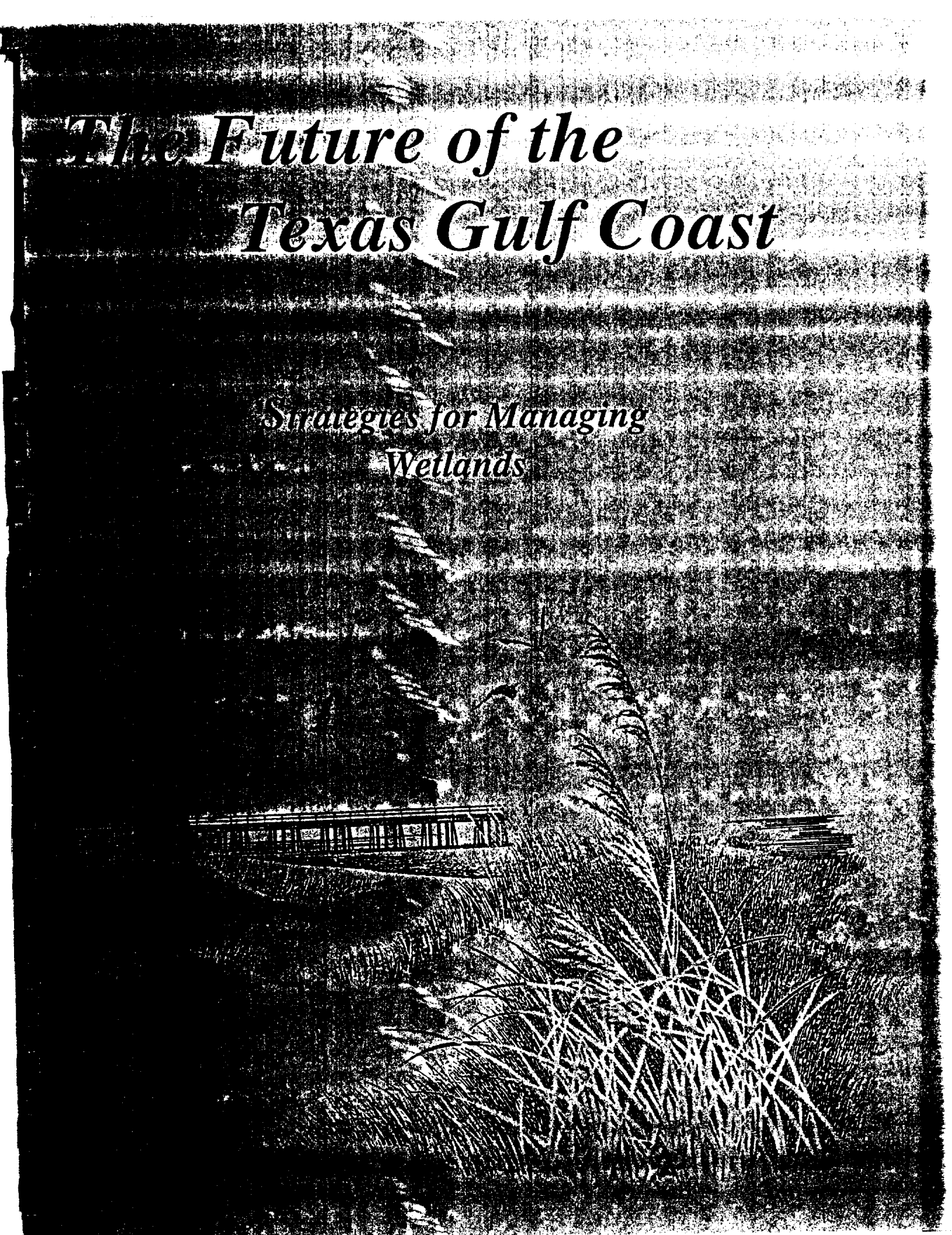
The Future of the Texas Gulf Coast

Strategies for Managing Wetlands



The Future of the Texas Gulf Coast

Strategies for Managing Wetlands

A Report Prepared for the
Texas General Land Office

by

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PREFACE

In 1989, the 71st Texas Legislature enacted Senate Bill 1571. This bill amended the Texas Natural Resource Code and appointed the Texas General Land Office (GLO) as the lead agency in developing a comprehensive plan for the state's coastal public lands. In response to SB 1571, the GLO appointed a citizens advisory committee, and state and federal agency task forces, to aid in formulating the plan.

Five public meetings were held on the Texas coast. These meetings pinpointed shoreline erosion/dune protection, wetlands, and beach access as the issues of greatest concern to the coastal community.

In the summer of 1990, the GLO employed the Office for Strategic Studies in Resource Policy at Texas A&M University to help develop a Texas coastal management plan. The Office used the Alternative Futures Assessment (AFA) Process, a computer assisted workshop procedure, as a means to incorporate the concerns of the coastal community into the plan. The ultimate goal -- to build a consensus on strategies that will resolve the top three issues affecting the Texas Gulf Coast.

An ideal strategy balances the needs of affected interests and inspires their active support. The strategy should also include practical courses of action to achieve the primary goal as well as actions to anticipate and mitigate unwanted side effects. The workshop participants strived to develop a strategy that comes close to the ideal.

This report documents the work of the participants in the AFA Process who contributed their time and effort to assist in resolving the wetlands issue. Their effort succeeded in producing a consensus on a general strategy to resolve the issue for the Texas Gulf Coast.

Companion reports for the shoreline erosion/dune protection issue and the beach access issue were also completed. This set of reports show that the these two issues, and the wetlands issue, are interrelated. Therefore, strategies to resolve the wetlands issue will require coordination with strategies adopted to resolve the other issues.

Funding for this project was provided by an interagency contract between the Texas General Land Office and the Texas Water Development Board. Matching support was made by the Office for Strategic Studies in Resource Policy at Texas A&M University. We would like to thank all of our participants for their time and cooperation on this project. We hope that this report will aid in improving the future of the Texas Gulf Coast.

CONTENTS

	Page
LIST OF FIGURES	v
LIST OF TABLES	vi
EXECUTIVE SUMMARY	1
INTRODUCTION	5
The AFA Process	5
The Software	5
The Workshops	7
Foundation Workshops	7
Strategy Workshop	7
Capstone Workshop	9
INTERESTS AND CONCERNS	12
Stakeholder Groups	12
Key Variables	12
TRENDS AND INTERACTIONS	19
Long-Term Trends	19
Interactions	19
Linking Trends and Interactions	22
POLICIES AND PRIORITIES	24
Defining the Issue	24
Stakeholder Objectives	24
Recommended Policy	27
Primary Policy	27
Mitigation Policies	27
Final Recommendation	28
Satisfaction of Objectives	31
Recommended Actions	34
Increase Appropriations for Wetlands	34
Increase Public Education	34
Increase Interagency Coordination	35
Increase Wetland Enhancement	35
Reduce Wetland Degradation	36
Reduce Boat Traffic Through Wetlands	36
Reduce Non-Point Source Pollution	37
Research Priorities	37

	Page
APPENDIX A: Stakeholder Objectives	41
APPENDIX B: Simulated Trends	45
APPENDIX C: Region I Foundation Workshop	51
APPENDIX D: Region II Foundation Workshop	57
APPENDIX E: Region III Foundation Workshop	63

LIST OF FIGURES

		Page
Figure 1.	Flowchart of the Alternative Futures Assessment (AFA) Process.	6
Figure 2.	Pyramid structure of workshops used to apply the AFA Process to the Texas Gulf Coast.	8
Figure 3.	Bar chart showing the expected change in variables under the current policy.	20
Figure 4.	Cross-impact matrix showing interactions among variables.	21
Figure 5.	Bar chart used to validate the computer model.	23
Figure 6.	Bar chart comparing the potential effects of the current and recommended policies.	30

LIST OF TABLES

		Page
Table 1.	Names of stakeholder groups and representatives in each group.	13
Table 2.	Key variables and estimated future trends.	15
Table 3.	Top priority (peremptory) variable identified by each stakeholder group.	17
Table 4.	Variables shared among two or more of the top three Texas Gulf Coast issues.	18
Table 5.	Definitions of objectives.	25
Table 6.	Summary of stakeholder objectives.	26
Table 7.	Change specified for each variable in the recommended policy.	29
Table 8.	Satisfaction levels for the recommended policy.	32
Table 9.	Comparison of satisfaction levels for the current and recommended policies.	33
Table 10.	Recommended list of priorities for future research.	39

EXECUTIVE SUMMARY

Introduction

The AFA Process

- The Alternative Futures Assessment (AFA) Process was used by the Office for Strategic Studies in Resource Policy at Texas A&M University to address the wetlands issue.

- The AFA Process is a computer-aided approach for bringing concerned parties together in a workshop setting to formulate strategies to resolve complex issues.

The Workshops

- A series of five workshops were conducted in the AFA Process for this issue. The first three were regional Foundation Workshops. A Strategy Workshop came next followed by a Capstone Workshop.

- The Capstone Workshop produced a consensus among participants on a recommended policy and courses of action to resolve the wetlands issue for the Texas Gulf Coast.

Interest and Concerns

Stakeholder Groups

- People who share a common interest are categorized as a stakeholder group. The interests and concerns of these groups are the driving force in the AFA Process.

- The Texas General Land Office defined 15 stakeholder groups and selected participants to represent the groups.

Key Variables

- The interests and concerns of participants were defined by variables. A variable is the name or description of something that changes, such as the area of wetlands.

- The participants selected 30 key variables, with units of measure, to represent the wetlands issue for the Texas Gulf Coast.

- Each stakeholder group had the right to select one variable that best defined their principal interest or concern. This variable is called peremptory because it must be included on the final list.

- There is significant overlap among the key variables for the top three Texas Gulf Coast issues. Therefore, strategies to resolve the wetlands issue will require coordination with strategies adopted to address the other issues.

Trends and Interactions

Long-Term Trends

- Participants estimated the trends in key variables that might occur over the next twenty years under current policies. Most of the variables were expected to increase, including the area of wetland created per year and the area of wetland lost per year. A number of variables were expected to decrease, including biodiversity, annual commercial fisheries harvest, freshwater inflows, freshwater inflow timing, and nursery areas.

- The affects of outside forces were also considered. For instance, the participants decided that 90 percent of freshwater inflows, freshwater inflow timing, oil and gas development, and subsidence, and 60 percent of the annual commercial fisheries harvest, cannot be controlled by the recommended policy.

Interactions

- The participants defined how the 30 key variables interact with one another. This was accomplished using a cross-impact matrix.

Linking Trends and Interactions

- The trends and interactions were linked using artificial intelligence techniques to form a working computer model of the issue. The model formalized the participant's mutual understanding of the issue.

  The participants used the computer model to compare the possible consequences of new policies with the probable consequences of continuing the old policies.

Policies and Priorities

Defining the Issue

- For the purpose of this study, the participants defined a wetland as state owned land that includes vegetated bay bottom and intertidal flats extending up to mean high tide.

- The participants selected the area of wetland lost per year as the variable that best defined the wetlands issue. The rate of wetland loss is expected to increase over the next twenty years.

Stakeholder Objectives

- An objective represents how a stakeholder group would like to see a variable change from the way it is today. For this issue, the time limit for reaching an objective was set at twenty years.

- There were eight objectives from which to choose. A stakeholder group specified an objective for each of the 30 key variables.

- The specified objectives revealed that the stakeholder groups share similar views on a desired future for the Texas Gulf Coast. However, there was a notable difference in objectives for the oil and gas development variable. The Don't Care objective was selected for this variable by 5 stakeholder groups, but 6 groups had a preference for an increase in oil and gas development and 3 groups had a preference for a decrease.

Recommended Policy

- The primary policy selected by participants involved increasing federal and state appropriations for wetlands, reducing wetlands degradation, increasing the area of wetlands enhanced, increasing public education about the wetlands issue, and increasing interagency coordination.

- The results of simulations showed that the primary policy is likely to reverse the upward trend in the loss of wetlands and reduce the rate of loss substantially below current levels. The rate of wildlife habitat loss would also be reduced.

- The participants felt that some of the side effects produced by simulating the primary policy were undesirable. To mitigate these unwanted side effects, the participants recommended reducing boat traffic through wetlands and reducing non-point source pollution.

- The recommended policy consists of the original changes in five target variables in the primary policy plus the changes in the two mitigation variables (boat traffic through wetlands and non-point source pollution) that were added to reduce unwanted side effects.

- The results of simulations showed that the recommended policy is likely to reduce the loss of wetlands and wildlife habitat. It could also reduce toxic substances and endangered species. The expected decline in biodiversity is also likely to reverse and improve slightly.

- The overall or total satisfaction of objectives is high for the recommended policy. The lowest level of satisfaction for a stakeholder group is 84 percent.

- Levels of dissatisfaction for the recommended policy are relatively low. The highest remaining dissatisfaction is for the Business/Landowners group, the Oil and Gas Pipeline group, and Senator Brown. The variable of concern to all three stakeholders is oil and gas wells developed in wetlands. These groups wanted oil and gas development to increase to the maximum, but the recommended policy had the effect of reducing development slightly below current levels. Nevertheless, the three groups are still 88, 90, and 94 percent satisfied, respectively, with the recommended policy.

- The recommended policy is superior to the current policy for three measures of success. For example, the recommended policy produces the lowest level of dissatisfaction for all groups and for any one group. It also provides the most benefits to all groups.

Recommended Actions

- The participants specified actions needed to bring about the recommended change in variables. They specified who should be responsible for taking the action. They also estimated the cost and source of funds. The recommended actions represent a consensus of the participants.

- The total cost of addressing the wetlands issue was estimated at about $490 million over the next twenty years. The participants felt that these funds should come from both legislative appropriations and private sources.

Research Priorities

- The participants used the cross-impact matrix to decide which interactions between variables were the most important to study. The highest priority means that research funds should be directed toward the interaction because it is not well understood, and it has a strong affect on the issue.

- The highest research priority focused on improving understanding about the affect of construction in wetlands on wetland enhancement. The affect of wetland loss on wildlife habitat loss tied as the top research priority.

- The second research priority was improving understanding about the affect of non-point source pollution on the concentration of toxic substances in wetlands.

- Research on five other interactions between variables tied for third priority, and nine interactions between variables tied for fourth priority.

INTRODUCTION

The AFA Process

The Alternative Futures Assessment (AFA) Process is a computer-aided approach for bringing concerned parties together in a workshop setting to formulate strategies to resolve complex issues. The AFA Process has successfully addressed a variety of complex resource, environmental and business management issues.

The AFA Process helps participants to pool their knowledge and experience and develop a detailed mutual understanding of the issue under consideration. It also assists them in exploring the potential consequences of alternatives so that they can develop policies. Finally, the AFA Process provides them with an opportunity to recommend funding priorities for research.

The workshops used in the AFA Process are conducted by a facilitator, a technical assistant, and a recorder. The facilitator mediates discussions among participants and guides them through the AFA Process. The technical assistant operates the computer and distributes the results of each exercise. The recorder helps the technical assistant and takes notes on important points in the discussions.

The AFA Process involves identifying trends that define an issue and evaluating different courses of action to deal with those trends. The AFA Process encourages participants to share their knowledge and experience, and work together as a team to explore solutions. Teamwork is fostered by using the step-by-step procedure shown in Figure 1.

An unavoidable characteristic of the AFA Process is that the participants in a workshop will determine the outcome. In other words, given the same issue, different participants would probably arrive at somewhat different conclusions. This is also true in other group decisionmaking processes, including legislatures, courts, and scientific committees. The AFA Process helps to reduce bias by making assumptions explicit so that others can evaluate the results. The potential problem of bias can be further reduced by involving a broad spectrum of concerned parties.

The Software

The computer software used in the AFA Process is an expert cross-impact simulation language that shows how variables interact over time. It runs on an IBM compatible personal computer. The software includes artificial intelligence to aid participants in using their knowledge and experience to build a computer model that describes the issue. The model they build formalizes their understanding of the issue. The participants also can quickly and easily make changes in the model as they learn from one another during the workshop. Thus the participants use their model to evaluate courses of action they recommend for resolving the issue.

