ACTION PLAN 1 OF 2

COLLABORATE WITH RESEARCH INSTITUTIONS TO SUPPORT FOCUS AREA APPLIED RESEARCH AND MONITORING (RES)

Scientific research forms the basis for models that predict or describe ecosystem function, justifies standards, and supports every aspect of the regulatory process. It is crucial to successful management of Galveston Bay and its resources.

Diverse concerns relating to aquatic habitat, wildlife, resource usage, water quality, and human health cannot be adequately addressed without the involvement of multiple natural-resource agencies and bay stakeholders. Challenges of a more regional nature – those affecting the entire ecosystem – require regionally coordinated efforts and a strong commitment to partnership.

The GBEP facilitates these partnerships to support an ecosystem-based approach by establishing research focus areas, defining the overall goals of research, and coordinating activities within a set of established priorities. The GBEP provides perspective and guidelines through assessments and regular interaction with scientists, bay managers and users, private industry, and the public to identify research needs. The GBEP then helps researchers match prioritized research needs with existing and potential funding services. Nonprofit organizations and environmental organizations, as well as universities, help with this process and leverage funding for more research.

> "There is a lot of practical value in learning how natural systems work, {and} how human activities and other influences perturb these systems, what causes these perturbations, how changes in one system affect other systems; and how knowledge may guide well-informed choices about means of transforming or restoring ecologic systems." *(Omenn, 2006, p. 1697)*

Example of Applied Research and Monitoring Action Implementation

During development of *GBP'18*, the GBEP and its partners emphasized the need for continued collaboration with research institutions, as well as between the subcommittees of the Council, on applied research and coordinated monitoring activities.

There have been many such successful collaborations since release of *GBP'95*, notably the Coastal Restoration Assessment. This project was a multipartner effort that began in 2007 and is still ongoing at publication of this document. Coastal marsh ecosystems anchored by smooth cordgrass (*Spartina alterniflora*) are some of the most highly productive ecologic communities in the lower Galveston Bay watershed, providing many ecologically

critical functions and services. In response to substantial loss of these ecosystems over the past 50 years, active restoration of numerous coastal wetland systems has been undertaken. Research on restoration techniques and success occurred in conjunction with replanting projects. The GBEP, in partnership with Lee College and the University of Houston-Clear Lake, examined whether functional differences are achieved through different marsh restoration techniques on a series of restored wetlands within Pierce Marsh, located in the lower Galveston Bay watershed. While the best methodology for marsh restoration has yet to match naturally occurring marsh ecologic functional development, this research demonstrated a successful collaboration between the NRU and M&R subcommittees of the Council and has informed additional restoration research efforts. This project is an example of how the GBEP and its partners support resource management through targeted research that increases ecosystem understanding.

Action Plan Overview

The RES Action Plan includes eight Actions to support applied research and monitoring in the Galveston Bay watershed. To increase understanding of the Galveston Bay ecosystem, specialized monitoring and research of biological stressors (**RES-1**), geochemical stressors (**RES-2**), and physical stressors (**RES-3**) must be conducted. Successful implementation of all three Actions requires coordination of all four subcommittees of the Galveston Bay Council and is necessary to the protection and preservation of Galveston Bay. Physical stressors include, but are not limited to, physical impacts to the estuary such as erosion (**HC-3**), litter (**PEA-1**, **NPS-2**), and freshwater inflows (**FWI-2**).

To better understand the factors that limit safe human use of Galveston Bay, a characterization of public contact recreation affected by waterborne pathogens and bacteria must occur to identify new or emerging pathogen indicators (**RES-4**). It is essential to identify sources of pollution, including legacy pollutants and run-off that impact seafood consumption in order to establish appropriate remediation activities (**RES-5**). Successful implementation of **RES-4** requires coordination with the WSQ subcommittee of the Council on Actions **PHA-2** and **PHA-3**, included under Plan Priority One: Ensure Safe Human and Aquatic Life Use. **RES-5** will require coordination on Actions **PHA-1**, **PHA-4**, and **PHA-5** included under Plan Priority One: Ensure Safe Human and Aquatic Life Use.

