
Rhode Island Environmental Monitoring Collaborative

2013 Summary Report

Nicole E. Rohr, Ph.D. (Chair)
*Coastal Institute, University of Rhode
Island*

Susan Kiernan (Vice Chair)
*RI Department of Environmental
Management*

Thomas Uva (Vice Chair)
Narragansett Bay Commission



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Executive Summary

The Rhode Island's environmental management objectives are based on promoting a healthy environment as the first step toward a strong economy and resilient coastal communities – safe and beautiful beaches attract visitors from around the world, healthy salt marshes protect coastal communities from the increasing threat of sea level rise and hurricanes, and clean marine waters of Narragansett Bay support robust fisheries and aquaculture industries, among others. Long-term environmental monitoring data reveals changes in ecosystem health that spur management actions, and guides assessment of management decisions. Healthy environments are intricately interwoven with healthy economies and quality of life, and environmental monitoring is the foundation upon which healthy environments are built.

The key aspects of the 2013 Rhode Island Environmental Monitoring Collaborative Report are highlighted below:

Critical Issues

Rhode Island's executive authorities face eroding state and federal support for environmental monitoring, and the RIEMC **projects an FY 2016 annual unmet need of \$2,651,000**. This ongoing shortfall is already disrupting several monitoring programs, which can lead to having to make management decisions with a shortage of information. Some examples:

- Monthly monitoring of the Pawcatuck River was reduced from 12 to 9 months due to funding limitations, and continued reductions may impact management decisions regarding water supply, drought response, flood control, or habitat restoration.
- Federal funding support through EPA for saltwater beach water quality monitoring is threatened each year and, if it is cut, there is no state funding available to conduct the water quality monitoring required to protect public health at Rhode Island's bathing beaches. This program is obviously critical to Rhode Island since it relied on this funding to keep beaches clean, healthy, and open to residents and the many visitors and tourists, all of which are primary contributors to the Rhode Island economy.
- Federal reductions to the Clean Water State Revolving Fund combined with increasing demands on the limited budget for the Rhode Island Department of Environmental Management threaten the fixed-site monitoring network, which is critical to measuring the improvements resulting from investments to upgrade wastewater infrastructure.

Findings and Accomplishments

Despite continued funding constraints, RIEMC programs have reported notable water quality improvements and several Rhode Island environmental monitoring programs launched enhancements to program methods, data analysis, and are diligently developing future plans to enhance the efficacy and efficiency of environmental monitoring. The best available science is key to the best decisions being made on future management issues that can properly protect Rhode Island's natural resources. Examples include:

- Significant reductions in nutrient discharges to upper Narragansett Bay have been realized, the result of over \$250 million in infrastructure improvements at wastewater treatment facilities.
- “The Effects of Sea Level Rise on RI’s Salt Marshes” workshop participants identified climate change impacts to salt marshes and discussed plans for adaptation, including continuation and enhancement of environmental monitoring to assess pilot projects. This type of future planning is critical to Rhode Island coping with future climate changes.
- Monitoring of marine water quality indicates that investments in wastewater treatment are reducing levels of harmful bacteria in upper Narragansett Bay, leading to discussions of licensing Sabin Point Beach in East Providence, providing more convenient beach access to urban residents.
- URI’s Watershed Watch Program developed a database application that improves management of its volunteer monitoring data on freshwater and marine water quality and takes a step toward making the data more easily accessible to scientists, state agencies, watershed organizations, and the public while maintaining data integrity.

Climate Change

Climate change is impacting Rhode Island’s natural environment in many ways. Environmental monitoring will facilitate the development of a comprehensive picture of the changes Rhode Islanders are currently facing and should continue to expect, and guide them in reducing harmful impacts and adapting to these changes. Areas of particular concern include:

- More frequent intense precipitation events will result in higher volumes of stormwater runoff that if not properly treated may result in more frequent beach closures and restrictions on shellfish harvesting.
- Warming water temperatures in Narragansett Bay are increasing the prevalence of shellfish diseases that have historically been restricted to the waters farther south.
- Changes in precipitation patterns will produce more intense rainfall events, but could also result in unusually dry periods in between, impacting river and stream flows, groundwater resources, flood mitigation, and drinking water supplies.

Rhode Island has shown itself to be a national leader on environmental and climate change issues, and has strong voices at the federal, state, and local levels. Investing in long-term environmental monitoring is critical to making the best management decisions for our natural resources and coastal communities, and ensuring the state remains a leader on how best to protect and use our unique natural resources.

If you would like more information on the Rhode Island Environmental Monitoring Collaborative or this report, please contact Nicole Rohr at nrohr@mail.uri.edu or visit the website at <http://www.coordinationteam.ri.gov/envirocollab.htm>

About the Rhode Island Environmental Monitoring Collaborative

"In the Ocean State, our economy and our way of life depend on the health of our environment."

–U.S. Senator Sheldon Whitehouse

Who We Are

The Rhode Island Environmental Monitoring Collaborative (RIEMC) identifies environmental monitoring priorities for the state, establishes statewide environmental indicators, and works to provide the public and elected leaders with a deeper understanding of the status of Rhode Island's environment and natural resources. To accomplish these goals, the RIEMC brings together stakeholders from executive agencies, university-based programs, non-governmental organizations, and others to enhance coordination and collaboration.

The RIEMC Annual Report provides information on the activities it is charged with by the Rhode Island General Assembly, and serves as an update on the progress made in environmental monitoring. The 2013 report:

- 1) Provides a detailed summary of the 20 monitoring initiatives identified by the RIEMC as critical to Rhode Island.
- 2) Highlights key environmental monitoring accomplishments and findings.
- 3) Outlines ways in which the work of the RIEMC supports decisions related to preparation for climate change.
- 4) Describes continued challenges that threaten the capacity to collect, analyze, and report monitoring data.

The Importance of Environmental Monitoring

Rhode Island relies on its natural resources as a major contributor to the state's economy and cultural identity. Environmental monitoring programs often do not produce attention-grabbing results worthy of banner headlines; therefore, they are often some of the first programs on the chopping block when budgets are tight. Nevertheless, robust environmental monitoring is integral to the maintenance of ecosystem services and natural resources productivity, and effective management of our natural resources relies on environmental monitoring to provide benchmarks and allow us to measure progress toward environmental objectives.

Rhode Island Environmental Monitoring Collaborative Members

| | |
|----------------------------|--|
| Tom Borden | Narragansett Bay Estuary Program |
| James Boyd | RI Coastal Resources Management Council |
| Kathy Crawley | RI Water Resources Board |
| Marci Cole-Ekberg | Save The Bay |
| Mark Gibson | RI DEM, Marine Fisheries |
| Paul Gonsalves | RI Statewide Planning |
| Linda Green | URI Watershed Watch |
| David Gregg | RI Natural History Survey |
| Susan Kiernan (Vice Chair) | RI DEM, Office Water Resources |
| John King | URI Graduate School of Oceanography |
| Charles LaBash | URI Environmental Data Center |
| Matthew Ladewig | ESS Group, Inc. |
| David Murray | Brown University |
| Amie Parris | RI Department of Health |
| Margherita Pryor | EPA, Region 1, Ocean/Coastal Protection |
| Nicole Rohr (Chair) | URI Coastal Institute |
| Robert Stankelis | Narragansett Bay National Estuarine Research Reserve |
| John Torgan | The Nature Conservancy, Rhode Island |
| Thomas Uva (Vice Chair) | Narragansett Bay Commission |
| Hal Walker | EPA, Atlantic Ecology Division |

For questions or comments regarding this report please contact Nicole Rohr at nrohr@mail.uri.edu or 401.874.4866.

Cover: (Left) NBC staff collecting water quality data in Narragansett Bay. Photo Credit: NBC. (Right) Scientists from RIDEM collecting data in a Rhode Island wadeable stream. Photo Credit RIDEM.

List of Abbreviations and Acronyms

| | |
|---------|--|
| ACOE | U.S. Army Corp of Engineers |
| AIS | Aquatic Invasive Species |
| ASMFC | Atlantic States Marine Fisheries Commission |
| BRWCT | Bays, Rivers and Watersheds Coordination Team |
| CHRP | Coastal Hypoxia Research Program |
| CRMC | Coastal Resources Management Council |
| CZM | Coastal Zone Management |
| DO | Dissolved Oxygen |
| EPA | U.S. Environmental Protection Agency |
| EPA AED | U.S. Environmental Protection Agency Atlantic Ecology Division |
| FDA | U.S. Food and Drug Administration |
| FEMA | Federal Emergency Management Agency |
| FY | Fiscal Year |
| GIS | Geographic Information Systems |
| MA | Massachusetts |
| NBC | Narragansett Bay Commission |
| NBEP | Narragansett Bay Estuary Program |
| NBFSMN | Narragansett Bay Fixed Site Monitoring Network |
| NBNERR | Narragansett Bay National Estuarine Research Reserve |
| NEFMC | New England Fishery Management Council |
| NEIWPC | New England Interstate Water Pollution Control Commission |
| NOAA | National Oceanic and Atmospheric Administration |
| NRCS | Natural Resources Conservation Service (part of USDA) |
| OWR | Office of Water Resources (part of RIDEM) |
| PWSB | Providence Water Supply Board |
| RI | Rhode Island |
| RIDEM | Rhode Island Department of Environmental Management |
| RIDOH | Rhode Island Department of Health |
| RIEMA | Rhode Island Emergency Management Agency |
| RIEMC | Rhode Island Environmental Monitoring Collaborative |
| RINHS | Rhode Island Natural History Survey |
| RWU | Roger Williams University |
| SAMP | Special Area Management Plan |
| SRF | State Revolving Fund |
| STB | Save The Bay |
| TMDL | Total Maximum Daily Load |
| URI CI | University of Rhode Island Coastal Institute |
| URI EDC | University of Rhode Island Environmental Data Center |
| URI GSO | University of Rhode Island Graduate School of Oceanography |
| URI WW | University of Rhode Island Watershed Watch |
| USDA | U.S. Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Service |
| WPWA | Wood-Pawcatuck Watershed Association |
| WRB | Rhode Island Water Resources Board |
| WWTF | Wastewater Treatment Facilities |

Introduction: Importance of and Challenges to Environmental Monitoring

Why is environmental monitoring important?

The cost of programs across state and federal budgets are highly scrutinized in the current fiscal climate. Environmental monitoring programs often do not produce attention-grabbing results worthy of banner headlines; therefore, they are some of the first programs on the chopping block. Nevertheless, monitoring provides important short-term and long-term indicators of environmental health and is integral to scientific research, management decisions and assessments, and policy development.

Environmental monitoring is essential to the effective management of our natural systems and allows us to quantitatively observe how the ecosystems in and around Narragansett Bay change over time. Monitoring is key to assessing whether change is within the expected natural range or if there is an external, most often man-made, force impacting the system. When monitoring efforts indicate that our natural systems are being impacted by outside influences, our state and federal regulatory agencies can develop or promulgate regulations and rules to mitigate these impacts. When such regulations and rules are implemented, environmental monitoring is important to assess whether human intervention yields positive results or if the rule or regulation requires further modification. Support for a robust environmental monitoring program is important due to its integral role in development, implementation, and maintenance of regulations that govern ecosystem health.

How are environmental monitoring data used to benefit the public?

The federal and state mandated programs governing water pollution control have resulted in significant investment by the public as well as various business sectors in actions to protect ecosystems and human health. We need to make sure these programs have the anticipated impact on ecosystem and human health, and are worth the cost to society and the economy. How do we analyze these impacts? Environmental monitoring. For example, the Narragansett Bay Commission (NBC) ratepayers have invested in NBC's combined sewage overflow abatement project to comply with Clean Water Act mandates to reduce pathogen inputs to Narragansett Bay and to ensure RI Department of Environmental Management permit requirements are met. Monitoring is essential to generating information to evaluate the progress made toward these goals.

Damage may also be done to the natural environment that is a direct result of the actions of a person, business, or other private interest. When this occurs, the responsible party is also often responsible for the restoration of the environment. While this is a complicated process that involves a number of state and federal agencies, the most significant factor in determining damages is having a baseline assessment of environmental health before the damage occurred. How do we develop the baseline? Environmental monitoring. A local example of this is the continued restoration efforts from the *North Cape* oil spill of 1996 that impacted sensitive habitats in southern RI and Block Island Sound.

Through this report the RI Environmental Monitoring Collaborative (RIEMC) highlights two major points: 1) accomplishments through environmental monitoring with regard to the RIEMC's twenty environmental monitoring priorities; and 2) a growing concern that the level of investment in core monitoring programs is insufficient to meet the information needs of management decision-makers. Reductions in federal and state funding have eroded important data collection efforts and constrained our ability to apply data effectively to policy and management. Intensifying challenges such as climate change and difficult government fiscal constraints reinforces the need for the RIEMC to continue to play a strong role in coordinating and optimizing the collective monitoring efforts underway in RI in order to invest limited government taxpayer dollars in the most effective way, reduce redundancies, and foster creative partnerships to leverage each dollar received.

Established by RI's 2004 Comprehensive Environmental and Watershed Monitoring Act (R.I.G.L. § 46-31), the RIEMC consists of executive agencies, university-based programs, non-governmental organizations, and other monitoring stakeholders throughout the state. The RIEMC strives to ensure aquatic and terrestrial monitoring, including long-term programs and targeted or specialized monitoring and research, is implemented in a coordinated, effective manner that is responsive to management needs. To accomplish this goal, the RIEMC brings stakeholders together to enhance coordination and collaboration. The RIEMC promotes better understanding and greater appreciation of Narragansett Bay and its watershed, and works with the RI Bays, Rivers, and Watersheds Coordination Team (BRWCT) to support strategic planning and management for RI's dynamic aquatic, marine, and terrestrial environments. The RIEMC

What is the greatest challenge to environmental monitoring?

Lack of funding threatens monitoring programs with disruptions that have cascading consequences. We realize this is a common concern to almost every state program, but environmental monitoring has been subject to a series of reductions at the state and federal levels and there are few options to fill the gaps.

Rhode Island is fortunate to have a broad range of academic and federal researchers who are willing and able to support monitoring efforts when funding is available. These researchers have been resourceful and helped the state to maintain monitoring even in light of shrinking budgets, but we are now at the point where monitoring efforts are ending due to insufficient funding to meet minimal requirements of the programs.

reviews major environmental monitoring initiatives, establishes statewide priorities for environmental monitoring, supports field program coordination of staff effort and equipment use, and is developing a Comprehensive Environmental Monitoring Strategy for RI.

The RIEMC reports to the BRWCT, a commission composed of seven state agencies that sets and pursues overall goals for water management and sustainable water-reliant economic development. As authorized by RI state law, the BRWCT has provided funding for environmental and economic monitoring in its implementation of the Rhode Island Bays, Rivers, and Watersheds Systems-Level Plan, with guidance and review from the RIEMC.

As noted in prior reports, RI has many unmet environmental monitoring needs. Concern has grown over the past year that a number of irreplaceable long-term monitoring programs are threatened with termination. It is extremely difficult, even with increased input and guidance from the RIEMC, for the BRWCT to allocate sufficient funds to maintain current environmental monitoring programs, address major funding gaps, and help RI take advantage of advances in technology, continue data analysis, and provide ongoing communication with the public. Over the last few years, BRWCT has been able to provide “stop-gap support” to some environmental monitoring programs, such as the RI Stream Gage Network. Unfortunately, BRWCT’s ability to provide support remains small relative to overall needs. Consequently, BRWCT is concerned that the current reliance on its office as the targeted funding source for a select number of environmental monitoring programs will result in other monitoring needs not being met. Moreover, such reliance on BRWCT funding limits its ability to allocate funds in a strategic, flexible manner, as originally intended.

Greater dialogue between the RIEMC and the BRWCT should stem from continued development of a Comprehensive Environmental Monitoring Strategy. This strategy would provide a framework to improve coordination of monitoring for water quality protection, water pollution control, fisheries and wildlife management, habitat restoration, coastal zone and watershed management, public health, and natural hazards response and recovery. It would also promote in-depth evaluation of the status and well-being of RI’s natural environment, and establish a unified framework to coordinate monitoring, pursue public education and management support via initiatives such as Watershed Counts, and increase the utility of monitoring data and findings for statewide policy, planning, and management.



Clockwise from left (photo credit): fixed-site buoy network for marine water quality (NBC); salt marsh along Narrow River (NBNERR); environmental surveys in salt marsh (NPS); large river and stream water quality monitoring (Save The Bay), meeting to discuss monitoring methods and impacts of climate change (RIDEM).

2013 Findings and Accomplishments

Rhode Island monitoring programs and data users have coped with flat and/or declining budgets for many years, and state and federal agencies and other monitoring stakeholders have long pursued alternative funding sources for monitoring. Despite continued challenges to RI environmental monitoring, important work has been accomplished and a number of innovations have occurred. The concern remains, though, that environmental monitoring programs often bear the brunt of funding cuts, and constraints are now impacting innovation.

Despite these constraints, in 2013 the RI Environmental Monitoring Collaborative continued to focus on sustaining and coordinating vital environmental monitoring activities and program functions. With much effort and creativity, several RI monitoring programs managed to launch enhancements to monitoring fieldwork and data analysis, and report on key environmental events and trends. A selection of these accomplishments and findings are summarized below.

Salt Marshes



On April 16, 2014, Save The Bay, the Narragansett Bay National Estuarine Research Reserve, Environmental Protection Agency's Atlantic Ecology Division (EPA AED), and the RI Coastal Resources Management Council co-hosted a workshop, "The Effects of Sea Level Rise on RI's Salt Marshes." Approximately 100 researchers, managers, and conservation group members gathered to present and discuss new research in our salt marshes, management plans to protect and restore these critical habitats, and potential adaptation strategies to sea level rise.

The innovative workshop fostered collaboration across all groups involved in salt marsh research and monitoring and resulted in a productive day of discussion and brainstorming of solutions. Materials from the workshop can be found at <http://nbwctp.org/programs/saltmarsh.html>. (Please see the salt marsh one-pager on page 38 for more details on RIEMC efforts). The next issue of the Narragansett Bay Journal will focus on the workshop, and it will be found at <http://www.nbep.org/bayjournal-currentissue.html>.

Workshop participants highlighted that salt marshes adapt to sea level rise by migrating inland; however, with the rate of sea level rise we are experiencing combined with the time it takes for a salt marsh to become established in an adjacent area, marshes are being submerged and drowned. In other places, roads, buildings, seawalls, and other hardened shorelines prevent

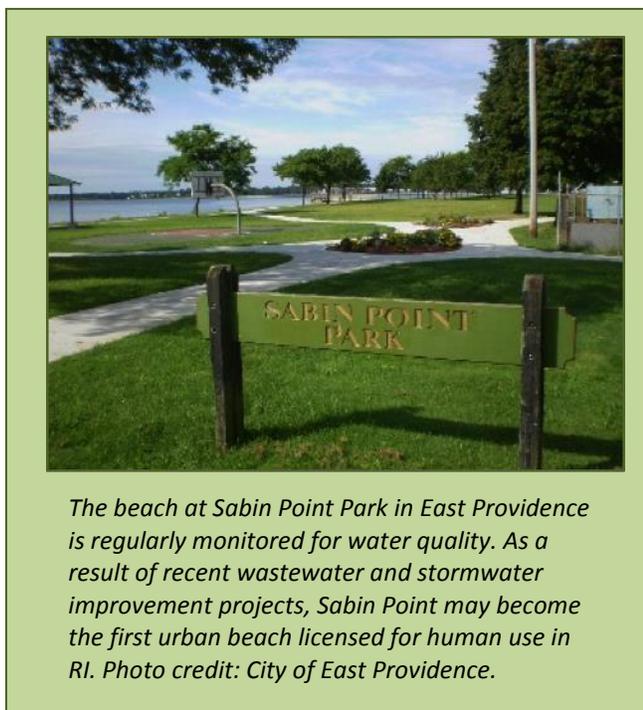
the migration of salt marshes causing this critical habitat to be squeezed between man-made structures and rising salt water until they disappear. The loss of salt marshes will result in a loss of habitat for shorebirds, nursery habitat for commercially important fish, and natural protection from storm surge and erosion for our communities.

It was not all negative news for salt marshes though. State, federal, and nongovernmental organizations are directing their resources and volunteer efforts toward preparing salt marsh habitats for sea level rise. Planting areas that have experienced marsh die-off, increasing connectivity among salt marshes, and reusing dredged sediment to facilitate accretion are all methods being tested. It is critical to continue environmental monitoring efforts in salt marsh areas to determine which approach works best for the survival of the salt marsh and provides the most return on investment.

Marine Beaches

Historically, the RI Department of Health (RIDOH) has deemed marine beaches in the Upper Narragansett Bay unsafe for swimming. During larger rainfall events, the high percentage of impervious cover in RI's urbanized metropolitan area increases stormwater runoff flowing into a combined portion of the wastewater system. If the facilities become overwhelmed, then untreated stormwater and wastewater can flow directly into the bay, discharging pathogens and preventing the establishment of beach facilities in the upper bay. On a seasonal basis, RIDOH monitors levels of bacteria that are harmful to human health and, when levels exceed the standard set forth by the EPA, beaches cannot be used for public recreation.