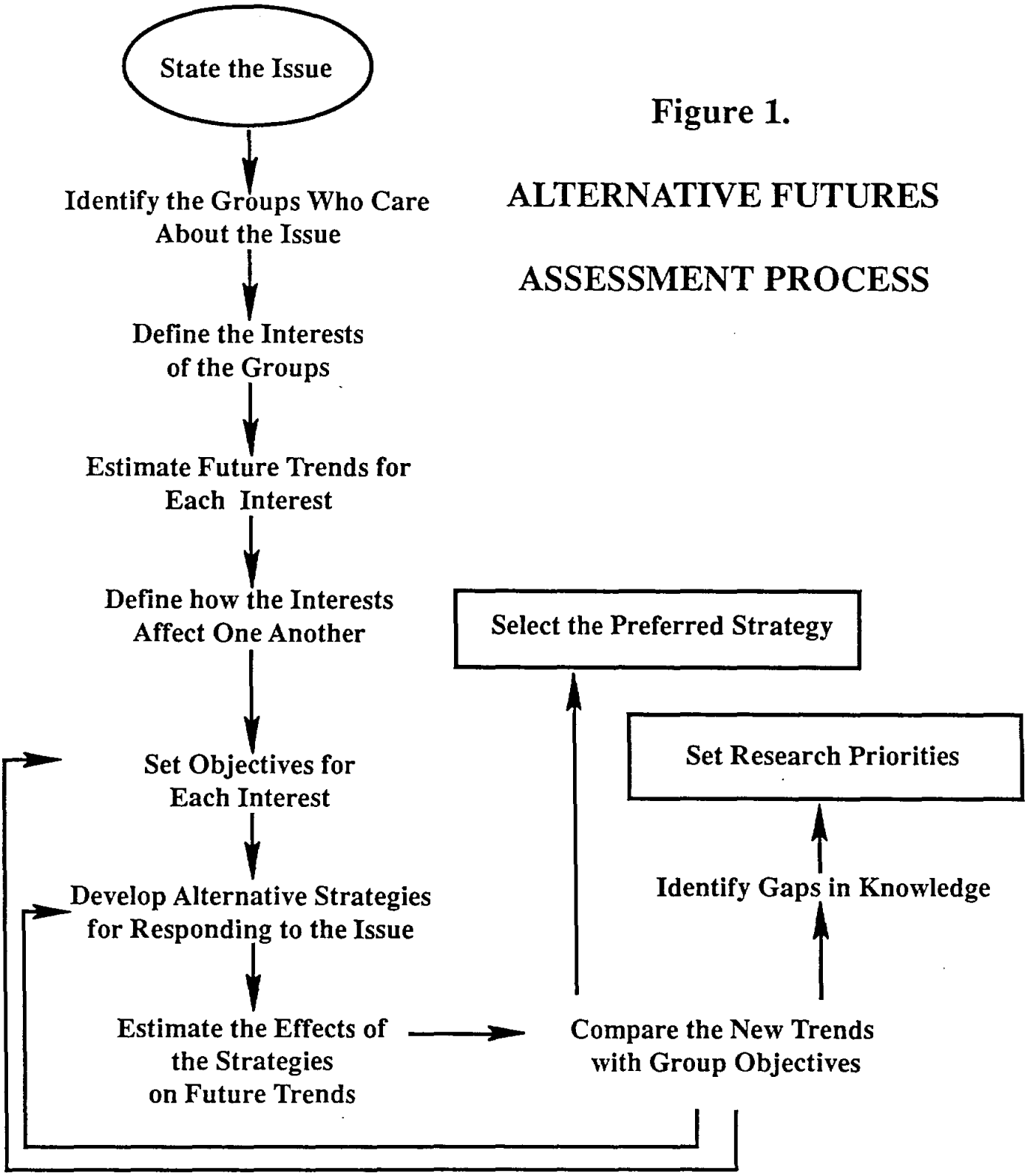


Figure 1.

ALTERNATIVE FUTURES ASSESSMENT PROCESS

The Workshops

A standard workshop takes 2 1/2 days and can be conducted in a location that is convenient for participants. A standard issue takes about 6 weeks to complete. The time required to complete the AFA Process, and the number and type of workshops, depends on the issue. The three issues addressed for the Texas Gulf Coast took 16 weeks to complete. Thus the AFA Process is a fast, portable, and cost-effective approach for building a consensus on strategies to resolve complex issues.

A series of five workshops were held to address the wetlands issue on the Texas Gulf Coast. The first three were Foundation Workshops. A Strategy Workshop came next followed by a Capstone Workshop. Like a pyramid, the AFA Process rested upon a broad base of information generated in the Foundation Workshops and became more focused in subsequent workshops (Figure 2).

Foundation Workshops

The purpose of the Foundation Workshops was to clarify how the issue affects a particular region of the coast. Recommendations to resolve the issue also were considered. Therefore, Foundation Workshops were conducted in three geographic regions: the lower, middle and upper coast. Workshops were conducted in Galveston on June 27, 1990, in Corpus Christi on July 11, 1990, and in Brownsville on July 17, 1990.

Each Foundation Workshop for the Texas Gulf Coast included up to 28 participants who represented a wide array of interests in a particular region. A few individuals representing statewide interests on the coast participated in more than one Foundation Workshop.

The Foundation Workshops were organized to gather as much information as possible from the participants in one day. The most important information provided by the participants was a ranked list of variables defining their interests and concerns. They also identified the top wetlands problems affecting their region and they recommended courses of action to resolve those problems (see Appendix C, Appendix D, and Appendix E).

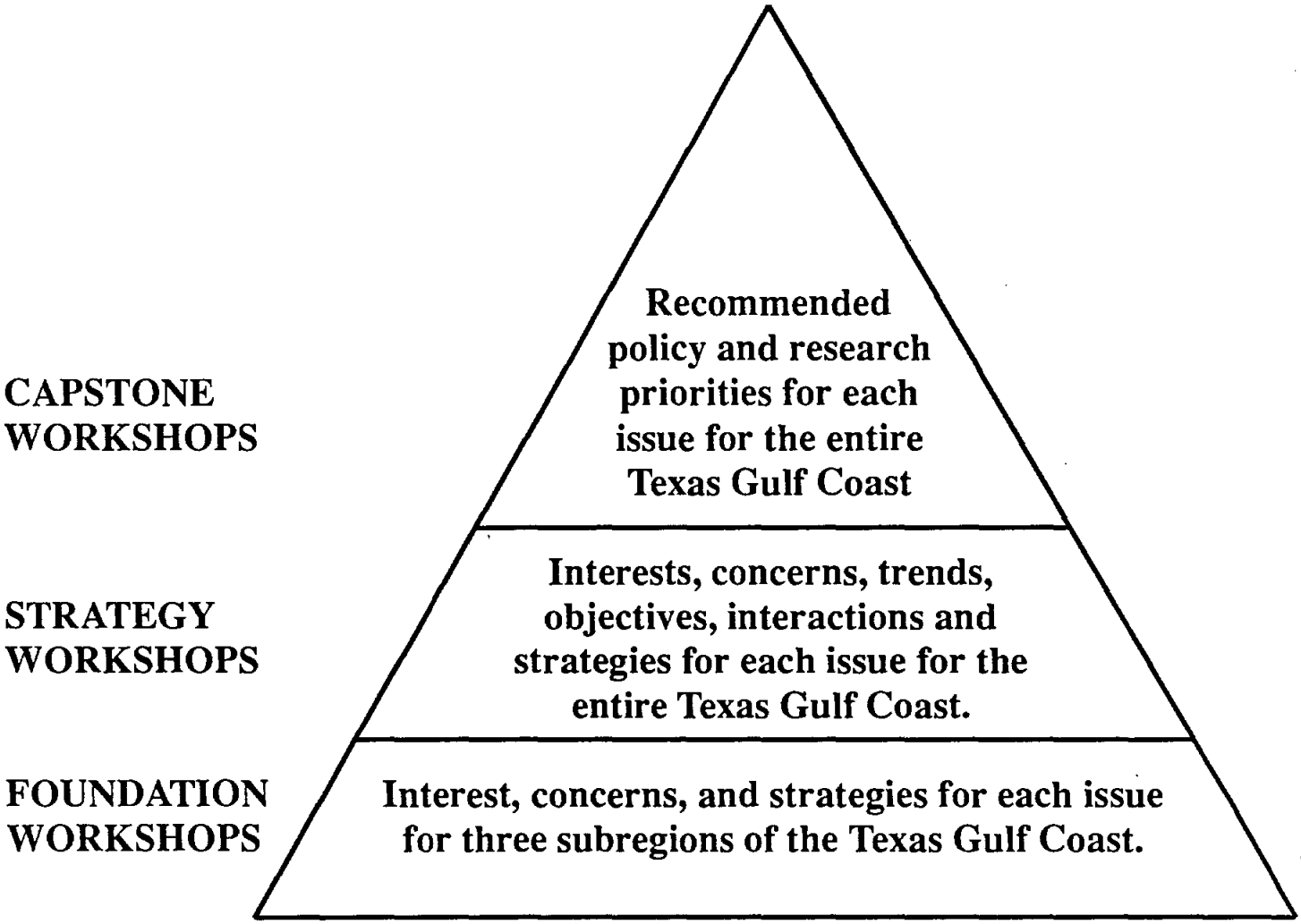
Strategy Workshop

The purpose of the Strategy Workshop was to build a computer model to evaluate the potential consequences of strategies to resolve the issue. Participants also specified their objectives and prepared a preliminary policy. The information and ideas generated in the Foundation Workshops served as the starting point.

The Strategy Workshop for the wetlands issue was held on August 7-8, 1990, in Clear Lake, Texas. Like the Foundation Workshops, the Strategy Workshop was structured to use time efficiently.

The Strategy Workshop participants were divided into 15 stakeholder groups. These groups represented the principal interests involved in the issue. Some participants in the Strategy Workshop also took part in the Foundation Workshops.

Figure 2.


CAPSTONE WORKSHOPS
Recommended policy and research priorities for each issue for the entire Texas Gulf Coast
STRATEGY WORKSHOPS
Interests, concerns, trends, objectives, interactions and strategies for each issue for the entire Texas Gulf Coast.
FOUNDATION WORKSHOPS
Interest, concerns, and strategies for each issue for three subregions of the Texas Gulf Coast.

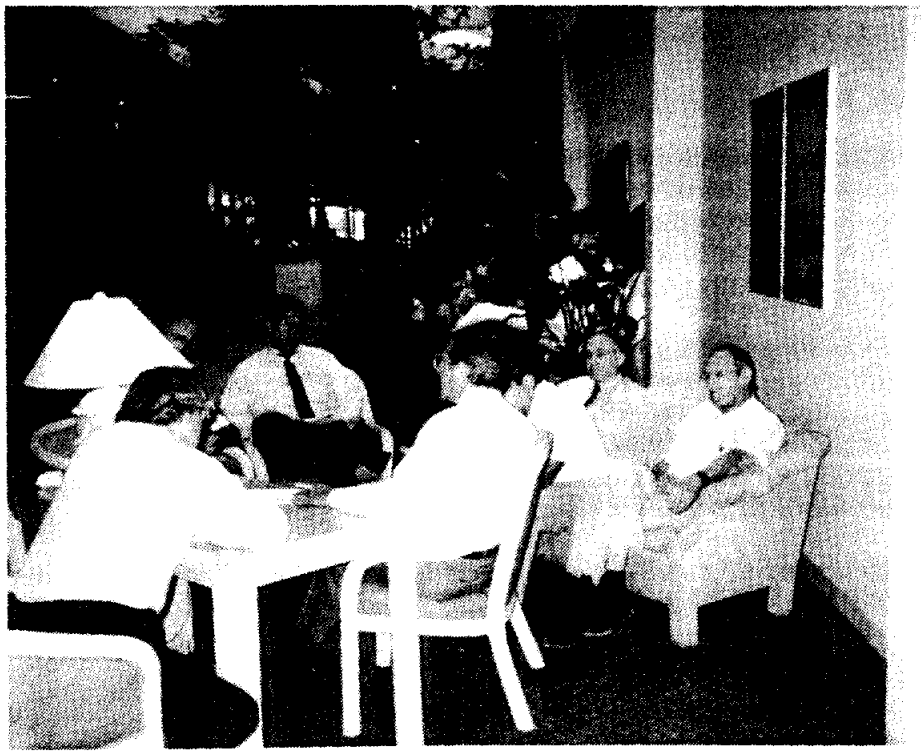
Capstone Workshop

The purpose of the Capstone Workshop was to build a consensus on a realistic strategy to resolve the wetlands issue for the Texas Gulf Coast. The workshop also involved identifying gaps in knowledge and recommending priorities for future research. The preliminary policy developed in the Strategy Workshop served as the starting point for the Capstone Workshop.

The Capstone Workshop for the wetlands issue was held in Clear Lake, Texas, on September 12, 1990. Most of the participants also took part in the Strategy Workshop for this issue. They were divided into the same 15 stakeholder groups in both workshops. ***The Capstone Workshop produced a consensus among participants on a recommended policy and courses of action to resolve the wetlands issue for the Texas Gulf Coast.***

WETLANDS CAPSTONE WORKSHOP

WETLANDS CAPSTONE WORKSHOP



INTERESTS AND CONCERNS

Stakeholder Groups

The first and most important step in the AFA Process is determining who cares about the issue and what they care about. People who share a common interest are categorized as a stakeholder group. In short, they have a direct stake in the outcome of decisions that address the issue. ***The interests and concerns of stakeholder groups are the driving force in the AFA Process.***

The computer software used in the AFA Process can accommodate up to 15 stakeholder groups. ***Since there were 47 participants involved in the workshop, those who shared similar interests formed coalitions.*** Each coalition represented a broad stakeholder group. Thus the members of the coalition had to agree on decisions for that stakeholder group. This approach fostered communication among participants who looked at their common interests from different perspectives.

The Texas General Land Office defined the stakeholder groups and selected participants to represent the groups. Table 1 shows the names of the 15 stakeholder groups involved in the Strategy and Capstone Workshops, and the participants that represented each group.

Key Variables

The interests and concerns of participants were defined by variables. A variable is the name or description of something that changes, such as sleep. To insure that everyone is discussing the same thing a variable must be defined with a unit of measure. For instance, sleep is ambiguous until it is assigned a unit of measure, such as nights of 8 hours sleep per year, or sleepless nights per year. Each unit of measure clarifies the meaning of sleep.

The participants selected 30 key variables, with units of measure, to represent the wetlands issue for the Texas Gulf Coast (Table 2). The name of the variable in the table is a seven character abbreviation. The number at the end of the abbreviation is a code that is used in the computer software. The other numbers in the table will be explained in the section on long-term trends.

The procedure for selecting variables began during the Foundation Workshops. A brainstorming session in each Foundation Workshop helped participants to nominate a large number of variables in a short time. This session yielded between 100 and 200 variables in one hour. The participants ranked the list to produce a short list of 30 variables that represented the issue in their region of the coast. The regional lists were combined and sent to the Strategy Workshop.

Participants in the Strategy Workshop clarified and expanded the list of variables they received from the three Foundation Workshops. The list again approached 100 variables. They used the same ranking procedure to reduce this list to the final list of 30 key variables that represented the issue for the entire Texas Gulf Coast (Table 2).

Table 1.

