

The Department of the Interior Metrics Expert Group Report

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December 10, 2015



Recommendations for assessing the effects of the DOI Hurricane Sandy Mitigation and Resilience Program on ecological system and infrastructure resilience in the Northeast coastal region

<https://www.doi.gov/hurricanesandy/news/hurricane-sandy-project-metrics-report>

The DOI Hurricane Sandy Program



- DOI funded over 140 projects, about \$342 million for projects aimed at improving resilience
- Need for a resilience assessment, to see how effective projects were
- July 2014, DOI convened a team of scientists and socio-economists charged by DOI to identify measurements to assess changes in coastal resilience resulting from DOI-sponsored projects.

Key Definitions

Resilience:

- *The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions (Executive Order 13653).*

Performance Metric:

- *A qualitative or quantitative measurement or suite of measurements (index) that can be used to detect and assess a change in DOI coastal resilience objectives.*

Core Performance Metrics:

- *A subset of performance metrics that are applied to multiple projects and at the full range of temporal and spatial scales to detect a change in resilience in one or more coastal features.*

Metrics Organized by Natural and Artificial Coastal Features

- ***Beach System: Beach, Barrier Island, and Dunes***
- ***Nearshore Shallow and Nearshore Deep***
- ***Riverine and Riparian Zone***
- ***Marshes and Wetlands***
- ***Uplands and Watersheds***
- ***Maritime Forests and Shrublands***
- ***Estuaries and Ponds***
- ***Built Environment: Grey infrastructure***
- ***Green Infrastructure: Living shorelines***
- ***Green Infrastructure: Other methods***



Ecological Performance Metrics

- ***Organized by Natural and Artificial Coastal Features***
- ***Provides Objectives and Ecosystem Services***
- ***Identifies Performance Metrics, and***
- ***Recommends Core Performance Metrics***



Protocols for measuring potential performance metrics

Provides protocol name, associated performance metrics, and citation/source

Organized by:

Biotic

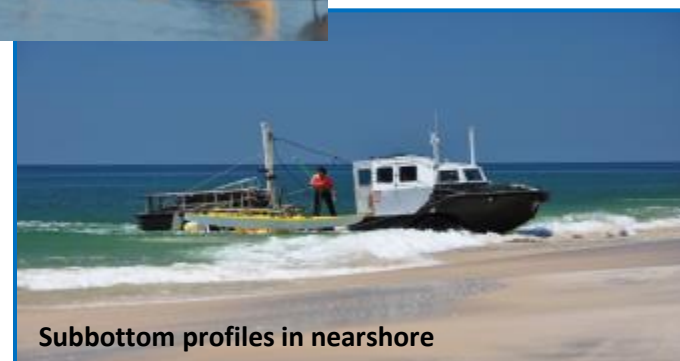
- Fish and Wildlife Species
- Habitat
- Landscape Context Metrics

Abiotic

- Hydrology/Wave Energy
- Water/Air Quality
- Soils/Sediment

Structural/Engineering

- Shoreline Position
- Coastal Topography/Elevation



Natural and Artificial Coastal Features

Marshes and Wetlands

Objectives and Ecosystem Services

1. Mitigate coastal flooding by restoring or improving marsh hydrology and tidal dynamics
2. Improve water quality and reduce contaminant levels
3. Provide high quality habitat for salt marsh biota
4. Decrease erosion and enhance marsh accretion and resilience to sea level rise
5. Maintain and enhance shoreline integrity; preserve marsh area and distribution to support migration corridors, e.g., maintaining marsh and wetland habitat in flyways
6. Dissipate wave energy from storm surges associated with future coastal storms to, protecting habitat and communities
7. Increase infiltration and decrease erosion by reducing impervious surface effects on resilience
8. Use information and modeling to help articulate community risk reduction benefits of marshes and wetlands

Recommended Core Performance Metrics

Biotic

- Salt marsh plant community monitoring (e.g., species composition, percent cover, areal coverage of the high and low marsh community type)
- Nekton abundance, species richness
- Species – based on accepted community of practice

Abiotic

- Marsh accretion and erosion
- Groundwater dynamics
- Water quality: salinity, conductivity, temperature, dissolved oxygen, pH

Structural/Engineering

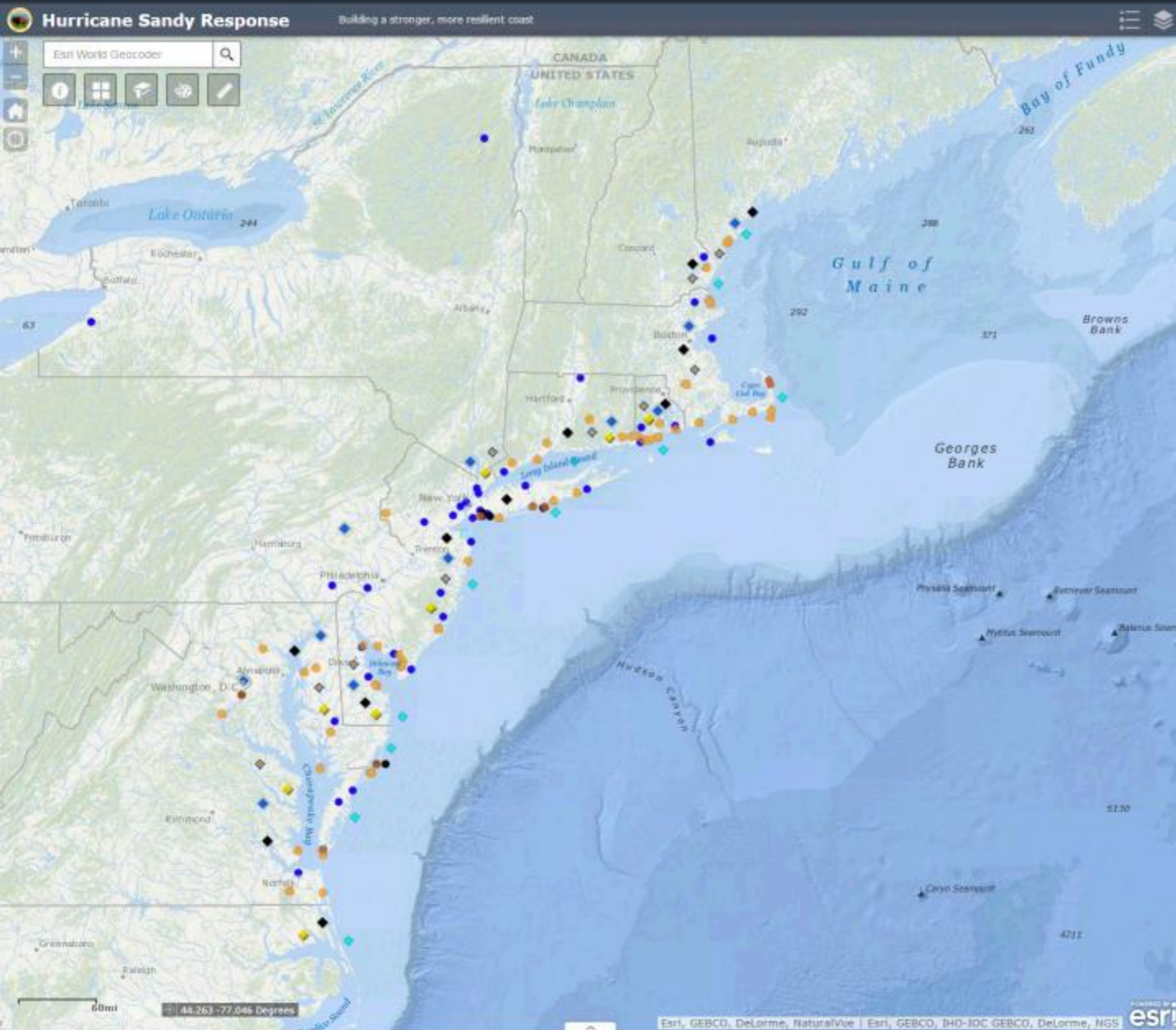
- Marsh surface elevation change trend - long-term 3+ years and short term

Note: Longer list of potential performance metrics in report

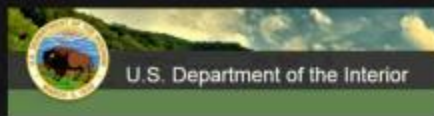
Next Steps

- **Develop Socio-economic Metrics**
- **Implement Ecological and Socio-economic Metrics – Targeted Geographies**
- **Conduct Independent Resilience Assessment of DOI Projects**





DOI Agency Response to Hurricane Sandy



The Department of the Interior (DOI) is investing \$787 million for Hurricane Sandy recovery to clean up and repair damaged national parks and wildlife refuges; restore and strengthen coastal marshes, wetlands and shoreline; connect and open waterways to increase fish passage and improve flood resilience; and bolster local efforts to protect communities from future storms.

US Fish & Wildlife Service Response

National Park Service Response

US Geological Survey Response

National Fish and Wildlife Foundation Response

Bureau of Ocean Energy Management Response

Bureau of Land Management Response

Bureau of Safety and Environmental Enforcement Response

Natural Infrastructure Metrics Workgroup

Rick Bennett

December 4, 2015



*A Systems Approach to Geomorphic Engineering (SAGE) Workgroup
U.S. Fish and Wildlife Service and National Wildlife Federation, co-chairs*

NIMW Goals:

Develop core metrics that cut across agency missions, supporting efficiencies and knowledge base that demonstrate that natural infrastructure is:

- **Effective**
- **Resilient**
- **Cost Effective**



NIMW Approach:

- 1) **Convene** multi-agency/organization team
- 2) **Compile** a list of intermediate and final services per organization
- 3) **Compile** list of metrics per organization
- 4) **Identify and fill** knowledge gaps
- 5) **Select** a common core set of metrics



Ecosystem Good or Service:

ECOLOGICAL: Provide Habitat; Maintain Biodiversity; Protect TES; Buffer Ocean Acidification

SOCIOLOGICAL: Provide Recreation; Provide & Support Navigation; Produce-Provide Food, Feed, etc.; Provide & Improve Aesthetics; Promote Environmental Justice; Protect Property Value; Protect Cultural Heritage; Provide & Support Education; Provide-Support Scientific Research

HYDROLOGICAL: Reduce Storm Surge & Flooding; Provide Flood Storage; Attenuate Waves; Provide and Store Groundwater; Reduce Overtopping; Reduce Current - Wave Velocity; Restore Functional Hydrology

GEOLOGICAL: Reduce & Control Erosion; Protect & Enhance Healthy Soils

BIOGEOCHEMICAL: Improve Water Quality; Sequester & Convert Nutrients; Reduce Hazardous-Toxic Materials

CLIMATOLOGICAL: Regulate Microclimate; Sequester Carbon

OTHER: Reduce Wildfire Potential; Protect Against Wind Shear; Attenuate Drought

Features:

- **Nearshore Shallow and Nearshore Deep**
- **Bluff or Scarp**
- **Marshes/Wetlands**
- **Beach System: Beach/Barrier Island/Dune**
- **Mudflat/Sandflat or Tidal Flat**
- **Estuaries/Ponds**
- **Upland/Watersheds**
- **Maritime Forests, Shrublands, and Grasslands**
- **Riverine/Riparian Zone**
- **Hybrid Infrastructure**
- **Hybrid Infrastructure - Living Shorelines**
- **Green Infrastructure**



The “Spreadsheet”

2015Dec3_NIWG_Metrics_TBL_presentation

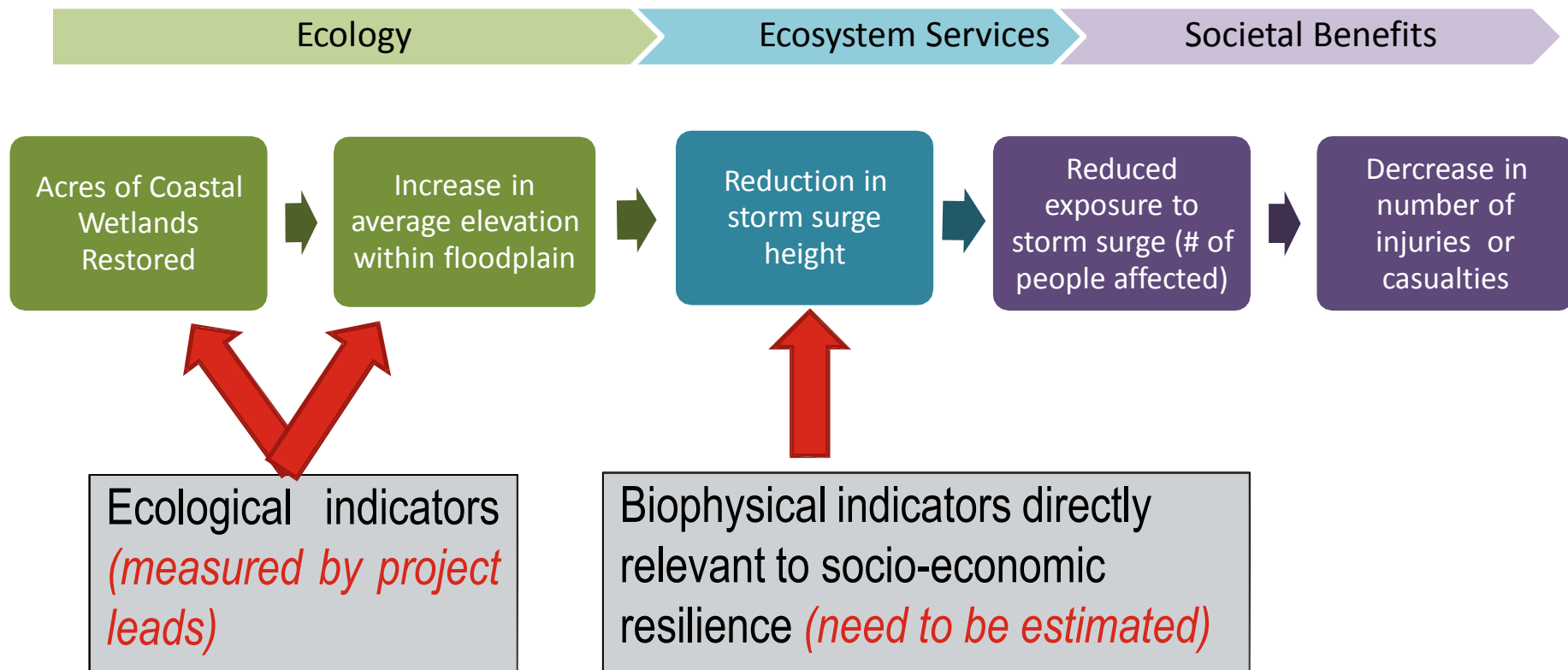
Ecosystem Good or Service →	Provide Habitat	Maintain Biodiversity	Protect TES	Buffer Ocean Acidification	Provide Recreation	Provide & Support Navigation	Produce-Provide Food, Feed, etc	Provide & Improve Aesthetics	Promote Environmental Justice	Protect Property Value	Provide & Support Heritage	Provide-Support Education	Reduce Storm Surge & Flooding	Provide Flood Storage	Attenuate Waves	Provide and Store Groundwater	Reduce Overtopping	Reduce
Features	Metrics																	
Nearshore Shallow and Nearshore Deep (includes submerged aquatic vegetation and/or aquatic vegetation bed both fresh and saline)																		
Bluff or Scarp (any material, if sand assume eroding dune)																		
Marshes/Wetlands (includes shrub-scrub wetlands, flooded swamp forests, emergent herbaceous marshes and/or wetlands that are either fresh, saline,																		
Beach System: Beach/Barrier Island/Dune (includes sand, gravel, cobble types of beaches, barrier islands complexes, island complexes, and dune/swale complexes)																		
Mudflat / Sandflat or Tidal Flat																		
Maritime Forests, Shrublands, and Grasslands																		
Hybrid Infrastructure - Other solutions (including breakwaters (submerged, subaerial, and emergent), sills, nearshore berms, nearshore shallow and nearshore deep, reefs (both natural (coral or mollusks)/artificial and intertidal/submerged)																		
Hybrid Infrastructure - Living Shorelines (can include a combination of wetland plants, sand fill, oyster reefs, submerged aquatic vegetation, stones, coir fiber logs, fiber matting, rock footers, etc.)																		
Green Infrastructure: Other methods (permeable road surfaces, flood diversion berms, holding																		

All Services & Metrics | Blank

Intermediate and Final Services are incorporated in the spreadsheet

Generate Causal Chain

- For example, Causal Chain for Wetland Restoration



Final Thought

“If resilience is built through a project, and no perfect resilience metric is around to measure it, does it have an impact?”

Anonymous, National Adaptation Forum, St. Louis, MO 2015

