

NEW YORK / NEW JERSEY HARBOR & ESTUARY PROGRAM

Environmental Monitoring Plan 2018

Recommendations for Environmental Research and Monitoring in the New York-
New Jersey Harbor Estuary



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Executive Summary

This report identifies priorities for supporting existing monitoring programs as well as recommending new programs to address the gaps in scientific knowledge and otherwise identify the changes taking place in the Harbor Estuary. The results of implementing the recommended monitoring can validate the effectiveness of current and planned management strategies, and suggest where concentrated attention would inform future assessments of the health of the estuary. This work is a cornerstone of the work of the New York – New Jersey Harbor & Estuary Program (HEP) and its partners to implement the 2017-2022 Action Agenda and undertake any subsequent revisions.

These recommendations are part of HEP's overall Environmental Monitoring Plan. Through the identification of 47 indicators selected by scientific and technical experts convened by HEP, the Environmental Monitoring Plan highlights indicators and the monitoring programs that are necessary to assess the status and trends in the health and abundance of the Harbor Estuary. The Environmental Monitoring Plan consists of three tools: an interactive map that inventories existing and historic efforts, a companion digital storymap, and this research and monitoring recommendations report. All of the resources are accessible by visiting www.hudsonriver.org/article/environmental-monitoring-plan. Together, the Environmental Monitoring Plan helps to coordinate monitoring efforts, make data accessible, improve data analysis, identify gaps, and identify priorities for future environmental monitoring.

To identify the recommendations made in this report, HEP held a series of conversations and meetings in 2018 with government, utility, civic, and academic partners. The 113 individual responses helped us identify the 20 monitoring recommendations and prioritize them. Due to the varying number of participants and the number of

recommendations across HEP's five goals, the list of the top ten recommendations includes the two highest weighted averages in each of the goals: **water quality**, **habitat and ecological health**, **public access and stewardship**, **port and maritime**, and **community engagement**. Across all the goals, HEP partners identified the following two monitoring programs as most critical for the Harbor Estuary:

- (1) Launch a near-shore pathogen monitoring program that provides high quality data to inform recreational water quality assessments.
- (2) Reinstate and fully fund the Regional Environmental Monitoring and Assessment Program (REMAP) or a similar benthic and toxic monitoring program.

Efforts by HEP and our partners are necessary to implement these and the other recommendations in this report. Key partners, potential funding sources, and connections to the 2017-2022 Action Agenda are highlighted for each monitoring program recommendation. In some cases, the recommendations identify the need to reinstitute or replace public and private funding that once supported important monitoring efforts. Other recommendations will require new budget commitments, revenue sources, and/or grant funding.

During the course of this assessment, a number of research needs were also identified. These actions, including research to improve monitoring practices, investigate new parameters, and better understand emerging contaminants, will help advance the science and practice of monitoring across the Hudson Raritan Estuary. These recommendations are not prioritized, but are identified by goal.

List of Monitoring Recommendations

The following top 10 monitoring recommendations, organized by HEP's five goals in order of priority, are included in this report:

- 1a. Launch a near-shore pathogen monitoring program that provides high quality data to inform recreational water quality assessments.
- 1b. Support quality assurance and quality control protocols for citizen science programs conducting nearshore pathogen monitoring to be utilized by government agencies.
2. Expand existing continuous monitoring program(s) for dissolved oxygen to include the Upper/Lower Bay, Kill van Kull, and the Arthur Kill.
3. Implement a recurring statewide wetland-mapping program in New York State to monitor areas of wetlands over time.
4. Expand and continue a long term fish survey in the Hudson Raritan Estuary.
5. Expand assessment of publicly accessible waterfront and on-water access points, and renew data every five years.
6. Implement a regular survey to capture the number of on-water programs and visitor information.
7. Reinstate and fully fund the Regional Environmental Monitoring and Assessment Program (REMAP) or a similar benthic and toxic monitoring program.
8. Expand the spatial and temporal extent of PCB monitoring in the Harbor Estuary occurring under existing programs.
9. Develop and adopt standard protocols and methods to collect data during stewardship events.
10. Refine and regularly implement the USDA Forest Service Stewardship Mapping and Assessment Project (STEW-MAP) analysis of civic capacity.

Other important monitoring recommendations, organized by goal in order of priority, include:

11. Establish a long term ambient water quality monitoring program in the main stem of the Hudson River.
12. Improve the spatial extent of nutrient monitoring across tributaries, specifically on reduced tidal exchange or low flow waterbodies within the Estuary.
13. Establish and adopt standard methods and protocols for microplastic monitoring programs.
14. Adopt common methods and protocols across existing monitoring programs for floatable debris collected on beaches.
15. Implement a comparable Chlorophyll Remote Sensing monitoring program in New York for early detection of harmful algal blooms.
16. Support the continuation of Light Detection and Ranging (LIDAR) monitoring for Submerged Aquatic Vegetation (SAV) in the Hudson-Raritan Estuary.
17. Develop a statewide riparian opportunity assessment program in New Jersey similar to that undertaken in New York.
18. Implement a long term GIS-based analysis of Harbor Herons habitat and bird occurrences.
19. Design and implement a rapid assessment survey for waterfront park visitation and use.

Acronym Key

CAC	Citizens Advisory Committee
CARP	Contamination Assessment and Reduction Project
CCMP	Comprehensive Conservation and Management Plan
HEP	New York-New Jersey Harbor & Estuary Program
HRF	Hudson River Foundation
HRPT	Hudson River Park Trust
IEC	Interstate Environmental Commission
MERI	Meadowlands Environmental Research Institute
NEIWPC	New England Interstate Water Pollution Control Commission
NGO	Non-governmental Organization
NJDEP	New Jersey Department of Environmental Protection
NJHDG	New Jersey Harbor Dischargers Group
NJSEA	New Jersey Sport and Exposition Authority
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NYCDEP	New York City Department of Environmental Protection
NYCDPR	New York City Department of Parks and Recreation
NYCEDC	New York City Economic Development Corporation
NYSDEC	New York State Department of Environmental Conservation
PANY/NJ	Port Authority of New York & New Jersey
RWG	Restoration Work Group
STAC	Science and Technical Advisory Committee
TFW	Trash Free Waters Partnership
TNC	The Nature Conservancy
WQWG	Water Quality Work Group
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency

Monitoring Recommendations for the Harbor Estuary

The Environmental Monitoring Plan consists of three tools: an interactive map, a companion digital storymap, and this report. Together, these tools help to coordinate monitoring efforts, make data accessible, improve data analysis, identify gaps, and identify priorities for future environmental monitoring. The purpose of this report is to identify future monitoring programs that address gaps and help track the environmental improvements made in the Harbor Estuary as we implement the [2017-2022 Action Agenda](#).