COASTAL MANAGEMENT PLAN

WETLANDS PARTICIPANTS

Stakeholder Group Name	Stakeholder Group Description	Representatives	Organization / Interest
Adv-Cons	Advisory/Consulting	Mike Hightower	Texas A&M Sea Grant
		Joe Moseley	Shiner, Moseley & Associates
		Tom Northrup	S. Frwy. Corridor Assn.
		Robert Jones	U.T. Marine Science Inst.
Bus-Land	Business/Landowners	Obie O'Brien	Mitchell Energy & Development
		Kerry Whelan	Houston Lighting and Power
		Rick Guiffre	S. Frwy. Corridor Assn.
PortDred	Ports/Dredging	Paul Carangelo	Port of Corpus Christi
		Richard Gorini	Port of Houston
		Steve Valerius	Hollywood Marine, Inc.
Conserv1	Conservation	Sharron Stewart	Tx Environmental Coalition
		Peter Bowman	University of Houston-Clear Lake
		Hermann Rudenberg	Sierra Club
Conserv2	Conservation	Mike Farmer	National Audubon Society
		John Eberling	Gulf Coast Rod & Reel Club
Com-Fish	Commercial Fishing	C. L. Standley	PISCES
		Mary Magee	Coastal Fishermen
Pipe-Oil	Oil & Gas/Pipeline	Lenny Chambers	MEPUS
		Bill Osborne	Enron
		Dana Larson	Enron
		Don Currens	Amoco
BoatMarn	Recreational Boating / Marinas	Larry Smith	BTAT/MAT
Loc-Govn	Local Government	Barbara K. Crews	Galveston Mayor
		John Cheesman	Galveston Bay Foundation
		John Damon	Brazoria County Judge
		Penny Sturdivant	Braz. Co. Floodplain Supv.
		Ray Holbrook	Galveston County Judge
		Bill Lauderbach	Galveston Chamber of Comm.
SenatorT	Senator Carlos Truan	Vick Hines	Senator Carlos Truan
SenatorA	Senator Kenneth Armbrister	Mario Munoz	Senator Kenneth Armbrister
SenatrBB	Senator J.E. Buster Brown	Joey Bennett	Senator J.E. Buster Brown

Table 1.

COASTAL MANAGEMENT PLAN

WETLANDS PARTICIPANTS

Stakeholder Group Name	Stakeholder Group Description	Representatives	Organization / Interest
SenatorB	Senator Chet Brooks	Neal Hunt	Senator Chet Brooks
StatAgny	State Agencies	Leland Roberts	Texas Parks & Wildlife Department
		Bruce Moulton	Texas Water Commission
		Garry Mauro	Texas General Land Office
		Andy Mangan	Texas General Land Office
		Don Cook	Texas General Land Office
		Sally Davenport	Texas General Land Office
		Tom Calnan	Texas General Land Office
		B.C. Gersch	State Department of Highways
FedlAgny	Federal Agencies	Tom Grahl	U.S. Fish & Wildlife Service
		Norman Sears	Environmental Protection Agency
		Fred Anthamatten	U.S. Army Corps of Engineers
		David Dale	National Marine Fisheries
		Gary Valentine	U.S. Soil Conservation Service
		Larry Land	U.S. Geological Survey
		David Myers	S.C.S.

Table 2.

WETLANDS

Variable List and Trends

No.	Variable Name	Variable Description	Unit of Measure	Maximum Increase (%)	Expected Change (%)	External Impact (% Exp.)
1	BIODIVR9	Biodiversity	Div Index Level	17.0 -	17.0	25.0
2	BOATTRF5	Boat Traf Thr Wetld	Aver #/Day	422.0	121.0	10.0
3	COMFISH0	Commercial Fisheries	Lbs Harvest/Yr	0.0 -	25.0	60.0
4	CONSTRC5	Construct in Wetland	Acs/Yr	222.0	34.0	10.0
5	SPOILIN5	Dredg Spoil in Wetld	Cu Yds/Ac/Yr	226.0	49.0	10.0
6	ENDANGR0	Endangered Species	# on List	388.0	80.0	25.0
7	ENFORCE1	Enforcement	Notices Viol/Yr	494.0	85.0	10.0
8	FILLWET5	Filling of Wetland	Acs Lost/Yr	353.0	55.0	10.0
9	FRESHTM1	Freshwater Timing	% Yearly Flow/Mo	17.0 -	17.0	90.0
10	FRESHIN1	Freshwater Inflows	Ac-Ft/Yr	0.0 -	13.0	90.0
11	APPRO$ 2	Fed/Stat Appr Wetlds	$/Yr	213.0	45.0	50.0
12	IRUNOFF5	Industrial Runoff	Ac-Ft/Yr	368.0	78.0	10.0
13	MITIGAT3	Mitigation	Acs/Yr	397.0	139.0	10.0
14	NPPOLUT5	Non-Point Pollution	Ac-Ft Abv TL/Yr	249.0	69.0	30.0
15	NURSERY0	Nursery Area	Acs	17.0 -	13.0	10.0
16	NUTRINT0	Nutrient Contrib	Lbs/Yr	20.0	18.0	10.0
17	O&GDEV 5	Oil & Gas Developmt	# Wells Devl/Yr	221.0	31.0	90.0
18	OSPILLS5	Oil Spills	Gallons/Yr	606.0	25.0	90.0
19	PUBEDUC1	Public Education	Hrs Exposure/Yr	338.0	90.0	10.0
20	RECEXP$0	Rec. Expenditures	$ Spent/Yr	309.0	70.0	50.0
21	SFCOORD1	Stat/Fed IntAg Coord	Eff Joint Act/Yr	296.0	76.0	10.0
22	SUBSIDE5	Subsidence	In/Yr	149.0	22.0	90.0
23	TOURSM$0	Tourism Revenue	$ Generated/Yr	246.0	95.0	50.0
24	TOXICS 5	Toxics	Concentration	328.0	41.0	10.0
25	WETCRTE3	Wetland Creation	Acs Created/Yr	252.0	28.0	10.0
26	WETHANC3	Wetland Enhancement	Acs Enhanced/Yr	304.0	49.0	10.0
27	WETID 1	Wetland Ident.	Acs/Jurisdiction	30.0	30.0	10.0
28	WETLOSS6	Wetland Loss	Acs Lost/Yr	518.0	70.0	10.0
29	WETDGRD5	Wetland Degradation	Acs Degraded/Yr	366.0	102.0	10.0
30	HABLOSS5	Wildlife Hab. Loss	Acs Lost/Yr	326.0	78.0	25.0

Time period is 20 YEARs, beginning 1/ 1991.

In the ranking procedure ***each stakeholder group had the right to select one variable that best defined their interest or concern. This variable is called peremptory because it must be included on the final list.*** In short, a stakeholder group owns the variable they select and no other group can challenge its right to use the variable in the computer model. Similarly, the variable can only be removed from the model with the consent of the stakeholder group. The peremptory variables are presented in Table 3.

The key variables identified by participants for the top three Texas Gulf Coast issues (i.e., shoreline erosion/dune protection, wetlands, and beach access) were compared to determine the degree to which the issues are interrelated. The variables were grouped if they shared a similar description. The results are presented in Table 4.

There is significant overlap among the key variables for the top three Texas Gulf Coast issues. For example, Table 4 shows that five variables are important to all three issues. The variables are tourism revenue, interagency coordination, habitat loss, public education, and funding. The wetlands issue shares four additional variables with the shoreline erosion/dune protection issue and one additional variable with the beach access issue. ***Therefore, strategies to resolve the wetlands issue will require coordination with strategies adopted to address the other issues.***

Table 3.

PEREMPTORY VARIABLES

Issue: WETLANDS

Group	Variable	Unit of Measure
Adv-Cons	Wetland Loss	Acs Lost/Yr
StatAgny	Wetland Loss	Acs Lost/Yr
FedlAgny	Wetland Loss	Acs Lost/Yr
Bus-Land	Wetland Identification	Acs/Jurisdictional
SenatorA	Wetland Identification	Acs/Jurisdictional
SenatrBB	Wetland Identification	Acs/Jurisdictional
PortDred	Non-Point Pollution	Ac-Ft Above Tolerable Level/Yr
Conserv1	State/Federal Interagency Coordination	Eff Joint Actions/Yr
Conserv2	Public Education	Hrs Exposure/Yr
Com-Fish	Commercial Fisheries	Lbs Harvest/Yr
Pipe-Oil	Construction in Wetlands	Acs/Yr
BoatMarn	Recreational Expenditures	$ Spent/Yr
Loc-Govn	Tourism Revenue	$ Generated/Yr
SenatorT	Wildlife Habitat Loss	Acs Lost/Yr
SenatorB	Toxics	Concentration

Table 4.

VARIABLES SHARED AMONG TWO OR MORE TEXAS GULF COAST ISSUES

	Issue		
Variable	Erosion	Wetlands	Access
Tourism Revenue	X	X	X
Interagency Coordination	X	X	X
Habitat Loss	X	X	X
Public Education	X	X	X
Funding	X	X	X
Ecological Integrity/Biodiversity	X	X	
Subsidence	X	X	
Wetlands	X	X	
Beach Nourishment	X		X
Dune Protection	X		X
Planning	X		X
Setbacks/Easements	X		X
Trash/Litter	X		X
Vehicles on Beach/Dunes	X		X
Enforcement		X	X

TRENDS AND INTERACTIONS

Long-Term Trends

The next step in the AFA Process involved estimating the trends in variables that might occur over the next twenty years under current policies. ***Most of the key variables were expected to increase, including the area of wetland created per year and the area of wetland lost per year. A number of variables were expected to decrease, including biodiversity, annual commercial fisheries harvest, freshwater inflows, freshwater inflow timing, and nursery areas.*** Stakeholder groups evaluated these trends as either desirable or undesirable. New policies addressed the undesirable trends.

Information was collected about two kinds of trends. The first trend is the possible or "maximum increase" for each variable over the next twenty years (Table 2). The maximum increase defines the upper limit for each variable. The second trend is the probable or "expected change" in each variable over the same period (Table 2). This is the trend that is likely to occur if current policies remain unchanged.

Information on trends was obtained from a questionnaire that was filled in by all participants. The participants were asked for their perceptions of the direction and magnitude of future trends. For example, if they thought a variable would change over the next twenty years, they were asked if it would be higher or lower than it is today. If the variable would be higher, the participants were given the option of saying it would be slightly, a little, moderately, a lot, or immensely higher.

The words in the questionnaire were associated with numbers that formed a geometric progression. For downward trends the progression ranged between 0 and -100 percent, and for upward trends it ranged between 0 and 1000 percent. The numerical values associated with the words selected by the participants were averaged. The averages were displayed, discussed, and modified as necessary. The final trends are illustrated with a bar chart in Figure 3.

The affects of outside forces were also considered. These forces are called external impacts (Table 2). This information is important because it points out how much, or how little, of the change in a variable may be controlled by policy. For instance, ***the participants decided that 90 percent of freshwater inflows, freshwater inflow timing, oil and gas development, and subsidence, and 60 percent of the annual commercial fisheries harvest, cannot be controlled by the recommended policy.***

Interactions

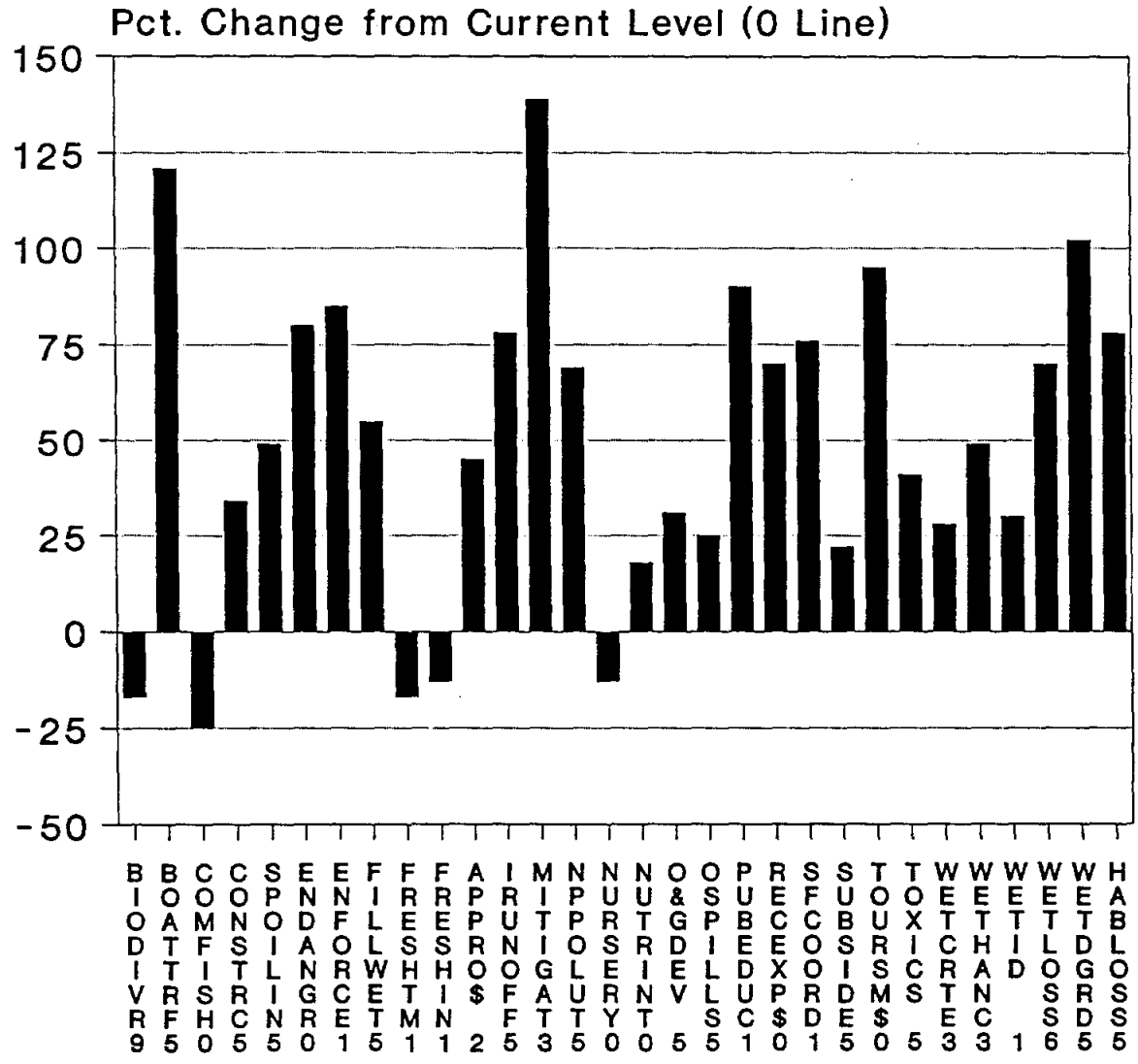
The next step in constructing a computer model is to show how the variables interact with one another to produce the estimated long-term trends. This is accomplished using a cross-impact matrix.

A cross-impact matrix is constructed by listing the key variables across the top of the matrix and then listing them again down the left side of the matrix (Figure 4). In a cross-impact matrix the column variable always impacts or affects the row variable. The number of filled cells in a column shows how many row variables that column variable affects, and in what way. The number of filled cells in a row shows how many column variables affect that row variable, and in what way.

Figure 3.

Wetlands

Expected Change in Variables Over the Next 20 Years for Current Policy



VARIABLE

NOTE: Estimates of expected change in variables were provided by the Wetlands Panel.

Figure 4.

CROSS-IMPACT MATRIX

Issue: WETLANDS

No.	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	BIODIVR9	+	-		-	-	-	+	-	+	+	+	-	+	-	+	+		-		-	+	-	-	-	+	+		-	-	-
2	BOATTRF5			+	+			-			+					+		+	-	-	+		+	+	-				-		-
3	COMFISH0	+	-		-	-	-		-	+	+		-	+	-	+	+		-			+	-		-	+	+		-	-	-
4	CONSTRC5						-	-						-		-		+			+	-		+	-		-	-	+	
5	SPOILIN5				+			-						-		-		+		-	+	-		+	-		-	-	+	-
6	ENDANGR0	-	+		+	+			+	-	-	-	+	-	+	-	-		+	-	+	-	+	+	+	-	-		+	+	+
7	ENFORCE1		+	+	+		+					+			+				+	+	+	+		+	+			+		+	+
8	FILLWET5				+	+	-	-				-		-		-		+		-	+	-		+	-		-	-		+	-
9	FRESHTM1				-						+									+	-	+		-							
10	FRESHIN1				-															+	-	+		-							
11	APPROS 2			+			+												+	+	+	+		+	+			+	+	+	+
12	IRUNOFF5				+			-												-		-									
13	MITIGAT3				+	+	+	+	+			+						+		+	+	+		+					+	+	+
14	NPPOLUT5				+	+		-	+		+									-	+	-		+							
15	NURSERY0		-		-	-	+		-	+	+	+	-	+	-			+	-	-	+	-		-	-	-	+	+		-	-	-
16	NUTRINT0					+				+	+				+							+	+		+		+	+		-		
17	O&GDEV 5				+		-																				-	-				
18	OSPILLS5							-										+		-		-									
19	PUBEDUC1						+					+	+	+		+			+		+	+		+	+				+		+
20	RECEXP$0	+	+		-	-	-		-	+	+	+	-	+	-	+	+		-	+		+	-	+	-	+	+		-		-
21	SFCOORD1			+	+	+						+		+					+	+					+			+	+	+	+
22	SUBSIDE5				+															-		-					-				
23	TOURSM$0	+	+	+			-	+	-	+	+	+	-	+	-	+			-	+	+	+	-		-	+	+		-		-
24	TOXICS 5					+		-	+		+	-	+		+				+	-	+	-		+		-	-				
25	WETCRTE3				+			+		+		+		+		+				+		+							+	+	+
26	WETHANC3				+			+		+		+		+		+			-	+		+				+			+	+	+
27	WETID 1											+		+		+				+		+									
28	WETLOSS6		+		+	+	-	-	+	-		-	+	-	+	-			+	-	+	-		+		-	-			+	+
29	WETDGRD5		+		+	+			+			-	+	-	+	-		+	+	-	+	-	+	+	+	-	-		+		+
30	HABLOSS5		+		+	+	-	-	+	-	-	-	+	-	+	-		+	+	-	+	-	+	+	+	-	-		+	+	

An interaction between two variables in the cross-impact matrix is represented by a plus "+" or a minus "-" sign. The cell is left blank if there is no interaction. A plus sign means that the row variable follows the column variable. In other words, if the column variable goes up the row variable will go up. A minus sign means that the row variable moves in the opposite direction of the column variable. That is, if the column variable goes up the row variable will go down.

