USDA

Coastal Ecosystem Enhancement and Restoration in the Barataria-Terrebonne Basin

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Proposal

USDA - NRCS, Louisiana

11/15/14

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Project Identification

Project Title: Coastal Ecosystem Restoration and Enhancement in the Barataria Terrebonne Basin	Project
State(s): Louisiana	County/City/Region: Lafourche and Terrebonne Parish//SE Louisiana

General Location: *Projects must be located within the Gulf Coast Region as defined in RESTORE Act. (attach map or photos, if applicable)*: Barataria Terrebonne National Estuary

Project Description

RESTORE Goals: *Identify all RESTORE Act goals this project supports. Place a **P** for Primary Goal, and **S** for secondary goals.*

S Restore and Conserve Habitat
P Restore Water Quality
__Restore and Revitalize the Gulf Economy
S Replenish and Protect Living Coastal and Marine Resources
__ Enhance Community Resilience

RESTORE Objectives: *Identify all RESTORE Act objectives this project supports. Place a **P** for Primary Objective, and **S** for secondary objectives.*

S Restore, Enhance, and Protect Habitats
P Restore, Improve, and Protect Water Resources
S Protect and Restore Living Coastal and Marine Resources
__Restore and Enhance Natural Processes and Shorelines
__ Promote Community Resilience
__Promote Natural Resource Stewardship and Environmental Education
__Improve Science-Based Decision-Making Processes

RESTORE Priorities: *Identify all RESTORE Act priorities that this project supports.*

X Priority 1: Projects that are projected to make the greatest contribution
X Priority 2: Large-scale projects and programs that are projected to substantially contribute to restoring
X Priority 3: Projects contained in existing Gulf Coast State comprehensive plans for the restoration
X Priority 4: Projects that restore long-term resiliency of the natural resources, ecosystems, fisheries …

RESTORE Commitments: *Identify all RESTORE Comprehensive Plan commitments that this project supports.*

X Commitment to Science-based Decision Making
X Commitment to Regional Ecosystem-based Approach to Restoration
X Commitment to Engagement, Inclusion, and Transparency
X Commitment to Leverage Resources and Partnerships
X Commitment to Delivering Results and Measuring Impacts

RESTORE Proposal Type and Phases: *Please identify which type and phase best suits this proposal.*

X Project ___ Planning X Technical Assistance X Implementation_____ Program

Project Cost and Duration

Project Cost Estimate:	**$**_____	**Project Timing Estimate**:
Total : $16,009,788		Date Anticipated to Start: Oct 1/2015 Time to Completion: 5 years Anticipated Project Lifespan: 5-10 years

II. Executive Summary

The Barataria-Terrebonne National Estuary Program (BTNEP) is a joint effort between the State of Louisiana and the U.S. Environmental Protection Agency to conserve the resources of the Barataria-Terrebonne Estuary. The Barataria-Terrebonne watershed includes 4.2 million acres of land between the Mississippi and Atchafalaya Rivers extending from the Gulf of Mexico north to the old river control structure. Recognized as a resource of national significance, the Barataria-Terrebonne Estuary (BTE) system plays a vital role in fisheries, agriculture, transportation, and energy. However, due to both natural and human-induced causes, land loss in the estuary is occurring at an alarming rate, habitat is being destroyed, water and sediment are being contaminated by toxic substances and organic materials, life cycles of animals are being disrupted, and the cultural heritage of residents is in jeopardy.

This coastal ecosystem enhancement project aims to create an ecosystem scale model for Gulf Coast restoration priorities. The primary goal is to protect and restore water quality while conserving critical habitat in the estuary system, in agreement with RESTORE Act Plan goals. The ultimate objective of restoring, protecting, and improving water resources and associated habitat value will be achieved by reducing the nutrient loading into impaired watersheds by (1) redirecting agricultural runoff (from soybean and sugarcane fields) through impounded and natural wetlands; (2) rerouting stormwater through wetlands to reduce pollution in local receiving water bodies (water bodies with established TMDLs); and (3) through coastal restoration and the implementation of native plantings and invasive species removal in marginal lands and impoundments to improve migratory bird habitat. In doing so, this project will restore key habitat functions important for coastal water birds, shorebirds, and commercial and recreational fisheries by reconnecting natural flow regimes from agricultural land and coastal communities to degrading wetlands.

Project implementation is 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 region. This project significantly contributes to the comprehensive restoration of one of Louisiana's priority watersheds, as identified in the 2012 Nonpoint Source (NPS) Management Plan as well as achieving objectives identified by the BTNEP Management Committee's Comprehensive Conservation & Management Plan.

This project will be carried out through a partnership between the USDA-Natural Resource Conservation Service (NRCS), Barataria Terrebonne National Estuary Program (BTNEP), Bayou Land Resource Conservation and Development (RC&D) Council, Louisiana Department of Agriculture and Forestry (LDAF) Office of Soil and Water Conservation, local Soil and Water Conservation Districts (SWCDs), and Nicholls State University. Project objectives will be accomplished through partnerships with other public and private landowners, businesses, and organizations as necessary. Project success will be measured throughout the course of this five-year project by implementing a performance based, task-driven monitoring program.

We are offering this proposal under the auspices of the Resources and Ecosystems Sustainability, Tourism Opportunities, and Revived Economies of the Gulf Coast States (RESTORE) Act and other applicable statutory authorities.

III Proposal Narrative

Introduction & Background

Louisiana contains approximately thirty percent (30%) of the total coastal wetland area, but accounts for ninety percent (90%) of the coastal land loss in the conterminous United States (Dahl 2000, Field et al. 1991, USGS 2003). Due to both natural and human-induced causes, land loss is occurring at accelerated rates, habitat is being destroyed, water and sediment are being contaminated by excess nutrient loading, toxic substances and organic materials, life cycles of animals are being disrupted, and the heritage and culture of the estuary residents are in jeopardy. The Barataria and Terrebonne basins, in particular, represent an enormously valuable national treasure where nearly 600,000 Louisiana citizens live, work, and play within the boundaries [1]. Many of today's proud inhabitants can trace their lineage to people whose existence revolved around the bounty of the basins' natural resources. Thus, the Barataria-Terrebonne Estuary (BTE) is a dynamic working system that supports the people of southeast Louisiana, the Nation's oil and gas infrastructure, as well as a diversity of flora and fauna. However, anthropogenic alterations to nutrient budgets within the BTE are coupled to an array of ecological impacts, and a growing number of these valuable ecosystem services are at risk of being compromised by nutrient-induced degradation of estuarine and near-shore marine habitats [1, 3]. It is, therefore, critical to implement a well-planned nutrient management strategy to protect and restore this ecologically, economically, and socially important ecosystem.

Ongoing federal efforts to restore parts of the Gulf Coast and the BTE have introduced many new practices, technologies, and philosophies, which are being discussed and promoted by multiple groups and partners to mitigate and recover from damages associated from the *Deepwater Horizon* spill. Restore Act funding will allow us to introduce a watershed-level restoration program for the BTE system. This coastal ecosystem enhancement and restoration project will achieve the goals of water quality improvement and habitat restoration by:

- Reducing the nutrient loading into impaired watersheds by redirecting agricultural runoff (from soybean and sugarcane fields) through impounded and natural wetlands.
- Rerouting stormwater through wetlands to reduce pollution in local receiving water bodies (water bodies with established TMDLs).
- Coastal restoration implementing native plantings and invasive species removal in marginal lands and impoundments to improve migratory bird habitat.

Agricultural Runoff Reduction

On the interior and northern part of the estuary system are the working agricultural lands that produce sugarcane and soybeans. In 2013, the total value of the sugarcane crop to Louisiana's producers, processors and landowners was over $770 million dollars**,** while soybeans contributed more than $908 million to Louisiana's economy. While the agricultural sector is undeniably an important economic resource to the people of southeast Louisiana, nutrient management within the Barataria Terrebonne Estuary system is critical to ecosystem health. Runoff from agricultural practices and urban stormwater, allowed to flow directly into receiving waters will negatively impact the lower basin fisheries. The lower reaches of the basins are a region upon which 97% of all commercially valuable Louisiana Gulf of Mexico fisheries species depends, for some or part of their life cycle [1].

Because the upper basins are tightly linked hydrologically to the lower basins, agricultural practices along with urbanization and industrialization can lead to increasingly eutrophic conditions within the basin's upper freshwater zone [3]. To facilitate field drainage, most agricultural runoff is channeled through ditches that lead to inland lakes, completely bypassing natural filters such as bottomland-hardwood forests and cypress-tupelo swamps. The result of this hydrological modification is eutrophication of the inland lakes and impounded, malnourished and degraded swamps. There are numerous impaired water bodies within the estuary with established TMDL's.

The USDA-NRCS will use a 3 phased approach on working lands within the estuary including conservation planning, design and voluntary implementation of conservation practices. Utilizing a 9-step planning process professional conservationists and engineers will work with landowners and producers to identify resource concerns and develop strategies to improve watershed health. In a voluntary approach of implementation, targeted suites of conservation practices will be utilized to reduce nutrient and sediment loss from working agriculture fields. Technical standards and criteria have been established for all NRCS conservation practices that provide the guidance and direction needed to address nutrient and sediment loss.