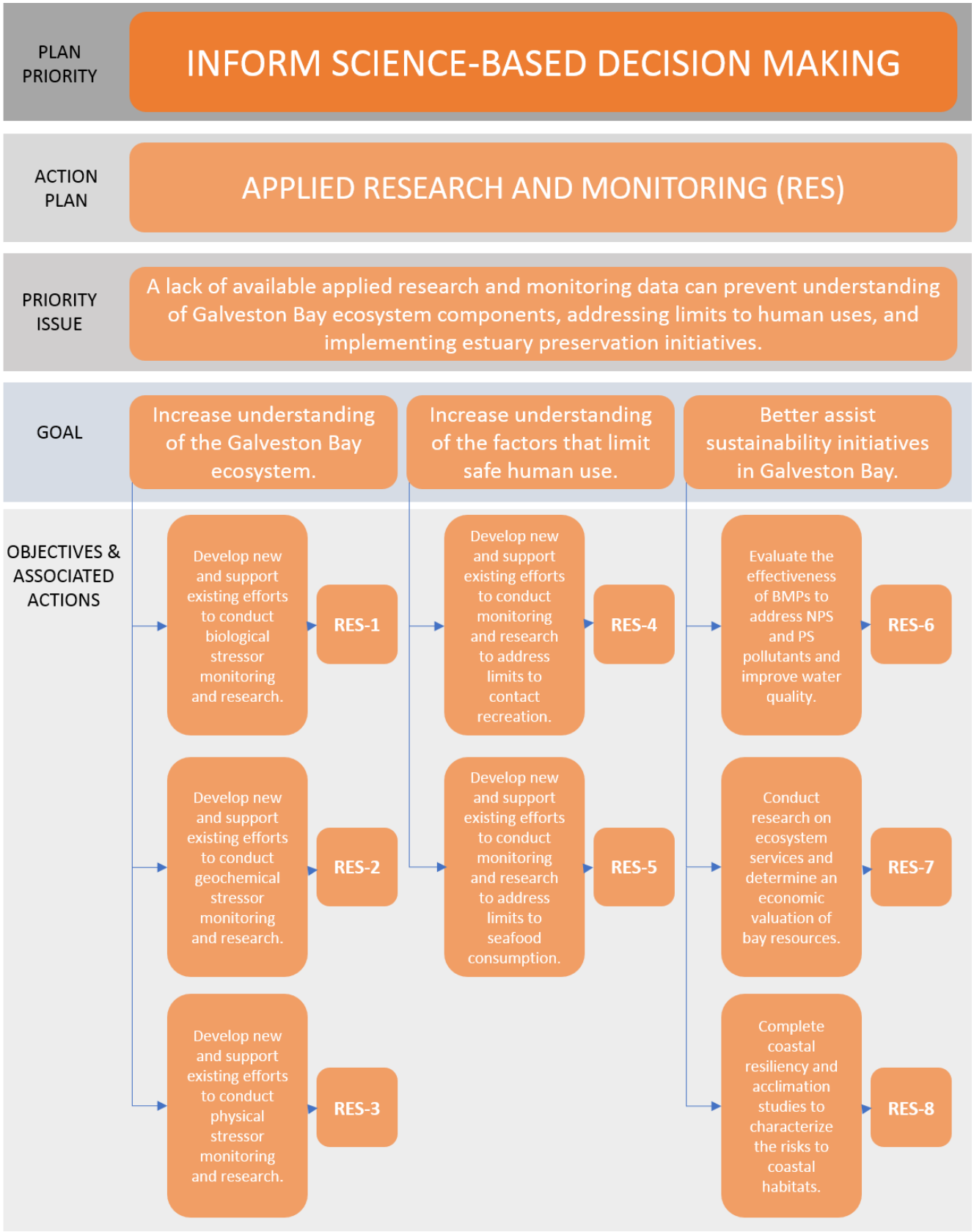
Understanding the limits to Galveston Bay's resiliency requires knowledge about BMP effectiveness for improved water quality (**RES-6**), determination of ecosystem services (**RES-7**), and the study of resiliency risk for coastal habitats (**RES-8**). Successful implementation of **RES-6** requires coordination with the WSQ Subcommittee of the Council on Action **NPS-3**, included under Plan Priority One: Ensure Safe Human and Aquatic Life Use.

FIGURE 30
RES ACTION PLAN MATRIX

ACTION PLANS AND CORRESPONDING ACTIONS			PLAN PRIORITIES			
			Ensure Safe Human and Aquatic Life Use	Protect and Sustain Living Resources	Engage Communities	Inform Science-Based Decision Making
Action Plan: Collaborate with Research Institutions to Support Focus Area Applied Research and Monitoring (RES)						
	RES-1	Conduct Biological Stressor Monitoring and Research	x	x	x	x
	RES-2	Conduct Geochemical Stressor Monitoring and Research	x	x	x	x
	RES-3	Conduct Physical Stressor Monitoring and Research	x	x	x	x
	RES-4	Conduct Monitoring and Research to Address Limits to Contact Recreation	x		x	x
	RES-5	Conduct Monitoring and Research to Address Limits to Seafood Consumption	x		x	x
	RES-6	Evaluate Best Management Practice (BMP) Projects	x		x	x
	RES-7	Conduct Research on Ecosystem Service and Economic Valuation of Bay Resources				x
	RES-8	Complete Coastal Resiliency and Acclimation Studies				x

Further information is given for the following: HC-3, page 81; PEA-1, page 116; NPS-2, page 49; FWI-2, page 96; PHA Actions, pages 64-68; NPS-3, page 50.

FIGURE 31
APPLIED RESEARCH AND MONITORING ACTION PLAN



RES-1

Conduct Biological Stressor Monitoring and Research

Objective: Develop new and support existing efforts to conduct biological stressor monitoring and research.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are evaluating the influence of biological stressors (these may include, but are not limited to, harmful algal blooms, *Toxoplasma gondii*, *Perkinsus marinus* {Dermo}, invasive species, and commercial and recreational harvest) on aquatic, semi-aquatic, and terrestrial species populations.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present biological stressor research results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect data and share biological stressor research results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of biological stressor research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate biological stressor research results into the *State of the Bay Report*.	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of biological stressor research studies completed.
2. Number of biological stressor white papers, presentations, and workshops completed.
3. Number GBEP website visits.

REFERENCES

GBP'95: Regional Monitoring Plan**,** RSC-2**,** RSC-3**,** RSC-4, PH-2, PH-3, SP-1, SP-2, SP-3, SP-4, SP-5, SP-8, SP-10
SAP Reference: Ecosystem and Human Health - Sustain and Restore Native Species Populations: Goal 1 / Objective A / Objective D; Ecosystem and Human Health - Sustain and Restore Native Species Populations: Goal 2 / Objective B **;** Ecosystem and Human Health – Water and Sediment Quality: Goal 1 / Objective C / Objective D**;** Monitoring and Research: Goal 1 / Objective A **;** Monitoring and Research: Goal 2 / Objective D**;** Monitoring and Research: Goal 1 / Objectives A and B, Goal 2: Objectives A, B, C, D**;** Freshwater Inflow and Bay Circulation: Goal 1 / Objective B