All cells in the matrix were considered one at a time to estimate interactions among the 30 key variables. This potentially tedious process of filling in the cells was simplified so that it took only three hours to complete. The workshop participants were assembled into teams, and each team was given up to 5 questionnaires. Each questionnaire focused on how a particular variable affected the other variables in the matrix. The question was stated as "If variable A goes up, then variable B goes up, down, or no impact?". The team then circled one answer for each affected variable. The completed questionnaires were displayed for discussion and revision. This procedure insured that participants agreed on the interactions used to describe the issue.

Linking Trends and Interactions

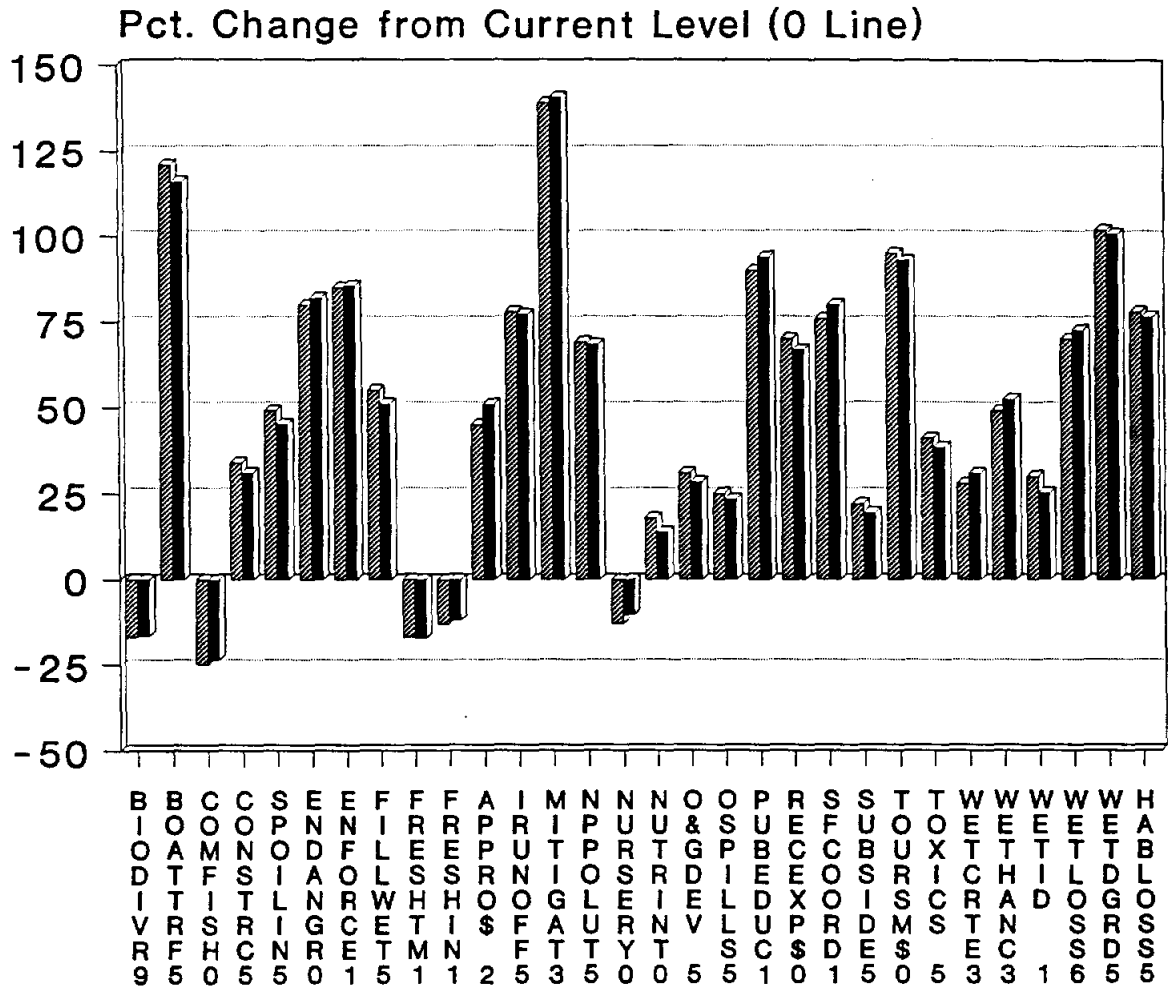
The software for the AFA Process uses artificial intelligence techniques to link the trends and the interactions in the cross-impact matrix to form a working computer model. The computer model is then validated. The closer the simulated trends from the model match the expected trends the better the model. Figure 5 shows that ***the wetlands model developed by the participants produces simulated trends that closely match the expected trends.***

The computer model formalized the participant's mutual understanding of the issue. It also provided a baseline for evaluating recommended policies. Thus participants used the model to compare the possible consequences of new policies with the probable consequences of continuing the old policies.

Figure 5.

Validation of Wetlands Computer Model

Estimated Changes for Current Policy vs. Simulated Changes from Computer Model



VARIABLE

ESTIMATED SIMULATED

NOTE: A valid computer model can approximate the expected changes in variables estimated by the Wetlands Panel.

POLICIES AND PRIORITIES

Defining the Issue

For the purpose of this study, the participants defined a wetland as state owned land that includes vegetated bay bottom and intertidal flats extending up to mean high tide.

The participants selected the area of wetland lost per year as the variable that best defined the wetlands issue for the Texas Gulf Coast. ***The rate of wetland loss is expected to increase over the next twenty years.***

Stakeholder Objectives

An objective represents how a stakeholder group would like to see a variable change from the way it is today. For this issue, the time limit for reaching an objective was set at twenty years.

There were eight objectives from which to choose (Table 5). They included No Change, Not Up, Not Down, Up %, Down %, Up Max., Down Max., and Don't Care. The definitions of the objectives are presented in Table 5. Since the objectives were stated simply, the stakeholder groups specified their objectives for the 30 key variables in less than one-half hour. They were also given an opportunity to change their objectives. Most of the participants took advantage of this opportunity on more than one occasion.

The computer software converts the objectives into a form that can be used to evaluate policies. The simulated trends in variables for a policy are compared with these objectives to determine the level of satisfaction achieved by a stakeholder group. The closer a variable comes to the objective the higher the stakeholder group's satisfaction. Thus satisfaction does not express a group's happiness, it defines the degree to which an objective is met.

Table 6 summarizes the objectives specified by the 15 stakeholder groups for the 30 key variables used to describe the wetlands issue. The Up Max., Up %, and Not Down objectives were grouped to illustrate a preference for an increase in the variable. Similarly, the Down Max., Down %, and Not Up objectives were grouped to illustrate a preference for a decrease in the variable.

Table 6 reveals that ***the stakeholder groups share similar views on a desired future for the Texas Gulf Coast. However, there was a notable difference in objectives for the oil and gas development variable.*** The Don't Care objective was selected for this variable by 5 stakeholder groups, but 6 groups had a preference for an increase in oil and gas development and 3 groups had a preference for a decrease. Appendix A shows the objectives for all stakeholder groups for all 30 variables.

Table 5.

DEFINITIONS OF OBJECTIVES

Objective	Definition
NO CHANGE	You do not want the variable to go higher or lower than its current level.
NOT UP	You do not want the variable to go higher than its current level, but you do not care if it goes lower.
NOT DOWN	You do not want the variable to go lower than its current level, but you do not care if it goes higher.
UP %	You want the variable to go up to or above a certain percent of its current level.
DOWN %	You want the variable to go down to or below a certain percent of its current level.
UP MAX.	You want the variable to go up as high as possible from its current level.
DOWN MAX.	You want the variable to go to zero.
DON'T CARE	You do not care about the variable.

TABLE 6.

SUMMARY OF GROUP OBJECTIVES

Issue: WETLANDS

Variable No.	Variable	No Change	Preference for Increase*	Preference for Decrease**	Don't Care
1	Biodiversity	0	15	0	0
2	Average Boat Traffic Through Wetlands	0	2	7	6
3	Annual Commercial Fisheries Harvest	0	12	2	1
4	Area of Wetlands Affected by Construction	0	3	12	0
5	Volume of Dredge Spoil Placed in Wetlands	0	0	14	1
6	Number of Endangered Species	0	0	15	0
7	Notices of Violations Affecting Wetlands	0	14	0	1
8	Area of Wetland Filled Per Year	1	0	13	1
9	Freshwater Inflow Timing	0	13	0	2
10	Volume of Freshwater Inflow	0	13	0	2
11	Federal/State Appropriations for Wetlands	0	15	0	0
12	Volume of Industrial Runoff	0	0	15	0
13	Area of Wetland Mitigated Per Year	0	15	0	0
14	Volume of Non-Point Source Pollutants	0	0	15	0
15	Nursery Area	0	15	0	0
16	Contribution of Beneficial Nutrients	0	15	0	0
17	Oil and Gas Wells Developed in Wetlands	1	6	3	5
18	Volume of Oil Spilled	0	0	15	0
19	Public Education on Issue	0	15	0	0
20	Annual Recreation Expenditures	0	12	1	2
21	Interagency Coordination	0	15	0	0
22	Subsidence Rate	0	0	13	2
23	Annual Tourism Revenue	1	12	0	2
24	Concentration of Toxic Substances	0	0	15	0
25	Area of New Wetland Created Per Year	0	15	0	0
26	Area of Wetland Enhanced Per Year	0	15	0	0
27	Area of Wetland Identified as Jurisdictional	0	15	0	0
28	Area of Wetland Lost Per Year	0	0	15	0
29	Area of Wetland Degraded Per Year	0	0	15	0
30	Wildlife Habitat Loss Rate	0	0	15	0

*The Up Max., Up %, or Not Down objectives were combined.
**The Down Max., Down %, or Not Up objectives were combined.

Recommended Policy

Primary Policy

The participants followed a step-by-step procedure do develop a recommended policy. They began by selecting up to 5 target variables that could reduce the loss of wetlands. ***The participants chose federal and state appropriations for wetlands, area of wetlands degraded, area of wetlands enhanced, public education about the wetlands issue, and interagency coordination as the five variables to include in their primary policy.*** They made this selection because the interactions in the cross-impact matrix showed that the five target variables directly affect the problem variable (Figure 4).

The primary policy is created by deciding the direction, magnitude, and rate of change needed to produce a new trend in each target variable. The assumption is that new trends in the target variables will cause favorable changes in the problem variable.

Computer simulations were performed by forcing the five target variables to follow the new trends specified in the primary policy. These new trends in the target variables then interacted through the cross-impact matrix to change the trend in the problem variable. The trends in other variables also changed because they are connected to one another in the matrix.

The results produced by simulating policies should be interpreted qualitatively since the data used in building the computer model also was qualitative. Thus a percentage change in a variable caused by a policy is best interpreted with words. For example, 100 percent above the current level might be stated as substantially higher, while 20 percent below the current level might be stated as slightly lower.

The simulation showed that the primary policy is likely to reverse the upward trend in the loss of wetlands and reduce the rate of loss substantially below current levels. The rate of wildlife habitat loss would also be reduced.

Mitigation Policies

The participants felt that some of the side effects produced by simulating the primary policy were undesirable. For example, boat traffic through wetlands increased above the expected level, which was already double the current level. This potential increase in boat traffic through wetlands was attributed to increased development, tourism, and fishing stimulated by the primary policy. Table 6 shows that most of the stakeholder groups want fewer boats in wetlands. Therefore, ***the participants recommended reducing boat traffic through wetlands to 50 percent below the current level over the next twenty years.*** Thus they added a mitigation variable to their primary policy to form a policy portfolio (Policy 2) that was again simulated to test for new side effects.

The results of simulating the second policy revealed another problem. Although the primary and secondary policies slightly reduced non-point source pollution, the participants still felt that pollution levels were too high. Therefore ***the participants recommended reducing non-point source pollution to 20 percent below the current level over the next twenty years.*** They added this mitigation variable to their policy portfolio (Policy 3) and conducted another simulation to test for additional problems. The results of the simulation were acceptable so this became the recommended policy (Table 7).

Final Recommendation

The recommended policy consists of the original five target variables in the primary policy plus the two mitigation variables that were added to reduce unwanted side effects. The recommended policy selected by participants includes 1) increasing federal and state appropriations for wetlands by 3 times, 2) increasing public education by 4 times, 3) increasing interagency coordination by 4 times, 4) increasing the area of wetland enhanced per year by 4 times, 5) reducing the area of wetland degraded per year to zero, 6) reducing boat traffic through wetlands by half, and 7) reducing non-point source pollution by 20 percent (Table 7).

A bar chart comparing the affects of the current policy and the recommended policy is presented in Figure 6. The chart is constructed with the zero line representing the current level of the variable. A bar above the line means that, over the next twenty years, the variable is likely to move higher than it is today. A bar below the line means that the variable is likely to move lower than it is today. The bars are shown in pairs. One bar is the expected change in a variable estimated by workshop participants for the current policy. The other bar is the simulated change produced for the recommended policy.

As Figure 6 shows, ***the recommended policy is likely to reduce the loss of wetlands and wildlife habitat. It could also reduce toxic substances and endangered species. The expected decline in biodiversity is likely to reverse and improve slightly.***

Table 7.