This project will identify working land tracts, within targeted focal areas of the estuary to implement a comprehensive conservation system on working lands. Project sites will be ranked and selected in hydrological sensitive areas that will target conservation practice investment. RESTORE funding will be used in conjunction with USDA-NRCS program dollars to maximize conservation benefit within the estuary. The Environmental Quality Incentives Program (EQIP) promotes agricultural production, forest management, and environmental quality as compatible goals, and optimizes environmental benefits. Through EQIP, the NRCS provides assistance to eligible farmers to address soil, water, and air quality, wildlife habitat, surface and groundwater conservation, and related natural resource concerns.

Comprehensive conservation planning and design will be uniquely accomplished through an interdisciplinary planning team that will work to integrate water quality and wildlife enhancement practices, and the creation of multi-functional wetland habitats. EQIP will be used as the primary tool to address improvements on farm and RESTORE funds will be used to restore less productive portions of fields (i.e., low end, marginal cropland) to wetlands designed to filter

nutrients and trap sediment. Redirecting agricultural runoff through impounded and natural wetlands from working agriculture lands the partnership will reduce the nutrient loading into impaired water bodies. This unique strategy will require a whole farm approach to the design and development of an advanced integrated system.

Environmental Compliance on Working Lands –Each individual conservation system and land treatment will undergo an Environmental Evaluation using the NRCS-CPA-52 Form. NRCS will utilize its Programmatic Agreement with Advisory Council on Historic Preservation and the National Conference of State Preservation Officers, as well as a State Level agreement with the State Historic Preservation Office (SHPO). Likewise, NRCS has programmatic consultation with the US Fish & Wildlife Service that addresses how Conservation Practices will be implemented in compliance with the Endangered Species Act.

Agricultural Runoff Reduction Implementation Methodology

Phase I. Planning
Timeframe: Oct 2015-Oct 2016

- Target priority watershed
- Outreach to and engagement with producers
- Site identification
- Landowner sign-up, identification of 2 landowner sites (200 acres each) at 400 acres of restoration

Phase II: Engineering & Design, Baseline Monitoring
Timeline: October 2015-October 2017

- Survey and engineering of the fields and wetland areas
- Identify site specific BMP and verification protocols
- Survey of potential monitoring & sampling sites
- Baseline (pre-implementation) monitoring by Nicholls University

Phase III. Implementation
Timeline October 2017-October 2019

- Equipment purchase
- BMP installation
- Survey & removal of invasive species in planted marginal lands & impounded areas

Phase IV: Post Construction Monitoring, Adaptation, Evaluation
Timeline October 2018-October 2020

- Post-construction monitoring & maintenance (2 yrs)

Rerouting Stormwater Through Wetlands To Reduce Pollution

At the southern end of the freshwater part of the BTNEP system are stormwater protection levees used to surround and protect human communities from flooding by stormwater and wind-blown water. Stormwater pumps move pathogen, sediment, metal, and nutrient-laden water from inside of the levee system, into canals that lead to shellfish-producing areas in the estuary, completely bypassing natural filters, such as coastal marsh habitats, and elevating fecal coliform levels to oyster-growing areas.

The concept of stormwater redirection to nourish wetlands and decrease pollutants in stormwater is a concept that goes back to the planning years of the Barataria-Terrebonne National Estuary Program's Comprehensive Conservation and Management Plan or CCMP, Action plan EM-12, Storm Water Management (David et al., 1996). Stormwater pumping stations are used to collect rainfall that has fallen inside of either flood or hurricane protection levees. The lower part of the BTNEP system is highly modified in terms of hydrology; pumping stations located on the interior of the extensive levee systems are now the collection points and outlets for these man-made watersheds. During a rainfall event the stormwater pumps are operated so that communities and agricultural land on the interior of the levee system does not fill with storm water. The storm water is usually pumped over the levee and into a man-made waterway or canal, bypassing natural wetland filters. The result is that the storm water becomes a delivery system of poorly treated human and animal wastewater, metals, nutrients, pathogenic bacteria, organic matter and sediments. Often, the canals lead directly into shellfish growing areas, which require low pathogenic bacterial levels for public health standards.

A stormwater redirection project would re-orient the outfall of the stormwater pumping station so that the water would flow through adjacent wetlands on the outside of the levee system. Many of the wetlands in the lower part of the BTES are grasses wetlands or marshes. Healthy marshlands help to complement levee systems by attenuating the energy from small to medium sized storms. Redirecting stormwater through these wetlands help to nourish and improve their health. Stormwater that flows through wetlands help to benefit the wetlands due to the addition of fresh water, sediments, nutrients and organic matter. The addition of the stormwater to wetlands benefits water quality and shellfish production by increasing pathogenic bacterial die-off, uptake of nutrients, removal of metals, and deposition of sediment and organic matter.

Healthy coastal wetlands provide a variety of ecologically and economically important functions and services, including flood and storm protection, sediment and carbon sequestration, water quality improvement, habitat for numerous species of birds, invertebrates, and mammals, and many others [45-48]. More specifically, coastal wetlands occupy a critical interface between upland nutrient sources and estuarine receiving basins, and therefore function as nutrient sinks that buffer adjacent ecosystems [49-51]. Indeed, numerous fertilization experiments have documented the capacity of these ecologically important ecosystems to assimilate and transform nutrients via enhanced plant growth and nutrient uptake [52-55], microbe-mediated processes such as denitrification [56-58] and soil sorption, burial, and organic matter accumulation [59-62].

Louisiana's 2012 Nonpoint Source Management Plan identifies Bayou Folse as a priority watershed while the 2012 Integrated Reports indicated that Bayou Folse was fully meeting Clean Water Act designated uses of secondary contact recreation and drinking water sources however, was impaired for primary contact recreation and fish and wildlife propagation. Suspected causes of these water quality impairments include high concentrations of nitrogen (N) and phosphorus (P), low dissolved oxygen (DO), and fecal coliform bacteria. For example, the Bayou Folse watershed sits along the eastern edge of the Terrebonne Basin (Figure 8). Within this heavily hydro modified watershed sits twelve pumps that route storm water and wastewater discharge into the Bayou Folse watershed from surrounding leveed lands.

By changing the orientation of 2 leveed stormwater pumping stations within the Bayou Folse Watershed flow will be directed through degraded wetlands and will enhance shellfish habitat

and nourish surrounding wetlands. Rerouting stormwater through wetlands will reduce pollution in local receiving water bodies in conjunction with the establishment of a healthy native plant community and integrate a vegetated terracing system.

Stormwater Runoff Reduction Implementation Methodology

Phase I Planning
Timeline: October 2015-October 2016

- Survey potential stormwater levee pump sites
- Recruit landowners
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Phase II: Engineering & Design, Baseline Monitoring
Timeline: October 2015-October 2017

- Purchase equipment
- Engineering and design
- Site selection for baseline and long term monitoring

Phase III: Implementation
Timeline: January 2017-January 2019

- Implement 2 stormwater redirection projects
- Survey, engineer and construct 50 acres (25acres/site) of terraces from local borrow in receiving areas
- Survey and removal of invasive species in receiving areas
- Native plantings in receiving areas and on terraces

Phase IV: Post Construction Monitoring, Adaptation, Evaluation
Timeline: October 2018-October 2020

- Monitor receiving areas and reference area
- Native coverage monitoring and replanting

Coastal Habitat Restoration

In the lower reaches of the Barataria Terrebonne Estuary lie tidal bays, saltwater marshes, beaches and chains of barrier islands. With their fine sand beaches, low dunes, shallow near shore water, deep passes and back barrier marshes, the islands protect coastal bays from waves and storm surges. This region has experienced extensive habitat loss due to subsidence, erosion, sea-level rise, storm activity, and development. These beaches are the primary, and in some case the only, resting, nesting, and foraging areas for colonial sea birds, migrating song birds, and shore birds.

Beginning in the fall of 2012, the Barataria-Terrebonne National Estuary Program (BTNEP) initiated a series of avian surveys along the Caminada Headland in southeast Louisiana. These surveys were designed to concentrate on a select group of shorebirds including Piping Plover (*Charadrius melodus*), Wilson's Plover (*Charadrius wilsonia*), Snowy Plover (*Charadrius nivosus*), and Red Knot (*Calidris canutus*) based on concerns about the implications of barrier island and headland beach restoration projects and their impacts on the distribution or takings (in the form of harassment) of Piping Plover, particularly during the active restoration phase. This resulted in permit requirements that mandated routine surveys to document the distribution of Piping Plover over time as the active restoration project was implemented. Analysis of Piping Plover distribution and habitat use as it relates to shoreline stabilization projects is called for in the Piping Plover Species Action Plan [4-5].

In order to establish an adequate baseline on the numbers and distribution of wintering Piping Plover prior to the active restoration of the Caminada Headland, the BTNEP program initiated avian surveys of the Caminada Headland in lower Lafourche and Jefferson parishes in September 2012. Three surveys were conducted, one a month between September and November 2012. Beginning in January 2013, the BTNEP program through an Interagency Agreement with the Coastal Protection and Restoration Authority (CPRA) began conducting two avian surveys per month through to the beginning of April 2013. In total, 10 surveys were accomplished during the 2012-2013 winter season (September 2012 through April 2013), prior to any restoration activity. Another 19 surveys were conducted over the 2013-2014 winter season (July 2013 through April 2014). Twenty surveys are planned for the 2014-2015 winter season and again for the 2015-2016 winter season (July through May). In total, some 69 surveys will have been completed before the active construction phase of the Caminada Headland is complete.