To comply with federal and state water pollution control strategies, strides have been taken by the Narragansett Bay Commission (NBC) to increase its stormwater and wastewater storage capacity through the ratepayer-funded combined sewage overflow (CSO) abatement project. While the project is not fully complete, the first stages of this development have resulted in an increase in the holding capacity of stormwater and wastewater. This means that during high flow times the water containing pathogens does not flow directly into the bay, but is stored until the facility is able to treat the water to eliminate the pathogens. Improvements in water quality have been measured by NBC, with this project being awarded the Water Environment Federation Water Quality



Improvement award for 2014. Due largely to NBC's CSO project, beach water quality at Sabin Point in East Providence has improved.

The RIDOH, Save The Bay, and the City of East Providence have conducted regular beach water quality monitoring at Sabin Point and the water is improving every year. For the first time since implementation of the federal BEACH Act in 2000, there are discussions of licensing the beach at Sabin Point for human access and use. There are still steps the City of East Providence must take to license Sabin Point Beach, but this would provide safe beach access to the thousands of people who live in and around our state's capitol.

Watershed Counts

Watershed Counts is a broad coalition of over 60 agencies and organizations who work together to examine and report on the condition of land and water resources of the Narragansett Bay Watershed Region. Watershed Counts is co-coordinated by the URI Coastal Institute and the Narragansett Bay Estuary Program, and benefits from the guidance of experts in RI, MA, and federal agencies.



The 2014 Watershed Counts Annual Report, issued in July 2014, focused on a “spotlight” issue: marine and freshwater beaches. By dedicating the majority of the report to a single issue, Watershed Counts provided more detail on the challenges that face beach managers in the Narragansett Bay Region with a greater focus on the steps being taken to improve water quality and reduce beach closures, particularly in light of the potential impacts of climate change. The full report as well as additional information can be found at <http://www.watershedcounts.org/>.

Water Quality Database Development

The URI Watershed Watch (URI WW) is a statewide volunteer monitoring program that collects basic data on surface water quality for RI's lakes, ponds, reservoirs, rivers, streams, and marine waters. This program was established 25 years ago and is highly respected throughout the state and region. URI WW is a sterling example of the value of citizen scientists.

The URI WW is funded through a number of sponsors including an annual grant from the RI Department of Environmental Management (RIDEM) with EPA funds; fees provided by watershed groups and volunteer monitoring organizations to cover the cost of supplies, training, and sample analysis; and grant money when awarded. Grant money is sought for large, one-time projects that are critical to the success of the program; however, URI WW historically has not had success in obtaining funds for the creation of a comprehensive database for water quality data that is easily accessed and queried by URI WW partners, including local watershed groups, researchers, and the RIDEM.

To remedy this problem, the URI Coastal Institute awarded URI WW a grant to initiate development of a database prototype that will eventually be expanded to a web-based platform accessible from anywhere and by anyone. This database will make data available to scientists and watershed organizations without special requests to URI WW, and will fulfill a critical role in making data transparent and accessible to the public while maintaining a high level of data quality control.

As support for environmental monitoring has eroded over time, program managers have been forced to allocate remaining funds to actual field collection of monitoring data, at the expense of support for reviewing, archiving, analyzing, and disseminating monitoring data. Hence, it is increasingly difficult to harvest the full value of environmental monitoring for management, and to demonstrate to public funders why environmental monitoring is so essential.

Nutrient Reduction Mandate

In August 2003, a major fish kill adversely impacted Greenwich Bay, killing an estimated one million fish, as well as hundreds of crabs, clams, and shrimp. Comprehensive studies determined the cause to be anoxic conditions (no dissolved oxygen in the water) due to an unusual, but hardly unique combination of high water temperatures, weak tidal mixing (a neap tide), Greenwich Bay's low flushing rates, and nutrient loadings from wastewater treatment facilities (WWTFs), septic systems, and stormwater runoff.



NBC collecting water quality data including dissolved oxygen levels. Photo credit: NBC

In response to this event, the RI legislature mandated a 50% reduction in summer nutrient discharges from RI WWTFs that discharge directly into upper Narragansett Bay or its major tributaries. Since then, WWTF ratepayers have paid over \$250 million toward this mandate.

Monitoring of plant discharges has shown excellent progress toward the 50% nutrient discharge reduction mandate, with some discharges in 2013 exceeding this benchmark. Multiple years of data will be needed to analyze and quantify progress toward restoring water quality in this portion of the bay.

These seasonal reductions in nutrient discharges from WWTFs are a great achievement that reflects the high priority Rhode Islanders place on the health of Narragansett Bay. Regardless, data collected on environmental health indicators (i.e., dissolved oxygen levels, shellfish pathogens, eelgrass beds, etc.) show continued stress on the system. Changing decades of environmental degradation cannot be reversed quickly. The reduction in nutrient loading may take time to manifest as it changes toward a healthier bay, making this a critical time to engage in long-term monitoring to measure the environmental responses to these efforts.

Climate Change: The Importance of Environmental Monitoring

The Bottom Line:

- Rhode Island relies on its natural resources as a major contributor to the state economy and cultural identity.
- State agencies manage our natural resources and monitoring allows them to assess whether their goals are being met and, if not, adapt their management strategy.
- Climate change is one of the greatest threats to our natural resources and the state is preparing for changes, as evidenced by the creation of and work by the RIEC⁴.
- RIEMC conducts monitoring related to climate change, and stands ready to work with the RIEC⁴ to expand the state's efforts in an efficient and cost-effective manner.

Rhode Island relies on its natural resources as a major contributor to the state economy and cultural identity. Whether it is the beautiful beaches that attract tourists from near and far; the fish and shellfish that support our commercial fishermen, shellfishermen, and aquaculturists; or the freshwater lakes, rivers, and ponds that host kayakers and family reunions, a healthy environment benefits everyone. Unfortunately, we all too often take it for granted.

Environmental monitoring allows agencies, scientists, and policymakers to determine if we are making the best management decisions to protect and restore natural resources, and to determine if there are unintended consequences of these management strategies. Monitoring data provides the information we need to adapt our management methods, if necessary, or provides support for staying the course.

In addition, monitoring often provides the first warning when there is a major change in our environment, and the data collected may indicate that action needs to be taken to reduce the threat, protect the resources, or prepare for impacts. Climate change is clearly a major threat. It is impacting nearly every environment in RI, but without short- and long-term monitoring, managers, decision-makers, and scientists cannot fully understand the magnitude or implications of these changes. Monitoring provides a series of snapshots in time that define both the status and trends of environmental change.

The RI General Assembly and Governor Chafee understand that climate change is here—it no longer looms on the horizon as a challenge for the next generation—and we as individuals and as a state can make strides to adapt to and mitigate the impacts. To coordinate state efforts and create a unified plan across all state agencies, Governor Chafee signed Executive Order 14-01 on February 21, 2014, to establish the RI Executive Climate Change Coordinating Council (RIEC⁴), which was signed into law on August 1, 2014, as part of the Resilient RI Act.

The RIEC⁴ recommended the improvement of data collection and monitoring to enhance understanding of impacts of climate change on natural resources through the strengthening and expansion of existing collaborative monitoring programs (Action 7.4.1).

While response to and assessment of climate change is not an explicit goal of the RI Environmental Monitoring Collaborative (RIEMC), many of the ongoing monitoring efforts included in this and previous reports are closely interwoven with climate change, and data supports climate change decisions made by the State.

Climate change is multi-faceted with a wide variety of potential impacts and myriad ways these impacts could interact. To gain a comprehensive picture of the changes Rhode

Islanders should expect to experience and how to prepare for these changes, environmental monitoring should cover a broad suite of indicators throughout Narragansett Bay, its coast, and its watershed. While the RIEMC currently conducts monitoring in 20 priority areas, there is much more that can—and should—be done to enhance the efficacy of efforts to adapt to or mitigate the impacts of climate change.

The state, with input and assistance from RIEC⁴ and the RIEMC, should expand monitoring efforts to include: testing pH of water in anticipation of impacts from ocean acidification, tracking terrestrial indicators to assess impacts on our forest habitats, and focusing on urban areas where humans have the most impact on the environment, among others. There are many impacts for which RI can monitor and take action, but climate change needs also to be addressed on the regional and national levels, with coordinated monitoring strategies.

While there are many ways to expand and build upon the efforts of the RIEMC, it is already focusing on climate change in certain areas, especially as it impacts our waters and coast. The following are examples of how RIEMC efforts directly relate to climate change and highlight areas where progress is being made and resources are being protected, but also areas where monitoring is at risk of being suspended due to rising costs and diminishing budgets.



The RI Executive Climate Change Coordinating Council listens to testimony to inform recommendations for Governor Chafee to help RI prepare for the impacts of climate change. Photo credit: State of RI Division of Planning.



Photo credit: RI Sea Grant, Shoreline Change SAMP

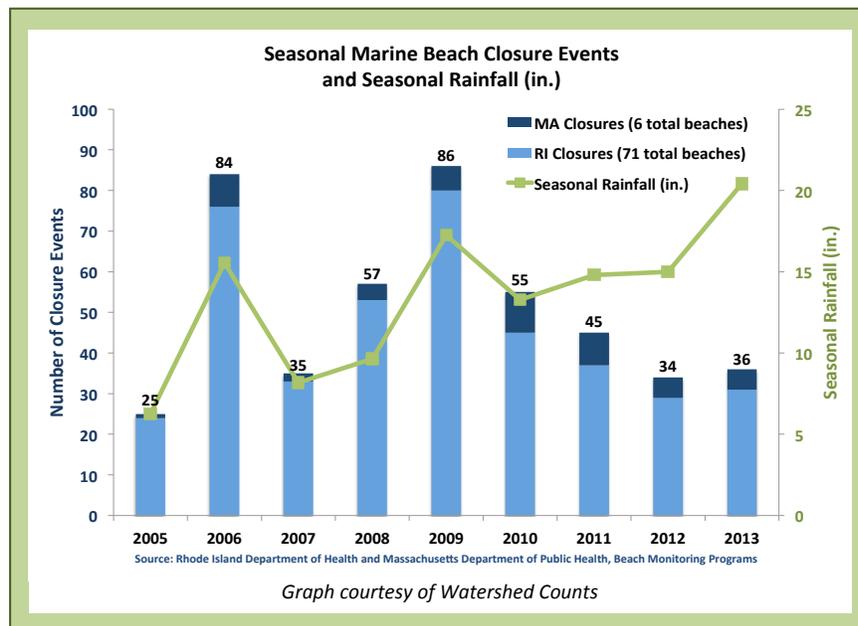
Climate Change Focus: Changes in Precipitation Impact Beaches and Marine Water Quality

The Bottom Line:

- Changes in precipitation patterns due to climate change are predicted to increase stormwater runoff, which is exacerbated by increasing amounts impervious surfaces.
- Increases in stormwater runoff can result in greater occurrences of harmful bacteria that affect our beaches and result in beach closures, and can lead to increased nutrient input to our marine waters that contribute to algal blooms and hypoxia.
- Assess how indicators such as harmful bacteria and dissolved oxygen levels in combination with rainfall, wind, and temperature data are impacted by climate change, and identifies the ramifications for resource management.

Stormwater Runoff and Beach Health

Climate change is expected to result in more frequent, intense rainfall events. Beach closure events are strongly influenced by the duration and intensity of precipitation events that generate increased stormwater runoff and carry bacteria into our waters from failing on-site wastewater systems, leaking sewer pipes, animal wastes, and other sources.



Marine beaches are monitored for bacteria that indicate fecal contamination. Human contact with contaminated beach water can lead to a wide range of health complications, which is the primary reason beaches are monitored.

Local governments are investing in improved stormwater management to address existing pollution problems and better protect beaches

from the anticipated impacts of changing rainfall patterns. These efforts have resulted in a statewide trend of fewer beach closure events even with more rainfall. Other actions contributing to the trend include the phase out of antiquated and failing septic systems, repair of leaking sewer lines, and public wastewater infrastructure improvements. For case studies, see Watershed Counts (<http://www.watershedcounts.org>.)

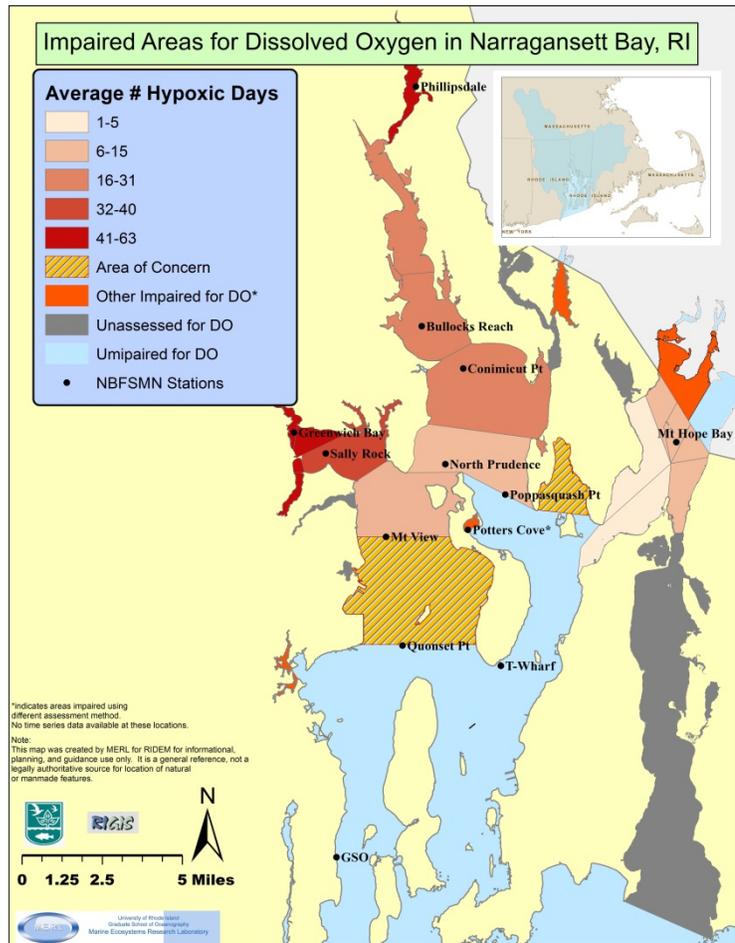
Environmental monitoring of beaches is not only important for public health and the assessment of improvement projects, but also provides insight as to whether or not Rhode Island is taking adequate actions to prepare for increased precipitation due to climate change.

Changing Precipitation and Hypoxia

Dissolved oxygen (DO) in the estuarine waters of Narragansett Bay is essential to support the variety of animals that live there including fish, shellfish, and other invertebrates. Low DO—hypoxia—is a symptom of eutrophication, which can cause rapid growth of phytoplankton and other algae that deplete DO in the water when they decompose. When low DO is pervasive, then animal diversity, environmental health, and ecosystem services decline. In extreme cases, we see slowed growth rates and even fish kills.

Restoring DO to acceptable levels is a management focus and there are a variety of pollution control actions that aim to improve conditions throughout Narragansett Bay, but particularly in the Upper Bay where human population is more concentrated and hypoxic conditions have been found more frequently.

In any year, the extent of hypoxia present in Narragansett Bay is influenced by climatic factors, among them precipitation patterns. Hypoxic conditions can be intensified when river flows are higher due to rainfall and its associated runoff. Increased runoff can deliver more nitrogen into the bay helping to fuel algal blooms. In addition, higher volumes of freshwater flows into the bay result in stratification which in turn limits mixing and prevents oxygen in the air from replenishing bottom waters.

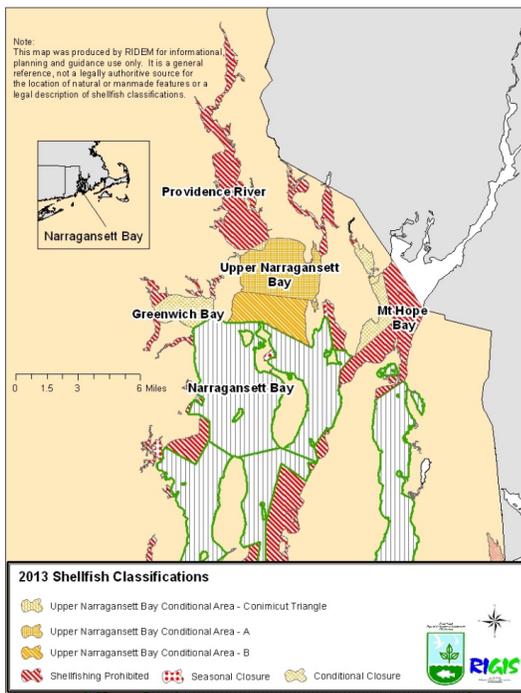


While much of the Upper Bay is impaired for DO, overall nitrogen inputs to Narragansett Bay have decreased in response to recent pollution control efforts and continued monitoring is expected to show improvements in the coming years; however, the system must be monitored in the same way a chronic disease is managed so adjustments can be made as warranted. With the frequency at which RI experiences intense rainfall events projected to rise with climate change, this continued monitoring becomes even more important to ascertain if management strategies will need to be adapted to changing conditions.

Climate Change Focus: Shellfish Growing Areas

The Bottom Line:

- Shellfish harvesting face a climate change double threat: increased stormwater runoff and increased water temperatures.
- Tracking and research of shellfish diseases that are more prevalent in warming waters is underway to better understand the potential impacts.
- Continuation of monitoring will assist managers to protect human health and the shellfish economy, and ensure management efforts are effective.



Shellfish harvesting in Rhode Island waters is facing a double threat from climate change: changing precipitation patterns that cause more pollution to run into our waters, and increased water temperatures that facilitate the prevalence of shellfish disease.

Increased stormwater runoff can result in bacteria and other pathogens polluting bay waters and preventing the harvest of shellfish. Sources of the pathogens include overflows from combined and sanitary sewers, failed septic systems, and pet wastes. Pathogens can build up in the tissue of shellfish, which filter the water to feed, and can cause illness if contaminated shellfish are consumed by humans. With a prediction of an increase in the number of extreme rainfall events, this poses a serious concern with shellfish harvesting.

Water pollution control actions, including major infrastructure investment to reduce combined sewer

overflows, has contributed to a 36% increase in the number of acre-days the Upper Bay was open to shellfishing in 2013 as compared to 2004, years with comparable rainfall. It will be important to monitor the effectiveness of pollution controls over time in order to identify when additional actions may be needed to adapt to changing climate conditions.

As water temperatures increase, shellfish diseases—and illness in consumers of infected shellfish—previously common in waters further south have become prevalent in RI. In 2014, increased incidence of disease associated with bacterium *Vibrio* prompted RIDEM to change procedures for shellfish harvesting to be more protective of public health, with an expected expansion to hard shell clams in 2015.

The RIDEM monitors shellfish growing areas for harmful pathogens and regulates harvesting. Continued monitoring is essential to maintaining a vibrant and sustainable shellfish industry and to ensuring shellfish in RI are safe for consumption.

Climate Change Focus: Groundwater Levels and Streamflow Monitoring

The Bottom Line:

- Changes in precipitation patterns will likely create more intense rainfall events with dry periods in between, altering current streamflow rates and groundwater storage.
- Maintenance of healthy ecosystems, allocation of water resources, and management and planning of flood-risk zones will all face challenges.
- Continuation of monitoring will allow water resource managers to make sound decisions to meet the needs of communities and the environment in a sustainable manner in light of climate change.

Climate change is expected to impact precipitation patterns in RI, by producing more intense rainfall events even though the overall rainfall amounts are not expected to increase significantly. This could result in unusually dry periods between these intense rainfall events, which could have significant impacts on stream flow and groundwater storage. During 2013, the U.S. Geological Service (USGS), in cooperation with the RI Department of Environmental Management, RI Water Resources Board, and the Providence Water Supply Board, monitors a network of 24 real-time streamgages and 6 real-time groundwater observation wells. Historic data are available at 57 streamflow and 225 groundwater sites at <http://ri.water.usgs.gov/>.

This monitoring network provides critical information on surface and groundwater resources that is used to improve river flood forecasting, track and manage drought, support sustainable management of water supplies, and determine streamflows needed to maintain healthy aquatic ecosystems. Specialized studies conducted by USGS with its partners, provide information on a range of water resources topics (<http://ri.water.usgs.gov/publications/>). These studies often use groundwater and surface-water modeling tools to assess the impacts of climate change on water supply, streamflows, and water quality.



USGS researchers install equipment for stream gage monitoring. Photo credit: USGS.

A recent publication on the magnitude of flood flows in RI shows a significant trend of increasing streamflow rates at most long-term streamgages. If the trend continues, we may expect flood magnification of 21 percent in 30 years. (<http://pubs.usgs.gov/sir/2012/5109/>)

We may not be able to reduce the frontline impacts of climate change, i.e., increased intensity of precipitation, but with foreknowledge and planning we can reduce the severity of potential damage and associated costs.

Critical Issues Regarding Federal & State Support for Environmental Monitoring

Rhode Island's executive authorities face the dilemma of eroding state and federal support for environmental monitoring. All states are coping with reductions in funding contained in the federal government's fiscal year (FY) 2014 budget, while still trying to recover from the federal budget sequestration in FY 2013 and the 17-day federal government shutdown in October 2013. The repercussions of these compounding stressors are expected to continue into at least the next several fiscal years. RI traditionally relies heavily on federal funds for many aspects of environmental and natural resources management, making the recent federal funding cutbacks—whether a series of small cuts that quickly add up or a single larger reduction—particularly harmful to the sustainability of our state's monitoring initiatives.

RI environmental monitoring relies on funding provided through federal agencies such as the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Service (USGS), and the U.S. Fish and Wildlife Service (USFWS).

The members of the RI Environmental Monitoring Collaborative (RIEMC) will work together to help federal and state legislators more fully recognize the value of environmental monitoring and thus restore and enhance financial support for environmental monitoring in RI. The RIEMC understands the many pressing interests that require funding; however, environmental monitoring is even more important as climate change threatens our natural resources with cascading effects on our communities, economies, and quality of life.

Against this background of fiscal challenges and substantial regulatory changes, it remains the mission of the RIEMC to foster coordination and collaboration among individual monitoring programs and related initiatives such as Watershed Counts and the Narragansett Bay Estuary Program Status and Trends Report, and to serve as a platform for articulating the importance of environmental monitoring for all facets of environmental management and sustainable economic development, including: stormwater and wastewater management, watershed management, habitat restoration, land-use planning, natural hazards mitigation, outdoor recreation, economic development, transportation infrastructure redevelopment, and public health, safety, and well-being.

While there are several examples of how RI environmental monitoring has been impacted by funding cuts (i.e., changes in established methodology that affect the applicability of the data; transfers of funds and/or personnel from other agency programs that are in turn diminished in capacity and effectiveness; suspension or delay of monitoring data analysis, archiving, and dissemination; reliance on funding from supplemental sources that may not be reliable moving forward; etc.), the most pressing challenges are highlighted below.

Stream Gage Network



Robert Bradley from the USGS New England Water Science Center makes a streamflow measurement, an important piece of data in the stream gage network. Photo credit: USGS/Dennis LeBlanc.

The maintenance of baseline environmental monitoring programs in light of cuts in support is exemplified by the efforts to maintain critical water monitoring programs that were historically supported by annual joint funding agreements between the U.S. Geological Survey (USGS), the RI Department of Environmental Management (RIDEM), and the RI Water Resources Board (WRB). Relying upon state funding and federal match support, the USGS has operated, maintained, and disseminated data from the RI Stream Gage Network, conducted water quality monitoring on RI's large rivers, and collected groundwater level observations. State general revenues relied on by RIDEM to support a significant share of its agreement with USGS were reduced in 2002, triggering a suspension of river water quality monitoring. Continued budget pressures resulted in the eventual elimination of RIDEM funding by 2009. During the same period, available state funding in the WRB also failed to keep pace with the rising costs of the joint agreements.

In response, because of the critical importance of the USGS water monitoring data for water quality management, drought response, flood control, habitat restoration, and water supply, the RI Bays, Rivers, and Watersheds Coordination Team (BRWCT) directed a portion of its funds to renew river monitoring and expand stream gage monitoring. For the past several years, the BRWCT has also directed funds to offset the declining state agency operating budgets in order to sustain the joint funding agreements.

Beginning in state FY 2008 with an initial grant of \$137,000, the BRWCT, in consultation with RIEMC, has subsequently provided most of the required state funding for the agreements with USGS, with support in FY 2015 totaling \$282,000. This is the largest single expenditure of BRWCT funds and significantly constrains the BRWCT's ability to strategically fund other projects in the manner stipulated in the BRWCT's original legislation. Despite its size, this grant was not large enough to maintain the historic level of USGS water monitoring because of rising program costs and reduced USGS funding.

In FY 2015, USGS and its RI partner agencies were forced to reduce the scope of water quality monitoring in large rivers and to redesign the groundwater observations program entirely. After USGS conducted an analysis of the network design in order to assess the disruptiveness of various options, the partners decided to: (1) eliminate three months of water quality sampling during the winter on the Pawcatuck River, and (2) shift from monthly measurements of groundwater levels at many sites to continuous measurements of groundwater levels at a network of nine sites. Finally, USGS was able to increase its allocation of funding to RI through the National Streamflow Information Program, which averted the need to completely discontinue a stream gage.

It is generally agreed that these alterations to the USGS water monitoring program will not degrade the statistical integrity of the monitoring data for streamflows, water quality, and groundwater, or the management utility of the data (scientific utility, however, may be diminished). Unfortunately, the costs to the state of maintaining the USGS water monitoring program in RI will continue to increase for the next several years. While the BRWCT anticipates providing the same amount of funding for this monitoring in FY 2016, it cannot increase the funding it provides to stream gage monitoring without jeopardizing funding commitments to other BRWCT agencies and initiatives. Given increasing costs of the water monitoring program, this means that the USGS and its state partners may have to make additional cuts to the USGS water monitoring program in FY 2016.

Cuts in critical baseline environmental monitoring programs such as the USGS water monitoring program will seriously degrade the ability of water resources managers to make smart, cost-effective decisions regarding water supply, water quality, or to respond effectively to storms and floods in order to protect public safety and health.

Saltwater Beach Water Quality

The sole source of funding for monitoring saltwater beach water quality is federal support through the U.S. Environmental Protection Agency (EPA) BEACH Act. There are currently two challenges facing this program: annual threats to cut funding for the program, and proposed changes to monitoring protocols that threaten whether RI is eligible for funding.



Scarborough Beach, one of the many popular beaches in Rhode Island. Photo credit: State of Rhode Island Division of Parks & Recreation.

Each year, Congress must appropriate approximately \$10 million to EPA for the beach program to be divided amongst the coastal and Great Lakes states. In recent years, the President's Budget has eliminated funding for the beach program, but fortunately Congress has restored the funding each year. Support for this EPA program is essential to ensure RI beaches remain open for enjoyment by residents, and by the many summer tourists who visit our coasts and significantly contribute to our economy.

There are challenges to environmental monitoring other than reduced funding at the state and federal levels. Most recently, the EPA has proposed updating the requirements under the BEACH Act that all states must meet in order to receive federal funding for marine beaches water quality monitoring (or Great Lakes beaches, where appropriate). These are substantial changes when compared with how the program has been ran in the past, and failure to comply will result in the loss of federal support—the only funding currently available for the RI saltwater beach monitoring program. While the update will incorporate new information on human health to keep people safe, implementation does pose logistical challenges that must be overcome.

The proposed rules would change how often and what methodology is used to monitor marine beach water quality with perhaps the most significant change being a reduction of the beach closure criterion from 104 colony forming units (cfu) of Enterococci bacteria per 100 mL of water to 60 cfu. In 2012, there were 111 beach closures. If the proposed EPA rule change had been in effect, RI would have had over 200 closures that year. There is significant concern that this change would lead the public to believe water quality is getting worse, which is not necessarily the case. An extensive—and expensive—public awareness campaign would be required to explain that such an increase in beach closures is justified for public health protection, and that the increase was not due to worsening water pollution.

The RI Department of Health (RIDOH) fully supports ensuring that beaches are safe and healthy for human enjoyment, and is working with EPA to plan the best path forward regarding future changes to saltwater beach monitoring in Rhode Island. RIDEM is also involved in the process, as it will need to propose modifications to the state’s Bathing Beach and Recreational Water Quality Regulations.

Wadeable Rivers and Streams

The RIDEM Ambient River Monitoring Program is the primary source of data for assessing the quality of wadeable rivers and streams and detecting changes in conditions resulting from management actions. (See page 44 for a description of the program). RIDEM relies entirely on federal funding through EPA to support this program. While adequately supported for FY 2015, limitations on funding threaten the long-term stability of the program.

Narragansett Bay Fixed-Site Monitoring Network

The network of continuous monitoring stations operating in Narragansett Bay is critical to measuring the improvements resulting from investments to upgrade wastewater infrastructure.

The majority of the network is operated by the University of Rhode Island Graduate School of Oceanography pursuant to an agreement with RIDEM. Currently, RIDEM utilizes a federal EPA funding source associated with the Clean Water State Revolving Fund to support this monitoring. Federal cuts made to the national State Revolving Fund program threaten the stability of funding for this program and as a result there is a need to find alternative sources of support to ensure continuity of data collection.



NBC researchers collect data from a buoy in the fixed-site monitoring network. Photo credit: NBC.

Table 1: Utility and Funding Status of the RIEMC’s Environmental Monitoring Priorities

| Monitoring Priority | Utility | Status | Current Funding & Program Support | State Funding Outlook |
|--|---|--|--|---|
| Coastal Water Quality | | | | |
| Narragansett Bay Dissolved Oxygen (NB Fixed-Site Monitoring Network) | <p>Decreases in DO are a major cause of water quality impairment in Narragansett Bay and require additional assessment, planning and wastewater treatment upgrades.</p> <p>Addressing water quality impairments requires comprehensive monitoring of DO in relation to improvements in wastewater treatment, nonpoint source pollution controls, and external drivers such as climate change and increasing water temperatures.</p> | <p>Implemented</p> <p>RIEMC recommends adding additional stations in lower Narragansett Bay & Sakonnet River</p> | <p>RIDEM covers most of this program using federal funds supported by Clean Water Act SRF Funding. NBC uses rate payer funds and NBNERR uses NOAA funds.</p> | <p>Assuming federal FY 2015 cuts to SRF funding are not significant, RIDEM funding is stable for FY15. However, reliance on SRF funding is not sustainable. Long-term program support must be diversified.</p> <p>Annual Unmet Need: \$350,000</p> |
| Narragansett Bay Dissolved Oxygen (Field Surveys) | <p>Provides cross-sectional information within the Bay, complements the fixed-site network and identifies areas that are at significant risk for hypoxic conditions to occur.</p> | <p>Implemented</p> | <p>Field operations supported by Brown University, URI GSO, RIDEM, and STB. Past support from NOAA CHRP program.</p> | <p>At risk of disruption</p> <p>Annual Unmet Need: \$51,000</p> |
| Shellfish Growing Areas | <p>Manages commercial shellfishing, harvesting, and public health protection.</p> | <p>Implemented</p> | <p>State general revenues</p> | <p>Currently stable.</p> |

| Monitoring Priority | Utility | Status | Current Funding & Program Support | State Funding Outlook |
|--|--|---|---|--|
| Rotating Assessment of Coastal Waters | Originally intended to address major water quality data gaps in coastal coves and embayments. Data is essential to assess point and non-point source pollution controls, cesspool phase-outs, and stormwater management. | Not implemented. Some data collected by RIDEM and volunteers. | No funding available | Annual Unmet Need: \$250,000 |
| Saltwater Beach Water Quality | Monitors saltwater beaches to protect public health, reduce illness associated with swimming in potentially contaminated bathing waters, and to find and eliminate sources of contamination. | Implemented | RIDOH uses EPA Beach Act funding. No federal funding may be available after 2015 field season | At risk for disruption Annual Unmet Need: \$212,000 |
| Volunteer Monitoring of Coastal Waters | Provides supplemental data essential for federal and state agencies to design their monitoring programs, assess indicators at watershed scale, and identify and target un-remediated pollution sources. | Implemented | Multiple sources including state and local sponsors | At risk of disruption Annual Unmet Need: \$25,000 |

| Monitoring Priority | Utility | Status | Current Funding & Program Support | State Funding Outlook |
|--|--|--|---|--|
| Freshwater Quality | | | | |
| Water Quality in Large Rivers | Monitors water quality in major rivers to track long term trends for managing water pollution sources. These programs also evaluate pollutant loadings into Narragansett Bay and coastal waters. Need MA rivers (Taunton, upstream portion of Blackstone) to be similarly monitored to support effective watershed management. | Implemented. Additional stations recommended in Pawtuxet River watershed. | USGS, BRWCT and NBC | At risk of disruption. Annual Unmet Need: \$155,000 |
| Water Quality in Wadeable Rivers and Streams (rotating assessment) | Assesses water quality in rivers and streams and guides water pollution control programs for rivers, streams, salt ponds and Narragansett Bay. | Implemented | RIDEM using EPA funds | At risk of disruption. Annual Unmet Need: \$260,000 |
| Volunteer Monitoring | <i>Rivers and Streams</i> Supplements data collected by the State to help assess changing conditions in rivers and streams. <i>Lakes and Ponds</i> Collects data on many state's lakes and ponds that would otherwise go un-assessed. This data improves statewide water quality assessments and management, but needs to be expanded to fill gaps. | Implemented Implemented, no funding for recommended expansion to unassessed lakes | URI, RIDEM using EPA funds, watershed organizations and various local sponsors URI CI gave a grant of \$100,000 towards the development of supported data base | At risk of disruption Annual Unmet Need: \$25,000 At risk of disruption Annual Unmet Need: \$80,000 |

| Monitoring Priority | Utility | Status | Current Funding & Program Support | State Funding Outlook |
|--|--|---|---|---|
| Freshwater Beach Water Quality | Freshwater beaches make up nearly half of RI's licensed swimming beaches, but are monitored far less frequently than saltwater beaches. Of particular concern are freshwater swimming beaches at youth summer camps. | Partially implemented by freshwater beach owners and operators. | No funding available to enhance the limited existing program | Annual Unmet Need: \$100,000 |
| Harmful Algal Blooms | Provides data to identify potential public health risks associated with harmful algal blooms in RI fresh waters. | Partially implemented | RIDEM and EPA funding provides for minimal amount of sampling | At risk of disruption Annual Unmet Need: \$50,000 |
| Toxic Contaminants in Freshwater Fish: Mercury | Efforts remain largely un-assessed in RI to determine the public health risks of toxic contaminants in freshwater fish. | Partially implemented; limited samples are processed annually | EPA in-kind services and RIDEM DFW using court settlement funds | Annual Unmet Need: \$105,000 |
| Physical Conditions | | | | |
| River and Stream Flows (RI Stream Gage Network) & Groundwater Level Measurements | Provides vital data for flood forecasting, flood response and risk management, water supply planning and management, drought management, water pollution control and water quality management. | Partially Implemented | BRWCT, USGS, RI WRB and Providence Water Supply Board | At risk of disruption Limited state funding provided with concerns for future data collection. Annual Unmet Need: \$173,000 |

| Monitoring Priority | Utility | Status | Current Funding & Program Support | State Funding Outlook |
|---|--|--|--|---|
| Shoreline Change | Provides data critical to development of CRMC's Shoreline Change Special Area Management Plan and to understand the threat of coastal erosion on public and private infrastructure and natural ecosystems. | Partially Implemented | URI, CRMC, and BRWCT | Annual Unmet Need: \$100,000 |
| <i>Biological Communities and Habitats</i> | | | | |
| Marine Fisheries Surveys | Efforts in data collection support stock assessments and management decision-making of important commercial fisheries, both finfish and shellfish, also provides ecological status and trends. | Implemented - Program enhancements recommended | RIDEM using USFWS funds | Projected as stable for certain programs Annual unmet need: \$200,000 |
| Lobster Population Surveys | Improves characterization of the abundance and recruitment of lobster. | Implemented | BRWCT and NOAA | At Risk of Disruption Annual Unmet Need: \$ 52,000 |
| Eelgrass Beds | Provides data for understanding long-term change in critical estuarine habitats that are critical for finfish, shellfish, and crustaceans. Provides a measure of overall estuarine ecological health and biological diversity. | Partially Implemented | Save The Bay, NBNERR, and CRMC using RI Coastal and Estuarine Habitat Restoration Trust Fund | Annual Unmet Need: \$33,000 and periodic investment for overflights, FY15 \$85,000 |

| Monitoring Priority | Utility | Status | Current Funding & Program Support | State Funding Outlook |
|--------------------------------------|--|-----------------------|---|--|
| Saltmarshes | Provides data essential for understanding long-term change in critical habitats for terrestrial, avian, and estuarine and marine species. Helps to assess climate and SLR risks to the shoreline erosion protection and storm buffer values (ecosystem services) that saltmarshes provide. | Partially implemented | CRMC using RI Coastal and Estuarine Habitat Restoration Trust Fund, RIDEM using USFWS Coastal Program and EPA funds. NBNERR and STB document monitoring strategy. | Annual Unmet Need: \$28,000 |
| Arrival and Spread of Marine AIS | Identifies invasive species, to allow for proper eradication and management techniques. | Partially implemented | CRMC, RIDEM, RINHS, NBNERR, EPA AED, RWU, URI WW | Annual Unmet Need: \$150,000 |
| Arrival and Spread of Freshwater AIS | Identifies species, to allow proper for eradication and management techniques. | Partially implemented | RIDEM using USFWS funds, RINHS, URI and NBNERR | Annual Unmet Need: \$200,000 |
| Freshwater Wetlands | Provides ecological condition data for freshwater wetlands and the stressors adversely affecting their functions and values. | Partially implemented | RIDEM using EPA funds and RINHS | At risk of disruption due to reliance on competitive funding. |
| | | | | FY16 Estimated Total Annual Unmet Need: \$2,651,000 |

Rhode Island Environmental Monitoring Collaborative Priorities

In 2005, the RI Environmental Monitoring Collaborative (RIEMC) established ten environmental monitoring priorities based upon their importance to understanding key environmental trends in Rhode Island, and the relative lack of active monitoring data collection and assessment being conducted for them. Since 2006, the RIEMC has reported on implementation of these monitoring priorities (see the Bays, Rivers, & Watersheds Coordination Team website for previous RIEMC Annual Reports). Based on a review of state monitoring priorities, the RIEMC expanded the list in 2012 to provide a more complete inventory or record of essential environmental monitoring priorities for Rhode Island. The priorities reflect long-term programs that provide data about the ambient environment that is or should be collected on an ongoing basis with the sampling frequency tailored to each program's information need. The list is not intended to reflect the complete universe of monitoring activities, which would include other activities such as pollution source monitoring, targeted short-term studies or assessments, as well as various research efforts. The 20 environmental monitoring priorities are:

- Coastal Fisheries – Trawl Surveys
- Coastal Ponds and Embayments – Rotating Assessment
- Eelgrass Beds
- Freshwater Aquatic Invasive Species
- Freshwater Beach Water Quality
- Freshwater Wetlands
- Harmful Algal Blooms and Cyanobacteria
- Large River Water Quality
- Lobster Population Surveys
- Marine Aquatic Invasive Species
- Narragansett Bay Dissolved Oxygen – Boat Surveys
- Narragansett Bay Water Quality – Fixed Site Monitoring Network
- River and Stream Flows
- Salt Marshes
- Saltwater Beach Water Quality
- Shellfish Growing Areas
- Shoreline Erosion, Accretion, and Sediment Transport
- Toxic Contaminants in Freshwater Fish: Mercury
- Volunteer Water Quality Monitoring
- Wadeable Rivers and Streams – Rotating Assessments

The RIEMC reviews and reports annually to the Governor, General Assembly, and public on the status of the environmental monitoring priorities. It collaborates with key initiatives such as the Narragansett Bay Estuary Program Status and Trends, and the RI Governor's Executive Climate Change Coordinating Council with the shared goals of support and improvement of environmental indicator development and application, and public communications. The RIEMC continues to develop a Comprehensive Environmental Monitoring Strategy for RI.

The following one-page summary sheets for each of the RIEMC environmental monitoring priorities review specific monitoring programs, data applications and on-line locations, the government agencies and programs performing the activities and utilizing data, and program funding information.

Coastal Fisheries - Trawl Surveys

Description: The RIDEM Division of Fish and Wildlife, Marine Fisheries Section, continued their comprehensive fishery resource assessment program encompassing Narragansett Bay, and Rhode Island and Block Island Sounds in 2013. The Marine Fisheries Section collects, summarizes and analyzes trawl data for biological and fisheries management purposes and provides seasonal and monthly identification of finfish and crustacean assemblages occupying Rhode Island coastal waters. Since the inception of the Rhode Island Seasonal Trawl Survey in April 1979, and the Narragansett Bay Monthly Trawl Survey in January 1990, 5,764 tows have been conducted within Rhode Island territorial waters with data collected on 132 species. The R/V *John H. Chafee* research vessel, built in 2002, is used for coastal trawl surveys. RIDEM Marine Fisheries Section added an age and growth element to the survey analysis in 2014. Stomach analysis and scale collection conducted in the field with subsequent laboratory analysis. Additional trawl surveys will be done by the URI GSO to supplement the RIDEM survey with a longer time series of abundance information. The top five species of the highest abundance in the 2013 Coastal Trawl Survey were butterfish, bay anchovy, longfin squid, scup and Atlantic herring.

FY 2015 Funding: Funding is stable with a University match from U.S. Fish and Wildlife Service and Federal Aid in Sportfish Restoration

Management Values:

- Supports local and regional fisheries stock assessments.
- Tracks the relative abundance of finfish and shellfish assemblages in Narragansett Bay, and Rhode Island and Block Island Sounds.
- Provides stock and recruitment information on key commercial and recreational species to help inform fishery management decisions based on stock size.
- Tracks changes in fishery dynamics as it relates to environmental changes.
- Collects local fish species for aquaria and events offered by the RI DEM Fish & Wildlife Division's Aquatic Education Program.

Implemented by: RIDEM Marine Fisheries Program, URI GSO

Used by: RIDEM, URI GSO, NOAA, ASMFC, NEFMC, fisheries managers and researchers

It's important because. . .

Trawl Survey data is vital to assessing the health and status of marine fisheries resources and their habitats, which is one of the most significant industries in the Ocean State. These data allow managers to assess the performance and effectiveness of management strategies for important species, and indicate when different techniques should be implemented. The Rhode Island Coastal Trawl Survey time series, which dates back almost 35 years, is the best tool for tracking the annual abundance of the most popular marine species in and around Narragansett Bay.



The catch from a coastal trawl survey aboard the R/V John H. Chafee Research vessel. Photo Credit: RIDEM Marine Fisheries.

Coastal Ponds & Embayments - Rotating Assessment

Description: The RI Water Monitoring Strategy recommends sampling RI's coastal ponds and embayments on a rotating basis, similar to the program design RIDEM utilizes to monitor RI's smaller wadeable rivers and streams. This strategy has not yet been implemented due to a lack of resources. Narragansett Bay-wide monitoring strategies do not collect data on the conditions in coves and embayments. While RIDEM's Shellfish Water Quality Monitoring Program collects bacteriological data throughout the states coastal waters, including salt ponds, it is not designed to collect data on other important water quality parameters. Despite the lack of a statewide strategy, a limited amount of data is being generated for a number of coastal ponds and embayments through volunteer efforts. For more information see page XX on volunteer monitoring. For example, the URI Watershed Watch Program lists over a dozen harbors, salt ponds and embayments among its active sampling locations. Various researchers may also contribute data from targeted studies. The Coastal Waters Rotating Assessment Program, when fully implemented, would complement other core monitoring programs and research efforts by generating water quality data for coastal waters of critical concern, such as Greenwich Bay and the Salt Ponds. Data gaps regarding the southwestern coastal ponds are considered a priority due to worsening or vulnerable water quality and potential for future aquaculture development in that region.

FY 2015 Funding: No state funding is currently available to implement this recommended program.

Management Values:

- Track changing conditions in bays, coves, embayments and coastal ponds.
- Track effects of wastewater and stormwater management efforts currently underway.
- Support development of water quality restoration plans.

Implemented by: Not implemented.

Used by: RIDEM, CRMC, NBC, EPA, NBNERR, watershed organizations and researchers

Data Available at: Limited data collected by volunteers available at <http://www.uri.edu/ce/wq/ww/data/DataTable.htm>

It's important because . . .

Coastal embayments and lagoons have unique circulatory regimes, biota, and watersheds that create management challenges distinct from those of the entire Narragansett Bay. Targeted water quality monitoring of these coastal water bodies is essential for managing their diverse resources and high productivity, and also ensuring the continuation of their many socio-economic values.



In April 2013 Save Bristol Harbor partnered with URI WW to train volunteers on water quality monitoring techniques to gather data on the harbor over a long period of time. Citizens of this community want to preserve this unique landscape for future generations. Photo Credit: Save Bristol Harbor.

Eelgrass Beds

Description: Eelgrass grows in shallow areas of Narragansett Bay and south shore salt ponds. It provides critical nursery habitat for species such as quahogs, lobster, tautog, and bay scallops. A three tiered-monitoring effort is required to comprehensively assess eelgrass bed areal extent, cover, and condition. Tier 1 uses aerial photography and remote sensing to map eelgrass distribution throughout RI coastal waters, and is implemented by the RI Eelgrass Task Force, a collaborative led by NBNERR, STB, and URI EDC. Tier 2 provides estimates of eelgrass bed spatial cover in specific areas, such as salt ponds, through rapid assessment techniques. Areas around Prudence Island were observed by NBNERR using underwater video at eighty monitoring stations. Tier 3 measures eelgrass biomass and other eelgrass bed properties over multiple time scales for specific areas and is implemented by STB. Based on the first two years of monitoring, Prudence Island showed no significant difference in eelgrass cover from 2012-2013. Eelgrass cover was nearly identical between these two years, which is encouraging as it shows little evidence of declining habitat. Mapping efforts are recommended every three years, thus funding will be sought to continue this project for 2015 mapping.

FY 2015 Funding: **Seeking funding for FY 2015.** Tier one monitoring requires \$85,000 every 3 years for aerial photography statewide. Tier two and three monitoring requires \$3,500-\$5,000 annually.

Management Values:

- Eelgrass bed extent and well-being is a critical indicator of estuarine ecosystem health and habitat quality.
- Complements Tier 1 data to gauge inter-annual variability.
- Implements data from Seagrassnet, which is conducted by Save The Bay, to follow monitoring protocols as developed by Dr. Neckles et al.

Implemented by: NBNERR, Save The Bay, and URI EDC

Used by: NBNERR, CRMC, RIDEM, ACOE, USFWS, NOAA, EPA and NBEP

Data Available at: www.edc.uri.edu/rigis
http://www.savebay.org/file/2012_Mapping_Submerged_Aquatic_Vegetation_final_report_4_2013.pdf

It's important because . . .

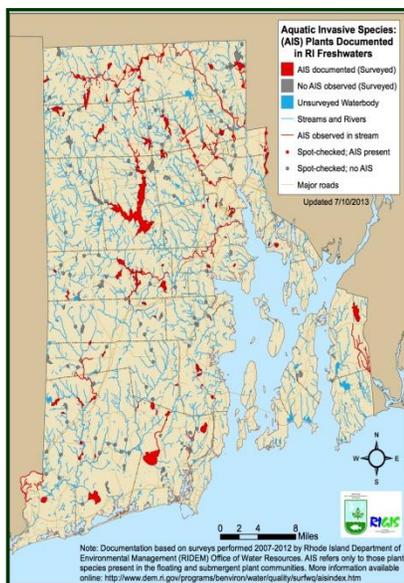
Eelgrass is a flowering underwater plant with meadows growing at depths of 3 to 12 feet in RI bays and coastal ponds. Narragansett Bay was once teeming with eelgrass, but today almost 90% of the beds have disappeared. This monitoring effort works to make sure RI does not lose any more of this valuable resource. Eelgrass beds provide critical habitat for numerous fish and invertebrate species, including shellfish. Furthermore, eelgrass stabilizes sediments, protects against shoreline erosion and filters particles from the water column. It functions as an excellent indicator of water quality due to its rapid response to both nutrient concentrations and in situ light levels.



Healthy eelgrass beds from restoration efforts in Narragansett Bay. Photo credit: Save The Bay.

Freshwater Aquatic Invasive Species (AIS)

Description: Aquatic invasive species are a widespread management concern in RI freshwaters. RIDEM continued its seasonal surveys of lakes and ponds with a goal of both detecting and tracking the occurrence of aquatic invasive species. Data available for 130 lakes and ponds indicated the presence of one or more aquatic invasive plants in 59% of the surveyed water bodies. Variable milfoil and fanwort were the most commonly detected of the 13 aquatic invasive plants species found. (See RIDEM report on lakes and ponds for more details.) RIDEM also continued to screen rivers and streams for AIS as part of the Rotating Basin Water Quality Monitoring program. Program partners collaborate with RIDEM by sharing reports of suspected problems and other information.



Map displaying spread of freshwater AIS throughout RI. More information at <http://www.dem.ri.gov/programs/benviron/water/wetlands/pdfs/invasive.pdf>

FY 2015 Funding:

Funding is limited and unstable hampering the development of effective surveillance and rapid response program.

Management Values:

- Characterizes the nature and extent of AIS.
- Continues surveillance of select freshwater sites.
- Refines management policies to improve effectiveness.

Implemented by:

RIDEM, RINHS, URI WW and Save The Lakes

Used by:

RIDEM, RINHS, URI WW, Save The Lakes, watershed associations and researchers

Data

Available at:

<http://www.dem.ri.gov/programs/benviron/water/wetlands/pdfs/invasive.pdf>
<http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/lakes012.pdf>
<http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/myrhet.pdf>

It's important because . . .

Invasive species change the ecology and economy of Rhode Island. Controlling and eradicating invasive species is most efficient when quickly identified and addressed. Rapid detection and response to invasive species require routine monitoring programs capable of promptly detecting their appearance.



Inflated bladderwort affecting the quality of the Wilson Reservoir. Photo and map credit: RIDEM.

Freshwater Beach Water Quality

Description: The RIDOH Beach Program oversees monitoring and public health notifications for 43 freshwater beaches throughout the state. Sources of contamination at freshwater beaches include outdated septic systems, cesspools and holding tanks, wildlife, and stormwater runoff. The RIDOH Beach Program uses the indicator bacteria *Enterococci* to determine safe water quality conditions in RI waters. These pathogens can cause a wide range of health problems including ear, nose, and throat infections, gastroenteritis, hepatitis, and respiratory illness. There are many potential pathogens and testing for all of them is not feasible, *Enterococci* are used as an indicator of the potential presence of these pathogens. RIDOH's Beach water quality monitoring program is currently dedicated entirely to saltwater beaches. Yet RI's freshwater beaches account for about one-third of the state's beach closures. Expansion of the RIDOH Beach Program would like to include a risk-based approach to monitoring of freshwater beaches.

Summer 2013 Beach Closure Summary . . .

- 8 freshwater beach closure days
- 5 freshwater beach closure events
- 5 freshwater beaches closed to swimming

FY 2015 Funding: Freshwater beach monitoring is not a funded effort. An estimated \$100,000 annually is required to monitor RI freshwater beaches.

Management Values:

- Finds and eliminates sources of contamination at licensed freshwater facilities.
- Develops preemptive closure protocols to better protect public health.
- Evaluates monitoring and notification methods currently in place.
- Incorporates cyanobacteria advisories and education at freshwater facilities.

Implemented by: Partially implemented by freshwater beach facility owners and operators

Used by: RIDOH, RIDEM, EPA, town beaches, municipalities, and other recreation facilities

Data at: <https://beaches.health.ri.gov/swim/>

It's important because . . .