CHANGES SPECIFIED FOR THE RECOMMENDED POLICY

Issue: WETLANDS

TARGET VARIABLES (Primary Policy)

Variable No.	Variable	Policy	%	Rate of Desired Change
11	Federal/State Appropriations for Wetlands	Up Max	213	Rapidly
19	Public Education on Issue	Up Max	338	Gradually
21	Interagency Coordination	Up Max	296	Rapidly
26	Area of Wetland Enhanced Per Year	Up Max	304	Gradually
29	Area of Wetland Degraded Per Year	Down Max	100	Gradually

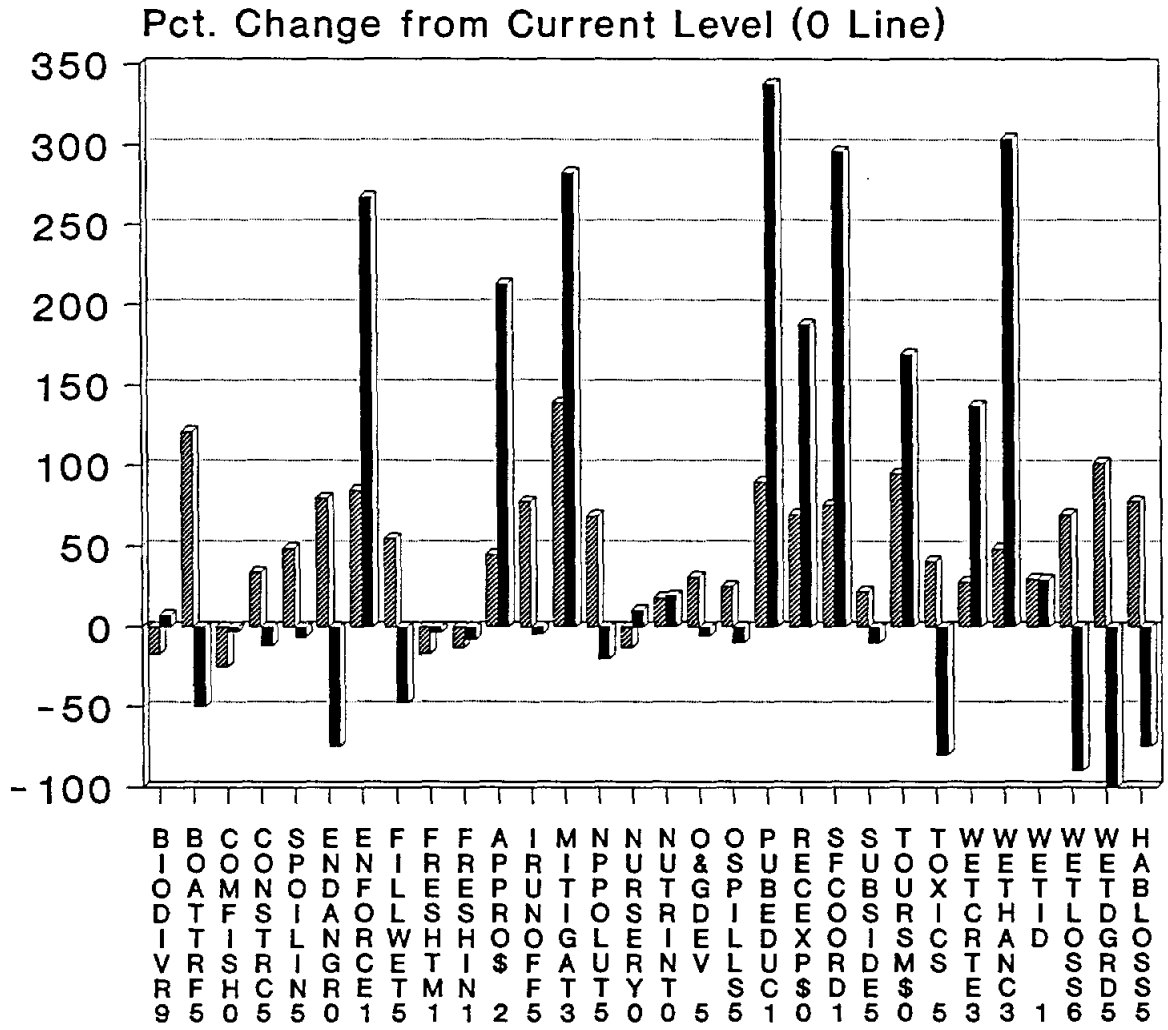
MITIGATION VARIABLES (Added to Primary Policy)

Variable No.	Variable	Policy	%	Rate of Desired Change
2	Average Boat Traffic Through Wetlands	Down	50	Gradually
14	Volume of Non-Point Pollutants	Down	20	Gradually

Figure 6.

Wetlands

Percentage Change in Variables for Current and Recommended Policies



VARIABLE

CURRENT POLICY RECOMMENDED POLICY

NOTE: The percentage shown is the total change that may occur over 20 years.

The line graphs presented in Appendix B show the simulated trends in variables over the next twenty years for the current policy and the recommended policy. The graphs are arranged in pairs with the same seven variables in each graph. The top graph shows the expected change in variables over time if current policies continue into the future. The lower graph shows the change that might occur in the same variables if the recommended policy is adopted.

Satisfaction of Objectives

Table 8 shows the satisfaction levels achieved by each stakeholder group for the recommended policy (Policy 3). The first column shows the names of the groups. The second column shows the total level of satisfaction achieved by each group. A 100 for a group would mean that all of their objectives were met or exceeded by the policy.

The third column in Table 8 shows the highest level of dissatisfaction experienced by a stakeholder group for any variable. In this case, a 100 for a group would mean that they are completely dissatisfied. That is, the group's objective for the variable was not even partially met. The last three columns show the name of the variable that caused the dissatisfaction, how much it changed as a result of the policy, and how the group wanted the variable to change.

The overall or total satisfaction of objectives is high for the recommended policy (Policy 3). The lowest level of satisfaction for a stakeholder group is 84 percent and the highest level is 94 percent.

Levels of dissatisfaction for the recommended policy are relatively low. The highest remaining dissatisfaction is for the Business/Landowners group, the Oil and Gas Pipeline group, and Senator Brown. The variable of concern to all three stakeholders is oil and gas wells developed in wetlands. These groups wanted oil and gas development to increase to the maximum, but the recommended policy had the effect of reducing development slightly below current levels. Nevertheless, the three groups are still 88, 90, and 94 percent satisfied, respectively, with the recommended policy (Table 8).

Table 9 compares the current policy (Expected) and the recommended policy (Policy 3). The table is constructed in three columns and the index of success used in each column is scaled between zero and 100 percent. In columns one and two the larger the percent the better the policy. In column three the smaller the percent the better the policy.

The recommended policy is superior to the current policy for three measures of success. For example, the first column in Table 9 shows that the recommended policy maximizes the minimum level of satisfaction for all groups (i.e., ***it produces a lower level of dissatisfaction for all groups than the current policy***). The second column shows that the recommended policy maximizes total satisfaction for all groups (i.e., ***it provides more benefits to all groups than the current policy***). The third column shows that the recommended policy minimizes total dissatisfaction for any one group (i.e., ***it produces a lower level of dissatisfaction for any one group than the current policy***).

Table 8.

WETLANDS

EXPERIMENT: POLICY3

Satisfaction of Group Objectives *

Group	Total Satisfaction (% of Max.)**	Highest Dissatisfaction (%)	Variables	Dif. From Initial Value (%)	Objective
Adv-Cons	89.4	38.1	ENFORCE1	267.7	Up Max. 494%
Bus-Land	88.2	70.5	O&GDEV 5	- 5.3	Up Max. 221%
PortDred	84.5	68.9	TOURSM$0	169.5	No Change
Conserv1	90.7	38.1	ENFORCE1	267.7	Up Max. 494%
Conserv2	88.6	38.1	ENFORCE1	267.7	Up Max. 494%
Com-Fish	90.4	38.1	ENFORCE1	267.7	Up Max. 494%
Pipe-Oil	90.9	70.5	O&GDEV 5	- 5.3	Up Max. 221%
BoatMarn	93.9	66.7	BOATTRF5	- 50.0	Up 50%
Loc-Govn	92.6	55.8	CONSTRC5	- 11.7	Up 100%
SenatorT	92.1	32.6	WETCRTE3	137.2	Up Max. 252%
SenatorA	95.2	36.1	SUBSIDE5	- 10.0	Down 100%
SenatrBB	94.0	70.5	O&GDEV 5	- 5.3	Up Max. 221%
SenatorB	90.3	38.1	ENFORCE1	267.7	Up Max. 494%
StatAgny	94.0	32.6	WETCRTE3	137.2	Up Max. 252%
FedlAgny	92.1	38.1	ENFORCE1	267.7	Up Max. 494%

* Computed using normalized (% of Max.) units.

** Maximum excludes variables assigned 'Don't Care'.

Table 9.

WETLANDS

Satisfaction of Objectives by Policy Experiment

Experiment	Total Min. Sat. All Groups (% of Max.)	Total Weighted Sat. All Groups (% of Max.)	Highest Total Dissat. Any One Group (% of Max.)
EXPECTED	60.4	71.7	36.6
POLICY3	[78.3]*	[91.1]**	[15.5]***

* MAXIMIN Solution: Policy maximizes total minimum satisfaction (i.e., policy is least hurtful to all groups).

** MAXIMAX Solution: Policy maximizes total weighted satisfaction (i.e., policy provides the most benefits to all groups).

*** MINIMAX Solution: Policy minimizes total dissatisfaction for any one group (i.e., policy is least hurtful to any one group).

Recommended Actions

The recommended policy is composed of seven variables. The participants specified how these variables should change over the next twenty years to resolve the wetlands issue. Their recommendation was based on the assumption that the changes in variables were optimistic but realistic.

The participants worked in multi-stakeholder teams to formulate workable actions to bring about the desired changes in variables. Each team was given up to two target and/or mitigation variables to review. The team filled in a questionnaire for each variable that requested information on the specific actions needed to bring about the recommended change. They specified who should be responsible for taking the action. They also estimated the cost and source of funds.

The proposed actions from the teams were displayed for discussion and revision by all participants. As a result, ***the recommended actions represent a consensus of the participants.*** These actions are listed below.

Increase Appropriations for Wetlands

ACTION: New money; dedicated funds; redirected funds; efficient use of existing funds by reducing duplication; combination of general and targeted or specific sources.

RESPONSIBLE PARTY: State legislature.

ESTIMATED COST: Year 1-5: $50 million; Year 6-10: $50 million; Year 11-15: $50 million; Year 16-20: $50 million.

SOURCE OF FUNDS: Taxes; user fees.

Increase Public Education

ACTION: Amend SB 1571 to provide funds for an educational component regarding wetland loss.

RESPONSIBLE PARTY: Texas General Land Office should select an advisory board from academia, industry, environmental conservation groups, communication specialists and other agencies to develop the educational program.

ESTIMATED COST: Year 1-5: $175,000; Year 6-10: $150,000; Year 11-15: 150,000; Year 16-20: $150,000.

SOURCE OF FUNDS: General appropriations as opposed to user fees.

Increase Interagency Coordination

ACTION: MOA's; modify rules and definition of wetlands (public hearings); study agency policies to determine impact on wetland loss; reduce fragmentation and jurisdictional overlap; examine the possibility of creating a formal coordinating mechanism between state agencies.

RESPONSIBLE PARTY: All state and federal agencies involved with wetlands (directly or indirectly); public hearings; state legislature.

ESTIMATED COST: Year 1-5: $250,000.

SOURCE OF FUNDS: The coordinating agencies.

Increase Wetland Enhancement

ACTION: Legislative clarification of mitigation policies; interagency MOUs/MOAs implementing mitigation policies; development of legislative/administrative policies/regulations for mitigation banking for certain project parameters; incentives to encourage private sector enhancement projects; create a wetlands institute for research and training on wetland creation, restoration, and enhancement techniques; establish a funding process; identify state lands suitable for enhancement.

RESPONSIBLE PARTY: State legislature; state agencies; local governments/special purpose districts; private companies/landowners.

ESTIMATED COST: Year 1-5: $25 million; Year 6-10: $25 million; Year 11-15: $25 million; Year 16-20: $25 million.

SOURCE OF FUNDS: Taxes and user fees; private sector; state and local governments.

Reduce Wetland Degradation

ACTION: Legislatively create a comprehensive wetland degradation policy; implement that policy through appropriate agencies; enlist the private sector to promote the policy and provide public education assistance; create public and private advisory committee.

RESPONSIBLE PARTY: At the state level, the Texas General Land Office as lead agency in coordination with appropriate state and federal agencies; encourage private sector involvement in public education and policy development through the previously mentioned advisory committee.

ESTIMATED COST: Minimal costs to the state for administration; undetermined cost to overall economy.

SOURCE OF FUNDS: General revenues to cover administration; the Texas economy must absorb the broader effect.

Reduce Boat Traffic Through Wetlands

ACTION: Educate boaters through sports clubs, rental facilities, dealers, boating clubs, and local governments; administrative designation of management areas; adopt management plans, including corridors, hull speed limits, no wake areas, penalties, bans of certain types of boats in designated areas; enforce regulations; legislature - enact prohibition against improper operation of boats in management areas with penalties, and designate responsible agency to designate management areas and enforce sanctions.

RESPONSIBLE PARTY: Texas Parks and Wildlife Department should be the designated agency for enforcement; Texas General Land Office should be the designated agency for creation and designation of management areas in consultation with Texas Parks and Wildlife.

ESTIMATED COST: Year 1-5: $5 million; Year 6-10: $1.25 million; Year 11-15: $1.25 million; Year 16-20: $1.25 million.

SOURCE OF FUNDS: Increase saltwater boat tax; fishing licenses; legislative appropriation for first five years; seek federal funds.

Reduce Non-Point Source Pollution

ACTION: Develop standards for non-point source pollution; delineate responsibility between federal/state and/or local authority; establish household hazardous wastes programs in cities to increase recycling of oil, pesticides, and fertilizers; establish education programs to encourage use of biodegradable pesticides; establish education programs for organic farming; create buffer zones along streams (i.e. similar to federal conservation reserve program); reduce use of chemicals; require construction run-off plans for new development; require revegetation of disturbed areas.

RESPONSIBLE PARTY: Environmental Protection Agency; Texas Water Commission; Congress; State Legislature; Local, private initiatives with state guidelines and incentives; Texas Department of Agriculture and state university extension service; TDA; Texas Parks and Wildlife Department, ASCS within USDA; local government permitting entities.

ESTIMATED COST: $ 15 million per year over twenty years.

SOURCE OF FUNDS: Federal, state, and local government; user fees on pesticides and chemicals; recycling; private sector sponsors.

Research Priorities

The cross-impact matrix was used to identify which interactions between variables are important to study. The participants were asked to rate up to 10 percent of the interactions in the matrix as unimportant and up to 10 percent as extremely important. The remaining 80 percent of the interactions were automatically rated as moderately important.

An unimportant rating means that research funds would be wasted on the interaction because it is either well understood or it has little affect on the issue. An extremely important rating means that research funds should be directed toward the interaction because it is not well understood, and it has a strong affect on the issue.

The ratings from the participants were processed with a statistical procedure that produces an importance index that varies between 0 and 100. The higher the index the more research effort should be focused on the interaction. An index of 100 would mean that all of the participants identified the interaction as extremely important. Thus research funding should start with interactions that have the highest importance index and work downward toward those with the lowest importance index.

The recommended priorities for future research on the wetlands issue are presented in Table 10. ***The highest research priority focused on improving understanding about the affect of construction in wetlands on wetland enhancement. The affect of wetland loss on wildlife habitat loss tied as the top research priority.***

The second research priority was improving understanding about the affect of non-point source pollution on the concentration of toxic substances in wetlands. Research on five other interactions between variables tied for third priority, and nine interactions between variables tied for fourth priority.

Table 10.

