Adaptive Management and Technical Assistance in Support of Gulf Ecosystem and Economic Restoration

Submitted by the US Geological Survey,

Department of Interior

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1. Summary Sheet

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Project Identification

Project Title: Adaptive Management and Technical Assistance in Support of Gulf Ecosystem and Economic Restoration

State(s): TX, LA, MS, AL, FL	County/City/Region: Defined Gulf Coast Region

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

Project Description

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

_P_ Restore and Conserve Habitat
_S_ Restore Water Quality
_S_ 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 Priority Objective, and **S** for secondary objectives.*

_S_ Restore, Enhance, and Protect Habitats
_S_ Restore, Improve, and Protect Water Resources
___ 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
_P_ Improve Science-Based Decision-Making Processes

RESTORE Priorities: *Identify all RESTORE Act priorities that this project supports. [full text provided in Guidelines: Section A(3)]*
_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.*

___ Project ____ Planning _X_ Technical Assistance ____ Implementation
_X_ Program

Project Cost and Duration

Project Cost Estimate:		**Project Timing Estimate**:
Total :	**$ 8.713M (Phase I)**	Date Anticipated to Start: 06 / 2015 Time to Completion: 3 years Anticipated Project Lifespan: 10 years (Future Phases)

2. Executive Summary

The US Geological Survey proposes a multidisciplinary program to provide science-based technical assistance to Council-funded Gulf restoration projects. These projects will benefit from technical experts using a structured decision-making process to ensure that proposed and implemented restoration projects are sound and based on the best available scientific expertise and guidance and have the greatest chance to achieve Council goals and priorities. Our approach will be an overarching, adaptive management-based program that will be implemented over three phases in 10 years, and will integrate four critical layers of information in support of Gulf ecologic and economic restoration – adaptive management, monitoring, restoration project sustainability, and valuation of ecosystem services and economic impacts.

The objectives of Phase I (this proposal, 3 years) are to: 1) establish a Gulf Restoration Adaptive Management and Technical Assistance Program (GRAMTAP) using an adaptive management framework to help design and execute technically sound and sustainable restoration projects; and 2) deliver local to regional-scale assistance including: guidance for consistent and integrated monitoring practices; tools to assess and increase restoration project sustainability; and valuation of ecosystem services and economic impacts.

GRAMTAP will be readily accessible and widely available to support Council-funded restoration projects, in close coordination with Council members and staff. GRAMTAP will connect resource managers and policymakers with experts, both within and outside of the USGS, in adaptive management, monitoring, project sustainability, and ecosystem services and economic impact valuation. These experts will provide access to existing programs, plans, data, and analyses to help determine the current state of restoration science, assistance and tools to develop monitoring and adaptive management programs tailored to specific restoration projects, connections to the global restoration science community, and comprehensive tracking for restoration success benchmarks. The USGS currently works with partners to provide adaptive management-based technical assistance in implementing Gulf ecosystem restoration, such as the Mississippi Coastal Improvements Program, the NRDAR Early Restoration Breton Island project, and the recently announced NFWF project on Dauphin Island, AL. We propose to build on these efforts and to provide access to additional interdisciplinary capacity in support of the development of Gulf restoration projects and programs. This support will enhance and ensure the long-term sustainability and resilience of Gulf ecosystems, increase the services they provide to communities, and increase chances of project success.

Adaptive management will serve as the organizing construct and integrative framework for GRAMTAP, permitting a broader understanding of Gulf ecosystems than could be achieved by individual, independently functioning managers and scientists working on separate projects. The components of assistance that will be available to restoration project practitioners include:

Monitoring: The USGS will partner with DOI and non-DOI monitoring practitioners with the scientific expertise and capacity to develop and review project-specific monitoring and adaptive management plans designed around the natural environments to be restored. This partnership will use a multi-disciplinary and integrated approach by combining expertise in ecology, biology, zoology, toxicology, geomorphology, geochemistry, freshwater quality, hydrology, computer science, spatial analysis, and socio-economics to address restoration monitoring and science needs. The monitoring approach will include: 1) inventory of existing restoration monitoring

projects, plans, and programs across the Gulf Coast and its watershed; 2) establishment of Gulf-wide status and trends of valued ecosystem attributes; 3) optimization of regional sampling designs; 4) development of a standard operating procedure library; 5) establishment of appropriate QA/QC guidelines; and 6) provision of data and information management.

Restoration project sustainability: Restoration projects are vulnerable to climate-driven impacts, human impacts, and the inherent variability in coastal environments, and are affected by freshwater inflows from the Gulf watershed. Large uncertainties in the sustainability of Gulf ecosystems result from the interaction between these factors. Climate-driven impacts include relative sea-level rise rates and storminess, while human impacts include oil spills, infrastructure development, and unintended adverse impacts of restoration designs. Technical assistance will be provided through GRAMTAP to help restoration project managers improve the long-term sustainability of their ecosystem restoration projects, both in their planning and implementation phases.

Ecosystem service valuation and economic impact analysis: To capture the complex human-ecosystem interactions within the Gulf of Mexico, an ecosystem services approach to restoration will be undertaken that focuses on the valuable goods and services that natural resources supply to people. We will conduct an extensive literature review to shed light on current ecosystem service efforts in the Gulf, partner with agencies such as BOEM, NOAA, and EPA as well as universities and NGOs to identify specific services to be valued, and initiate ecosystem service valuations through the development of survey instruments and the compilation of existing data. The USGS will also utilize a survey of service providers to determine how restoration project funding is directly spent within the Gulf economy to assess the economic benefits of RESTORE Council projects. This information will be used by experts through the GRAMTAP to build economic models to estimate the broader and cascading effects of these expenditures.

Our primary metric of success is whether GRAMTAP resources are used to integrate science into RESTORE Council project proposals and during project implementation. GRAMTAP can provide resources to projects to ensure a sound science foundation and tools to assess the efficacy and sustainability of proposed and implemented actions and likelihood of project success. Over time, assessments of project success in providing enhanced resilient, sustained, and quantified ecosystem services will inform further project design and decision-making. This adaptive management feedback loop will help Council decision-makers prioritize future projects and support decisions. All program information will be made available to the public, will leverage existing efforts, and will include active input from the Council, coastal communities, and scientists.

The activities proposed herein establish the foundation by which Council commitments to science-based decision-making, regional ecosystem-based approaches to restoration, and delivering results and measuring impacts of restoration projects can be achieved. These activities also meet the RESTORE Act Priority Criteria to support 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. This proposed technical resource program will be led by a project coordinator reporting to the USGS Southeastern Regional Director in consultation with the RESTORE Council Executive Director and RESTORE Council Science Advisor.

3. Proposal Narrative

I. Background and Introduction

Background

The RESTORE Council's Initial Comprehensive Plan provides a region-wide framework to implement Gulf Coast ecologic and economic restoration. The Plan sets forth the Council's goals for restoring and protecting the natural resources and economy of the Gulf Coast region. The Council adopted five goals for an integrated and coordinated approach for region-wide Gulf Coast restoration: 1) restore and conserve habitat; 2) restore water quality; 3) replenish and protect living coastal and marine resources; 4) enhance community resilience; and 5) restore and revitalize the Gulf economy. To achieve these goals, the Council commitments include science-based decision-making, regional ecosystem-based approaches to restoration, and delivering results and measuring impacts.

The Council decided on focus and emphasis areas for this first-funded priorities list (FPL) to ensure that proposals address habitat or water quality, are foundational in nature, i.e., form an initial core step or steps in addressing a significant ecosystem issue, and that future activities can be tiered to substantially increase the benefits. In addition, proposals should include how the activity will be sustainable over time, why it is likely to succeed, and how it benefits the human community. Finally, proposals eligible for funding must address one or all of these phases of restoration projects – planning, technical assistance, and implementation.

Introduction

A scientific approach to decision-making is needed to achieve the goals, commitments, focus, and emphasis areas referenced above. Therefore, we propose a multidisciplinary program that will provide science-based technical assistance to Gulf restoration projects. These projects will benefit from a structured decision-making process and from readily accessible technical assistance to ensure sound restoration plans that are based on the best available scientific expertise and guidance. Council-funded projects also will benefit from: consistent and integrated monitoring across the Gulf region; knowledge required to ensure restoration efforts are sustainable in the face of climate change, hurricanes, impacts from freshwater inflows, and other threats; and valuation of ecosystem services and economic impacts. With this assistance readily available to all restoration projects, the Council can measure restoration impacts and demonstrate progress towards achieving their goals and objectives, as well as make science-based decisions leading to greater certainty and success with subsequent restoration projects.

Many layers of information are needed to achieve these goals and commitments. The US Geological Survey (USGS) proposes an overarching, adaptive management-based framework to integrate four critical layers of information in support of Gulf ecologic and economic restoration – adaptive management, monitoring, sustainability, and economic analysis. The core of our approach is readily available technical assistance to all Gulf restoration activities. Our proposal meets the RESTORE Act Priority Criteria to support large-scale projects and programs that will substantially contribute to restoring and protecting the natural resources, ecosystems, fisheries, habitats, beaches, and coastal wetlands of the Gulf Coast ecosystem.

Our organizing construct – adaptive management – is a decision science-based process with a formalized framework for capturing management objectives, current knowledge of ecological and economic systems, and evaluation of restoration scenarios (Williams et al. 2007). This

framework permits science-based learning and decision-making while restoration is underway, promoting greater support of restoration efforts by explicitly including broad stakeholder involvement (Williams and Brown 2014). Adaptive management provides the opportunity for "learning while doing", which is particularly important for critical, time-sensitive restoration projects where the risks of inaction far outweigh the risks of proceeding immediately with some scientific uncertainty. The Gulf ecosystem is experiencing rapid declines that may become irreversible before complete scientific understanding can be obtained. Adaptive management provides decision-support tools that explicitly address critical uncertainties leading to timely planning, design, and implementation of restoration projects that proceed concurrently with science activities in support of such projects.

Our work will be implemented over three phases in 10 years. Phase I (this proposal, 3 years) compiles knowledge and tool sets needed to provide technical assistance to Council-funded restoration projects. Identification of restoration projects that would benefit from technical assistance, whether in their proposal, design, or implementation phases, will be accomplished by a process that includes the Council Science Coordinator/Advisor, project proposers, and Council members. Knowledge and tool sets to be applied include: development of adaptive management mechanisms; monitoring inventories; identification of data and information gaps; database development; vulnerability assessments; and ecosystem service valuation and estimation of economic impacts. Phase II (5 years) will resolve information gaps identified in Phase I, expansion and refinement of tool kits, and continued implementation of technical assistance for restoration projects. Phase III (2 years) will include: assessment and synthesis of restoration project progress focusing on ecosystem process, status and trends, and ecosystem services; and comparison to pre-restoration or reference conditions.

<u>Phase I Objectives (this proposal, 3 years):</u>

1. Establish a Gulf Restoration Adaptive Management and Technical Assistance Program (GRAMTAP) that is readily accessible and widely available to facilitate the design and execution of technically sound and sustainable habitat and water quality restoration projects.

2. Collaborate with project management team after initial Council selection to identify GRAMTAP technical assistance that would benefit the project at no additional project cost.

3. Deliver enhanced local to regional-scale knowledge to those projects to provide: consistent and integrated monitoring practices; assessments of sustainability that can affect restoration project effectiveness; and ecosystem service and economic impact indicators that reflect stakeholder preferences and values.

With respect to evaluation criteria specified in Proposal Submission Guidelines, this proposal will address the single primary goal of *restore and conserve habitat*, with secondary goals of *restore water quality*, *replenish and protect living coastal and marine resources*, and *restore and revitalize the Gulf economy*. The single primary objective addressed by this proposal is to *improve science-based decision-making processes*. Secondary objectives are to: *restore, enhance, and protect habitats*; and *restore, improve, and protect water resources*.

We are aware that some of the activities proposed here potentially overlap with activities proposed in the joint NOAA/USGS monitoring proposal, and to a lesser extent with the joint EPA/USGS monitoring proposal. These overlaps include conducting data inventories, identification of data gaps, some aspects of monitoring, and outreach. Should all of these

RESTORE projects be funded, we will work with NOAA and EPA to avoid duplication, to maximize complementarity, and to adjust budgets accordingly.

As the nation's non-regulatory science agency, the USGS is uniquely qualified to provide technical assistance to restoration practitioners, accessing resources within and outside of the USGS from across the country. The USGS operates multiple science centers in the Gulf states, including the National Wetlands Research Center in Lafayette, LA, the Southeast Ecological Science Center in Gainesville, FL, the St. Petersburg Coastal and Marine Science Center, and multiple water science centers. These USGS scientists already work with partners to provide expert knowledge of the Gulf, with specializations in hydrology, water quality, endangered species, community ecology, coastal processes, and decision-science, among other areas. By leveraging USGS resources and expertise, partnerships with others, and structuring GRAMTAP around an adaptive management framework, we can engage with and provide decision support for Gulf restoration projects throughout their lifespan, providing critical integration and feedback mechanisms among agencies, non-governmental organizations, and the public. This approach also will facilitate integration and consistency across all Gulf restoration projects.

II. Implementation methodology

GRAMTAP – We propose a Gulf Restoration Adaptive Management and Technical Assistance Program (GRAMTAP) to provide restoration project managers and practitioners with resources and information they need to implement successful restoration projects based on the best available science. The program will be readily accessible to support Council-funded restoration projects at no additional project costs, providing restoration practitioners with experts in adaptive management, monitoring, project sustainability, and ecosystem services and economic impact valuation. Experts identified by GRAMTAP will provide access to: existing data and analyses to help determine the current state of restoration science; assistance in developing monitoring and adaptive management programs tailored to specific projects; connections to the larger restoration science community; and tracking of restoration success. This interdisciplinary, governmental, and non-governmental capacity will support project development that will provide long-term sustainability and resilience of Gulf ecosystems, increase the services they provide to communities, and increase chances of project success.

GRAMTAP will provide this expertise and assistance to restoration projects across four, science-based components– all with the goal of providing systematic, robust decision-making. These components are: 1) adaptive management-based decision support (the overarching framework); 2) monitoring support; 3) ways to increase restoration project sustainability; and 4) valuation of ecosystem services and economic impacts.

Adaptive management will provide a science-based framework for learning while doing. Standardized monitoring of the ecological systems affected by Gulf restoration will provide the backbone needed to understand and predict its response to restoration and natural or human-caused impacts. Integrating data with models helps predict and evaluate the possible trajectories and long-term sustainability of a restoration project in the face of threats such as climate change and hazards, and impacts from freshwater inflows containing nutrient and pollutant loading – ultimately leading to the design of more sustainable projects and ecosystems. Human impacts include both planned (e.g., restoration) and unplanned (e.g., response to natural disasters) drivers that affect Gulf Coast ecosystems, which in turn impact

human well-being and local economies dependent upon ecosystem goods and services. Ecosystem service valuation will contribute to a more comprehensive accounting of the economic benefits provided by ecosystems, and can be used by policymakers and the public to understand potential tradeoffs and benefits resulting from restoration activities in the Gulf. The activities proposed under GRAMTAP will provide a robust restoration science toolbox that can be used by those developing restoration project proposals and implementing successful projects. This framework will clearly outline the ecological metrics and economic benefits that will be of primary interest to ensuring sustainable, resilient restoration projects, as well as evaluating their outcomes.

GRAMTAP Components

Adaptive management

Decision science provides a framework for capturing current ecological knowledge in the form of predictive models, as it can formalize uncertainty in a way that applies science-based learning to reduce uncertainty. Decision science has been referred to as structured decision-making (SDM, Runge 2011, Williams 2011). Adaptive management is a special case of SDM where monitoring and modeling can reduce system uncertainty and allow decision-makers to adapt in light of this new knowledge. For Gulf restoration projects, decision science can identify areas of high uncertainty and guide project monitoring, modeling, and/or research efforts to reduce that uncertainty even as projects are underway, and after additional knowledge is acquired, to subsequently guide project adaptation so that a project can successfully reach its goals (Williams and Brown 2012, 2014). The Science-Based Adaptive Management chapter in the Gulf of Mexico Regional Ecosystem Restoration Strategy calls for "a process …that allows for restoration efforts… to move ahead in a scientifically defensible manner, increasing the fundamental scientific certainty necessary for successful restoration and expanding current knowledge of the state of the system. This process, and its associated resources, should be integrated into restoration planning and projects to ensure that the science is appropriately considered and sufficiently supported" (Gulf Coast Ecosystem Restoration Task Force 2011). Particularly in light of the complex and large-scale RESTORE projects, readily available and coordinated adaptive management expertise can be applied to specific projects based on need.

Adaptive management will serve as the organizing construct for GRAMTAP in support of Council-funded restoration projects, connecting resource managers and decision-makers with experts in decision-making and adaptive management. The USGS has nationally recognized expertise in decision science and adaptive management, and its scientists have been involved with application of these disciplines to large-scale restoration programs such as the Platte River, the California Bay/Delta, coastal Louisiana, and the Everglades. The adaptive management framework integrates and coordinates the technical assistance components described below. GRAMTAP will provide technical support and development tools for optimal decision-making at the complex scale of Gulf restoration. Optimal decision-making is especially important during the conceptualization and design of restoration projects. It can guide disparate groups of decision-makers, scientists, and restoration practitioners through the complex decision-making processes to reach consensus on shared goals and measures of success. Decision science will facilitate a broader understanding of Gulf ecosystems and their restoration than could be achieved by individual scientists working in their separate disciplines on their separate projects.

GRAMTAP will be poised to address the full breadth of restoration project scales and complexities. Assistance provided could include, for example: helping Gulf states determine where to create fish habitats and structures; supporting management plans for invasive species; assisting with decisions on when and where to restore barrier islands and sandy beaches; and helping determine optimal ways to protect salt marsh edge habitats. One tool that GRAMTAP could provide restoration project managers is stakeholder workshops to clearly define objectives, develop future scenarios using conceptual models and performance measures, conduct uncertainty and risk analyses, and ultimately to select the optimal course of action to achieve restoration objectives that appeal to both the decision-makers and the public.

As part of the Adaptive Management component, we propose to conduct monitoring and modeling inventories to identify data gaps and assess the suitability of present modeling and monitoring programs in the Gulf to support coastal restoration. Also, we will design, disseminate, and support monitoring/research approaches via GRAMTAP to improve understanding of the restoration of water and habitat quality for living coastal resources. Data from national databases that apply to the region will be accessed as well as regional-scale databases, such as those maintained for Gulf states' monitoring programs. A diverse range of models will be evaluated for their applicability and use at relevant spatial and temporal scales. Deliverables (Table 1): *structured decision-making workshops; inventory of existing restoration modeling programs; template for integration of decision science elements into projects; library of conceptual ecological models; performance measures and inventory of performance measures by objective and project type; modeling and monitoring inventories and gap analyses available digitally via a mapper (part of the Monitoring component below).*

Monitoring

Monitoring in the absence of an adaptive management framework commonly leads to a disconnect within decision-making processes and limits the learning that results from monitoring (Steyer and Llewellyn 2000, Convertino et al. 2013). The Gulf Coast Ecosystem Restoration Task Force recommended the development of a comprehensive monitoring strategy to integrate existing monitoring networks, assemble and share monitoring data, and ensure data collected would support decision-making (Walker et al. 2012). The USGS has the unique monitoring design capability to ensure that data collected are desired by decision-makers. We will approach monitoring design from a multi-disciplinary perspective by combining expertise in ecology, biology, toxicology, geomorphology, geochemistry, freshwater quality, hydrology, spatial analysis, and socio-economics. Our scientists already conduct monitoring and research both in the Gulf and in its watershed that contribute to restoration assessments. Our ongoing work will be leveraged by RESTORE Council-funded projects. Technical assistance provided by USGS scientists with experience in large restoration programs such as in Chesapeake Bay, the Everglades, Louisiana Coastal Wetlands, and San Francisco Bay-Delta will aid Council projects in project monitoring design, plan development, and implementation.

Through GRAMTAP, the USGS will partner with monitoring practitioners that have scientific expertise to develop and review project-specific monitoring and adaptive management plans designed around the natural environments to be restored. In developing these plans, our monitoring practitioners can offer expertise on fundamental concepts such as monitoring metrics, performance measures, habitat status and trends across marine, estuarine, and

freshwater habitats, experimental design, estimation of uncertainty, standard operating procedures, data quality guidelines, and scaling from site to landscape-scale assessments.

The monitoring practitioners working on restoration projects and activities will be part of a larger monitoring community of practice (CoP) that will be enhanced by GRAMTAP. The CoP provides a mechanism for extracting the knowledge and project monitoring experience of practitioners and transferring them to the larger restoration community. It also provides opportunities to: share lessons-learned, best practices, and resources; discuss ways to collect high-quality data and maintain consistency and compatibility in data used to help assess restoration success of Council-selected projects; and help ensure that the many existing and new monitoring programs (such as NAS, NOAA RESTORE Act Science Program) are leveraged by the Council, reducing duplication of efforts and monitoring costs for Council-funded projects.

Inventory existing restoration monitoring projects, plans and programs: Initial inventories of monitoring programs have been compiled by the Gulf Coast Ecosystem Restoration Task Force Science Coordination Team, USGS, Ocean Conservancy, Gulf of Mexico Alliance, and others since 2012. These existing program catalogs will be expanded to provide a living and web-accessible directory of active programs searchable by geography, monitoring metric, habitat, status, and restoration project type. The USGS has an existing data catalog product developed for the New Orleans District Corps of Engineers and Louisiana Coastal Protection and Restoration Authority that will be used as a container for this effort providing easy access to all data records regardless of data type (i.e., spatial, tabular, presentation, report) (Figures 1 and 2). Both within and outside of these monitoring programs, project-specific monitoring plans exist on hundreds of restoration projects across the Gulf Coast and in its watershed. These inventories, combined with modeling and data gap assessments conducted under the Adaptive Management component above, will facilitate the development of monitoring and adaptive management plans for future RESTORE Council project submittals.

Establish Gulf-wide status and trends of valued ecosystem attributes: We propose a Gulf-wide assessment of status and trends of valued ecosystem attributes. Valued ecosystem attributes include extent of coastal habitats and important wildlife species (including threatened and endangered species). Information from on-going USGS programs focusing on habitats such as upstream freshwater ecosystems, wetlands, barrier islands, and species such as sea turtles, manatees, anadromous fish, wading birds, and shorebirds will form the basis of this assessment. This effort also will leverage data and information from state and federal agencies (e.g., USFWS, NOAA) and programs (e.g. NOAA's C-CAP, DOI Landscape Conservation Cooperatives, and NPS Vital Signs Program). A list of ecosystem attributes to be assessed will be developed initially from a literature review of existing status and trends. An early project task will be to finalize this list based on input from the monitoring CoP. We will seek input from the Sustainability and Ecosystem Service practitioners (below) on the social-ecological value of these attributes and consensus on their suitability as indicators of restoration success.

We will investigate status and trends and spatial-temporal variability of areal extent – highly-valued indicators that are common restoration targets – as a pilot during Phase I. The assessment of areal extent will focus on coastal emergent habitats and will utilize information contained in existing, but inconsistent, large-scale land-cover detection databases such as the USGS National Land Cover Database Program, the USGS Coastal Hazards Portal, the NOAA Coastal Change Analysis Program, and the National Wetland Inventory, along with remote-

sensing information on habitat quality available through the USGS Landsat Program and other platforms. Coastal emergent habitat classifications will be standardized and the emerging comprehensive dataset will serve as a baseline for all RESTORE Council projects focused on coastal habitats. Physical and environmental factors developed in the Sustainability component (below) will be included to develop a multi-criteria evaluation to assess effects of the variation in habitat extent, providing information that we can then use to develop optimized Gulf-wide monitoring designs and indicators of restoration success based on these attributes.

Optimize regional sampling designs: We will use status and trends data for available Gulf and upstream habitats to statistically assess changes in areal extent and variability in habitat classifications at multiple spatial scales. Variability assessments will be provided to habitat-specific expert panels within the monitoring CoP that will develop the sampling design for the optimization network in workshop settings. Spatial and temporal resolution of data and use of baseline reference conditions will be considered in the design to evaluate the accuracy, power, and eventual applicability of data for ensuring that ecological changes can be quantified within acceptable uncertainty limits. This approach has been used previously by USGS to design and develop Louisiana's Coastwide Reference Monitoring System (CRMS, Steyer et al. 2003). Similar to what is needed for the GRAMTAP monitoring program, CRMS integrates data from multiple spatial and temporal scales and from multiple sources, generating visualizations, tools, and reports geared towards a wide range of user groups (Figures 3, 4 and 5).

Develop standard operating procedure library: There are many state, regional, and national monitoring programs that are active currently in the Gulf region utilizing standard monitoring methodologies and operating procedures. Some of these methodologies have been peer-reviewed, whereas others have been in place for decades and utilize older sampling approaches. This library will categorize existing procedures and a minimum acceptable standard will be recommended to the Council, once vetted within the Gulf monitoring CoP.

Establish appropriate data quality guidelines: To ensure consistent and compatible data are collected from all Council projects and can be synthesized into larger ecosystem assessments, minimum quality assurance and quality control guidelines must be met. Data quality policies of existing Gulf and watershed monitoring programs will be reviewed for five aspects of data quality: representativeness, completeness, comparability, accuracy, and precision. From this assessment, Council guidelines for reviewing new proposals for the five aspects of data quality will be developed, once vetted within the Gulf monitoring CoP.

Data and Information Management: GRAMTAP will establish clear and consistent data management, monitoring, modeling, adaptive management, and science delivery policies as part of its overarching restoration support strategy. GRAMTAP will include on-line tools and spatial mapping applications for data discovery, dissemination, and integration building off of USGS experience with regional monitoring and adaptive management programs (e.g., Louisiana's Coastwide Reference Monitoring System, Nonindigenous Aquatic Species, Joint Ecosystem Modeling, Coastal Information Management System, etc.) (see section 7 Data/information sharing and Figures 6, 7, and 8). Data will comply with the Open Geospatial Consortium standards, ensuring seamless integration into other data management infrastructures including RESTORE Council partners, national mapping programs such as NOAA's *Gulf of Mexico Data Atlas* and USGS's *The National Map,* or state programs such as Mississippi Coastal Improvements Program or Louisiana Coastal Information Management System.

Deliverables (Table 1): *inventories of monitoring programs; libraries of monitoring standard operating procedures and data quality policies; literature review of existing Gulf Coast habitats status and trends; pilot status and trends assessment of extent of emergent habitats and examination of optimal sampling designs; directory of monitoring practitioners; monitoring CoP reviews of monitoring products; and on-line mapping applications and searchable databases of GRAMTAP adaptive management, monitoring, sustainability and ecosystem valuation products.*

Sustainability

Technical assistance will be provided to project managers via GRAMTAP to improve the long-term sustainability of restoration projects both in their planning and implementation phases, as well as enhancing sustainability for ecosystems those projects are restoring. Restoration projects are vulnerable to climate-driven impacts, human impacts, the inherent variability in coastal environments, and are affected by inflows from the Gulf watershed. Large uncertainties in ecosystem sustainability result from the interaction between these factors. Climate-driven impacts include sea-level rise, storminess, and increased/decreased freshwater inflows. Human impacts include oil spills, infrastructure development, and unintended adverse impacts of restoration projects. Acknowledging these impacts as contributors to project uncertainty and incorporating the appropriate science and monitoring in project design and implementation will increase project sustainability. Sustainability assessments require monitoring in the Gulf and its watershed to capture extreme events and long-term trends, and development of predictive scenarios based on detailed numerical and statistical models.

Once specific restoration projects or potential geographic areas proposed for restoration needing technical assistance are identified, data can be obtained from existing sources or from new measurements. For example, vulnerability of coastal projects can be characterized via mapping (e.g., LiDAR topography, LiDAR and acoustic bathymetry, and aerial, satellite, and submarine imaging) to define project-wide variability and by local measurement. Local measurement is required to determine actual physical and ecological processes (e.g., water level, flow, turbidity, deposition, erosion, and organic matter dynamics) relevant to a project's sustainability. The role of the Sustainability component of GRAMTAP is to identify data required for hazard and change assessments (Stockdon et al. 2012, Gutierrez et al. 2014). These data can be updated and supplemented and used in the adaptive management of specific restoration projects. Other data requirements include coastal elevation, historical trends, storm or sea-level rise statistics and projections, and stream inflow and quality in some locations.

Because the ecosystem drivers are inherently uncertain, assessments of vulnerability and sustainability of any particular project could necessitate developing predictive scenarios based on numerical and statistical models, because the models help account for the physical environment modification planned in the restoration design. Existing models, identified here and/or in the Adaptive Management component (above), can be used to develop hazard scenarios (e.g., sea-level rise, storms, pollutant loading from upstream sources). These inventories also can contribute to historical and future assessments, or even real-time assessments of restoration projects, and may include climate models (Horton et al. 2014), hydrodynamic models (Walker et al. 2012, Long et al. 2014), morphological models (Sherwood et al. 2014), and statistical models (Plant and Stockdon 2012, Plant et al. 2013). Because coastal systems are driven by hydrologic and oceanographic forces, coastal and ocean hydrodynamic

models are fundamentally important to all activities presented in this proposal, and integration via adaptive management will maximize the value of the modeling inventory.

The USGS, working with other federal, state, local, and non-governmental organizations, has a proven track record in conducting hazard assessments that provide restoration practitioners with information concerning the sustainability of barrier islands, wetlands, and shorelines. The knowledge gained and techniques developed by USGS working on Hurricane Sandy assessments illustrate how this information can be used to make sound decisions on both the type of restoration and techniques for Gulf restoration.

Deliverables (Table 1): *data inventory with sustainability-related gap analysis (e.g., topography, geology, oceanography across Gulf and watershed habitats); inventory of existing model frameworks relevant to specific projects; pilot vulnerability assessments, model output, and underlying data at identified restoration sites; modeling and monitoring inventories and gap analyses available digitally via a mapper delivered as part of the Monitoring component.*

Ecosystem service valuation and economic impact analysis

Ecosystem service valuation: GRAMTAP will provide an ecosystem services approach to restoration to capture the complex human-ecosystem interactions within the Gulf. This approach, which focuses beyond the natural resources themselves to encompass the valuable goods and services these resources supply to people, was recommended by NRC (2013). Ecosystem service valuation contributes to a more comprehensive accounting of the economic benefits provided by ecosystems – information that is being promoted in federal decision-making (PCAST 2011) and can be used by both policy-makers and the public to understand potential tradeoffs and benefits resulting from restoration activities (NRC 2013). Further, this approach allows for stakeholders to express their preferences for restoration activities that impact their livelihoods and communities.

When monetizing the economic value of ecosystem services, a big challenge is linking changes in ecosystem function to the production of valuable goods and services at appropriate spatial and temporal scales (NRC 2005, Polasky and Segerson 2009, Barbier 2013); hence, one component of this effort will involve restoration-focused ecological modeling to help establish these linkages. Some of the necessary modeling will be completed as part of this proposal, some of it will be conducted through other efforts in the northern Gulf (e.g., NOAA can provide information on changes to commercial and recreational fisheries), and modeling not captured through other efforts will be completed here, utilizing expertise from the USGS National Wetlands Research Center. The results of the ecological modeling will be used to link changes in ecosystem services resulting from restoration efforts to gains and losses in human welfare. This linkage will be achieved through economic valuation approaches, including stated preference methods, revealed preference methods, benefit transfer methods, and cost-based approaches.

While there are a wide range of ecosystem services provided by estuarine and coastal ecosystems (see Barbier et al. 2011, Barbier 2013 for a summary), a subset of the ecosystem services that could be impacted by Gulf restoration activities will be monetized through this effort. Specific ecosystem goods and services that will likely be targeted include fish and wildlife species/habitat, flood control, water quality, carbon storage, property values, and recreation and tourism. However, the determination of which services can be valued will depend on the ecological modeling as well as the stated objectives of restoration projects. Further, we will

coordinate with other ecosystem service valuation efforts in the Gulf to avoid redundancy and the inefficient use of funding. This coordination will include partners such as the University of Wyoming, who are conducting an ecosystem service valuation analysis in Louisiana.

We will conduct an extensive literature review in Phase I of this work to describe and measure current ecosystem service efforts in the Gulf of Mexico, partner with agencies such as NOAA and EPA to identify specific services to be valued, and initiate ecosystem service valuations through the development of survey instruments and the collection of existing data.

Economic impact analysis: The implementation of restoration projects in the Gulf has an immediate positive impact on jobs and income in local, regional, and state economies. In addition, recreation and tourism not only have an economic value to the visitor taking part in these activities, but also benefit local, regional, and state economies through visitor spending. This effort will capture the linkages between ecological and economic recovery of Gulf states.

Economic impacts measure how spending cycles through local economies, generating business sales and supporting jobs and income. In the case of ecosystem restoration, economic impacts are generated directly through the expenditures and effort applied to restore the health of ecosystems. The scope of the restoration work required in the Gulf of Mexico and the influx of money to the region to meet this need will provide a substantial stimulus to the US Gulf of Mexico economy. USGS will utilize a survey of service providers to determine how restoration funding is directly spent within the US Gulf economy. This information will be used to build computable general equilibrium models and input-output models to estimate the ripple effects of these expenditures. The resultant output would be measures of the direct and secondary impacts of RESTORE funding to the Gulf economy in terms of the jobs, income, and contribution to Gross Regional Product supported by RESTORE funding.

The economic activity generated through restoration activities provides an immediate stimulus to the economy and generates short-term employment and economic growth in the area. This effort will develop baseline conditions, beginning in 2009, for a set of economic health indicators at the county level, and will track these indicators over time. These indicators include such measures as employment, poverty, racial makeup, and in-migration and out-migration. This information will be useful to inform the overall trend in economic health in the region, and could be used to identify areas that are in greatest need of support.

In addition to supporting the recovery and resilience of the Gulf coastal economies, ecosystem restoration specifically generates economic activity through increased tourism resulting from visitors being drawn to the restored environment. These effects have a long-term impact on the economy, as visitors to the area spend money on goods and services such as lodging, dining, entertainment, and nature-based recreation opportunities. This effort would utilize information collected from local visitor bureaus and tourism organizations on changes in Gulf visitation as well as data on visitor spending patterns collected through visitor surveys to measure and provide a link between restored ecosystems and economic activity generated through increased recreation and tourism using input-output modeling.

Deliverables (Table 1): *literature review of ecosystem service valuation efforts in Gulf Region; identification of specific ecosystem services to be valued; completion of survey sampling plan and development of surveys that will be used in Phase II to conduct the valuation of ecosystem services and economic impacts; identification of county-level economic health indicators, and collection of data from 2009 baseline to present; annual reports and interactive*

graphs used to track the health of Gulf coastal economies over time; compilation of restoration-focused ecological models linking changes in ecosystem function to the production of valuable goods and services will be delivered as part of the Adaptive Management component.

III. Monitoring and adaptive management of the project or program

Not applicable. The adaptive management framework is described above.

IV. Measures of success for the proposed project or program

Adaptive management: The measure of success is whether the science-based resources provided are integrated into Council project submissions and selected projects. Projects that utilize these resources will have a stronger science basis by utilizing the most recent data sources and techniques. These resources will help decision-makers prioritize projects and support project selection decisions. The resources provided by GRAMTAP will grow over time, both in terms of access to restoration practitioners and in the expanded inventories, libraries of information on monitoring, modeling, and adaptive management. Engagement with the stakeholder community will garner stronger support for Council investments in projects.

Monitoring: Measures of success include utilization of a broader, more interconnected CoP. Interactions through the monitoring CoP will lead to improved quality of monitoring plans, greater standardization in monitoring protocols and QA/QC, and reduced duplication and increased leveraging of monitoring efforts. Enhancing data delivery mechanisms and providing resource managers and stakeholders access to baseline datasets and queriable databases will increase the potential for project success.

Sustainability: Measures of success are support to the Adaptive Management and other components by providing vulnerability assessment model results and/or underlying data for these models. This component also will support the data inventory and gap analysis required to ensure applicability of existing models and assessments. Projects will benefit from technical guidance in the use of data and models to assess vulnerability to climate and human-driven impacts, and how these impacts contribute to project uncertainties.

Valuation of economic services: Measures of success are survey approval through the Office of Management and Budget for Phase I, as well as compiled and published restoration-focused ecological models linking changes in ecosystem function to the production of valuable goods and services at appropriate spatial and temporal scales. Other measures include high survey response rates and results that reveal a range of economic values associated with restoration activities for Phase II of this effort. Similarly, successful quantification of economic impacts would be reflected by the completion of comprehensive data collection and modeling, and results that reveal a range of economic impacts associated with restoration activities in Phase II.

V. Risks and Uncertainties

The 3-year duration of Phase I can accommodate the development and completion of all programmatic resources (i.e., libraries, inventories, literature reviews, data delivery on the web). There is limited risk in meeting this timeline because USGS will be building off of existing

adaptive management-based technical assistance and data delivery programs. There are modest, but controllable, uncertainties associated with project technical assistance. Our approach follows prescribed processes that we have already employed on restoration projects within Gulf ecosystems and includes exploration of stakeholder values, actions, modeling, and management strategy evaluation. However, decision problems feature complexity that defies customary approaches and calls for new tool development. The number of Gulf projects that could be approached through adaptive management is likely to exceed the capacity of available expertise. Therefore, priorities must be set, with consideration given to a project's breadth of impact, availability of appropriate expertise, preferences of stakeholders, immediacy of implementation, and other attributes (Gregory et al. 2006, Williams et al. 2007).

Potential risks associated with the proposed monitoring activities include the lack of use of GRAMTAP resources, low engagement by the monitoring CoP, and lack of future funding to support the maintenance and updating of resources in additional phases. Another significant risk is that restoration projects do not sufficiently budget for specific monitoring activities.

Potential risks associated with the Sustainability component are that data and model gaps identified under this effort are not addressed. Additionally, future severe storms with the potential to dramatically alter barriers, wetlands, estuaries, and stream inflow can cross thresholds such that ecosystem function is permanently changed, requiring unanticipated monitoring and modeling. Severe impacts could require a variety of responses from the RESTORE Council and include those that are part of ongoing USGS responsibilities.

When conducting economic valuation of ecosystem services, there may be uncertainties with the extent to which ecosystem function changes can be linked to production of valuable goods and services. Coordinating with existing ecological modeling efforts can help alleviate this risk. Regarding the quantification of economic impacts, there are risks associated with being able to gather the necessary expenditure data. Through previous efforts, we know that the successful collection of the required expenditure data from the firms implementing the restoration projects will most likely require a mandate from the funding agency. When quantifying economic values or impacts, it will be extremely important to isolate the effect of restoration activities on these economic outcomes.

VI. Outreach and education opportunities

All monitoring information will be publicly available, and will be leveraged with existing efforts and include input from the Council, coastal communities, and scientists. Leveraging will be accomplished via the web, meetings, and a Gulf Sea Grant restoration specialist liaison to work closely with the Council, Council staff, Council-funded project managers, and GRAMTAP, ensuring that this work closely aligns with Council needs.

The Sea Grant restoration specialist would: 1) identify opportunities for target audiences and the public to engage in the adaptive management framework; 2) develop outreach materials about GRAMTAP; 3) identify science and/or monitoring results that may interest specific audiences; 4) facilitate the development of and networking within the monitoring CoP; and 5) evaluate outreach effectiveness. GRAMTAP leadership will work with Sea Grant Directors to develop an annual work plan to ensure clear communication and effective product delivery. Specific audiences could include restoration practitioners, natural resource managers, non-

profit staff, industry leaders of local and regional businesses, community leaders, university researchers, and youth interested in science and decision-making.

The number of Gulf restoration projects envisioned to be approached through this proposed work is likely to exceed the capacity of available expertise. This project will provide opportunities to train new decision scientists for roles including internships, apprentice roles, and co-lead roles to work with experienced decision analysts on complex problems.

The synthesis of existing monitoring plans, SOPs and data quality guidelines will be conducted by student interns under the guidance of experienced monitoring practitioners, providing historical context and real-world experience to the next generation of scientists. Outreach and educational opportunities will be expanded through the monitoring CoP as best practices and lessons learned are exchanged.

Field- and model-based assessment protocols will be refined and re-prioritized over time, and robust management options identified, through routine interactions with restoration managers, RESTORE stakeholders, and partnering agencies. Results, particularly on priority issues, will be presented in public seminars at Gulf universities, regional water science centers, and local environmental/municipal centers, including coastal tribal communities.

For the ecosystem valuation component, surveys of the general public (working with the Sea Grant liaison) will provide an important outreach tool about restoration activities and the environmental benefits they are expected to provide. Surveys provide an opportunity to connect with the general public and obtain feedback regarding their preferences and values associated with restoration in the Gulf of Mexico. In addition, the full suite of economic outcomes quantified through this effort will be provided to the public, providing them with an understanding of how restoration activities benefit their communities and states.

VII. Leveraging of resources and partnerships

The adaptive management efforts proposed here are similar to the successful model for collaborative decision analysis used by the USFWS National Conservation Training Center. The decision analysts that will be part of our effort have been working through complex decision problems brought by state and federal agencies and NGOs. In addition, the USGS has a strong decision science program at the Patuxent Wildlife Research Center. Therefore, by leveraging existing resources, start-up time for the decision analysts would be minimal.

There will be considerable collaboration and leveraging of knowledge with DOI sister bureaus, as well as federal and state agency Council members and partners with adaptive management, monitoring, and science expertise. Individuals with local knowledge of the Gulf region, as well as individuals with subject area expertise outside of the region, will be involved to incorporate a diversity of perspectives and to document lessons learned. The USGS and partners will enhance the monitoring CoP that will build upon and make informed decisions from the scientific information assembled and synthesized here. This CoP will facilitate coordination and communication of scientific knowledge among all participants.

In order to assign values to ecosystem services and economic impacts, USGS will partner with the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the National Park Service, the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency, the U.S. Forest Service, Colorado State University, as well as local and state tourism

departments. Our economic impact analyses will leverage experience the USGS has gained estimating economic impacts of federally funded restoration projects.

To develop the pool of experts available via GRAMTAP, we will build upon existing ecosystem restoration communities of practice (Daoust et al. 2014), such as the Large-scale Ecological Restoration Section of the Society of Ecological Restoration. In Section 9 (Other), we list potential partners both within and external to the USGS that have agreed to contribute to GRAMTAP depending on the need of specific restoration projects. This list is not exhaustive and will be expanded based on the needs for additional expertise identified by the Council members, Council staff, or restoration project and program managers. It is important to note that many permanent USGS scientists have to provide external funding for portions of their salaries; thus, the proposed FTEs in the budget draw largely upon existing experienced staff – not new staff. Portions of USGS base-funded salaries will be provided as match.

VIII. Proposal project/program benefits

The activities proposed herein directly address Council commitments to science-based decision-making, regional ecosystem-based approaches to restoration, delivering results, and measuring project impacts. We will provide a collaborative framework that links otherwise isolated and disparate restoration science information developed at local and state scales under a Gulf-wide umbrella. Decision support tools will be applied collaboratively to engage stakeholders in what the science means, how it should be used, and identifying metrics of success. We will provide technical assistance in the form of data, expertise, and tools necessary to improve project planning, design, implementation, and assessment. These products can be used in the future to enhance projects that address all five of the Council goals.

The proposed activities will provide RESTORE-funded projects easy, free access to restoration science resources and practitioners from within and outside USGS with experience working in any Gulf ecosystem. This work will synthesize information and knowledge from past Gulf restoration efforts, and communicate lessons learned to practitioners through GRAMTAP, leading to improved, science-based restoration planning and implementation. This program will accelerate learning curves of restoration practitioners, helping to place sustainable projects on the landscape that have a high probability of success and positive impact. The outreach and educational components will facilitate integrating science and linking efforts across federal and state agencies and universities and other RESTORE Act initiatives.

Part of the ecosystem service valuation and economic impact analysis is aimed at quantifying ecosystem service values and economic impacts associated with restoration activities in the five Gulf Coast states. Highlighting the effects of restoration on both local economies and human well-being supports the Council's goal of understanding how restoration activities restore and revitalize the Gulf economy, and supports the Council's objective of improving science-based decision-making processes. The economic effects quantified through this effort will provide a measure of restoration success, and provide guidance for improving ecosystem service and other economic benefits in the restoration of healthy ecosystems.

To better illustrate the process and type of technical assistance that we will provide, we have included a hypothetical, yet realistic, example of assistance provided to a Council-funded state coastal marsh creation project. Upon Council selection of projects for the FPL, the

GRAMTAP coordinator meets with the Council Science Advisor/Coordinator to identify projects that GRAMTAP could assist (Figure 9). They provide Council members a project list for approval, such as the state marsh creation project. The GRAMTAP project coordinator develops a scope of work that identifies GRAMTAP activities, scientists, timelines, and deliverables, with concurrence from the project manager and the Council Science Advisor/Coordinator.

There are several restoration alternatives with varying costs, and stakeholders are concerned about viability of the alternatives, location, impacts on downstream resources, costs, and effect on the local economy (Figure 10). Working through GRAMTAP, we help the state evaluate multiple restoration alternatives by engaging stakeholders in a structured decision-making exercise that will help them achieve their objectives (for example, a long-term, sustainable, restored marsh that supports living resources, is accessible to local tourists, and has the highest cost-to-benefit ratio). The evaluation, conducted through workshop settings with wide stakeholder participation, will provide decision-makers with the best available science-based decision support using a structured, open, and transparent process, and measures of progress and success that the parties find mutually acceptable.

GRAMTAP, via its Adaptive Management component, will help provide project analysis and alternative evaluation by identifying linkages between the coastal marsh and connected ecosystems that affect restoration project success (Figure 10). Existing data will be identified and used to establish foundation information via its Monitoring component. The upstream processes and potential impacts from freshwater inflows will be evaluated as well as the project sustainability via the Monitoring and Sustainability components. All of these aforementioned, high-quality scientific analyses will be utilized during the structured decision-making process to identify preferred alternatives that best meet the objectives. The state and Council member will be engaged from beginning to end and are provided the technical assistance necessary to make an informed decision with a process that is transparent to stakeholders.

After an alternative is selected, and throughout the detailed project planning, the project team will use GRAMTAP to develop the monitoring and adaptive management plan necessary for project success (Figure 10). The initial project goals will be metrics that show how well actions are achieving the desired outcomes. This development will include example monitoring plans from similar project types, standard operating procedures, data quality guidelines, and existing monitoring being conducted in the project vicinity. If the project team needs assistance with any aspect of project monitoring, GRAMTAP will provide restoration monitoring practitioners to assist. GRAMTAP also will work with existing entities to leverage monitoring resources and maintain reporting consistency with other Council-funded restoration projects.

During this analysis, the value of ecosystem services and economic impacts will be assessed to provide the state and other stakeholders estimates of financial benefits, in monetary terms, to the community from the project (via the Economics component) (Figure 10). There will be outreach and education throughout the life of the project to inform the public of how science is being incorporated in the decision-making process, provide opportunities for public engagement, report project economic benefits, and to provide ecosystem benefits (for example, increase in marsh or utilization of living resources) from monitoring data.

4. Location information

The northern Gulf region, including the lower watershed, is considered to be the location for this proposed project. As our proposal primarily is a technical assistance proposal, the specific locations will be tied to the locations of Council-funded restoration projects for which we can provide assistance.

5. High-level budget narrative

Overview: The FTEs represented below are for salaries for existing USGS staff (not for new federal staff), or for contractors, external researchers/experts, students, and local government. The intent is to leverage existing personnel and resources as much as possible, bring local jobs to the Gulf, increase education and outreach, and to not grow the federal government presence in the Gulf. Salaries, benefits, travel costs, and other expenses are estimated using standard federal government rates.

Project coordination, GRAMTAP, and outreach: (Total for Phase I - $1.752M)

A full-time Project Coordinator for GRAMTAP will be required, and will report to the USGS Southeastern Regional Director. The Regional Director and Project Coordinator will work closely with the RESTORE Council Executive Director and Science Advisor. The Project Coordinator will have experience in leading multi-disciplinary and multi-agency teams, will have a technical background relevant to the proposed work, and will be at a senior level. The Regional Director will seek cost sharing for this position, but for now it is budgeted at the full amount ($184K/year; Total $552K).

Subject matter experts (see example list of experts and their expertise in Section 9: (Other) will be required depending on specific restoration project needs ($250K/year; Total $750K).

A full-time Sea Grant restoration specialist liaison will be funded during years 1-3 to support outreach and engagement of state partners and interested public in GRAMTAP and share the results of products ($150K/year; Total $450K).

Adaptive management: (Total for Phase I - $1.938M)

The adaptive management component will be coordinated by a position based in a Gulf state. The coordinator will have knowledge and experience in decision analysis and will lead the adaptive management efforts as well as spending half-time in a decision analyst role ($150K/year; Total $450K).

Data management and application programming will be provided for user-friendly products to RESTORE project managers. These needs will be conducted by the Advanced Applications Team at the USGS National Wetland Research Center and will be done in coordination with the programming budgeted in the Monitoring component ($60K/year; Total $180K).

Inventory of performance measures by objective and project type; inventory of conceptual ecological models; inventory of existing restoration monitoring and modeling projects and programs. Modeling and monitoring inventories and gap analyses will be coordinated with the Monitoring, Sustainability, and Economics components and will be available digitally via a mapper provided in the Monitoring component ($184K/year; Total $552K).

Lead roles on specific restoration projects will rest with professional decision analysts within USGS, FWS, universities, or other entities who would be retained on a half-time basis to focus on RESTORE projects. Their roles also include workshops for specific projects, and a template for integration of decision science elements into projects including adaptive management and monitoring ($252K/year; Total $756K).

Monitoring: (Total for Phase I - $1.807M)

Full-time program manager and coordinator that will lead the development of the monitoring inventories, SOPs and QA/QC guidelines; mentor 1 student intern; direct the regional sampling design; and facilitate the Community of Practice (CoP). Will be done in coordination with Adaptive Management and Sustainability components ($184K/year; Total $552K).

One student intern will be funded to assemble the monitoring plans, SOP library, QA/QC policies, and directory of monitoring practitioners. Will be coordinated with the Adaptive Management component ($47K/year; Total $141K).

A research scientist to oversee the regional sampling design project ($125K/year; Total $375K).

A data delivery and visualization specialist will provide all GRAMTAP data and information products through the web. Programming and deliverables will be coordinated and linked with the Adaptive Management, Sustainability, and Economics components and deliverables ($63K/year; Total $189K).

Equipment to set-up the web-based distribution of data, metadata, and other science products through a publicly available GRAMTAP geo-portal. Geospatial data will be publicly available using open geospatial consortium standards. Will be coordinated and linked to Adaptive Management programming and deliverable distribution, as well as deliverables from Sustainability and Economics components ($50K/year; Total $150K).

Funding to conduct a pilot Gulf Coast emergent habitats status and trends assessment, leveraging available state land change assessments, C-CAP, NLCD, and NWI datasets from 1979-2015 to develop a standardized classification and baseline status and trends assessment. Additional datasets will be developed, as necessary, where they do not exist and are needed to demonstrate how to optimize regional sampling designs ($400K for one year only; Total $400K).

Sustainability: (Total for Phase I - $1.617M)

Research staff and associated support staff and travel for data mining; inventory of data with sustainability-related gap analysis (e.g., topography, geology, oceanography across multiple Gulf and watershed habitats); identifying underlying data that support pilot vulnerability assessment. Supports the data inventory and gap analysis required to ensure applicability of existing models and assessments and done in coordination with Adaptive Management and Monitoring components ($276k /year; Total $828K).

Model inventory of existing model frameworks relevant to restoration projects; pilot vulnerability assessment including model output and utilizing underlying data identified above at restoration sites; research staff and support staff and travel. This work also supports the model inventory task as part of the Adaptive Management component. Modeling and monitoring inventories and gap analyses will be available digitally via a mapper delivered as part of the Monitoring component ($263K/year; Total $789K).

Ecosystem service valuation and economic impact analysis: (Total for Phase I - $1.599M).

One project manager that will coordinate efforts both internally and externally, and oversee all survey development, data collection, and analysis ($53K/year; Total $159K).

Data collection and modeling to tie ecological functions to the production of ecosystem services, literature review on ecosystem service valuation efforts in the region, travel to collaborate with partners and identify survey sampling plans and development of survey instruments, initiation of ecosystem service valuation, annual reports, and interactive graphs. Compilation of restoration-focused ecological models linking changes in ecosystem function to the production of valuable goods and services will be coordinated and delivered on-line as part of the Adaptive Management and Monitoring components ($340K/year; Total $1.02M).

Identify economic health indicators, develop economic impact models, and initiate surveys of businesses. Indicators and impact models will be coordinated with the Adaptive Management and Monitoring components ($140K/year; Total $420K).

Overall project cost for Phase I - $8.713M

<u>In-kind contributions:</u>

USGS scientists involved in this program will provide a portion of their salary as in-kind contribution. Additionally, to conduct the ecosystem service valuation and economic impact analyses, the USGS has confirmed partnerships with DOI's Office of Policy Analysis, NOAA, the Army Corps of Engineers, the National Park Service, and Colorado State University. This includes an in-kind salary contribution of ~$900,000 for phase I.

6. Environmental compliance

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, USFWS)				X
Endangered Species Act – Section 7 – Permit for Take (NMFS, USFWS)				X
Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) – Consultation (NMFS)				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 (USFWS)				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 Agreement				X
Tribal Consultation (Government to Government)				X
Coastal Barriers Resource Act – CBRS (Consultation)				X
State				
As Applicable per State				X

7. Data/information sharing

The data management proposed for this effort will describe the environmental data types to be collected, data stewardship and preservation, and the standards surrounding data descriptions, collection formats and sharing protocols. Furthermore, the effort will leverage the USGS data management capacities currently managing data from numerous federal and state projects across the Gulf of Mexico region (ex, JEM, EverView, MsCIP, NAS, CRMS, CIMS).

Environmental Data Types - The Gulf Restoration Adaptive Management Technical Assistance Program (GRAMTAP) will be coordinating and synthesizing monitoring and

observational data as well as data products from hydrologic, oceanographic, morphologic, geological, ecological and human-use systems in the Gulf of Mexico. Where applicable, pre-defined standard data formats will be promoted for use for each data type. All monitoring and observational data as well as created analysis and visualization products will be represented within the proposed infrastructure. Having prior experience in collecting, maintaining, and/or analyzing these data types, USGS can leverage existing processes and infrastructures in place to aid in the storage, transformation, and dissemination of these types of data.

Stewardship/Preservation - Through numerous ongoing data management activities, USGS has amassed the infrastructure in various key locations across the Gulf of Mexico necessary to support large scale monitoring and modeling activities.

Web services enable relational tabular monitoring databases and spatial databases to be seamlessly integrated into other platforms through web mapping services (WMS), web coverage services (WCS), or OpenDAP interfaces. Additionally, USGS can leverage the existing scientific and data management platform, ScienceBase, providing a centralized permanent archive for USGS data and information products.

Standards -

Data Description (metadata) - All digitally managed data will contain FGDC compliant descriptive metadata describing data content. The required metadata will facilitate the discovery of relevant project information and promote data use for future gulf restoration efforts.

Sharing Protocols (WAF and CSW) - The USGS will initially consolidate data and information from the GRAMTAP on the existing "USGS and the Gulf of Mexico" website at gom.usgs.gov. Web accessible folders (WAF) and catalog services for the web (CSW) will be utilized so that all data, metadata, standards, catalogs, and inventories assembled as a part of this proposal will be maintained through web services and exposed online for access by all users with a web browser. Data discovery, access and visualization services will utilize the open source Esri Geoportal Server promoting authoritative data integrity and easy-to-use data discovery technologies.

USGS will leverage capacity and expertise from other successful data management activities to publicly expose data, visualizations, charting, and interactive maps to the user. The interactions between USGS computer scientists and researchers, both federal and academic, have resulted in powerful data management systems allowing scientists to abandon traditional desktop spreadsheets for online systems exposing complex query and reporting functionality. Examples of such systems are:

- Coastwide Reference Monitoring System (CRMS)
http://lacoast.gov/crms_viewer2/Default.aspx

- Joint Ecosystem Modeling (JEM) - Biological Database
http://jem.gov/Map
- Nonindigenous Aquatic Species (NAS)
http://nas.er.usgs.gov

Policy - Data and information discovery, access and preservation will follow federal mandates and policy guidance on open data policies that has been outlined and described in OMBM-13-13, OMB Circular A-130, and OMB Circular A-16. These open data policies include machine readable and open formats, data standards, and common metadata catalogue services for all new information creation and collection efforts. A shared, distributed data design will be utilized that leverages existing data management activities among federal, state and academic institutions to promote the use, sharing, and dissemination of both geospatial and non-geospatial data and information.

-- White House "Open Data Policy" (OMB M-13-13) of May 9, 2013 which supports the related Executive Order of May 9, 2013 (Making Open and Machine Readable the New Default for Government Information). This policy requires federal agencies to collect or create information in a way that supports downstream information processing and dissemination activities. This includes using machine readable and open formats, data standards, and common core and extensible metadata for all new information creation and collection efforts.

-- OMB Circular A-130 which states "The open and efficient exchange of scientific and technical government information, subject to applicable national security controls and the proprietary rights of others, fosters excellence in scientific research and effective use of federal research and development funds. The nation can benefit from government information disseminated both by federal agencies and by diverse nonfederal parties, including state and local government agencies, educational and other not-for-profit institutions, and for-profit organizations."

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Relevant web sites:

Storms:
http://marine.usgs.gov/coastalchangehazards/

Sustainability:
http://coastal.er.usgs.gov/bier

Related (Hurricane Sandy)

(http://www.usgs.gov/hurricane/sandy/#research_themes.html!research_theme_understanding_change.html

9. Other

Table 1. List of deliverables and timelines for each GRAMTAP component

GRAMTAP ACTIVITY	DELIVERABLES	TIMELINE
Inventories	Monitoring inventory	Years 1 & 2 (updated thereafter)
	Existing monitoring program QA/QC policy review	Years 1 & 2 (updated thereafter)
	Modeling inventory	Years 1 & 2 (updated thereafter)
	CEM library	Year 1 (updated thereafter)
	PM inventory	Year 1 (updated thereafter)
	SOP library	Years 1 & 2 (updated thereafter)
Data Gap Assessment	Data gap assessment	Year 2
	Status and Trends literature review	Year 1
	Sustainability literature review	Year 1
	Ecosystem Service Valuation literature review	Year 1
	Ecosystem Service Valuation survey development plan	Years 1, 2 & 3
Baseline Monitoring	Coastal emergent habitat baseline assessment of areal extent	Years 1 & 2
	County-level economic health indicators baseline assessment	Years 1, 2, & 3
Workshops	Structured Decision-Making (SDM) Introduction	Year 1
	Regional Sampling Design and minimum QA/QC requirements – monitoring CoP	Years 1 & 2
Project specific	Pilot SDM applications	Years 1, 2 & 3
	Pilot vulnerability assessments	Years 1, 2 & 3
	Monitoring & Adaptive Management plan development	Years 1, 2 & 3
Data Management	FGDC compliant metadata	Years 1, 2 & 3
	On-line mapping applications of GRAMTAP products	Years 1, 2 & 3
	Searchable databases of GRAMTAP products	Years 1, 2 & 3

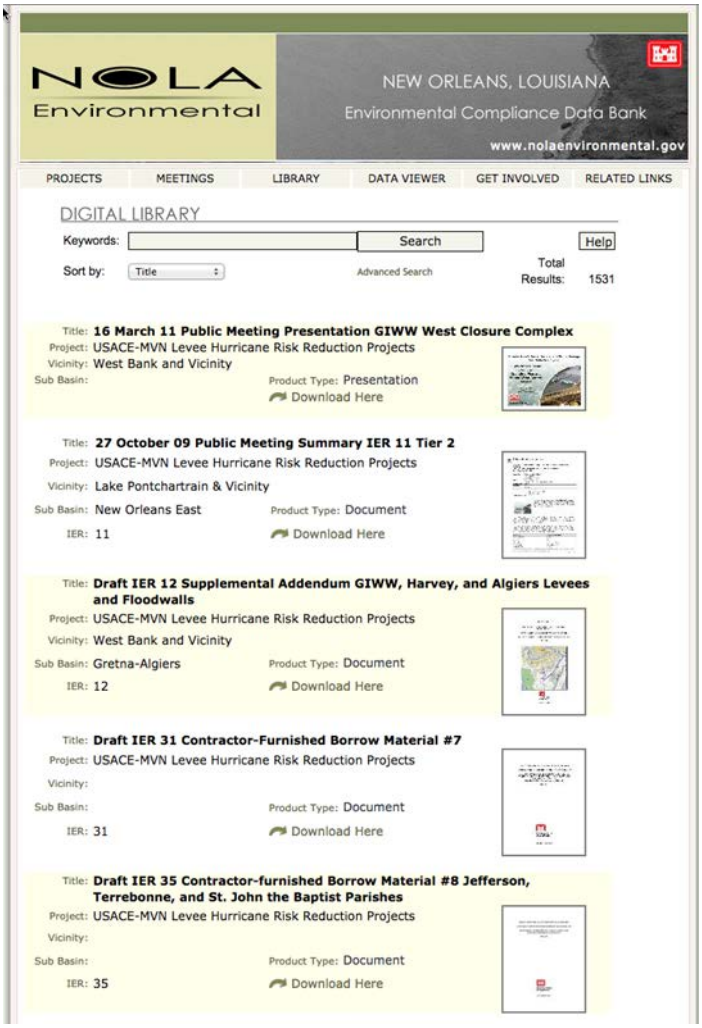

Figure 1. The development of digital libraries by the USGS facilitate data discovery and dissemination.

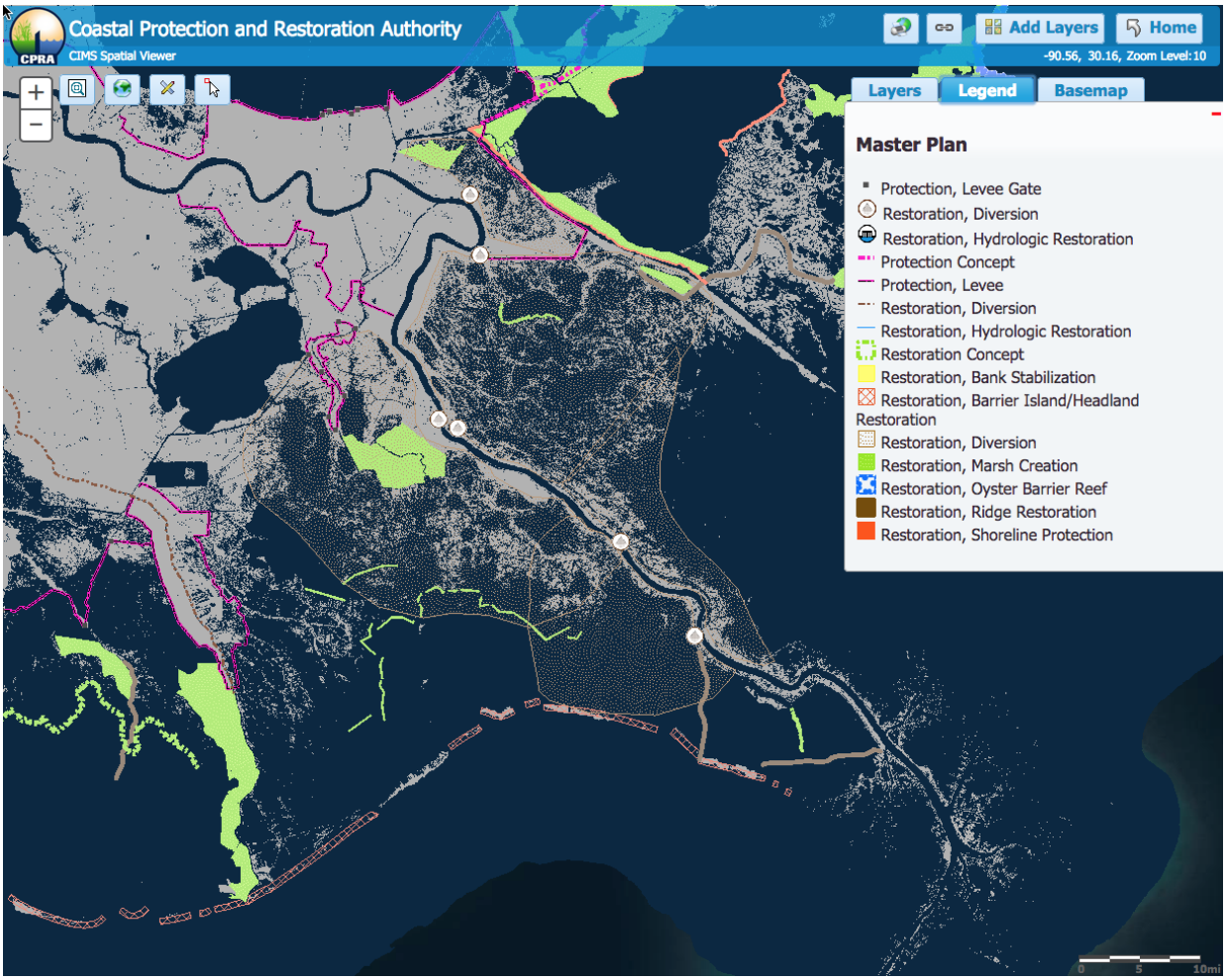

Figure 2. Spatial visualizations have been designed to incorporate decision support processes, such as the evaluation of restoration alternatives by the Louisiana Coastal Protection and Restoration Authority.

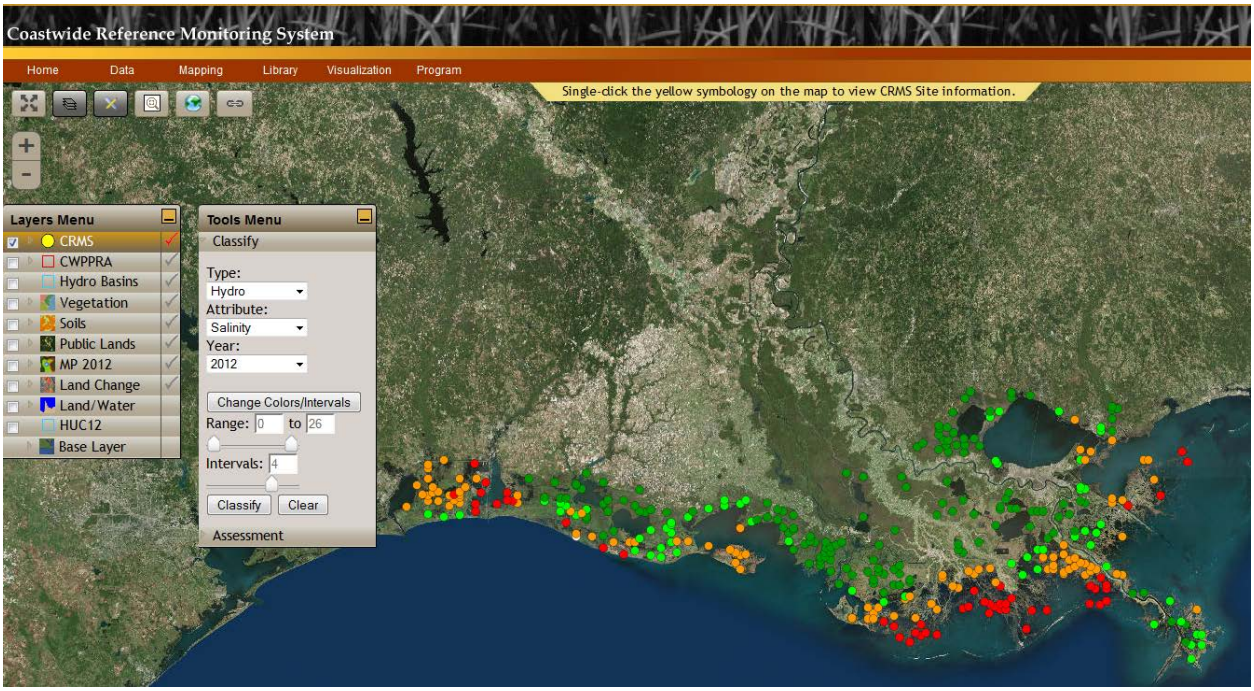

Figure 3. A web-based visualization from the Coastwide Reference Monitoring System (CRMS, www.lacoast.gov/crms2) illustrating wetland monitoring stations in coastal Louisiana and user-driven classification tools.

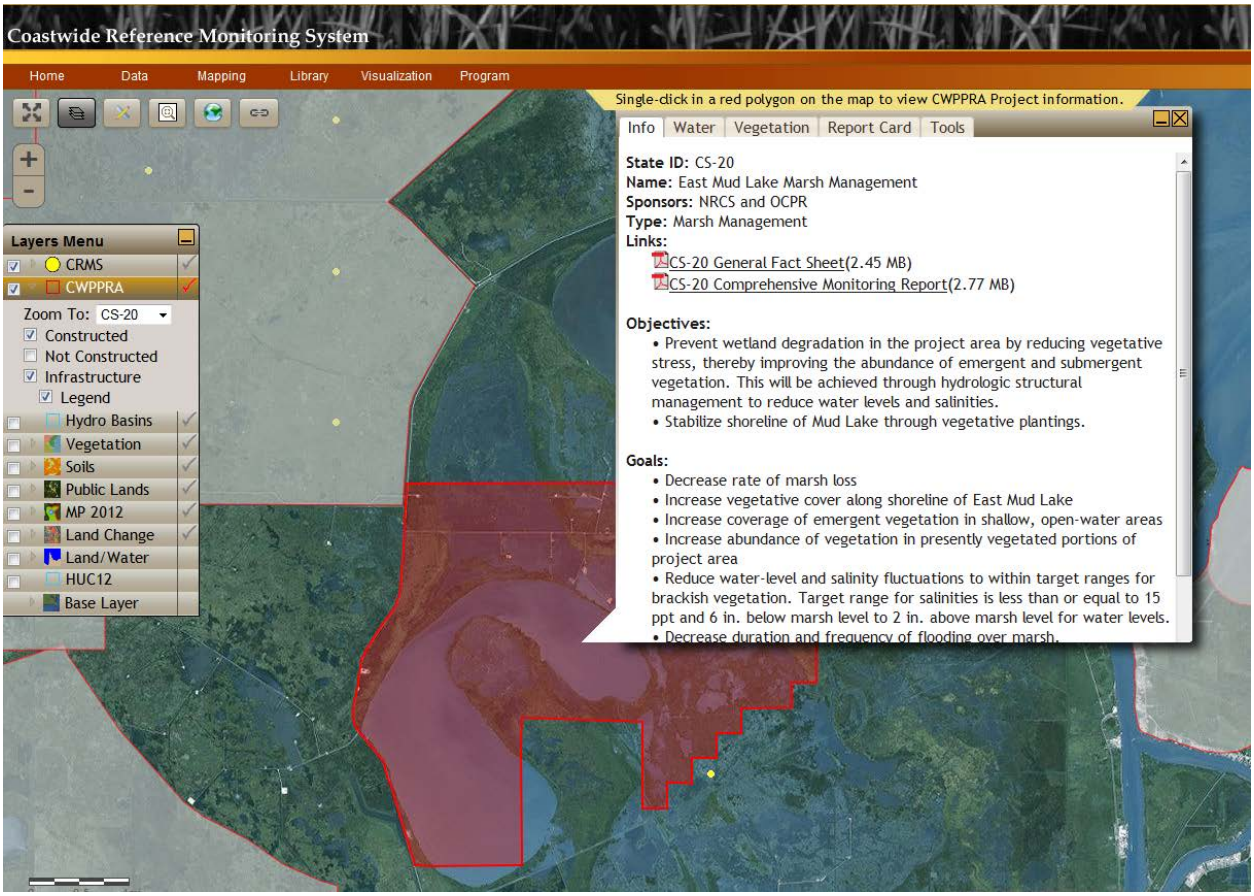

Figure 4. A web-based visualization from the Coastwide Reference Monitoring System (CRMS, www.lacoast.gov/crms2) illustrating the organization of wetland monitoring data and information for assessing restoration project goals and objectives.

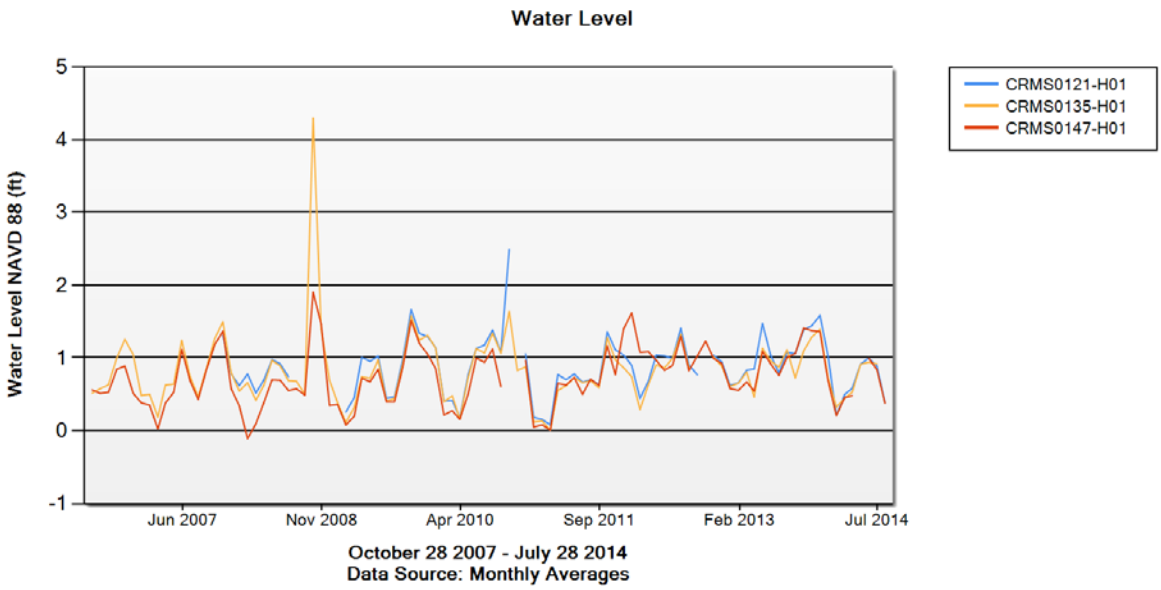

Figure 5. A web-based, user-driven charting application from the Coastwide Reference Monitoring System (CRMS, www.lacoast.gov/crms2) illustrating data comparisons across multiple spatial and temporal scales.

Figure 6. Large national datasets compiled by numerous partners are shared through USGS standards-compliant web services.

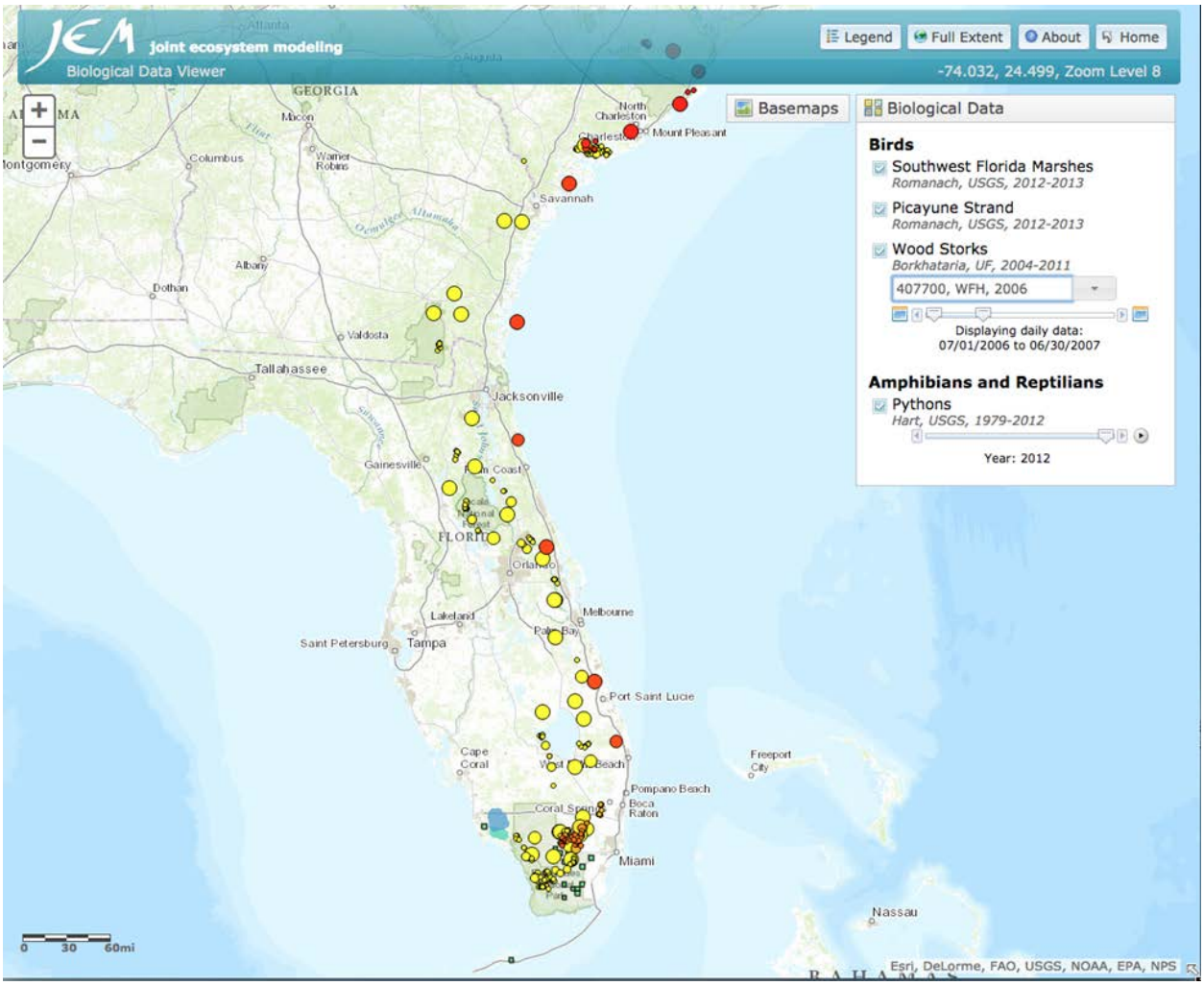

Figure 7. USGS effectively partners with natural resource agencies and entities to represent numerous data types in a single spatially explicit platform.

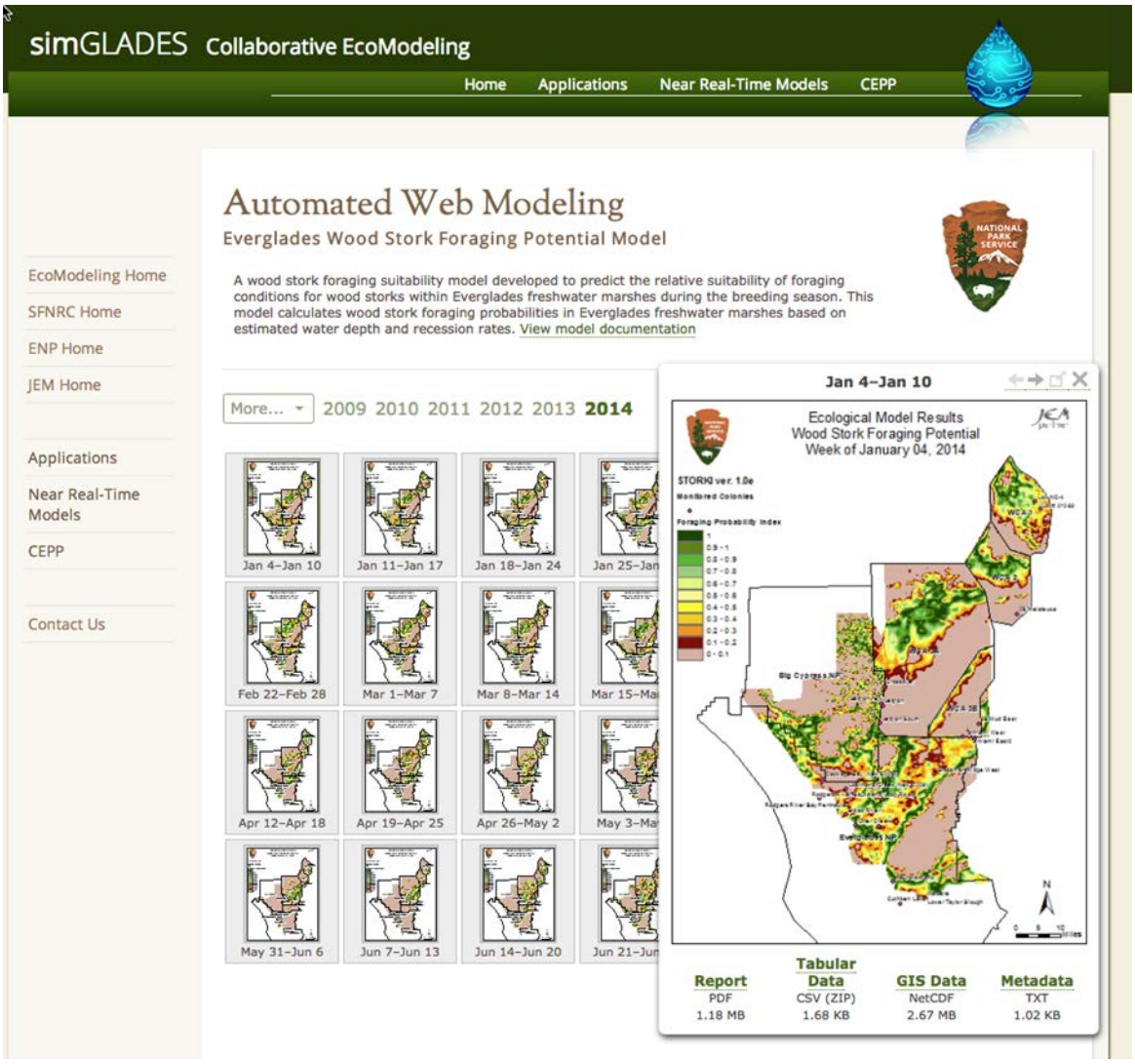

Figure 8. On-line ecological modeling tools have also been incorporated into spatial platforms, such as the Everglades National Park Wood Stork foraging model, and used to drive water control structure operations in the Park on a weekly basis.

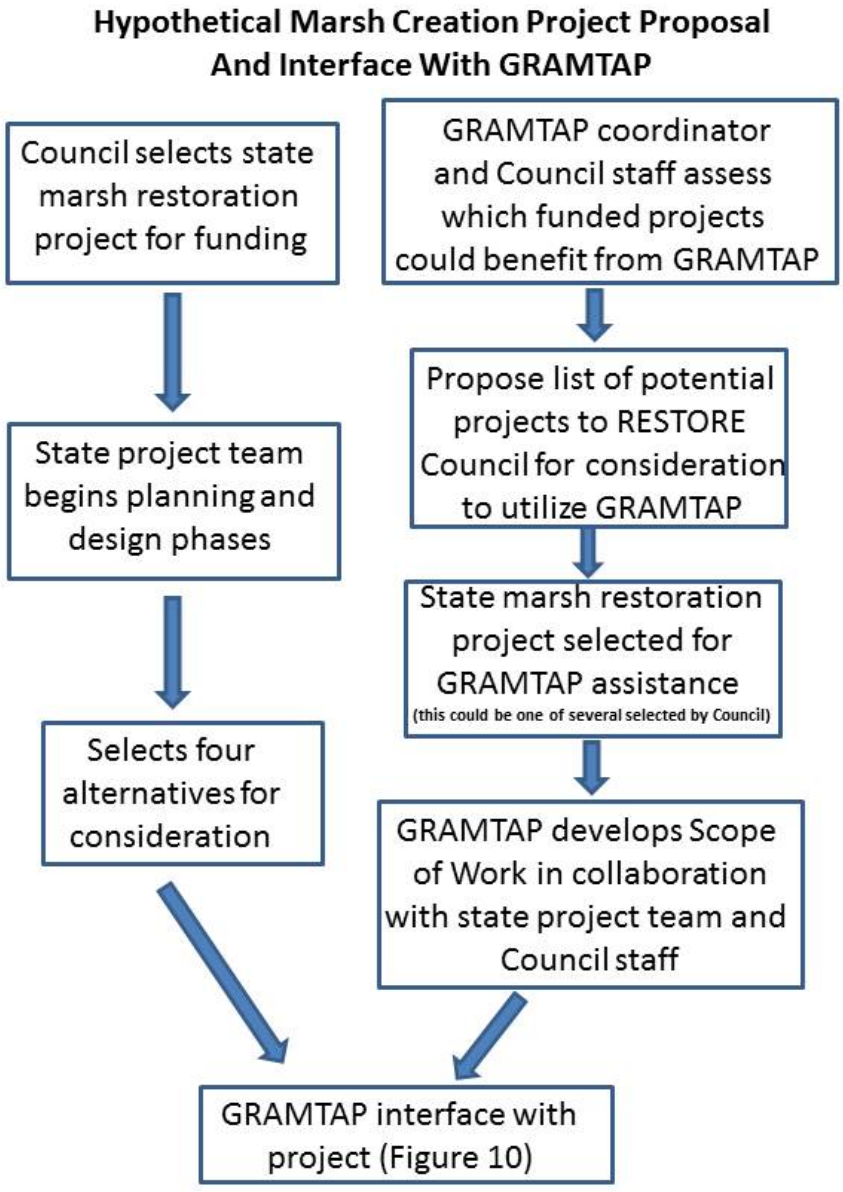

Figure 9. Identification and selection of restoration projects for GRAMTAP assistance will be accomplished in close coordination between the GRAMTAP coordinator, the project proposer(s), the Council members and Council staff.

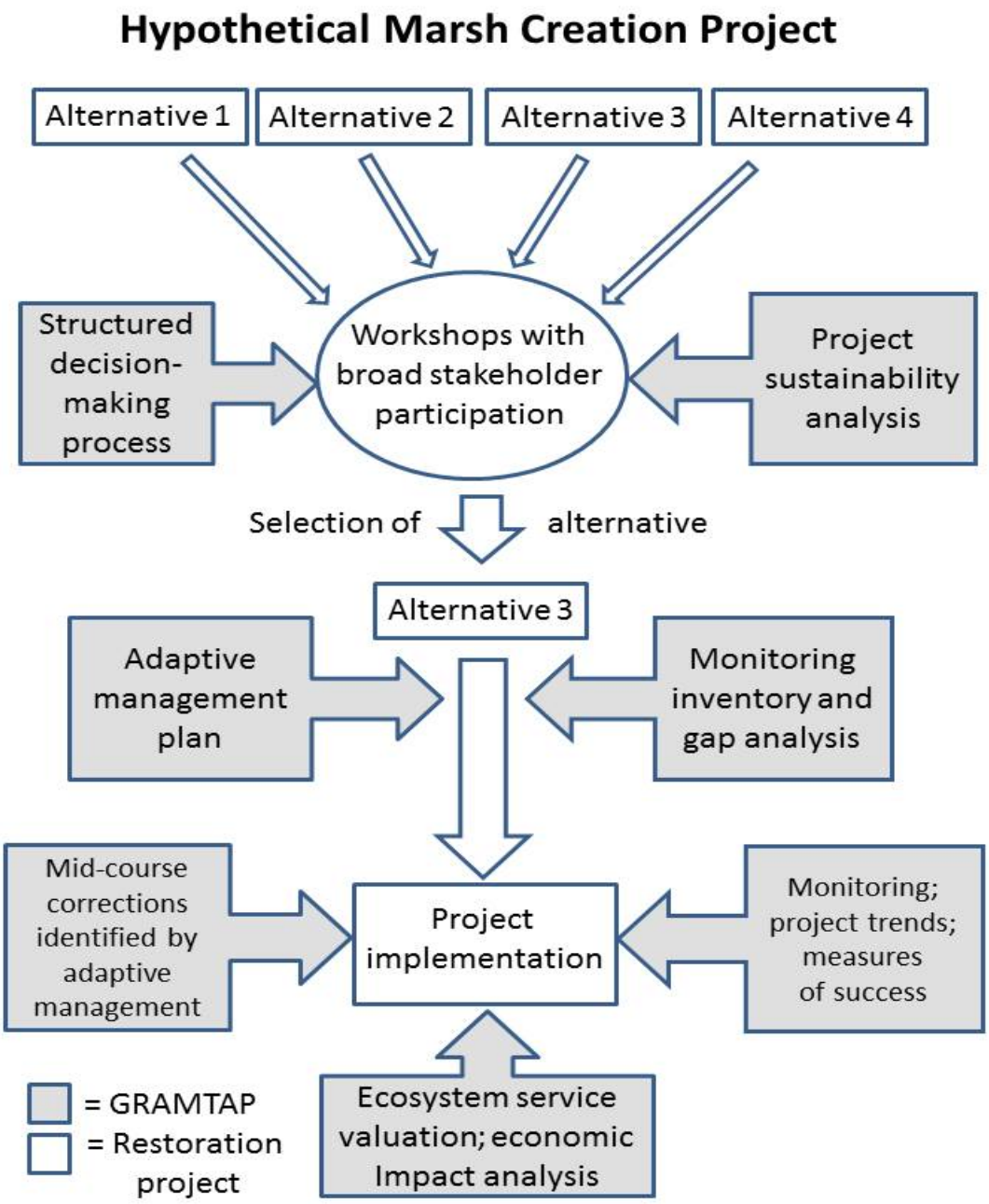

Figure 10. Illustration of how and where GRAMTAP can provide technical assistance to a specific restoration project.

List of experts:

Adaptive Management

Matt Catalano, Auburn University – modeling and decision science for adaptive fishery management

Vern Herr and Brett Boston, Group Solutions, Inc., Atlanta, Georgia – stakeholder engagement and objective setting, peer-to-peer digital assimilation of expert opinion

Greg Kiker, University of Florida – decision science, coastal restoration and adaptive management, stakeholder interface tools

Julien Martin, USGS – modeling of animal populations, adaptive management of natural resources

Conor McGowan, USGS – modeling animal populations, adaptive management of shorebirds

Angela Romito, USFWS – modeling and decision science for natural resource management

Carl Walters, University of Florida – modeling fish populations, sustainable and adaptive management of fisheries

Monitoring:

Nate Booth, USGS – data integration and analytical applications

Tim Carruthers, The Water Institute of the Gulf – conceptual models, ecological report cards, adaptive management

Betsy Gardner, NOAA – geospatial mapping and data management

Matt Howard, Gulf of Mexico Coastal Ocean Observing System – water quality, mapping products

Mike Lee, USGS – water quality, statistical analyses

Paul Montagna, Texas A&M University, Harte Research Institute for Gulf of Mexico Studies – monitoring

Ed Patino, USGS – water quality, statistical analyses

Richard Rebich, USGS – water quality, statistical analyses, modeling

Dale Robertson, USGS – water quality, modeling, statistical analyses

Martha Segura, NPS – monitoring program development

Steve Traxler, USFWS – habitat conservation, status and trends

Robert Twilley, LSU – integrated ecosystem assessments, monitoring/modeling integration

***Sustainability*:**

Tim Dellapenna, Texas A&M University – geologic data collection expertise and equipment

Mike Miner, BOEM – coastal geomorphology, marine minerals

Maitane Olabarrietta, University of Florida – modeling

Tim Saultz, USGS – LiDAR and photo acquisition

Brett Webb, University of South Alabama – data acquisition (water levels, waves, bathymetry)

Jennifer Wozencraft, USACE – LiDAR

***Valuation of economic services*:**

Harvey Cutler, Colorado State University – development of computable general equilibrium models

Kelly Keefe, USACE – facilitation of ecosystem service valuation efforts, linkages between biologists, ecologists, other scientists, and economists

Chris Kelble, NOAA – ecosystem service valuation, coordination to ensure that work being done by USGS and NOAA is complementary

Lynne Koontz, NPS – economic impact analysis, ecosystem service valuation, survey sampling planning, any survey development focused on National Park Service lands

John Loomis, Colorado State University – ecosystem service and nonmarket valuation, survey administration and analyses

Mike Osland, USGS – ecological perspectives, modeling linkages between ecological functions, ecosystem good and services in a restoration context

Bruce Peacock, NPS – ecosystem service valuation, analyses related to National Park Service lands

Kristin Skrabis, DOI Office of Policy Analysis – ecosystem service valuation, economic impact analysis

ELIGIBILITY REVIEW

Bucket 2 – Council Selected Restoration Component

PROPOSAL TITLE

Adaptive Management and Technical Assistance in Support of Gulf Ecosystem and Economic Restoration

PROPOSAL NUMBER

DOI-5

LOCATION

Defined Gulf Coast Region

SPONSOR(S)

Department of the Interior

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

Technical Assistance

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:

The proposal aims to provide adaptive management and technical assistance in support of Gulf Ecosystem and Economic Restoration.

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: