APPENDICES

APPENDIX B. GLOSSARY OF KEY TERMS AND FEATURE DEFINITIONS

APPENDIX B: GLOSSARY OF KEY TERMS AND FEATURE DEFINITIONS

Assessment points: points along the profile lines that are reasonably representative of the surrounding area. Assessment points should be selected during the first site visit and are used repeatedly during subsequent site visits (see Fig. 2).

Control points: semi-permanent, fixed, locations that should be easy to locate. Control points define the landward most point on a profile line (typically). Their location with respect to the reference point should be carefully determined. Points may be marked with PVC stakes, large spikes driven in the ground, or other markers as appropriate (see Fig. 2).

Ecologically-Enhanced Hard Structural Features (EEF): features that would generally be categorized as hard structural features, but have been designed in a manner so that they provide or are designed to provide additional ecological benefits or reduce ecological impacts relative to traditional HSF. These features are largely used in heavily urbanized areas where environmental degradation, regulatory constraints, or critical infrastructure prohibit the use of natural or nature based shoreline infrastructure. An example might be the integration or use of marine concrete technology to support enhanced biological activity on structures that traditionally would not support robust marine habitat. (source: developed by project team)

Erosional Areas: areas within a site which show evidence of past or ongoing erosion and potentially have implications for structural stability of feature.

Feature: see shoreline feature.

Feature Displacement: the location of natural or man-made objects, as it is tracked over time.

Hard Structural Features (HSF): typically constructed of stone, pressure-treated wood, compacted earth, or hard human-made materials (concrete, metal, etc.) and designed to control or direct water and/or sediment movement. These features typically disrupt natural features and processes, and have limited or no living components. Some examples include levees, bulkheads, seawalls, revetments, dams, structural stream channels and stormwater conveyances. Hard structural features are not natural resilience features. (source: CRRA)

High-water line (aerial imagery): the inland / upland limit of the tidal range as visible from aerial / satellite imagery. See protocols for methods for determining the high water line. A shading difference is typically visible between the wet and dry area due to the recent recession of the high tide. A fresh wrack line of algae or debris may be visible as well, but should be relatively close to the water line of th e aerial image. The identification of the high-water line may be more difficult in salt marsh areas. The high-water line is typically easier to identify along sandy and rocky shorelines. For shorelines with bulkheads or piers, the high-water line may be at the structure itself, especially in deep water within harbor areas.

High-water line: the approximated location of high water (mean high water) derived from observations of aerial imagery. See "Mean high water" under "tide levels"

High Tide: see tide levels.

Indicator: a measurable or traceable attribute of a shoreline feature that can be used to evaluate progress toward or achievement of a particular performance goal.

Intertidal: the area between the highest high tide and the lowest low tide, and is flooded once or twice daily by the tide. Also see tidal range.

Low Tide: see tide levels.

Material Degradation: The degradation of man-made objects, that can be tracked over time to understand structural stability and potentially magnitude of forces operating on the feature.

Mean Higher High Water (MHHW): see tide levels.

Mean High Water (MHW): see tide levels.

Mean Sea Level (MSL): see tide levels.

Mean Low Water (MLW): see tide levels

Mean Lower Low Water (MLLW): see tide levels

Native vegetation (or species): a plant (or animal) that is part of the balance of nature that has developed over hundreds or thousands of years in a particular region or ecosystem. It is typically contrasted with invasive vegetation (or species), which are artificially introduced and able to establish on many sites, grow quickly and spread to the point of disrupting ecosystems in a harmful way, causing damage to the environment, economy or human health.

Natural Features (N): features created by physical, geological, biological, and chemical processes that evolve over time through the forces of nature. These include features like wetlands, floodplains, dunes, and barrier islands. Individual features are part of larger natural systems and are linked by natural processes (source: CRRA; USACE). Natural features can be

> (1) **Conserved Natural Features**, when existing natural systems/features are protected and managed to conserve the benefits they provide for future generations, or
>
> (2) **Restored Natural Features**, when natural features and processes that have been degraded or altered are re-established to enhance the natural capacity of the feature while supporting the native ecological systems. (source: CRRA)

Nature-Based Features (NBF): features that mimic natural features and processes and are designed to provide specific services, such as preventing erosion, reducing flood risk, increasing habitat or improving water quality. They typically incorporate or promote the growth of living materials and limit disturbance to existing habitat. Based on a number of factors, including site conditions, nature-based features may include hard structural components (e.g. stone, concrete). However, they use the minimum amount of structural components necessary to achieve project goals, while also realizing habitat and resilience benefits. (source: CRRA)

Percent Cover: a visual estimate of the relative abundance of a particular ground cover type (e.g., vegetation, bare soil, gravel) in a given space .

Performance parameter: a factor that allows the evaluation of the relative effectiveness of a shoreline management feature in providing ecological function, hazard mitigation services or socio-economic benefits.

Points of interest (POI): points or features of interest that the site steward may wish to document over time. POI may or may not be on a profile line and can be added at any time, but should be tracked over time. Examples of POI include: large woody debris, erosional features, and parameters related to the condition/function of erosion control structures.

Protocol: the specifications for collecting, recording/reporting, and storing data related to the agreed upon indicators.

Reference points: permanent immovable objects that will presumably survive storms and other events. These will provide a fixed geospatial reference point against which all other measurement points can be compared (see Fig. 2).

Resilience service: the high-level grouping / categorization of the type of services and benefits that shoreline management features provide to communities and ecosystems. For this project, three resilience services have been identified: (1) Ecological function, which assesses a project's contribution to ecosystem health; (2) Hazard Mitigation & Structural Integrity, which identifies how well a project mitigates risks associated with hazards and its ability to sustain that performance; and (3) Socio-Economic Outcomes, which captures the project's associated services that may impact community resilience and well-being.

Segments: large areas of the site (on the order of 50 to several 100 feet) which are reasonably similar (i.e. natural shoreline, bulkhead, revetment). No segment should consist of more than one shoreline feature type. There can be multiple different segments within an individual site/feature (see Fig. 2).

Shapefile (.shp): a geospatial point and vector data format for geographic information system (GIS) software. It is developed and regulated by Esri as a mostly open specification for data interoperability among Esri and other GIS software products. The shapefile format can spatially describe vector features: points, lines, and polygons, representing, for example, water wells, rivers, and lakes. Each item usually has attributes that describe it, such as name or temperature.

Shoreline: the boundary between the water and the land. The actual shoreline is dynamic and moves with changing water levels. For the purposes of mapping and tracking shoreline change, the high water line or mean high water is used to define the shoreline so that it can be compared over time.

Shoreline Feature: any type of shoreline; for the purpose of this monitoring framework this include natural shorelines, nature-based shorelines, ecologically enhanced hard structural shorelines, and hard structural shorelines. See the shoreline feature definitions and feature definition crosswalk at the end of this glossary for a list of shoreline features used in the context of this monitoring framework. In completing the protocols, 'feature' refers to a specific descriptor of the shoreline feature being monitored (i.e. Coxsackie Boat Launch Nature-Based Shoreline).

Site or site/feature (for monitoring): the boundary of the shoreline feature or combination of contiguous shoreline features being monitored. Adjacent areas (e.g. the neighborhood surrounding the site) beyond the boundaries of the site may be part of some of the monitoring and if so are called out as such in the protocol.

Species richness: Species richness is simply the number of species present in a sample area (e.g. a plot with X, Y, and Z species has a species richness of 3).

Species composition: Species composition describes the relative proportion of individuals present in a population by species (e.g. a plot with 5 individuals of X, 4 individuals of Y, and 1 individual of Z has a species richness of 3 and a species composition of 0.5 (50%) for X, 0.4 (40%) for Y, and 0.1 (10%) for Z).

Subtidal: areas below the mean low water that are always inundated.

Tide levels (tidal datums): a standard elevation defined by a certain phase of the tide. Tidal datums are used as references to measure local water levels. For the purpose of this monitoring framework, we will use the definitions of tidal datums maintained by the Center for Operational Oceanographic Products and Services and used by NOAA, including

> **Mean Higher High Water (MHHW):** The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.
>
> **Mean High Water (MHW):** The average of all the high water heights observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.
>
> **Mean Sea Level (MSL):** The arithmetic mean of hourly heights observed over the National Tidal Datum Epoch. Shorter series are specified in the name; e.g. monthly mean sea level and yearly mean sea level.

Mean Low Water (MLW): The average of all the low water heights observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.

Mean Lower Low Water (MLLW): The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch. For stations with shorter series, comparison of simultaneous observations with a control tide station is made in order to derive the equivalent datum of the National Tidal Datum Epoch.

Tidal Range: the difference between the highest and lowest tide in the tidal cycle.

Transects (Profile Lines): sampling lines perpendicular to the water's edge (the shoreline). There should be a minimum of two transects per segment. Preliminary transects laid out during pre-site visit planning should be confirmed during the first site visit and monitored during each subsequent visit.

Wave energy: the force a wave is likely to have on a shoreline. Wave energy at a specific site depends on environmental factors like shore orientation, wind, channel width, and bathymetry. Boat wakes can also generate waves (CRRA)

Wave Height: the vertical distance between the trough of a wave and the following crest (see Fig. 1)

Wave Period: the time required for two successive wave crests (peaks) to pass a fixed point (measured in seconds) (see Fig. 1)

Wave Runup: the maximum vertical extent of wave uprush on a beach or structure above the still water level (see Fig. 1).

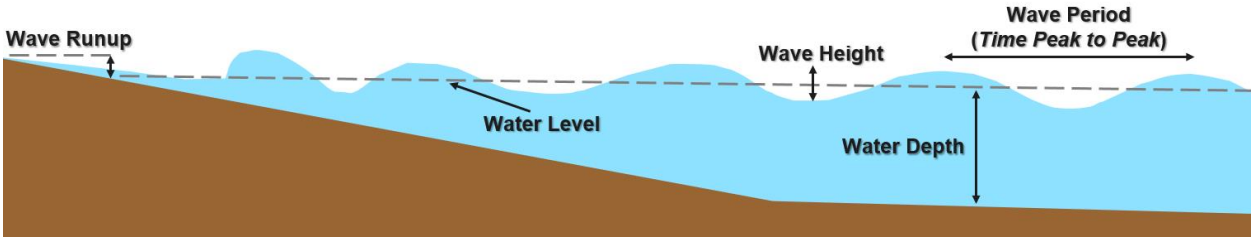


Figure 1

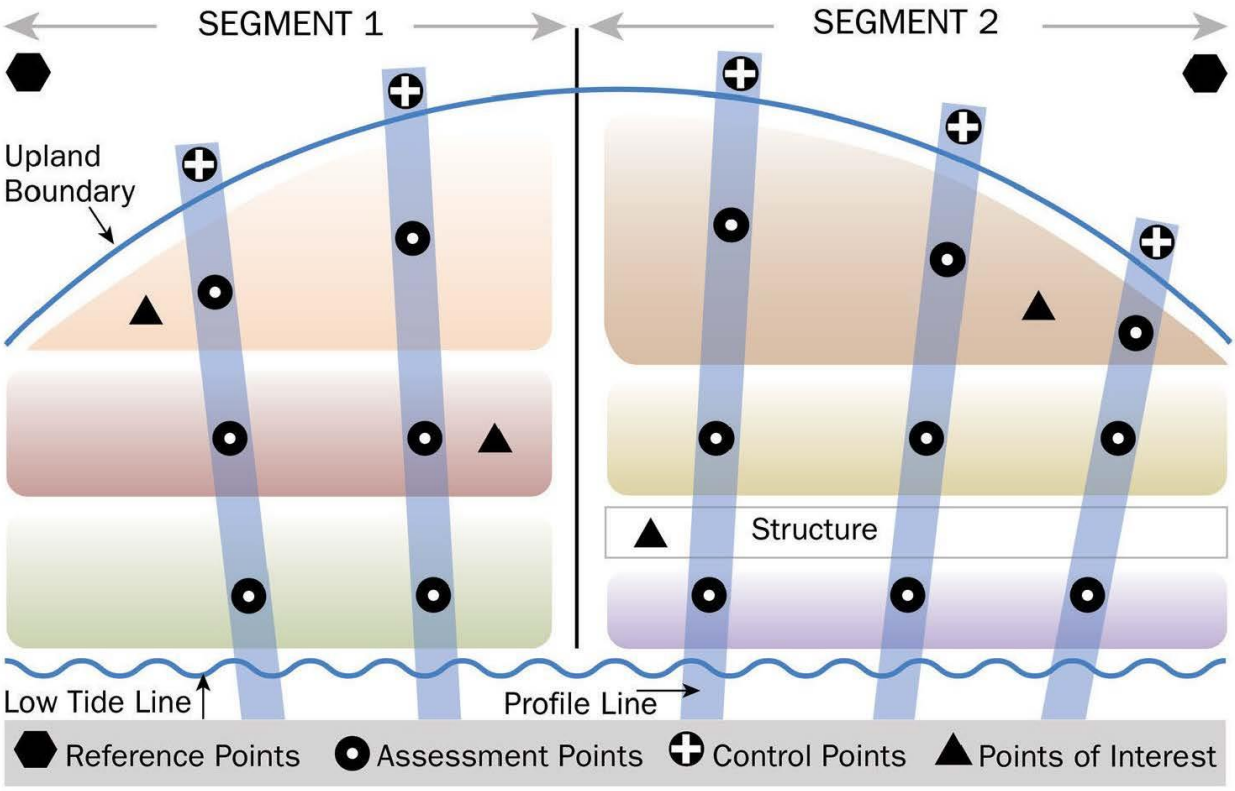

SEGMENT 1
SEGMENT 2
Upland Boundary
Structure
Low Tide Line
Profile Line
Reference Points
Assessment Points
Control Points
Points of Interest

Figure 2

List & description of potential shoreline features / shoreline management strategies for consideration by source

The below is a working list and definitions and is intended to be updated as understanding of feature types evolve and new types of features emerge. It is intended as a starting point to develop consensus, for the purposes of this project, among project sta monitored

Shoreline Measure / Feature	Type / Category	Definition / Description	source of definition
Shoals, Mudflats, nearshore	**N/NB**	The tidal wetland zone that at high tide is covered by saline or fresh tidal waters, at low tide is exposed or is covered by water to a maximum depth of approximately one foot, and is not vegetated.	NYS DEC Tidal Wetland Categories https://www.dec.ny.gov/lands/5120.html
Shellfish beds / Reefs / Constructed Reefs	**N/NB/EEF**	Structured habitat formed by marine organisms within the subtidal and sometimes intertidal zone(s).	
Breakwaters	**HSF/EEF**	Shore-parallel structures built within a water body to reduce wave energy and erosion on the shoreward side. They can be made of wood, timber, rock, concrete, rock cribbing, or other materials.	Sustainable Shorelines Project. https://www.dec.ny.gov/docs/remediation_hudson_pdf/shorelineterminology.pdf
Submerged Aquatic Vegetation	**N/NB**	Submerged aquatic vegetation (often shortened to SAV) is plants that are always under water. The most common native species of SAV in the Hudson River watershed is water celery (Vallisneria americana), but other species include clasping leaved pondweed (Potamogeton perfoliatus), and such non-native plants as curly pondweed (Potamogeton crispus) and Eurasian water milfoil (Myriophyllum spicatum).	NY DEC; https://www.dec.ny.gov/lands/87648.html
Living Shoreline (sill type)	**NB**	Shoreline techniques that incorporate natural living features alone or in combination with structural components such as rock, wood, fiber rolls, bagged shell, and concrete shellfish substrate.1 This combination is also called hybrid. To be considered a living shoreline the techniques shall: • Control or reduce shoreline erosion while maintaining benefits comparable to the natural shoreline such as, but not limited to, allowing for natural sediment movement; • Use the minimum amount of structural components necessary for hybrid techniques to obtain project goals; • Improve, restore, or maintain the connection between the upland and water habitats; and • Incorporate habitat enhancement and natural elements, frequently includes native re-vegetation or establishment of new vegetation that is consistent with a natural shoreline typical of the site location	NY DEC, 2017. http://www.dec.ny.gov/docs/fish_marine_pdf/dmrlivingshoreguide.pdf
Tidal Wetlands / Salt marsh	**N/NB**	Tidal wetlands are the areas where the land meets the sea. These areas are periodically flooded by seawater during high or spring tides or, are affected by the cyclic changes in water levels caused by the tidal cycle. Salt marshes and mud flats are some typical types of tidal wetlands found along New York's marine shoreline. For the purposes of this project, "tidal wetlands" are vegtated features, and mud flats (unvegetated) are listed separately. In NY State, tidal wetlands are classified by the amount of water covering the area at high and low tides and the type of vegetation. New York State uses specific categories and codes to describe and represent different types of coastal, tidal and fresh water wetlands; these are: Intertidal Marsh; High Marsh; Fresh Marsh; Formally Connected; Coastal Shoals, Bars, and Mudflats; Littoral Zone; Adjacent Area; Dredge Spoil	NYS DEC Tidal Wetland Categories https://www.dec.ny.gov/lands/5120.html
Groin / Jetty	**HSF**	Shore-perpendicular structures built within a water body to reduce wave energy and erosion on the shoreward side. They can be made of wood, timber, rock, concrete, rock cribbing, or other materials.	Sustainable Shorelines Project. https://www.dec.ny.gov/docs/remediation_hudson_pdf/shorelineterminology.pdf

List & description of potential shoreline features / shoreline management strategies for consideration by source

The below is a working list and definitions and is intended to be updated as understanding of feature types evolve and new types of features emerge. It is intended as a starting point to develop consensus, for the purposes of this project, among project sta monitored

Shoreline Measure / Feature	Type / Category	Definition / Description	source of definition
Revetment	**HSF / EEF**	Large sloping structures that armor the shore slope, or bank, to protect against erosion. Typically constructed of large rocks or concrete armor units, revetments dissipate wave and current energy along their slopes and within their void spaces. Rock revetments differ from traditional rip-rap slope stability methods in that they are designed through a more rigorous engineering analysis and thus provide a higher degree of protection.	Sustainable Shorelines Project. https://www.dec.ny.gov/docs/remediation_hudson_pdf/shorelineterminology.pdf
Bulkhead	**HSF / EEF**	Bulkheads are vertical walls which prevent the loss of soil and the further erosion of the shore. Bulkheads are a commonly engineered shoreline method used to provide working waterfront or protect vulnerable and eroding shorelines. They can be made of a variety of materials including but not limited to rock, steel, concrete and wood.	Sustainable Shorelines Project. https://www.dec.ny.gov/docs/remediation_hudson_pdf/shorelineterminology.pdf
Levee	**HSF**	A levee as a man-made structure that helps contain or control the flow of water during a flood.	FEMA; https://www.fema.gov/media-library/assets/documents/22951
Bluff	**N/NB**	A bluff is any bank or cliff with a steeply sloped face that is along a body of water. A bluff extends from the edge of a beach or nearshore area, to 25 feet landward of the bluffs peak.	NY DEC; https://www.dec.ny.gov/lands/86559.html
Beach / Beach Berm	**N/NB**	The beach is the zone of earth that extends from the mean low water line, to the waterward toe of a dune or bluff, whichever is closest to the water. Where no dune of bluff exists, the limit of a beach is 100 feet landward from in the line of permanent vegetation.	NY DEC; https://www.dec.ny.gov/lands/86559.html
Dune	**N/NB**	A dune is a ridge or hill of loose, windblown, or artificially placed sand, and its vegetation. A dune extends from the edge of its connecting beach, to 25 feet landward from the landward toe of the dune.	NY DEC; https://www.dec.ny.gov/lands/86559.html
Maritime upland vegetation/habitat] forests / shrublands / grasslands	**N/NB**	terrestrial habitats not directly influenced by the tidal zone but adjacent to (upland of) the shoreline / tidal zone. This includes many specific habitat types.	team defined.

List & description of potential shoreline features / shoreline management strategies for consideration by source

The below is a working list and definitions and is intended to be updated as understanding of feature types evolve and new types of features emerge. It is intended as a starting point to develop consensus, for the purposes of this project, among project stakeholders around how to define and categorize the features / shoreline measures being monitored

Shoreline Measure / Feature	Type / Category	Definition / Description	source of definition	guidance for physical deliniation the feature
Shoals, Mudflats, nearshore	**N/NB**	The tidal wetland zone that at high tide is covered by saline or fresh tidal waters, at low tide is exposed or is covered by water to a maximum depth of approximately one foot, and is not vegetated.	NYS DEC Tidal Wetland Categories https://www.dec.ny.gov/lands/5120.html	Understanding the location of tidal range within the site, this community can be delineated based upon the general lack of vegetation within the intertidal zone, substrate (i.e., deposition of mud, silts, and clays), and geomorphic position (i.e., typically found in sheltered areas). These habitats can be differentiated from beaches primarily by substrate (i.e., beaches are primarily sand), and beaches are located in higher wave environments.
Shellfish beds / Reefs / Constructed Reefs	**N/NB/EEF**	Structured habitat formed by marine organisms within the subtidal and sometimes intertidal zone(s).		These features can be delineated at low tide around the perimeter of the hard structure providing wave attenuation and/or hard substrate to shellfish, benthic organisms, and other aquatic populations. The perimeter of this hard structure can be differentiated from the surrounding intertidal, and sub-tidal bottom that are typically flat, and consisting of fine sediments and sands.
Breakwaters	**HSF/EEF**	Shore-parallel structures built within a water body to reduce wave energy and erosion on the shoreward side. They can be made of wood, timber, rock, concrete, rock cribbing, or other materials.	Sustainable Shorelines Project. https://www.dec.ny.gov/docs/remediation_hudson_pdf/shorelineterminology.pdf	
Submerged Aquatic Vegetation	**N/NB**	Submerged aquatic vegetation (often shortened to SAV) is plants that are always under water. The most common native species of SAV in the Hudson River watershed is water celery (Vallisneria americana), but other species include clasping leaved pondweed (Potamogeton perfoliatus), and such non-native plants as curly pondweed (Potamogeton crispus) and Eurasian water milfoil (Myriophyllum spicatum).	NY DEC; https://www.dec.ny.gov/lands/87648.html	
Living Shoreline (sill type)	**NB**	Shoreline techniques that incorporate natural living features alone or in combination with structural components such as rock, wood, fiber rolls, bagged shell, and concrete shellfish substrate.1 This combination is also called hybrid. To be considered a living shoreline the techniques shall: • Control or reduce shoreline erosion while maintaining benefits comparable to the natural shoreline such as, but not limited to, allowing for natural sediment movement; • Use the minimum amount of structural components necessary for hybrid techniques to obtain project goals; • Improve, restore, or maintain the connection between the upland and water habitats; and • Incorporate habitat enhancement and natural elements, frequently includes native re-vegetation or establishment of new vegetation that is consistent with a natural shoreline typical of the site location	NY DEC, 2017. http://www.dec.ny.gov/docs/fish_marine_pdf/dmrlivingshoreguide.pdf	Typically, living shorelines include multiple native habitats along the shoreline based upon tidal inundation. Delineation of the perimeter of these features should be guided by the restoration design, baseline conditions, as well as guidance for habitat types provided herein (i.e., tidal wetlands, reefs, beach/dunes).
Tidal Wetlands / Salt marsh	**N/NB**	Tidal wetlands are the areas where the land meets the sea. These areas are periodically flooded by seawater during high or spring tides or, are affected by the cyclic changes in water levels caused by the tidal cycle. Salt marshes and mud flats are some typical types of tidal wetlands found along New York's marine shoreline. For the purposes of this project, "tidal wetlands" are vegtated features, and mud flats (unvegetated) are listed separately. In NY State, tidal wetlands are classified by the amount of water covering the area at high and low tides and the type of vegetation. New York State uses specific categories and codes to describe and represent different types of coastal, tidal and fresh water wetlands; these are: Intertidal Marsh High Marsh Fresh Marsh Formally Connected Coastal Shoals, Bars, and Mudflats Littoral Zone Adjacent Area Dredge Spoil	NYS DEC Tidal Wetland Categories https://www.dec.ny.gov/lands/5120.html	These features can typically be delineated by utilizing the edge of vegetated communities within the intertidal zone. The mean higher high water line should be used at the upland boundary for this habitat type. If important to the project monitoring, the high marsh can be delineated from the low marsh utilizing plant community composition or by understanding the mean high water line for the project area.

List and crosswalk of potential shoreline features / shoreline management strategies for consideration by source

The below list of shoreline features (first two collumns) was develop for the purpose of gaining consensus, for the purposes of this project, among project stakeholders around (1) what features / shoreline measures being considered for monitoring under this project, and (2) how those features shoudl be categorized (as Natural (F), Nature-based (NB), Ecologically Enhanced Hard Structural Features (EEF), or Hard Structural Features (HSF) The additional collumns of the table provide a "crosswalk" thta references literature (papers, guidelines, pollicies, etc.) that have discussed or defined NNBF and how the terms they have used or how they have categorized these features.

OUR PROJECT - MEASURING FOR SUCCESS		NY CRRA		USACE, Use of NNBF for coastal resilience (see table 20)		DOI (2015). Recommendations for assessing the effects of the DOI Hurricane Sandy Mitigation and Resilience Program	ABT (2015) Developing Socio-Economic Metrics to Measure DOI Hurricane Sandy Project and Program Outcomes	MARCO (2017) Working towards a robust monitoring framework for natural and nature-based features in the mid-Atlantic using citizen science	NYC Coastal Green Infrastructure Research Agenda (2013)	A Framework for Developing Monitoring Plans for Coastal Wetland Restoration and Living Shoreline Projects in NJ (2016)	Terminology for the Hudson River Sustainable Shorelines Project
Shoreline Measure / Feature	**Type / Categor**	**Measure / Feature**	feature type	**Measure / Feature**	**Type / Category**	**Measure / Feature**	**Measure / Feature**	**Measure / Feature**	**Measure / Feature**	**Measure / Feature**	**Measure / Feature**
		Inlets	Natural Features				Bay				
Shoals, Mudflats, nearshore	**N/NB**	Nearshore Area	Natural Features			Nearshore Shallow and Nearshore Deep					
		Shoals		Mudflats / sandflats	NNBF			Mudflat			
		Barrier Island	Natural Features	Island (can include one or more of beach, dune, breakwater, bluff, marsh, maritime forest, other vegetation)	feature complex	Barrier Island					
				Islands	NNBF						
				Barrier Island (can include one or more of beach, dune, breakwater, bluff, marsh, maritime forest, other vegegtation)	feature complex						
Shellfish beds / Reefs / Constructed Reefs	**N/NB/EEF**	Shellfish Beds/Reefs	Natural Features	Reef, intertidal or submerged (also see breakwater)	feature complex			Shellfish reefs	Constructed Reefs		
				Breakwater , submerged (nearshore berm, sill, artifical reef - if containing living organismes or plants, see reef)	feature complex						
Breakwaters	**HSF/EEF**								Constructed Breakwater Islands		
				Breakwater, subaerial or emergent (nearshore berm, sill, reef, can contain oysters, rock, shells, mussels, submerged aquatic vegetation(SAV), emergent or herbaceous vegetation)	feature complex						breakwater
				Breakwater	Structural						
Submerged Aquatic Vegetation	**N/NB**	Submerged Aquatic Vegetation	Natural Features				Submerged	Submerged aquatic vegetation			Aquatic Vegetation
Living Shoreline (sill type)	**NB**			Living Shoreline (e.g. vegetation w/ sills, benches, breakwaters)	feature complex	Green Infrastructure: living shorelines	Shoreline		Living Shorelines	Living Shorelines (natural, hybrid, and structural)	Sill with Constructed Near-Shore Wetland
Tidal Wetlands / Salt marsh	**N/NB**	Tidal Wetlands	Natural Features	Salt Marsh	NNBF	Marshes and wetlands	Wetland	Wetlands	constructed wetlands*	tidal wetland restoration	Marsh Vegetation
		Non-tidal Wetlands	Natural Features	Fresh Emergent Marshes/Wetlands	NNBF						
				Fresh Shrub-scrub Wetland	NNBF						
				Brackish Shrub-scrub Wetland	NNBF						
				Brackish Flooded Swamp Forests	NNBF						
				Fresh Flooded Swamp Forest	NNBF						
Groin / Jetty	**HSF**			Groin	Structural	Grey infrastructure			Ecologically-enhanced bulkheads and revetments		jetty
Revetment	**HSF / EEF**			Seawall / revetment / bulkhead	Structural						revetments
											revetments (modified for ecological services)
					Structural						live crib walls, live cribbing, or vegetated cribbing
					Structural						Rip-Rap
											timber cribbing
											gabions
											sill
Bulkhead	**HSF / EEF**			Storm surge barrier	Structural						Bulkheads
											bulkhead (modified for ecological services)
											Seawall
Levee	**HSF**			Levee	Structural						
Bluff	**N/NB**	Bluff		Bluff	NNBF						
Beach / Beach Berm	**N/NB**	Beach		Beaches (sand, gravel, cobble)	NNBF	Beach	Beach	Beaches			
Dune	**N/NB**	Dune		Dune / swale complex	NNBF	Dunes	Dune	Dunes			
[Maritime upland vegetation/habitat] forests / shrublands / grasslands	**N/NB**	Maritime Forests		Maritime Forests	NNBF	Maritime forests and shrublands		Maritime forests	constructed maritime forests*		planted shoreline
				Maritime Grasslands	NNBF						
				Maritime Shrublands	NNBF						
		Floodplain					Coastal floodplain				
							Floodplain				
		Riparian Area		Riparian Buffers	NNBF	Riverine and Riparian Zone	Riparian	Riparian buffer			
				Pond	NNBF	Estuaries and Ponds					
		Forests		Terrestrial Forest	NNBF		Forests				
				Terrestrial Shrublands	NNBF						terrestrial vegetation
				Terrestrial Grasslands	NNBF						
		Bank									Vegetated Geogrid
											Bio/Green walls
		Stream									joint planting, live stakes or vegetated rip-rap
						Uplands and watersheds					
						Green infrastructure: other methods					
								Urban retrofit			

APPENDIX C. SUMMARY OF REGIONAL WORKSHOPS

APPENDIX C: SUMMARY OF REGIONAL WORKSHOPS

Written by Helen Cheng, New York Sea Grant – Science and Resilience Institute at Jamaica Bay

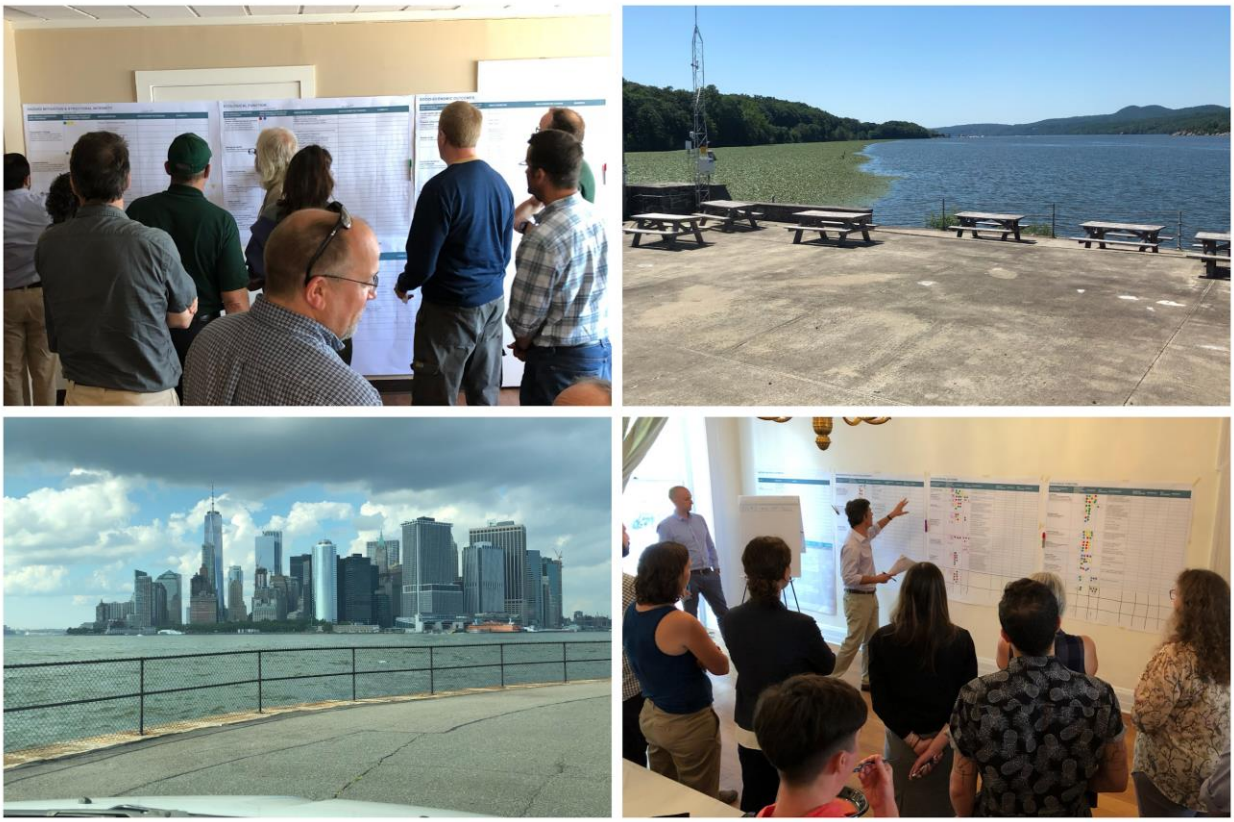


Figure 1: Photographs of regional workshops and locations at Hudson River Estuary (top) and NY-NJ Harbor (bottom)

Table 1: Meetings locations of regional workshops and affiliations of the participants from respective regions

Hudson River Estuary *Meeting Location: Norrie Point*	**New York – New Jersey Harbor** *Meeting Location: The Admiral's House on Governors Island in New York*
Environmental Center- State Park in Staatsburg	Cornell University: College of Architecture, Art, and Planning
Hudson River Estuary Program	New York City Emergency Management
Milone & MacBroom, Inc.	Waterfront Alliance
Metro North	Trust for Governors Island
NYS Department of Conservation Hudson River National Estuarine Research Reserve	New York – New Jersey Baykeeper
NYS Department of Conservation	Biohabitats
Hudson River National Estuarine Research Reserve	Freshkills Park Alliance
Hudson River Fishermen's Association	Randall's Island Park Alliance
NY Sea Grant	New York City Parks and Recreation
NYS Office of Parks, Recreation and Historic Preservation	Princeton University
Hudson River Valley Greenway Communities Council	New York City Department of City Planning
Westchester County Environmental Planning	Bronx River Alliance
Palisades Interstate Park Commission	Port Authority of New York – New Jersey
Center for the Urban River at Beczak, Sarah Lawrence	New York State Department of Conservation
The Nature Conservancy	The Nature Conservancy
Lamont-Doherty Earth Observatory of Columbia University	New York City Department of Environmental Protection
Assessment and Restoration Division, NOAA	Billion Oyster Project
Shadel Environmental	National Park Service, Gateway National Recreation Area
RACE Coastal Engineering	U.S. Army Corp of Engineers
VanLuven Environmental and Town of Bethlehem	Brooklyn Bridge Park Conservancy
Scenic Hudson	

Long Island *Meeting Location: Danfords Hotel and Marina in Port Jefferson*	**Great Lakes** *Meeting Location: Sabin Hall at Fair Haven Beach State Park in Sterling*
GF55 Partners	Village of Sodus Point
Fire Island National Seashore	New York Sea Grant
Stony Brook University	Consultant
South Shore Estuary Reserve	Eastern Lake Ontario Dune Coalition
Nelson, Pope, & Voorhis, LLC	University of Pennsylvania – Landscape Design
Peconic Estuary Program	NYS Department of Environmental Conservation
NYS Department of Environmental Conservation	Wayne County Soil & Water Conservation District
The Nature Conservancy	Town of Greece
Nassau County Soil & Water Conservation District	SUNY Oswego – Biology
Long Island Sound Study	The Nature Conservancy
Suffolk County Department of Economic Development., Planning & Environment	U.S. Coastal Guard Auxiliary
GEI Consultants	Cornell University – Landscape Architecture
Town of East Hampton	Save our Sodus
First Coastal Corporation	Save the River
Town of Babylon	

Regional Workshops

Prior to each workshop, there was a pre-workshop webinar to provide context to participants on the project, the draft monitoring framework, and the layout of the workshop day prior to the workshop day.

For the day of the workshop, the agenda included a presentation of the Monitoring Framework with discussion of clarity of definitions and goals, a ranking activity on the draft monitoring parameters and indicators, break-out sessions to discuss protocols for each resilience service area, and overall feedback on the monitoring framework and network. See Supplemental Information 1 below.

The agenda for each workshop, format, and hand-outs remained relatively consistent with the exception of the Great Lakes Regional Workshop, in which a slight change to the prompt questions addressed in Session 4 were adjusted. These adjustments were made in response to feedback from the Hudson, New York City, and Long Island workshops and reflections from the Core Team. Specifically, it was suggested that the workshops could generate better feedback on monitoring protocols by identifying existing protocols in addition to the example in the Draft Monitoring Framework.

Supplemental Information 1: The following is the External Agenda from the Great Lakes Regional Workshop held in September 2018.

AGENDA

Welcome, Introductions and Overview

Greeting, Workshop Host

Welcome, Project Sponsors

Workshop participant introductions

Agenda review and workshop protocols

Discussion Session #1: Understanding the Monitoring Framework

Project overview

Overview of draft Monitoring Framework

Our Goals and Assumptions

Overview of Framework table and key definitions

Participant Questions

Small Group Discussions

Are the goals and assumptions reasonable and accurate? Are the definitions clear?

Are there other things you want this group to consider?

Opportunity for brief report back on most salient themes raised

Discussion Session #2: Providing Feedback on Monitoring Parameters

Overview of draft candidate monitoring parameters

Hazard Mitigation and Structural Integrity

Ecological Function

Socio-Economic Outcomes

Exercise: Gauging participant feedback on draft monitoring parameters

Group discussions on exercise results: commonalities, divergent views, issues needing further consideration

Discussion Session #3: Providing Feedback on Monitoring Indicators

Overview of draft candidate indicators

Hazard Mitigation and Structural Integrity

Ecological Function

Socio-Economic Outcomes

Exercise: Gauging participant feedback on draft monitoring indicators

Group discussions on exercise results: commonalities, divergent views, issues needing further consideration

Discussion Session #4: Providing Feedback on Monitoring Protocols

Plenary: Review project goals/assumptions, session overview

Breakout sessions by resilience service area

Review example protocols

Breakout group discussions on elements of a good monitoring protocol

What protocol is used widely and effectively in this region already?

-Does it works across shoreline types?
-Does it addresses resilience service areas?
-Does it generate information that would support comparative analysis? Why/why not?

Compare and contrast the existing protocol with the example from 'Draft Framework'

-What would we have to change/adjust to make our protocol more effective?

Report back in plenary on key discussion themes by resilience service area

Discussion Session #5: Monitoring network

Developing a regional network

Would you use this framework, if we come to consensus on it? Would others? What would encourage you to use it?

What are the opportunities to get groups involved in organized collection of data in this region using this framework?

What are the barriers to using this framework? Can they be overcome? How?

Are there potential monitoring sites in this region?

Workshop Wrap-up and Next Steps

Discussion of project next steps

Participant feedback on workshop

Closing remarks

In addition to the regional working group lead of a particular region, members of the core team, including our regional working group coordinator and 1-2 technical working group leads/ representatives, were present at every workshop.

At each workshop, regional workgroup leads welcomed participants and handled logistics throughout the day. Core team representatives led discussions introducing the monitoring framework and the ranking activity on the draft monitoring parameters and indicators. Technical working group members provided context to their respective resilience service areas and led the break-out discussions. Roles of facilitation and note-taking throughout the discussions were divided among the core team including the regional working group lead and the technical working group lead/ representatives.

Discussion sessions were structured to gather individual and group feedback on the draft performance parameters and indicators, and feedback from previous workshops were added to the presentation materials, allowing the participants to view and build on previous comments. Participants of the regional workshops shared shoreline management experience from their region. A 'Workshop Participant Comment Sheet' was developed to provide additional feedback throughout and at the end of the workshop.

After hosting all four regional workshops, the Core Team synthesized discussion notes, completed charts, comments, suggestions, recommendations, and feedback into consolidated discussion summaries. Syntheses of each of the workshops were done by their respective regional workshop lead.

Regional Workshop Synthesis

Each regional synthesis summarized cross-cutting themes from the day-long regional workshop, and provided a summary from each workshop session. Upon completion of the four regional syntheses, the project team combined them into an overarching synthesis. This broader summary highlighted priority items/ issues raised by each of the regions and identified common concerns/ issues across regions, within each session of the agenda. Common themes and concerns that were identified throughout all the sessions and all the regional workshops were noted. This regional synthesis was presented at the first Permit Reviewers meeting (Task 6).

Concurrently, the Technical Working Group members, particularly those who were in attendance at one or more of the regional workshops, provided a summary of key takeaways for their particular area of focus. These summaries were categorized by resilience service area. Each resilience service area summary was then organized by region, followed by the sessions asking for feedback on Parameters, Indicators, and Protocols.

Finally, overall take-aways and impressions from the technical working group members were noted.

In addition to Regional Workshop narrative summaries, matrices from each regional workshop were combined into an Excel file tracking the 'ranking' of each parameter and indicator. The compiled matrix shows which parameters and indicators were prioritized by participants at each regional workshop, and overall. The combined matrix is available at the end of this summary (within Appendix C).

Findings from Regional Workshops

The workshops generated important feedback. Some was general in nature; others focused on specific comments to strengthen the framework's utility and applicability.

Most broadly, workshop participants saw value in striving to develop a statewide framework and generally supported the broad approach put forward. That said, the workshops generated a number of themes, issues and concerns regarding the draft framework - some cross-cutting across all four workshops, others unique to a particular region or two. In general, comments raised across all four regions fell into two broad categories: (1) data and (2) people.

Across all four regions, participants voiced concern regarding the potential to establish a consensus perspective on the baseline measurement needed for data collection and standardization of data collection given site-specific characteristics, goals and needs

Capacity and audience for this framework also was raised in each session as participants were unclear on the intended audience for this framework. Given the effort needed to implement this project, there were questions of: who will do this work and who will fund this work/ where will the funding come from?

There was also feedback that varied across the regions. In the Hudson River Estuary, participants cited existing work already focused on the success of living shorelines. Entitled *The Sustainable Shorelines Project*, this project was highlighted by the participants, one of whom has been serving as the project coordinator. There were also comments on the importance of determining the success of the project and the need of an evaluation process of the project.

In New York City, participants discussed the need to clarify data standardization, usage, distribution, and ownership. Additionally, emphasis was made on considering specific site goals and the need to decide whether to monitor the NNBF structure or what is behind the NNBF.

On Long Island, participants emphasized the need to clarify and confirm the appropriate sea level rise projections to use in conjunction with the framework. Long Island participants

specifically emphasized the imperative of engaging property owners, especially private property owners.

The Great Lakes regional workshop was the last one held. After hearing feedback from the previous workshops, participants emphasized distinguishing attributes of the Great Lakes region important to factor into any framework, including the impacts of the St. Lawrence River and the need to measure and account for sediment budget and ice impacts.

Analyses were also conducted based on the feedback and notes from each of the sessions and discussions of the day. Specific comments were made on the parameters, indicators, and sample protocols of the three resilience services: 1) hazard mitigation and structural integrity, 2) socio-economic outcomes, and 3) ecological function socio-economic outcomes.

Feedback on Hazard Mitigation and Structural Integrity included consideration of physical processes such as land movement and water levels. The importance of tracking contaminants was met with mixed reviews from the regions; participants from the Great Lakes did not think measuring contaminants was relevant. In regards to indicators, there were considerations of using existing data and tools available as well as other indicators such as wind and waves. When it comes to building a protocol, in reference to the sample protocols provided, there was a need to provide instruction and training, and to utilize existing tools and data sets.

Feedback on the Socio-economic Outcomes underscored the importance of tracking such measurements. Parameters of public access and quality of life was rated highly. In order to measure these successfully, people and communities need to be involved in order to understand the value of the project and project success. For indicators, there was concern of implicit bias in terms of language and assigning value (i.e. good or bad) to an indicator, for example property value and tourism. The sample protocols for this resilience service area can use existing data such as ticket sales etc. There were concerns of defining engagement, especially engagement with the NNBF, as well as the 'who' of use, whether the NNBF should encourage residents versus non-residents. Additionally, there were concerns about collecting data on private and public property, lands, and sites.

Finally feedback on Ecological Function parameters focused on the concerns of lumping and splitting parameters. There were also suggested additions based on the regions including carbon, ice impacts, and species. There were also cross-cutting parameters with Hazard Mitigation and Structural Integrity resilience service. Additionally, participants noted that multiple indicators could be successfully tracked with one protocol but it was important to be mindful of the frequency and extent of monitoring needed. Protocol discussions highlighted the need to provide instruction, units of measurements as well as defining the scale of monitoring, such as how often and spatial and vertical limits.

Finally, as part of the last session of the workshop, we gathered feedback on establishing a Monitoring Network, addressing what sites to monitor, partners to collaborate with, as well as the challenges of using the Framework and how to overcome those challenges.

Overall, participants viewed the Framework and the overall project highly. Participants would use the framework if the following criteria were investigated and confirmed:

Funding provided
Interest/ support/ buy-in
Simple and easy to use
Inexpensive
Sustainable and has long term use
Considers site specific goals.

Participants identified challenges but also strategies to overcome those challenges. Challenges in funding and capacity can be addressed by grants, collaborations, integrating with other projects, and involvement from the community. Challenges in understanding the Framework can be resolved by highlighting the value, providing incentives, and demonstrating success. When addressing complexing scale, considering direct application to current issues and/or projects, training and mentoring, and simple explanations would overcome this challenging. Finally, fear of skepticism, fear and distrust, can be addressed by highlighting the value for users, education and demonstrations, and access to the data.

Ecological Function: Regional Workshop Ranking Results

PERFORMANCE PARAMETER/ Goal statement	Hudson Valley Regional Workshop		NYC Regional Workshop		Long Island Regional Workshop		Great Lakes Regional Workshop		INDICATOR/METRIC	Hudson Valley Regional Workshop		NYC Regional Workshop		Long Island Regional Workshop		Great Lakes Regional Workshop		
	supportive	not supportive	supportive	not supportive	supportive	not supportive	supportive	not supportive		supportive	not supportive	supportive	not supportive	supportive	not supportive	supportive	not supportive	Totals
Biodiversity	10	0	13	0	5	4	13	0	Species richness and evenness by plant community / habitat type	6	0	9	0	3		7		25
(species richness and species evenness)									Benthic invertebrate abundance, composition, richness, biomass, population density	6	0	11	0	4		5		26
Sustain & increase native biodiversity (consider targeting biodiversity of healthy reference sites,as determined by site visits and historical literature).									Mobile organisms (ie fish) abundance, richness	7	0	9	0	1		2	1	19
									vertebrates							2		2
Biological Health	12	0	13	1	19	0	9	0	% vegetative cover/species or functional group or area	9	0	10	0	21		2	1	42
(abundance / size /reproduction)									Height of vegetation / # stems (to assess biomass/size/cover)	0	0	0	0	0	1	1		1
Conserve or restore habitats.									% native vegetation cover, % non-native vegetation cover, % bare ground/sand, % wrack, % woody debris (branches, logs)	3	0	7	1	11		2		23
									Survival rate of living material	7	0	6	0	6		6		25
									Flowering, fruiting	1	0	0	4	1	2	2		4
									Recruitment of plant species	2	0	3	0	3		0	1	8
									Plant community (composition, richness, invasives)	6	0	5	0	0	1	14		25
									Area (sq. acreage) of Natural habitat and expansion of area					18	0	1		19
Habitat connectivity	9	0	12	0	18	0	5	0	Connectivity across land/water interface / connection of upland to in-water habitat	4	0	11	0	8		2		25
Sustain or Increase habitat connectivity along and across the shoreline zone.									Connectivity of/within same / similar type habitats	2	0	3	0	7		1		13
									connectivity water -> WETLAND -> pland							0		0
Hydrology	4	0	11	0	13	0	6	0	Tidal hydrology (continuous & discrete data): inundation frequency, (peak) water level	6	0	5	0	11		0		22
(water movement/tidal movement/flushing)									tidal flushing / residence time	1	0	9	0	6		1		17
Maintain, restore or enhance tidal and internal site hydrology.									Marsh sediment accretion rates with surface elevation tables and horizon markers	5	0	2	0	17		3		27
Water quality	5	0	12	0	7	5	11	0	Nutrients (nitrogen, phosphate) / denitrification	4	0	4	0	0	4	11		19
(processes that support / contribute to quality)									Presence and abundance of filter feeders	0	0	4	0	0	1	0		4
Improve or maintain processes that contribute to water quality.									Dissolved oxygen	6	0	7	0	2	2	5		20
									Salinity			2	0	2		1		5
									macro/chem/phys parameters DEC protocol?							1		1
Sediment and substrate	8	0	4	0	9	0	15	0	Survival of living material (proper implementation of maintenance guidance for NNBF)	7	0	6	0	4		5		22
(availability / transport / distribution at and/or adjacent to site)																		0
Maintain, restore or enhance sediment availability and transport processes.									Transition of shore building materials (sand) ACCRETION?	8	0		0			11		19
Contaminants	5	0	3	4	0	8	0	5	Presence of toxins & contaminants	10	0	4	2	0	7	0		14
(that affect ecological function)																		0
Reduce contaminants that threaten ecosystem function.									This should combine with Biol Health									0
Carbon Value (sequestration)	1	0	2	5		10	0	6										0
Land Use					2	4	2	1	this may be 1 standard question on a tool to establish if a change has occurred							1		1

Key

black text: draft framework language

red text: added by a participant during regional workshop

Hazard Mitigation and Structural Integrity: Regional Workshop Ranking Results

PERFORMANCE PARAMETER/ goal statement	Hudson Valley Regional Workshop		NYC Regional Workshop		Long Island Regional Workshop		Great Lakes Regional Workshop		INDICATOR/METRIC	Hudson Valley Regional Workshop		NYC Regional Workshop		Long Island Regional Workshop		Great Lakes Regional Workshop		
	supportive	not supportive	supportive	not supportive	supportive	not supportive	supportive	not supportive		supportive	not supportive	supportive	not supportive	supportive	not supportive	supportive	not supportive	Total supportive
Topographic Change	14	0	12	0	21	0	15	0	Change in vertical elevation of asset.*	10		8		9		6		33
Maintain natural coastal processes while reducing or avoiding increase in exposure of people, property, and ecosystems to coastal hazards through shoreline erosion									Change in shoreline position / sea level rise adaptability.	7		14		20		6		47
									Change in horizontal position of asset.*	2		1		4		5		12
									Loss or gain of sediment updrift/downdrift.	3		7		17		12		39
Change in the shoreline feature itself									Change in shoreline position of adjacent bank					2		8		10
Coastal Hazards	15	0	14	0	21	0	15	0	Wind driven wave heights / wave periods landward/seaward of asset.	10		7		8		13		38
Reduce exposure or vulnerability of people, property, or ecosystems to coastal flooding hazards (storm surge, wave attack, high tide flooding, sea level rise, currents, etc.)									Boat wake wave heights / wave periods landward/seaward of asset.	3		4		1	3	4	1	12
									Change in water elevation as a measure of flooding, surge, SLR, tides, etc landward/seaward of asset	10		9		16		5		40
									Currents adjacent to asset.	6		4		0	1	2		12
Change in the area around/adjacent/behind the feature									other types of flooding aside from wave heights (surge/high tide/rainfall runoff)			2						2
Structural Integrity	12	0	15	0	18	0	10	0	Change in vertical elevation of asset.	3		4		11		0		18
Avoid structural failure and sustain the structural integrity of the shoreline feature									Change in horizontal position of asset.	2		3		9		0		14
									Change in vegetation, shellfish, or other biomass of structure.	6		8	1	8		4		26
									Local scour, visible erosion, escarpments. Recognize regional diversity	10		10		18		5		43
									Grey material degradation.	1		5		3		3		12
									Ice scour / extent more less							9		9
Upland Connectivity/Access for people			2	0	2	0	2(?)	1(?)	pre - post implementation comparison					3		5		8
ie) emerging management, evacuation									Long term marsh sedimentation rates (See ecological)	4								4
Influences (increase/decrease) development/settlement areas exposed to hazards			2	0	8	0	2	0										0
																		0

Key

black text: draft framework language

red text: added by a participant during regional workshop

Socio-Economic Benefits: Regional Workshop Ranking Results

PERFORMANCE PARAMETER/goal statement	Hudson Valley Regional Workshop		NYC Regional Workshop		Long Island Regional Workshop		Great Lakes Regional Workshop		INDICATOR/METRIC	Total supportive
	supportive	not supportive	supportive	not supportive	supportive	not supportive	supportive	not supportive		
Human health and safety *Improve human health, safety, or wellness*	7	0	8		13		13	0	# of households potentially impacted by a resilience project	25
									# of households exposed to flooding/erosion	35
									# of recreational facility users	1
									# of closed rec areas due to water quality	2
Property value and infrastructure *Enhance or protect Property and infrastructure value*	8	0	7	4	6		8	5	Public facilities (e.g., parks) and critical facilities protected by proposed project	32
									Sales values of homes/% change in home values	3
									Critical facilities protected by proposed project (combined above)	14
									societal demographics	4
Quality of life *Enhance / protect quality of life*	5	0	7	0	11		3	2	Reportings and expressions from participants of how the shoreline factors into the life of their community	23
									Opinions from participants on major enviornmental risks in a community.	12
									Tellings and expressions of the sacred, revered, and unique aspects of a community as told by participants.	6
Economic resilience and livelihoods *Improve / increase / enhance economic resilience and livelihood opportunities*	8	0	6	2	9		8	0	# of days residents are unable to work because of disturbance	10
									Monthly (or yearly) rent of residential homes in $	1
									# of days of business closure	12
									# applications for new business permits	0
									# of overnight stays of tourists in local guest lodging (hotels, AirBNB)	3
									# of site visits (resident vs non-resident if possible)	8
									# of people employed in fisheries and aquaculture	3
									$ value of all recreation and tourism	26
									# of primary jobs generated by construction and maintenance of a waterfront project	4
									flood insurance rates	0
Institutional knowledge and individual capacity *Increase / enhance Institutional knowledge and individual capacity* *Adaptation - the ability of an organization or group to adapt to change*	0		3	5	8		6	4	# of FTE staff employed at local institutions per year	1
									# of FTE staff engaged with/working on waterfront	3
									# educational programs/events on waterfront	12
									# of local school classes incorporating waterfront into curriculum	5
									Tellings and observations from participants of how they are adapting to major climate risks	6
									Expressions of the benefits and drawbacks of nature-based shoreline features among local communities	17
									avoided costs (i.e. value of risk reduction)	1
Participation and stewardship *Increase Participation and stewardship*	7	0	11	0	13		6	0	# different stakeholder groups participating in public meetings related to waterfront project	22
									# groups (or diversity of participants) participating in waterfront stewardship	20
									Expressions of distrust between participants and other members / stakeholders / power holders in/of the community.	5
									Expressions of trust and connectivity between participants and other members / stakeholders / power holders in/of the community	16
									Observations and sightings of formal and informal public uses of waterfront public space	17
Public Access	13	0	11	0	6		5	0	Linear feet of accessible shoreline	3
									Financial mobility of vulnerable communities	3

Key

black text: draft framework language

red text: added by a participant during regional workshop

APPENDIX D. SUMMARY OF PERMIT REVIEWER MEETINGS

Measuring Success: Monitoring Natural and Nature Based Features in New York State

Permit Managers Call #1

Wednesday, January 3rd, 2019 1:00-2:30 pm

Virtual Webinar

Participants: Permit Staff

Dawn McReynolds (NYSDEC R1)
Steve Metivier (USACE)
Matt Chlebus (NYSDEC Central Office)
Peter Weppler (USACE)
Candice Piercy (USACE)
Corbin Gosier (NYSDEC)
Cate Alcoba (USACE)
James Haggerty (USACE)
John Petronella (NYSDEC, R3)
Tom Voss (NYSDEC, R6)
Michael Marrella (NYC City Planning)
Amanda Regan (USACE)
Brian Drumm (NYSDEC, R3)
Heather Gierloff (NYSDEC R3/ HRNERR)
Angela (Betsy) Schmizzi (NYSDEC, R3)
Roselle Henn Stern (USACE)
Matt Maraglio (NYDOS)
Rich Groh (Town of Babylon)
Rena Weichenberg (USACE)
Jonathan Stercho (NYSDEC, R7)
Dave Bimber - (NYSDEC, R7)
Daria Mazey- (USACE)
Michael Morgan (USACE)
Alexa Fournier (NYSDEC)
Beth Geldard (NYSDEC)

Participants: Core Team

Marit Larson (NYC Parks)
Helen Cheng (SRIJB/NYSG)
Adam Parris (SRIJB)
Katie Graziano (SRIJB)
Bennett Brooks (Consensus Building Institute)
Carolyn Fraioli (NYDOS)
Kathleen Fallon (NYSG)
Kristin Marcell (DEC)
Roy Widrig (NYSG)
Amanda Stevens (NYSERDA)
Hannah Davis (Scape)
Rob Pirani (HEP)
Novem Auyeung (NYC Parks)
Doug Partridge (Arcadis)
Isabelle Stinnette (HEP)
Pippa Brashear (Scape)
Kathy Bunting-Howarth (NYSG)

Notes

1:00-1:05

Welcoming Remarks

Adam Parris, SRIJB Carolyn Fraioli, DOS Amanda Stevens, NYSERDA **Introductions and Ground Rules**

Bennett Brooks (Facilitator, Consensus Building Institute)

1:05-1:35

Project Overview and Background

Adam Parris, SRIJB

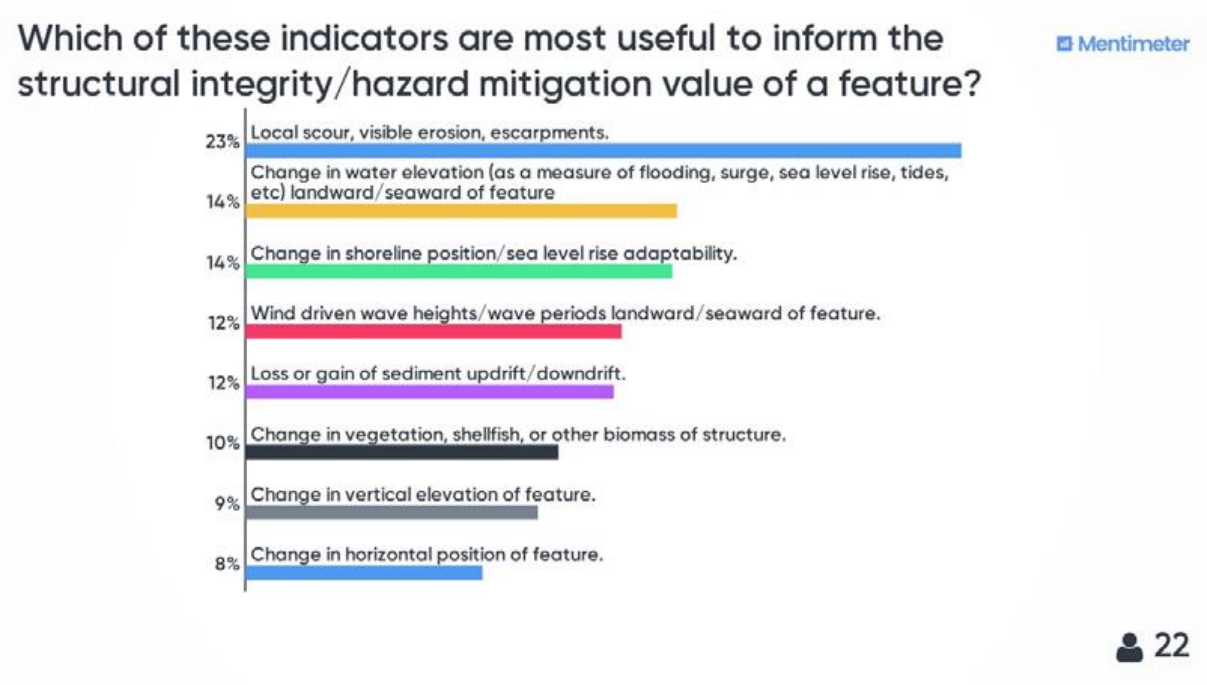
Regional Workshop Summaries

Helen Cheng, SRIJB

1:35-2:15

Evaluating Indicators: Mentimeter Surveys and Discussion

Structural Integrity/Hazard Mitigation



Local Scour/Erosion/Escarpments came out as a high priority – Why?

- This what people are asking us for. People ask for permits so that they don't lose their house into the lake.

• We used NNBF as part of our coastal storm risk management suite of measures, but we really defined it as an erosion control feature that is connected to a larger design. So being able to demonstrate the erosion control helps to make that case and collect that data for the future.
• Local scour will be relatively easy to measure.

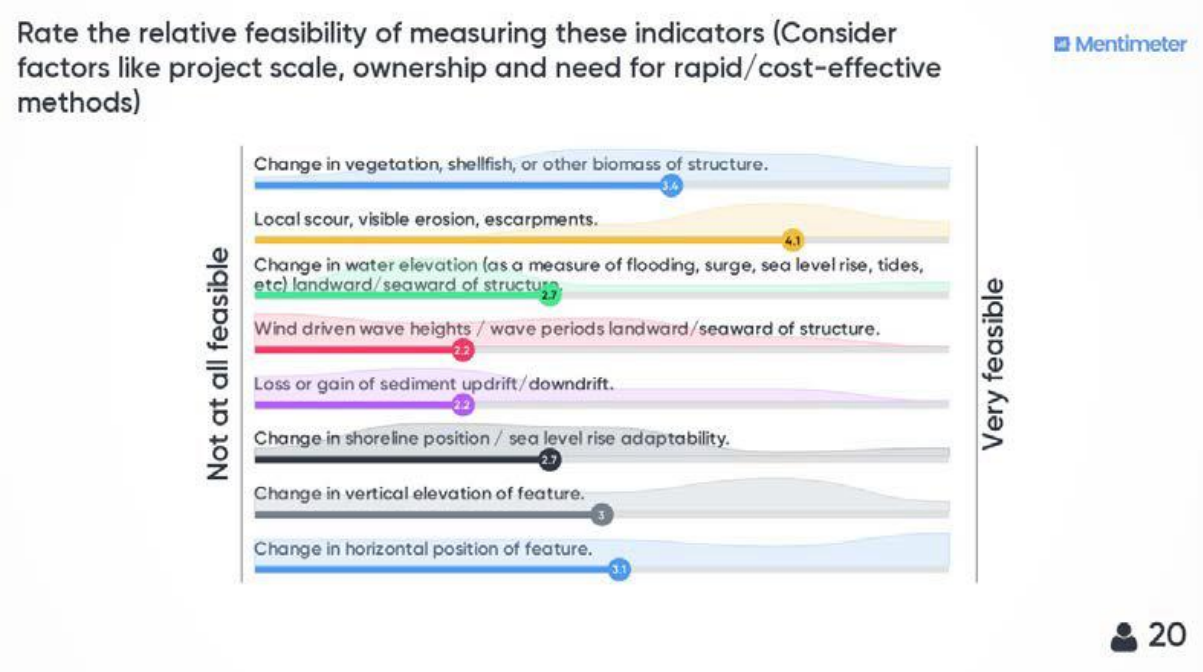
Why did certain indicators rank lower?

• I did not rank local scour very high, I thought that if you measure primary things – horizontal / vertical position, that would quantify it better and still get at the same answer. More basic measurements, and more scientific.
• There's a difference between structural integrity and hazard mitigation – you might get your structure intact, but might not be the same as hazard mitigation. In general, better to think of those as separate categories.
• Chat box: I ranked "Change in vegetation, shellfish, or other biomass of structure" high because it is relatively easy to measure and can be used to assess the success of the design and helpful for adaptive management and maintenance of the project.

[Participant Question about who was invited to the Regional Workshops]

Core Team (via Chat): Regional workshop participants were people in the regions who are working on NNBFs related to the resilience service areas of ecological function, socio-economic services, and hazard mitigation and structural integrity. Participants ranged from NGOs, academics, Feds and non-feds, experts, leads of homeowner's associations, and more.

Feasibility:



Participant Question: Should we assume that this is over the duration of roughly 2 years of monitoring?

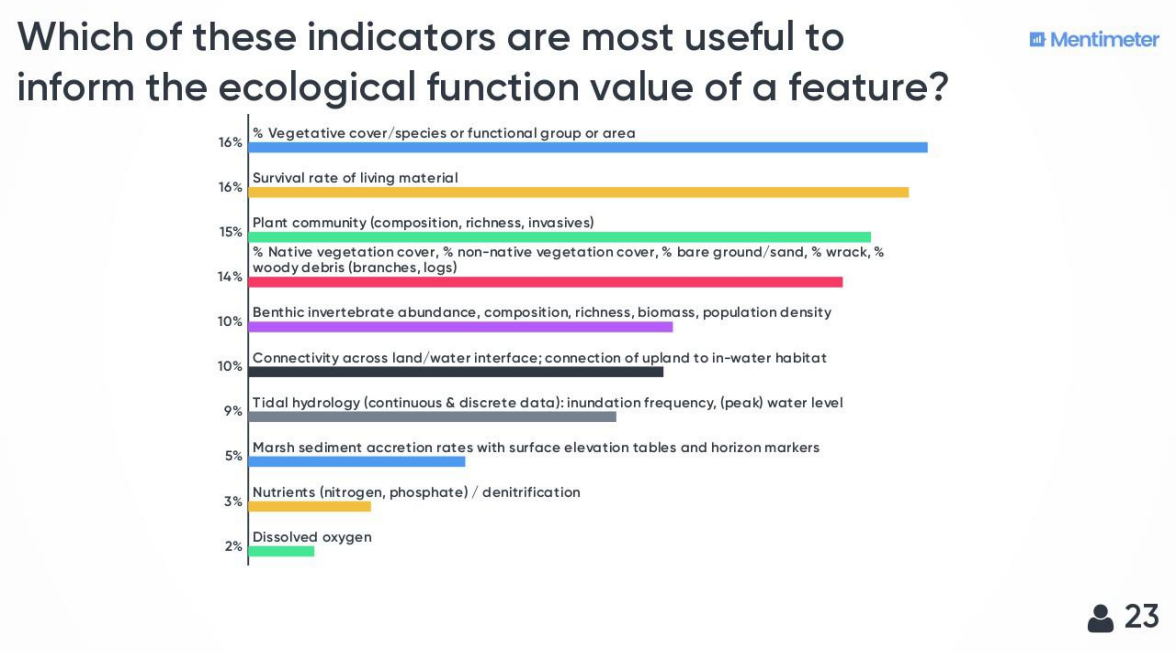
Assume that we are speaking over the duration of one season of measurements.

Two stand out as most feasible – Local scour, and change in vegetation. Thoughts?

• Participant Q: What is the focus? From a coastal protection/resiliency perspective? Is that the main focus, or are we considering everything that the measure would provide?
    - Think of it in three areas (structural integrity/ hazard mitigation, ecological function, socioeconomic benefits)
    - One thing we didn't say at the outset, while we're asking you to poll, nothing is being voted off the island – we're looking to get input, to get a nuanced and detailed understanding of how we think about these indicators. All of this input goes back to Technical Working Groups, all informing. Regional workshop participants were people in the regions who are working on NNBFs related to the resilience service areas of ecological function, socio-economic services, and hazard mitigation and structural integrity.
    - Participants ranged from NGOs, academics, Feds and non-feds, experts, leads of homeowner's associations, and more.

• Change in elevation, horizontal position, and shoreline is simple because routine topo/bathymetric lidar surveys via the national coastal mapping program already measure these

Ecological Function Indicators



Top four are emerging as higher priorities than the others. Why are those particularly important indicators?

• Some of those are a lot easier to measure, and easier to compare amongst each other.
• Depends on the feature. You can't rule out other aspects that are not as high.

So if we're trying to narrow it down, do any emerge as something that would work across features? Does it need to really vary based on feature?

• Yes, it needs to vary based on the feature. If you're on a hard structure, you're not gonna have any vegetation. So you'll have to look at other things – benthic inverts, fisheries, etc.

• (Core Team) We recognize that we're not going to get a 'positive' results for all the indicators, but the point is to be able to share that – just that a bulkhead is different than a living shoreline. Understanding that those features are going to vary, but we want to capture that result even if it is zero.

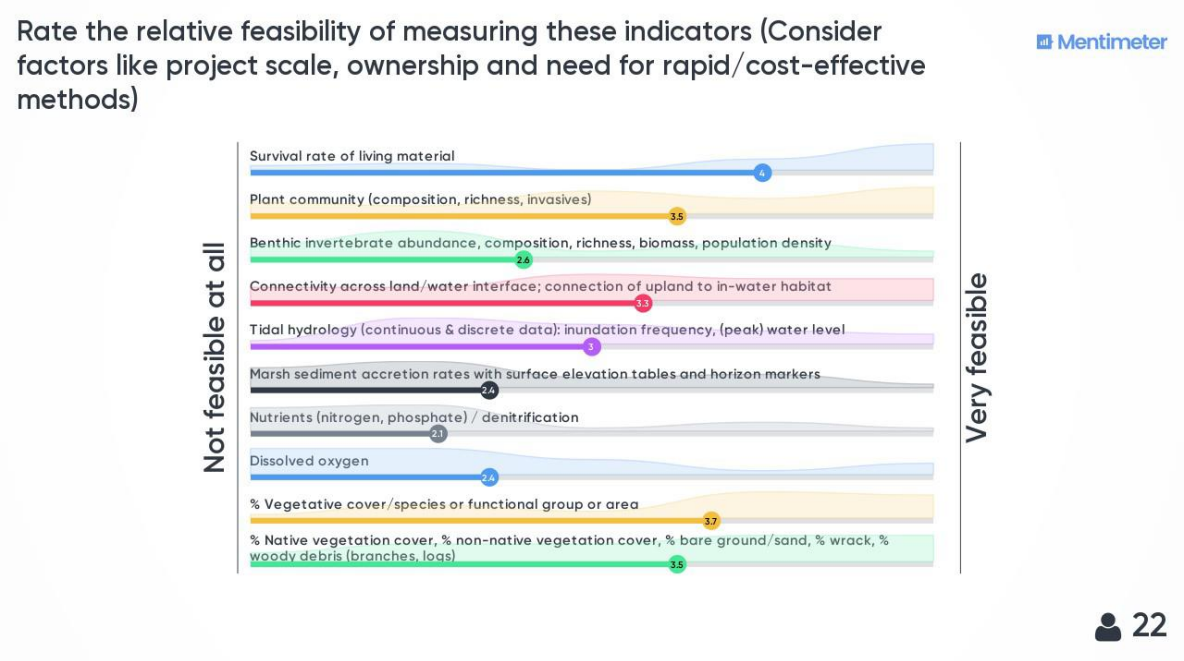
Any indicators that you expected to see, but you didn't see here?

• Benthic invertebrates /macroalgae are going to be more important on a breakwater than in other categories. Say there isn't vegetation – there may be something else providing ecological function.

• (Core Team): It's also considering how much gray or green is being put in. Impervious cover /more or less- The hard structure may provide attachment points, it all depends on what the feature is and what you are monitoring for.

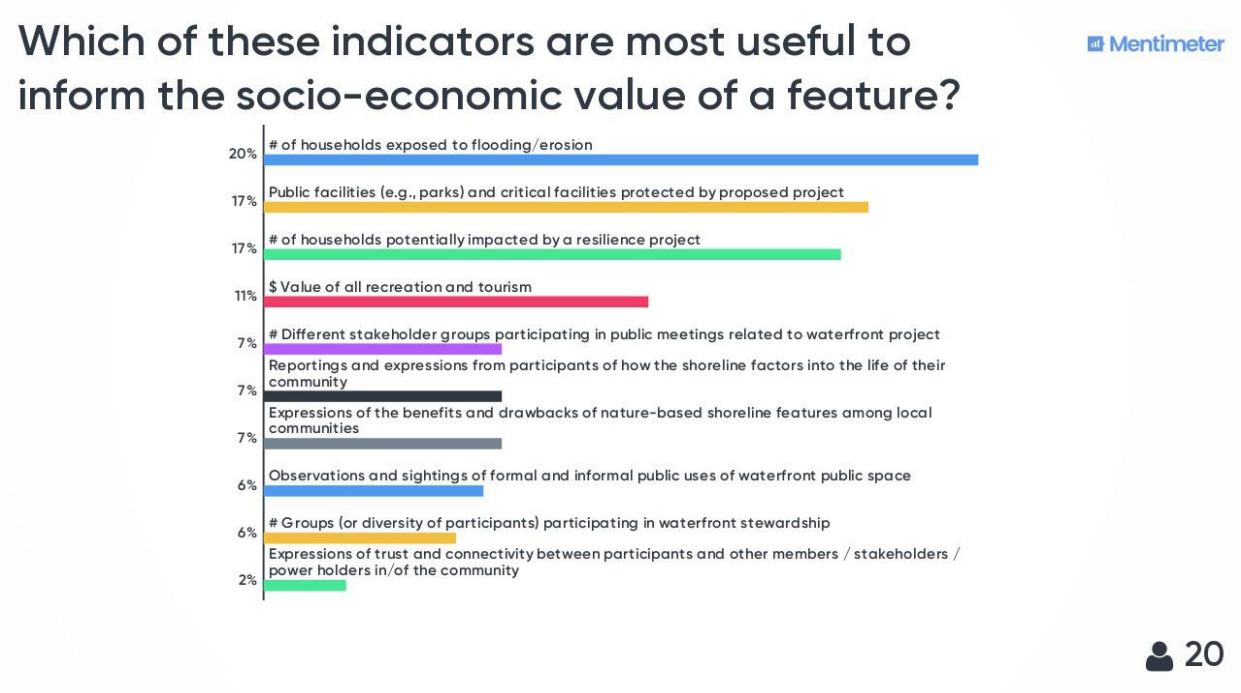
• (Core Team): Question also is tied to the wording. This asks about function of a feature, but we also want to expand it out to site level.

Feasibility – Ecological



Chat box: Measuring is relative - is it quantitative or qualitative. You can get a sense/ relative measure via homeowners taking pictures as an example

Socio-Economic Indicators

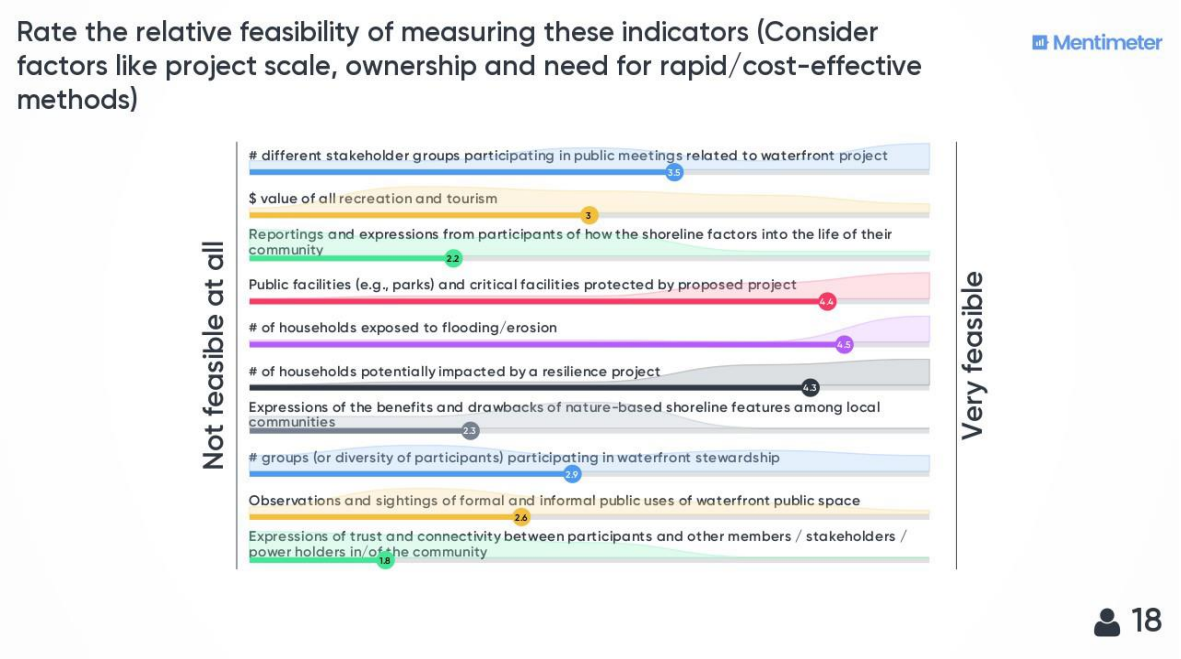


Top 4, why did they emerge as a high priority indicator?

- A lot of these shoreline projects tend to be, when there's an even like Lake Ontario a few years ago, many households have the same problem – solutions are group solutions of ones that work, not individual solutions. So number of households is an important indicator.
- Anything quantifiable is going to come out higher for me, just to justify. From a COE perspective, the numbers are more important, the other things might be important from a political perspective.

Anything missing?

- No answer.



The indicators that start with a # or $ sign is ranked more feasible. Is that a fair interpretation? Any surprises?

- Loss of life and safety is a huge socio-economic factor, along with economic value of protecting homes/infrastructure. This also parallels with the Corps analysis for CSRM projects. Recreation and tourism also have socioeconomic value and are recognized in the Corps planning process.

(Core Team): Let us know in the chat box (or via email) whether this type of polling is effective.

2:15-2:25

Considering Regional Differences

Do you have any advice or recommendations for us, for how we should handle differences? In other words, what is distinct that you would want taken into account when comparing projects in your region to projects in other areas in the state?

- Every single project is for a different purpose and has slightly different site characteristics, even if they are right next door to each other. So you need to account for intra-regional differences also.
- Must make sure to not be dis-incentivizing work in an urban environment
- Depends on your goals and objectives – for example, non-native vs native - - will you spend the money to remove non-native for native habitat? When it comes down to cost and actual objectives, it's important to think of the purpose of the project, what it is trying to achieve.
- Echoing the authority that we're working under – if it's a multi-objective project, looking at restoration plus storm risk management, or justifying it just on storm risk management benefits alone – for us that makes a big difference. Having a monitoring framework that can allow us to gather data and build a case for NNBF long term, to measure benefits but not setting up expectations for how a project is going to perform, that are either hard to measure/demonstrate early on.
- Having a monitoring framework that can allow us to gather data and build a case for NNBF long term, and get that data to measure benefits, but also make sure that we're not setting up

expectations for how a project is going to perform that aren't in line with the objective of the project, or are just hard to demonstrate early on. Making sure that we're helping ourselves, not hurting ourselves.

Core Team – We should mention, there is a separate section on basic project information that is baseline information that everyone collects. From a scientific standpoint, we want to lean towards indicators that we know we can monitor over a long period of time, because for resilient service areas (ecological function, socio-economic outcomes) , those are things where the longer we collect data/more robust a trend we see, is going to be more telling over longer time. That's part of what distinguishes what someone might collect on their project, going back to the question about the timeframe.

Core Team– Flip the question real quick, it's easy to think about where there are differences, but if we back up and try to look statewide – Are any of these indicators a measure of ecological value that we can use statewide? Where is the commonality?

- No response – Leave that question with you, and let you think about it.

2:25- 2:30

Conclusions and Next Steps

We want to continue to get your feedback – send us emails, stay in touch between now and second meeting which is Jan. 25, 1-2:30.

Measuring Success: Monitoring Natural and Nature Based Features in NYS
Permit Call #2 Notes
Virtual Webinar
January 25, 2018
1:00-2:30 pm

PARTICIPANTS: PERMIT STAFF
Alexa Marinos (T. of Babylon)
Amanda Regan (USACE)
Angela Schimizzi (NYSDEC R3)
Brian Drumm (NYSDEC R3)
Candice Piercy (USACE)
David Bimber (NYSDEC R7)
Dawn McReynolds (NYSDEC R1)
Heather Gierloff (NYSDEC R3)
Michael Morgan (USACE)
Peter Weppler (USACE)
Richard Groh (T. of Babylon)
Steven Metivier (USACE)
Tiffany Toukatly (NYSDEC R7)
Jean Foley (NYSDEC R7)
Tom Voss (NYSDEC R6)

PARTICIPANTS: CORE TEAM
Katie Graziano (Science and Resilience Institute at Jamaica Bay)
Helen Cheng (SRIJB/ NY Sea Grant)
Adam Parris (SRIJB)
Bennett Brooks (Consensus Building Institute)
Carolyn Fraioli (NYSDOS)
Tanna LeGere (NYSDOS)
Amanda Stevens (NYSERDA)
Katinka Wijsman (New School)
Kathleen Fallon (NY Sea Grant)
Pippa Brashear (SCAPE)
Chris Haight (NYS Parks)
Vince DeCapio (Arcadis)
Peter Groffman (CUNY)
Isabelle Stinnette (NY NJ HEP)
Marit Larson (NYC Parks)
Rob Pirani (NY NJ HEP)
Roy Widrig (NY Sea Grant)
Hannah Davis (SCAPE)
Kristin Marcell (NYSDEC)

I. Introduction
Adam Parris (SRIJB)

- Thank you for taking the time to fill out surveys, we will send results from that.

II. Key takeaways from last call (Permit Reviewer Call #1):

1) 26 participants, most people stayed with us throughout the call.
2) Reviewed the Framework – 3 resilience service areas
    a) Structural Integrity/Hazard Mitigation (heard some feedback to split those apart) – most relevant to permitters
    b) Ecosystem Function
    c) Socio-economic Outcomes
3) Ranked indicators according to usefulness and feasibility
    a) 3 or 4 emerged from each group as the top-rated, and there was good agreement between usability and feasibility.
    b) Combining with feedback from Regional Workshops to create 'core' indicators today, to go through similar exercises.

III. Agenda Review

IV. MENTIMETER VOTING ON 'CORE' INDICATORS
Core Team – Circle back on the indicator level. Aim is to gauge interest and support for indicators that have risen to the top in each service area.

Hazard Mitigation/Structural Integrity – Which are most helpful to gauge the function of shoreline measures toward reducing risk to people, property, shoreline ecosystem.

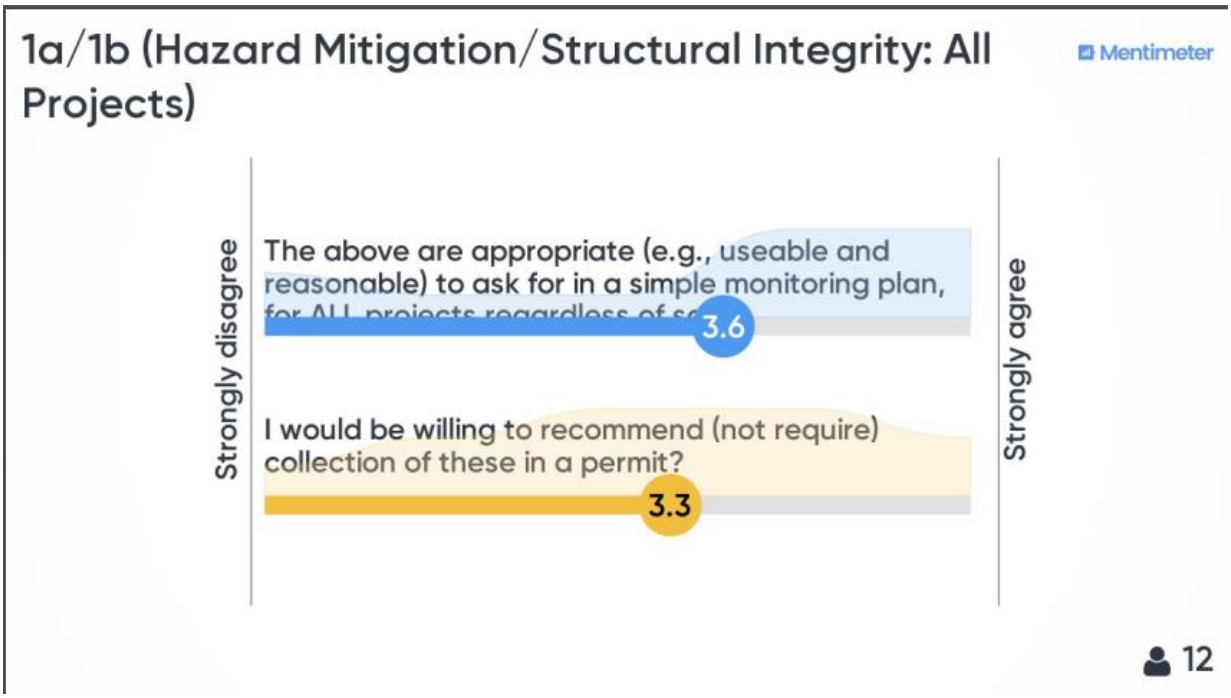
The question is whether the whole group of indicators is useful for all projects, and would you recommend collection of these indicators.

Hazard Mitigation/Structural Integrity: All Projects

- **Local scour/visible erosion**
- **Slope or change in slope**
- **Change in water elevation and/or wave heights landward/seaward of the feature**
- Change in vertical elevation of points on the feature
- Change in horizontal position of points on the feature

1a. The following are useable and reasonable to ask for in a simple monitoring plan, for ALL projects regardless of scale

1b. I would be willing to recommend (not require) collection of these in a permit*?



- Depending on the scale of the project, private landowners aren't going to be able to do some of this monitoring. They don't necessarily know anything about anything, it would have to be really easy
- Change in vertical elevation/horizontal elevation is easy to do in GIS. But Local scour can't be looked at from GIS data. The metric needs to meet the size/scale of the project, and it depends who will be responsible for the monitoring.
- The idea is that landowners would be expected to collect the data. would you be willing to recommend that
- it depends on the magnitude of the data you want collected. I could ask them to collect it, but might not be scientifically rigorous. I could say take a picture, or tell me if it fell apart. Depends on rigor and who will do the collection.
- Scale of the project and who will be constructing it would affect the willingness of someone to provide this information. But until we can enforce a standard process and a solid monitoring plan that would contribute to the knowledge about the success of the project, I would hesitate to recommend anything. Nobody wants to do more than they are required. If we include special conditions, they are written in a way that they need to be enforceable and are tied to compliance -when we require mitigation, we have a set standard language, no ambiguity and everything we require is justified, it's not a suggestion. We can't be liberal with that kind of language. People will only do what they have to do.

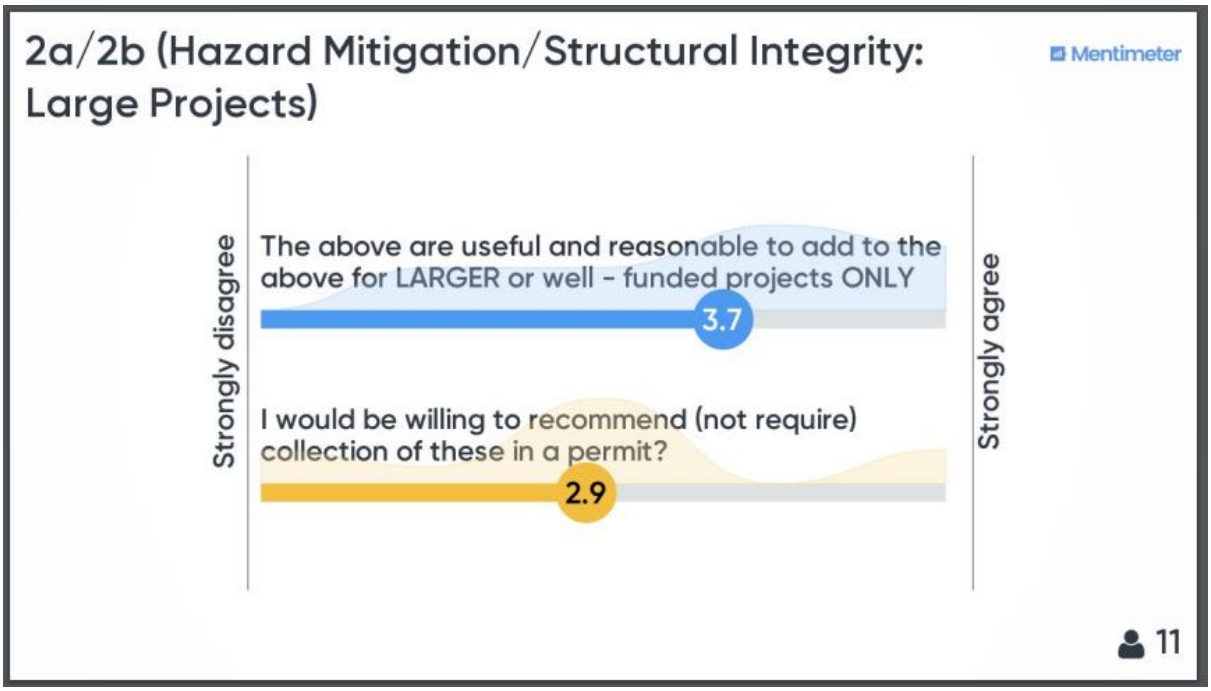
- Compliance of the permit – did they build what they said they would build. The question of how is it working – I'm with xx here, we don't put that in permit. It's nice to do if they want to, but it won't really fly.

Haz Mitigation/Structural Integrity (for large scale projects)

- Wave heights/wave energy
- Sediment loss/gain downdrift/updrift of the feature
- Survival rate of living material/change in biomass

2a. The above are useful and reasonable to add to the above for LARGER or state- funded projects ONLY (Type of question: Agree/ Disagree):

2b. I would be willing to recommend (not require) collection of these in a permit. (Type of question: Yes/No)



Generally feeling they are useful and reasonable, but not very willing to recommend them.

- Agree with [USACE] relating to enforceability and compliance – we don't issue permits with voluntary conditions. Who would handle enforcement?

(Core Team)– We've skirted around the issue of enforceability. We thought as it more about incentives. What incentives might be appealing. The larger struggle is with smaller private land

owners – it's not enforceable unless there is something that feeds off the permitting process. On larger projects, it might be a question of consistency – we can make sure that we are collecting comparable data. Maybe it would have the same format of required data.

- Tidal wetlands…. I'm thinking in the context of projects down state, like living shorelines ,fills, shoreline types that are going to fill below mean high water, or something that trips it so that I can require monitoring. But like a bulkhead that doesn't trip certain requirements, I can't ask for it.

(Core Team, Facilitator) Can you recommend it?

- Yea you could but, you wouldn't put that in a permit condition. The permit conditions are only what the applicant has to do. A large chunk of the projects would trip the regulatory thing that would require the applicant to do it - - but not every single NNBF project.

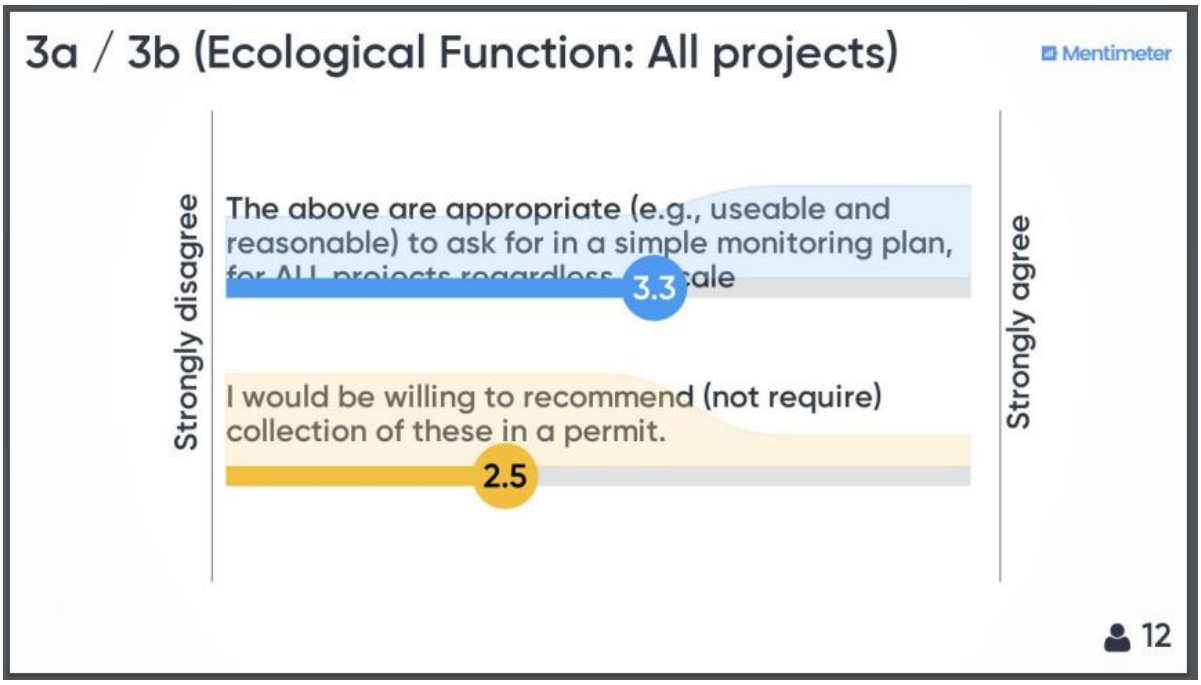
(Core Team, Facilitator) - a situation could present an opportunity where it could be required. If a larger project is generating impacts, it could be a part of the condition to require monitoring. Hitch your wagon to these opportunities.

Ecological Function – All Projects

- **Vegetative cover (%)**
- **Survival rate of living material/change in biomass**
- Species composition/richness/native vs. non-native
- Wrack/woody debris on shoreline

3a. The following are useful and reasonable ask for in a simple monitoring plan, for ALL projects regardless of scale (Type of question: Agree/ Disagree):

3b. Would you be willing to recommend (not require) collection of these in a permit? (Type of question: Discussion)



- Slightly disagree. I'm not sure why you would ask about vegetative cover for bulkheads because the answer would be 0. Some of it is not applicable to certain types of projects. It doesn't apply to things that aren't natural and nature-based.

Core Team – I can clarify. One of the ways we're thinking about the framework is comparative analysis of performance. The simple fact that it's "0" is relevant, because it tells us something about ecological function. The comparative analysis is something we're trying to get at to tell us how NNBF work for hazard mitigation, ecological function.

Core Team– We want to be able to compare. In this case, 'all project' means all scales of project.

- I disagreed, because we're working with private small owners, who would probably look at those words and run away screaming, because it's not written for the general public. Unreasonable expectation that people can provide that information, or an accurate account of what is being requested of them.

Core Team, Facilitator: If they were worded differently, would your comfort level increase?

- At the heart of it. it is offputting to the homeowner, there is already a sense of a burden, so when we consider new conditions, we have to make sure we absolutely need it. The vegetative cover would only come in if it was relevant to our decision making process. Not necessarily if it's just to figure out whether NNBF work. We are constrained by laws and regulations, so we are sensitive to additional requests.

Core Team: What are the consequences, if I was getting the permit, and it's not ecologically function - so say it met certain goals and not others. What is the agreed upon purpose and need, and what is the incentive for the applicant. Would they have leeway ….

Core Team: Is there a benefit and a consequence to the homeowner?

- In the ecological function group, it was designed by basic research scientists, and we tried to be very simple, but the top two – they are simple, easy to assess, fundamental to the performance of the feature. So whatever the consequences are, if there's no vegetative cover where it's supposed to be living, that's a clear indicator of success/problem.

Core Team – This monitoring is to learn and gather knowledge. Is there an idea that there would be consequences to the homeowner.

Core Team– I think that's for permitters to answer.

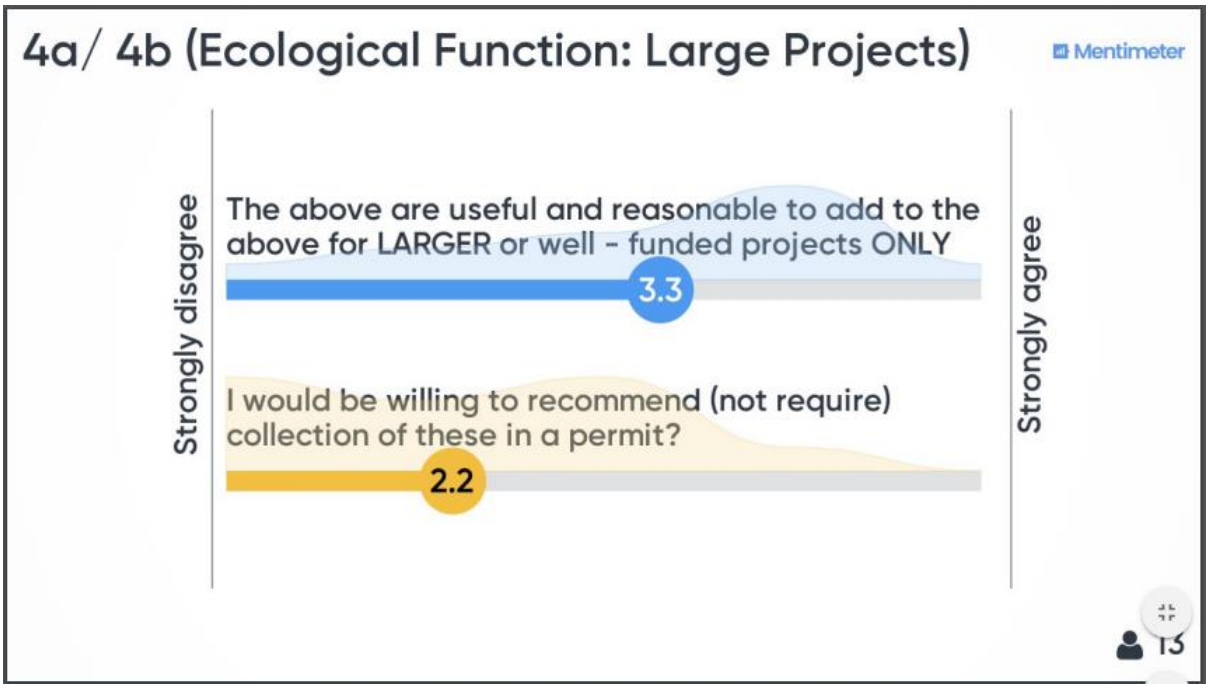
Core Team – this is related to the difference between recommend and require. Those distinctions are difficult – the boundary between recommend and require is not all that clear. Whatever is attached to the permit requirement can have consequences for them. We still want to learn in this area and figure out how to do that – the question for me is, who are we incentivizing and what mechanisms are we using? Does it have to be the Permit? Can it be NEPA review, or incentivizing conservation groups that are right now the most active and focused on learning in this area.

Ecological Function – large, well-resourced projects.

4a. The following are useful and reasonable to add to the above for LARGER or state- funded projects ONLY (Type of question: Agree/ Disagree):

4b. I would be willing to recommend (not require) collection of these in a permit? (Type of question: Agree/Disagree)

- Species Diversity
- Connectivity across land/water interface
- Benthic invertebrate abundance
- Tidal hydrology
- Sediment accretion (marshes only)



Core Team: There's already kind of a culture/practice of monitoring for ecological impacts.

- I wear a lot of hats. In that capacity, we do recommend to partners and are successful in getting these things done.

Core Team, Facilitator – Willingness to recommend seems lower. Maybe the nature of the conversation, and people taking that in.

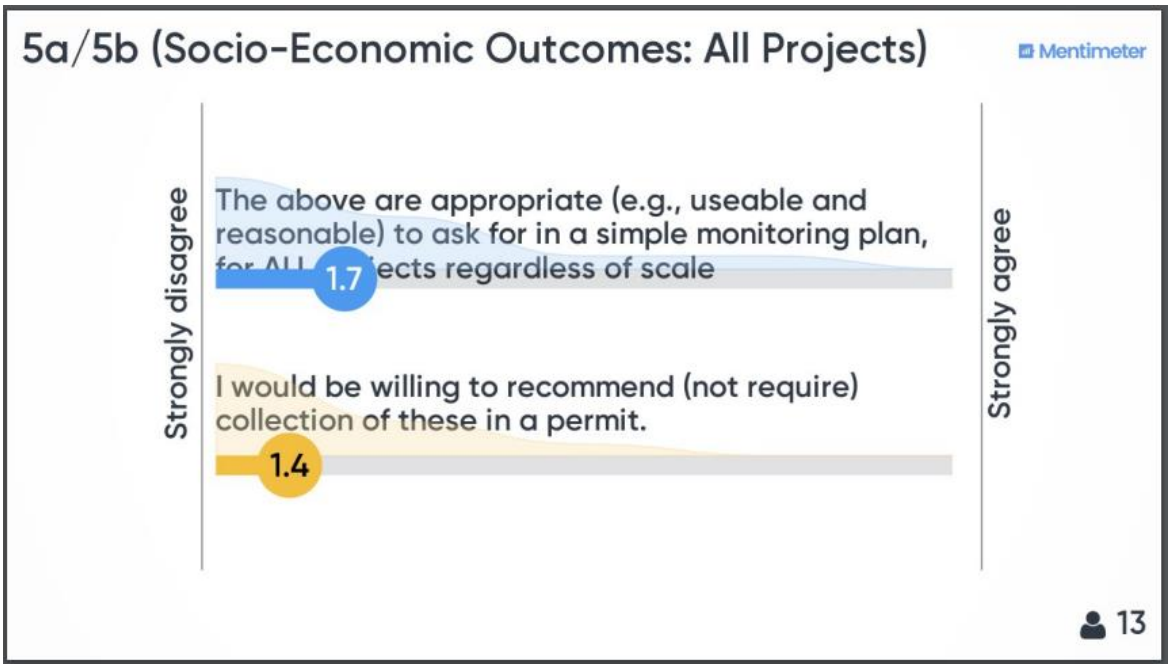
- I think it's possible that we're all thinking about it and are less willing to recommend, overall.
- Some of the hesitation on these parameters is the difficulty in the measurement methods. Equipment is hard to require or even suggest. So the difficulty/cost/specialty is a factor .

Socio-Economic Outcomes – All projects.

5a. The following are useful and reasonable to ask for in a simple monitoring plan, for all projects regardless of scale: (Type of question: Agree/ Disagree)

5b. I would be willing to recommend (not require) collection of these in a permit. (Type of question: Agree/disagree + Discussion)

- # of stakeholders / groups participating in stewardship activities
- **# households exposed to flooding and/or erosion**
- # public facilities with reduced risk



Core Team, Facilitator - Pretty strongly 'disagree'

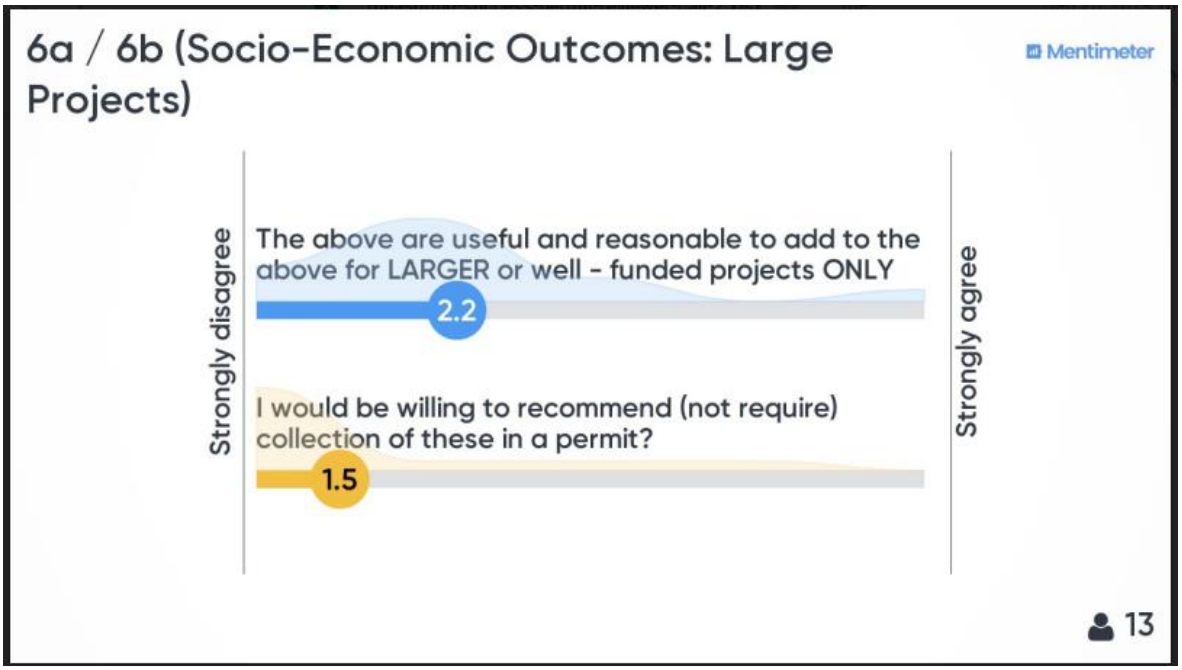
- This is sort of the take home point, that it's not the responsibility of permitees to handle this, it requires modeling, it needs to happen at a higher level.

Socio-economic Outcomes – Large Projects.

6a. The following are useful and reasonable to add to the above for larger or well- funded projects ONLY (Type of question: Agree or Disagree):

6b. I would be willing to recommend (not require) collection of these in a permit (Type of question: agree/disagree)

- Change in value of recreation and tourism
- # and diversity of stakeholders attending public meetings in project design
- Survey of community shoreline use or attitudes toward shoreline feature benefits/costs



- for me this is farther and farther away from what we actually regulate. At the water, that's where our permit ends – recreation and tourism, those kinds of things are just not associated with our permit.
- **chat box –** in my opinion, this is information that everyone would like to have, but requiring through homeowners – I would be more willing to recommend allowing access for others to monitor, i.e. researchers.

Core Team– Maybe the question is not doing the monitoring, but providing the access for others to the monitoring. I think that's a really interesting things to highlight.

Core Team – In San Francisco, it's a similar mechanism to what [DEC] proposed – the key though is taking a percentage of the permit fees and putting it into a pot of money that supports the data collection and analysis. So you have to look at the structure of permit fees, or find some source of funding for outside parties to do the monitoring.

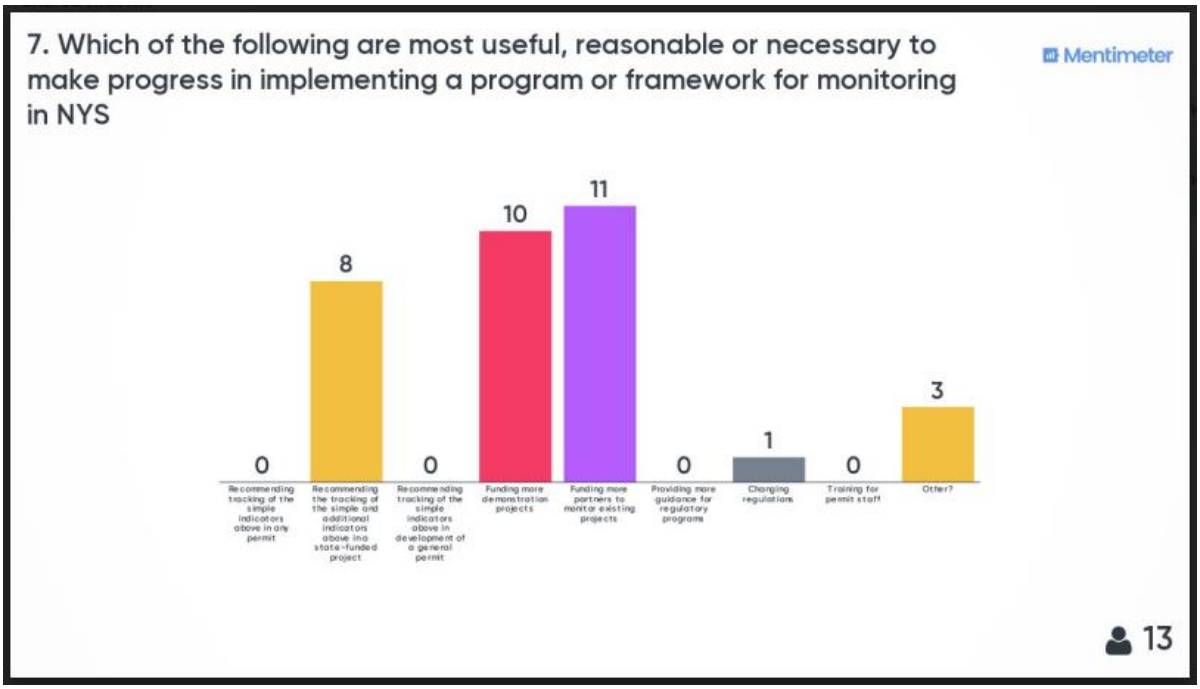
Implementing the Framework

Which of the following are most useful, reasonable or necessary to make progress in implementing a program or framework for monitoring in NYS. (Type of question: choose top three)

(The following correspond with categories on the x-axis of chart below)

- Recommending tracking of the simple indicators above in any permit
- Recommending the tracking of the simple and additional indicators above in a state-funded project

- Recommending tracking of the simple indicators above in development of a general permit
- Funding more demonstration projects
- Funding more partners to monitor existing projects
- Providing more guidance for regulatory programs
- Changing regulations
- Training for permit staff
- Other?



- One of the others would be projects that were undertaken for public benefit, on state land – not necessarily demonstration projects, but areas where this can be done where you can incorporate monitoring money for funding allocation. Different from 'state funded' projects – Lake Ontario Flood Relief money went to individual homeowners. It's still state-funded, but going to individuals.

Core Team, Facilitator - Why did monitoring existing projects rank so highly?

- Given the current way regulations are written, I don't see how most projects could require that people do this monitoring. Could be voluntary outside of the permit process, like send a letter after someone receives a permit, but would probably lead to inconsistent data. If you want consistent data, and make sure work gets done, provide funding for some outside agency to do the monitoring.

Core Team – Funding more demonstration projects and funding more partners to monitor – is there a benefit to a demonstration project if there's no way to measure the success of the project? Those two seem to go hand in hand.

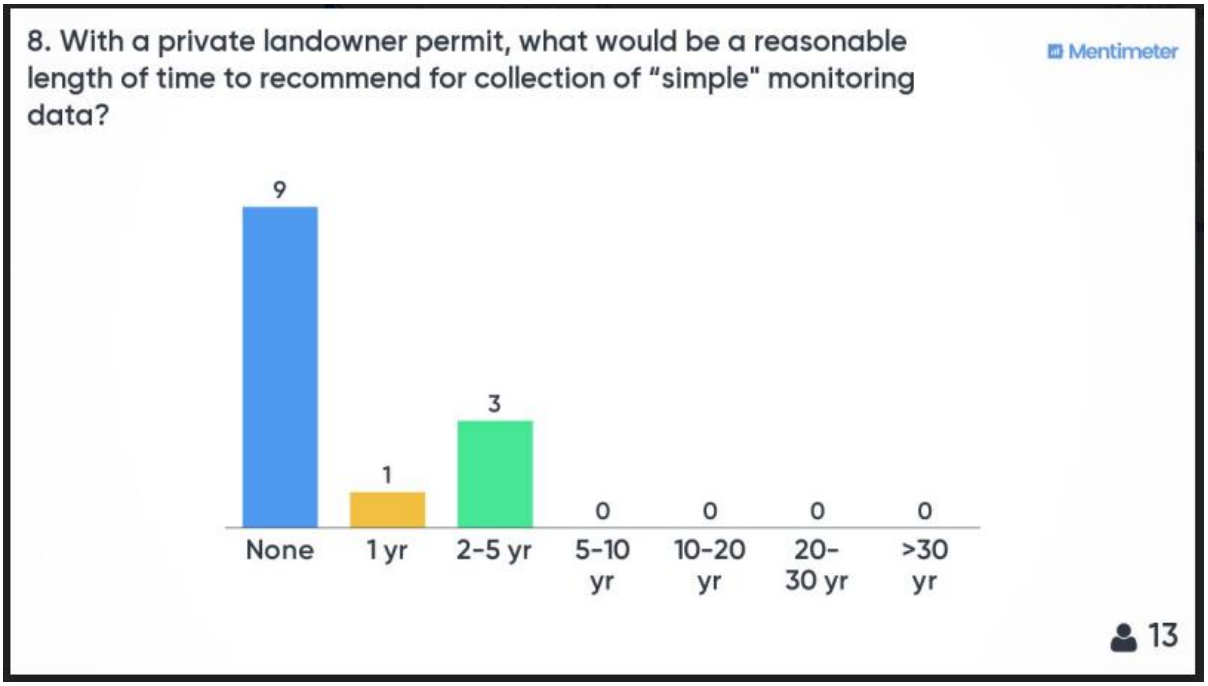
Assumption that for a demonstration project, monitoring was implied.

Core Team – Caveat, including monitoring as a funding requirement – but a lot of grant projects only fund capital investment, not monitoring. So as we think about the mechanisms, it's important to think about.

Core Team – the idea of 'Recommending tracking of simple indicators in general permit,' nobody thought that was a feasible way. Why?

- If you're going to require it in a general permit, you still need regulatory backing to do that. I'm not sure what that regulatory backing would be.
- At USACE, those general permits exist and they don't have the requirement in them.
- So until the regulations change, that idea is a non-starter.
- I don't know how you'd put incentives – If you want to bring in an incentive, a general permit wouldn't be the right place for that. The only thing people want from a permit is to get them faster. If you were to use that to incentivize - - it sounds like you're paying to play, and that's just not the way we work.

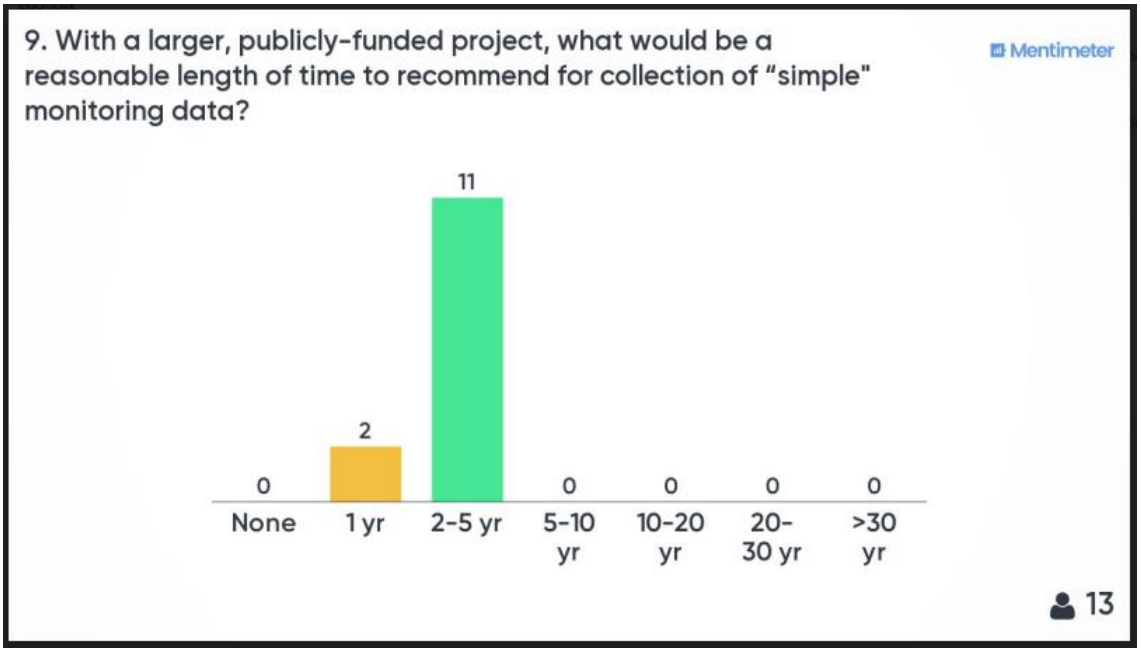
Monitoring Length Questions



- In a regulatory context, you can always have those conversations and recommend, certain projects where I can require, I have two hats – I do things to promote projects moving forward. The 5 years is based on NYS monitoring.

Core Team, Facilitator: If you think about the permitee – would asking for data collection from a 2-5 year period, how much resistance would that meet?

- The type of projects that I'm thinking about – like new innovative shoreline types – if someone is willing to do that in the first place, they are likely willing to do some amount of monitoring.
- Find out where it's a good fit – it may not be as much of a burden for those going down a more innovative path.
- **(on chat)-** wouldn't be comfortable asking the monitoring, btu if someone was interested in doing it we could recommend that 2-5 years is a good time.



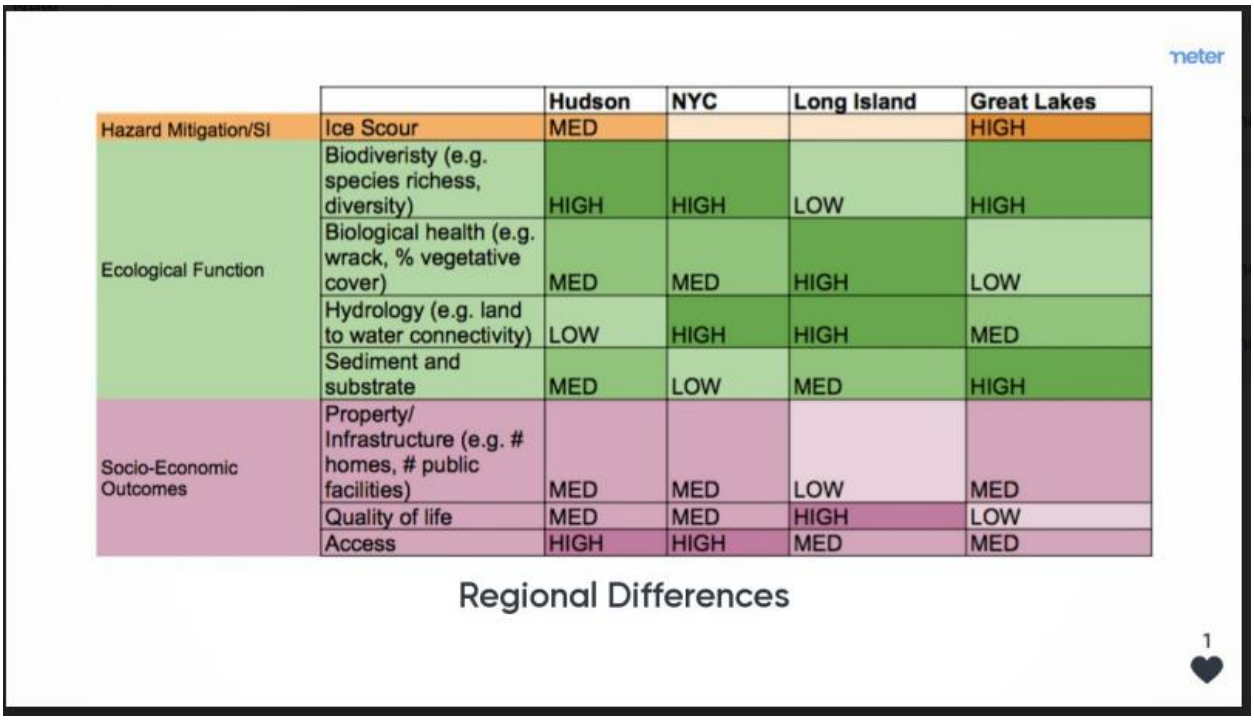
- Depends on magnitude of the project.

Core Team, Facilitator: What's the longest you can imagine? Is there a band beyond the 5 years?

Core Team: A lot of people are answering 2-5 years, which is lower than I expected. Do you feel like having the 2-5 year tracking would give you enough to feel confident that you had an understanding of how the project is performing?

- Depends on the magnitude – and is it a pilot? Is it a brand new thing? If it's something people are pretty confident about already, you can ask for less.

Regional Differences



		Hudson	NYC	Long Island	Great Lakes
Hazard Mitigation/SI	Ice Scour	MED			HIGH
Ecological Function	Biodiveristy (e.g. species richess, diversity)	HIGH	HIGH	LOW	HIGH
	Biological health (e.g. wrack, % vegetative cover)	MED	MED	HIGH	LOW
	Hydrology (e.g. land to water connectivity)	LOW	HIGH	HIGH	MED
	Sediment and substrate	MED	LOW	MED	HIGH
Socio-Economic Outcomes	Property/ Infrastructure (e.g. # homes, # public facilities)	MED	MED	LOW	MED
	Quality of life	MED	MED	HIGH	LOW
	Access	HIGH	HIGH	MED	MED

Core Team, Facilitator: Is this real? Are these regional differences real?

- No I don't think it's a real difference. Sediment monitoring, substrate, should be similar throughout all the regions. It might depend more on the site/project, not the state region.
- I think Ice Scour is probably more important in the great lakes but otherwise I don't think so.

CONCLUSIONS AND NEXT STEPS

Core Team: TWG finalize draft framework, monitoring in spring and summer.

APPENDIX E. DRAFT MONITORING FRAMEWORK MATRICES AND PRELIMINARY PROTOCOLS

This appendix describes the draft list of indicators and potential protocols that were shared with the Regional working groups.

ECOLOGICAL FUNCTION

DRAFT MONITORING FRAMEWORK MATRIX

Ecological Function: One of the most compelling features of NNBF is the ecological benefits that they can provide. These benefits range from increasing biodiversity and habitat at a site to providing connectivity to other sites. NNBF can facilitate hydrologic functions within and between coastal sites and can support processes that improve water quality. Much of this function is facilitated by maintenance of sediment formation and transport processes. The natural processes and ecological functions of shorelines are closely linked to their provision of other benefits, including hazard mitigation and social and economic benefits. Thus monitoring strategies for these benefits are highly complementary and should be coordinated with monitoring plans for hazard mitigation and structural integrity and socio-economic outcomes. There is high potential for low-cost, possibly citizen-based rapid assessment protocols for these ecological benefits. There are potential concerns with ecological disamenties, for example installation of ecologically attractive features at a site with past contamination could create an "attractive nuisance" and facilitate wildlife exposure to contaminants.

PRELIMINARY PROTOCOLS

The draft summary table contains a subset of possible protocols that can be used for monitoring each ecological parameter and metric listed. The protocols come from a variety of sources, and we drew from existing, published protocols when possible. The current list of protocols for monitoring biotic parameters (i.e., biodiversity, biological health) are mostly focused on marsh and upland systems, and most protocols require medium to high levels of expertise and effort. Although some protocols can be used to monitoring multiple parameter or metrics, unlike the Hazard Mitigation & Structural Integrity TWG, many of our protocols are suitable for measuring only one parameter or one metric.

DRAFT

QUESTIONS FOR THE RWG

- Ideally, we will end up with a list of parameters and metrics that are measurable using rapid field protocols that are low cost and require minimal expertise. Also, which metrics would be easiest to compare across all types of NNBF? At the moment, the protocols listed in the summary table are mostly intended for wetlands, so we would be interested in suggestions for protocols that could be applied to other NNBF types.
- What level of detail should protocols included with draft monitoring framework have?
- Are there other rapid protocols not included in this monitoring framework that need to be considered? Which parameters and metrics could they monitor?
- We also understand that there is often a tradeoff between rapid, low cost protocols and data quality and robustness, so we are looking for feedback on how to best balance the need for data that can detect differences in NNBF with protocols that are not cost-prohibitive or require expertise that most groups would not have.
- Should we be considering the potential ecological disamenities, for example installation of ecologically attractive features at a site with past contamination could create an "attractive nuisance" and facilitate wildlife exposure to contaminants?

DRAFT

ECOLOGICAL FUNCTION MATRIX

RESILIENCE SERVICE	PERFORMANCE PARAMETER	POTENTIAL PERFORMANCE GOAL STATEMENT	INDICATOR/METRIC	PROTOCOL
Ecological Function	Biodiversity (species richness and species evenness)	Sustain & increase native biodiversity (consider targeting biodiversity of healthy reference sites,as determined by site visits and historical literature).	Species richness and evenness by plant community / habitat type	2-Fauna Presence
				3-Horseshoe Crab Spawning Activity Survey
				4-Standardized North American Marsh Bird Monitoring Protocol
				5-Saltmarsh Habitat & Avian Research Programs (SHARP)
				6-Monitoring Nekton as a Bioindicator in Shallow Estuarine Habitats
				7-Quantifying Vegetation and Nekton Response to Tidal Restoration of a New England Salt Marsh
				8-Plant and animal species ID using iNaturalist
				9-Natural Areas Conservancy Upland Forest Assessment
			Benthic invertebrate abundance, composition, richness, biomass, population density	2-Fauna Presence
				10-Benthic epifauna survey
				11-Benthic fauna survey
	Biological Health (abundance / size / reproduction)	Conserve or restore habitats.	% vegetative cover/species or functional group or area	12-Vegetation extent using aerial imagery
				13-Vegetation extent in field transects/plots (area covered by veg)
				9-Natural Areas Conservancy Upland Forest Assessment
			Height of vegetation / # stems (to assess biomass/size/cover)	14-Rapid assessment protocol TBD
				1-Change in vegetation structure
			% native vegetation cover, % non-native vegetation cover, % bare ground/sand, % wrack, % woody debris (branches, logs)	1-Change in vegetation structure
			Survival rate of living material	17-Vegetation survival survey
			Flowering, fruiting	1-Change in vegetation structure
			Recruitment of plant species	1-Change in vegetation structure
			Plant community (composition, richness, invasives)	18-Invasive plant survey
				1-Change in vegetation structure
	Habitat connectivity	Sustain or Increase habitat connectivity along and across the shoreline zone.	Connectivity across land/water interface / connection of upland to in-water habitat	16-Rapid assessment protocol (TBD)
			Connectivity of/within same / similar type habitats	16-Rapid assessment protocol (TBD)
	Hydrology (water movement, including tidal movement / flushing)	Maintain, restore or enhance tidal and internal site hydrology.	Tidal hydrology (continuous & discrete data): inundation frequency, (peak) water level	19-NOAA Inundation Analysis Tool
				20-NOAA Tide Level Monitoring Protocol
			tidal flushing / residence time	TBD
			Marsh sediment accretion rates with surface elevation tables and horizon markers	21-Marsh surface elevation tables (SET)
				22-Real time kinematic (RTK) positioning
	Water quality (processes that support / contribute to quality)	Improve or maintain processes that contribute to water quality.	Nutrients (nitrogen, phosphate) / denitrification	Rapid assessment protocol TBD
			Presence and abundance of filter feeders	10-Benthic epifauna survey
			Dissolved oxygen	30-USGS National Field Manual for the Collection of Water-Quality Data
				27-USGS Guidelines and Standard Procedures for Continuous Water-Quality Monitors
	Sediment and substrate (availability / transport / distribution at and/ or adjacent to site)	Maintain, restore or enhance sediment availability and transport processes.	Survival of living material (proper implementation of maintenance guidance for NNBF). sediment availability / transport / distribution*. bio accumulation / substrate accumulation over time	Rapid assessment protocol TBD
				23-Spatially integrative metrics reveal hidden vulnerability of microtidal salt marshes
				24-USGS measurement, controlling factors, and error analysis for SS fluxes in a tidal wetland
	Contaminants (that affect ecological function)	Reduce contaminants that threaten ecosystem function.	Presence of toxins & contaminants	25-Site history analysis (TBD)
				29-Contaminant testing in soils, plants, and/or animal tissues
				26-USGS NFM for the Collection of Water-Quality Data--Chapter A8. Bottom-Material Samples
				31-USGS SOP for collection of soil and sediment samples for the SCoRR strategy pilot study

ECOLOGICAL FUNCTION PRELIMINARY PROTOCOL LIST

#	PROTOCOL NAME	EXISTING AVAILABLE PROTOCOL?	APPLICABLE TO ALL NNBFS?	STATUS	TYPE	EXPERTISE REQUIRED	COST/ EFFORT	SOURCE
Example Protocol								
1	Change in vegetation structure	Y		Draft Included	Field	Medium	Medium	NYC Parks Salt Marsh Monitoring Guidelines
Additional Protocols to Consider								
2	Fauna Presence	Y	Y	Suggested	Field	Low	TBD	NYC Parks Salt Marsh Monitoring Guidelines
3	Horseshoe Crab Spawning Activity Survey	Y	N (beach/ sandy shorline)	recommended existing protocol	Field	Medium	TBD	Sclafani, M., K. McKown, B. Udelson. 2014. Horseshoe Crab (Limulus polyphemus) Spawning Activity Survey Protocol for the New York State Marine District. Cornell University Cooperative Extension of Suffolk County. New York State Department of Environmental Conservation. (http://nyhorseshoecrab.org/NY_Horseshoe_Crab/Documents_files/Total%20Count%20Protocol.pdf)
4	Standardized North American Marsh Bird Monitoring Protocol	Y	N (salt marsh)	Draft Included	Field	High	TBD	Conway, C.J. 2011. Standardized North American Marsh Bird Monitoring Protocol. Waterbirds 34(3):319-346. http://www.bioone.org/doi/pdf/10.1675/063.034.0307
5	Saltmarsh Habitat & Avian Research Programs (SHARP)	Y	N (salt marsh only)	recommended existing protocol	Field	High	TBD	Saltmarsh Habitat & Avian Research Program. 2015. Nest Monitoring Standard Operating Procedure. (https://www.tidalmarshbirds.net/?page_id=1596)
6	Monitoring Nekton as a Bioindicator in Shallow Estuarine Habitats	N*	N (sea grass and salt marsh)	Suggested	Field	High	TBD	Raposa, K.B., C.T. Roman, Heltshe, J.F. 2003. Monitoring nekton as a bioindicator in shalLestuarine habitats. Environmental Monitoring and Assessment 81: link.springer.com/chapter/10.1007/978-94-017-0299-7_21
7	Quantifying Vegetation and Nekton Response to Tidal Restoration of a New England Salt Marsh	N^	N (salt marsh)	Suggested	Field	High	TBD	Roman, C.T., K.B. Raposa, S.C. Adamowicz, M.J. James-Pirri, J.G. Catena. 2002. Quantifying Vegetation and Nekton Response to Tidal Restoration of a New England Salt Marsh. Restoration Ecology 10(3):450-460. https://onlinelibrary.wiley.com/doi/full/10.1046/j.1526-100X.2002.01036.x
8	Plant and animal species ID using iNaturalist	Y	Y	Suggested	Field	Low	TBD	https://www.inaturalist.org/pages/how+can+i+use+it
9	Natural Areas Conservancy Upland Forest Assessment	Y	N (upland forest)	Suggested	Field	High	TBD	Natural Areas Conservancy
10	Benthic epifauna survey	Y	N (salt marsh)	Suggested	Field	Medium	TBD	NYC Parks Salt Marsh Monitoring Guidelines
11	Benthic fauna survey	Y	N (salt marsh)	Suggested	Field	High	TBD	NYC Parks Salt Marsh Monitoring Guidelines
12	Vegetation extent using aerial imagery	Y	N (salt marsh)	Draft Included	Desktop	Low	TBD	NYC Parks Salt Marsh Monitoring Guidelines
13	Vegetation extent in field transects/ plots (area covered by veg)	Y	N (salt marsh)	Suggested	Field	Medium	TBD	NYC Parks Salt Marsh Monitoring Guidelines
14	Rapid assessment protocol to measure height of vegetation (to be developed?)	TBD	TBD	TBD	Field	Low	TBD	TWG?
15	Hudson River Living Shorelines Rapid Assessment Protocol	Y	TBD	recommended existing protocol	Field	Low	TBD	Findlay, S. O. Ferguson, E. Hauser, J. Miller and A. Williams. Hudson River Monitoring Protocol: Living Shorelines Rapid Assessment Protocol. NYSDEC Hudson River National Estuarine Research Reserve, Norrie Point Environmental Center, Staatsburg, NY 12580.
16	Rapid assessment protocol connectivity across land/water (to be developed?)	TBD	TBD	TBD	Field	Low	TBD	TWG?
17	Vegetation survival survey	Y	N (salt marsh)	Suggested	Field	Medium	TBD	NYC Parks Salt Marsh Monitoring Guidelines
18	Invasive Plant survery	Y	N (salt marsh)	Suggested	Field	Medium	TBD	NYC Parks Salt Marsh Monitoring Guidelines
19	NOAA Inundation Analysis Tool	Y	Y	Suggested	Desktop	Low	TBD	https://tidesandcurrents.noaa.gov/inundation/usersguide/usersguide.pdf
20	NOAA Tide Level Monitoring Protocol	Y	Y	Suggested	Desktop	Low	TBD	NOAA
22	Marsh surface elevation tables (SET)	Y	N (salt marsh)	Suggested	Field	High	TBD	NYC Parks Salt Marsh Monitoring Guidelines
22	Real time kinematic (RTK) positioning	Y	N (salt marsh)	Suggested	Field	High	TBD	NYC Parks Salt Marsh Monitoring Guidelines
23	Spatially integrative metrics reveal hidden vulnerability of microtidal salt marshes	N ^	N (salt marsh)	TBD	Desktop	High	TBD	https://www.nature.com/articles/ncomms14156
24	USGS measurement, controlling factors, and error analysis for SS fluxes in a tidal wetland	N *	N (salt marsh)	TBD	Field	High	TBD	https://pubs.er.usgs.gov/publication/70027349
25	Site history analysis?	TBD	TBD	TBD	TBD	TBD	TBD	TBD
26	USGS NFM for the Collection of Water-Quality Data--Chapter A8. Bottom-Material Samples	Y	TBD	TBD	Field	High	TBD	https://water.usgs.gov/owq/FieldManual/Chapter8/508Chap8final.pdf
27	USGS Guidelines and Standard Procedures for Continuous Water-Quality Monitors	Y	TBD	TBD	Field	High	TBD	https://pubs.usgs.gov/tm/2006/tm1D3/
28	Rapid assessment protocol - sediment/ substrate (to be developed?)	TBD	TBD	TBD	Field	Low	TBD	TWG?
29	Contaminant testing in soils, plants, and/or animal tissues	Y	N (salt marsh)	Suggested	Field	High	TBD	NYC Parks Salt Marsh Monitoring Guidelines
30	USGS National Field Manual for the Collection of Water-Quality Data	Y	TBD	TBD	Field	High	TBD	https://water.usgs.gov/owq/FieldManual/index.html
31	USGS SOP for collection of soil and sediment samples for the SCoRR strategy pilot study	Y	TBD	TBD	Field	High	TBD	https://pubs.er.usgs.gov/publication/ofr20151188B
32	Photo Points	Y	Y	Suggested	Field	Low	TBD	NYC Parks Salt Marsh Monitoring Guidelines

^methods from study
**guidelines for developing protocol*

EXAMPLE PROTOCOL: CHANGE IN VEGETATION STRUCTURE

Purpose:

Characterize the restored vegetation communities and determine plant survival, cover, and density over time. Determine if the restoration successfully provides the function of vegetated habitat.

Definition: Vegetation structure is the cover, density, height, and diameter attributes of the vegetation.

Metrics:

- Percent cover of vegetation, by species
- Stem density (number of stems per unit area), by species
- Stem height, by species
- Stem diameter, by species

Methods:

Percent cover:

Characterize percent cover of vegetation and non-vegetation in plots (Figure 1). Use visual percent cover estimates to determine the cover of vegetation by individual species and non-vegetation (bare ground, plant litter, organic wrack, garbage, etc.) in each quadrat. Estimate percent cover to a midpoint of the agreed-upon vegetation class and come to a consensus on cover class for each species, for example, using the Ecological Society of America cover class midpoints (0.50%, 2.50%, 8.75%, 18.75%, 37.50%, 62.50%, 87.50%). Use midpoints of cover classes instead of the cover class range to facilitate data summary and analysis. Assign cover class midpoints for each species within a plot, rather than absolute values. Cover may be impacted based on structural diversity (e.g. species occur in different strata and may overlap), thus the plot total percent cover may be less than or greater than 100%.

Stem density:

Determine stem density by counting the number of individual stems for each plant species within a subplot of the same plots used for percent cover (Figure 1). Make separate counts of both the number of flowering and non-flowering stems.

Stem height:

Measure stem height from the bottom of the stem at the ground or above any exposed roots to the terminal leaf node (final leaf branching point) prior to the base of the inflorescence (flowering head). Measure the stem height of five random stems of the dominant species in plots (Figure 1).

Stem diameter:

Measure stem diameter of the same five stems of the dominant species measured for stem height in the same plot. Measure the diameter a quarter of the height of the stem (e.g. stem height=100cm, measure stem diameter 25cm from the ground) using millimeter calipers.

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Data Management:

Field crews can collect data on paper or digitally using portable tablets or data loggers in the field. If using paper data sheets, use of waterproof paper sheets , is advised to ensure data are not lost due to rain or other issues with water that may occur in the field. Field collected data should be checked for completeness prior to leaving the field site. The field collected data should be scanned or downloaded and stored digitally once monitoring is complete. Upon return from the field, data should be entered into a computer spreadsheet, such as Microsoft Excel, or monitoring database, and checked against the field collected data record by an independent observer for quality assurance. Quality assurance should reflect protocols outlined in the project QAPP, if one exists for the project.

All digital data (entered data, spatial data, photos, analysis, etc.) should be stored with metadata that describes the data and their source. Sampling metadata should define all column headers in data spreadsheets and spatial data metadata should describe the spatial data type (point, line, polygon), what the data represent (sampling area, plots, transects, etc.), the source of the data (field location, collectors, and collection date), and any additional attributes.

Ideally, a plan for what type(s) of data analysis will be conducted should be developed before any data are collected. Data analysis can range from descriptive statistics and graphs that summarize metrics to inferential statistical analyses that test hypotheses regarding different restoration methods or site characteristics. For inferential statistics, picking an appropriate statistical model that is suitable for the data being collected ensures that the results are interpreted properly. For example, some statistical models assume that data are normally distributed. If a dataset does not meet that assumption, this can lead to erroneous results. Finally, all analysis should be tracked and documented fully (include all formulas, computational language, and test results for statistical analyses).

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HAZARD MITIGATION & STRUCTURAL INTEGRITY

DRAFT MONITORING FRAMEWORK MATRIX

Hazard Mitigation: How well does this feature reduce risk? While shoreline management features cannot prevent hazards from occurring, they can mitigate their negative effects on people or assets by reducing their exposure or vulnerability to that hazard. By hazard, we are referring to a potential source for damage, harm or other adverse effect like flooding and coastal erosion.

Structural Integrity: How well will the shoreline management feature "hold up" and still maintain other performance goals (goals related to hazard mitigation, ecological performance, or community benefits)? These metrics should consider material performance and physical condition over time among other things. Note: This topic is relevant to the other resilience service areas, and may be its own resilience service, but for now has been examined alongside hazard mitigation.

The Hazard Mitigation and Structural Integrity group developed the evaluation roadmap to specifically address the following performance parameters:

- In the evaluation of topographic change due to natural coastal processes and large storm events, a feature should be designed to maintain natural coastal processes, allow a shoreline to adapt to sea level rise, as well as reduce shoreline erosion that can have adverse effect on people, property, and native ecosystems.
- In the evaluation of the coastal flooding hazards, a feature should be designed to reduce the exposure or vulnerability to coastal flooding that can have adverse effect on people, property, and native ecosystems.
- In the evaluation of structural integrity, a feature should be designed and built to sustain structural integrity over time within context of natural coastal processes, as well as large storm events.

To evaluate these three performance parameters, eleven distinct indicators or metrics were identified. To facilitate measurements of these indicators/metrics, seven protocols have been developed. The TWG is cognizant of the fact that additional protocols may be necessary to facilitate different levels of expertise required to evaluate the identified indicators or metrics.

PRELIMINARY PROTOCOLS

The TWG developed or identified seven protocols to evaluate performance goals, and more specifically the identified metrics/indicators. The protocols developed by the TWG drew from existing, published protocols when possible, as well as best professional judgment. While many of the published protocols are based upon natural shorelines or NNBFs, the TWG attempted to develop protocols that were not specific to asset type (i.e., inclusive of both "grey" and "green" shoreline types).

The TWG recognizes that current protocols require a higher level of expertise, or are more intensive field protocols. Future revisions may address the following to better reflect input from the RWGs:

- Simplify existing protocols, or develop parallel protocols that are more directed to citizen science.
- Develop more qualitative protocols to address (1) evaluation of grey degradation, and/or (2) degradation, local scour, visible erosion, escarpments.
- Modify existing protocols to better address regionally specific storm events or seasonality of monitoring
- Customize existing protocols for tide level and boat wake.

DRAFT

QUESTIONS FOR THE RWG

- We need feedback regarding the scope of metrics and practicality of implementing outlined protocols.
- Are there metrics/indicators that should be added?
- Are there protocols that need to be added, modified or built upon?
- Do metrics/protocols adequately address shorelines in your region?
- Are protocols too intensive? Can protocols be simplified, but still retain ability to accurately evaluate identified metrics/indicators? Or should TWG develop parallel protocols more directed towards citizen science?

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HAZARD MITIGATION & STRUCTURAL INTEGRITY MATRIX

RESILIENCE SERVICE	PERFORMANCE PARAMETER	POTENTIAL PERFORMANCE GOAL STATEMENT	INDICATOR/METRIC	PROTOCOL
Hazard Mitigation & Structural Integrity	Topographic Change	Maintain natural coastal processes while reducing or avoiding increase in exposure of people, property, and ecosystems to coastal hazards through shoreline erosion	Change in vertical elevation of asset.	2-Asset Elevation
			Change in shoreline position / sea level rise adaptability.	1-Erosion Pin Install - NYCDPR*
				1-Footprint Change - NYCDPR*
				1-Asset Aerial Dimension
			Change in horizontal position of asset.	1-Asset Aerial Dimension
			Loss or gain of sediment updrift/downdrift.	1-Asset Aerial Dimension
				2-Asset Elevation
	Coastal Hazards	Reduce exposure or vulnerability of people, property, or ecosystems to coastal flooding hazards (storm surge, wave attack, high tide flooding, sea level rise, currents, etc.)	Wind driven wave heights / wave periods landward/seaward of asset.	3-Wave Measurement
			Boat wake wave heights / wave periods landward/seaward of asset.	4-Boat Wake monitoring - NYCDPR*
			Change in water elevation landward/seaward of asset	5-Tide Level monitoring - NYCDPR*
			Currents adjacent to asset.	6-Current Measurement
	Structural Integrity	Avoid structural failure and sustain the structural integrity of the shoreline feature	Change in vertical elevation of asset.	2-Asset Elevation
			Change in horizontal position of asset.	1-Asset Aerial Dimension
			Change in vegetation, shellfish, or other biomass of structure.	7-Asset Vegetation, Shellfish, or Other Biomass
			Local scour, visible erosion, escarpments.	1-Asset Aerial Dimension
				2-Asset Elevation
			Grey material degradation.	1-Asset Aerial Dimension
				2-Asset Elevation

*may not apply to all regions

HAZARD MITIGATION & STRUCTURAL INTEGRITY PRELIMINARY PROTOCOL LIST

#	PROTOCOL NAME	EXISTING AVAILABLE PROTOCOL?	STATUS	TYPE	EXPERTISE REQUIRED	COST/LEVEL OF EFFORT	SOURCE
Example Protocol							
1	Asset Aerial Dimension	Y	Draft Included	Field	Medium	Medium	Erosion Pin Install - NYCDPR, Oyster Monitoring Guidelines*
Additional Protocols to Consider							
2	Asset Elevation	Y	Draft Included	Field	High	TBD	Erosion Pin Install - NYCDPR, Oyster Monitoring Guidelines*
3	Wave Measurement	N	Draft Included	Field	High	TBD	TWG
4	Boat Wake monitoring - NYCDPR	Y	recommended existing protocol	Field	High	TBD	NYCDPR
5	Tide Level monitoring - NYCDPR	Y	recommended existing protocol	Field	Medium	TBD	NYCDPR
6	Current Measurement	N	Draft included	Field	High	TBD	TWG
7	Asset Vegetation, Shellfish, or Other Biomass	N	Draft included	Field	Medium	TBD	TWG

**may not apply to all regions*

EXAMPLE PROTOCOL: ASSET AERIAL DIMENSION

Summary information:

Protocol name / shorthand: Asset Aerial Dimension

Related resilience service category: Hazard Mitigation

Associated Parameter: Topographic Change / Structural Integrity

Associated Metric(s): (1) change in shoreline position/sea level rise adaptability; (2) change in horizontal position of asset; (3) loss or gain of sediment updrift/downdrift; (4) local scour, visible erosion, escarpments; and/or (5) grey material degradation.

Quantitative/qualitative: Quantitative

Data output / data format: Elevations and geographical extent, typically exported to excel spreadsheet as well as Geographic Information System (GIS)

Protocol type (easy, medium, hard): Medium

Description of monitoring methods / field protocols:

This protocol involves the data collection relative to mapping the aerial dimension of the asset. In term of hazard mitigation, the measure of aerial dimensions of an asset is critical to estimating the amount of restored area (if measuring a NNBF), persistence of the asset over time, as well as the quality of intended services provided to the shoreline over time. The aerial dimensions of an asset is necessary in evaluating the following metrics:

- Change in shoreline position/sea level rise adaptability
- Change in horizontal position of asset
- Loss or gain of sediment updrift/downdrift
- Local scour, visible erosion, escarpments
- Grey material degradation

At a negative low tide (if applicable), the perimeter of the asset footprint should be mapped using a mapping/survey grade Global Positioning System (GPS) with post-processing capabilities. Collection of as many data points as possible is recommended and could be facilitated through continuous measurements within GPS. The larger the data set of data points, the more accurately the perimeter of the asset can be delineated. Temporary place markers (i.e., wood stakes or PVC pipes) can be placed along the asset perimeter for reference in subsequent surveying events. Photographs should be taken along perimeter to provide reference of site conditions. Data forms to be developed by a project at a minimum should include the following base information:

- Observers
- Site location.
- Survey data and time.
- Time as it relates to tidal period (i.e., low tide, high tide)
- Survey settings: (1) equipment; (2) coordinate system; (3) datum; and (4) base monument (if utilized).

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Requirements (equipment, training, etc.):

This protocol does require use of a mapping/survey grade Global Positioning System (GPS) with post-processing capabilities. These can be rented on a daily or weekly basis from multiple vendors throughout New York. Alternatively, a standard handheld GPS could be used. Data collection with the GPS will require definition of at least the following settings:

- Frequency. Point – 1 second. Polyline – 1 foot.
- Minimum positions per point observation – 10 positions
- PDOP mask – A PDOP threshold of 6 is necessary to achieve sub-meter accuracy.
- Coordinate system – project specific.
- Real time settings. In order to guarantee the ability to post-process, real time data correction should always be set to NO.

Data points should be transferred from GPS into mapping software (e.g., ArcGIS) or civil engineering software (e.g., AutoCAD, Microstation). Transfer of data and post-processing should be performed with GPS-specific software (i.e., Trimble TerraSync), and typically is supplied by GPS rental company. Monitoring frequency should occur immediately after construction (i.e., baseline), and then annually. Additional surveys are recommended after events that could alter shoreline position (e.g., hurricanes). Seasonal monitoring may also be needed in October and April to account for changes in weather/wind patterns, seasonality of the beach profile, and seasonal above ground biomass changes.

Data QA/QC procedures:

An engineer or scientist with background in mapping should review the dataset to verify the data set is consistent with existing project mapping, and that the geographic points makes sense based upon site observations. Publicly available aerial photography can also be utilized to confirm mapping.

Data format and management requirements:

Data sets will be transferred from GPS as either a text file or ESRI shape file. Text files which can be quite large would then be converted or projected in an appropriate mapping program (i.e., ArcGIS). It is assumed that data is collected in the appropriate coordinate system and does not need to be converted at a later date. Management of data is best done through appropriate definitions of metadata. Metadata describes geographic information system (GIS) resources in the same way a card in a library's card catalog describes a book. It then supports sharing of files and data.

Data analysis protocols

Data points should be transferred from GPS into mapping software (e.g., ArcGIS, ESRI, Redlands, CA). Post-processing should be completed consistent with mapping software protocols. Mapping software should allow mapping of the geographical extent of the asset overlaid on a basemap (i.e., topography, aerial photograph). This can provide comparisons to as-built conditions or previous monitoring events. In addition, the mapping software can facilitate calculation of the aerial extent reported in square feet or acres.

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SOCIO-ECONOMIC OUTCOMES

DRAFT MONITORING FRAMEWORK MATRIX

Socio-Economic Outcomes captures the shoreline services that may impact community resilience and well-being. This can be difficult to define and may overlap with other areas, but essentially, this category is aimed at assessing if and how shoreline management features contribute to the community's or society's quality of life.

The socio-economic framework has been divided up into six primary categories in order to best capture the outcomes most directly tied to improving the environment as well as the health and well-being of the local community. Human health and safety is framed at the household – community level and designed to the dynamics happening at that level. Property value and infrastructure is framed at the community-regional scale with the ability to compare and contrast with other areas throughout the state. Quality of life is how the feature might benefit or impact an individual, group, or community's comfort, happiness or general satisfaction in the vicinity of the project. Economic resilience and livelihoods speak to the special feature of the coastlines and how they uniquely impact the economic vitality of a region. Institutional knowledge and individual capacity are tied together as a lens to better understand local culture and capacity. Participation and stewardship is viewed as critically important for education and political engagement around these issues and areas.

PRELIMINARY PROTOCOLS

The current list of protocols is wide-ranging and requires a more nuanced understanding of what is needed at each site and across sites. The types of protocols used will depend on the resources, time and energy that is available to deploying these protocols. Also, in some cases, protocols can be used as a rapid assessment and in others situations, it will require longer periods of time to collect the data. In addition, some protocols might be repeated at different timeframes and intervals. Overall, there is a range of protocols that include using publicly available datasets (i.e. property values, health indicators, employment stats). The mixed method data protocols (qualitative and quantitative) can be bundled into survey, observation and informant interviews. These protocols would be used to assess outcomes and issues related to quality of life, civic engagement and social cohesion.

DRAFT

QUESTIONS FOR THE RWG

- Which socio-economic outcomes are viewed as most important and WHY? What appears less important and WHY? Knowing the why is critical.
- We would like to know more about the application of the most important protocols.
    - Who will be collecting data using these protocols?
    - How much time will they have?
    - Who will analyze / prepare the data once it is collected?
    - What mechanisms are in place to view, share and interpret the data?
    - Ideally, it would be helpful to know about the context of how these protocols will be implemented in these areas.

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SOCIO-ECONOMIC OUTCOMES MATRIX

RESILIENCE SERVICE	PERFORMANCE PARAMETER	POTENTIAL PERFORMANCE GOAL STATEMENT	INDICATOR/METRIC	PROTOCOL
Socio-economic Outcomes	Human health and safety	Improve human health, safety, or wellness	# of households potentially impacted by a resilience project	11-Households Potentially Impacted by Resilienece Project
			# of households exposed to flooding	12-Households Exposed to Flooding
	Property value and infrastructure	Enhance or protect Property and infrastructure value	Public facilities (e.g., parks) protected by proposed project	16-Public Facilities Protected by Project
			Sales values of homes	15-Market Values of Homes
	Quality of life	Enhance / protect quality of life	Reportings and expressions from participants of how the shoreline factors into the life of their community	TBD
			Opinions from participants on major enviornmental risks in a community.	TBD
			Tellings and expressions of the sacred, revered, and unique aspects of a community as told by participants.	TBD
	Economic resilience and livelihoods	Improve / increase / enhance economic resilience and livelihood opportunities	# of days residents are unable to work because of disturbance	18-Days Unable to Work because of Disturbance
			Monthly (or yearly) rent of residential homes in $	17-Monthly Rent
			# of days of business closure	1-Days of Business Closure
			# applications for new business permits	2-Applications for New Business Permits
			# of overnight stays of tourists in local guest lodging (hotels, AirBNB)	20-Overnight Stays in Local guest lodging
			# of site visits (resident vs non-resident if possible)	1-Site Visits
			# of people employed in fisheries and aquaculture	7-People Employed in fisheries and Aquaculture
			$ value of all recreation and tourism	10-Value of Recreation and Tourism
			# of primary jobs generated by construction and maintenance of a waterfront project	9-Primary Jobs Generated by Const. & Maint.
	Institutional knowledge and individual capacity	Increase / enhance Institutional knowledge and individual capacity	# of FTE staff employed at local institutions per year	13-FTE Staff Employed at Local Institutions
			# of FTE staff engaged with/working on waterfront	14-FTE Staff Engaged with/Working on Waterfront
			# educational programs/events on waterfront	5-Educational Programs/Events on waterfront
			# of local school classes incorporating waterfront into curriculum	TBD
			Tellings and observations from participants of how they are adapting to major climate risks.	TBD
			Expressions of the benefits and drawbacks of nature-based shoreline features among local communities.	6-Local Schools Incorporaring Waterfront into Curriculum
	Participation and stewardship	Increase Participation and stewardship	# different stakeholder groups participating in public meetings related to waterfront project	4-Stakeholder Groups in Public Meetings
			# groups (or diversity of participants) participating in waterfront stewardship	TBD
			Expressions of distrust between participants and other members / stakeholders / power holders in/of the community.	TBD
			Expressions of trust and connectivity between participants and other members / stakeholders / power holders in/of the community	3-Groups Participating in Waterfront Stewardship
			Observations and sightings of formal and informal public uses of waterfront public space.	TBD

SOCIO-ECONOMIC OUTCOMES PRELIMINARY PROTOCOL LIST

#	PROTOCOL NAME	EXISTING AVAILABLE PROTOCOL?	STATUS	TYPE	EXPERTISE REQUIRED	COST/LEVEL OF EFFORT	SOURCE
Example Protocol							
1	Site Visits	N	Draft Included	TBD	TBD	TBD	TWG
Additional Protocols to Consider							
2	Applications for New Business Permits	N	suggested	TBD	TBD	TBD	TBD
3	Groups Participating in Waterfront Stewardship	N	Draft Included	TBD	TBD	TBD	TWG
4	Stakeholder Groups in Public Meetings	N	Draft Included	TBD	TBD	TBD	TWG
5	Educational Programs/Events on waterfront	N	suggested	TBD	TBD	TBD	TBD
6	Local Schools Incorporaring Waterfront into Curriculum	N	suggested	TBD	TBD	TBD	TBD
7	People Employed in fisheries and Aquaculture	N	Draft Included	TBD	TBD	TBD	TWG
8	Operating Fisheries	N	suggested	TBD	TBD	TBD	TBD
9	Primary Jobs Generated by Const. & Maint.	N	Suggested	TBD	TBD	TBD	TBD
10	Value of Recreation and Tourism	N	Suggested	TBD	TBD	TBD	TBD
11	Households Potentially Impacted by Resilience Project	N	Draft Included	TBD	TBD	TBD	TWG
12	Households Exposed to Flooding	N	Draft Included	TBD	TBD	TBD	TWG
13	FTE Staff Employed at Local Institutions	N	Suggested	TBD	TBD	TBD	TBD
14	FTE Staff Engaged with/Working on Waterfront	N	Suggested	TBD	TBD	TBD	TBD
15	Market Values of Homes	N	Draft Included	TBD	TBD	TBD	TWG
16	Public Facilities Protected by Project	N	Draft Included	TBD	TBD	TBD	TWG
17	Monthly Rent	N	Draft Included	TBD	TBD	TBD	TWG
18	Days Unable to Work because of Disturbance	N	Draft Included	TBD	TBD	TBD	TWG
19	Days of Business Closure	N	suggested	TBD	TBD	TBD	TBD
20	Overnight Stays in Local guest lodging	N	Draft Included	TBD	TBD	TBD	TWG
21	Expressions of trust/connectivity between participants and other members / stakeholders of the community	N	suggested	TBD	TBD	TBD	TBD
22	Reportings and expressions from participants of how the shoreline factors into the life of their community	N	suggested	TBD	TBD	TBD	TBD
23	Opinons from participants on major environmental risks in a community	N	suggested	TBD	TBD	TBD	TBD
24	Tellings and observations from participants of how they are adapting to major climate risks	N	suggested	TBD	TBD	TBD	TBD
25	Expressions of the benefits and drawbacks of features	N	suggested	TBD	TBD	TBD	TBD
26	Expressions of distrust between participants and members / stakeholders / power holders in/of the community	N	suggested	TBD	TBD	TBD	TBD
27	Observations of public uses of waterfront public space	N	suggested	TBD	TBD	TBD	TBD
28	Tellings/expressions of the sacred, revered, and unique aspects of a community as told by participants	N	suggested	TBD	TBD	TBD	TBD

EXAMPLE PROTOCOL: # OF SITE VISITS (RESIDENT VS NON-RESIDENT IF POSSIBLE)

Summary information

Protocol name / shorthand: Site Visits

Related resilience service category: Socio-Economic

Associated Parameter: Economic Resilience / Livelihood Opportunities: Tourism & Recreation

Associated Metric(s): # of Site Visits

Quantitative/qualitative: Quantitative

Data output / data format: TBD

Protocol type (easy, medium, hard): TBD

Description of monitoring methods / field protocols

- Map project site and entry and exit points from site.
- Visit site on weekdays and weekends and different times of day to observe and verify entry and exit from site at mapped points.
- Determine rank order of use of entry points.
- Place visitor counter in discrete location at top ranked entry point. Install additional counters at secondary entry and exit sites as appropriate.
- Mount video camera overlooking site where can observe overall use of site.
- Collect data from counters on weekly basis and review video footage on weekly basis (video should be reviewed at greater than normal speed to expedite analysis).
- Compare ratios of counts from counters with numbers of individuals observed on video camera for weekly period. If ratios appear stable can discontinue video camera and rely on counters for ongoing monitoring.
- Conduct visitor survey (see attached sheet) monthly for 1 year after project completion to understand origins of visitors and non-resident versus resident proportions.
- Map annual visitor zip codes into ArcGIS.
- Characteristics of the site will determine how complicated process will be (i.e., single access/entry/exit sites easier to monitor for visitation in this way).

Requirements (equipment, training, etc)

- Person counter
- Mounted camera
- Statistical software
- *T*raining in review of video and in statistical analysis techniques may be necessary.
- Instruction in process for accessing counter data
- Counter data and video camera data should be monitored continuously. Data analysis can occur on a seasonal or annual basis.

DRAFT

Data QA/QC procedures

Videos should be counted by two individual with counts compared for accuracy. Outliers in daily counter data should be evaluated and compared against special events, etc. that may have driven visitors to site.

Data format and management requirements

Data will be numeric and entered into database program such as Excel or other statistical program.

Data analysis protocols

Data from the counts and the survey may be analyzed in Excel but more in-depth statistical analyses would likely require more advanced statistical software. Annual average counts should be tracked from (ideally) prior to project completion to 5 years after project completion. For sites, where it is known there was no visitation (or no significant visitation) it would be appropriate to assume 0 as the pre-project average.

Responses from the proposed visitor survey can be mapped into ArcGIS to evaluate any decay in likelihood of visitation with distance from the site. Question 2 from the survey can be analyzed using qualitative approaches to identify any commonalities in reasons people indicate that they would visit the site.

On-site visitor survey

"Hello, I'm conducting a survey for XX to evaluate the use of this site. This should only take a few minutes."

SURVEY DATE: **NAME OF PERSON CONDUCTING SURVEY:**	
1. Zip code of visitor	
2. Why are you visiting this site?	
3a. Have you visited this site before?	
3b. If Yes, how many times have you visited this site?	
4a. Did you stay in a hotel or other overnight rental accommodation last night?	
4b. If yes, what is the address of the accommodation?	

DRAFT

ADDITIONAL PROJECT INFORMATION

In addition to information specific to the three resilience services the framework is monitoring for, it will be important to also gather key metadata regarding the scale, context, cost, and maintenance of the individual shorelines being monitored. This information is important to contextualize the scope of certain interventions and better enable comparison across different shoreline features or feature types. In some cases, this information may also be quantitative data. For example, maintenance costs of NNBF tend to decrease over time, whereas it tends to increase over time for hardened structures. Data on these trends, and others, can be derived from the 'Annual cost of maintenance' indicator specified in the table below.

RESILIENCE SERVICE	PERFORMANCE PARAMETER	POTENTIAL PERFORMANCE GOAL STATEMENT	INDICATOR/METRIC
Additional Project Information	Project costs	be cost-effective: achieve	Cost of construction (need to define what costs are included here)
			Soft costs: cost of design, environmental review, and permitting
			Annual cost of maintenance
	Maintenance and Operation requirements	be able to maintain and operate over time at reasonable cost / effort	type(s) of maintenance and operation required
			Skillsets required for maintenance and operation
			Maintenance or repair frequency
	Timeline	NA	time required for design, environmental review, permitting and construction
	Size	NA	project area

DRAFT

APPENDIX F. BIBLIOGRAPHY OF DOCUMENTS REVIEWED

Prepared by Katinka Wijsman – Katinka.wijsman@newschool.edu. With input from Alison Schlesinger and Jessica Fain.

APPENDIX F: BIBLIOGRAPHY OF DOCUMENTS REVIEWED

Literature under consideration

Reference number	Name	Full name	Title
1	DOI-MEG	Department of the Interior (Metrics Expert Group)	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
2	NJRCI	New Jersey Resilient Coastlines Initiative (Measures and Monitoring Workgroup)	A framework for developing monitoring plans for coastal wetland restoration and living shoreline projects in New Jersey
3	NYCEDC	New York City Economic Development Corporation	Waterfront Facilities Maintenance Management System Inspection Guidelines and Manual
4	Stoddard	Stoddard, Larsen, Hawkins, Johnson, Norris in *Ecological Applications*	Setting expectations for the ecological condition of streams: the concept of reference condition
5	ABT	ABT Associates	Developing Socio-Economic Metrics to Measure DOI Hurricane Sandy Project and Program Outcomes
6	USACE	United States Army Corps of Engineers	North Atlantic Coast Comprehensive Study, Use of Natural and Nature-Based Features for Coastal Resilience
7	USGS-FI	United States Geological Survey	Fire Island Coastal Change
8	MARCO	The Mid-Atlantic Regional Council on the Ocean	Working towards a robust monitoring framework for natural and nature-based features in the mid-Atlantic using citizen science Atlantic regional council on the ocean
9	NYS	New York State Department of State and Department of Environmental Conservation	New York State Salt Marsh Restoration and Monitoring Guidelines
10	USGS-JB	United States Geological Survey	Jamaica Bay wetland response to Hurricane Sandy
11	HRNERR	Hudson River National Estuarine Research Reserve	(a) Hudson River sustainable shorelines project phase I: mitigating shoreline erosion along the Hudson River estuary's sheltered coasts; (b) sustainable shorelines along the Hudson river estuary: phase II, promoting resilient shorelines and ecosystem services in an era of rapid climate change; (c) assessing ecological and physical performance
12	USGS-CRMS	United States Geological Survey	Coast-wide Reference Monitoring System in Louisiana
13	RCF	Reef Check Foundation	Reef Check California Instruction Manual: A guide to rocky reef monitoring

Geography, terminology, audience, web basis

Reference number	Name	Year	No of pages	Geographic situatedness	NNBF term	Audience	Web-based?
1	DOI-MEG	2015	69	North East Coastal Region	Ecological and community resilience projects	Evaluators of DOI-sponsored projects	No
2	NJRCI	2016	57	New Jersey (and beyond)	Natural and Nature-based Solutions (living shorelines and tidal wetlands)	User groups: academics, environmental non-profits, regulatory agencies, restoration professionals, community organizations, funding agencies, citizen science groups, and private landowners.	No
3	NYCEDC	2016	319	New York City	n/a	City agencies and their consultants working on the city's waterfront (especially EDC)	Yes
4	Stoddard	2006	10	n/a	n/a	Scientists conducting a ecological assessment of stream environments	No
5	ABT	2015	125	Northeastern U.S. coast	Green Infrastructure	Evaluators of DOI-sponsored projects (but hoping to go beyond)	No
6	USACE	2015	479	North Atlantic Coast	Natural and Nature-based Features	A technically-oriented audience, focus on vulnerability assessment and the use of NNBF to improve coastal resilience	No
7	USGS-FI	2012	n/a	Fire Island	Beaches, dunes	Protocol is "hidden"; website is reporting results. Protocol for scientists?	Yes
8	MARCO	2017	23	Mid-Atlantic coast	Natural and Nature-based Features	Citizen science monitoring	No
9	NYS	2000	147	New York State	Salt marsh restoration	Intended for use with voluntary projects sponsored by municipalities. Little and more experienced individuals both.	No
10	USGS-JB	2015	2 (project sheet)	Jamaica Bay	Tidal Wetland	Protocol is "hidden"; website is reporting results. Protocol for scientists?	Yes
11	HRNERR	2013; 2015; 2017	34; 32; 32	Hudson River Shoreline	Sustainable shorelines	Range of users: property owners, policy-makers, government regulators, consultants, experts, advocates. Protocol is developed for non-scientists	Yes
12	USGS-CRMS	2010	2 (project sheet)	Louisiana coast	Coastal protection and restoration efforts	Variety of user groups: resource managers, academics, landowners, researchers	Yes
13	RCF	2015	106	Temperate rocky reefs of California	Management of coral reefs	Citizen-scientists volunteers who are experienced divers	Yes

Prepared by Katinka Wijsman – Katinka.wijsman@newschool.edu. With input from Alison Schlesinger and Jessica Fain.

Organization of monitoring metrics and usability for NNBF project

Reference number	Name	Organization	Good for?
1	DOI-MEG	Typology linked to goals	Comprehensive examples for all but community benefits monitoring categories. Core metrics allow comparability across scales
2	NJRCI	Both typology and goals (separate metric tables)	User friendly format and inclusion of citizen scientists for monitoring. Includes a sample monitoring plan template
3	NYCEDC	Typology (hard structures, shoreline, wetland)	Grey infrastructure considerations for our comparisons, especially in urbanized shoreline projects. Online database and standardization of data collection
4	Stoddard	n/a	Framework for how to understand baseline conditions and then monitor change
5	ABT	Typology on the basis of resilience goals	Socio-economic metrics of resilience identified with accompanying methods of data collection; case-study examples. Detailed. Synergies between biophysical and ecological outcomes and socio-economic resilience goals
6	USACE	Typology (with ecosystem service considerations)	Provides metrics for a vulnerability assessment which could function as input for performance assessments. Includes perspective on regional sediment management, and takes a systems approach. Detailed.
7	USGS-FI	Site performance	Comprehensive long-term shoreline monitoring program, but expensive
8	MARCO	Goal based	Metrics are created by bringing goals and habitats together; methods are developed in easier and more difficult scenarios. Accessible and comprehensive
9	NYS	Site performance	Guidance for voluntary restoration projects, not mitigation projects. Appendix includes insight into permitting and regulatory context.
10	USGS-JB	Site performance	Focus on assessing estuarine and adjacent wetland physical response to major storm events. Long term data gathering, but costly to operate.
11	HRNERR	Site performance	Focus on shoreline stabilization techniques. Explicitly discusses trade-offs between ecological, engineering, and economic goals in shoreline management options.
12	USGS-CRMS	Site performance	Site with data collection of approximately 400 reference sites, running since 2005. Requires upfront investment
13	RCF	Typology (counting species)	Example for making monitoring accessible to citizen scientists

NNBF and Non-NNBF features discussed

		NNBF types mentioned (n.b. different levels of detail)									**Non-NNBF features addressed**				
Reference number	**Name**	Wetlands and/or marshes	Living shoreline	Beach/ Dunes	Reefs	Maritime forests and/or shrublands	Mudflats	Riparian buffer	Barrier Islands	Other	Grey infra-structure (over-arching)	Revet-ments	Break-waters	Bulkheads	Other
1	DOI-MEG	√	√	√	√	√	√	√	√	Nearshore shallows and deeps; uplands and watersheds; estuaries and ponds	√	-	√	-	-
2	NJRCI	√	√	√	√	-	-	-	-	-	-	-	√	√	-
3	NYCEDC	√	√	√	-	√	-	-	-	-	√	√	-	√	Groyne, Wave screen
4	Stoddard	-	-	-	-	-	-	√	-	-	-	-	-	-	-
5	ABT	√	√	√	√	-	-	√	-	-	-	-	-	-	-
6	USACE	√	√	√	√	√	√	√	√	Submerged aquatic vegetation, ponds, swamps, terrestrial grassland / shrubland / forests	√	√	√	√	Groins, levee
7	USGS-FI	-	-	√	-	-	-	-	√	-	-	-	-	-	-
8	MARCO	√	-	√	√	√	√	√	-	Submerged aquatic vegetation, urban retrofit	-	-	-	-	-
9	NYS	√	√	-	-	-	√	-	-	-	-	-	-	-	-
10	USGS-JB	√	-	-	-	-	-	-	-	-	-	-	-	-	-
11	HRNERR	√	√	-	-	-	-	-	-	-	√	-	-	-	-
12	USGS-CRMS	√	-	-	-	-	-	-	-	-	-	-	-	-	-
13	RCF	-	-	-	√	-	-	-	-	-	-	-	-	-	-

Resilience goal categories discussed and metrics suggested

		Resilience goal categories discussed				Metrics				
Reference number	**Name**	Ecological function	Structural Integrity	Hazard Mitigation	Community benefits	**Ideas for core metrics?**	Ideas for ecological function metrics?	Ideas for structural integrity metrics?	Ideas for hazard mitigation metrics?	Ideas for community benefits metrics?
1	DOI-MEG	√	√	√	-	√	√	√	√	-
2	NJRCI	√	√	√	√	√	√	√	√	√
3	NYCEDC	√	√	√	-	-	-	√	√	-
4	Stoddard	√	-	-	-	-	√	-	-	-
5	ABT	√	√	√	**√**	√	-	-	√	√
6	USACE	√	√	√	√	-	-	√	√	√
7	USGS-FI	√	-	√	-	-	√	-	√	-
8	MARCO	√	√	√	√	√	√	√	√	√
9	NYS	√	-	√	-	-	√	-	-	-
10	USGS-JB	√	-	√	-	-	√	-	-	-
11	HRNERR	√	√	√	√	-	√	-	-	-
12	USGS-CRMS	√	-	-	-	-	√	-	-	-
13	RCF	√	-	-	-	-	√	-	-	-

APPENDIX G. PROJECT CORE TEAM AND WORKING GROUP MEMBERSHIP

APPENDIX G: PROJECT CORE TEAM AND WORKING GROUP MEMBERSHIP

Project Core Team

Project Manager

Katie Graziano, Project Scientist, Science and Resilience Institute at Jamaica Bay (SRIJB)
(Previously: Jessica Fain, SRIJB)

Principal Investigator

Brett Branco, Executive Director, SRIJB
(Previously: Adam Parris, Executive Director, SRIJB)

Project Sponsorship and State Management Support

Carolyn Fraioli, New York Department of State (NYDOS)

Tanna Legere, New York Department of State (NYDOS)

Amanda Stevens, New York State Energy and Research and Development Authority (NYSERDA)

Core Team Members

Katherine Bunting-Howarth, *NY Sea Grant*

Katinka Wijsman, *The New School* **(Member of Socio-Economic TWG)**

Kristin Marcell, *NYS Department of Environmental Conservation (NYSDEC) Hudson River Estuary Program/ Cornell* **(Co-lead for Permit Reviewer Meetings)**

Marit Larson, *NYC Parks Department*

Novem Auyueng, *NYC Parks Department* **(Pilot data collection for NYC; Database Development Co-Lead)**

Chris Haight, *NYC Parks Department* **(Pilot data collection for NYC)**

Rob Pirani, *NY-NJ Harbor and Estuary Program*

Technical Working Group (TWG) Leads

Pippa Brashear, *SCAPE* **(Overall TWG Lead, Framework Development Lead)**

Peter Groffman, *Cary Institute, CUNY Advanced Science Research Center and Brooklyn College* **(TWG Lead: Ecological Function)**

Doug Partridge, *Arcadis* **(TWG Lead: Structural Integrity and Hazard Mitigation; Database Development co-lead)**

Vince DeCapio, *Arcadis* **(TWG Lead: Structural Integrity and Hazard Mitigation)**

Erika Svendsen, *US Forest Service* **(TWG Co-Lead: Socio-Economic Outcomes)**

Regional Working Group (RWG) Leads

Bennett Brooks, *Consensus Building Institute* **(Overall RWG Project Lead)**

Helen Cheng, *Science and Resilience Institute at Jamaica Bay, NY Sea Grant* **(RWG Lead for New York City)**

Kathleen Fallon, *NY Sea Grant* **(RWG Lead for Long Island)**

Isabelle Stinnette, *NY-NJ Harbor and Estuary Program* **(RWG Lead for Hudson River)**

Roy Widrig, *NY Sea Grant* **(RWG Lead for the Great Lakes)**

Pilot Data Collection

Data collection leads for sites in New York City Harbor:

Novem Auyueng, NYC Parks Department

Chris Haight, NYC Parks Department

Data collection leads for sites in Hudson Valley, Long Island, and Great Lakes region:

Katie Graziano, SRIJB **(Field Coordination)**

Katharhy G., SRIJB/Brooklyn College **(Ecological Function)**

Dylan Corbett, SRIJB/Arcadis **(Hazard Mitigation and Structural Integrity)**

Lindsey Strehlau-Howay, SRIJB **(Socio-Economic Outcomes)**

Project Advisory Committee

Alison Branco, Coastal Director, *The Nature Conservancy New York, Long Island Chapter*

Dawn McReynolds, Assistant Director, *Marine Resources Division NYS Department of Environmental Conservation*

Doug Wilcox, Empire Innovation Professor of Wetland Science, *SUNY Brockport and Great Lakes Restoration Initiative*

Heather Weitzner, Coastal EIT, *OBG*

Kim Penn, Climate Coordinator, *NOAA Office of Coastal Management*

Lisa Auermuller, Watershed Coordinator, *Jacques Cousteau National Estuarine Research Reserve*

Peter Murdoch, Science Advisor, *Northeast Region United States Geological Survey*

Ernie Holmberg, Geotechnical Engineering Bureau, *NYS Department of Transportation*

Todd Bridges, Senior Research Scientist, *US Army Engineer Research and Development Center*

Tom Herrington, Research Professor, *Monmouth University*

Technical Working Group (TWG) Members

Overall TWG Project Lead: Pippa Brashear, SCAPE **(Core Team Member)**

Ecological Function:

(TWG Lead) Peter Groffman, *Cary Institute, CUNY Advanced Science Research Center and Brooklyn College*
Marit Larson, *NYC Parks* **(Core Team Member)**
Novem Auyeung, *NYC Parks* **(Core Team Member)**
Christopher Haight, *NYC Parks* **(Core Team Member)**
Christina Kaunzinger, *Rutgers University*
Joshua Unghire, *USACE*
Colin Beier, *SUNY ESF*
Laura Johnson, *Heidelberg*
Shimrit Perkol-Finkel, *SEARC*
Stuart Findlay, *Cary Institute*
Chris Schubert, *USGS*

Hazard Mitigation & Structural Integrity:

(TWG Lead) Doug Partridge, *Arcadis*
(TWG Lead) Vince DeCapio, *Arcadis*
Norbert Psuty, *Rutgers University*
Jon Miller, *Stevens Institute of Technology*
Catherine Seavitt, *City College of New York*
Bryan Hinterberger, *USACE*
Amy Simonson, *USGS*
Andy Peck, *The Nature Conservancy*
Pauk Cocca, *USACE*
Tanna LeGere, *NYS DOS*

Socio-Economic Outcomes:

(TWG Co-Lead) Erika Svendsen, *US Forest Service*
(TWG Co-Lead – Phase 1) Phil Silva, *The Nature Conservancy*
(TWG Co-Lead – Phase 2) Katie Graziano, *Science and Resilience Institute*
Katinka Wijsman, *The New School,* **(Core Team Member)**
Anthony Dvarskas, Stony Brook University
Jennifer Bolstad, *Local Office*
Malgosia Madajewicz, *Columbia University*
MichaelSchwebel, *100 Resilient Cities*
Sara Meerow, *University of Michigan*
Shorna Allred, *Cornell University*
Valerie Luzadis, *SUNY*

APPENDIX H. PROJECT WORKPLAN AND SCHEDULE

APPENDIX H: PROJECT WORKPLAN AND SCHEDULE

PROJECT PHASES:

Phase I: Draft Monitoring Framework, March - May 2018

- Develop Draft Monitoring Framework (roadmap + protocols) largely based on input and recommendations from Technical Working Groups.

Phase II: Regional Workshops, June 2018 – November 2018

- Gather and synthesize input on Draft Framework through regional workshops.

Phase III: Revised Monitoring Framework, December 2018 – February 2019

- Develop Revised Monitoring Framework based on Regional Workshops and Agency Meetings/Feedback.

Phase IV: Monitoring Data Collection at Pilot Sites, June 2019 - September 2019.

- Conduct training with monitoring teams at the beginning of monitoring season.
- Implement Revised Monitoring Framework to monitoring of pilot sites: target of 4 sites (2 nature-based, 1 natural, and 1 structural feature) per region (Long Island, New York City, Hudson River, Great Lakes).
- Synthesize findings from pilot application of monitoring framework, and make recommendations for framework modification based on the pilot application.

Phase V: Final Monitoring Framework, August 2019 - January 2020

- Finalize the Monitoring Framework based on feedback and recommendations from pilot testing.
- Develop database to house data collection, and populate with collected data from pilot sites.
- Publish and circulate final monitoring framework (including an informational webinar open to public and all stakeholders contacted throughout the process).
- Write and submit manuscript for peer review.