RECOMMENDED RESEARCH FUNDING PRIORITIES

Issue: WETLANDS

Rank	Importance Index		Interaction
1	53%	AFFECT OF	the Area of Wetlands Affected by Constriction
		ON	the Area of Wetland Enhanced Per Year
	53%	AFFECT OF	the Area of Wetland Lost Per Year
		ON	the Wildlife Habitat Loss Rate
2	48%	AFFECT OF	the Volume of Non-Point Source Pollutants
		ON	the Concentration of Toxic Substances
3	42%	AFFECT OF	the Volume of Dredge Spoil Placed in Wetlands
		ON	the Area of Wetland Lost Per Year
	42%	AFFECT OF	Freshwater Inflow Timing
		ON	the Wildlife Habitat Loss Rate
	42%	AFFECT OF	the Volume of Freshwater Inflow
		ON	the Volume of Non-Point Source Pollutants
	42%	AFFECT OF	the Volume of Industrial Runoff
		ON	Annual Tourism Revenue
	42%	AFFECT OF	the Contribution of Beneficial Nutrients
		ON	Biodiversity
4	36%	AFFECT OF	Freshwater Inflow Timing
		ON	Biodiversity
	36%	AFFECT OF	Freshwater Inflow Timing
		ON	the Annual Commercial Fisheries Harvest
	36%	AFFECT OF	Freshwater Inflow Timing
		ON	the Nursery Area
	36%	AFFECT OF	the Volume of Industrial Runoff
		ON	the Area of Wetland Degraded Per Year
	36%	AFFECT OF	the Area of Wetland Mitigated Per Year
		ON	the Area of Wetland Enhanced Per Year
	36%	AFFECT OF	the Area of Wetland Mitigated Per Year
		ON	the Wildlife Habitat Loss Rate
	36%	AFFECT OF	the Volume of Non-Point Source Pollutants
		ON	the Wildlife Habitat Loss Rate
	36%	AFFECT OF	the Contribution of Beneficial Nutrients
		ON	the Nursery Area
	36%	AFFECT OF	the Volume of Oil Spilled
		ON	the Wildlife Habitat Loss Rate

APPENDIX A
Stakeholder Objectives

WETLANDS

Objective Specified for Each Variable by Each Group

		GROUP				
No.	Variable	Adv-Cons	Bus-Land	PortDred	Conserv1	Conserv2
1	BIODIVR9	Up Max.	Not Down	Up Max.	Up Max.	Up Max.
2	BOATTRF5	Not Up	Not Down	Down 50%	Not Up	Not Up
3	COMFISH0	Not Down	Don't Care	Up Max.	Not Up	Up Max.
4	CONSTRC5	Down Max.	Not Down	Down Max.	Down 50%	Down Max.
5	SPOILIN5	Down Max.	Down 50%	Down Max.	Down 50%	Down Max.
6	ENDANGR0	Down Max.	Not Up	Down Max.	Down 50%	Down Max.
7	ENFORCE1	Up Max.	Don't Care	Up Max.	Up Max.	Up Max.
8	FILLWET5	Down Max.	No Change	Down Max.	Down Max.	Down Max.
9	FRESHTM1	Up Max.	Don't Care	Up Max.	Up Max.	Up Max.
10	FRESHIN1	Up Max.	Don't Care	Up Max.	Up Max.	Up Max.
11	APPRO$ 2	Not Down	Up 45%	Up 50%	Up Max.	Up Max.
12	IRUNOFF5	Down Max.	Not Up	Down Max.	Down Max.	Down Max.
13	MITIGAT3	Up Max.	Up 25%	Up Max.	Up Max.	Up Max.
14	NPPOLUT5	Down Max.	Not Up	Down Max.	Down Max.	Down Max.
15	NURSERY0	Up Max.	Up Max.	Up Max.	Up Max.	Up Max.
16	NUTRINT0	Up Max.	Up 18%	Up Max.	Up 50%	Up Max.
17	O&GDEV 5	Don't Care	Up Max.	Don't Care	Not Up	No Change
18	OSPILLS5	Down Max.	Down Max.	Down Max.	Down Max.	Down Max.
19	PUBEDUC1	Up Max.	Up Max.	Up Max.	Up Max.	Up Max.
20	RECEXP$0	Up Max.	Up Max.	Down 50%	Up 75%	Don't Care
21	SFCOORD1	Not Down	Up Max.	Up 25%	Up Max.	Up Max.
22	SUBSIDE5	Not Up	Down Max.	Down Max.	Down Max.	Down Max.
23	TOURSM$0	Not Down	Up Max.	No Change	Not Down	Don't Care
24	TOXICS 5	Down Max.	Down Max.	Down Max.	Down Max.	Down Max.
25	WETCRTE3	Up Max.	Up 100%	Up Max.	Up Max.	Up Max.
26	WETHANC3	Up Max.	Up 150%	Up Max.	Up Max.	Up Max.
27	WETID 1	Up Max.	Up Max.	Up Max.	Up Max.	Up Max.
28	WETLOSS6	Down Max.	Down 50%	Down Max.	Down Max.	Down Max.
29	WETDGRD5	Down Max.	Not Up	Down Max.	Down Max.	Down Max.
30	HABLOSS5	Down Max.	Down 50%	Down Max.	Down Max.	Down Max.

Objective Specified for Each Variable by Each Group

		GROUP				
No.	Variable	Com-Fish	Pipe-Oil	BoatMarn	Loc-Govn	SenatorT
1	BIODIVR9	Up Max.	Up Max.	Up Max.	Not Down	Up Max.
2	BOATTRF5	Don't Care	Don't Care	Up 50%	Not Up	Down 75%
3	COMFISH0	Up Max.	Not Up	Not Down	Not Down	Up Max.
4	CONSTRC5	Not Up	Not Up	Not Up	Up 100%	Down Max.
5	SPOILIN5	Down Max.	Not Up	Not Up	Not Up	Down Max.
6	ENDANGR0	Down Max.	Down Max.	Down 25%	Not Up	Down Max.
7	ENFORCE1	Up Max.	Not Down	Up 50%	Up Max.	Up 50%
8	FILLWET5	Down Max.	Not Up	Down Max.	Not Up	Down Max.
9	FRESHTM1	Up Max.	Up Max.	Up Max.	Not Down	Up Max.
10	FRESHIN1	Up Max.	Not Down	Up Max.	Not Down	Up Max.
11	APPROS 2	Up Max.	Not Down	Up 100%	Up Max.	Up 50%
12	IRUNOFF5	Down 50%	Down Max.	Down 50%	Down Max.	Down Max.
13	MITIGAT3	Not Down	Not Down	Up 250%	Not Down	Up 50%
14	NPPOLUT5	Down Max.	Down Max.	Down 50%	Down Max.	Down Max.
15	NURSERY0	Up Max.	Up Max.	Up Max.	Not Down	Up Max.
16	NUTRINT0	Up Max.	Up Max.	Up 100%	Not Down	Up Max.
17	O&GDEV 5	Don't Care	Up Max.	Not Up	Don't Care	Don't Care
18	OSPILLS5	Down Max.	Down Max.	Down Max.	Down Max.	Down Max.
19	PUBEDUC1	Up Max.	Up 50%	Up 100%	Up Max.	Up Max.
20	RECEXP$0	Up Max.	Up 70%	Up 25%	Up Max.	Up 30%
21	SFCOORD1	Up Max.	Up Max.	Up 250%	Up Max.	Up Max.
22	SUBSIDE5	Not Up	Down Max.	Down 50%	Not Up	Don't Care
23	TOURSM$0	Up Max.	Up Max.	Up 50%	Up Max.	Up 30%
24	TOXICS 5	Down Max.	Not Up	Down 50%	Not Up	Down Max.
25	WETCRTE3	Up Max.	Up Max.	Up 50%	Not Down	Up Max.
26	WETHANC3	Up Max.	Up Max.	Up 100%	Not Down	Up Max.
27	WETID 1	Up Max.	Up Max.	Up Max.	Up Max.	Up Max.
28	WETLOSS6	Down Max.	Not Up	Down Max.	Not Up	Down Max.
29	WETDGRD5	Down Max.	Not Up	Down Max.	Not Up	Down Max.
30	HABLOSS5	Down Max.	Not Up	Down Max.	Not Up	Down Max.

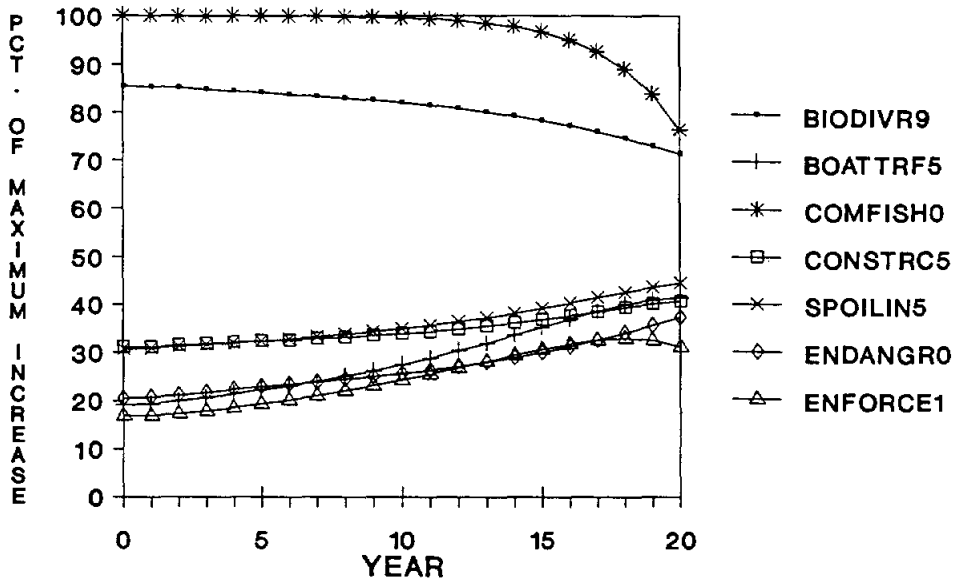
Objective Specified for Each Variable by Each Group

		GROUP				
No.	Variable	SenatorA	SenatrBB	SenatorB	StatAgny	FedlAgny
1	BIODIVR9	Up Max.	Not Down	Up Max.	Up Max.	Up Max.
2	BOATTRF5	Don't Care	Don't Care	Don't Care	Not Up	Don't Care
3	COMFISH0	Not Down	Up Max.	Up Max.	Not Down	Up Max.
4	CONSTRC5	Down 80%	Not Down	Not Up	Down 25%	Not Up
5	SPOILIN5	Not Up	Don't Care	Not Up	Down Max.	Down Max.
6	ENDANGR0	Not Up	Not Up	Down Max.	Down Max.	Down Max.
7	ENFORCE1	Up 20%	Not Down	Up Max.	Up 85%	Up Max.
8	FILLWET5	Not Up	Don't Care	Not Up	Down Max.	Down Max.
9	FRESHTM1	Up Max.	Don't Care	Up Max.	Up Max.	Not Down
10	FRESHIN1	Not Down	Don't Care	Up Max.	Not Down	Not Down
11	APPRO$ 2	Up 20%	Not Down	Up Max.	Up Max.	Up Max.
12	IRUNOFF5	Not Up	Not Up	Not Up	Not Up	Down Max.
13	MITIGAT3	Up 10%	Up 100%	Up Max.	Up Max.	Not Down
14	NPPOLUT5	Not Up	Down Max.	Down Max.	Not Up	Down Max.
15	NURSERY0	Up 10%	Not Down	Up Max.	Up Max.	Up Max.
16	NUTRINT0	Up 20%	Not Down	Up Max.	Up Max.	Up Max.
17	O&GDEV 5	Up 5%	Up Max.	Not Down	Up 15%	Not Up
18	OSPILLS5	Down Max.	Down Max.	Down Max.	Down Max.	Down Max.
19	PUBEDUC1	Up 50%	Up Max.	Up Max.	Up Max.	Up Max.
20	RECEXP$0	Up 20%	Not Down	Up Max.	Up 60%	Don't Care
21	SFCOORD1	Up 100%	Up Max.	Up Max.	Up 100%	Up Max.
22	SUBSIDE5	Down Max.	Don't Care	Down Max.	Not Up	Not Up
23	TOURSM$0	Up Max.	Up Max.	Up Max.	Up 60%	Don't Care
24	TOXICS 5	Down 80%	Not Up	Down Max.	Down 50%	Down Max.
25	WETCRTE3	Up 20%	Up 20%	Up Max.	Up Max.	Up Max.
26	WETHANC3	Up 75%	Not Down	Up Max.	Up 100%	Up Max.
27	WETID 1	Up Max.	Up Max.	Up Max.	Up Max.	Up Max.
28	WETLOSS6	Down 90%	Not Up	Down Max.	Down 30%	Down Max.
29	WETDGRD5	Not Up	Not Up	Down Max.	Down 50%	Down Max.
30	HABLOSS5	Not Up	Not Up	Down Max.	Down 40%	Down Max.