The indicators and monitoring recommendations in this plan were identified through a series of conversations organized through our Management Committee, Science and Technical Advisory Committee (STAC), and Citizens Advisory Committee (CAC) as well as several technical work groups addressing Water Quality, Restoration, and Public Access issues. Over the course of 15 individual meetings and a number of exchanges between the STAC and partners, 113 individuals identified 20 monitoring recommendations. Upon identifying monitoring recommendations, a series of four surveys were distributed to the STAC and the CAC to identify the top 10 recommendations across five goals: water quality, habitat and ecological health, public access and stewardship, port and maritime, and community engagement. In addition, the technical work groups and the Contamination Assessment and Reduction Project (CARP) technical advisory committee were invited to participate in the surveys. The

table below provides the percentage of responses for each survey by individual participants.

This prioritization provides a clear path forward for HEP and our partners to begin addressing the needs and advance monitoring efforts. In coordination with the 2017-2022 Action Agenda, these monitoring program recommendations are linked to objectives and actions that HEP will focus efforts on with our partners. HEP anticipates that this plan will be revisited every five years to re-evaluate its appropriateness and effectiveness in improving the health of the estuary.

Monitoring the changing condition of the estuary requires financial support. In some cases, the recommendations note the need to reinstitute or replace public and private funding that once supported important monitoring efforts. Other recommendations will require agency partners to step up and provide resources from their annual budgets. While several recommendations reflect the growing appreciation for having citizen scientists collect and analyze data, these academic and non-profit programs rely on grant funding and philanthropic support. HEP's [Options for Funding Program Priorities Report](#) describes 28 potential funding sources to broaden the depth and breadth of funding available for implementing the HEP Action Agenda and these monitoring recommendations, including stormwater fees and other means of equitable rate restructuring, aviation impact and petroleum facility host fees, and coordinated philanthropy.

Goal-based Survey	Invited Participants	Total Participants	% Response Rate
Water Quality	74	57	77%
Habitat and Ecological Health	69	37	54%
Public Access and Stewardship	57	40	70%
Port and Maritime	56	35	63%
Community Engagement	57	40	70%

Top Ten Monitoring Recommendation Priorities

The following monitoring programs were identified as having the highest priority in each of HEP's five goals of water quality, habitat and ecological health, public access and stewardship, port and maritime, and community engagement. HEP is committed to working with its committees, technical work groups, and partners to implement these monitoring recommendations in conjunction with the 2017-2022 Action Agenda.



PHOTO: Brett Bragin



WATER QUALITY

1a. Launch a near-shore pathogen monitoring program that provides high quality data to inform recreational water quality assessments.

Human exposure to waterbodies, whether primary or secondary contact, are not limited to official bathing beaches in the Harbor Estuary. Contact occurs from swimming off boats, at boat launches, waterfront parks, and other on-water programs or recreational activities. Near-shore pathogen monitoring utilized for water quality assessments is limited. Routine agency sampling is typically conducted mid-channel by boat, while recreational seasonal shoreline sampling only occurs at designated, official beaches. Many residents and visitors boat and swim in areas that are either being monitored infrequently or not at all. Near-shore pathogen monitoring is a significant gap in current monitoring programs, as little is known about the levels of *Enterococcus* or fecal coliform near shorelines, typically where the end of an outfall is located (e.g., combined sewer overflow (CSO) pipes). Existing agency pathogen monitoring programs should include near-shore monitoring stations to capture human risk exposure from the high pathogen levels. Another approach could include working with citizen science programs conducting near-shore pathogen monitoring and support government agencies in utilizing their data (see #1b).

ACTION AGENDA REFERENCE: Water Quality, Objective C-1: Pathogen Monitoring

KEY PARTNERS: IEC, NYCDEP, NJDEP, USEPA, NJHDG, NYSDEC, WQWG, State and local health departments, NGOs

RESOURCES: Staff and Leveraging; Grant Funded Project >\$200,000; On-Going Operating.

TIMELINE: 2017-2022. HEP will work with partners beginning in 2018 to develop a monitoring plan and define needs. Monitoring will be conducted as needed through 2022.

1b. Support quality assurance and quality control protocols for citizen science programs conducting near-shore pathogen monitoring to be utilized by government agencies.¹

Water quality data collected by citizen science programs are not utilized by government agencies for regulatory compliance comparisons, but are commonly used for advocacy and educational purposes on near-shore pathogen levels. Improving quality assurance and quality control protocols, especially for data collection, safety, and the use of certified laboratories has a number of benefits for both citizen scientists, researchers, and government agencies. In particular, it will enable government agencies to better utilize citizen science data. Citizen science programs can increase the available data for a given waterbody and can improve water quality modeling and reduce spatial and temporal gaps on pathogen data. These programs typically extend seasonal grab sampling from May through October, and capture tributaries not always covered by regulatory compliance programs.

ACTION AGENDA REFERENCE: Water Quality, Objective C-1: Pathogen Monitoring; Community Engagement, Objective A-1: Shared Protocols

KEY PARTNERS: IEC, NYCDEP, NJDEP, USEPA, NJHDG, NJCSO Group, NYSDEC, State and local health departments, NGOs, CAC

RESOURCES: Staff and Leveraging; Grant Funded Project >\$200,000; On-Going Operating.

TIMELINE: 2018-2022. HEP will work with partners to begin to develop a monitoring plan and needs with IEC, NGOs and government agencies.

1. Because advancing the quality citizen science programs is an important means of addressing near-shore pathogen monitoring, these recommendations are described in series. Note that advancing the quality and number of citizen science programs is applicable to many of the monitoring recommendations that follow.



WATER QUALITY

2. Expand existing continuous monitoring program(s) for dissolved oxygen to include the Upper/Lower Bay, Kill van Kull, and the Arthur Kill.