RES-2

Conduct Geochemical Stressor Monitoring and Research

Objective: Develop new and support existing efforts to conduct geochemical stressor monitoring and research.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are investigating the effect of geochemical stressors (e.g., eutrophication, biomagnification of legacy toxins, and endocrine disrupters) on aquatic, semi-aquatic, and terrestrial species populations found in the Galveston Bay watershed. They will also evaluate fate and transport through the environment and develop baselines for future comparison.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present geochemical stressor research results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect geochemical stressor research data and share results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of geochemical stressor research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate geochemical stressor research results into the *State of the Bay Report*.	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of geochemical stressor research studies completed.
2. Number of geochemical stressor white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: Regional Monitoring Plan, RSC-2, RSC-3, RSC-4, PH-1, SP-10, WSQ-1, WSQ-2, WSQ-6, WSQ-7, NPS-3
SAP Reference: Ecosystem and Human Health - Sustain and Restore Native Species Populations: Goal 1 / Objective A / Objective D ; Ecosystem and Human Health - Public-Health Protection: Goal 3 / Objective A; Ecosystem and Human Health - Public-Health Protection: Goal 2 / Objective B; Monitoring and Research: Goal 1 / Objective A ; Monitoring and Research: Goal 2 / Objective D; Monitoring and Research: Goal 1 / Objectives A and B, Goal 2: Objectives A, B, C, D; Public-Health Protection: Goal 1/ Objective C, Goal 2/ Objective B, Goal 3, Objective Freshwater Inflow and Bay Circulation: Goal 1 / Objective B

RES-3

Conduct Physical Stressor Monitoring and Research

Objective: Develop new and support existing efforts to conduct physical stressor monitoring and research.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are studying the influence of physical changes to the estuary (e.g., litter and illegal dumping, modified freshwater inflows, bay circulation, coastal erosion, shoreline hardening, land use changes, and loss or fragmentation of habitats) on aquatic, semi-aquatic, and terrestrial species populations found in the Galveston Bay watershed.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present physical stressor research results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect physical stressor research data and share results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of physical stressor research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate physical stressor research results into the *State of the Bay Report.*	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

Houston Wilderness
Texas Living Waters Project / National Wildlife Federation
Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of physical research stressor studies completed.
2. Number of geochemical stressor white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: HP-3, FW-5, FW-7, RSC-2, SM-4
SAP Reference: Monitoring and Research: Goal 1 / Objectives A and B, Goal 2: Objectives A, B, C, D; Ecosystem and Human Health - Sustain and Restore Native Species Populations: Goal 1 / Objective A / Objective D; Ecosystem and Human Health - Freshwater Inflow and Bay Circulation: Goal 1 / Objective B

RES-4

Conduct Monitoring and Research to Address Limits to Contact Recreation

Objective: Develop new and support existing efforts to conduct monitoring and research to address limits to contact recreation.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are initiating and completing studies that characterize the public's contact recreation risks from waterborne pathogens in Galveston Bay and its tributaries. Partners are conducting bacteria source tracking to characterize sources of pathogens and evaluate the emergence of new pathogen indicators.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present contact recreation research results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect contact recreation research data and share results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of contact recreation research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate contact recreation research results into the *State of the Bay Report*.	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

GLO
EPA
Local Governments
TCEQ
USGS
Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of contact recreation research studies completed.
2. Number of contact recreation white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: PH-3, RSC-2
SAP Reference: Monitoring and Research: Goal 1 / Objectives A and B, Goal 2: Objectives A, B, C, D; Public-Health Protection: Goal 1 / Objective C

RES-5

Monitoring and Research to Address Limits to Seafood Consumption

Objective: Develop new and support existing efforts to conduct monitoring and research to address limits to seafood consumption.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are identifying sources and evaluating remedial actions to address legacy pollutants, run-off, illegal dumping, and air deposition that can affect the size of recreational shellfish harvest areas or number of seafood advisories. Known pollutants of concern include PCBs, dioxins, and mercury.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present seafood consumption limitation research results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect seafood consumption research data and share results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of seafood consumption research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate seafood consumption research results into the *State of the Bay Report.*	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

City of Houston
EPA
Food and Drug Administration
Houston Wilderness
NOAA
Research Institutions
TCEQ
Texas Department of State Health Services
Texas Parks and Wildlife Department