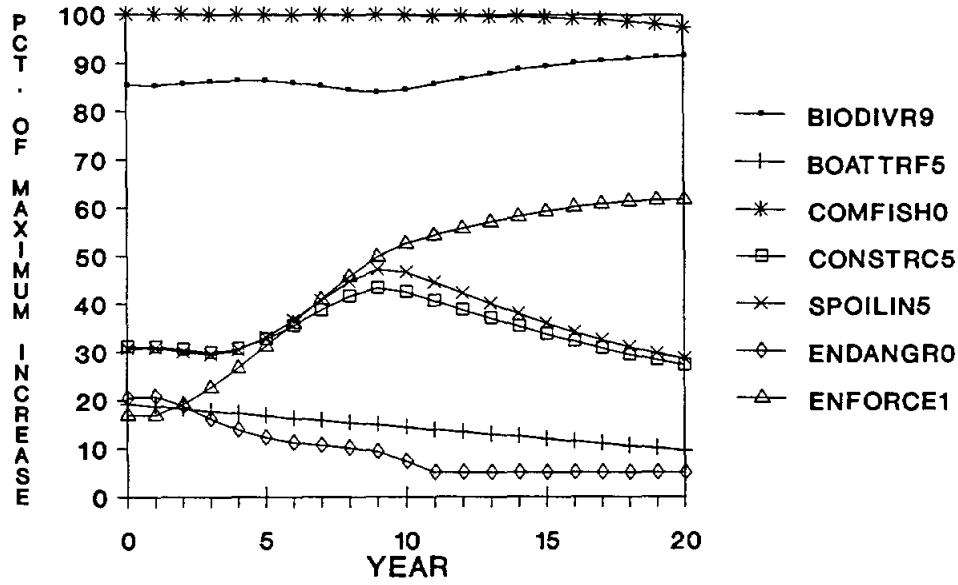
APPENDIX B
Simulated Trends

Wetlands

Simulated Trends for Current Policy

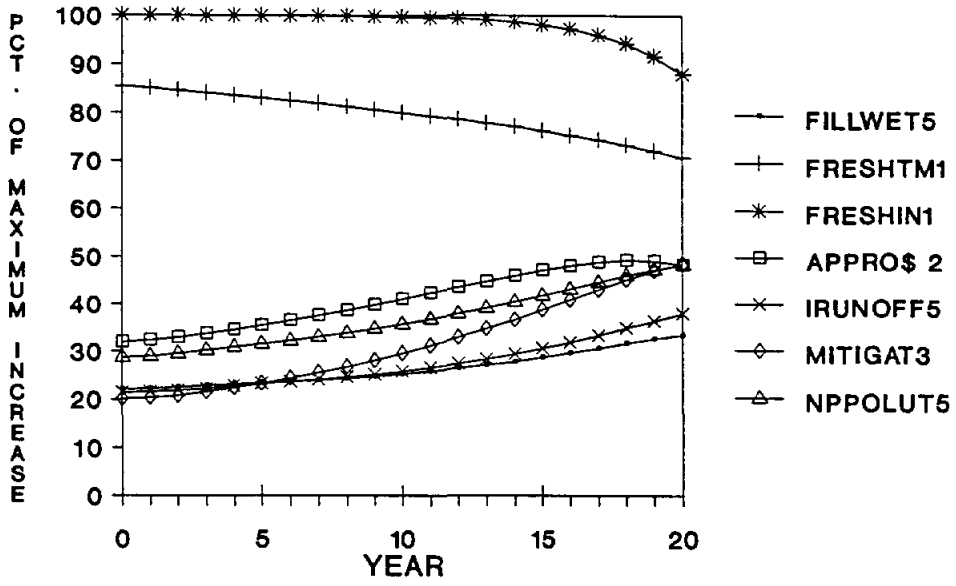


Simulated Trends for Recommended Policy



Wetlands

Simulated Trends for Current Policy



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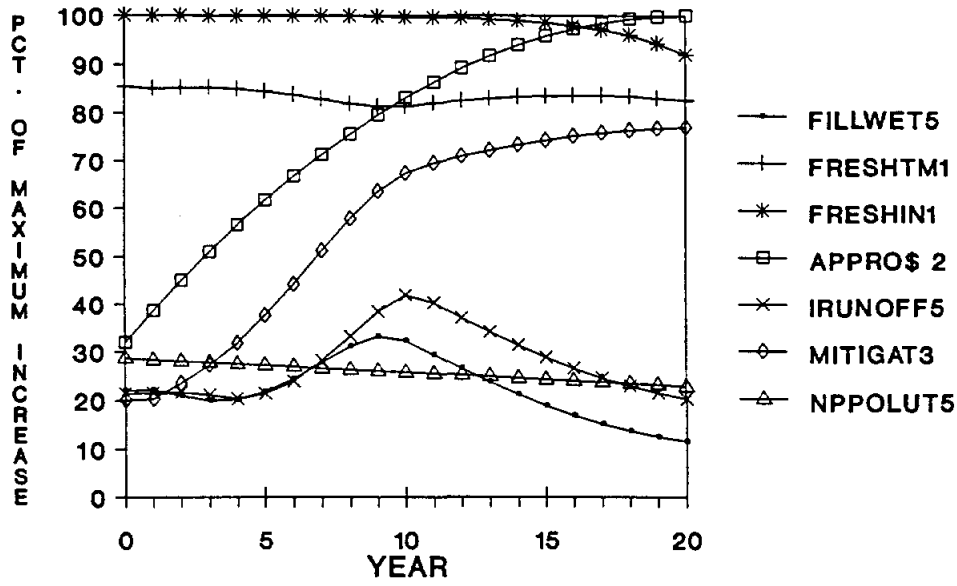
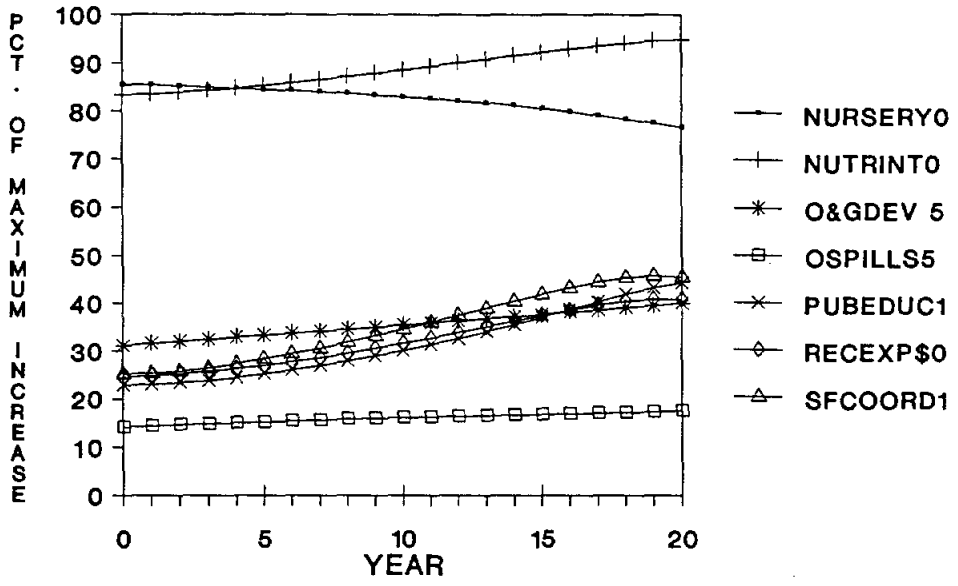


Wetlands

Simulated Trends for Current Policy



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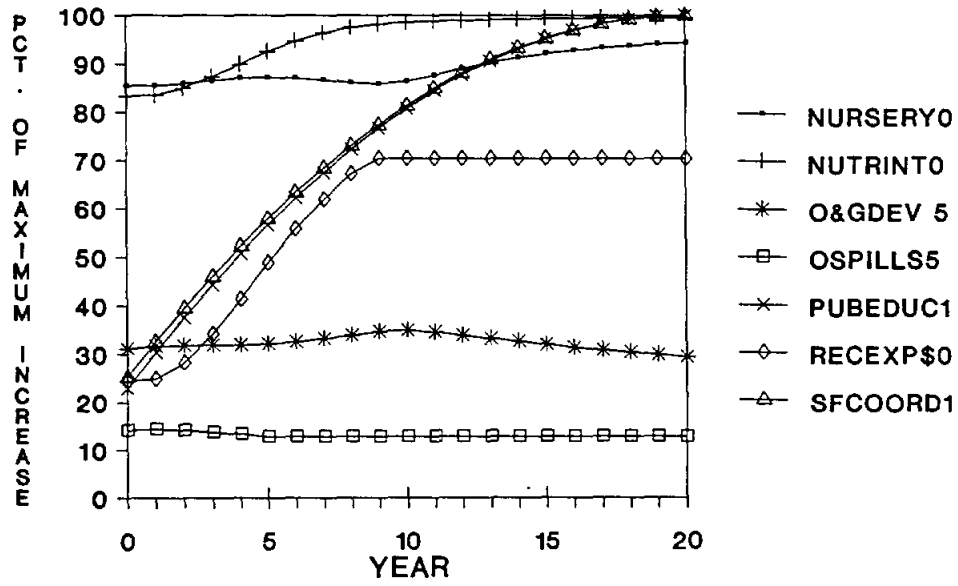
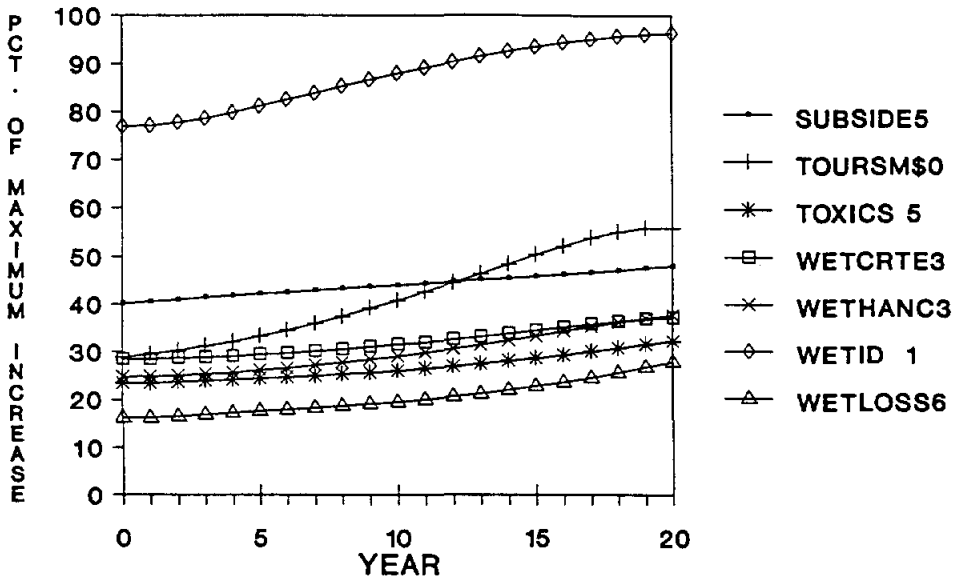
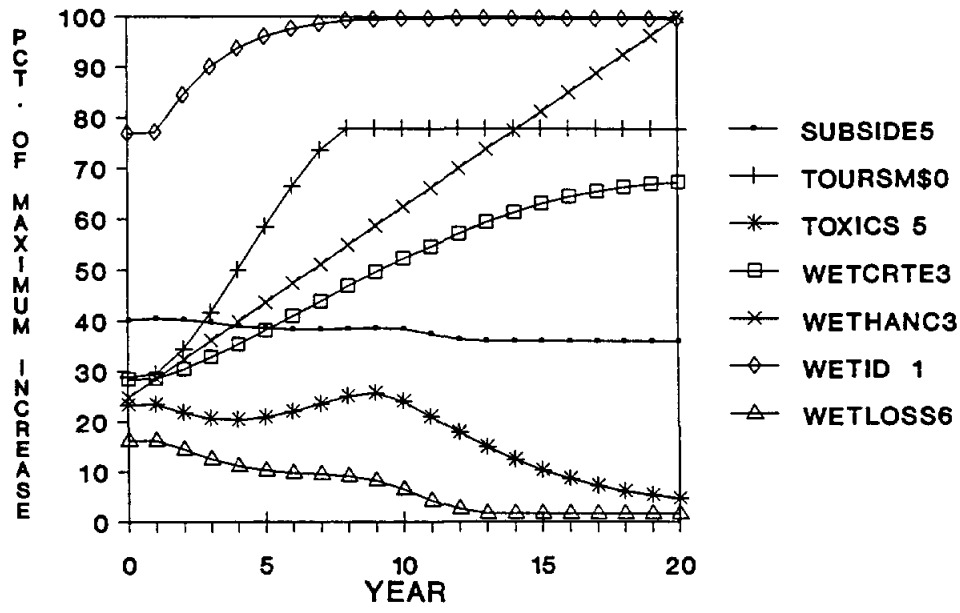


Wetlands

Simulated Trends for Current Policy

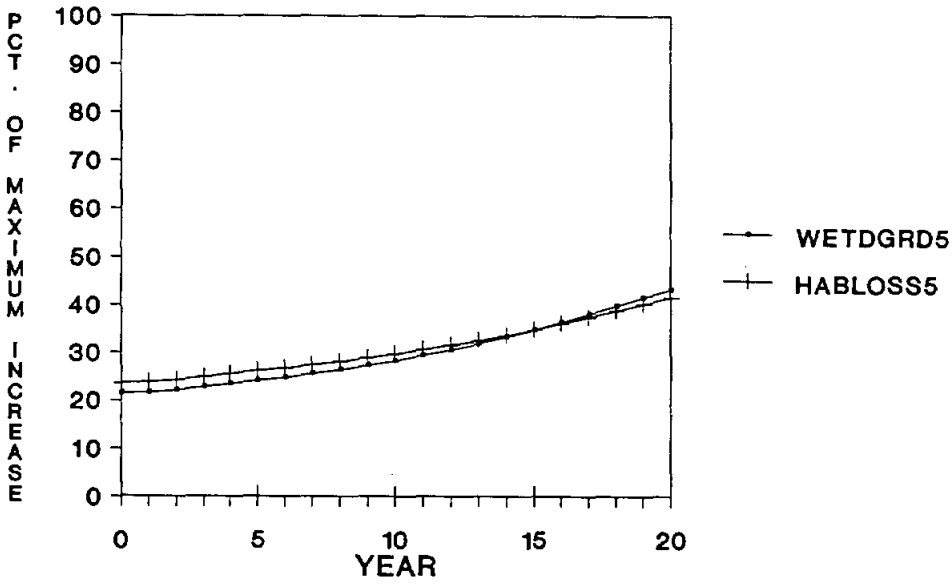


Simulated Trends for Recommended Policy



Wetlands

Simulated Trends for Current Policy



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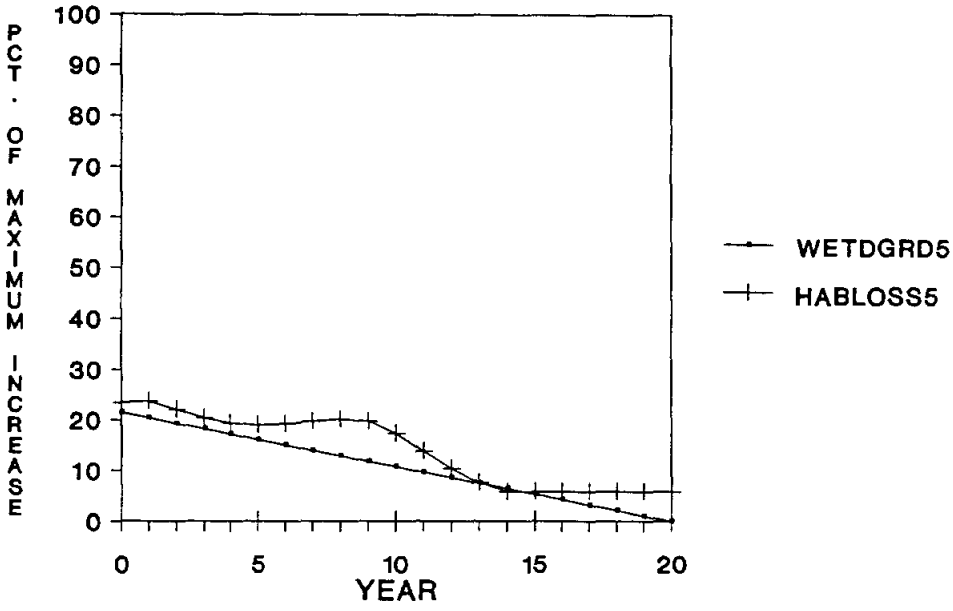

APPENDIX C
Region I Foundation Workshop

REGION I

PARTICIPANT LIST

John Arrington, *Galveston resident*
Peter Bowman, *University of Houston - Clear Lake*
Patsy Clapper, *Representative Mark Stiles*
Marty Conway, *Senator Carl Parker*
Dale Durr, *Chevron Chemical Co.*
John Eberling, *Gulf Coast Rod, Reel & Gun Club*
Russell E. Eitel, *Galveston Beach Environmental Committee*
Frank Frankovich, *Dannenbaum Engineering*
Richard Gorini, *Port of Houston*
Pat Halliseey, *Galveston County Parks Board*
Wilson Hillman, *Standley (commercial fishing)*
Neal Hunt, *Senator Chet Brooks*
James D. McNicholas, *Jefferson County Drainage District Committee*
Karen O'Neal, *Houston/Galveston Subsidence District*
A.R. "Babe" Schwartz, *lobbyist/attorney*
Eddie Seidensticker, *U.S. Soil Conservation Service*
Linda Shead, *Galveston Bay Foundation*
Gwen Smith, *Texas League of Women Voters*
Sam O. Smith, *Jefferson County Drainage District Committee*
Sharron Stewart, *Texas Environmental Coalition*
Robert Stroder, *Jefferson Co. Engineer*
Mary Ellen Summerlin, *Mayor, Port Arthur*
Steve Valerius, *Hollywood Marine, Inc.*
John Watson, *Mitchell Energy and Development*
Kerry Whelan, *Houston Power and Light*

REGION I
RANKED VARIABLE LIST

Issue: WETLANDS

RANK	VARIABLE	DEFINITION
1	Wetland Definition in Fed Manual	Breadth or Range
2	Planning	# Plans/Yr
3	Public Education	Time/Yr
4	State Interagency Coordination	MOUs/Yr
5	Inland Waterway Loss	# Breaks Through Barrier Islands
6	Wave Action	Frequency and Rise
7	Salinity	Ppt
8	Freshwater Inflows	Ac Ft/Yr
9	Bay Shoreline Vegetation	Area Covered
10	Intercoastal Dredging	Vol Sed Removed/Yr
11	Shoreline Boundary	Mean High Tide
12	Tourism	$ Generated/Yr
13	Wetland Permitted to be Destroyed	Acres/Yr
14	Wetland Creation	Acres Created/Yr
15	Population Density on Coastline	#/Sq Mile
16	Gen Fed/State Appr Man/Wetland	$/Yr
17	Boundary Disputes	#/Yr
18	Oil Spills	#/Yr
19	Wetland Identification	Acres/Jurisdictional
20	Regulations	Mi Affected/Yr
21	Bay Shoreline Erosion	Area Lost/Yr
22	Toxics in Freshwater Inflow	Concentration
23	Storm Events	#/Yr
24	Subsidence	In/Yr
25	Sea Level Rise	In/Yr
26	Compliance	Notices of Violation/Yr
27	Non-Point Pollution	Vol Above Tolerance Level/Yr
28	Dredged Spoil Reused	Vol/Yr
29	Wetland Value	Assigned Value
30	Point Source Pollution	Vol Above Tollerance Level/Yr

1 Problem for Region I

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 1 Wetland Definition in Federal Manual (Breadth of Range)	- An untenable and unacceptable amount of land in Texas will be classified as "Wetlands" due to the revised definition - Causes great economic costs to private and public interests - Lack of a clear definition of Wetland - The vast increase in areas now considered as jurisdictional under the new manual has caused great concern - Threatens total disruption of virtually all new development on the Gulf Coast	- GLO should work with other agencies to recommend revisions to Wetlands definition and manual to clearly outline criteria for determination - Must develop a clearer definition of what a wetland constitutes - Redefine wetlands or restore previous definition
# 2 Planning (Plans/Yr)	- Lack of planning that bridges the gap between the environment and human needs - Present planning is not comprehensible and with little enforcement - Areas/Habitats/Species are not being preserved	- Identify wetlands - More cooperation between government agencies - All state agencies shall comment on all 404 dredging permits and even turn down permits - Open discharge dredging prohibited - Repeal Texas Material Dredging Act - Map shoreline boundaries on the ground - Define how area can and cannot be used in Texas laws - Areas/Habitats/Species should have high priority in agency implementation
# 3 Public Education (Time)	- Lack of education creates part of the problems with the other variables	- Develop a state education program about all the variables identified - Educational material furnished by federal and state agencies to schools, youth activity groups and others - Public service television announcements should be aired to highlight specific wetland characteristics and values

1 Problem for Region I

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 13 Area Permitted to be Destroyed (Acres/Yr)	- Loss of habitat and loss of bay productivity and biotic diversity - Inability to produce anymore wetlands	- Better planning - Inter-agency coordination - Slow down and eliminate subsidence - More funding for creation, restoration and enhancement of wetlands - Beneficial uses of dredge material - Better regulations on development and water quality - Need close supervision of our marshes and appropriate laws to stop their destruction - Reduce or stop wetlands from being destroyed
# 14 Wetland Creation (Acres/Yr)	- Destruction of wetlands presents danger of extinction to wildlife and natural resources - Lack of wetlands creates more greenhouse effect - Wetlands are surrounded by development - Sea level rise will wipe out the wetlands	- Prevent development of residential and commerical use - Prevent pollution of wetlands - Preserve natural state of wetlands - Reserach into the method of creating wetlands
# 4 Interagency Coordination (MOUs/Yr)	- Lack of coordination at the policy level - Agencies competing; overlapping and conflicting jurisdictions	- Create institutionally an interagency board to deal with coastal issues
# 9 Bay Shoreline Vegetation (Acres Covered)	- Loss of habitat - Decrease in fisheries - Loss of diversity - Loss of water quality	- Public education - Wetland creation and plantings - Utilize dredge spoil on subsided areas - Tax incentives for private protection and management
# 21 Bay Shoreline Erosion (Area lost/Yr)	- Loss of habitat (i.e., vegetation, animals) - Loss of microbes for processing toxics - Causes more boundary disputes - Increases flooding in storm events	- Location and regulation of point and non-point pollutors (i.e., education and penalties) - Promote re-vegetation programs - Limit use and access where causing damage - Regulate freshwater inflow - Regulate sediment and nutrient trapping by upstream structures

1 Problem for Region I

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 22 Toxics in Freshwater Inflow (Concentration)	- Permanent damage has been done by private enterprise	- Increase monitoring of effluents from all industrial sites - Force industry to increase prices to support ecological treatment of effluents
# 28 Dredged Spoil Reused (Vol/Yr)	- Dredge material can help slow the erosion process and build up shoreline in low areas	- More pro-active stand by Texas Highway department toward working with the Corps of Engineers and other state agencies to develop sites for beneficial dredge disposal

APPENDIX D
Region II Foundation Workshop

REGION II

PARTICIPANT LIST

Anthony Amos, *University of Texas Marine Science Institute*
J.C. Barr, *Port Aransas City Government*
Hugo Berlaga, *Texas House of Representatives*
Paul Carangelo, *Port of Corpus Christi*
George Deshotels, *Matagorda County, Precinct 2*
Carl Duncan, *Commissioner, Precinct 2*
Sharon Weaver, *Representative Robert Early*
Alex Hernandez, *Calhoun County Judge*
Henry Hildebrand, *Environmental and fisheries*
William H. Holmes, Jr., *Boating Trades Association of Texas*
Todd Hunter, *Texas House of Representatives*
Ray Allen, *Central Power and Light*
Robert Jones, *University of Texas Marine Science Institute*
Ted Jones, *Environmental*
Kenneth Lester, *Mayor, Port Lavaca*
J.P. Luby, *Nueces County Commissioner*
David McKee, *Corpus Christi State University*
Joe Moseley, *Shiner, Moseley and Associates, Inc.*
Bob Mullen, *Builder*
Erma Patton, *Patton Sea Foods*
George Fred Rhodes, *Port Lavaca resident*
Harrison Stafford, II, *County government*
Charles Stone, *County government*
Mary Thorpe, *Del Mar College*
Vic Hines, *Senator Carlos Truan*
Ro Wauer, *National Audubon Society*
Willie Younger, *Texas A&M Marine Advisory Service*

REGION II
RANKED VARIABLE LIST

Issue: WETLANDS

RANK	VARIABLE	DEFINITION
1	Wetland Loss	Acres/Yr
2	Water Quality	Index Level
3	Biodiversity	Index
4	Freshwater Inflow	Vol/Yr
5	Nursery Habitat Marine Species	Area
6	Large Oil Spills	Barrels/Yr
7	Construction in Wetlands	Area Affected
8	Wetland	Area
9	Ecological Integrity	Area Undisturbed
10	Loss of Recreation Fisheries	$
11	Wetland Enhancement	Area Enhanced
12	Recreation Use	#/Area
13	Landscape Fragmentation	Pattern & Diversity
14	Wetland Creation	Area Created
15	Loss of Rec Fisheries	Harvest
16	Nutrient Contribution	Lbs/Yr
17	Public Indifference/Ignorance	Public Informed
18	Loss of Commercial Fisheries	Harvest
19	Pesticides	Lbs into Wetland
20	Dredging	Area Wetland Lost
21	Herbicides	Lbs into Wetland
22	Filling	Area Wetland Lost
23	Urban Non-Point Pollution	Toxicity
24	Pollutant Uptake	Lbs/Yr
25	Breeding Grounds for Birds	Area Suitable
26	Sediment Budget	Vol Available
27	Urban Non-Point Pollution	Volume
28	Available Data	Useful Information
29	Dredge Spoil Disposal	Vol Beneficial Use
30	Waterfowl	# Wintering

1 Problem for Region II

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action

# 1 	
Wetlands Loss
(Acres/Yr)
	- Wetlands - quality and quantity are critical keys of coastal ecosystems
	- Freshwater inflows impact quality
	- Economy depends on healthy wetlands
	- Present permit system allows destruction
	- Much of the current mitigation fails with a significant drop in productivity
	- Many activities by man impact on the wetlands
	- As wetlands are lost:
	  - Habitat is destroyed for the marine nurseries
	  - Wintering-ground for waterfowl
	  - Protection to upland areas
	- Loss of wetlands affects the entire ecosystem of the coastal region and the economic structure of the coastal population
		- Establish a program where the required mitigation could be done in "large blocks"
		- Establish system to mandate freshwater inflows by requiring storage in all reservoirs to be set aside for estuarine releases
		- Monitor all point source pollution and minimize
		- Monitor dredging
		- Monitor water needs of the wetlands and prioritize water uses for wetland preservation
		- Do marine studies on individual wetlands as to enhancement practices
		- Studies should be made before areas are disturbed
		- Protect from development that damages the wetlands
		- Sediment must be increased back to much higher levels
		- Escrow mitigation lands and have a central authority direct large scale wetland creation projects with the assistance and guidance of appropriate agencies and authorities
		- Install erosion control structures which protect and enhance wetlands
		- Evaluate and implement viable strategies which effectively reduce environmental stresses on wetlands
		- Educate the public on the causes and consequences of wetland losses
		- EIS on all construction within wetland areas
		- Continued study on man-made chemical action on the wetlands

1 Problem for Region II

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 3 Biodiversity (Index)	- Affects most other variables - Biodiversity has declined drastically in recent decades due to inappropriate land use that has evolved by lack of environment consensus - Biodiversity is important because it assures us of sustainable development	- Stringent enforcement of Endangered Species Act - Strict NEPA Process - Pass state environmental policy act - Form private wetlands trust to reduce mitigation confusion and to develop a coherent mitigation program - Educate and encourage local governments and industry to use artificial wetlands for pollution control - Enforcement and strengthening of inflow requirements for bay/estuaries - Restoration or construction of wetlands, the cost of which would be paid by persons required to provide mitigation - Initiate inventory of wetlands in state and rank them in order of ecological importance - Initiate communication and agreement with federal CZM program for funding support - Move forward with solid program that complies with CZM, request approval for state plan, and apply for funds that are available
# 28 Available Data (Useful information)	- Lack of description of wetlands - All other items on the list to some degree depend upon understanding the causes and effects of loss of wetlands and the development of management plans - Management cannot proceed without scientific input	- More data and definition of wetlands needed - Research and understand the thirty variables on the list - A coastal planning group should be formed to prioritize and coordinate this research. One agency should be the lead role and involve the others - There must be a long term source of research funding
# 7 Construction in Wetlands (Area Affected)	- Any blanket or selective prohibition of construction in the coastal zone would prove to be intolerable for the economic and social growth of the people of Texas. The oil and gas industry alone has endorsed and supported the concept of multiple use	- See that any Coastal Zone/Land Use plan include wherever possible the concept of multiple use

1 Problem for Region II

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 8 Wetlands (Area)	- Loss of wetlands has resulted in a significant population decline of certain species - Total wetland area is still declining as well as overall wetland quality	- No net loss of wetlands or decrease in wetland quality - Efforts to enhance, restore and create additional wetlands
# 11 Wetland enhancement (Area Enhanced)		- Projects that enhance the wetlands is an item that should be encouraged and permitted - This is an issue that law should control and available funding through grant money and local money should be made available - Task force of environmental organization to study and make recommendations to the GLO for action and funding
# 13 Landscape Fragmentation (Pattern & Diversity)	- Piece meal development and large engineering projects have resulted in loss, degradation or functionally useless wetlands on a landscape scale - Existing wetlands are subject to developmental pressure - Regulatory agencies have no basis for determining cumulative impact of proposed losses	- Focused study of historic and existing distribution of estuarine and palustrine wetlands - Focus on large scale habitat development projects applying beneficial use of dredged material - Societal choice of importance of wetlands for food - recreation - production - Review mitigation with reorganization of wetland impacts from sea level rise - Land planning of non-wetlands from existing wetland setbacks, deed restrictions and mapping - Allow enforcement action $ be used for studies
# 17 Public Indifference/ Ignorance (Public informed)	- An uninformed public doesn't understand the importance of wetlands to our overall ecological balance - Indifference will allow creeping destruction of our wetlands which will cause havoc with just about all of the other variables listed in this area	- Start environmental and ecology courses in Jr. and Sr. high school - Public information program - Add ecology information to hunter safety courses - Information pamphlets available to public
# 23 Urban Non-Point Pollution (Toxicity)	- The unseen and seen introduction of urban pollutants has been ignored - It destroys coastal water quality which diminishes wetland survivability	- Reduce dissolved and solid urban runoff - Identify & quantify sources - Pass legislation to force reduction - Public awareness

APPENDIX E
Region III Foundation Workshop

REGION III

PARTICIPANT LIST

Gary Becher, *City Manager's Office, SPI*
Sid Beckman, *Brownsville Navigation District*
Deyaun Boudreaux, *Texas Environmental Coalition*
Sudie Blakcburn, *Keep Brownsville Beautiful*
Calvin Byrd, *Mayor, Port Isabel*
Jack Campbell, *Brownsville Economic Development Council*
Mary Lou Campbell, *Sierra Club*
Ken Conway, *Cameron County Parks*
Ed Cooper, *Valley Sportsman Club*
Merriwood Ferguson, *Frontera Audubon Society*
J.A. Garcia, Jr., *Kenedy County Judge*
Joe Garcia, *Representative Eddie Lucio*
Antonio O. Garza, Jr., *Cameron County Judge*
Eustolio Gonzalez, *Senator Carlos Truan*
Wayne Halbert, *Harlingen Irrigation District*
Vic Hines, *Senator Carlos Truan*
Don Hockaday, *Coastal Studies Lab, University of Texas - Pan Am*
Herb Houston, *Alderman, SPI*
Darlene Caines, *SPI National Seashore*
Harris Lasseigne, Jr., *Texas Shrimp Association*
Robert Lerma, *Attorney*
Eddie B. Long, *Texas Pipe Trades Association*
Richard McInnis, *Gulf Coast Conservation Association*
Diana Munoz, *Representative Larry Warner*
Pete Pranis, *COSTEP*
Sonny Ramirez, *Businessman*
Mike Reuwsaat, *Kleberg County Park System, King Ranch*
Laurel Devaney, *Laguna Atascosa National Wildlife Refuge*
Rob Youker, *Lower RGV Boating Trades Assocation*

REGION III
RANKED VARIABLE LIST

Issue: WETLANDS

RANK	VARIABLE	DEFINITION
1	Wetland	Area
2	Wetland Loss	%/Yr
3	Endangered Species	#
4	Commercial Fisheries Value	$
5	Recreational Value	$
6	Wildlife Habitat Loss	Area Lost/Yr
7	Nursery Area	Area
8	Water Quality	Contaminants
9	Ownership (Private)	%
10	Management Plans	# of Good Ones
11	Dredge Spoil Placement	Vol Placed in Wetlands
12	Regulations	#
13	Boat Traffic Through Wetland	#/Day
14	Shorebird Habitat	Available Habitat
15	Municipal Runoff	Vol
16	Aquatic Vegetation	Quality
17	Waterfowl Population	#
18	Industrial Runoff	Vol
19	Ownership (Private/Dev)	%
20	Agricultural Runoff	Vol
21	Oil & Gas Development	# Wells Developed
22	Shoreline Vegetation	Density
23	Aquatic Vegetation	Density
24	Maintenance Dredging	Frequency
25	Spoil Disposal	Area Wetland Affected
26	Bayside Vegetation (Marsh)	Area
27	Water Quality	Salinity
28	Ownership (Public)	%
29	Freshwater Inflow	Frequency
30	Access Points (Public)	#

1 Problem for Region III

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 2 Wetland Loss (%/Yr)	- Loss of breeding grounds for a variety of species - Loss of economic value because of impact on tourist trade - Contributes to erosion - Impacts productivity of bays and estuaries - Pollutants in the wetlands - Urban growth - Lack of fresh water inflow - Loss of vegetation - Dredging - Oil & gas development - Draining for agriculture and industry	- Legislation to protect wetlands and developing unified large areas of wetlands - Prevent any further loss of wetlands - Replenish former wetlands and maintain at the proper levels to encourage natural breeding cycles - Increase public awareness and public education - Implement "no net loss" program - Eliminate dredge disposal in tidal flats and wetlands - Elminate oil and gas development in sensitive wetland areas - Identify non-point sources of pollution and enforce laws - Change no net loss to no loss of wetlands
# 1 Wetland (Area)	- Lack of healthy wetland for nursery, water fowl habitat - Lack of filter system - Protect what we have - Difficult to reclaim and return to natural state	- Use municipal sewage effluent to creat mini wetlands as water purification of local ponds, marshes - Allow swap of shorefront wetlands for land further inland that could be converted to wetland. Perhaps 2 new acres for one shorefront - Clean up effluents going into bays/rivers - Let rivers wander more, remove straightening measures - Enforce existing wetland regulations - Develop a mitigation plan that will replace wetlands that are destroyed - More control over development in the wetlands with detailed field investigations, stringent permit requirements and greater mitigation requirements

1 Problem for Region III

Issue: WETLANDS

Problem Variable	Problem Explanation	Proposed Action
# 6 Wildlife Habitat Loss (Area Lost/Yr)	- Loss of endangered and non-threatened species populations	- State environmental impact statement (NEPA model) - State wetland creation policy - Design artificial wetlands to achieve broad range of habitat enhancement - Develop coherent mitigation policy, coordination among agencies, to develop unified effective habits - Require inventory of RTC property for natural values and acquire significant properties - Net gain policy - 15% increase - The Corps of Engineering needs to do a better job of actually classifying wetlands - Stricter regulations concerning development in and around wetlands - Tougher runoff regulations - Better monitoring systems for both water quality and numbers and types of species
# 10 Management Plans (# of Good Ones)	- Lack of agreement by concerned parties	- Agencies/entities develop vehicles through which opposing groups can work to reach agreement on policy, programs, etc.
# 12 Regulations (#)	- Regulations dictate both human and non-human impacts on wetlands	- Assemble a data base on wetlands that includes values, cost/benefits and impacts - Develop and implement regulations and programs which regulate natural and man-made action on wetlands for the desired effect
# 27 Salinity (Hyper-salinity)	- Hyper-salinity is tied to the lack of freshwater inflow - Over channelization is causing salt water intrusion and killing certain species of plants - Loss of plant life increases erosion	- Keep "systems" in mind when planning any dredging - Develop water-shed based comprehensive plan; give as few variances as possible
# 29 Freshwater Inflow (Frequency & Quantity)	- Lack of water quality	- Appropriate water rights for Texas rivers to bay inflows - Further improve municipal water treatment in Texas to meet minimum standards - Allocate treated effluent appropriations to river recharge