Continuous monitoring of dissolved oxygen (DO) provides scientists and researchers valuable information when low DO can be harmful to marine life and informs habitat protection efforts in the region. Extending the spatial range of continuous DO monitoring captures the dynamic changes in DO (e.g., day versus night) across the Harbor Estuary that would otherwise be missed with current grab sampling approaches. Advanced technology improves management decisions and enables data synthesis to incorporate a watershed approach. Data management should also be considered for data synthesis that enables scientists and researchers to view a number of stations' data together. The Hudson River Environmental Conditions Observing System (HRECOS) platform offers a consistent platform or database, to access data and visualize the spatial and temporal extent of all continuous DO monitoring for the Harbor Estuary. Creating new stations in Upper/Lower Bay, Kill van Kull, and the Arthur Kill and linking those stations to HRECOS is recommended. In addition, existing continuous monitoring by U.S. Geological Survey (USGS) and New York City Department of Environmental Protection (NYCDEP) in the East and Harlem Rivers should also explore linkages to the HRECOS platform. Continuous monitoring considerations include costs of the physical systems, operation and maintenance procedures, safety and vandalism, and data management. Future climate projections and vulnerability may require a reevaluation of current agency standards for DO, especially DO-base standards that are limited by their failure to consider episodic as well as continuous DO conditions, and thermal effluent in the Harbor Estuary.

ACTION AGENDA REFERENCE: Water Quality, Objective C-2: Dissolved Oxygen Monitoring

KEY PARTNERS: USEPA, USGS, NYCDEP, NJHDG, NJDEP, NYSDEC, IEC, HRECOS, NGOs, Academia

RESOURCES: Staff and Leveraging; Grant Funded Project >\$200,000.

TIMELINE: 2017-2020. HEP will explore funding possibilities in partnership with HRECOS, NYCDEP, and IEC.



HABITAT AND ECOLOGICAL HEALTH

3. Implement a reoccurring statewide wetland-mapping program in New York State to monitor area of wetlands over time.

A current statewide wetland mapping effort does not exist outside of the historic data from the National Oceanic and Atmospheric Administration C-Cap program and localized efforts. Establishing a statewide wetland mapping effort in New York State would improve wetland characterization over time. Such a program has already been undertaken by New Jersey Department of Environmental Protection's (NJDEP) Land Use/Land Cover program; New York City Department of Parks and Recreation (NYCDPR) has also developed some helpful land use/land cover information.

ACTION AGENDA REFERENCE: Habitat and Ecological Health, Objective C-1: Habitat Monitoring; Objective D-1: Sea Level Rise

KEY PARTNERS: RWG, USACE, NJDEP, NYSDEC, SRIJB, NYCDPR, NOAA, HRF, HREP, NGOs

RESOURCES: Grant projects >< \$200,000.

TIMELINE: 2020-2022. HEP will work with partners to identify opportunities and challenges.

4. Expand and continue a long term fish survey in the Hudson Raritan Estuary.

With the anticipated closing of Indian Point, the Long River, Fall Juvenile, and Beach Seine Surveys are now discontinued. They were last conducted in the fall of 2018. Fish monitoring programs by the utilities represents the best long term fish abundance survey of any temperate estuary and provide a record of ecological changes in the Harbor Estuary. There is a compelling need to track ecological responses to climate change and understand the effects and recovery trajectories of environmental damages such as oil spills, as well as the effects of environmental improvements. In addition, the three surveys should be re-evaluated to include a comprehensive monitoring metric or approach to track the individual status of Hudson River fish species at risk (or potentially increasing), increase the focus on adult fish species monitoring, and explore expanding the spatial coverage of these surveys beyond the Hudson River.

ACTION AGENDA REFERENCE: Habitat and Ecological Health, Objective C-1: Habitat Monitoring

KEY PARTNERS: HRF, NYSDEC, NJDEP, USEPA, HREP, Academia

RESOURCES: Grant projects > \$500,000.

TIMELINE: 2018-2022. HRF will continue dialogues with NYSDEC and stakeholder to support the continuation of long term fish surveys.



PUBLIC ACCESS

5. Expand assessment of publicly accessible waterfront and on-water access points, and renew data every five years.

In 2016, HEP and partners from the USDA Forest Service NYC Urban Field Station, undertook an assessment to establish a baseline of publically accessible waterfront and on-water access points in the Harbor Estuary, and assess accessibility relative to need. The assessment, using data from NJDEP, New York City Department of Parks and Recreation (NYCDPR), and other public sources was compiled into a report called [“Connecting with Our Waterways: Public Access and its Stewardship in the New York - New Jersey Harbor Estuary.”](#) Access information included a variety of public spaces as well as human-powered boat launches, ferry landings, and swimming beaches. A similar analysis should be completed for the Hudson Raritan Estuary recently. This information should be monitored every five years. The assessment could be expanded to capture the quality of public access points, universal access features, such as ramps and ADA compliance, and the relationship to the needs of the surrounding community.

ACTION AGENDA REFERENCE: Public Access and Stewardship, Objective A-1: Increase Access

KEY PARTNERS: USDA, NJDEP, NYCDPR, NYCDPR, HREP, NGOs

RESOURCES: Staff and Leveraging; Grant Projects <>\$200,000.

TIMELINE: 2021-2022. The CAC and the Public Access Work Group will work with the USDA Forest Service to implement a survey.

6. Implement a regular survey to capture the number of on-water programs and visitor information.

The Waterfront Alliance, in collaboration with HEP, conducted a one-time survey of boathouses and the types of programs and number of participants during 2010 to 2017. While data exist for ferry ridership, boat ownership, and other indicators of on-water use, it has not been compiled for the purpose of analyzing public access and stewardship. Undertaking a regular survey, whether annual or bi-annual, would improve overall tracking on the number of on-water programs and increase the spatial extent of this data. Considerations for this effort include how best and how often to collect data on the overall number, and other characteristics, of visitors to the Estuary, its waterfront parks, and boathouses. Such an effort should be done in coordination with the improvements to waterfront access monitoring (#5).

ACTION AGENDA REFERENCE: Public Access and Stewardship, Objective A-2: Access Goals

KEY PARTNERS: Public Access Work Group, CAC, USDA, NYCDPR, NJDEP, Waterfront Alliance, NYC Water Trails Association, and other state and local park agencies in both states

RESOURCES: Staff and Leveraging; Grant Projects < \$200,000.