PERFORMANCE MEASURES

1. Number of research studies conducted addressing limits to seafood consumption completed.
2. Number of limitation of seafood consumption white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: PH-1**,** WSQ-2**,** RSC-2
SAP Reference: Ecosystem and Human Health - Public-Health Protection: Goal 2 / Objective B**;** Ecosystem and Human Health - Public-Health Protection: Goal 3 / Objective A**;** Monitoring and Research: Goal 1 / Objective A; Monitoring and Research: Goal 2 / Objective C

RES-6

Evaluate Best Management Practice Projects

Objective: Evaluate the effectiveness of BMPs to address NPS and PS pollutants and improve water quality.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are evaluating data from BMPs or from future planned BMPs. Partners will monitor new BMPs to collect stormwater run-off in watersheds with impaired waters.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present BMP project results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect data and share present BMP project results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of BMP project research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate BMP project results into the *State of the Bay Report*.	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

Houston Wilderness
Local Governments

Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of BMP project evaluations completed.
2. Number of BMP project evaluation white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: NPS-2, NPS-5, NPS-11, RSC-2
SAP Reference: Ecosystem and Human Health – Water and Sediment Quality: Goal 1 / Objective C; Monitoring and Research: Goal 1 / Objective A; Monitoring and Research: Goal 2 / Objective C

RES-7

Evaluate Ecosystem Services and Determine Economic Valuation

Objective: Conduct research on ecosystem services and determine an economic valuation of bay resources.

Priority Issue: A lack of available applied research and monitoring data can prevent understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are describing the ecosystem services provided by Galveston Bay and upland habitats and determining an economic value for each.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present ecosystem services and economic valuation results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect ecosystem services and economic valuation data and share results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of ecosystem services and economic valuation research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate ecosystem services and economic valuation results into the *State of the Bay Report*.	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

Houston Wilderness

Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of ecosystem service and economic evaluation research studies conducted.
2. Number of ecosystem service and economic evaluation white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: N/A
SAP Reference: Ecosystem and Human Health - Habitat and Landscape Level Conservation: Goal 1 / Objective A / Objective D; Monitoring and Research: Goal 1 / Objective A; Monitoring and Research: Goal 2 / Objective D

RES-8

Complete Coastal Resiliency and Acclimation Studies

Objective: Complete coastal resiliency and acclimation studies to characterize the risks to coastal habitats.

Priority Issue: A lack of available applied research and monitoring data can prevent the understanding of Galveston Bay ecosystem components, addressing limits to human uses, and implementing estuary preservation initiatives.

Description: The GBEP and its partners are characterizing the risks to coastal habitats from changing sea levels, altered precipitation patterns, and changes to the frequency and size of tropical systems. Partners will determine the effects and ecosystem adaptations to a changing environment.

Implementation location: Lower Galveston Bay watershed.

ACTIVITIES	TIMEFRAME AND OUTPUT(S)	IMPLEMENTATION COST
Present coastal resiliency research results at the State of the Bay Symposia.	Within 2-5 years, host a State of the Bay Symposium.	$0 - $200,000
Collect coastal resiliency research data and share results and partner publications through GBEP website.	Within 2-5 years, collect data and share results through GBEP website.	$200,000 - $1 Million
Support the development and public delivery of coastal resiliency research.	Within 2-5 years, provide support on the development and public delivery of white papers, technical presentations, and workshops (number TBD).	$0 - $200,000
Incorporate coastal resiliency research results into the *State of the Bay Report*.	On a cycle of every 5-10 years, use research data to create the *State of the Bay Report.*	$0 - $200,000

POTENTIAL IMPLEMENTERS

Various Research Institutions, Agencies, and Nonprofit Organizations

PERFORMANCE MEASURES

1. Number of coastal resilience and assimilation research studies conducted.
2. Number of coastal resilience and assimilation white papers, presentations, and workshops completed.
3. Number of GBEP website visits.

REFERENCES

GBP'95: N/A
SAP Reference: Monitoring and Research: Goal 1 / Objective A; Monitoring and Research: Goal 2 / Objective D