RESTORE Council Proposal Document

General Information

Proposal Sponsor: Texas Commission on Environmental Quality (TCEQ)

Title:
Shoreline Protection Through Living Shorelines

Project Abstract:
Texas, through the Texas Commission on Environmental Quality (TCEQ), is requesting $15M in Council-Selected Restoration Component funding for the Shoreline Protection Through Living Shorelines program. This would include $1,575,000 in planning and project management funds as FPL Category 1, as well as a separate $13,425,000 implementation component as an FPL Category 2 priority for potential funding. The program will support the primary RESTORE Comprehensive Plan goal to restore and conserve habitat through the construction of large-scale living shorelines that will stabilize estuarine shorelines and protect large tracts of land and coastal resources along the Texas coast. The program will target highly eroding shorelines along the Gulf Intracoastal Waterway, vulnerable bay shorelines, and locations that have been identified as suitable areas for a living shoreline installation. This program will also address degrading coastal structures that need repair, such as critical seawalls, and add living shoreline elements to enhance their protective capabilities. The program will utilize specified criteria for selecting projects that were identified earlier through public meetings and as part of a stakeholder process.

Living shorelines can reduce damage to shorelines by dampening wave action and trapping sediments, elevating shore profiles to a level that will support marsh vegetation. This program will also provide ecosystem services by creating hard structure habitats for fish and oysters, nutrient and sediment removal, seagrass protection, and water quality improvement. Program duration is 4 years.

FPL Category: Cat1: Planning/ Cat2: Implementation

Activity Type: Program

Program: Shoreline Protection Through Living Shorelines

Co-sponsoring Agency(ies): N/A

Is this a construction project?:
Yes

RESTORE Act Priority Criteria:
(I) Projects that are projected to make the greatest contribution to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region, without regard to geographic location within the Gulf Coast region.
(II) Large-scale projects and programs that are projected to substantially contribute to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast ecosystem.
(III) Projects contained in existing Gulf Coast State comprehensive plans for the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and

coastal wetlands of the Gulf Coast region.

Priority Criteria Justification:
This program will meet three of the RESTORE Act Priority Criteria:
1. Projected to make the greatest contribution to restoring and protecting natural resources
This program will protect and restore shorelines and the habitats they provide and discourage the use of traditional armoring methods that impede the development of natural environments. In some cases large tracts of critical marsh habitat will be protected from erosion.

2. Large-scale projects and programs
This program includes a variety of individual, large-scale living shorelines along the Texas coast whose combined impacts would be substantial and serve as a demonstration to local communities on the effectiveness of nature-based solutions over traditional armoring techniques. The combined benefits of each project within the program will increase the resiliency of the Texas coast by providing for shoreline stabilization, increased habitat, and a buffer against the effects of storms and sea level rise.

3. Contained in existing Gulf Coast State comprehensive Plans
Most of the prospective projects in this program that were evaluated by the Texas FPL3b working group were sourced from the 2019 Texas Coastal Resiliency Master Plan (TCRMP), the state comprehensive coastal plan for Texas. Each project ranked highly in the TCRMP Tier 1 project list with high scores from the Technical Advisory Committee (TAC) members. The TAC was comprised of coastal experts from state and federal agencies, NGOs, local governments, academics, and engineering firms (TGLO, 2019).

Project Duration (in years): 4

Goals

Primary Comprehensive Plan Goal:
Restore and Conserve Habitat

Primary Comprehensive Plan Objective:
Restore and Enhance Natural Processes and Shorelines

Secondary Comprehensive Plan Objectives:
N/A

Secondary Comprehensive Plan Goals:
N/A

PF Restoration Technique(s):
Create, restore, and enhance coastal wetlands, islands, shorelines and headlands: Protect natural shorelines

Location

Location:
Texas Coastwide

HUC8 Watershed(s):
Texas-Gulf Region(Neches) - Neches(Lower Neches)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(East Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(West Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Austin-Oyster)
Texas-Gulf Region(Lower Colorado-San Bernard Coastal) - San Bernard Coastal(East Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(East Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(West Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(West San Antonio Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(Aransas Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(North Corpus Christi Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(South Laguna Madre)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Sabine Lake)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(North Laguna Madre)

State(s):
Texas

County/Parish(es):
TX - Aransas
TX - Brazoria
TX - Calhoun
TX - Cameron
TX - Chambers
TX - Galveston
TX - Jefferson
TX - Matagorda
TX - Nueces
TX - Orange
TX - San Patricio

Congressional District(s):
TX - 27
TX - 14
TX - 36
TX - 34

Narratives

Introduction and Overview:

The Shoreline Protection Through Living Shorelines program will construct large-scale living shorelines to protect estuarine shorelines and marshes from loss due to erosion along erosional hotspots on the Texas coast. This program may also address degrading coastal protective structures that need repair, such as critical seawalls, and add living shoreline elements to enhance their protection capabilities. Living shorelines can reduce damage to shorelines by dampening wave action and trapping sediments, elevating sub-aqueous shore profiles to a level that will support marsh vegetation. Living shorelines consist of either marsh plantings or oyster reefs alone in low energy environments, or rock breakwaters combined with marsh vegetation in moderate energy environments. This program will provide ecosystem services by creating hard structure habitats for fish and oysters, nutrient removal, sediment retention, seagrass protection, and water quality improvement (Davis et al., 2006; Gittman et al., 2014; Gittman et al., 2016). The program will offer the Texas coast an alternative to hard structuring methods such as sheet piling and bulkheads that result in decreased species diversity, carrying capacity and productivity by preventing the development of critical natural environments like flats, marshes, mangroves, and beaches (Dugan et al., 2011; Dugan et al., 2018; Prosser et al., 2018). A number of factors have contributed to bay and channel shoreline loss, including boat traffic, altered sediment regimes, and increasing rates of relative sea level rise (Sweet et al., 2017; Prosser et al., 2018). As a result, growing numbers of private and public waterfront landowners are looking to harden or armor shorelines to stop or reduce rates of shoreline loss, which has produced a patchwork of bulkheads and riprap along the shore. The length of armored shoreline increased by approximately 376 miles along the Texas coast from the 1990's to 2010's (HRI analysis of ESI shoreline type maps). Unprotected shorelines, however, are vulnerable to storms, floods, land loss, and sea level rise, along with the daily erosive forces of wind, wave, and tidal energy (Kennish, 2001; Lotze et al., 2006; Leonardi et al., 2016).

The construction of living shorelines on the Texas coast will help stabilize shorelines while creating new and protecting existing critical environments. Living shorelines incorporate nature-based solutions to fully or partially reduce the impact of erosive forces while allowing natural processes to take place (Bilkovic et al, 2016; Gittman et al., 2016). Living shorelines work best in lower energy environments such as bay and estuary systems or other protected areas. Living shorelines are designed according to their specific location and contain several natural components that work together, including native or mixed vegetation, oyster reef, and seagrasses. These features can be adaptable, changing and growing over time as conditions change around them. They also increase coastal resiliency by providing effective protection from storm impacts, such as storm surge and storm water flow (Swann, 2008; Smith et al., 2018).

Past successful living shoreline projects implemented in Texas include Clear Lake Forest Park on Galveston Bay and the Shipe Woods living shoreline on Trinity Bay. Both living shorelines were constructed with funding from NOAA and the Galveston Bay Foundation. The two projects are on higher energy, eroding shorelines and include breakwater elements combined with marsh plantings (GBF, 2014).

This program aims to construct individual, large-scale living shorelines that protect large tracts of land and coastal resources, targeting highly eroding shorelines along the GICWW, vulnerable bay shorelines, and locations that have been identified as suitable areas for living shoreline installation. The program will develop a process for selecting locations for living shorelines that builds on Texas' stakeholder-driven process for developing the Planning Framework and for selecting preliminary projects for FPL3 consideration. During this earlier work, county governments, NGOs, and a workgroup made up of Texas NRDA and Texas Coastal Resiliency Master Plan (TCRMP) representatives submitted 38 projects for FPL3 consideration. Coastal experts, HRI staff, and TCEQ

staff reviewed the projects and selected 23 for public comment. Among these 23 projects, one project included 21 individual living shorelines that this program will consider for implementation (see table and map). The 21 independent project sites that were evaluated by the Texas FPL3 working group were sourced from the TCRMP Tier 1 project list, which were highly scored by a Technical Advisory Committee comprised of local, state, and federal experts and local governments (TGLO, 2019). The TGLO is the state permitting agency for living shoreline projects in Texas and has experience partnering with local NGOs like Galveston Bay Foundation, Matagorda Bay Foundation, and Coastal Bend Bays and Estuaries Program to implement shoreline stabilization projects. Each project may have a different sponsor depending on the region where the project will be implemented.

This program will also consider the living shoreline components of projects that were assessed during the Texas FPL3 review process. A key assessment for project acceptance will be consideration of the suitability of using living shoreline techniques for specific locations and objectives. The potential sites vary in their coastal setting and may require different methods of living shoreline implementation, described further in the methods section below.

This program is requesting $15,000,000 in funds for an estimated program duration of 4 years. In general, the first year will focus on selecting ideal sites for program activities. Year two will consist of engineering and design. Years three and four will span construction and monitoring activities. The cost of a living shoreline project will vary based on size, method used, location, materials, plants selected, permitting and engineering requirements and complexity. Because of the wide array of living shoreline techniques, it's difficult to calculate a standard cost for each project. Although hard stabilization techniques are preferred by landowners as they typically have well-defined and easily understood cost parameters, less frequently taken into consideration are the hidden costs associated with the structure's gradual failure over their 15 to 20-year lifespan and the significant land loss that can occur as a bulkhead collapses and the land is converted back to open water. Many factors may affect the cost of a living shoreline, including:

- Permitting and surveying costs
- Engineering and design of the project
- Shipping of materials
- Accessibility and procurement of materials such as recycled shell, reef dome materials, crushed or bagged concrete, limestone, stone, etc.
- Annual or bi-annual project monitoring and maintenance (e.g., additional vegetation plantings, removal of debris at the project site, possible repositioning of structural project components)

The projects within the program will be scalable. Several independent project sites will be identified with distinct line item budgets for each component. The project can be phased with construction at each site. If funded for less than the requested amount, projects within the program can be scaled down (for example, reducing the length of shoreline) or reduced in number.

This program addresses 2016 update to the Comprehensive Plan by using the best available science for shoreline restoration, developing a monitoring and data management framework, and defining metrics of success of the living shoreline projects. Additionally, this program conforms to the Planning Framework by adhering to the priority to create, restore and enhance coastal wetlands, islands, shorelines, and headlands. The program also has the potential to restore natural processes and build oyster habitat along suitable portions of the Texas coast.

Potential partners could include the Texas General Land Office, who are responsible for non-federal permitting of living shorelines in Texas. The TGLO has identified potential activities included in this

program in the 2019 Texas Coastal Resiliency Master Plan. Additional partners could include local NGOs in targeted areas with experience in living shoreline implementation.

Proposed Methods :

This program aims to construct large-scale living shorelines on highly eroding shorelines along the GICWW, vulnerable bay shorelines, and locations that have been identified as suitable areas for beneficial placement of dredge materials. The program will develop a process for selecting locations for living shorelines that builds on Texas' stakeholder-driven process for developing the Planning Framework and for selecting preliminary projects for FPL3 consideration. The geographic scope of this project includes a large portion of Texas coast and would consider numerous sites along the GICWW and bay systems. A key component of this program will be identifying the ideal technique for the identified targeted locations. In general, the living shoreline design and implementation process will follow these steps:

1. Identify priority areas and analyze site-specific information
2. Engineering and design
3. USACE & TGLO Permitting
4. Oversee bidding and contractor selection
5. Construction
6. Monitoring and adaptive management.

The type of living shoreline the individual projects in this program will implement must be location-specific. Living shorelines are not a one size fits all mechanism - they are versatile and can be designed and tailored to fit the specific conditions at that site (Morris et al., 2018). Site conditions that will affect living shoreline design include water depth, wave energy and the current rate of erosion. Living shorelines can be completed in phases that can be built up over time, as budget allows. For example, planting native vegetation could first be installed along the existing shoreline. Over time and if needed, an offshore breakwater could then be installed for an additional layer of protection.

In general, there are two main living shoreline techniques– soft stabilization and hybrid stabilization. Determining which type of living shoreline is best suited is the first step toward implementation. Each technique works best in a specific set of conditions and has several associated implementation methods to decrease erosion, protect the shoreline and prevent land loss.

Soft stabilization methods are non-structural in nature and involve planting marsh grasses or placing oyster reef along the existing shoreline. In hypersaline parts of the coast, the use of benthic algal mats may be implemented where vascular plants do not grow well (Pulich and Rabalais, 1986). These techniques work best on shallow, low-energy shorelines. Marsh grass planting involves the placement of native plants, such as native low marsh (Spartina alterniflora) and high marsh (Spartina patens) species, planted along the existing shoreline. Plant roots help hold soil in place and shoots will break small waves and increase sediment deposit. Marsh planting projects may be designed and constructed as a component of a larger project or done as a stand-alone project. Shoreline grading or the addition of sediment may be needed to obtain appropriate elevations, to provide a suitably gradual slope for marsh creation, or to enable a marsh to maintain its elevation with respect to sea level rise. This technique can create a variety of habitats, including salt marsh, a tidal buffer landward of the salt marsh, coastal beach, and mud flat.

Another soft stabilization technique commonly used is creating submerged oyster shell beds by placing a hard substrate, often recycled oyster shells or crushed concrete, limestone, or river rock on the seafloor and seeding them with oyster larvae. The larvae attach to the shells or rocks and begin to grow. Oyster shell-based living shorelines will primarily be an option on the mid-Texas coast. This technique creates habitats such as shellfish reef and structure for fisheries habitat (Scyphers et al.,

2011).

Hybrid stabilization methods incorporate the living materials used in soft techniques combined with the construction of breakwater features to provide additional erosion protection and increase sediment retention. This technique is suited for low to moderate energy shorelines. Low-profile breakwaters are constructed nearshore or along the shoreline to break waves, reduce erosion and promote accumulation of sand and gravel landward of the structure (Hardaway et al., 2019). Nearshore low-profile breakwaters typically have marsh grass plantings appropriate for salinity and site conditions behind them. Materials required generally include living reef materials (oysters/mussels) or precast concrete forms or stone, typically limestone. Low-profile breakwaters can be irregularly shaped or spaced in a specific pattern and involve placing low-profile stone, bagged concrete or shell bag structures in the water and then plants are added to the march environment behind. The breakwater structures cam become valuable substrate for marine organisms, as well as provide shelter and habitat for many fish, crab and other mobile species (Bushek et al., 2016).

Environmental Benefits:

The numerous benefits of living shorelines make them appealing for long-term coastal resiliency planning in suitable settings. Implementation of the program has the potential to protect wetlands, reduce erosion, improve water quality, create habitat, provide land reclamation, and increase coastal resiliency by buffering storm surges (Arkema et al., 2013; Barbier et al., 2013; Manis et al., 2015). Living shorelines are resilient as they mimic natural shoreline processes, having the ability to adapt to changing conditions to endure over time (Mitchell et al., 2019). In addition, strategic placement of shore protection projects will facilitate the use of dredge material for marsh restoration activities.

Living shorelines are also an economical solution as they can cost less to build and maintain and can provide equal or greater protection from erosion than an armored structure (Gittman et al., 2014). Living shorelines can also recover naturally and more quickly after disruptive weather and tidal events than armored options (Gittman et al., 2014; Gittman et al., 2015). Traditional hard stabilization structures can increase erosion to adjacent shorelines whereas living shorelines may increase sedimentation (Sutton-Grier et al., 2018).

Specific methods provide for different environmental benefits. Marsh plantings in particular can increase water infiltration, uptake of nutrients, filtration, denitrification and sediment retention, and recruitment of vegetation (Davis et al., 2015; Kibler et al., 2019). The extensive root systems of marsh vegetation help to retain the existing soil, thus reducing erosion while plant stems attenuate wave energy. A healthy salt marsh may reduce wave energy and provide habitat for many species of plants and animals while maintaining the aquatic/terrestrial interface. Marshes also provide carbon sequestration services, suggesting that the widespread use of living shoreline techniques may provide climate benefits (Davis et al., 2015).

Oyster reefs and breakwater structures can become valuable substrate for marine organisms, as well as provide shelter and habitat for many fish, crab, oysters and other mobile species (Davis et al., 2006; Scyphers, et al., 2011). Reefs and offshore structures also dampen wave energies and increase sediment retention. Because shellfish are filter feeders, oyster reefs can improve water quality (Scyphers, et al., 2011). Living shorelines also contribute to healthy habitat for juvenile fish, which can improve recreational and commercial fisheries in the area, thus protecting important natural resources that support actives which are critically important to the region's economy such as fishing, hunting, and nature-based tourism (Sutton-Grier et al., 2015).

Metrics:

Metric Title: HR012 : Shoreline protection - Miles of living shoreline installed
Target: TBD
Narrative: The goal of this program is to install relatively large scale living shorelines over a broad geographic area to enhance bay shorelines coastwide in Texas. The target is to install living shoreline features within the four-year project timespan, which will provide the maximum benefit to reducing shoreline erosion and preserving the greatest amount of critical environments given the funding amount requested. After project selection and design is complete, a quantitative target of shorelines protected will be set. Texas will provide annual updates to the Council on the length of shoreline features installed and the types of features constructed.

Metric Title: HR014 : Habitat restoration - Acres of coastal habitat prevented from eroding
Target: TBD
Narrative: The goal of installing living shoreline features is to reduce or prevent the erosion of coastal environments, including marshes, beaches, mudflats, and uplands. A critical metric of the program's success will therefore be the quantity of critical environments that would have eroded if not for the living shorelines. We do not have a good target at this time of the length and location of shoreline to be protected, and therefore, we do not have a target for amount of habitat not eroded. Once project selection is made, a reasonable target can be set. Texas will report to the Council an estimated area of coastal habitats that were prevented from eroding throughout the lifetime of the program and throughout continued monitoring of the program's activities. This metric will be quantified through ground and aerial surveys and comparison to past rates of erosion.

Risk and Uncertainties:

The placement of living shorelines is a widely used marsh protection technique that has proven to be effective and successful in application. However, there are risks and uncertainties to the implementation and success of the program. Short-term implementation risks and uncertainties will vary based on each individual project and its various elements. The most important uncertainties to consider are the longevity of the project, how much sediment will be needed, sea level rise impacts, how the project could affect natural processes like vertical accretion of sediment, impacts on native flora and fauna, and the impacts on the overall functioning of the ecosystem (Bushek et al., 2016). For each project, the risks and uncertainties will be identified once an E&D phase has identified the type of project suitable.

The predominant risk to utilizing breakwaters is relative sea level rise and compaction of soils which lowers breakwater elevation, reducing their effectiveness. Relative sea level rise also has the potential to drown intertidal marsh plantings. In order the alleviate this risk, relative sea level rise will be incorporated into the design to ensure that elevations remain sufficient to protect the shorelines from erosive forces and promote sediment trapping to decrease water depths to levels that support marsh vegetation.

A risk in the placement of marsh plantings is identifying the proper vegetation for a site given changing wave energy, water depth and salinity conditions over time. There is the potential for the vegetation to fail to take root and die off, requiring re-planting. Monitoring will decrease these risks. The potential for a storm to strike the site of a project is another risk. For example, the plantings may not be adequately protected from increased wave energy if a breakwater is not place or is compromised, requiring the need to re-plant or repair a damaged structure.

In addition, risks for implementing living shorelines include identifying a proper design for site-

specific conditions. Incomplete geotechnical information regarding substrate stability and data on wave and tidal energy, sea level changes, water quality, and sediment supply can cause a project to be risky. This program will assess each project site for data gaps and for suitability for using a living shoreline technique.

Monitoring and Adaptive Management:

Project monitoring for this program will involve observations for ensuring (1) proper construction, (2) performance, and (3) to support adaptive management (NAS, 2017). Types of monitoring data will include biophysical observations (elevation, morphology, vegetation, hydrologic) of the project and of adjacent areas to serve as reference sites and to detect off site impacts (DWH-NRDA, 2017). Monitoring will occur on semiannual or annual bases for a minimum of two years following project completion.

A successful living shoreline requires maintenance and monitoring (NAS, 2017; Thayer et al., 2005; TGLO, 2020). It is important to recognize that design life may be shorter in the future given changes in sedimentation rates, sea level rise, and other climate change impacts (Thayer et al., 2005). Monitoring the area over time will help determine how well the living shoreline is performing and if it is providing the expected benefits. Before and after testing of the project site will help evaluate project success. Baseline elevations of the vegetation line, structures and other features, as well as documentation of flora and fauna, including quadrat photos, percent land cover, and fauna counts of oysters and other native species, will be measured at the start of the project and compared after the project has been implemented (Bushek, et al., 2016). These observations will continue to be monitored over time. Semiannual or annual project monitoring will enable effective adaptive management actions such as additional vegetation plantings, removal of debris at the project site, and repositioning of structural components (Kreeger and Moody, 2014; GBF, 2019; TGLO, 2020).

To assess how well the shoreline has been stabilized, the elevation at the edge of the marsh and the position of the continuously vegetated shoreline will be monitored (Kreeger and Moody, 2014). Vegetation plantings will be monitored for size, density, area of coverage, the abundance of native species, and wave attenuation performance (NAS, 2017; Thayer et al., 2005). For stone or concrete breakwaters and oyster reefs whose main purpose is shoreline stabilization, the structural integrity will be monitored (Kreeger and Moody, 2014).

Maintenance activities will likely include periodic removal of large debris, such as logs, algae mats, and trash, from the site to protect wetland plants from being smothered. Non-native invasive plants, including invasive Phragmites, should be controlled and possibly replaced with native wetland plants and shrubs (Bushek, et al., 2016; Saltonstall, 2002). Plants that are removed or die during the early stages of growth need to be replaced immediately to ensure the undisturbed growth of the remaining plants. After significant growth has occurred, only periodic inspections may be necessary (TGLO, 2020).

Data Management:

Data management for this program is designed to make data publicly available thereby enhancing outcomes and future restoration efforts.

Planning data: During program planning, a variety of existing data and newly acquired data will be gathered. Data in this category includes mostly existing geospatial data on shoreline change rates, land cover, elevation, and ecological data describing past and current environmental conditions. Geotechnical and engineering data with construction specifications are also included.

Project implementation data: these data are needed for determining as-built conditions. Detailed engineering survey data and photography are included.

Post-project implementation data: these data are needed for monitoring performance, informing adaptive management actions, and for improving future projects. They include time series of biophysical and engineering data plus hydrological data for understanding trends.

Program activities will identify data used. TCEQ and GRIIDC (Gibeaut, 2016) will work with data users to ensure data are shared when key activities end. GRIIDC is a well-known data repository designed to receive data from a variety of sources and from various scientific and engineering disciplines. GRIIDC will track, curate, and archive data in the GRIIDC repository and make it publicly discoverable and available. Metadata will follow the ISO 19115-2 standard and datasets will be reviewed for completeness and organization to enable reuse.

Collaboration:

Two Texas workgroups were established to provide input on coastal priorities: State & Federal Representatives and Non-Governmental Organizations. On-line and in-person meetings were held to discuss plans to develop Texas coastal priorities and to ensure the public's involvement. A survey was developed that asked for individual's coastal priorities. These surveys were available to the public and were also completed by members of the two work groups. Public meetings were conducted in three coastal cities for the public to present their issues and concerns. Information received from workgroup meetings, discussions with elected officials, public meetings and the surveys was used to develop a list of priorities to be included in the RESTORE Council's Planning Framework document. These efforts of collaboration will continue throughout the process to develop programs and projects. Work will continue with Texas representatives for NRDA/NFWF to consider leveraging opportunities.

Public Engagement, Outreach, and Education:

The decision to submit this program was based on many months of discussions with work groups and participation by the public. It began with discussions with the Texas representatives for NRDA & NFWF to identify programs/projects for FPL 3b. This identified list was shared with the two workgroups (State & Federal and NGOs) established for Bucket 2 planning purposes, for their review and comment. County judges in the coastal area also were given the opportunity to identify potential programs/projects for their areas. Using the information compiled as part of this process, a list of 23 projects were posted for public comment on the Texas RESTORE website. In addition, two public hearings were held in coastal cities. In reviewing the comments received, the timing to move forward with proposals, and in discussions with the Texas Governor's staff, it was determined that program rather than project specific proposals would be submitted. The development of the program proposals was done to ensure that projects posted for public comment could be considered in at least one of the program submissions. Much of the work has already been done to identify projects that could be funded within this program submission. The process to select FPL 3b grant recipients will include the requirement that projects will have to already been vetted by this process or through other public processes such as the GLO's Coastal Resiliency Master Plan, or NRDA & NFWF related activities. The criteria to select the specific projects would include, but not limited to, the following: addresses issues presented in the program proposal; amounts of funds available for the program; readiness; leveraging opportunities; scalability; risk/benefit ratio; and distribution of funds across the Texas coastline. Notification of the projects selected to receive grant funds will be posted on the Texas RESTORE website. This overall process, parts already completed and others to be completed after the program has been approved for FPL 3b funds, will ensure that the ultimate selection of projects for this program are not only consistent with the RESTORE Planning Framework document, but also reflect the ideas that were discussed by the work groups, the elected officials, the public and the Office of the Governor.

Leveraging:

Funds: TBD
Type:
Status:
Source Type:
Description: As part of the process to initially identify programs for FPL 3b, Texas held discussions with county judges, NGOs, NRDA and NFWF. Projects that are selected for funding in Texas could likely include partnerships leveraging various funds, including RESTORE, NRDA and NFWF monies. All parties have emphasized the need to leverage DWH Oil spill associated funds, as well as other funds, and it is Texas' intent to consider leveraging as a criteria in selecting projects, including the recognition of previous projects and the potential for a new project to add to the cumulative impact to the area. This selection process would be similar to the decision-making associated with the proposed programmatic areas included in the Texas pre-proposals.

Environmental Compliance:

Construction involving the discharge of fill into the waters of the United States below mean high tide requires a permit from the U.S. Army Corps of Engineers. Living shorelines will require Section 10 and 404 permits from the Corps and a submerged lands lease from the Texas General Land Office. The Corps permit process ensures compliance with all applicable federal laws, primarily environmental laws such as the Clean Water Act. Coordination is planned with the USACE and reviewing agencies such as Texas General Land Office, United States Fish and Wildlife Services, Texas Commission on Environmental Quality will be necessary to address regulation compliance with the Coastal Zone Management Act, Endangered Species Act, Clean Water Act, Coastal Barrier Resource Act, and the Rivers and Harbors Act, and other as applicable.

The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. Texas intends to work with other members of the Council in an effort to move some or all of the implementation component to Category 1 prior to a Council vote on the final FPL.

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Budget

Project Budget Narrative:
The total requested for this program is $15 million. Of that amount, approximately $14 million will be provided to sub-recipients to implement projects selected for this program. TCEQ estimates that it will require approximately $1 million to support the following: administrative expenses (salary, indirect, travel, fringe, supplies, etc.); hosting & maintenance costs for the Texas RESTORE web site; and for a contract to provide technical assistance to TCEQ staff.

Category 1: $1,575,000

Planning (5%) = $750,000
Project Management (5.5%) = $825,000

Category 2: $13,425,000
Implementation (86.5%) = $12,975,000
Contingency (3%) = $450,000

Data management and monitoring & adaptive managements costs are included in the implementation costs.

Since some costs are uncertain depending on the type of individual project ultimately selected, contingency costs are included at this point and could be considered in a project specific budget as appropriate.

Total FPL 3 Project/Program Budget Request:
$ 15,000,000.00

Estimated Percent Monitoring and Adaptive Management: 0 %
Estimated Percent Planning: 5 %
Estimated Percent Implementation: 86.5 %
Estimated Percent Project Management: 5.5 %
Estimated Percent Data Management: 0 %
Estimated Percent Contingency: 3 %

Is the Project Scalable?:
Yes

If yes, provide a short description regarding scalability.:
Several independent project sites will be identified with distinct line item budgets for each component. The project can be phased with construction at each site. If funded for less than the requested amount, projects within the program can be scaled down (for example, reducing the length of shoreline) or reduced in number.

Environmental Compliance[1]

Environmental Requirement	Has the Requirement Been Addressed?	Compliance Notes (e.g.,title and date of document, permit number, weblink etc.)
National Environmental Policy Act	Yes	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Endangered Species Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
National Historic Preservation Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical

[1] Environmental Compliance documents available by request (restorecouncil@restorethegulf.gov).

		Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Magnuson-Stevens Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Fish and Wildlife Conservation Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council

		vote on the final FPL.
Coastal Zone Management Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Coastal Barrier Resources Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Farmland Protection Policy Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently

		proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Clean Water Act (Section 404)	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
River and Harbors Act (Section 10)	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Marine Protection, Research and Sanctuaries Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning,

		research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Marine Mammal Protection Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
National Marine Sanctuaries Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.

Migratory Bird Treaty Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Bald and Golden Eagle Protection Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Clean Air Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If

		applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Other Applicable Environmental Compliance Laws or Regulations	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If any other environmental compliance laws of regulations are applicable, those requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.

Maps, Charts, Figures

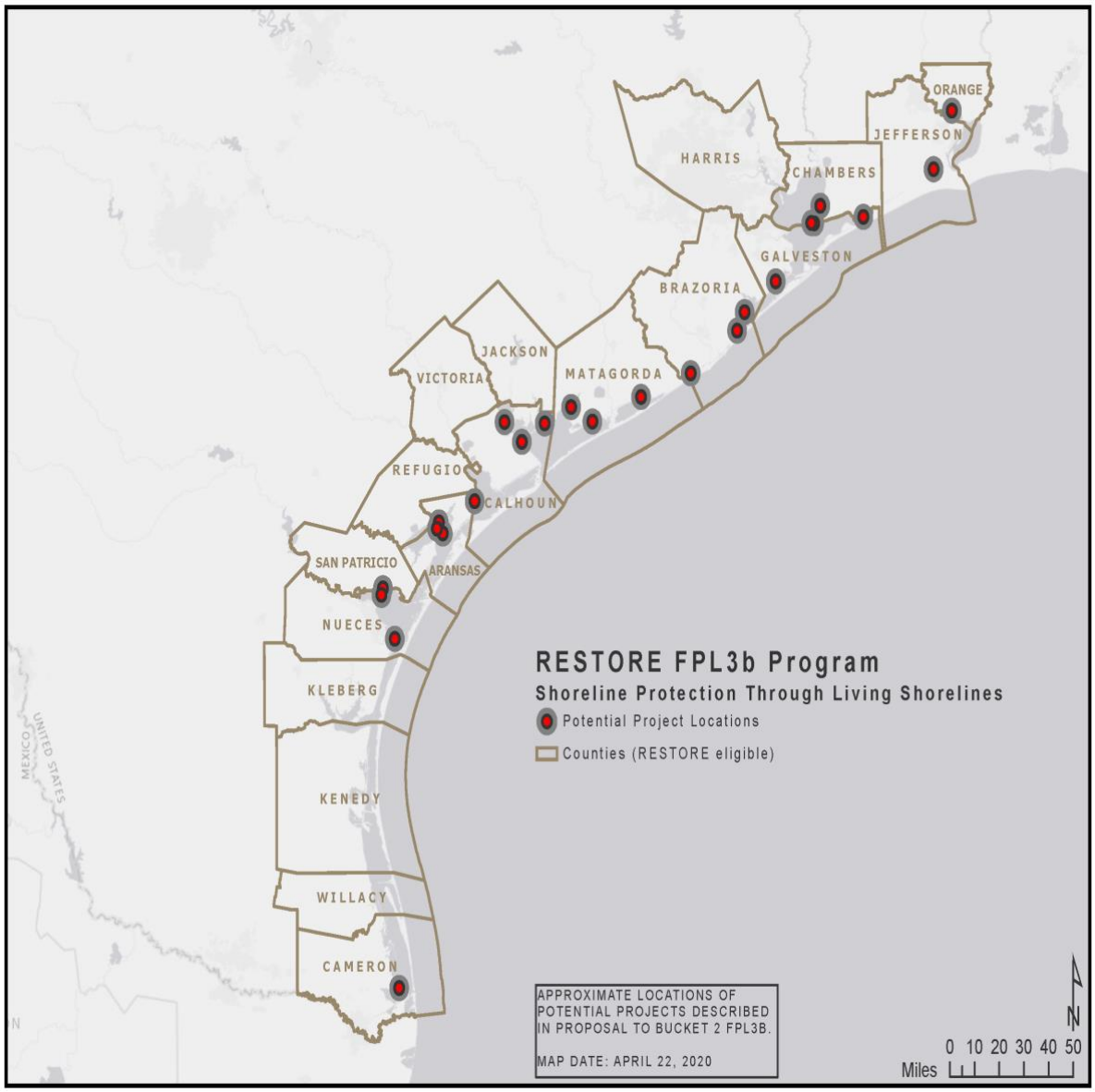

Figure 1: Approximate locations of potential living shoreline projects.

Other Uploads

Tables_1:
Table_ShorelineProtectionThroughLivingShorelines_Program_20200717.docx
Potential projects, locations, and nominators for Texas' Shoreline Protection Through Living Shorelines program.
Link to Download
http://www.restorethegulf.gov/apps/piper/web/Uploads/Download/proposal/826/42

Tables_2:
Table_ShorelineProtectionThroughLivingShorelines_Program_20200717.docx
Potential projects, locations, and nominators for Texas' Shoreline Protection Through Living Shorelines program.
Link to Download
http://www.restorethegulf.gov/apps/piper/web/Uploads/Download/proposal/827/42

RESTORE Council FPL 3 Proposal Document

General Information

Proposal Sponsor:
Texas Commission on Environmental Quality

Title:
Shoreline Protection Through Living Shorelines

Project Abstract:
The Shoreline Protection Through Living Shorelines program will construct large-scale living shorelines that will stabilize estuarine shorelines and protect large tracts of land and coastal resources along the Texas coast. Living shorelines consist of marsh vegetation planting typically combined with rock breakwaters or oyster reefs to protect bay shorelines and marshes from loss due to erosion. The program will target highly eroding shorelines along the GIWW, vulnerable bay shorelines, and locations that have been identified as suitable areas for a living shoreline installation. This program will also address degrading coastal structures that need repair, such as critical seawalls, and add living shoreline elements to enhance their protective capabilities. The program will develop a process for selecting locations for living shorelines that builds on Texas' stakeholder-driven process for selecting preliminary projects for FPL3 consideration. Living shorelines can reduce damage to shorelines by dampening wave action and trapping sediments, elevating shore profiles to a level that will support marsh vegetation. This program will provide ecosystem services by creating hard structure habitats for fish and oysters, nutrient and sediment removal, seagrass protection, and water quality improvement. This program is requesting $15,000,000 in funds for an estimated program duration of 4 years, covering both the planning and implementation portions of the program.

FPL Category: Cat1: Planning/ Cat2: Implementation

Activity Type: Program

Program: Shoreline Protection Through Living Shorelines

Co-sponsoring Agency(ies): N/A

Is this a construction project?:
Yes

RESTORE Act Priority Criteria:
(I) Projects that are projected to make the greatest contribution to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region, without regard to geographic location within the Gulf Coast region.
(II) Large-scale projects and programs that are projected to substantially contribute to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast ecosystem.
(III) Projects contained in existing Gulf Coast State comprehensive plans for the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region.

Priority Criteria Justification:
This program will meet three of the RESTORE Act Priority Criteria:
1. Projected to make the greatest contribution to restoring and protecting natural resources
This program will protect and restore shorelines and the habitats they provide and discourage the use of traditional armoring methods that impede the development of natural environments. In some cases large tracts of critical marsh habitat will be protected from erosion.

2. Large-scale projects and programs
This program includes a variety of individual, large-scale living shorelines along the Texas coast whose combined impacts would be substantial and serve as a demonstration to local communities on the effectiveness of nature-based solutions over traditional armoring techniques. The combined benefits of each project within the program will increase the resiliency of the Texas coast by providing for shoreline stabilization, increased habitat, and a buffer against the effects of storms and sea level rise.

3. Contained in existing Gulf Coast State comprehensive Plans
Most of the prospective projects in this program that were evaluated by the Texas FPL3b working group were sourced from the 2019 Texas Coastal Resiliency Master Plan (TCRMP), the state comprehensive coastal plan for Texas. Each project ranked highly in the TCRMP Tier 1 project list with high scores from the Technical Advisory Committee (TAC) members. The TAC was comprised of coastal experts from state and federal agencies, NGOs, local governments, academics, and engineering firms (Texas General Land Office, 2019).

Project Duration (in years): 4

Goals

Primary Comprehensive Plan Goal:
Restore and Conserve Habitat

Primary Comprehensive Plan Objective:
Restore and Enhance Natural Processes and Shorelines

Secondary Comprehensive Plan Objectives:
N/A

Secondary Comprehensive Plan Goals:
N/A

PF Restoration Technique(s):
Create, restore, and enhance coastal wetlands, islands, shorelines and headlands: Protect natural shorelines

Location

Location:
Texas Coastwide

HUC8 Watershed(s):
Texas-Gulf Region(Neches) - Neches(Lower Neches)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(East Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(West Galveston Bay)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Austin-Oyster)
Texas-Gulf Region(Central Texas Coastal) - San Antonio(Lower San Antonio)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(East Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(West Matagorda Bay)
Texas-Gulf Region(Central Texas Coastal) - Central Texas Coastal(Aransas Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(North Corpus Christi Bay)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(South Laguna Madre)
Texas-Gulf Region(Galveston Bay-San Jacinto) - Galveston Bay-Sabine Lake(Sabine Lake)
Texas-Gulf Region(Nueces-Southwestern Texas Coastal) - Southwestern Texas Coastal(North Laguna Madre)

State(s):
Texas

County/Parish(es):
TX - Aransas
TX - Brazoria
TX - Calhoun
TX - Cameron
TX - Chambers
TX - Galveston
TX - Jefferson
TX - Matagorda
TX - Nueces
TX - Orange
TX - San Patricio

Congressional District(s):
TX - 27
TX - 14
TX - 36
TX - 34

Narratives

Introduction and Overview:

The Shoreline Protection Through Living Shorelines program will construct large-scale living shorelines to protect estuarine shorelines and marshes from loss due to erosion along erosional hotspots on the Texas coast. This program may also address degrading coastal protective structures that need repair, such as critical seawalls, and add living shoreline elements to enhance their protection capabilities. Living shorelines can reduce damage to shorelines by dampening wave action and trapping sediments, elevating sub-aqueous shore profiles to a level that will support marsh vegetation. Living shorelines consist of either marsh plantings or oyster reefs alone in low energy environments, or rock breakwaters combined with marsh vegetation in moderate energy environments. This program will provide ecosystem services by creating hard structure habitats for fish and oysters, nutrient removal, sediment retention, seagrass protection, and water quality improvement (Davis et al., 2006; Gittman et al., 2014; Gittman et al., 2016). The program will offer the Texas coast an alternative to hard structuring methods such as sheet piling and bulkheads that result in decreased species diversity, carrying capacity and productivity by preventing the development of critical natural environments like flats, marshes, mangroves, and beaches (Dugan et al., 2011; Dugan et al., 2018; Prosser et al., 2018). A number of factors have contributed to bay and channel shoreline loss, including boat traffic, altered sediment regimes, and increasing rates of relative sea level rise (Sweet et al., 2017; Prosser et al., 2018). As a result, growing numbers of private and public waterfront landowners are looking to harden or armor shorelines to stop or reduce rates of shoreline loss, which has produced a patchwork of bulkheads and riprap along the shore. The length of armored shoreline increased by approximately 376 miles along the Texas coast from the 1990's to 2010's (HRI analysis of ESI shoreline type maps). Unprotected shorelines, however, are vulnerable to storms, floods, land loss, and sea level rise, along with the daily erosive forces of wind, wave, and tidal energy (Kennish, 2001; Lotze et al., 2006; Leonardi et al., 2016).

The construction of living shorelines on the Texas coast will help stabilize shorelines while creating new and protecting existing critical environments. Living shorelines incorporate nature-based solutions to fully or partially reduce the impact of erosive forces while allowing natural processes to take place (Bilkovic et al, 2016; Gittman et al., 2016). Living shorelines work best in lower energy environments such as bay and estuary systems or other protected areas. Living shorelines are designed according to their specific location and contain several natural components that work together, including native or mixed vegetation, oyster reef, and seagrasses. These features can be adaptable, changing and growing over time as conditions change around them. They also increase coastal resiliency by providing effective protection from storm impacts, such as storm surge and storm water flow (Swann, 2008; Smith et al., 2018).

This program aims to construct individual, large-scale living shorelines that protect large tracts of land and coastal resources, targeting highly eroding shorelines along the GICWW, vulnerable bay shorelines, and locations that have been identified as suitable areas for living shoreline installation. The program will develop a process for selecting locations for living shorelines that builds on Texas' stakeholder-driven process for developing the Planning Framework and for selecting preliminary projects for FPL3 consideration. During this earlier work, county governments, NGOs, and a workgroup made up of Texas NRDA and Texas Coastal Resiliency Master Plan (TCRMP) representatives submitted 38 projects for FPL3 consideration. Coastal experts, HRI staff, and TCEQ staff reviewed the projects and selected 23 for public comment. Among these 23 projects, one project included 21 individual living shorelines that this program will consider for implementation (see map). The 21 independent project sites that were evaluated by the Texas FPL3 working group were sourced from the TCRMP Tier 1 project list, which were highly scored by a Technical Advisory Committee comprised of local, state, and federal experts and local governments (TGLO, 2019). This program will also consider the living shoreline components of projects that were assessed during the

Texas FPL3 review process. A key assessment for project acceptance will be consideration of the suitability of using living shoreline techniques for specific locations and objectives. The potential sites vary in their coastal setting and may require different methods of living shoreline implementation, described further in the methods section below.

This program is requesting $15,000,000 in funds for an estimated program duration of 4 years. In general, the first year will focus on selecting ideal sites for program activities. Year two will consist of engineering and design. Years three and four will span construction and monitoring activities. The cost of a living shoreline project will vary based on size, method used, location, materials, plants selected, permitting and engineering requirements and complexity. Because of the wide array of living shoreline techniques, it's difficult to calculate a standard cost for each project. Although hard stabilization techniques are preferred by landowners as they typically have well-defined and easily understood cost parameters, less frequently taken into consideration are the hidden costs associated with the structure's gradual failure over their 15 to 20-year lifespan and the significant land loss that can occur as a bulkhead collapses and the land is converted back to open water. Many factors may affect the cost of a living shoreline, including:

- Permitting and surveying costs
- Engineering and design of the project
- Shipping of materials
- Accessibility and procurement of materials such as recycled shell, reef dome materials, crushed or bagged concrete, limestone, stone, etc.
- Annual or bi-annual project monitoring and maintenance (e.g., additional vegetation plantings, removal of debris at the project site, possible repositioning of structural project components)

The projects within the program will be scalable. Several independent project sites will be identified with distinct line item budgets for each component. The project can be phased with construction at each site. If funded for less than the requested amount, projects within the program can be scaled down (for example, reducing the length of shoreline) or reduced in number.

This program addresses 2016 update to the Comprehensive Plan by using the best available science for shoreline restoration, developing a monitoring and data management framework, and defining metrics of success of the living shoreline projects. Additionally, this program conforms to the Planning Framework by adhering to the priority to create, restore and enhance coastal wetlands, islands, shorelines, and headlands. The program also has the potential to restore natural processes and build oyster habitat along suitable portions of the Texas coast.

Potential partners could include the Texas General Land Office, who are responsible for non-federal permitting of living shorelines in Texas. The TGLO has identified potential activities included in this program in the 2019 Texas Coastal Resiliency Master Plan. Additional partners could include local NGOs in targeted areas with experience in living shoreline implementation.

Proposed Methods :

This program aims to construct large-scale living shorelines on highly eroding shorelines along the GICWW, vulnerable bay shorelines, and locations that have been identified as suitable areas for beneficial placement of dredge materials. The program will develop a process for selecting locations for living shorelines that builds on Texas' stakeholder-driven process for developing the Planning Framework and for selecting preliminary projects for FPL3 consideration. The geographic scope of this project includes a large portion of Texas coast and would consider numerous sites along the GICWW and bay systems. A key component of this program will be identifying the ideal technique for the identified targeted locations. In general, the living shoreline design and implementation

process will follow these steps: 1. Identify priority areas and analyze site-specific information 2. Engineering and design 3. USACE Permitting 4. Oversee bidding and contractor selection 5. Construction 6. Monitoring and adaptive management.

The type of living shoreline the individual projects in this program will implement must be location-specific. Living shorelines are not a one size fits all mechanism - they are versatile and can be designed and tailored to fit the specific conditions at that site (Morris et al., 2018). Site conditions that will affect living shoreline design include water depth, wave energy and the current rate of erosion. Living shorelines can be completed in phases that can be built up over time, as budget allows. For example, planting native vegetation could first be installed along the existing shoreline. Over time and if needed, an offshore breakwater could then be installed for an additional layer of protection.

In general, there are two main living shoreline techniques– soft stabilization and hybrid stabilization. Determining which type of living shoreline is best suited is the first step toward implementation. Each technique works best in a specific set of conditions and has several associated implementation methods to decrease erosion, protect the shoreline and prevent land loss.

Soft stabilization methods are non-structural in nature and involve planting marsh grasses or placing oyster reef along the existing shoreline. This technique works best on shallow, low-energy shorelines. Marsh grass planting involves the placement of native plants, such as native low marsh (Spartina alterniflora) and high marsh (Spartina patens) species, planted along the existing shoreline. Plant roots help hold soil in place and shoots will break small waves and increase sediment deposit. Marsh planting projects may be designed and constructed as a component of a larger project or done as a stand-alone project. Shoreline grading or the addition of sediment may be needed to obtain appropriate elevations, to provide a suitably gradual slope for marsh creation, or to enable a marsh to maintain its elevation with respect to sea level rise. This technique can create a variety of habitats, including salt marsh, a tidal buffer landward of the salt marsh, coastal beach, and mud flat.

Another soft stabilization technique commonly used is creating submerged oyster shell beds by placing a hard substrate, often recycled oyster shells or crushed concrete, limestone, or river rock on the seafloor and seeding them with oyster larvae. The larvae attach to the shells or rocks and begin to grow. Oyster shell-based living shorelines will primarily be an option on the mid-Texas coast. This technique creates habitats such as shellfish reef and structure for fisheries habitat (Scyphers et al., 2011).

Hybrid stabilization methods incorporate the living materials used in soft techniques combined with the construction of breakwater features to provide additional erosion protection and increase sediment retention. This technique is suited for low to moderate energy shorelines. Low-profile breakwaters are constructed nearshore or along the shoreline to break waves, reduce erosion and promote accumulation of sand and gravel landward of the structure. Nearshore low-profile breakwaters typically have marsh grass plantings appropriate for salinity and site conditions behind them. Materials required generally include living reef materials (oysters/mussels) or precast concrete forms or stone, typically limestone. Low-profile breakwaters can be irregularly shaped or spaced in a specific pattern and involve placing low-profile stone, bagged concrete or shell bag structures in the water and then plants are added to the march environment behind. The breakwater structures cam become valuable substrate for marine organisms, as well as provide shelter and habitat for many fish, crab and other mobile species.

Environmental Benefits:

The numerous benefits of living shorelines make them appealing for long-term coastal resiliency planning in suitable settings. Implementation of the program has the potential to protect wetlands, reduce erosion, improve water quality, create habitat, provide land reclamation, and increase coastal resiliency by buffering storm surges (Arkema et al., 2013; Barbier et al., 2013; Manis et al., 2015). Living shorelines are resilient as they mimic natural shoreline processes, having the ability to adapt to changing conditions to endure over time (Mitchell et al., 2019). In addition, strategic placement of shore protection projects will facilitate the use of dredge material for marsh restoration activities.

Living shorelines are also an economical solution as they can cost less to build and maintain and can provide equal or greater protection from erosion than an armored structure (Gittman et al., 2014). Living shorelines can also recover naturally and more quickly after disruptive weather and tidal events than armored options (Gittman et al., 2014; Gittman et al., 2015). Traditional hard stabilization structures can increase erosion to adjacent shorelines whereas living shorelines may increase sedimentation (Sutton-Grier et al., 2018).

Specific methods provide for different environmental benefits. Marsh plantings in particular can increase water infiltration, uptake of nutrients, filtration, denitrification and sediment retention, and recruitment of vegetation (Davis et al., 2015; Kibler et al., 2019). The extensive root systems of marsh vegetation help to retain the existing soil, thus reducing erosion while plant stems attenuate wave energy. A healthy salt marsh may reduce wave energy and provide habitat for many species of plants and animals while maintaining the aquatic/terrestrial interface. Marshes also provide carbon sequestration services, suggesting that the widespread use of living shoreline techniques may provide climate benefits (Davis et al., 2015).

Oyster reefs and breakwater structures can become valuable substrate for marine organisms, as well as provide shelter and habitat for many fish, crab, oysters and other mobile species (Davis et al., 2006; Scyphers, et al., 2011). Reefs and offshore structures also dampen wave energies and increase sediment retention. Because shellfish are filter feeders, oyster reefs can improve water quality (Scyphers, et al., 2011). Living shorelines also contribute to healthy habitat for juvenile fish, which can improve recreational and commercial fisheries in the area, thus protecting important natural resources that support actives which are critically important to the region's economy such as fishing, hunting, and nature-based tourism (Sutton-Grier, et al., 2015).

Metrics:

Metric Title: HR012 : Shoreline protection - Miles of living shoreline installed : Habitat Restoration
Target: TBD
Narrative: The goal of this program is to install relatively large scale living shorelines over a broad geographic area to enhance bay shorelines coastwide in Texas. The target is to install living shoreline features within the four-year project timespan, which will provide the maximum benefit to reducing shoreline erosion and preserving the greatest amount of critical environments given the funding amount requested. After project selection and design is complete, a quantitative target of shorelines protected will be set. Texas will provide annual updates to the Council on the length of shoreline features installed and the types of features constructed.

Metric Title: HR014 : Habitat restoration - Acres of coastal habitat prevented from eroding : Habitat Restoration
Target: TBD
Narrative: The goal of installing living shoreline features is to reduce or prevent the erosion of coastal environments, including marshes, beaches, mudflats, and uplands. A critical metric of the program's success will therefore be the quantity of critical environments that would have eroded if not for the living shorelines. We do not have a good target at this time of the length and location of shoreline to be protected, and therefore, we do not have a target for amount of habitat not eroded. Once project selection is made, a reasonable target can be set. Texas will report to the Council an estimated area of coastal habitats that were prevented from eroding throughout the lifetime of the program and throughout continued monitoring of the program's activities. This metric will be quantified through ground and aerial surveys and comparison to past rates of erosion.

Risk and Uncertainties:

The placement of living shorelines is a widely used marsh protection technique that has proven to be effective and successful in application. However, there are risks and uncertainties to the implementation and success of the program. The predominant risk to utilizing breakwaters is relative sea level rise and compaction of soils which lowers breakwater elevation, reducing their effectiveness. Relative sea level rise also has the potential to drown intertidal marsh plantings. In order the alleviate this risk, relative sea level rise will be incorporated into the design to ensure that elevations remain sufficient to protect the shorelines from erosive forces and promote sediment trapping to decrease water depths to levels that support marsh vegetation. Another risk in the placement of marsh plantings is identifying the proper vegetation for a site given changing wave energy, water depth and salinity conditions over time. There is the potential for the vegetation to fail to take root and die off, requiring re-planting. Monitoring will decrease these risks. The potential for a storm to strike the site of a project is another risk. For example, the plantings may not be adequately protected from increased wave energy if a breakwater is not place or is compromised, requiring the need to re-plant or repair a damaged structure.

In addition, risks for implementing living shorelines include identifying a proper design for site-specific conditions. Incomplete geotechnical information regarding substrate stability and data on wave and tidal energy, sea level changes, water quality, and sediment supply can cause a project to be risky. This program will assess each project site for data gaps and for suitability for using a living shoreline technique.

Monitoring and Adaptive Management:

Project monitoring for this program will involve observations for ensuring (1) proper construction, (2) performance, and (3) to support adaptive management (NAS, 2017). Type of monitoring data will include biophysical observations (elevation, morphology, vegetation, hydrologic) of the project and of adjacent areas to serve as reference sites and to detect off site impacts (DWH-NRDA, 2017). Monitoring will occur on semiannual or annual bases for a minimum of two years following project completion.

A successful living shoreline requires maintenance and monitoring (NAS, 2017; Thayer et al., 2005; TGLO, 2020). It is important to recognize that design life may be shorter in the future given changes in sedimentation rates, sea level rise, and other climate change impacts (Thayer et al., 2005). Monitoring the area over time will help determine how well the living shoreline is performing and if it is providing the expected benefits. Semiannual or annual project monitoring will enable effective adaptive management actions such as additional vegetation plantings, removal of debris at the project site, and repositioning of structural components (Kreeger and Moody, 2014; GBF, 2019; TGLO, 2020).

To assess how well the shoreline has been stabilized, the elevation at the edge of the marsh and the position of the continuously vegetated shoreline will be monitored (Kreeger and Moody, 2014). Vegetation plantings will be monitored for size, density, area of coverage, the abundance of native species, and wave attenuation performance (NAS, 2017; Thayer et al., 2005). For stone or concrete breakwaters and oyster reefs whose main purpose is shoreline stabilization, the structural integrity will be monitored (Kreeger and Moody, 2014).

Maintenance activities will likely include periodic removal of large debris, such as logs, algae mats, and trash, from the site to protect wetland plants from being smothered. Non-native invasive plants should be controlled and possibly replaced with native wetland plants and shrubs. Plants that are removed or die during the early stages of growth need to be replaced immediately to ensure the undisturbed growth of the remaining plants. After significant growth has occurred, only periodic inspections may be necessary (TGLO, 2020).

Data Management:

Data management for this program is designed to make data publicly available thereby enhancing outcomes and future restoration efforts.

Planning data: During program planning, a variety of existing data and newly acquired data will be gathered. Data in this category includes mostly existing geospatial data on shoreline change rates, land cover, elevation, and ecological data describing past and current environmental conditions. Geotechnical and engineering data with construction specifications are also included.

Project implementation data: these data are needed for determining as-built conditions. Detailed engineering survey data and photography are included.

Post-project implementation data: these data are needed for monitoring performance, informing adaptive management actions, and for improving future projects. They include time series of biophysical and engineering data plus hydrological data for understanding trends.

Program activities will identify data used. TCEQ and GRIIDC (Gibeaut, 2016) will work with data users to ensure data are shared when key activities end. GRIIDC is a well-known data repository designed to receive data from a variety of sources and from various scientific and engineering disciplines. GRIIDC will track, curate, and archive data in the GRIIDC repository and make it publicly discoverable

and available. Metadata will follow the ISO 19115-2 standard and datasets will be reviewed for completeness and organization to enable reuse.

Collaboration:

Two Texas workgroups were established to provide input on coastal priorities: State & Federal Representatives and Non-Governmental Organizations. On-line and in-person meetings were held to discuss plans to develop Texas coastal priorities and to ensure the public's involvement. A survey was developed that asked for individual's coastal priorities. These surveys were available to the public and were also completed by members of the two work groups. Public meetings were conducted in three coastal cities for the public to present their issues and concerns. Information received from workgroup meetings, discussions with elected officials, public meetings and the surveys was used to develop a list of priorities to be included in the RESTORE Council's Planning Framework document. These efforts of collaboration will continue throughout the process to develop programs and projects. Work will continue with Texas representatives for NRDA/NFWF to consider leveraging opportunities.

Public Engagement, Outreach, and Education:

The decision to submit this program was based on many months of discussions with work groups and participation by the public. It began with discussions with the Texas representatives for NRDA & NFWF to identify programs/projects for FPL 3b. This identified list was shared with the two workgroups (State & Federal and NGOs) established for Bucket 2 planning purposes, for their review and comment. County judges in the coastal area also were given the opportunity to identify potential programs/projects for their areas. Using the information compiled as part of this process, a list of 23 projects were posted for public comment on the Texas RESTORE website. In addition, two public hearings were held in coastal cities. In reviewing the comments received, the timing to move forward with proposals, and in discussions with the Texas Governor's staff, it was determined that program rather than project specific proposals would be submitted. The development of the program proposals was done to ensure that projects posted for public comment could be considered in at least one of the program submissions. Much of the work has already been done to identify projects that could be funded within this program submission. The process to select FPL 3b grant recipients will include the requirement that projects will have to already been vetted by this process or through other public processes such as the GLO's Coastal Resiliency Master Plan, or NRDA & NFWF related activities. The criteria to select the specific projects would include, but not limited to, the following: addresses issues presented in the program proposal; amounts of funds available for the program; readiness; leveraging opportunities; scalability; risk/benefit ratio; and distribution of funds across the Texas coastline. Notification of the projects selected to receive grant funds will be posted on the Texas RESTORE website. This overall process, parts already completed and others to be completed after the program has been approved for FPL 3b funds, will ensure that the ultimate selection of projects for this program are not only consistent with the RESTORE Planning Framework document, but also reflect the ideas that were discussed by the work groups, the elected officials, the public and the Office of the Governor.

Leveraging:

Funds: $TBD
Type:
Status:
Source Type:
Description: As part of the process to initially identify programs that Texas could submit as proposals for FPL 3b, discussions were held with county judges, NGOs, NRDA and NFWF. The expectation is that programs projects that are ultimately selected for funding in Texas could likely include partnerships leveraging various funds, including RESTORE, NRDA and NFWF monies. All parties have emphasized the need to leverage all DWH Oil spill associated funds, as well as other funds, and it is Texas' intent to consider leveraging as a criteria in selecting projects. This selection/determination process would be similar to the decision-making associated with the proposed programmatic areas included in the Texas pre-proposals.

Environmental Compliance:

Construction involving the discharge of fill into the waters of the United States below mean high tide requires a permit from the U.S. Army Corps of Engineers. Living shorelines will require Section 10 and 404 permits from the Corps and a submerged lands lease from the Texas General Land Office. The Corps permit process ensures compliance with all applicable federal laws, primarily environmental laws such as the Clean Water Act. Coordination is planned with the USACE and reviewing agencies such as Texas General Land Office, United States Fish and Wildlife Services, Texas Commission on Environmental Quality will be necessary to address regulation compliance with the Coastal Zone Management Act, Endangered Species Act, Clean Water Act, Coastal Barrier Resource Act, and the Rivers and Harbors Act, and other as applicable.

The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. Texas intends to work with other members of the Council in an effort to move some or all of the implementation component to Category 1 prior to a Council vote on the final FPL.

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Budget

Project Budget Narrative:
The total requested for this program is $15 million. Of that amount, approximately $14 million will be provided to sub-recipients to implement projects selected for this program. TCEQ estimates that it will require approximately $1 million to support the following: administrative expenses (salary, indirect, travel, fringe, supplies, etc…); hosting & maintenance costs for the Texas RESTORE web site; and for a contract to provide technical assistance to TCEQ staff.

Total FPL 3 Project/Program Budget Request:
$ 15,000,000.00

Estimated Percent Monitoring and Adaptive Management: 0 %
Estimated Percent Planning: 5 %
Estimated Percent Implementation: 86.5 %
Estimated Percent Project Management: 5.5 %
Estimated Percent Data Management: 0 %
Estimated Percent Contingency: 3 %

Is the Project Scalable?:
Yes

If yes, provide a short description regarding scalability.:
Several independent project sites will be identified with distinct line item budgets for each component. The project can be phased with construction at each site. If funded for less than the requested amount, projects within the program can be scaled down (for example, reducing the length of shoreline) or reduced in number.

Environmental Compliance[1]

Environmental Requirement	Has the Requirement Been Addressed?	Compliance Notes (e.g.,title and date of document, permit number, weblink etc.)
National Environmental Policy Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Endangered Species Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
National Historic Preservation Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Magnuson-Stevens Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and

[1] Environmental Compliance document uploads available by request (restorecouncil@restorethegulf.gov).

		documentation will be supplied prior to a Council vote on the final FPL.
Fish and Wildlife Conservation Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Coastal Zone Management Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Coastal Barrier Resources Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Farmland Protection Policy Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Clean Water Act (Section 404)	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the

		Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
River and Harbors Act (Section 10)	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Marine Protection, Research and Sanctuaries Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Marine Mammal Protection Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
National Marine Sanctuaries Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.

Migratory Bird Treaty Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Bald and Golden Eagle Protection Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Clean Air Act	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If applicable, these requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.
Other Applicable Environmental Compliance Laws or Regulations	No	The FPL Category 1 portion of this program involves only planning actions that are covered by the Restore Council's NEPA Categorical Exclusion for planning, research, or design activities (Section 4(d)(3) of the Council's NEPA Procedures). The implementation component is currently proposed for Category 2. If any other environmental compliance laws of regulations are applicable, those requirements will be addressed and documentation will be supplied prior to a Council vote on the final FPL.

Maps, Charts, Figures

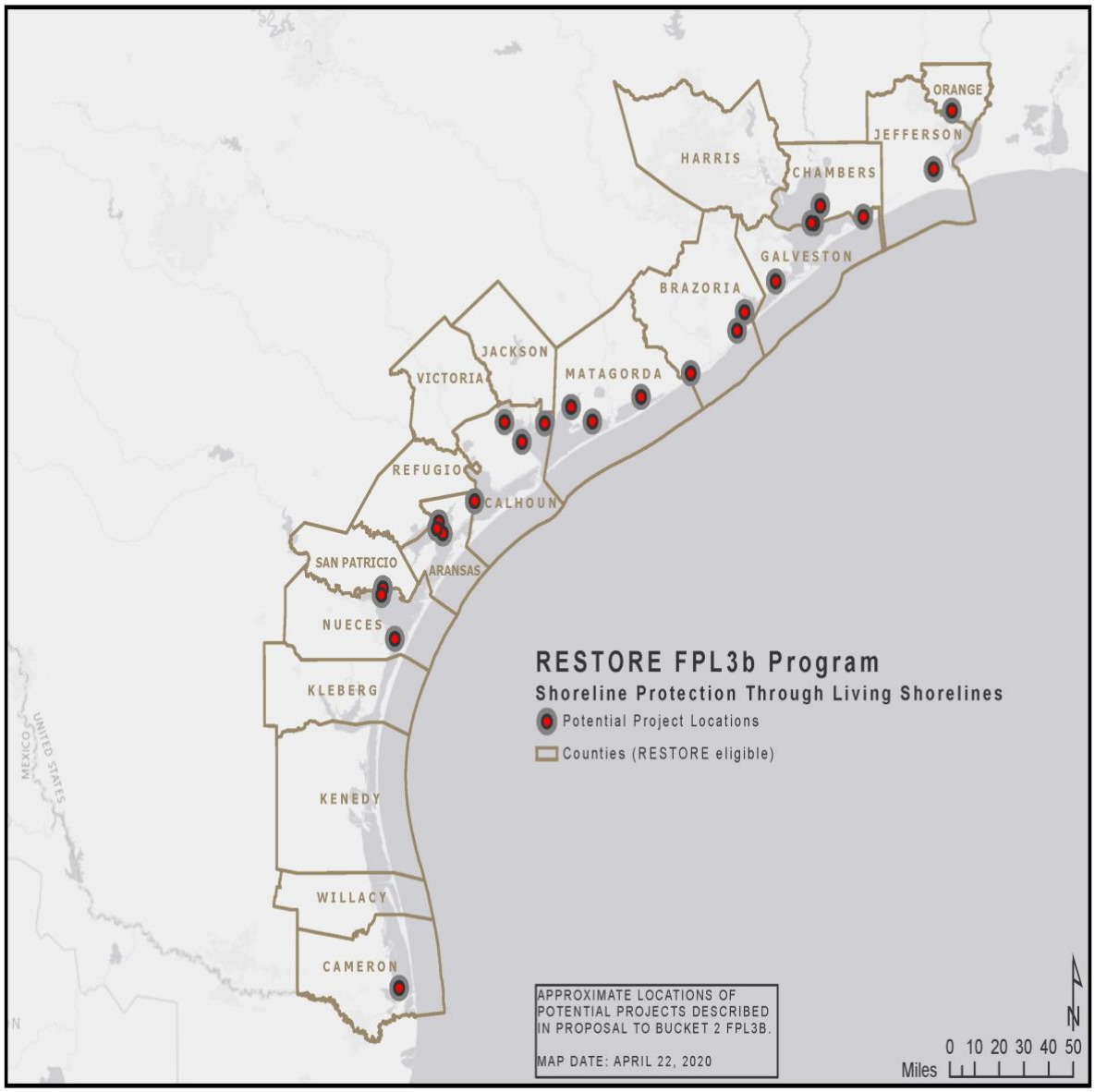

Figure 1 : Approximate locations of potential living shoreline projects.

FPL 3b Internal Staff Review of Proposal Submitted 4/24/2020

Project/Program	Shoreline Protection Through Living Shorelines		
Primary Reviewer	Heather Young	Sponsor	Texas
EC Reviewer	Heather Young	Co-Sponsor	

1. Is/Are the selected Priority Criteria supported by information in the proposal?	Yes
Notes	

2. Does the proposal meet the RESTORE Act geographic eligibility requirement?	Yes
Notes	

3. Are the Comprehensive Plan primary goal and primary objective supported by information in the proposal?	Yes
Notes	

4. Planning Framework: If the proposal is designed to align with the Planning Framework, does the proposal support the selected priority approaches, priority techniques, and/or geographic area?	Yes
Notes	

5. Does the proposal align with the applicable RESTORE Council definition of project or program?	Yes
Notes	

6. Does the budget narrative adequately describe the costs associated with the proposed activity?	No
Notes	Council staff recommend that the budget narrative be edited to specifically identify the amount of funding being requested in FPL Category 1 and FPL Category 2. The proposed budget indicates that 5% of the overall program cost will be dedicated to Planning, and an additional 5.5% ($1 million) for Program Management. Program Management activities described in the narrative can be grouped with Planning under Cat 1. A small amount of funding is budgeted for contingency, and the discussion of risks references several activitries, such as replanting of vegetation, that support the inclusion of contingency costs in the budget request. Council staff recommend including a statement in the budget narrative that the need for

	contingency costs will be considered as appropriate when developing individual project-specific budgets.

7. Are there any recommended revisions to the selected leveraged funding categories?			No
Notes			

8. Have three external BAS reviews been completed?	Yes
Notes	Please see the external BAS review comments, and external reviews summary attached with these review comments.

9. Have appropriate metrics been proposed to support all primary and secondary goals?	Yes
Notes	

10. Environmental compliance: If FPL Category 1 has been selected for the implementation component of the project or program, does the proposal include environmental compliance documentation that fully supports the selection of Category 1?	N/A
Notes	Council staff recommends revising the environmental compliance checklist to indicate "Yes" for NEPA and "N/A" for all other environmental requirements since no implementation is proposed as Category 1 at this time. The additional compliance notes provided are appreciated and can be left as is. If this activity is included in FPL 3b, the subsequent award document would require compliance with all applicable laws in the event that field sampling is required in association with the approved planning, engineering and design.

11. Geospatial Compliance: Have the appropriate geospatial files and associated metadata been submitted along with a map of the proposed project/program area?	More information needed
Notes	The submitted GIS project boundary intersects the West San Antonio Bay watershed and does not intersect the Lower San Antonio watershed. Council staff recommends the sponsor add West San Antonio Bay watershed and remove Lower San Antonio watershed.

FPL3b BAS Reviews Summary -- Shoreline Protection Through Living Shorelines

May, 2020

Overall the external Best Available Science Reviews for the *Shoreline Protection Through Living Shorelines* proposal are positive. Reviewers agree that proposal objectives and methods have been justified using peer reviewed and/or publicly available information and are directly pertinent and/or well adapted to the program region. They also agree that the applicants have demonstrated that they've evaluated uncertainties and risks in achieving the program objectives over time.

All reviewers believe that the proposal objectives, including proposed methods, have been justified using peer reviewed and/or publicly available information. Reviewer 1 further adds that additional resources might be found from the North Carolina Sounds, Delaware Bay, and Chesapeake Bay Region, in particular from the Maryland Department of Natural Resources and the Virginia Institute of Marine Science. They feel that the projects in these regions could give a better idea of successes and failures of similar projects. Reviewer 2 also suggests that evaluating the successes and failures of similar projects should be more developed in the proposal.

In general, reviewers agree the proposal provides reasonable justification that the program is based on science and clearly documents and communicates risks. All reviewers, however, provide comments on the programmatic monitoring described in the proposal. Reviewer 1 notes that demonstrating program success will require some long-term monitoring effort. They further recommend the monitoring of the non-native Phragmites invasion of a project. Reviewer 2 recommends that the program would benefit from before/after testing and that the period of stabilization may require anywhere from two to six years (four years being insufficient time to monitor success or failure). They also comment that a metric of X miles of restored habitat is not the same as X miles of highly functional habitat. Reviewer 2 further goes on to say that the program lacks the detail for measuring success and that no monitoring (e.g. long-term monitoring) is included in the proposal. It should be noted, however, that "miles of restored habitat" is a high-level RESTORE Council grant metric, and that a detailed monitoring plan that would describe the parameters needed to demonstrate functional habitat, is not required at the FPL proposal stage.

Reviewers also agree that the proposal provides a clear description of and justification for methods proposed. Reviewer 1 is concerned, however, that the shoreline erosion processes may be too far along for a phased implementation approach, and recommends that the design also include Geotech. Reviewer 2 comments that the proposal should consider the use of benthic algal mats in hyperaline portions of the coast as the vascular plants will not grow well in all environments. Reviewer 2 also would like the proposal to provide more information on the criteria for selecting sites for this program, and adds that data management only considered the repository aspects and not the data mining to evaluate project success.

Reviewers 1 and 3 would like to see more information on the applicant's experience in implementing similar programs. In particular, Reviewer 3 would like to see more details regarding the possible partnership with NGOs with experience in living shoreline projects.

Reviewers 1 and 3 would also like to see more information on short-term implementation risks and scientific uncertainties. Reviewer 3, in particular, is concerned by how the living shorelines will affect, and be affected by, the rapidly expanding armored Texas shorelines.

Reviewer 1 notes that a summary table of the 23 potential projects/areas included in this program would be helpful, but also provides this summary comment: "This program appears to have been fully 'vetted' over the past few years by numerous entities as part of the Texas Coastal Resiliency Master Plan including the Tier 1 project list. The element of each section of program is well thought out within the confines of the references and experiences of the 'team' members involved."

Texas Shoreline Protection Through Living Shorelines Program

RESTORE Act Bucket 2 FPL3b Proposal

Response to Best Available Science External Review

15 June 2020

From summary of BAS reviews provided by RESTORE Council Staff:

"Overall, the external Best Available Science Reviews for the *Shoreline Protection Through Living Shorelines* proposal are positive. Reviewers agree that proposal objectives and methods have been justified using peer reviewed and/or publicly available information and are directly pertinent and/or well adapted to the program region. They also agree that the applicants have demonstrated that they've evaluated uncertainties and risks in achieving the program objectives over time."

Following are replies to specific comments.

(1) Reviewer 1: Suggests additional resources might be found from the North Carolina Sounds, Delaware Bay, and Chesapeake Bay Region from the Maryland Department of Natural Resources and the Virginia Institute of Marine Science.

Reply: We have cited VIMS through the inclusion of publications by Donna Marie Bilkovic. We will Add the following additional references and text to the Methods section:

Text: "The breakwater structures can become valuable substrate for marine organisms, as well as provide shelter and habitat for many fish, crab and other mobile species (Bushek, et al., 2016)."
Reference: Bushek D, Kreeger D, Moody J, Padeletti A, and Whalen L. 2016. Practitioner's Guide to Shellfish-Based Living Shorelines for Salt Marsh Erosion Control and Environmental Enhancement in the Mid-Atlantic. Partnership for the Delaware Estuary.

Text: "Low-profile breakwaters are constructed nearshore or along the shoreline to break waves, reduce erosion and promote accumulation of sand and gravel landward of the structure (Hardaway et al., 2019)."
Text: "Non-native invasive plants, including invasive Phragmites, should be controlled and possibly replaced with native wetland plants and shrubs (Bushek, et al., 2016; Saltonstall, 2002)."
Reference: Hardaway, SC, Milligan DA, and Duhring, K. "Living Shoreline Design Guidelines for Shore Protection in Virginia's Estuarine Environments." Special Report in Applied Marine Science and Ocean Engineering No. 421, Virginia Institute of Marine Science, September 2010.

(2) Reviewer 2: Suggests that evaluating the successes and failures of similar projects should be more developed in the proposal.

Reply: We will incorporate references to well documented case studies in Texas. There are several projects in Galveston Bay implemented by the Galveston Bay Foundation (Clear Lake Forest Park and Shipe Woods) that have been successful. Potential failures will be addressed in risk and uncertainties.

To be inserted in the Narrative section:

Text: “Past successful living shoreline projects implemented in Texas include Clear Lake Forest Park on Galveston Bay and the Shipe Woods living shoreline on Trinity Bay. Both living shorelines were constructed with funding from NOAA and the Galveston Bay Foundation. The two projects are on higher energy, eroding shorelines and include breakwater elements combined with marsh plantings.” Reference: Galveston Bay Foundation (GBF). 2014. Living Shorelines: A Natural Response to Erosion Control. Link.

(3) Reviewer 1: Demonstrating success will require long-term monitoring and recommends monitoring of non-native Phragmites invasion of projects

Reply: There is a line in the monitoring section that references monitoring for invasive species. We will add an explicit reference and text regarding non-native Phragmites as follows:

Text: “Non-native invasive plants, including invasive Phragmites, should be controlled and possibly replaced with native wetland plants and shrubs (Bushek, et al., 2016; Saltonstall, 2002).”

Citation: Saltonstall, K. 2002. Cryptic invasion by a non-native genotype of the common reed, Phragmites australis, into North America. Proceedings of the National Academy of Sciences, 99(4):2445-2449.

(4) Reviewer 2: The program would benefit from before and after testing and 4 years is insufficient time to monitor success or failure.

Reply: Monitoring and maintenance beyond the 4-year time span of the project will be dependent upon funding, but it is agreed that long-term maintenance will be needed. We will add text about before and after testing to the Monitoring section as follows:

Text: “Before and after testing of the project site will help evaluate project success. Baseline elevations of the vegetation line, structures and other features, as well as documentation of flora and fauna, including quadrat photos, percent land cover, and fauna counts of oysters and other native species, will be measured at the start of the project and compared after the project has been implemented (Bushek, et al., 2016). These observations will continue to be monitored over time.”

(5) Reviewer 2: Comments that the program lacks the detail for measuring success and no long-term monitoring is included in the proposal, and comments that x miles of restored habitat is not the same as x miles of highly functional habitat.

Reply: As noted in the RESTORE Council Staff review summary: “miles of restored habitat” is a high-level RESTORE Council grant metric, and a detailed monitoring plan that would describe the parameters needed to demonstrate functional habitat, is not required at the FPL proposal stage.

(6) Reviewer 1: Shoreline erosion may be too far along for a phased implementation approach and recommends that the design also include Geotech.

Reply: Each site will be constructed according to the unique properties of the shoreline with a full E&D process. The proposal in general mentions broad types of living shoreline techniques, not specific methods that will be utilized since it will vary widely from project to project.

(7) Reviewer 2: Program should consider the use of benthic algal mats in hypersaline portions of the coast where vascular plants will not grow well.

Reply: We will include a reference to the use of benthic algal mats since plantings are primarily mentioned as the methodology. As noted above, each project will be unique to that shoreline and the best methods will be implemented to maximize success. The proposal in general mentions broad types of living shoreline techniques, not specific methods that will be utilized.

In the Methods section, we will add the following:

Text: "Soft stabilization methods are non-structural in nature and involve planting marsh grasses or placing oyster reef along the existing shoreline. *In hypersaline parts of the coast, the use of benthic algal mats may be implemented where vascular plants do not grow well (Pulich and Rabalais, 1986).* Soft techniques work best …"
Reference: Pulich, W and Rabalais, S. (1986). Primary Production Potential of Blue-Green Algal Mats on Southern Texas Tidal Flats. *The Southwestern Naturalist, 31*(1), 39-47. doi:10.2307/3670958

(8) Reviewers 1 and 2: The proposal should provide more information on the criteria for selecting sites and Reviewer 1 says a summary table of the 23 potential sites would be helpful.

Reply: The project selection process is mentioned in the first section, page 4. Selection for project implementation among the 24 potential sites will depend upon the funding amount of the program. Priority will be given to projects that are appropriately large scale, will have the greatest impact to the eroding shoreline, will have the greatest chance of long-term success, and/or projects that are shovel ready.

Potential Project	**Nominator**	**HUC6 (BASIN)**	**HUC8 (SUBBASIN)**
Bessie Heights Drainage Outfall Repair and Improvement Project	Orange County	Neches	Lower Neches
Anahuac National Wildlife Refuge Living Shoreline	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	East Galveston Bay
Gordy Marsh Restoration and Shoreline Protection	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	East Galveston Bay
Candy Abshier Wildlife Management Area Shoreline Protection and Marsh Restoration	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	East Galveston Bay
East Bay Living Shorelines and Wetland Restoration	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	East Galveston Bay
Green's Lake Shoreline Protection & Wetland Restoration - Phase 2	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	West Galveston Bay
Brazoria National Wildlife Refuge GIWW Shoreline Protection	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	Austin-Oyster
Oyster Lake - West Bay Breach Protection - Phase 3	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	Austin-Oyster
Brazos River to Cedar Lake Creek GIWW Stabilization	NRDA/NFWF/GLO	San Bernard Coastal	East Matagorda Bay
Boggy Cut GIWW Stabilization	NRDA/NFWF/GLO	San Bernard Coastal	East Matagorda Bay
Redfish Lake Living Shoreline	NRDA/NFWF/GLO	Central Texas Coastal	East Matagorda Bay

Mad Island Shoreline Protection and Ecosystem Restoration	NRDA/NFWF/GLO	Central Texas Coastal	East Matagorda Bay
Palacios Shoreline Revitalization Project	NRDA/NFWF/GLO	Central Texas Coastal	East Matagorda Bay
Ocean Drive Living Shoreline	NRDA/NFWF/GLO	Central Texas Coastal	West Matagorda Bay
Port Lavaca Living Shoreline	NRDA/NFWF/GLO	Central Texas Coastal	West Matagorda Bay
Aransas National Wildlife Refuge Dagger Point Shoreline Preservation	NRDA/NFWF/GLO	Central Texas Coastal	West San Antonio Bay
Goose Island State Park Habitat Restoration and Protection	NRDA/NFWF/GLO	Central Texas Coastal	Aransas Bay
Shell Point Ranch Wetlands Protection	NRDA/NFWF/GLO	Central Texas Coastal	Aransas Bay
Newcomb's Point Shoreline Stabilization	NRDA/NFWF/GLO	Central Texas Coastal	Aransas Bay
Portland Living Shoreline	NRDA/NFWF/GLO	Southwestern Texas Coastal	North Corpus Christi Bay
Indian Point Marsh Area Living Shoreline	NRDA/NFWF/GLO	Southwestern Texas Coastal	North Corpus Christi Bay
Bejarano McFarland Memorial Park Living Shoreline	City of Port Isabel	Southwestern Texas Coastal	South Laguna Madre
Willow Lake Shoreline Stabilization	NRDA/NFWF/GLO	Galveston Bay-Sabine Lake	Sabine Lake
Flour Bluff Living Shoreline	NRDA/NFWF/GLO	Southwestern Texas Coastal	North Laguna Madre

(9) Reviewers 1 and 3: Provide more information on the applicants experience in implementing similar programs and provide more details on possible partnership with NGOs with Living Shoreline project experience (Reviewer 3).

Reply: We will add the following information to the proposal: Projects that will be considered for implementation have been vetted for inclusion by Texas' FPL3 work group or for inclusion in the Texas General Land Office's Texas Coastal Resiliency Master Plan by a Technical advisory Committee made up of federal, state, and local experts. The TGLO is the state permitting agency for living shoreline projects in Texas and has experience partnering with local NGOs like Galveston Bay Foundation, Matagorda Bay Foundation, and Coastal Bend Bays and Estuaries Program to implement shoreline stabilization projects. Each project may have a different sponsor depending on the region where the project will be implemented.

(10) Reviewers 1 and 3: Need more information on short-term implementation risks and uncertainties including how will the rapidly expanding armoring of shorelines affect the Living Shorelines and how will the Living Shorelines affect the armoring.

Reply: We will ensure the following points are made in the proposal: Short-term implementation risks and uncertainties will vary based on each individual project and its various elements. The most important uncertainties to consider are the longevity of the project, how much sediment will be needed,

sea level rise impacts, how the project could affect natural processes like vertical accretion of sediment, impacts on native flora and fauna, and the impacts on the overall functioning of the ecosystem (Bushek et al., 2016). For each project, the risks and uncertainties will be identified once an E&D phase has identified the type of project suitable. Since living shorelines mimic natural shorelines, there should be no adverse effects on any previously armored shorelines. Hardened shorelines will also not affect the implementation of living shorelines and could be retrofitted to include elements of a living shoreline depending on the offshore profile. A potential benefit of implementing these projects will be to showcase the success of large-scale living shoreline projects, which may discourage the use of armoring where greener techniques that are less expensive and more environmentally friendly can succeed.

Gulf Coast Ecosystem Restoration Council

FPL 3b Internal Best Available Science Review Panel Summary

July 2020

Introduction

On Tuesday, June 30, and Wednesday July 1, 2020 the RESTORE Council convened the Funded Priorities List (FPL) 3b Internal Best Available Science (BAS) Review Panel. The purpose of this internal panel was to use Council member-agency expertise to address external BAS review comments provided for FPL 3b submitted project/program proposals, and potentially identify project/program synergies not identified prior to proposal submission. The ultimate goal of the panel was to provide Council members with substantive best available science content to inform their decision-making.

The internal panel was convened via webinar with representatives from each of the Council's eleven member agencies present. Each BAS Panel member was provided the following:

1) Full FPL 3b proposals
2) 3 external BAS reviews for each proposal
3) Summary of external BAS reviews for each proposal
4) Proposal Sponsor's response to the BAS reviews summary
5) Any proposed revisions to the proposal

Proposal sponsors provided a brief synopsis of their proposal to the panel, a summary of comments made in external reviews, and discussed their proposed response to the external reviews. Council staff then solicited feedback from the panel on the proposal sponsor's presentation of comments and responses to those comments, and any additional BAS concerns. Council staff also solicited feedback on any existing or future synergies with other Gulf restoration activities. The proceedings of the meeting for this proposal are summarized below.

Texas

Shoreline Protection Through Living Shorelines Program

Feedback from the panel on the proposal sponsor's presentation of comments and responses to those comments, and any additional BAS concerns:

References: Additional resources might be found from the North Carolina Sounds, Delaware Bay, and Chesapeake Bay Region from the Maryland Department of Natural Resources and the Virginia Institute of Marine Science.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Lessons learned: Evaluating the successes and failures of similar projects should be more developed in the proposal.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Long-term monitoring: Demonstrating success will require long-term monitoring and recommends monitoring of non-native Phragmites invasion of projects.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Long-term monitoring: The program would benefit from before and after testing and 4 years is insufficient time to monitor success or failure.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Tracking success: Comments suggest that the program lacks the detail for measuring success and no long-term monitoring is included in the proposal; and suggest that x miles of restored habitat is not the same as x miles of highly functional habitat.

- The BAS panel agrees that Texas has appropriately addressed this comment.

Implementation strategy: Shoreline erosion may be too far along for a phased implementation approach and recommends that the design also include Geotech.

- The BAS panel agrees that Texas has appropriately addressed this comment.

Methodology: The program should consider the use of benthic algal mats in hypersaline portions of the coast where vascular plants will not grow well.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Site selection: The proposal should provide more information on the criteria for selecting sites, and a summary table of the potential sites would be helpful.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Past experience: Provide more information on the applicant's experience in implementing similar programs and provide more details on possible partnership with NGOs with Living Shoreline project experience.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Short-term risks: More information is needed on short-term implementation risks and uncertainties including how the rapidly expanding armoring of shorelines will affect the Living Shorelines and how the Living Shorelines will affect the armoring.

- The BAS panel agrees that the response Texas has indicated will appropriately address this comment.

Panel comments on existing or future synergies with proposed activity:
Panelists highlighted the existence of several tools that could support this program, such as the NOAA RESTORE Act Science Program Living Shoreline Tool and the Texas General Land Office Living Shoreline Site Suitability Model.

SCIENCE EVALUATION

Bucket 2: Comprehensive Plan Component

Proposal Title: Shoreline Protection Through Living Shorelines
Location (If Applicable): Texas
Council Member Bureau or Agency: Texas Commission on Environmental Quality
Type of Funding Requested: Planning / Implementation

Reviewed by: Reviewer 1
Date of Review: May 6, 2020

Best Available Science:

These 4 factors/elements help frame the reviewer's answers to A, B and C found in next section:

Question 1.	
Have the proposal objectives, including proposed methods, been justified using peer reviewed and/or publicly available information?	Yes
Comments:	
Of course there are more references that could be utilized that pertain to Living Shoreline Design and Performance. Chesapeake Bay has perhaps the greatest number of projects installed ove the last 30 years. Reference MD Dept of Natural Resoureces and the Virginia Institute of Marine Science.	

Question 2.	
If information supporting the proposal does not directly pertain to the Gulf Coast region, are the proposal's methods reasonably supported and adaptable to that geographic area?	Yes
Comments:	
North Carolina Sounds, Chesapeake Bay and Delaware Bay and have similar fetch exposures and tide ranges so research in the Gulf Coast Region would further support and enlighten the ongoing efforts there. The true measure of Living Shoreline Projects is long term performance which requires some long term monitoring effort.	

Question 3.	
Are the literature sources used to support the proposal accurately and completely cited? Are the literature sources represented in a fair and unbiased manner?	Yes
Comments:	
Click here to enter text.	

Question 4.	
Does the proposal evaluate uncertainties and risks in achieving its objectives over time? (e.g., is there an uncertainty or risk in the near- and/or long-term that the project/program will be obsolete or not function as planned?)	Yes
Comments:	
Although I understand the concept but “we” are too far along on this process to do phasing (page 6, paragraph 2) like if marsh plantings don’t work, then install a breakwater. Also, it’s the long term you must deal with. The one thing that must be monitored for is the Non-native Phragmites invasion of a project. The risk have been identified on page 8 but the design must include the Geotech, as noted, so a breakwater does not have to be revisited. Sand and plant replacement is noted and to be expected.	

Based on the answers to the previous 4 questions, and *giving deference to the sponsor to provide within reason the use of best available science,* the following three questions can be answered:

Question A	
Has the applicant provided reasonable justification that the proposal is based on science that uses peer- reviewed and publicly available data?	Yes
Comments:	
Click here to enter text.	

Question B	
Has the applicant provided reasonable justification that the proposal is based on science that maximizes the quality, objectivity, and integrity of information (including, as applicable, statistical information)?	Yes
Comments:	
Click here to enter text.	

Question C	
Has the applicant provided reasonable justification that the proposal is based on science that clearly documents and communicates risks and uncertainties in the scientific basis for such projects/programs?	Yes
Comments:	

Click here to enter text.

Science Context Evaluation:

Question A	
Has the project/program sponsor or project partners demonstrated experience in implementing a project/program similar to the one being proposed?	Need more information
Comments:	
Click here to enter text.	

Question B	
Does the project/program have clearly defined goals objectives?	Yes
Comments:	
Click here to enter text.	

Question C

Has the proposal provided a clear description of the methods proposed, and appropriate justification for why the method is being selected (e.g., scientifically sound; cost-effectiveness)?	Yes
Comments:	
Click here to enter text.	

Question D	
Does the project/program identify the likely environmental benefits of the proposed activity? Where applicable, does the application discuss those benefits in reference to one or more underlying environmental stressors identified by best available science and/or regional plans?	Yes
Comments:	
Click here to enter text.	

Question E	
Does the project/program have measures of success (i.e., metrics) that align with the primary Comprehensive Plan goal(s)/objectives? (Captures the statistical information requirement as defined by RESTORE Act)	Yes
Comments:	
Click here to enter text.	

Question F	
Does the proposal discuss the project/program's vulnerability to potential long-term environmental risks (i.e., climate, pollution, changing land use)? (Captures risk measures as defined under best available science by the RESTORE Act)	Yes
Comments:	
In particular, climate change and sea level rise are included as risks but not how to migtigate specifically is not clear.	

Question G	
Does the project/program consider other applicable short-term implementation risks and scientific uncertainties? Such risks may include the potential for unanticipated adverse environmental and/or socio-economic impacts from project implementation. Is there a mitigation plan in place to address these risks? Any relevant scientific uncertainties and/or data gaps should also be discussed. (Captures risk measures as defined under best available science by the RESTORE Act)	Need more information
Comments:	
Click here to enter text.	

Question H	
Does the project/program consider recent and/or relevant information in discussing the elements above?	Yes
Comments:	
Click here to enter text.	

Question I	
Has the project/program evaluated past successes and failures of similar efforts? (Captures the communication of risks and uncertainties in the scientific basis for such projects as defined by the RESTORE Act)	Need more information
Comments:	
Again there is a wealth of data from other regions on what has and has not performed adequately or as proposed.	

Question J	
Has the project/program identified a monitoring and data management strategy that will support project measures of success (i.e., metrics). If so, is appropriate best available science justification provided? If applicable, how is adaptive management informed by the performance criteria? (Captures statistical information requirement a defined by the RESTORE Act)	Yes
Comments:	
Click here to enter text.	

Please summarize any additional information needed below:

This program appears to have been fully “vetted” over the past few years by numerous entities as part of the Texas Coastal Resiliency Master Plan including the Tier 1 project list. The element of each section of progam is well thought out within the confines of the references and experiences of the “team”members involved.
I thought that I would be reviewing actual project designs during this process. In looking though some of the online information about the Plan, I found come conceptual plans and typical cross-sections developed by AECOM in 2016. Furthermore, there were project specific plans and costs. This helped clarify the fact that there has been a concerted effort to develop Living shoreline and shore protection projects along the Texas coast and that this program has developed a short list of 23 sites to consider. A summary table of those with locations would be helpful.
As defined by the proposal document, the Living Shorelines will generally set in low to medium wave energy environments. This will allow some flexibility in designing more habitat oriented projects.

SCIENCE EVALUATION

Bucket 2: Comprehensive Plan Component

Proposal Title: Shoreline Protection Through Living Shorelines
Location (If Applicable): Texas
Council Member Bureau or Agency: Texas Commission on Environmental Quality
Type of Funding Requested: Planning / Implementation

Reviewed by: Reviewer 2
Date of Review: 12 May 2020

Best Available Science:

These 4 factors/elements help frame the reviewer's answers to A, B and C found in next section:

Question 1.	
Have the proposal objectives, including proposed methods, been justified using peer reviewed and/or publicly available information?	Yes
Comments:	
This was a well written proposal with adequate citations to support their approach.	

Question 2.	
If information supporting the proposal does not directly pertain to the Gulf Coast region, are the proposal's methods reasonably supported and adaptable to that geographic area?	Yes
Comments:	
All approaches will have use in Texas- no issues.	

Question 3.	
Are the literature sources used to support the proposal accurately and completely cited? Are the literature sources represented in a fair and unbiased manner?	Yes
Comments:	
This is well done!	

Question 4.	
Does the proposal evaluate uncertainties and risks in achieving its objectives over time? (e.g., is there an uncertainty or risk in the near- and/or long-term that the project/program will be obsolete or not function as planned?)	Yes
Comments:	
This was answered but was weak. It is not surprising given each site will have different contingencies. Not an issue to this reviewer.	

Based on the answers to the previous 4 questions, and *giving deference to the sponsor to provide within reason the use of best available science,* the following three questions can be answered:

Question A	
Has the applicant provided reasonable justification that the proposal is based on science that uses peer- reviewed and publicly available data?	Yes
Comments:	
Click here to enter text.	

Question B	
Has the applicant provided reasonable justification that the proposal is based on science that maximizes the quality, objectivity, and integrity of information (including, as applicable, statistical information)?	Need more information
Comments:	
Use of before/after testing would benefit this work.	

Question C	
Has the applicant provided reasonable justification that the proposal is based on science that clearly documents and communicates risks and uncertainties in the scientific basis for such projects/programs?	Yes
Comments:	
This is a well developed section of the proposal	

Science Context Evaluation:

Question A	
Has the project/program sponsor or project partners demonstrated experience in implementing a project/program similar to the one being proposed?	Yes
Comments:	
This proposal demonstrates awareness of complexity of large projects	

Question B	
Does the project/program have clearly defined goals objectives?	Yes
Comments:	
One issue is saying x miles of restored habitat does not mean it is x miles of highly functional habitat.	

Question C	
Has the proposal provided a clear description of the methods proposed, and appropriate justification for why the method is being selected (e.g., scientifically sound; cost-effectiveness)?	Yes
Comments:	
The use of hard and soft shoreline stabilization makes sense. I would include the use of benthic algal mats in hyperaline portions as the vascular plants will not grow well in these environments. Mats of sand-tidal mats in Laguna Madre have maintained sediments after hurricane passage! Stating you will remove algal mats seems arbitrary-the reason for the growth of these algae is a function of the new conditions you have made!	

Question D	
Does the project/program identify the likely environmental benefits of the proposed activity? Where applicable, does the application discuss those benefits in reference to one or more underlying environmental stressors identified by best available science and/or regional plans?	Yes
Comments:	
This is covered in broad strokes, but lacks details essential for measuring "success" There also is no monitoring period!	

Question E	
Does the project/program have measures of success (i.e., metrics) that align with the primary Comprehensive Plan goal(s)/objectives? (Captures the statistical information requirement as defined by RESTORE Act)	Yes
Comments:	
There is no evaluation of before/after health. There is no period of stabilization-often requiring 2-6 yrs!	

Question F	
Does the proposal discuss the project/program's vulnerability to potential long-term environmental risks (i.e., climate, pollution, changing land use)? (Captures risk measures as defined under best available science by the RESTORE Act)	Yes
Comments:	
Click here to enter text.	

Question G	
Does the project/program consider other applicable short-term implementation risks and scientific uncertainties? Such risks may include the potential for unanticipated adverse environmental and/or socio-economic impacts from project implementation. Is there a mitigation plan in place to address these risks? Any relevant scientific uncertainties and/or data gaps should also be discussed. (Captures risk measures as defined under best available science by the RESTORE Act)	Yes
Comments:	
This is adequately covered herein.	

Question H	
Does the project/program consider recent and/or relevant information in discussing the elements above?	Yes
Comments:	
Click here to enter text.	

Question I	
Has the project/program evaluated past successes and failures of similar efforts? (Captures the communication of risks and uncertainties in the scientific basis for such projects as defined by the RESTORE Act)	No
Comments:	
This is not developed in the proposal	

Question J	
Has the project/program identified a monitoring and data management strategy that will support project measures of success (i.e., metrics). If so, is appropriate best available science justification provided? If applicable, how is adaptive management informed by the performance criteria? (Captures statistical information requirement a defined by the RESTORE Act)	No
Comments:	
Data management only considered the repository aspects. It does not consider the data mining to evaluate project success.	

Please summarize any additional information needed below:
There are many sites identified, more than that which can be improved with these funds. What are your criterion for selecting sites? The hardening of shoreline does not mean improvement. There has to be environmental benefit measured after functionality has been established. A 4-yr period is not sufficient for this to occur-this may be a failing of the funding program, but it immediately requires additional sources of funding to monitor after construction

SCIENCE EVALUATION

Bucket 2: Comprehensive Plan Component

Proposal Title: Shoreline Protection Through Living Shorelines
Location (If Applicable): Texas
Council Member Bureau or Agency: Texas Commission on Environmental Quality
Type of Funding Requested: Planning / Implementation

Reviewed by: Reviewer 3
Date of Review: 5/13/20

Best Available Science:

These 4 factors/elements help frame the reviewer's answers to A, B and C found in next section:

Question 1.	
Have the proposal objectives, including proposed methods, been justified using peer reviewed and/or publicly available information?	Yes
Comments:	
Click here to enter text.	

Question 2.	
If information supporting the proposal does not directly pertain to the Gulf Coast region, are the proposal's methods reasonably supported and adaptable to that geographic area?	Yes
Comments:	
Click here to enter text.	

Question 3.	
Are the literature sources used to support the proposal accurately and completely cited? Are the literature sources represented in a fair and unbiased manner?	Yes
Comments:	
Click here to enter text.	

Question 4.	
Does the proposal evaluate uncertainties and risks in achieving its objectives over time? (e.g., is there an uncertainty or risk in the near- and/or long-term that the project/program will be obsolete or not function as planned?)	Yes
Comments:	
Click here to enter text.	

Based on the answers to the previous 4 questions, and *giving deference to the sponsor to provide within reason the use of best available science,* the following three questions can be answered:

Question A	
Has the applicant provided reasonable justification that the proposal is based on science that uses peer- reviewed and publicly available data?	Yes
Comments:	
The TGLO, 2020 Living Shoreline Manual is cited 3 times. It is under review and not yet published. Therefore, it cannot be evaluated, but I view this as a demonstration of commitment to, and acquired knowledge of, living shorelines and not detrimental.	

Question B	
Has the applicant provided reasonable justification that the proposal is based on science that maximizes the quality, objectivity, and integrity of information (including, as applicable, statistical information)?	Yes
Comments:	
Click here to enter text.	

Question C	
Has the applicant provided reasonable justification that the proposal is based on science that clearly documents and communicates risks and uncertainties in the scientific basis for such projects/programs?	Yes
Comments:	
Click here to enter text.	

Science Context Evaluation:

Question A	
Has the project/program sponsor or project partners demonstrated experience in implementing a project/program similar to the one being proposed?	No
Comments:	
It was noted that potential partners "could" include NGOs with experience in living shoreline implementation (p. 5).	

Question B	
Does the project/program have clearly defined goals objectives?	Yes
Comments:	
Click here to enter text.	

Question C	
Has the proposal provided a clear description of the methods proposed, and appropriate justification for why the method is being selected (e.g., scientifically sound; cost-effectiveness)?	Yes
Comments:	
Click here to enter text.	

Question D	
Does the project/program identify the likely environmental benefits of the proposed activity? Where applicable, does the application discuss those benefits in reference to one or more underlying environmental stressors identified by best available science and/or regional plans?	Yes
Comments:	
Benefits discussed in reference to environmental stressors and the 2019 Texas Coastal Resiliency Master Plan.	

Question E	
Does the project/program have measures of success (i.e., metrics) that align with the primary Comprehensive Plan goal(s)/objectives? (Captures the statistical information requirement as defined by RESTORE Act)	Yes
Comments:	
Click here to enter text.	

Question F	
Does the proposal discuss the project/program's vulnerability to potential long-term environmental risks (i.e., climate, pollution, changing land use)? (Captures risk measures as defined under best available science by the RESTORE Act)	Yes
Comments:	
Relative sea level rise, compaction of soils, and changing wave energy, soil depth and salinity were acknowledged.	

Question G	
Does the project/program consider other applicable short-term implementation risks and scientific uncertainties? Such risks may include the potential for unanticipated adverse environmental and/or socio-economic impacts from project implementation. Is there a mitigation plan in place to address these risks? Any relevant scientific uncertainties and/or data gaps should also be discussed. (Captures risk measures as defined under best available science by the RESTORE Act)	Need more information
Comments:	
The proposal states that 376 miles have armored shoreline have been constructed over the past 20 years (p. 4). It is not clear how the living shorelines will affect, and be affected by, the rapidly expanding armored shoreline provisions. Will armored and living shorelines complement or counteract each other? Data gaps that could threaten the project are acknowledged and are proposed to be identified with site-specific suitability assessments, but it is not stated how these data gaps will be filled.	
Question H	
Does the project/program consider recent and/or relevant information in discussing the elements above?	Yes
Comments:	
Click here to enter text.	

Question I	
Has the project/program evaluated past successes and failures of similar efforts? (Captures the communication of risks and uncertainties in the scientific basis for such projects as defined by the RESTORE Act)	Yes
Comments:	
Recent literature was cited that supports the benefits and potential pitfalls of implementing living shorelines.	

Question J	
Has the project/program identified a monitoring and data management	Yes

strategy that will support project measures of success (i.e., metrics). If so, is appropriate best available science justification provided? If applicable, how is adaptive management informed by the performance criteria? (Captures statistical information requirement a defined by the RESTORE Act)	

Comments:

Phased introduction of living shoreline (p. 6). Proposed adaptive management techniques are closely tied to performance metric HR014.

Please summarize any additional information needed below:

It is stated that monitoring will be conducted to evaluate the potential environmental risks that could threaten the effectiveness of the project (Question F), but is is not clear where the resources would come from for the adaptive management maintenance and repair of living shorelines outside the project window. Please ignore this comment if it is beyond the scope of this scientific review.