Currently, funding is in place to provide for these specific surveys through to mid 2016 coinciding with the completion of the active restoration phase. This proposal seeks to continue the same level of effort once construction is complete to evaluate Piping Plover use and distribution along the Caminada Headland and to determine the positive or negative response post construction. The proposal seeks to document trends in occurrence/use as successional changes occur. All barrier island restoration projects include some level of vegetative plantings followed by natural successional changes that occur as a response to site-specific restoration. These changes – from bare sand to a vegetated platform – may impact occurrence and use by Piping Plover and other shorebirds. This project seeks to measure/document that response if any.

Piping Plover

The Piping Plover is a medium sized shorebird native to the North American continent (Figure 1). Today, this species is considered to have three separate distinct breeding populations including the Atlantic coast from North Carolina to Canada, the Great Lakes region, and the Northern Great Plains [4-7]. An international population census in 2001 estimated a combined total of approximately 6,000 individuals remaining [8].

Figure 1. Piping Plover on Caminada Headland. Photo by John Spoher

Winter distribution of Piping Plover is based on habitat conditions. A variety of foraging and roosting habitats in close proximity are important factors that regulate distribution of these birds. Microhabitats including intertidal mud flats and sand flats serve as primary foraging areas for Piping Plover and a host of shorebird species [6]. Restoration templates for large barrier islands that don't provide for these microhabitats will not meet the needs of wintering Piping Plover nor will these templates provide for a host of temperate migrant shorebirds that spend their winters along the northern gulf.

The partnership will nourish existing wetland and create new maritime forest habitat with native woody species for migratory and nesting shore birds, because while upper estuary water quality and habitat restoration is critical, it is understood that without wetland restoration, Louisiana will likely lose another 4,548 km^2 of coastal land over the next 50 years [9].

The Caminada Headland at the southernmost reach of the estuary supports beach, dune, and marsh habitat. This barrier island system currently supports numerous microhabitats in the form of shallow washover flats. These flats will likely become vegetated as a result of the aforementioned restoration project and could result in diminished use/occurrence of Piping Plover. This too will be a parameter measured as part of this proposal.

Coastal Habitat Restoration Implementation Methodology

Phase I Planning
Timeline: October 2015-March 2016

- Survey potential planting sites
- Determine best plant species composition
- Three Soil & Water Conservation District (SWCD) Technicians will be hired; one each in the Plaquemines, Crescent, and Lafourche-Terrebonne SWCDs (districts 42, 26 and 19,) to carry out SWCD related contributions to all phases of the partnership RA program effort.

Phase II: Engineering & Design, Baseline Monitoring
Timeline: October 2015-March 2016

- Grow out submerged and emergent native plant materials
- Grow out native woody species
- Establish planting scheme, invasive survey and develop baseline monitoring

Phase III: Implementation
Timeline: June 2016-October 2020

- Transport plant materials to site
- Plant materials in shallow edge areas along bayous, lakes and canals. Each linear mile of established emergent vegetation will enhance and protect approximately 2,400 acres of coastal wetlands for an anticipated total of 18,000 acres of enhanced and protected acres.
- Plant woody species on elevated man-made upland areas such as spoil banks, retention dikes and derelict levees
- Enhance habitat and establish educational signage and trails and for Prothonotary warblers at 3 locations in coastal wooded areas over a 5 year project
- Implement native plantings in marginal lands and impoundments to increase nutrient assimilation and improve migratory bird habitat over 5 years.
- Establish a coastal headlands and barrier island bird habitat restoration initiative and Prothonotary warbler trail

Phase IV: Post Construction Monitoring, Adaptation, & Evaluation
Timeline: October 2017-October 2020

- Quantify nesting patterns/life histories of endangered bird species: piping plover (U.S. and Canada) and Prothonotary warbler (Canada only).
- Data analysis and data sharing

Our Partnership recognizes both immediate needs for projects that address agricultural runoff, stormwater runoff, and habitat degradation in the estuary that will work in concert to foster long-term ecological sustainability.

Monitoring and adaptive management

Drs. Sean Graham, Aaron Pierce, and Balaji Ramachandran of Nicholls State University will provide technical advice for site selection and experimental design. Drs. Graham, Pierce, Ramachandran, and their students will work with other project team members to design and implement baseline monitoring. In project year two, pre-implementation sampling will begin once contracts are in place with landowners and reference/implementation sites are selected. In project years four and five, the Nicholls State University team will monitor post-implementation of agricultural runoff rerouting by tracking changes over time within application sites and comparing these sites to an appropriate reference site.

Within each agricultural runoff discharge site, five permanent sampling stations (i.e., plots) will be located near the agricultural inflow and outflow for a total of 10 plots per site. Implementation site sampling locations will be paired with five randomly selected plots located within a nearby reference area containing a similar vegetation community. Sample collections will occur at each plot three times per year at the beginning, peak, and end of the growing season for four years, unless specified otherwise.

Within each stormwater discharge site, experimental plots will be established within the wetland at increasing distances from the point of discharge (Near, Mid and Far), with three replicates of each distance. Three reference plots will also be established in an adjacent marsh that is not impacted by stormwater discharge with hydrologic separation. Boardwalks will be constructed at each plot for water quality sampling, vegetative analysis and sediment accretion analysis.

Measures of Success

The success of this project will be identified at multiple scales. In year one of the project, measurable success will be determined as the number of landowners engaged and committed to implementing in-field and edge-of-field conservation practices and agricultural runoff rerouting. As runoff is managed, nutrient reductions will be measured through analysis of data collected both in receiving wetlands and compared with on-going water quality data collected from local receiving water bodies where nutrient removal may be detectable. The project team will track changes in nutrients in receiving wetlands for two years post implementation. Throughout the project timeframe, successful habitat restoration and invasive species removal will be measured in terms of changes in invasive and native plant species composition, relative dominance, richness, and biomass.

Risks and Uncertainties

It is well established that the hydro-period of a wetland system significantly affects nutrient transport, transformation, availability and off-gassing to the atmosphere [10]. Nutrients can be re-introduced into a wetland from the sediment, or by microbial transformation, potentially resulting in a long recovery period even after pollutant sources have been reduced [10]. It is therefore critical that The Partnership works to maintain a hydrologic regime that promotes optimal plant growth. This project will incorporate managed drawdowns to facilitate wetland vegetation growth, recruitment and nutrient sequestration.

Hurricanes and the impact on beaches and near shore vegetative communities is another potential concern. Hurricanes typically reduce vegetation across the beach community establishing more open bare sand habitat. This typically results in impacts to both nesting shorebirds and wintering shorebirds in a positive way by establishing habitats important to this guild of birds. However, one of the strategies of this project along the coastal reaches of the BTE is to document vegetative change through time either negative or positive and correlate that to the presence/use of this habitat by Piping Plover.

Outreach & Education

Each partner is committed to supporting, and publicizing this project through multiple channels. Outreach channels will include: agency and university websites, direct mail to high priority landowners, Barataria Terrebonne National Estuary Program Management Conference meetings. Louisiana Native Plant Initiative open farm days, volunteer training events, public workshops, newsletters, press releases, radio interviews, and newspaper articles.

In addition, this project will support two graduate students and three undergraduate student workers for four years, potentially enhancing the educational opportunities of up to 10 students total.

Leveraging of Resources and Partnerships

This project will be carried out through a partnership between the USDA-Natural Resource Conservation Service (NRCS), Barataria Terrebonne National Estuary Program (BTNEP), Bayou Land Resource Conservation and Development Council (RC&D), the Louisiana Department of Agriculture and Forestry (LDAF), Office of Soil and Water Conservation, local Soil and Water Conservation Districts (SWCDs) and Nicholls State University.

The Natural Resources Conservation Service (NRCS) is an agency of the United States Department of Agriculture (USDA) that provides technical assistance to farmers and other private landowners and managers. Its mission is to improve, protect, and conserve natural resources on private lands through a cooperative partnership with state and local agencies. NRCS has significant authority and opportunity to leverage FARM Bill Program dollars in the Environmental Quality Incentives Program and Agricultural Conservation Enhancement Program. Within the estuary NRCS has the **Golden Meadow Plant Materials Center (LAPMC) s**erving

areas in the States of Louisiana, Mississippi, and Texas. The LAPMC in Galliano, Louisiana provides plant solutions to address soil health, air quality, energy, wildlife habitat, erosion control and water quality pertaining to coastal wetland, coastal prairie and Chenier ridge restoration and enhancement. The Center supports NRCS field office activities and programs, academic institutions, private landowners and individuals, and Federal, State, Local and Tribal governments.

The Barataria Terrebonne National Estuary Program (BTNEP) is one of 28 estuaries of significance identified by the EPA National Estuary Program (NEP). The NEP was established under Section 320 of the 1987 Clean Water Act (CWA) Amendments as a U.S. Environmental Protection Agency (EPA) place-based program to protect and restore the water quality and ecological integrity of estuaries of national significance. BTNEP is charged with developing a management plan for protecting and restoring the more than 4 million acres between the Mississippi and Atchafalaya rivers. This plan, called the Comprehensive Conservation & Management Plan (CCMP), defines specific steps that citizens, businesses, and government agencies should take to protect and restore this nationally important system.

Bayou Land Resource Conservation & Development (RC&D) Council is a non-profit organization that serves the communities of Southeastern Louisiana. Bayou Land collaborates with a wide-array of community partners to promote and implement natural resource restoration and conservation as well as community development. The mission of Bayou Land RC&D Council is to improve the quality of life in rural and urban communities; to promote the wise use of our natural resources; and to improve the economic, environmental and social conditions in the Bayou Land area.

The **Louisiana Department of Agriculture and Forestry** is responsible for administering many of the programs and enforcing the regulations that impact every aspect of the state's agriculture and forestry. At the farm and forest level, these industries contribute $10 billion annually to the state's economy.

OFFICE OF SOIL & WATER CONSERVATION DISTRICTS provides financial assistance, administrative support, centralized direction and coordination to Louisiana's 44 **Soil & Water Conservation Districts (SWCDs)** which provide conservation planning services to landowners within their individual districts. SWCDs are local units of state government with capabilities very unique to any other form of state or local government, due mainly to their capability of entering private property at the request of landowners to plan and/or construct various conservation systems.

Nicholls State University
Nicholls is part of the University of Louisiana System of universities and is located in Thibodaux Louisiana in the heart of the Barataria-Terrebonne Watershed. Professors, Drs. Sean Graham, Aaron Pierce, and Balaji Ramachandran from the award winning Department of Biological Sciences will serve as integral team members within this partnership. Nicholls State University has pledged in-kind resources in the amount of $261,344. This amount reflects 3 months of pledged professional staff time, student tuition waver, as well as use of boats, motor vehicles and required research equipment.

If this project is fully funded, confirmed contributions by each partner include:

NRCS

Golden Meadow Plant Materials Center

- Provide technical support for site assessment and plant selection
- Provide infrastructural support including facilities and equipment
- Continue to provide support to commercial growers
- Utilize Earth Team volunteers to carry out project objectives

Local NRCS Field Office

- Work with and consult local private land owners to identify potential project areas
- Utilize Earth Team volunteers to carry out project objectives

LDAF

Office of Soil and Water Conservation

- Provide staff to assist with logistical vegetative establishment
- Provide equipment to support the completion of project objectives
- Work with and consult local private land owners to identify potential project areas
- Coordinate with other state and local agencies and organizations

BTNEP

- Lead stormwater re-routing, from feasibility study to monitoring & maintenance.
- Lead Prothonatary warbler trail restoration
- Continue shorebird surveys for Plover species
- Engage business, government and citizen stakeholders

SWCDs

Crescent, Plaquemines, Terrebonne-Lafourche

- Contribute district technicians to carry out project objectives
- Work with & consult local private land owners to identify potential project areas

Bayou Land RC&D Council

- Provide vegetative technical support, site assessment & plant selection
- Provide plant materials currently unavailable on the commercial market
- Plan, coordinate, and facilitate volunteer activities
- Provide access to surface water quality data collected within local watersheds as needed (Bayou Folse & Bayou Terrebonne)

Nicholls State University

Drs. Sean Graham, Aaron Pierce, and Balaji Ramachandran

- Will provide technical advice for site selection and experimental design.
- Will monitor Ag Runoff Redirection into bottomland hardwood swamps (task 1)

Proposal Benefits

Numerous studies have investigated the function of wetlands in the removal of pollutants, including nutrients [10-13]. Both man-made and natural wetlands function to buffer downstream water quality by storing and transforming nutrients [14]. In addition to reducing water pollution in estuaries, coastal wetlands provide a wide range of valuable ecosystem services, including habitat support of fish and wildlife, countless recreation opportunities, nutrient assimilation, carbon sequestration, and erosion control, in addition to providing storm surge protection for coastal communities [15-20]. Therefore, constructed wetlands can be a critical component of watershed management strategies, especially in areas where wetlands have been lost [22]. Additional benefits may also include increased primary productivity, habitat diversity, export to adjacent systems, and services to human society such as aesthetics, hunting, recreation, and research [12].

One of the key biological benefits of constructed wetlands is their ability to provide habitat for a diversity of flora and fauna. Many animals periodically use wetlands as drinking sources, breeding sites, nurseries, refuge, and foraging areas. For example, in a California wetland restoration project, a series of shallow ponds were constructed to maximize NO_3 removal; these ponds also had an average avian species richness ranging between 65 and 76 species per month, including both common and rare species [2]. Locally, the use of a natural forested wetland in the Mississippi Delta for wastewater treatment over 50 years has shown significant sedimentation and resulted in increased accretion rates [21]. The addition of nutrient-rich water into natural wetlands has been demonstrated to increase productivity of woody vegetation (increased stem diameter growth) and growth of herbaceous emergent and aquatic vegetation [21]. Enhanced vegetation growth contributes to soil accretion, thereby reducing nutrient loads and improving downstream habitat. The application of nutrient-rich wastewater, and the resulting sedimentation, can also gradually increase wetland elevations and counteract some of the negative effects of sea level rise on coastal wetlands [21].

Thus, while our primary objective in creating this ecosystem enhancement and restoration project is to restore, enhance and protect water resources, the methodology will also enable us to work towards restoration, enhancement, and protection of key coastal habitats.

IV. Location Information

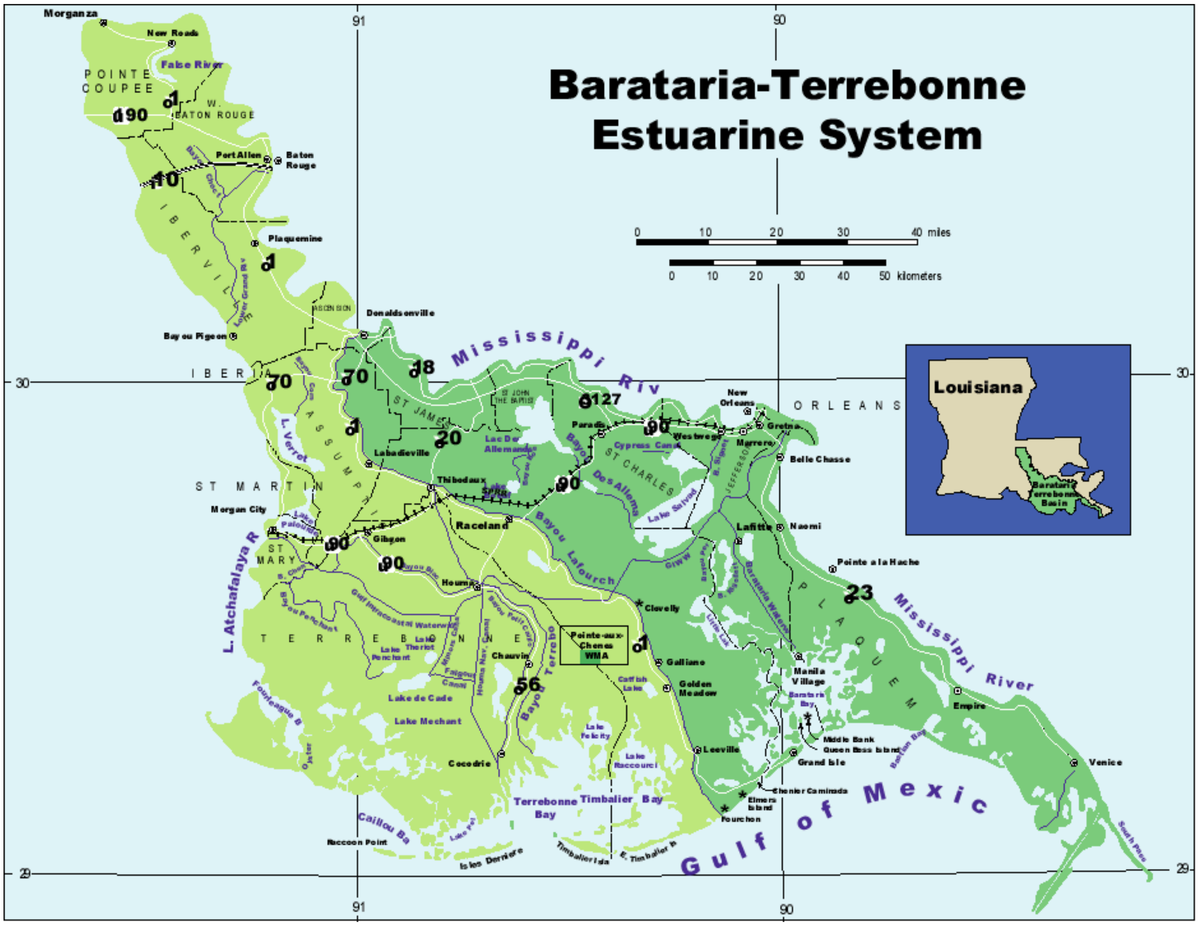

Figure 2. Location of the Barataria Terrebonne National Estuary

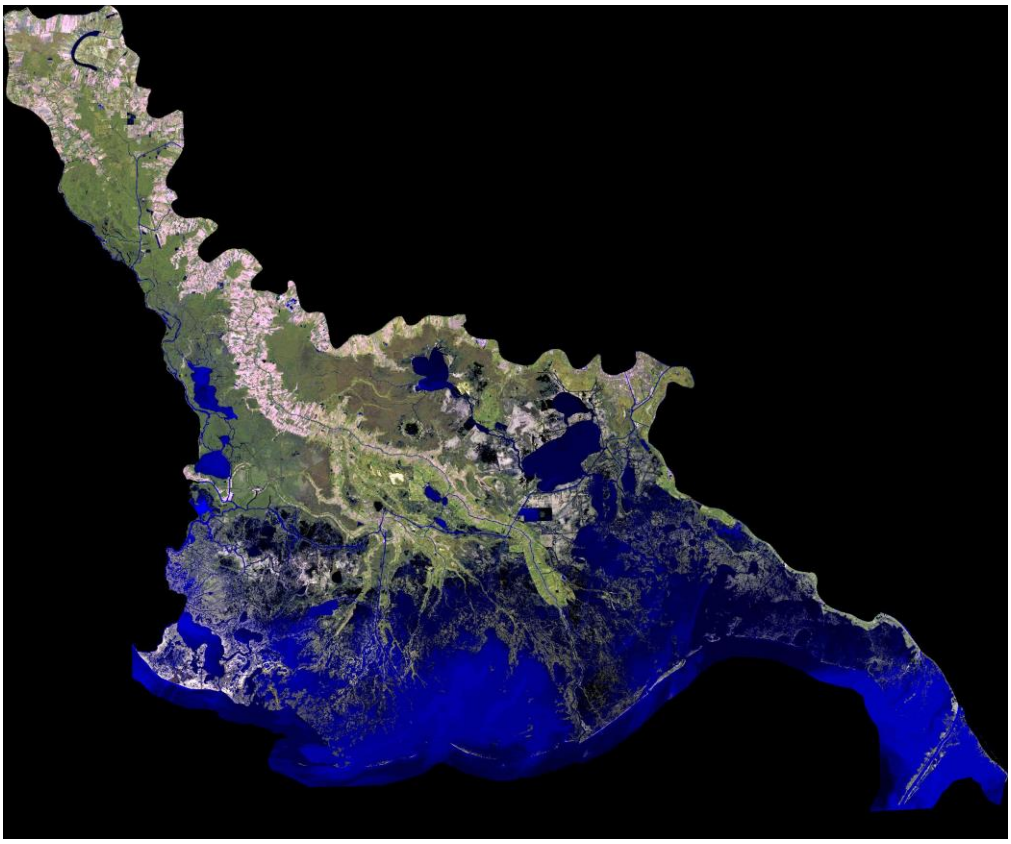

Figure 3. Satellite view of the Barataria Terrebonne Estuary

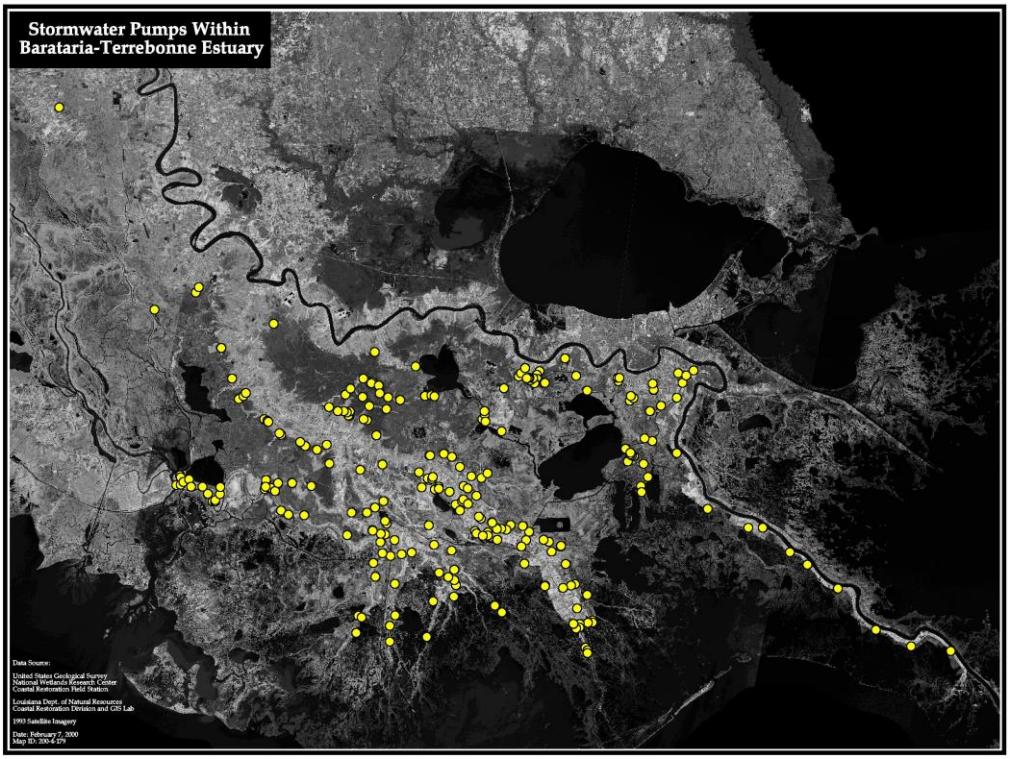

Figure 4. Stormwater Pump stations within the Barataria-Terrebonne Estuary

Figure 5. Image of a stormwater pump station within the Terrebonne Basin

Figure 6. Satellite view of a stormwater pump station in the Terrebonne Basin

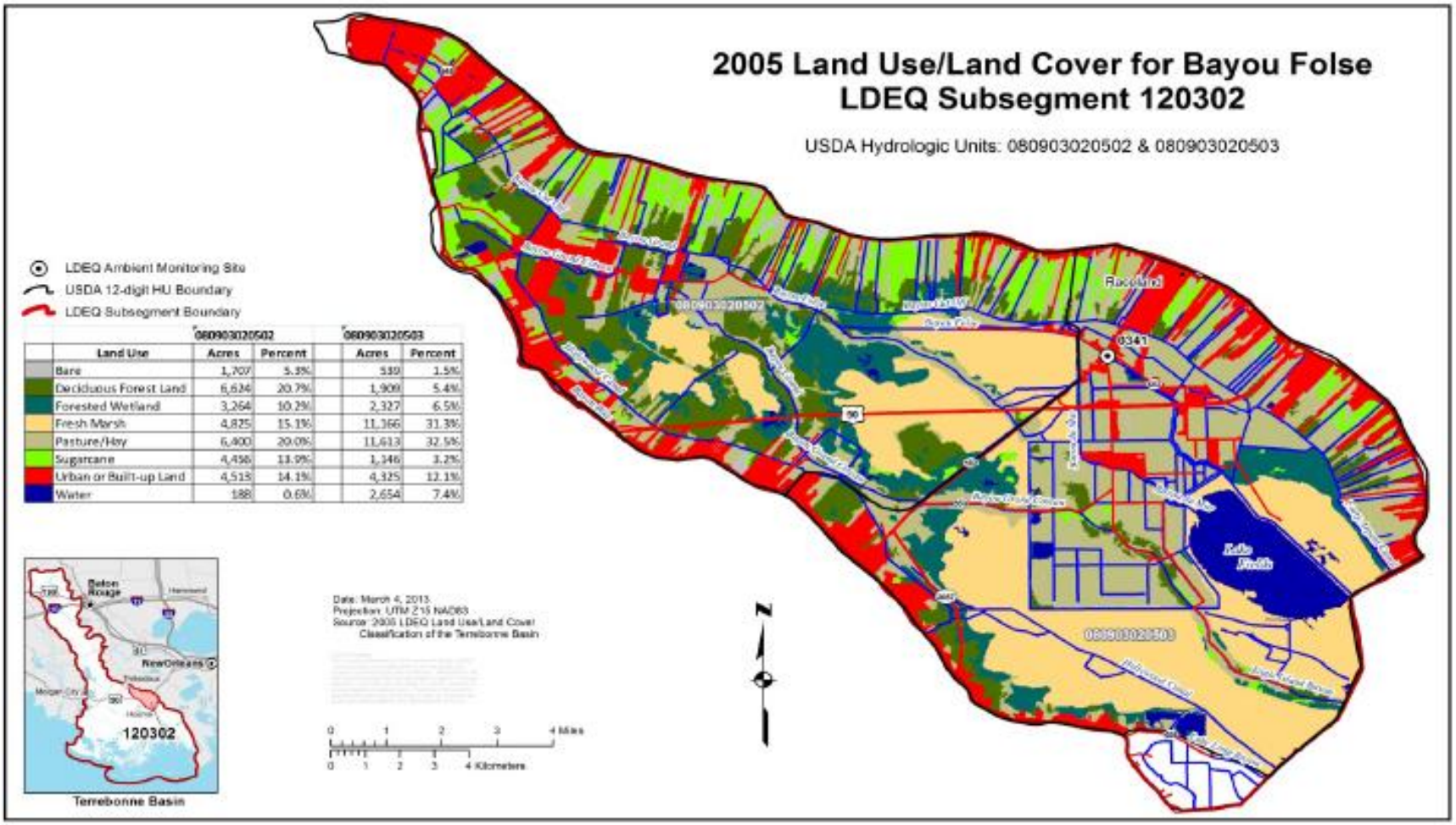

Figure 7. Land use map of the impaired Bayou Folse watershed

V. Budget

Task 1.0 Route Agricultural Runoff through Impounded and Natural Wetlands, Landowner Signup and Engineering

- Task 1.11 Survey and engineering of the fields and wetland areas - $500,000 (assumes $250,000/site)
- Task 1.12 Landowner sign-up 2 landowner sites (200 acres ea.) at 400 acres of restoration
- Task 1.13 NRCS Thibodaux Field Office, Landowner sign-up – ($30,000/year)

Subtotal Task 1.0 $580,000

Task 1.1 Route Agricultural Runoff through Impounded and Natural Wetlands, Monitoring

- Equipment purchase, survey of potential sampling sites, installation, and monitoring for 4 years - $713,309 (*match $259,623*)

Subtotal Task 1.1 $713,309

Task 1.2 Route Agricultural Runoff through Impounded and Natural Wetlands, Invasive Plant Removal

- Survey and removal of invasive species in planted marginal lands and impounded areas - $100,000 ($10,000/site/year)
- Monitoring of pre-construction and post construction

Subtotal Task 1.2 $600,000

Task 2.0 Redirect Stormwater Runoff into Adjacent Wetlands, Engineering and Implementation

- Survey potential stormwater levee pump sites, recruit landowners, complete engineering and implement 2 stormwater redirection projects - $8,000,000 ($4 million/site)

Subtotal Task 2.0 $8,000,000

Task 2.1 Redirect Stormwater Runoff into Adjacent Wetlands, Monitoring

- **Equipment purchase, survey of potential sampling sites, installation, and monitoring for 5 years - $1,100,000 ($110,000/site/year)**

Subtotal Task 2.1 $1,100,000

Task 2.2 Redirect Stormwater Runoff into Adjacent Wetlands, Invasive Plant Removal

- Survey and removal of invasive species in receiving areas -($10,000/site/year)

Subtotal Task 2.2 $100,000

Task 2.3 Redirect Stormwater Runoff into Adjacent Wetlands, Native Plantings

- Native plantings (BTNEP)) in receiving areas and on terraces. Native coverage monitoring and replanting. - $1,000,000 ($100,000/site/year)

Subtotal Task 2.3 $1,000,000

Task 2.4 Redirect Stormwater Runoff into Adjacent Wetlands, Terrace Construction

- Survey, engineer and construct 50 acres (25acres/site) of terraces from local borrow in receiving areas $1,750,000 ($35,000/acre)

Subtotal Task 2.4 $1,750,000

Task 3.0 Reestablish submerged and emergent vegetation in degraded tidal bays, mid-estuary bays and marsh areas. NRCS, Plant Materials Center. Assumes 4 sites and 2 linear miles per site ($100,000/site/year + 120,000 total for maintenance and monitoring)

- NRCS-ARS Plant Materials Center will grow out submerged and emergent plant materials at the Golden Meadow PMC, survey potential planting sites, transport plant materials to site, and plant materials in shallow edge areas along bayous, lakes and canals
- Each linear mile of established emergent vegetation will enhance and protect approximately 2,400 acres of coastal wetlands for an anticipated total of 18,000 acres of enhanced and protected acres.

Subtotal Task 3.0 $520,000

Task 4.0 Reestablish wooded coastal ridges and other maritime gallery forests by utilizing existing spoil disposal areas and retention dikes, derelict levees and other suitable elevated upland areas within the lower BTNEP complex. NRCS, Soil and Water Conservation Districts, BLRCD.

- Grow out, transport and plant woody species on elevated man-made upland areas such as spoil banks, retention dikes and derelict levees (assumes 2 sites, 310 seedlings per acre, $10,000 per site, 10 acres per site, 5 year project)
- 310 tree/shrub seedlings per acre, each acre planted in optimum configuration, can in turn enhance the long-term wildlife use on the adjacent 5.5 acres or more

for an anticipated total of 10 ac planted per year and a total of 275 acres coastal ridges and other maritime gallery enhanced.

- Once mature, these established trees and shrubs will provide considerable storm surge protection to leeward wetland areas.
- Utilization of the current NRCS/LDAF/SWCD Coastal Vegetative Planting Program (VPP) network by utilizing VPP staff to assist, by logistical, equipment, and personnel aid, all Restore Act vegetative establishment requirements (salaries, fuel & equipment)
- Three Soil & Water Conservation District (SWCD) Technicians will be hired; one each in the Plaquemines, Crescent, and Lafourche-Terrebonne SWCDs (districts 42, 26 and 19,) to carry out SWCD related contributions to all phases of the partnership RA program effort.

Subtotal Task 4.0 $779,664

Task 4.1 Coastal Headlands and Barrier Island Bird Habitat Restoration Initiative, Prothonotary Warbler Trail

- Enhance habitat and establish educational signage and trails and for Prothonotary warblers at 3 upland locations in coastal wooded areas over a 5 year project (60,000/site)
- 2nd Year Educational Outreach and Construction of Nest Boxes & 5 yr. Pre & Post Construction Prothonotary Warbler Surveys

Subtotal Task 4.1 $180,000

Task 4.2. Piping Plover Survey on Coastal Beaches and Barrier Islands

- 1st Year Post Construction Piping Plover Surveys. 20 surveys; $190,260
- 2nd Year Post Construction Piping Plover Surveys $190,260
- 3rd Year Post Construction Piping Plover Surveys $190,260
- 1st Year Aerial Photography and GIS Analysis $27,761
- 2nd Year Aerial Photography and GIS Analysis $27,761
- 3rd Year Aerial Photography and GIS Analysis $27,761
- Final Report, printing, outreach and dissemination $32,752

Subtotal Task 4.2 $686,815

Total Proposal Budget: $16,009,788

VI. Environmental Compliance Checklist

Gulf Coast Ecosystem Restoration Council
Environmental Compliance Checklist

Please check all federal and state environmental compliance and permit requirements as appropriate to the proposed project/program

Environmental Compliance Type	**Yes**	**No**	**Applied For**	**N/A**
Federal				
National Marine Sanctuaries Act (NMSA)		X		
Coastal Zone Management Act (CZMA)	X			
Fish and Wildlife Coordination Act	X			
Farmland Protection Policy Act (FPPA)		X		
NEPA – Categorical Exclusion		X		
NEPA – Environmental Assessment	X			
NEPA – Environmental Impact Statement		X		
Clean Water Act – 404 – Individual Permit (USACOE)	X			
Clean Water Act – 404 – General Permit(USACOE)		X		
Clean Water Act – 404 – Letters of Permission(USACOE)		X		
Clean Water Act – 401 – WQ certification	X			
Clean Water Act – 402 – NPDES	X			
Rivers and Harbors Act – Section 10 (USACOE)	X			
Endangered Species Act – Section 7 – Informal and Formal Consultation (NMFS, USFWS)	X			
Endangered Species Act – Section 7 - Biological Assessment (BOEM,USACOE)		X		
Endangered Species Act – Section 7 – Biological Opinion (NMFS,		X		
Endangered Species Act – Section 7 – Permit for Take (NMFS, USFWS)		X		
Magnuson-Stevens Fishery Conservation and Management Act Essential Fish	X			
Marine Mammal Protection Act – Incidental Take Permit (106) (NMFS, USFWS)		X		
Migratory Bird Treaty Act (USFWS)	X			
Bald and Golden Eagle Protection Act – Consultation and Planning	X			
Marine Protection, Research and Sanctuaries Act – Section 103 permit (NMFS)		X		
BOEM Outer Continental Shelf Lands Act – Section 8 OCS Lands Sand permit		X		
NHPA Section 106 – Consultation and Planning ACHP, SHPO(s), and/or THPO(s)	X			
NHPA Section 106 – Memorandum of Agreement/Programmatic	X			
Tribal Consultation (Government to Government)	X			
Coastal Barriers Resource Act – CBRS (Consultation)		X		
State				
As Applicable per State	X			

VII. Data/Information Sharing

Verified and documented forms of all appropriate data and metadata will be prepared and placed in a publically accessible data archive or library following National Science Foundation (NSF) data archiving policies, excepting circumstances of pending publication or patent. In such cases, an embargo will be held during the publication or patenting process. Possible data storage locations include the Consultative Group on International Agriculture Research (CGIAR), the Oak Ridge National Laboratory - Distributed Active Archive Center (ORNL-DAAC), Ecological Archives, NatureServe, and Dryad, among others. In addition, information on experimental design and methodological procedures, as well as any unusual circumstances will be available to the general public upon request.

Environmental Data:

1) Hydrologic Monitoring: Site hydrology will be continuously monitored at each sampling location.
2) Surface Water Nutrient Inflows/Outflows: Surface water NO_2+NO_3 and PO_4 concentrations will be monitored at each site near points of inflow and outflow.
3) Vegetation Biomass (Above- and Below-ground): Perennial productivity will be monitored at each plot by measuring temporal trends of trees with a diameter at breast height (DBH) > 10 cm. Extracting soil cores from each plot and sieving, sorting, and weighing the contents will determine belowground biomass.
4) Percent cover and end-of-season live Biomass (EOSL): Marsh vegetation will be collected at each station, sorted into live and dead matter, dried at 60 ^{o}C and weighed. Percent cover will be estimated during spring to determine vegetation composition.
5) Nutrient Assimilation by the Vegetation: Dried green leaf tissue from the forest community dominant will be analyzed for total carbon (C), nitrogen (N), phosphorus (P), and used to calculate tissue nutrient ratios accumulation rates.
6) Vegetation Decomposition (Above- and Below-ground): Four litterbags will place in the soil and on it's surface at each plot and collected annually.
7) Species Composition and Richness: Species richness will be determined as the total number of tree species per plot.
8) Soil Accretion, Organic Matter accumulation, and Mineral Sediment Deposition: Soil accretion will be determined as the vertical accumulation of mineral sediment and organic matter above feldspar marker horizons established at each plot.
9) Soil Nutrient Accumulation: Soil samples will be analyzed for total C, N, and P to determine soil nutrient accumulation at each plot.
10) Avian Use and Productivity: Avian point count surveys will be conducted at each site during the breeding season to determine avian breeding species composition, species richness, and relative abundance. In addition, Prothonotary Warbler nests and nest boxes will be monitored to determine hatching and fledging success and productivity.

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IX. Other

Data: Standard Operating Procedures (SOPs) & Quality Assurance (QA)

Surface Water Nutrient Inflows/Outflows

Surface water nutrient (NO_2+NO_3 and PO_4) concentrations will be monitored at each implementation site by collecting five replicate samples near points of inflow and outflow. All samples will be stored on ice while in the field, immediately frozen at -20 ^oC upon returning to the lab, and analyzed within 28 days of collection following standard methods [26].

Water quality

Temperature, dissolved oxygen (D.O.), pH, specific conductivity, and salinity will be measured quarterly for 2 years during the pre-discharge period and 2 years during the post-discharge period. Water samples will be collected in 1-liter dark, acid-washed bottles for analysis of chemical and biological parameters. The sample bottles will be pre-rinsed three times with water samples prior to the collection of the sample water. Sample water will be transferred to a sterile Whirl-Pak, sealed and stored on ice for fecal coliform bacteria (FCB) analysis within 6 hours of collection. One liter collection bottles will be filled and stored on ice until laboratory analysis within 24 hours of sample collection. Each of these bottles will be sub-sampled for total suspended sediments (TSS), organic matter (OM), chlorophyll a (Chl a), nitrate+nitrite (NOx), NH4, ortho-phosphate (PO4), silicate (SiO3), chloride (Cl), total nitrogen (TN) and total phosphorus (TP). Total nitrogen and total phosphorus will be analyzed as NOX and orthophosphate using the persulfate digestion technique [38]. All dissolved nutrients will be analyzed using U.S. Environmental Protection Agency (USEPA) certified techniques. Chlorophyll a will be analyzed using a method described by Burnison [30] where chlorophyll using a DMSO extraction and measured on a flourometer. Total suspended solids (TSS) and organic matter (OM) will be determined gravimetrically using a modified procedure from Greenberg et al. [34]. Fecal coliform bacteria will be analyzed using the Fecal Coliform Membrane Filtration Technique [40].

Vegetation Biomass (Above- and Below-ground)

Aboveground biomass will be monitored by identifying all trees with a diameter at breast height (DBH) greater than 10 cm, recording DBH, and tagging each individual with an identification number. These data will then be used to calculate relative importance of each tree species for each sampling location based on relative density, relative dominance, and relative frequency [27]. In addition, annual re-measurements of DBH will be used to monitor perennial productivity by calculating increases in biomass using allometric equations [37,41]. Ephemeral productivity will be measured using 0.25 m^2 leaf litter boxes with screened bottoms and approximately 10 cm wide sides. Leaf litter will be collected periodically and dried to a constant mass at 60 ^oC and weighed.

Belowground biomass will be determined by extracting a 7.62 cm diameter by 30 cm long soil cores from a representative location within each plot. Upon removal, cores will be sieved over a 2-mm mesh screen to remove mineral sediment and fine particulate

organic matter. The remaining material will then be categorized as live roots, live rhizomes, and dead roots + rhizomes using a combination of characteristics, including color, turgidity, and evidence of decomposition (e.g., epidermal lesions and resistance to breakage). After sieving and sorting, all material will be dried to a constant mass at 60 ^{o}C and weighed.

Nutrient Assimilation by the Vegetation

Dried green leaf tissue from the forest community dominant will be ground and analyzed for total nitrogen (N) using a Costech 4010 CHNS/O Elemental Combustion System and total phosphorus (P) using Inductively Coupled Plasma (ICP) Spectrometry (Spectro Ciros) following nitric acid digestion. Tissue N and P concentrations will then be used to calculate N:P ratios [36].

Vegetation Decomposition (Above- and Below-ground)

Above- and belowgrund litter decomposition will be measured at each plot using 6 cm wide x 30 cm long litterbags constructed from 1-mm^2 nylon mesh. Aboveground decomposition of the dominant species will be estimated by placing four litterbags filled with 10 g (oven-dried) of stems/leaves on the forest floor. Belowground decomposition will be estimated by inserting four litterbags filled with 5 g (oven-dried) of roots/rhizomes into the soil at a depth of 15 cm. One randomly selected above- and belowground litterbag will then be retrieved yearly. Upon retrieval, the bags will be rinsed of all mud, and any identifiable in-grown roots/rhizomes will be removed. The remaining material will be dried to a constant weight at 60 °C, and weighed.

For marsh vegetation sampling

Percent cover and end-of-season live Biomass (EOSL) will be collected at each of the station subplots using a 530-cm2 ring. Each sample will be sorted into live and dead matter, dried at 60^{o}C and weighed. Percent cover will be estimated in a 1-m2 area during spring to determine the typical vegetation composition of the marsh.

Species Composition and Richness

Species richness will be determined as the total number of tree species per plot. We will calculate importance values of each tree species based on relative density (i.e., individuals of a species/total individuals of all species), relative dominance (i.e., total basal area of a species/total basal area of all species), and relative frequency (i.e., frequency of species/total frequency of all species in area) [27].

Soil Vertical Accretion, Organic Matter accumulation, and Mineral Sediment Deposition

Soil accretion will be determined as the vertical accumulation of mineral sediment and organic matter above two 0.25 m x 0.25 m feldspar marker horizons laid down in each plot in project year two [31]. Soil cores that penetrate the feldspar layer will then be extracted using a 5.08 cm diameter aluminum corer. Upon extraction, the height of material above the feldspar layer will be measured to the nearest mm at three to four locations around each core and averaged. In conjunction with each accretion measurement, mineral sediment and organic matter accumulation will be determined by

collecting a separate core to the same depth as the feldspar horizon using a 7.62 cm diameter aluminum core tube. The contents of each core will be dried and weighed to determine soil bulk density [29], and then ground and combusted at 550 ºC to determine organic/mineral matter content [32]. The product of vertical accretion, soil bulk density, and soil organic/mineral matter content will then be used to calculate mineral sediment and organic matter accumulation over time.

Soil Nutrient Accumulation

Prior to combustion for organic/mineral matter content determination, a subsample from each core will be used to determine total N using a Costech 4010 CHNS/O Elemental Combustion System and total P by Inductively Coupled Plasma (ICP) Spectrometry (Spectro Ciros) following nitric and perchloric acid digestion (Sommers and Nelson 1972).

Avian Use and Productivity

Avian point count surveys will be conducted during the breeding season at each site and consist of a 10-minute fixed-radius count [35]. Plots for point count sampling will be spaced at least 200 m apart and will be located at least 50 m from any anthropogenic edge (e.g. fields). All birds detected visually or audibly will be recorded and distance from plot center will be estimated in addition to cardinal direction. Survey data will be used to determine avian breeding species composition, species richness, and relative abundance.

Nest searches will be conducted along established transects at each site to identify Prothonotary Warbler nests and to determine their productivity. Hatching success and fledging success of each nest will be determined through weekly nest monitoring. In addition, artificial nest boxes for Prothonotary Warbles will be installed at each site. Nest boxes will be monitored throughout the breeding season to determine hatching success and fledging success.

Geospatial technologies integration

Geospatial technologies employed in this project will be supplement and support tasks in steps 1) through 9) by developing a robust biophysical model.

Unmanned Aerial Systems – Monumentation and Reconnaissance: Dr. Ramachandran in consultation with Dr. Graham will apply for a Certificate of Authorization (COA) with Federal Aviation Administration (FAA) to perform unmanned aerial systems (UAS) mission in the civilian air space over the study sites. Upon COA approval, permanent horizontal ground control points will be monumented using mapping grade GPS (GeoXH 6000 GPS). Control points will then be used to establish the spatial position and orientation of images taken from an unmanned aerial vehicle (UAV) across the study and tie in spatial and temporal data. Deliverables from UAV imagery will include: (1) development of an automated approach to extract bird counts and abundance data directly from the digital images and correlate with traditional ground sampling data; (2) determination of species composition and richness by using image classification techniques in the visible (RGB) and Near-infrared (NIR) bands of the electromagnetic spectrum; (3) identification of invasive species locations within the study site; (4)

development of an orthophoto mosaic of the images for the study site for integration in GIS; and (5) development of a digital surface model from the point cloud generated by the overlapping images for drainage patterns studies.

Real Time Kinematic (RTK) GPS: Monumentation and documentation of conventional ground sampling monitoring points will be supported with Real Time Kinematic (RTK) GPS survey. In addition, methods that require accurate elevation around the monitoring points will be determined using RTK GPS.

Image preprocessing and classification methods: Image pre-processing, including radiometric correction, geometric correction, terrain correction, image enhancement, and feature selection, will be implemented (ERDAS Imagine 2014). The basic spectral properties of features of interest (e.g., vegetation types, wildlife count, and nesting patterns) will be developed using spectral indices more sensitive to feature and their reflectance in each of the spectral bands, thus serving as possible indicators of restoration success.

Biophysical GIS data model: ESRI's ArcView 10 GIS software will be used to implement the GIS data model as a geodatabase. The processed images from above will be used to create data layers in a GIS format. Other relevant existing layers for the study site will be used to develop a generic, flexible, adaptive, and robust baseline monitoring GIS data model.

Quality Assurance and Quality Control: Standards for Quality Assurance and Quality Control will be developed for sampling protocols and environmental data generated as part of this project using QAPP development guidelines outlined by the U.S. EPA G/5 [43] Standards for data/information collection, storage, stewardship, preservation, access, security and sharing will also follow U.S. EPA G/5 [43]. The standards that will be used for geospatial data and metadata format and content will be developed and follow U.S. EPA methods for development and standards found in U.S. EPA G/5G [44].

BTNEP
BARATARIA-TERREBONNE
NATIONAL ESTUARY PROGRAM

November 11, 2014

Members of the Gulf Coast Ecosystem Restoration Council,

The purpose of this letter is to provide a statement of support to the project entitled, "Coastal Ecosystem Enhancement and Restoration in the Barataria-Terrebonne Basin," which is applying for RESTORE Act funds to conduct water quality and habitat restoration in the Barataria-Terrebonne National Estuary Program (BTNEP) Area.

The BTNEP area is congressionally-recognized as a nationally-significant area. BTNEP is one of 28 National Estuary Programs in the country. The BTNEP area is represented by all of the land between the Mississippi and Atchafalaya Rivers, bordered on the north by the Old River Control structure and the south by the Gulf of Mexico. The southernmost portion of BTNEP estuarine area was the area most heavily impacted by the Deepwater Horizon Oil Spill of 2010.

During the 1990s, BTNEP led an intense planning effort that included representatives of 42 public and private agencies who defined the problems threatening our estuary and formulated 51 Action Plans to implement restoration. The collection of these action plans is called the Comprehensive Conservation and Management Plan (CCMP), which was signed by then Louisiana Governor Murphy J. "Mike" Foster, approved by the EPA, and awarded a national planning award by the American Planning Association in 1996.

The proposal is broken into major tasks that are designed to restore water quality and provide habitat improvement through wetland assimilation. The first major task of the proposal will provide water quality improvement and habitat restoration by redirecting agricultural runoff from sugarcane and soybean fields into bottomland-hardwood wetlands in the Lake Verret watershed as well as in the Bayou Folse Priority Watershed in the southern part of the Barataria-Terrebonne Estuarine System (BTES). The second major task will provide water quality improvement and habitat restoration by redirecting stormwater discharges from pumping stations into marsh wetlands in the Bayou Folse Priority Watershed and well as an undesignated watershed within Terrebonne Parish. The third major task will focus on habitat

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restoration of submerged aquatic vegetation, the prothonotary warbler and the endangered piping plover.

In addition to providing vital water quality improvement and habitat restoration, these projects will directly implement Action Plans within the BTNEP CCMP, including: EM-10 Reduction of Sewage Pollution, EM-11 Reduction of Agricultural Pollution, EM-12 Stormwater Management, and EM-15 Protection of Habitat for Migratory and Resident Birds. These large, scalable, watershed-level, multi-agency partner projects are the types of projects that were originally intended for implementation through the BTNEP CCMP.

We strongly support this proposal entitled "Coastal Ecosystem Enhancement and Restoration in the Barataria-Terrebonne Basin," and will provide staff time, vehicles, boats and equipment to assist in the implementation of the project. We appreciate your serious consideration of this proposal.

Sincerely,

Dean Blanchard

Dean Blanchard, Interim Director
Barataria-Terrebonne National Estuary Program

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NICHOLLS
STATE UNIVERSITY
A MEMBER OF THE UNIVERSITY OF LOUISIANA SYSTEM

7 November 2014

To Whom It May Concern:

This letter is to confirm that the Department of Biological Sciences and the Department of Applied Sciences, both reporting to the Dean of the College of Arts and Sciences, are fully committed to supporting the proposal titled "Coastal Ecosystem Enhancement and Restoration in the Barataria-Terrebonne Basin" by our colleague Dr. Sean Graham. The rate of land loss within the Barataria-Terrebonne National Estuary is of national importance and has had negative impacts on industry, culture, and the ecology of the region. Although degradation of an abandoned delta is a normal ecological process, human influence on the Mississippi River has exacerbated the degradation of the Barataria-Terrebonne National Estuary. The knowledge and technology is available to conserve wetlands that still exist and to restore some areas that have been lost. Nicholls State University is the only university located within the Barataria-Terrebonne National Estuary and has a long history of coastal wetland conservation and restoration activity.

The relatively long-term (more than 2 years) and large-scale project being proposed is exactly what is needed to move forward with coastal conservation. Although much of the coastal work has focused in the salt marshes of the estuary, the estuary is an interconnected network of cypress-tupelo swamps, fresh marsh, intermediate marsh, brackish marsh, and salt marsh. Restoration efforts must include all aspects of the estuary for comprehensive conservation. Agricultural lands compose a large portion of the landscape in the fresh water regions of the Barataria-Terrebonne National Estuary and are a source of nutrients via precipitation runoff. Estuary eutrophication is a global problem. However, wetland plants have a large capacity for using excess nutrients and can potentially reduce the impacts of agricultural runoff to estuarine waters.

Drs. Sean Graham, Aaron Pierce, and Balaji Ramachandran have strong backgrounds in monitoring wetlands and are more than capable of completing the work they are proposing. Drs. Graham and Pierce are faculty in the Department of Biological Sciences, and Dr. Balaji Ramachandran is Head of the Department of Applied Sciences. It is also understood that these researchers will need to travel to conduct field research and attend relevant conferences. The Department of Biological Sciences will allow them to use departmental vehicles and boats for this project at no cost beyond the cost of fuel. As the direct supervisors of the investigators on this project, we are undersigned in full approval and support.

Sincerely yours,

Quenton Fontenot, Ph.D.
Head, Department of Biological Sciences

John P. Doucet, Ph.D.
Dean, College of Arts and Sciences

BAYOU LAND
RC&D Council

November 10, 2014

Members of the Gulf Coast Ecosystem Restoration Council:

The purpose of this letter is to provide a statement of support to the project entitled, "Coastal Ecosystem Enhancement and Restoration in the Barataria-Terrebonne Basin", which is applying for RESTORE Act funds to conduct water quality and habitat restoration in the Barataria-Terrebonne National Estuary Program (BTNEP) Area.

Bayou Land RC&D Council is a 501(c)3 non-profit organization serving the communities of Southeastern Louisiana. Bayou Land collaborates with a wide array of community partners to promote and implement natural resources restoration and conservation as well as community development. We work across Southeastern Louisiana in the parishes of Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. John the Baptist, and Terrebonne. The mission of Bayou Land Resource Conservation and Development Council is to improve the quality of life in rural and urban communities; to promote the wise use of our natural resources; and to improve the economic, environmental and social conditions in the Bayou Land area.

If this proposal is approved, Bayou Land will assist with outreach to land owners and other community members. Bayou Land has a great deal of experience working with community groups, especially in the areas of watershed protection and habitat restoration. Bayou Land will also continue our work as part of the Louisiana Native Plant Initiative. Our Vegetative Specialist, Gary Fine, has several plots of different ecotypes of native plants collected from across coastal Louisiana. These plants are used for ongoing habitat restoration projects across South and Central Louisiana.

We strongly support this proposal entitled "Coastal Ecosystem Enhancement and Restoration in the Barataria-Terrebonne Basin", and will provide staff time and equipment to assist in the implementation of the project. We appreciate your serious consideration of this proposal.

Sincerely,

Kathy Russo
Board President
Bayou Land RC&D Council

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ELIGIBILITY REVIEW

Bucket 2 – Council Selected Restoration Component

PROPOSAL TITLE

Coastal Ecosystem Enhancement and Restoration in the Barataria Terrebonne Basin

PROPOSAL NUMBER

USDA-5

LOCATION

Barataria Terrebonne National Estuary, Louisiana

SPONSOR(S)

Department of Agriculture

TYPE OF FUNDING REQUESTED (Planning, Technical Assistance, Implementation)

Technical Assistance, Implementation

REVIEWED BY:

Bethany Carl Kraft/ Ben Scaggs

DATE:

November 18, 2014

1. Does the project aim to restore and/or protect natural resources, ecosystems, fisheries, marine and wildlife habitat, beaches, coastal wetlands and economy of the Gulf Coast Region?

◉ YES ○ NO

Notes:

This coastal ecosystem enhancement project aims to create an ecosystem scale model for Gulf Coast restoration priorities.

2. Is the proposal a project?

◉ YES ○ NO

If yes, is the proposed activity a discrete project or group of projects where the full scope of the restoration or protection activity has been defined?

◉ YES ○ NO

Notes:

3. Is the proposal a program?

◯ YES ◉ NO

If yes, does the proposed activity establish a program where the program manager will solicit, evaluate, select, and carry out discrete projects that best meet the program's restoration objectives and evaluation criteria?

◯ YES ◯ NO

Notes:

4. Is the project within the Gulf Coast Region of the respective Gulf States?

◉ YES ◯ NO

If no, do project benefits accrue in the Gulf Coast Region?

◯ YES ◯ NO

Notes:

Eligibility Determination

ELIGIBLE

Additional Information

Proposal Submission Requirements

1. Is the project submission overall layout complete? ***Check if included and formatted correctly.***

A. Summary sheet	☑	F. Environmental compliance checklist	☑
B. Executive summary	☑	G. Data/Information sharing plan	☑
C. Proposal narrative	☑	H. Reference list	☑
D. Location information	☑	I. Other	☑
E. High level budget narrative	☑		

If any items are NOT included - please list and provide details

2. Are all proposal components presented within the specified page limits (if applicable)?

◉ YES ○ NO

Notes: