PRACTITIONER GUIDANCE FOR GEMS SOCIAL AND ECONOMIC METRICS

Green Infrastructure for Water Management

Stormwater and wastewater management are issues of concern in communities across the Gulf of Mexico. Stormwater flooding occurs when the rain falls faster than it can percolate into the ground; this problem is exacerbated by extensive paved surfaces in developed areas and increased frequency of intense precipitation caused by climate change. These flooding issues can cause a variety of impacts, ranging from water contamination to damaged property and loss of recreational opportunities. Wastewater treatment is another key water management issue in the region. In some areas, existing septic systems are not sufficiently treating wastewater; in others, centralized wastewater treatment plants require upgrades to handle additional capacity or more effectively remove pollutants such as nutrients that can degrade water quality in the Gulf of Mexico. While traditional gray infrastructure approaches can help to address these water management problems, green infrastructure provides opportunities for these communities to simultaneously create a multitude of co-benefits.

EKISTICS DESIGN STUDIO

Green infrastructure for stormwater management includes a variety of methods designed to slow or retain precipitation where it falls, rather than collecting precipitation and directing it to a centralized treatment system, and may include bioswales, rain gardens, permeable pavements, green roofs, and constructed wetlands. For wastewater management, the primary green infrastructure approach is using **constructed treatment wetlands** to perform tertiary wastewater treatment, often to support existing traditional wastewater treatment systems. Green infrastructure is an emerging approach that is gaining traction. The Federal Emergency Management Agency (FEMA) funds green infrastructure through its hazard mitigation assistance programs, including several recent projects in the Gulf of Mexico region. Local water management authorities have also funded projects through bonds (see the Exploration Green example on the last page of this guide).

THE GEMS PROJECT

GEMS: Gulf of Mexico Ecosystem Services Logic Models & Socio-Economic Indicators

With support from the National Academies of Sciences, Engineering, and Medicine – Gulf Research Program, Duke University's Nicholas Institute for Environmental Policy Solutions, The Harte Research Institute at Texas A&M University-Corpus Christi, the Bridge Collaborative, and The Nature Conservancy have developed a standard set of conceptual models linking restoration investments to social and economic outcomes and identified related metrics that can be used to track restoration success. The metrics and models serve as a starting point and should be tailored to each project.

Restoration actions, outcomes, and metrics were collaboratively developed through workshops with state representatives, restoration funders, regional decision makers, and local experts from specific estuaries to ensure applicability of the outcomes and metrics across scales. The conceptual models and metrics were further informed by literature reviews, expert interviews, and feedback from a distinguished advisory council.

nicholasinstitute.duke.edu/project/gems

Monitoring Green Infrastructure Projects in the Gulf: Current Practice

Monitoring green infrastructure projects is often limited to the specific water management issue the project is designed to address and driven by regulatory requirements such as permitting. A green infrastructure toolkit from the Georgetown Climate Center suggests monitoring for additional social, economic, and environmental benefits, including avoided costs of additional gray infrastructure, increased property values, recreational opportunities, and improved air quality, but does not include specific guidance for measuring these benefits. FEMA's Hazard Mitigation Grant Program requires benefit-cost analysis for proposed projects and provides tools for quantification of some benefits, but this process can be time-consuming and expensive. The GEMS project aims to make measuring socioeconomic benefits of green infrastructure projects more accessible by providing a set of vetted metrics and details on how to measure them.

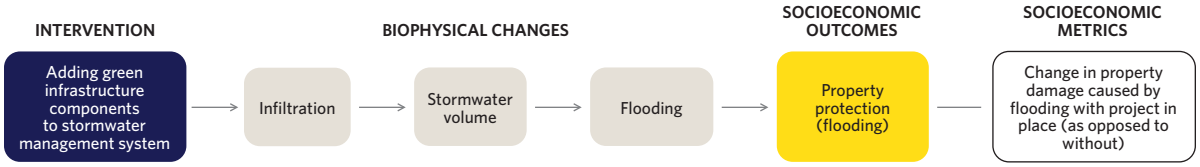
Monitoring Social and Economic Outcomes: Recommendations from the GEMS Project

Although green infrastructure projects are gaining popularity in the Gulf, there is no shared platform to guide assessment and reporting of project progress and effectiveness for the broad set of social and economic goals (such as community resilience and economic revitalization) shared by the many institutions working in the region. The GEMS project created a set of logic models to identify outcomes and metrics relevant across projects, programs, and locations that can facilitate effective and consistent project planning and evaluation throughout the Gulf. The two green infrastructure approaches that this guide covers are a subset of seven water quality project types included in the GEMS project. For more information, see the GEMS project website.

Identifying Social and Economic Outcomes for Project Justification and Monitoring

Practitioners developing projects or programs for green infrastructure installation can use the GEMS ecosystem services logic models (ESLMs) to identify specific social and economic outcomes of their project or program that link to a set of metrics which can be used for monitoring. For example, the flow chart below demonstrates a pathway resulting in socioeconomic outcomes that can be measured by metrics like avoided property damage. This pathway is one part of a larger, more comprehensive ESLM. Chains of the ESLMs can also be used to tell stories about your project or program to explain how a sequence of events or activities leads to an economic or social benefit. See more about developing value chain stories from Sea Grant.

Ecosystem Service Logic Model

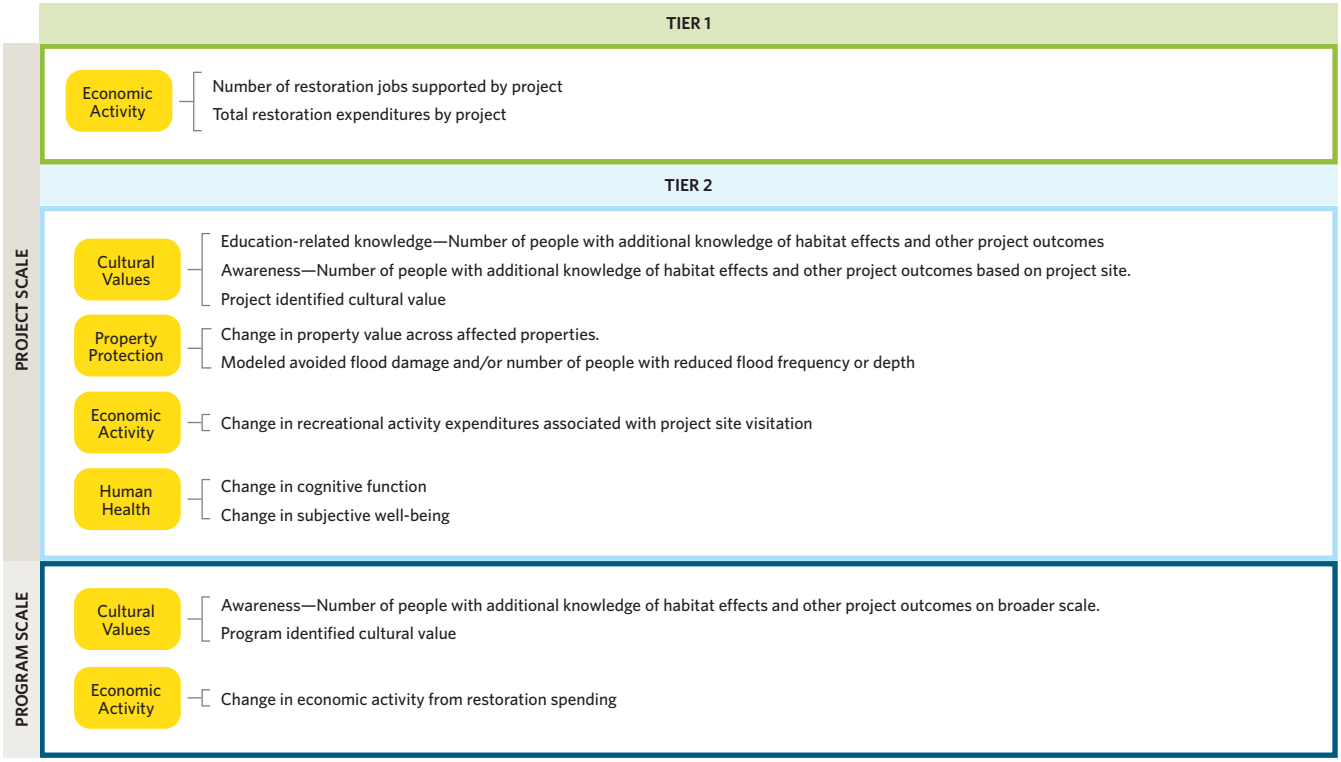


Visit the GEMS website to use ESLMs to identify the full suite of relevant social and economic outcomes for developing project justification or monitoring plans.

Recommended Social and Economic Metrics for Monitoring

The metrics below were selected by experts and practitioners in the Gulf of Mexico as core metrics relevant for monitoring the identified social and economic outcomes of green infrastructure projects. Core metrics are likely to show a significant change across multiple project types (more information on core metrics is available here). Similar to NRDA's core parameters for measuring biophysical and ecological outcomes, using core metrics allows for consistency, comparison, and rolling up results. Use this resource and the linked online database to identify the socioeconomic outcomes that are relevant to your project goals.

Metrics are categorized by scale and tier. Project-scale metrics measure changes in outcomes due to one project, while program-scale metrics measure cumulative changes in outcomes for multiple projects. Tier 1 metrics require relatively few resources or specialized skills to measure, while tier 2 metrics may require bringing in partners/students with relevant skills and take more time to measure. Several socioeconomic outcomes of green infrastructure projects have metrics that are not fully established or required data are not readily available. These research and development (R&D) metrics are not shown here but are included in the full metrics list in the Appendix.



In Depth: GEMS Recommended Metrics

SEE BELOW FOR METRICS IDENTIFIED THROUGH STAKEHOLDER MEETINGS, LITERATURE REVIEW, AND EXPERT CONSULTATION. MEASUREMENT PROTOCOLS ARE ON THE GEMS WEBSITE.

TIER 1, PROJECT SCALE METRICS

Number of restoration jobs supported by project: The number of jobs directly supported by the restoration project, including but not limited to project design, construction, project site maintenance, education, and monitoring, reported every year.

Total restoration expenditures by project: The total amount of money spent on the restoration project as reported in the project budget every year.

TIER 2, PROJECT SCALE METRICS

Education-related knowledge: Number of people with additional knowledge of habitat effects and other project outcomes: The number of people with additional knowledge of habitat effects and other project outcomes due to project-associated educational outreach, assessed using project-scale methodologies such as surveys, interviews, or focus groups.

Awareness: Number of people with additional knowledge of habitat effects and other project outcomes based on project site: The number of people with additional awareness of habitat effects and other project outcomes due to proximity to the project, assessed using project-scale methodologies such as surveys, interviews, or focus groups.

Change in project-identified cultural value: Identification and evaluation of cultural ecosystem services (CES), which vary by community, for monitoring (e.g., Pascua et al. 2017). Where possible, project team can develop framework for pre- and post-restoration monitoring of CES.

Change in property value across affected properties: Changes to property values based on proximity to project site, using a hedonic pricing method.

Modeled avoided flood damage and/or number of people with reduced flood frequency or depth: Change in coastal or inland flood damages and/or number of people experiencing reduced flood depths or frequencies based on models that compare flood scenarios with and without the project.

Change in recreational activity expenditures associated with project site visitation: Estimate of total recreational activity expenditures due to the project compared to baseline of recreational activity expenditures in surrounding area, calculated as the number of recreational trips to the project site (estimated from random sampling counts as part of structured monitoring).

Change in cognitive function: Change in performance on simple recall or other cognitive function tests pre- and post-recreation activity or time at project site.

Change in subjective well-being: Change in self-reported state of well-being. Survey of visitors pre- and post-time at project site.

TIER 2, PROGRAM SCALE METRICS

Awareness: Number of people with additional knowledge of habitat effects and other project outcomes on broader scale: The number of people with additional awareness of habitat effects and other project outcomes due to living or working in proximity to the project, assessed using program-scale methodologies such as surveys, interviews, or focus groups.

Change in program-identified cultural value: Identification and evaluation of cultural ecosystem services (CES), which vary by community, for monitoring. Where possible, program team can develop framework for pre- and post-restoration monitoring of CES.

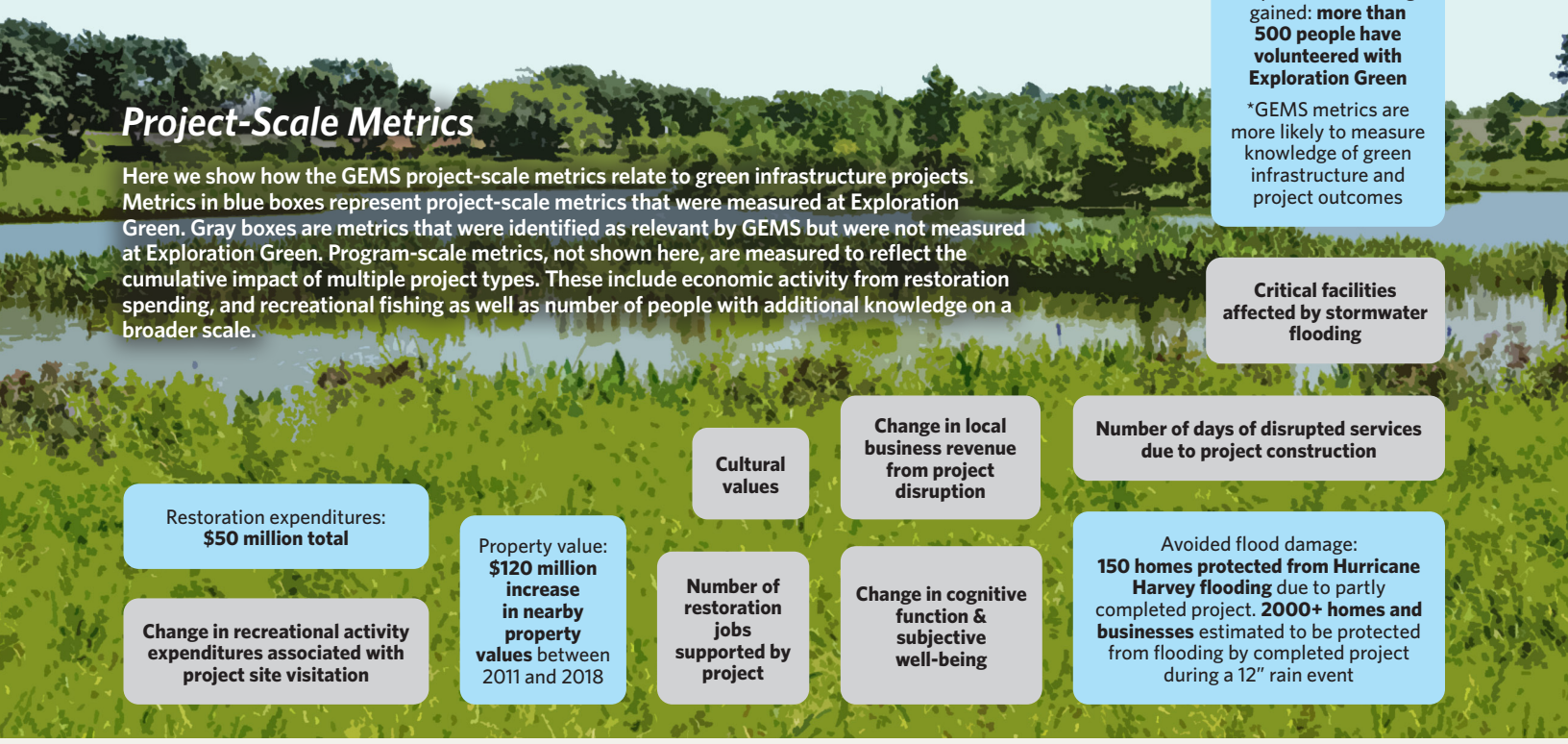
Change in economic activity from restoration spending: Jobs, labor income, gross state product, and total industry output would be modeled based on project expenditures

Applying the GEMS Metrics to a Green Infrastructure Project: Exploration Green

Exploration Green is a green infrastructure project covering 178 acres on a former golf course in Houston, Texas. Originally built in the 1960s as the area was developed in conjunction with the establishment of the Johnson Space Center, the golf course was no longer in use and had fallen into disrepair when it was purchased by the Clear Lake City Water Authority (CLCWA) to use for stormwater detention. With extensive input from the local community, the project was designed to include green space for recreation and stormwater wetlands as well as five stormwater detention lakes. Funding for excavation and construction of the detention lakes comes from the CLCWA through bonds; Exploration Green Conservancy raises funds to cover the other components (wetland and tree plantings, recreational amenities) and manages the property along with CLCWA. Galveston Bay Foundation holds a conservation easement on the property that prevents development and will ensure the project is managed in an environmentally sound way into the future. Construction is being completed in five phases: as of spring 2021, two of the phases are essentially complete, and two more are in progress, with an anticipated end date in 2022. Work on vegetation plantings and recreational amenities will continue into 2023.

In addition to storing 500 million gallons of stormwater runoff and reducing the depth and extent of flooding, the stormwater lakes and wetlands will improve the quality of water that is released to Horsepen Bayou and eventually flows into Galveston Bay. Exploration Green also provides habitat for a variety of wildlife, including birds, amphibians, turtles, fish, and butterflies (two butterfly gardens on the property are part of the Houston Zoo's pollinator pathways project). Six miles of trails provide opportunities for walking, running, biking, and birding, and fields are available for youth athletic practice and events such as outdoor concerts. Exploration Green has already revitalized the community by providing a resource for recreation and community events like birding walks and outdoor yoga, in collaboration with local organizations including Houston Audubon, Texas Master Naturalists, and Galveston Bay Foundation, as well as improving neighborhood aesthetics and home values.

Exploration Green Project



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The Nature Conservancy

TEXAS A&M UNIVERSITY CORPUS CHRISTI | HARTE RESEARCH INSTITUTE FOR GULF OF MEXICO STUDIES

BRIDGE COLLABORATIVE

For more information, visit nicholasinstitute.duke.edu/project/gems

Appendix: Full Metrics List for Green Infrastructure Projects

This list includes all metrics that are likely to show a significant change from at least one of the green infrastructure project types. Additional details about these metrics, including measurement protocols for tier 1 and 2 project-scale metrics, are available on the GEMS website.

The relevant project types column lists the types of green infrastructure projects for which the metric is expected to show a significant change. Green infrastructure project types are green infrastructure for stormwater management (SW) and constructed treatment wetlands (TW).

OUTCOME	METRIC	TIER	SCALE	RELEVANT PROJECT TYPES
Cultural Values				
Knowledge	Awareness: Number of people with additional knowledge of habitat effects and other project outcomes on broader scale	2	Program	SW, TW
Knowledge	Education-related knowledge: Number of people with additional knowledge of habitat effects and other project outcomes	2	Project	SW, TW
Knowledge	Awareness: Number of people with additional knowledge of habitat effects and other project outcomes based on project site	2	Project	SW, TW
Other	Change in project identified cultural value	2	Project	SW
Other	Change in program identified cultural value	2	Program	SW
Economic Activity				
Restoration/Intervention	Number of restoration jobs supported by project	1	Project	SW, TW
Restoration/Intervention	Total restoration expenditures by project	1	Project	SW, TW
Restoration/Intervention	Change in economic activity from restoration spending	2	Program	SW, TW
Recreation and tourism	Change in recreational activity expenditures associated with project site visitation	2	Project	TW
Local businesses	Change in local business revenue from project disruption	2	Project	SW
Human Health				
Mental health and psychological well-being	Change in cognitive function	2	Project	SW
Mental health and psychological well-being	Change in subjective well-being	2	Project	SW
Property Protection & Value				
Property protection (flooding)	Modeled avoided flood damage and/or number of people with reduced flood frequency or depth	2	Project	SW
Property protection (flooding)	Change in property damage (per value of property) caused by flooding with the project in place (as opposed to without)	2	Project	SW
Property value	Change in property value across affected properties.	2	Project	SW, TW
Social Disruption				
Social disruption due to project or flooding	Number of days of disrupted services due to project	1	Project	SW
Social disruption due to project or flooding	Change in number of critical facilities (roads, hospitals, schools) affected by stormwater flooding (with frequency and duration of closures if possible)	2	Project	SW
Water System Costs				
Wastewater treatment costs	Episodic storm related costs (Change in incidence of (or total fines paid by treatment plants for) wastewater discharge violations reported annually)	R&D	Project	SW, TW
Wastewater treatment costs	Change in wastewater treatment cost (at facility)	R&D	Project	SW, TW
Freshwater cost	Change in homeowner cost of fresh water for irrigation	2	Project	TW
Freshwater cost	Change in municipal water costs	R&D	Project	TW
Gray stormwater infrastructure improvement costs	Change in cost of stormwater treatment facility upgrades or maintenance due to addition of green infrastructure	R&D	Program	SW