recommends the program change goal from "eliminate" wet weather bypasses and overflows to "control" them.	The Management Conference appreciates the fact that "eliminate" conveys an absolute meaning, however this wording appears in a goal statement only, and is consistent with other goals stated in the plan, which are intended to provide an ideal target, against which future progress can be measured.
PS-6	208	States that any discharge can cause harm, however slight; rather than "eliminate harm" from produced waters, use "substantially reduce or eliminate significant harm."	Revisions were made to clarify this action.
PS-6	208	(VERBAL) How many thousands of barrels a day of salt water produced from oil production are going into the bay?	Permitted volume in 1991 was 15.2 million gallons per day, however the actual discharge is less than that amount due to voluntary elimination of discharges, and discharges which do not discharge the full amount allowed.
PS-6	208	States that EPA intends to issue the NPDES Coastal General Permit for produced water discharges (schedule for June, 1994 was not met).	The Management Conference supports this action.

RESEARCH

Action	Page	Summary of Comment	Summary of Response
		Recommends inclusion of a statement to indicate research costs are included in the other action plans, and that universities and other research entities (while not agencies) also play role in research to support the Plan.	Revisions were made to reflect roles of universities and other research entities. Research needs were identified in the other action plans (summarized in Appendix E). Funding is to be sought through existing research funding programs, while the costs of <i>The Plan's</i> research initiative is to be funded throughout the Galveston Bay Program.
RSC-1	216	Recommends inclusion of the State Soil and Water Conservation Board on the Research Coordination Board.	This will be an action of the Galveston Bay Council, however the Management Conference advises inclusion of the SWCB.
RSC-1	216	States that the research board should have public and environmental group representation.	The proposed research board is to be a committee of technical experts appointed under the authority of the Galveston Bay Council. The board could have representatives from the groups suggested if they are qualified scientists.

RSC-1	216	Recommends revision of Step 2 so first priority of Research Coordinating Board is to rank research needs already identified.	Revised as suggested.
RSC-2	217	Recommends <i>The Plan</i> state how research will be reviewed and will provide feedback to management.	Action RSC-3 addresses this issue; the goal is dissemination of findings to the public and bay managers at regular intervals.
RSC-2	217	States that all three steps should begin in 1996 rather than 1997.	Revised as suggested.
RSC-3	218	States that <i>The Plan</i> should emphasize the importance of the State of the Bay process, which should be conducted biennially and involve public.	This is the intent of action RSC-3.

PUBLIC PARTICIPATION AND EDUCATION

Action	Page	Summary of Comment	Summary of Response
		Emphasizes the importance of citizen involvement in the programs being proposed, with a strong role in implementation.	The Management Conference concurs, and intends a continuation of the high level of stakeholder involvement, under the auspices of the Galveston Bay Council.
		(VERBAL) How much citizen involvement will there be during Plan implementation?	See above.
		(VERBAL) Commented that information about Galveston Bay is now on the Internet, urges continued use of this medium for outreach and education.	The Management Conference concurs. Currently, several key publications are being placed on Internet.
		States that <i>The Plan</i> should recommend teams of volunteers to monitor industrial and other point sources.	The Management Conference supports expansion of citizen's monitoring efforts to augment the information available about the bay. The Management Conference does not take a position on whether this should include point source monitoring.
PPE-1	227	States that <i>The Plan</i> implies that only urban citizens will be involved; rural involvement is essential.	Revised to clarify the need for public involvement of people from diverse geographic, socioeconomic, and racial backgrounds.
PPE-1	227	Urges adequate public participation in the development and implementation of any new regulatory programs to implement the CCMP, to ensure the success of the Special Area Management Plan adoption under CZMA requirements.	The Management Conference, in its PPE-1 action, intends for strong public participation to occur. Special Area Management Plan adoption, if it occurs, will happen after <i>The Plan</i> is federally approved, and is not a decision of the Management Conference.
PPE-1	227	Recommends evaluation of public involvement periodically, for example every 5 years.	<i>The Plan</i> currently supports this suggestion, in its recommendation to evaluate and redirect <i>The Plan</i> (if necessary) every five years.
PPE-1	227	Recommends insertion of a new step to "Hire a full-time public participation director to direct the public participation effort." Re-evaluate costs to eliminate any double-counting.	Revised as suggested.
PPE-3	229	States that there is a need for more than one public information officer; need a whole team; why is public involvement and education always poor-boyed to death?	While the Management Committee recommends only one public information officer, that officer will supervise a staff (dependent on full funding of <i>The Plan</i>).
PPE-3	229	(VERBAL) States that there needs to be some sort of publicity addressed.	The Management Conference concurs, and addresses the issue in this action.
PPE-3	229	States that the press should somehow be convinced that bay is newsworthy and vital to Houston; recommends regular (at least weekly) columns to inform public of important monitoring details such as which areas are safe or unsafe for seafood harvest.	The Management Conference supports public information/education efforts of the sort suggested, including periodic publication of a "bay barometer" to succinctly communicate the state of the bay to citizens, and periodic seafood safety advisories (see action PH-1).
PPE-3	229	Recommends insertion of a new step to "Hire a full-time public information officer (PIO) reporting to the Public Participation Director."	Revised as suggested (dependent upon Plan funding).

Recommends development of quality assurance plans to document changes in the bay to verify that planned efforts achieve stated goals.	This has been accomplished in the revised strategy.
Recommends that <i>The Plan</i> specifically reference the Monitoring Strategy produced by the program.	Revised as suggested.
Recommends revised description of Regional Monitoring Program Steering Committee. States that current text suggests Committee would be an independent body from the Galveston Bay Program, with a separate budget and full-time staff. States that the Committee should be a policy/technical advisory arm of the Galveston Bay Program, with budget and staff support as part of the Program.	Revised as suggested.
States that monitoring is weakest part of plan. Proposes the current multi-agency fragmented system be replaced by use of one or a few specialized professional monitoring teams, combined with citizen monitoring. Recommends use of a comprehensive strategy with buy-in from all the stakeholders, with goals of database generation and emergency response to natural and man-made disasters	The strategy was revised to reflect implementation of a unified regional monitoring program with participation by the entities which carry on monitoring activities in the bay. Sampling locations, types of parameters measured, sampling frequencies, quality assurance and control, and other strategy elements have been designed to produce a unified data set appropriate to understanding the state of the bay and the results of Plan implementation.
(VERBAL) States that monitoring is the weakest section of <i>The Plan</i> , recommends using a few specialized professional monitoring teams as well as citizen's monitoring.	See above.
States that the Data and Information Strategy is too restrictive on making information available. Recommends access to data should be improved by posting it on a bulletin board system.	The Management Conference intends that monitoring data and information be freely available, including potential computer availability.
(VERBAL) States that the Data/Information Management Proposal in the Plan is too restrictive.	See above.

THE PUBLIC ROLE IN DRAFTING *THE GALVESTON BAY PLAN*

Summary of Comment	Summary of Response
(VERBAL) States the process by which this plan has been developed is something that is different than what has been going on in the past.	The Management Conference concurs. The degree of stakeholder involvement in development of <i>The Plan</i> has been excellent.
(VERBAL) States that <i>The Plan</i> has had a lot of public input.	See above.
States that radio advertising for public meetings presented a "doomsday" message, was misleading, did not reflect the facts revealed by the program, and can destroy the fragile trust it has taken so long to build.	These radio spots were canceled. The Management Conference supports use of objective information about the bay, to support well-reasoned management decisions by the bay community.
(VERBAL) States opposition to the radio advertisement campaign.	See above.
(VERBAL) States that Trinity Bay Soil and Water Conservation District was ignored in <i>The Plan</i> development process.	The Trinity Bay Soil and Water Conservation District was represented on the Local Government Advisory Committee by its Chairman. Soil and water conservation districts will also be represented during implementation of <i>The Plan</i> by inclusion of the Texas State Soil and Water Conservation Board (a board of soil and water conservation districts) on the Galveston Bay Council.
Recommends that <i>The Plan</i> include a list of public meeting notifications and a summary of the responses to public comments.	Revised as suggested.

APPENDICES

Summary of Comment	Summary of Response
Recommends addition of an appendix listing Management Conference Membership/Affiliations.	Revised as suggested.

States that agricultural non-point source is ranked too high in the priority problems list.

The Management Conference previously reduced the priority category of the goal: "reduce agricultural NPS pollutant loads" from "high" to "moderate" in Appendix A. *The Plan* has been further revised to include an explicit ranking of individual actions proposed in *The Plan* (Appendix F) based upon Management Conference consensus.

LIST OF COMMENTORS

Pete Alfero (Mayor, Baytown) (VERBAL)
Association of Consulting Municipal Engineers, Houston Chapter
Leroy Azer (VERBAL)

Father Kevin Badeaux (VERBAL)
Rosie Barrera (Port of Houston Authority) (VERBAL)
Bob Bass (VERBAL)
Don Bass (Galveston Bay Foundation) (VERBAL)
Don Bass (GBNEP Citizen's Advisory Steering Committee) (VERBAL)
Bob Bond (VERBAL)
Peter Bowman (VERBAL)
Ronnie Broaddus (Commissioner, Brazoria County Precinct One)
Ronnie Broaddus (Commissioner, Brazoria County Precinct One)
(VERBAL)
Harry Brown
Harry Brown (VERBAL)
Mary Brown (VERBAL)

Glenda Callaway (Galveston Bay Foundation) (VERBAL)
Don Carroll (City Planner, City of Texas City) (VERBAL)
Jack Chandler (VERBAL)
City of Texas City
City of Dickinson
City of LaMarque
City of Liberty
City of Houston (Mayor's Advisory Committee on Environment)
City of Houston (Public Works and Engineering Department)
Robert Cole (Lazy Bend Community Association) (VERBAL)
George Colles (VERBAL)

Robert Dawson (VERBAL)
Mary Decker (VERBAL)
Louis Decker (City of Dickinson) (VERBAL)
Charles Doyle (Mayor, Texas City)
Barbara Duryea
Barbara Duryea (VERBAL)

East Harris County Manufacturer's Association
Billy Edwards (Trinity Soil Conservation Board) (VERBAL)

Sally Fish (Galveston Bay Foundation) (VERBAL)
Steve Fitzgerald (VERBAL)
Phil Flake
Robin Fontenot (VERBAL)
George Freda (VERBAL)
Hans R. Friedli (VERBAL)
Friendswood Development Company

Galveston Bay Foundation
Galveston County Health Department
Mary Gillette (League of Women Voters) (VERBAL)

Mary Gillette (Galveston Bay Foundation) (VERBAL)
Greater Houston Partnership
Walter G (?). (VERBAL)

Dianna Harmon (VERBAL)
Charles Herbeck (Galveston Bay Foundation)
Charles Herbeck (Galveston Bay Foundation) (VERBAL)
Houston Audubon Society
Houston-Galveston Area Council
Houston Lighting and Power
Eric Halverson (VERBAL)

Guy Jackson
Guy Jackson (VERBAL)
Jess Jackson (Trinity Bay Soil & Water Conservation District)
Jess Jackson (Trinity Bay Soil & Water Conservation District)
(VERBAL)
Jesse H. Jones Park and Nature Center
Dennis Johnson,
Robin Jones
Robin Jones (VERBAL)

Louis Kelly
Louis Kelly (VERBAL)
Marvin Krueger (VERBAL)

Bob Lanier, Mayor of Houston
League of Women Voters of Houston
Jim Lester
Jim Lester (VERBAL)

Brandt Mannchen
Ralph Marquez (City of Texas City)
Ralph Marquez (City of Texas City) (VERBAL)
David Marrack
Stephen McNair (VERBAL)
Will G. McNiel
Gerhart Meinecke
Gerhart Meinecke (VERBAL)
Bobby Miles (VERBAL)
Mitchell Energy and Development Corporation
P. J. Mock
P. J. Mock (VERBAL)

Barbara Neal (VERBAL)
Doris Nelson (Galveston Bay Foundation) (VERBAL)
Jim Neville
Jim Neville (VERBAL)
Fred Newton (VERBAL)

Dr. Frank Parker

Dr. Frank Parker (VERBAL)
Sandy Pickett (Councilwoman, City of Liberty) (VERBAL)
Neal Platzer (Galveston Bay Foundation) (VERBAL)
Carl Poldrack
Carl Poldrack (VERBAL)
Port of Houston Authority

Catherine Yeargan
Bill Yenne (City Manager, Lake Jackson)
Bill Yenne (City Manager, Lake Jackson) (VERBAL)

James C. Reitmeyer, Dr. P.H.
James C. Reitmeyer, Dr. P.H. (VERBAL)
Elton Robbins
Ellyn Roof (Galveston Bay Conservation and Preservation
Association) (VERBAL)
Carl Routh
Carl Routh (VERBAL)

Sandra Seale (VERBAL)
Robert Sellers (VERBAL)
Frank Simpson (City of LaMarque) (VERBAL)
Dave Smith (VERBAL)
Sharron Stewart (Galveston Bay Foundation) (VERBAL)
Storm Water Management Joint Task Force
Johnnie Strimple
Johnnie Strimple (VERBAL)

Phyllis Taylor (Clear Lake Marina Operators Association) (VERBAL)
Texas Chemical Council
Texas General Land Office
Texas Historical Commission
Texas Railroad Commission
Texas Sea Grant College Program
Texas State Soil and Water Conservation Board
Lial F. Tischler
David A. Todd
Ed P. Trudell
Ed P. Trudell (VERBAL)
John Tunks (Galveston Bay Foundation) (VERBAL)

U. S. EPA Region 6
U. S. EPA, Office of Wetlands, Oceans, and Watersheds
U. S. EPA, Office of Wetlands, Oceans, and Watersheds, Ocean
Dumping Section
U. S. EPA, Office of Wetlands, Oceans, and Watersheds, Permits
Division
U. S. Department of Commerce, National Oceanic and Atmospheric
Administration, National Marine Fisheries Service
U. S. Department of Commerce, National Oceanic and Atmospheric
Administration, Office of Ocean and Coastal Mangement

Shiela Wheeler (Harris County Pollution Control) (VERBAL)
Dick White (VERBAL)
Melanie Wiggins
Melanie Wiggins (VERBAL)
Floyd Wilcox (Trinity Bay Conservation District) (VERBAL)
Floyd Williams (VERBAL)
Page Williams (Houston Audubon Society) (VERBAL)
John Wilson (VERBAL)
Peter H. Wilson
Peter H. Wilson (VERBAL)
Jerry Wooster (Saltwater Anglers of Texas)
Jerry Wooster (Saltwater Anglers of Texas) (VERBAL)