TIMELINE: 2019-2022. HEP will work with Waterfront Alliance to conduct a survey.



PORT AND MARITIME

7. Reinstate and fully fund the Regional Environmental Monitoring and Assessment Program (REMAP) or a similar benthic and toxic monitoring program.

The U.S. Environmental Protection Agency's (USEPA) REMAP conducted baseline sediment assessments in the New York Bay, Newark Bay, and Jamaica Bay every five years since 1993. The program has been discontinued since 2013. The result is a temporal gap in the monitoring of sediment dioxins and the benthic community in the New York Bay. The reestablishment of REMAP is a critical monitoring need for the Harbor Estuary. In addition, REMAP was the only program that provided a comprehensive, standardized, long term data set of benthic conditions in the Harbor Estuary. Remobilized bed sediment could increase the exposure of people and biota to contamination. Although the dynamics of contaminated sediments under climate change is not fully understood, the potential for new/additional sources of sediment and remobilization of previously buried sediment suggests increased challenges for addressing sediment contamination in the Harbor Estuary.

ACTION AGENDA REFERENCE: Port and Maritime, Objective A-1: Sediment Quality; Habitat and Ecological Health, Objective B-3: Recontamination.

KEY PARTNERS: USEPA, USACE, NOAA, USFWS, HRF, IEC, NYSDEC, NJDEP, NYCDEP, NJDOT, Monmouth University, USACE, PANY/NJ, NYCEDC, Rutgers University, HREMAC, RWG

RESOURCES: Staff and Leveraging; Grant funding > \$200,000. For 2019, USEPA is working with the Interstate Environmental Commission (IEC) to deliver some of the funding needed. It is possible that in-kind support could also be provided by the Contamination Assessment Reduction Program (CARP II) supported by NJDOT and managed by HRF.

TIMELINE: 2019-2021. HEP will promote the continuation of REMAP and support efforts to analyze data.

8. Expand the spatial and temporal extent of PCB monitoring in the Harbor Estuary occurring under existing programs.

More than one million pounds of PCBs entered the upper Hudson River from the 1940s through the 1970s. A number of monitoring programs for PCBs have been implemented across the Harbor Estuary. Led largely by the USEPA, USGS, U.S. Army Corp of Engineers (USACE), National Ocean and Atmospheric Administration (NOAA), New York State Department of Environmental Conservation (NYSDEC), and the Meadowlands Environmental Research Institute (MERI), these programs vary in objective, spatial and temporal extent, medium of samples, and toxicants. Improving contaminant track-down and advancing site cleanups require increasing the spatial and temporal extent of PCB monitoring to cover larger areas of the tidal Hudson River from below the Troy Dam to the Harbor. Sediment monitoring through CARP II provides data to support improved dredged material management and monitoring of PCBs entering the Harbor, but additional data collection throughout the estuary and tributaries is needed. Extending the spatial and temporal extent of existing PCBs and sediment monitoring programs will address these needs.

ACTION AGENDA REFERENCE: Port and Maritime, Objective A-1: Sediment Quality

KEY PARTNERS: USEPA, NYSDEC, USACE, NOAA, HRF, HREMAC, USGS, NOAA, MERI

RESOURCES: Grant projects > \$500,000; Potential funding option include Maintenance Dredging; Harbor Maintenance Trust Fund.

TIMELINE: 2018-2022. HRF will continue to evaluate the results from CARP II to refine these recommendations.



COMMUNITY ENGAGEMENT

9. Develop and adopt standard protocols and methods to collect data during stewardship events.

Participation in stewardship events is difficult to assess and compare from year-to-year because of a number of reasons such as staff capacity, number of entry points and methodologies. Improving protocols and methods employed by individual groups would address the spatial and temporal gaps. For example, HEP's State of the Estuary report highlights three stewardship events (City of Water Day, (Hudson) Riverkeeper Sweep, and A Day in the Life of the Hudson & Harbor), but there are additional annual stewardship events in the Harbor Estuary such as Hudson River Park Trust's Submerge and Hackensack Riverkeeper's shoreline cleanups. The Citizens Advisory Committee and Public Access Work Group should identify additional annual stewardship events and develop and adopt common methods and protocols for collecting participation data. The data generated will improve connections to agencies' public outreach efforts, resource sharing, and identifying program needs and challenges.

ACTION AGENDA REFERENCE: Community Engagement, Objective A-1: Shared Protocols

KEY PARTNERS: CAC, RWG, WQWG, IEC, USEPA, NGOs, Public Access Work Group

RESOURCES: Staff and leveraging; Grant projects <\$200,000.

TIMELINE: 2020-2022. The CAC and the Public Access Work Group will explore possibilities for developing protocols.

10. Refine and regularly implement the USDA Forest Service Stewardship Mapping and Assessment Project (STEW-MAP) analysis of civic capacity.

The U.S. Department of Agriculture (USDA) Forest Service Stewardship Mapping and Assessment Project (STEW-MAP) analyzes the presence, interests, capacity, and stewardship coverage area of civic groups with an objective to understand and strengthen civic capacity in communities. HEP has cooperated to conduct surveys in 2007, 2015, and 2017. Continuing this collaboration would help show community engagement trends over time. The next survey could compile additional data as to the specific needs of groups and organizations as producers of knowledge and information that is important for policy, programs, and decision-making. Another important potential expansion could be assessing how stewardship groups share and integrate different types of data. Finally, the survey could be used to also explore specifically how stewardship group membership, participation, capacity, actions, activities, and/or events increase awareness of the estuary.

ACTION AGENDA REFERENCE: Community Engagement (all); Public Access Objective B: Improve Stewardship and Programming.

KEY PARTNERS: CAC, USEPA, NGOs, USDA, Public Access Work Group

RESOURCES: Staff and leveraging; Grant projects <\$200,000.

TIMELINE: 2022. HEP and the USDA Forest Service will explore updating STEW-MAP.

Other Monitoring Recommendations

The following monitoring programs have also been identified as significant by HEP's partners.

11. Establish a long term ambient water quality monitoring program in the main stem of the Hudson River.²

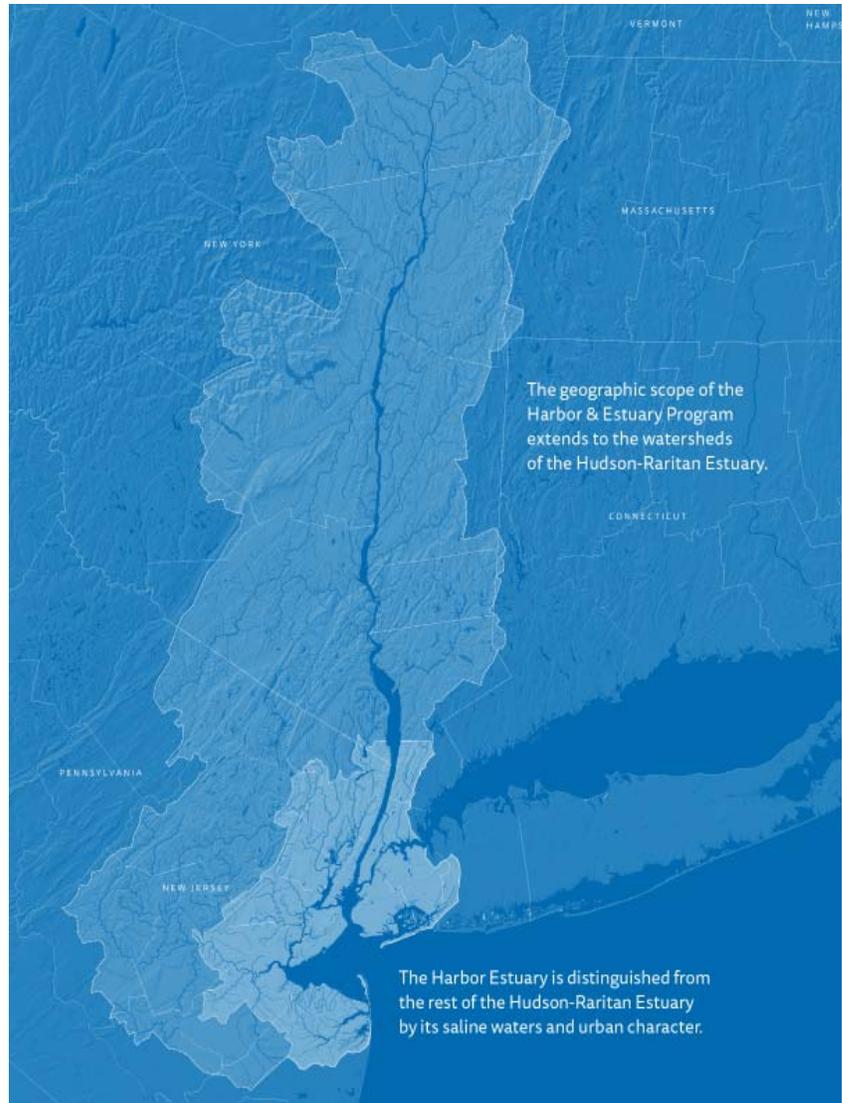
HEP's work extends to the watersheds of the Hudson-Raritan Estuary, often in collaboration with the Hudson River Estuary Program. There is limited water quality data available in the Hudson River main stem, from the Mario Cuomo (Tappan Zee) Bridge to the Troy Dam. To address this gap, the design and implementation of a long term ambient water quality program would require a design study to establish baseline conditions. The NYCDEP and the New Jersey Harbor Dischargers Group's (NJHDG) harbor-wide water quality monitoring program frameworks should be evaluated for comparability, as well as the choice of indicators to be monitored (i.e., pathogens, dissolved oxygen, and in situ parameters, etc.). The design study would inform the strategy needed to measure water quality conditions at a reasonable and informative frequency. The extension of water quality monitoring to include the Hudson River main stem would benefit water quality management decisions for the watershed and increase data to understand the influence of the main stem inputs on the Harbor Estuary.

ACTION AGENDA REFERENCE: Water Quality, Objective C

KEY PARTNERS: USEPA, NYSDEC, HREP, NYCDEP, NJDEP, NJHDG

RESOURCES: Grant project >> \$200,000 for study design. Long term operating

TIMELINE: 2019-2021. HEP will continue dialogue with the Hudson River Estuary Program and NYSDEC's Water Quality Division to advance efforts on establishing a long term monitoring program.



2. This monitoring program was not prioritized by HEP's committees and technical work groups, but is an important monitoring program to address a critical data gap in the Hudson Raritan Estuary.



12. Improve the spatial extent of nutrient monitoring across tributaries, specifically on reduced tidal exchange or low flow waterbodies within the Estuary.

Improving spatial extent of nutrient monitoring in the Harbor Estuary would benefit from active monitoring of dissolved oxygen as an indicator for nutrient loading. In low flow waterbodies, such as in Jamaica Bay and the Hackensack River, excess nutrients settle for longer periods. The existing dissolved oxygen problems in these waterbodies will likely be exacerbated in extent and severity as a result of climate change. Extending monitoring in these waterbodies can improve management actions and inform assessments of nitrogen and phosphorus reductions at sewage treatment plants. Further monitoring of nutrients such as carbon would improve synthesis of how nutrients cycle through the water, sediment and biota within the estuary. Understanding these nutrient dynamics may identify further parameters that could be utilized to improve management actions.

ACTION AGENDA REFERENCE: Water Quality, Objective E: Climate Impacts

KEY PARTNERS: USEPA, NYSDEC, NJDEP, NYCDEP, NJH-DG, HREP, HRF, Academia

RESOURCES: Grant project >\$200,000.

TIMELINE: 2018-2022. HEP will work with partners to identify opportunities to capture additional nutrient data.

13. Establish and adopt standard methods and protocols for microplastic monitoring programs.

Support is needed to monitor and research contaminants of emerging concern such as microplastics and microfibers. Standard methods and protocols for sampling microplastics needs to be adopted by the scientific community to improve the ability of data synthesis across the Harbor Estuary. Further research is required in this field to understand the concentrations, distribution, effects on organisms and the ecosystem, and the ability to transport toxicants up the food chain.

ACTION AGENDA REFERENCE: Water Quality, Objective C-3: Emerging Contaminants

KEY PARTNERS: USEPA, NYCDEP, NJHDG, NJDEP, NYS-DEC, HRF, NGOs, Academia, Plastic Free Waters Partnership

RESOURCES: Staff and Leveraging; Grant project >\$200,000.

TIMELINE: 2018-2022. HRF has identified contaminants of emerging concern, including microplastics, as an area of strategic interest in its current and upcoming requests for research proposals.



PHOTO: Hudson River Park Trust



14. Adopt common methods and protocols across existing monitoring programs for floatable debris collected on beaches.

Trash and debris in the Estuary are a persistent problem. While various clean-up programs and techniques are essential, they often do not address the problem at the source. Innovative solutions that expand on the engagement of stakeholders and reduce the input of floatable debris to the Estuary are necessary to make a lasting impact. Beach cleanups are valuable in monitoring floatable debris, but also important are engaging volunteers to advocate and educate on the need to reduce the use and disposal of floatable debris. A number of organizations that conduct annual beach cleanups vary in their methods and measurements. This reduces the comparability analysis across programs in the Harbor Estuary. Establishing common methods and protocols for data analysis, such as pounds of debris per mile of shoreline, will improve data analysis of floatables found in the estuary. In addition, synthesizing the data across the Estuary can inform management actions to reduce floatable debris through outfall nettings, hot spot street sweeping, catch basin designs, and other innovative tools that can capture or eliminate floatables from entering the water column.

ACTION AGENDA REFERENCE: Water Quality, Objective B-5: Trash Reduction

KEY PARTNERS: Plastic Free Waters Partnership, USEPA, NYCDEP, NJHDG, NGOs, Community Groups

RESOURCES: Staff and Leveraging; Grant project >\$200,000.

TIMELINE: 2018-2020. HEP began a trash track down project in 2016 within the Passaic River Watershed. Additional grant funded projects began in 2018 to increase spatial extent.

15. Implement a comparable Chlorophyll Remote Sensing monitoring program in New York for early detection of harmful algal blooms.

Harmful algal blooms (HABs) can have severe impacts on human health and aquatic ecosystems. NJDEP's Chlorophyll Remote Sensing program estimates chlorophyll levels along coastal waters of the state by aircraft to detect potential blooms. This early detection of HABs improves management decisions to reduce the impacts to the ecosystem. It is recommended that NYSDEC and NYCDEP explore opportunities to develop a comparable monitoring program to NJDEP's Chlorophyll Remote Sensing. In addition, existing pathogen monitoring programs can incorporate HAB monitoring as a means to detect early warning of potential water quality impairments. A pilot program of existing pathogen monitoring and incorporating HABs is recommended to begin in Jamaica Bay.

ACTION AGENDA REFERENCE: Water Quality, Objective C

KEY PARTNERS: USEPA, IEC, NJDEP, NYSDEC, NYCDEP, Academia, State and local health departments

RESOURCES: Grant project > < \$200,000.

TIMELINE: 2019-2022. HEP will work with IEC and state partners to identify opportunities for collaboration.



PHOTO: Edward H. Blake



16. Support the continuation of Light Detection and Ranging (LIDAR) monitoring for Submerged Aquatic Vegetation (SAV) in the Hudson-Raritan Estuary.

The projected increases in temperatures may inhibit growth of eelgrass and other populations of SAV, posing challenges to restoration efforts. Increasing the available use of LIDAR data would support prioritization efforts of candidate areas for active planting of seeds and seedlings in certain candidate areas, as has been done successfully in Chesapeake Bay. Concomitant restoration of bivalves, such as oysters, may also help reduce turbidity and enhance SAV growth in the estuary. A limited amount of monitoring has been conducted for SAV, with the majority of their focus being along the Hudson River.

ACTION AGENDA REFERENCE: Habitat and Ecological Health, Objective B-2: Shoreline Assessments
KEY PARTNERS: NYSDEC, HREP, NJDEP, HRF, TNC, NYCDPR, NYCEDC, PANYN, Academia
RESOURCES: Grant projects >\$200,000
TIMELINE: 2020-2022. HEP will collaborate with key partners on the opportunities to support LIDAR monitoring.

17. Develop a program for New Jersey similar to the Statewide Riparian Opportunity Assessment program undertaken in New York.

The Statewide Riparian Opportunity Assessment developed by NYSDEC and the NY Natural Heritage Program supports the identification and prioritization of riparian sites for restoration or protection. This program includes assessment of subwatersheds through comprehensive monitoring and analysis of ecological health and stress. Factors include connectivity, tree cover, ecological significance, native fisheries significance, water quality impairments, and impervious coverage, among others. Evaluations of recent successful dam removals in the Raritan River may also provide additional framework or references to assess predicted habitat and ecological health.

ACTION AGENDA REFERENCE: Habitat and Ecological Health, Objective A-4: Prioritization
KEY PARTNERS: NYSDEC, NY Natural Heritage Program, NPS, NYCDPR, NJDEP
RESOURCES: Staff and Leveraging; Grant projects <\$200,000.
TIMELINE: 2020-2022. HEP to establish dialogues with NJDEP and other partners on the Statewide Riparian Opportunity Assessment benefits to improving management.

18. Implement a long term GIS-based analysis of Harbor Herons habitat and bird occurrences.

Continuing to document nesting pairs of Harbor Herons, foraging areas, and location and population sizes of active rookeries provides an important indicator for the Harbor Estuary. Long term GIS-based analysis of Harbor Herons habitat and bird occurrence will provide critical information on habitat suitability in the Harbor Estuary. Current reports on birds with field readable bands and/or tracking devices are providing high quality data to assess local and long distance habitat use.

ACTION AGENDA REFERENCE: Habitat and Ecological Health, Objective B-1: Restoration Best Practices
KEY PARTNERS: RWG, NYC Audubon, NJ Audubon, NJSEA
RESOURCES: Grant project >< \$200,000.
TIMELINE: 2020-2022. HEP will work with key partners to identify opportunities.



19. Design and implement a rapid assessment survey for waterfront park visitation and use.

Comprehensive visitation data for the Estuary do not exist. It is unclear as to whether the parks that are collecting visitation data are using established protocols in place or whether they are consistent with their surveys. A rapid assessment survey for waterfront park managers could be designed and completed annually. The assessment could report on general observations regarding waterfront use, correlating that with available demographic data, and key changes in waterfront use.

ACTION AGENDA REFERENCE: Public Access and Stewardship, Objective A-1: Increase Access; Objective B-1: Stewardship; Habitat and Ecological Health, Objective A-4: Prioritization

KEY PARTNERS: NYSDEC, NY Natural Heritage Program, NPS, NYCDPR, NJDEP, Public Access Work Group, CAC, USDA Forest Service NYC Urban Field Station, NGOs, Partnerships for Parks, Urban Federal Waters Partnership, NJ local government

RESOURCES: Staff and Leveraging; Grant projects >>\$200,000.

TIMELINE: 2018-2022



PHOTO: Shelly Xia

Science and Research Needs for the Harbor Estuary

HEP and its public agency, utility, civic, and academic partners have identified a number of science recommendations in relationship to HEP's Environmental Monitoring Plan. These recommendations, which include research, surveys and data collection, are identified below. Addressing them will aid in the: interpretation of monitoring results and the refinement of the monitoring programs associated with HEP (including new sampling sites, parameters to be measured, frequency of sampling, etc.). These recommendations are organized by HEP's five goals. Bold text indicates an indicator used in the current State of the Estuary and Environmental Monitoring Plan.

Water Quality

- A more thorough analysis of continuous **dissolved oxygen** data would be beneficial in order to increase the understanding of changing conditions in the estuary. The analysis of existing data may encourage the modifications of programs to recognize the importance of early morning and midday sampling to capture the impacts of nighttime respiration. This analysis would also be useful to better determine whether areas of the estuary are subject to water quality contraventions.
- There is increasing interest on human exposure to **fecal pathogens**, particularly in areas that are now being used for wading and bathing that in the past were unfit for those uses. One issue that requires further technical insights is the persistence of pathogens in benthic sediment along bathing beach shorelines. Fecal pathogens in sediment may demonstrate the potential for significant concentrations and exposure risks where sediment resuspension can influence the pathogen levels found in the water column.
- There is a need to better understand the relationship of **in situ parameters** to water quality concerns and how these parameters will be affected by climate change.
- Some monitoring programs have collected total suspended solids (TSS) data. Exploring this parameter and its relationship to pathogens and dissolved oxygen should be analyzed.
- With the large quantities of **nutrients** discharged to the estuary, it is important to understand the cycling of them through the water, sediment and biota within the estuary, especially in light of climate change and changing storm water and wastewater discharges resulting from new regulations and infrastructure upgrades. Understanding nutrient dynamics could prove to be a better indicator to inform management actions, including those related to ecosystem restoration.
- Microplastics pose a serious concern, yet they are not a well-studied contaminant in the estuary. Having a better understanding of the sources, fates, and effects of **microplastics** will benefit the management of them. Once more is learned about them, it may be prudent to establish a new monitoring effort to track their abundance and distributions in the estuary, along with determining how they are changing over time.

- Like microplastics, **chemical contaminants of emerging concern** in the estuary are of concern, but understanding their fate and effects requires further research and monitoring. A few studies are currently ongoing, and HEP may soon have some important insights into determining whether future monitoring of these contaminants is warranted.

Habitat and Ecological Health

- Further coordination with agencies and academic partners would be helpful to evaluate the best way to measure acreage of **habitat exposed to low dissolved oxygen** and in particular in enclosed and confined waterways.
- There is very little baseline scientific data on **whale and dolphin presence or relative abundance** of them in the Harbor Estuary. However, citizen scientists are now collecting whale sighting data on offshore whale watching cruises, and a new scientific investigation to track vocalizing whales and dolphins entering the estuary was initiated this year. Data from both these efforts should be reviewed by HEP in the future, and recommendations for further monitoring should be made.
- Researching the value of ribbed mussels in ecosystem restoration, including reducing pathogen levels would be beneficial. Monitoring programs designed to determine the effectiveness of restoration could include water quality parameters as well as more standard marsh health parameters.
- Aquatic restoration efforts would greatly benefit from an up-to-date nearshore and shallow water harbor-wide bathymetry survey. Accurate location of shallow waters would inform monitoring and planning efforts for habitat protection and prioritization.
- Conducting surveys of **benthic invertebrates** would be beneficial, especially in areas of the estuary where benthic surveys have not been performed for many years, or not at all. Utilizing the Barnegat Bay and Little Egg Harbor Benthic Invertebrate Community Monitoring Study as framework.
- Assessing and tracking stream crossings for wildlife connectivity in New Jersey would help gauge progress along with developing a fuller understanding of **tributary habitat connectivity**. A coordinated assessment is needed using the protocol developed by the North Atlantic Aquatic Connectivity Collaborative.
- Researching the ecology of **shoreline and shallow habitat**, including an evaluation of percent and distribution of natural shorelines and their projected future conditions would be beneficial. Collaborating with the Port Authority of New York and New Jersey and the New York City Economic Development Corporation during their maintenance activities as an opportunity for research monitoring.
- The use of satellite data and LIDAR for quantifying the amount of intertidal areas and natural shorelines should be explored to determine whether these tools can be used to effectively and economically track the loss of intertidal areas.
- Research into the habitat suitability of shoreline and shallow water areas with respect to the **distribution and abundance of horseshoe crabs** in Jamaica Bay is desirable and could lead to new monitoring protocols.

- An evaluation of existing monitoring and mapping of **invasive and exotic species** would be a valuable exercise to inform management actions.
- It would be desirable to identify and assess tidal wetlands to include **wetland quality and functionality** on a watershed scale.
- Gaining a better understanding of how contaminants in tissue relate to **Harbor Heron** reproductive success can help to conserve Harbor Herons in the region and better understand the trends we see.
- It would also be helpful to improve the understanding of spatial relationships between existing **Harbor Heron** nesting areas and available foraging habitat, including telemetry and banding research, to determine feeding and distances species travel. This would aid in planning and refining future monitoring.

Public Access and Stewardship

- Exploring the use of large-scale anonymized cell phone data sets to track visitor information and/or to monitor twitter data (i.e. how people feel about the area) could be a means to collect data on the overall number and other characteristics of **waterfront visitors**.

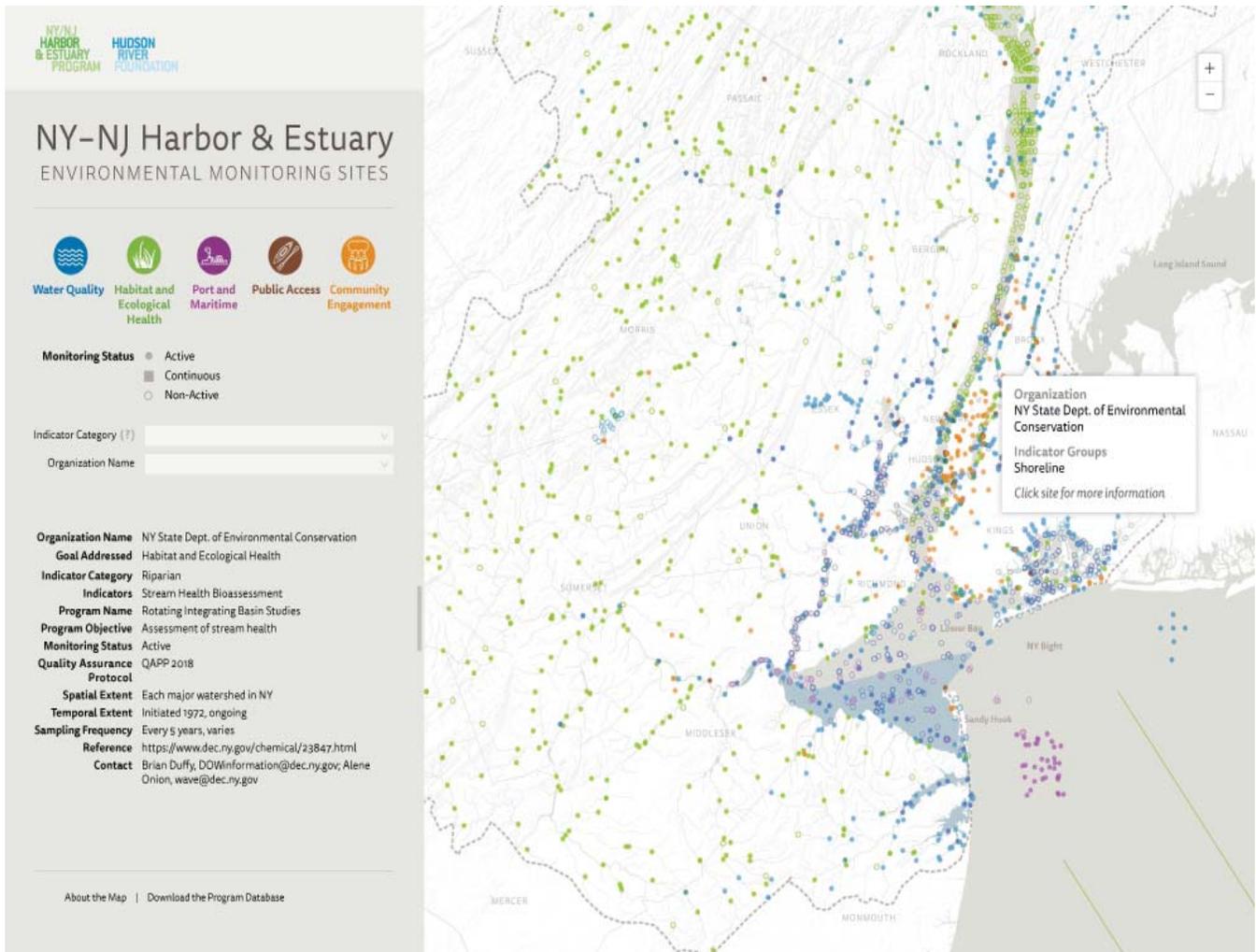
Port and Maritime (Toxics)

- Research is needed to understand how cleanup efforts of **PCBs, PAHs, dioxins, and heavy metals** affect water quality and ecological health of the Harbor Estuary. This will determine whether levels of toxicants recommend other approaches to address the legacy contaminants. The long term monitoring of legacy contaminant levels is essential.
- Research is needed to better understand the impacts that legacy and emerging toxicants may be having on water quality, ecological health, and fish consumption. This new information should guide future monitoring of selected contaminants.

Community Engagement

- Surveys of organizations hosting **citizen science programs** should explore the possibility of capturing cultural impacts of programs to inform outreach materials and increase engagement of diverse and underrepresented communities in these programs.

Monitoring Inventory and Interactive Map



The interactive map allows users to locate monitoring sites for 29 environmental indicators and access downloadable data from specific organizations in the Hudson Raritan Estuary.

www.hudsonriver.org/hep-emp/

Acknowledgements

This report was prepared by Rosana Da Silva and the staff of the New York-New Jersey Harbor & Estuary Program and Hudson River Foundation with the assistance of HEP's Policy, Management, and Citizens Advisory Committees; the Science and Technical Advisory Committee; technical work groups addressing Water Quality, Restoration, and Public Access issues; and the participants at HEP's public conference. We would like to thank our partners for sharing their monitoring programs and data, and we thank the following individuals for their generous help with review of the indicators, monitoring programs, or final document. Members of HEP's Science and Technology Advisory Committee are indicated with a *:

Francisco Artigas*, Ana Baptista*, Brett Branco*, Lindsay Campbell, Hugh Carola, Susan Elbin, Kevin Farley*, Stuart Findlay*, Thomas Grothues*, Jeff Levinton*, Daniel R. Millemann*, Greg O'Mullan, Philip Orton*, Mark Reiss*, Erika Svendsen*, Judith Weis*, Ike Wirgin*, David Yozzo*, and Chester Zarnoch*

Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under agreement to the Hudson River Foundation, it has not undergone the Agency's publications review process and therefore, may not necessarily reflect the views of the Agency, and no official endorsement should be inferred.

CITATION:

Da Silva, R; Pirani, R; Stinnette, I; Suskowski, D; and Lodge, J. 2019. Environmental Research and Monitoring in the New York-New Jersey Harbor Estuary, Hudson River Foundation. New York, NY.



PHOTO: Kate Boicourt

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www.hudsonriver.org/NYNJHEPEnvironmentalMonitoring.pdf

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