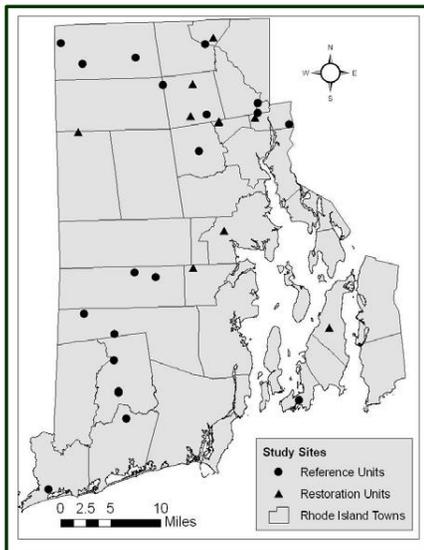
Freshwater beaches account for a large portion of RI shorelines. These watersheds impact recreation, habitat, and aquatic life. Children are at the highest risk for contracting water-borne illness from swimming in contaminated waters. More than half of all licensed freshwater facilities are children's summer camps and recreational facilities. Routine monitoring allows authorities to close beaches in a timely manner to ensure the safety of our residents, both young and old.



A popular freshwater beach in Rhode Island that was closed to recreation due to poor water quality in the summer of 2013. Photo Credit: RIDOH Beach Program.

Freshwater Wetlands

Description: Since 2005, RIDEM, in partnership with the RINHS, has developed and refined a rapid assessment method (RAM), which has been applied to assess the condition of freshwater wetlands. Information is collected through field inspections that are used to characterize the ecological condition of the wetland and identify stressors to the functions of wetlands. The data collected is used as part of a continuing effort to evaluate the overall state of wetland protection and restoration programs in RI. In 2013, freshwater wetland monitoring applied RAM to previously disturbed sites that had been restored, and to reference, or undisturbed sites.



RIDEM freshwater wetland monitoring locations using RIRAM in 2013. View larger image at <http://www.dem.ri.gov/programs/benviron/water/wetlands/pdfs/wma11fin.pdf> Photo Credit: RIDEM

FY 2015 Funding: Applied for through a competitive U.S. EPA grant.

Management Values:

- Characterizes wetland condition which provides vital services as stream and lake buffers and can reduce the impacts of stormwater runoff.
- Provides information on long term changes in freshwater wetlands and can be used to determine how these areas are impacted by stressors such as proximity to development.
- Assesses the effectiveness of management strategies and assists in directing future strategies.
- Aides in the prioritization of wetland restoration projects.

Implemented by: RIDEM and RINHS

Used by: RIDEM, EPA, USFWS, and researchers

Data Available at: <http://www.dem.ri.gov/programs/benviron/water/wetlands/wetldocs.htm>

It's important because. . .

Systematic monitoring of wetland ecosystems is an essential element of the comprehensive water monitoring strategy. These data help to characterize the location, extent and condition of our freshwater wetlands which provide valuable ecosystem services. The data improves the protection and management of these areas by allowing appropriate buffer zones to be implemented for zoning purposes. The data also assists in the identification and quantification of major stressors to this resource.



Wetland monitoring goals involve understanding the cumulative impacts of human activities on wetland conditions to improve proper protection and management techniques. Photo Credit: RIDEM.

Harmful Algal Blooms & Cyanobacteria

Description: Cyanobacteria, also known as blue-green algae, blooms are a growing public safety concern across the country as well as in Rhode Island. Warmer water temperatures and increased nutrients favor their growth, sometimes causing pea soup conditions. These blooms can result in the release of natural toxins that can sicken dogs, livestock and people. Growing awareness of the presence of cyanobacteria in recreational waters prompted RIDEM and RIDOH to continue their limited monitoring program to both screen for and confirm the presence of cyanobacteria. RIDOH issues public health advisories when certain thresholds have been exceeded. While samples are screened internally by RIDEM, confirmation of the species and the amount of toxicity are done at an out-of-state laboratory. URI WW recently purchased a field instrument that measures the amount of cyanobacteria right in a water body, as well as count the number of algal cells. This not only supplements RIDEM's efforts but can also provide more in-depth results in order to better track causes and bloom conditions. This probe, along with routine URI WW monitoring of overall algae levels and cyanobacteria concentration measurements allows for comparison of results, and gives staff the ability to gain more insight as to their occurrence. Data are still under review, but fewer cyanobacteria blooms were reported in 2013 than 2012. URI WW volunteers and members of the public are often the first to notify RIDEM of harmful algal blooms.

FY 2015 Funding: **No state funding is currently available.** URI WW uses program funds to support this work as well as limited federal grant funding from RIDEM.

Management Values:

- Allows public health advisories to be issued when harmful blooms are detected.
- Allows for more timely detection of blooms.
- Provides data to assist in finding and eliminating sources of contamination that contribute to blooms

Implemented by: RIDEM, URI WW, RIDOH, watershed organizations, lakeside residents, and consulting services

Used by: RIDOH, RIDEM, URI WW, EPA, watershed organizations, municipalities and veterinarians

Data Available at: <http://www.dem.ri.gov/programs/benviron/water/quality/surfwq/pdfs/cyano13.pdf>

It's important because . . .

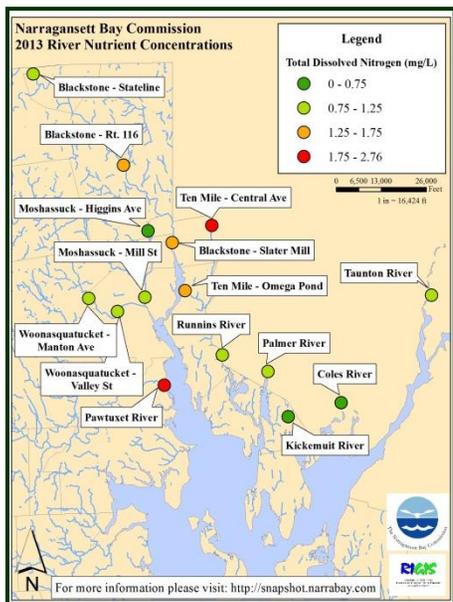
Cyanobacteria blooms can release natural toxins that pose a serious health threat to humans and animals even at very low levels. Blooms can contaminate shellfish populations, a top economic industry in Rhode Island. They can also cause fish kills, smother aquatic organisms and form smelly, algae coated shorelines. Cyanobacteria blooms are often an indicator of nutrient loading.



Nitrogen and phosphorus are essential nutrients for healthy plant and animal growth. When a water body receives high amounts of nutrients algae growth may cause the area to become eutrophic or even hyper-eutrophic, as pictured above. Photo Credit: RIDEM

Large River Water Quality

Description: With funding from the BRWCT, RIDEM partners with USGS on a water quality monitoring program in which over a dozen water quality parameters are sampled, at five stations on Rhode Island’s largest three rivers: the Blackstone, Pawtuxet and Pawcatuck. The data from these stations support the assessment of water quality in these rivers which drain large watersheds, and over time allows for trend analysis. Supplementing this program, NBC’s river water quality monitoring program also generates data on the Blackstone and Pawtuxet Rivers. Samples are analyzed for the full suite of nitrogen parameters, orthophosphate, total suspended solids, dissolved organic carbon and metals. The rivers are sampled as part of a larger NBC program that monitors the estuarine waters of the Providence and Seekonk Rivers and the freshwater tributaries which flow into this area. In 2013, NBC added two new nutrient monitoring stations, one on the Ten Mile River near the RI/MA border and one near Pawtuxet Cove in the Providence River.



Nutrient concentrations found throughout RI Rivers. More information at <http://snapshot.narrabay.com/app/MonitoringInitiatives/NutrientMonitoring>
Photo Credit: NBC.

FY 2015 Funding:

RIDEM funding is unstable. Reductions in the program are expected unless alternate sources of funding are found. NBC funding is stable.

Management Values:

- Evaluates trends in river water quality
- Tracks and determines pollutant loadings from MA portion of watershed.
- Develops discharge permit limits and water quality modeling.

Implemented by:

USGS, RIDEM and NBC

Used by:

RIDEM, USGS, EPA, NBC, researchers and watershed organizations

Data Available at:

<http://waterdata.usgs.gov/ri/nwis/current/?type=quality&group%20Key=basin%20cd>
<http://snapshot.narrabay.com/app/WaterQuality/NutrientMonitoring>

It's important because . . .

These data are critical to tracking long-term trends in river flow and riverine pollutant loading to coastal waters. The state’s largest river systems receive storm and waste water discharges causing water quality issues, which also contribute a significant amount of nutrients, and chemical and biological contaminants to Narragansett Bay.



A USGS employee collecting water quality data along the Blackstone River. Photo Credit: USGS.

Lobster Population Surveys

Description: The RIDEM Marine Fisheries Program, in cooperation with commercial lobstermen, has been participating in regional sea sampling, ventless trap, and settlement surveys of lobster populations in RI waters. These surveys provide important data on the lobster populations in shallow and rocky bottom habitats that are not currently sampled by the RIDEM trawl surveys. RI's commercial lobster fishery is the most valuable in terms of landed value, and is in peril due to declining recruitment in southern New England stocks, meaning inadequate numbers of young lobsters are not surviving to adulthood. This survey was implemented to improve the characterization of the lobster stock and provide data to improve understanding of the lobster population. In addition to ventless trap surveys, RIDEM also conducts annual lobster settlement surveys through diver based suction sampling. Young of the year lobster abundance is measured and reported as part of the regional Atlantic Lobster Settlement Index (ALSI). The 2013 Sea Sampling and Ventless surveys indicate that lobster abundance in RI's coastal waters continues to be low. However, the Settlement Index has shown increased abundance for the last two years, showing the importance of multiple monitoring efforts. The ventless trap survey time series is now being incorporated into the ASMFC American Lobster Stock Assessment.

FY 2015 Funding: Funding is currently available but unstable. Other sources will need to be secured to sustain the program beyond state FY15.

Management Values:

- Improves assessment of lobster stocks to inform fisheries management and conservation efforts.

Implemented by: RIDEM and commercial lobstermen

Used by: RIDEM, ASMFC, ALSI and researchers

Data Available at: Available from RIDEM Marine Fisheries Program upon request.

It's important because . . .

This initiative provides pertinent information to improve our understanding of the status of our lobster populations – the second most valuable commercial fishery to RI.



Photo of young lobsters and divers using suction sampling for survey collection. Photo Credit: RIDEM Marine Fisheries.

Marine Aquatic Invasive Species (AIS)

Description: CRMC first investigated the impact of Marine AIS in 2000 when it conducted a rapid assessment survey (RAS) for the presence of AIS at floating docks in Narragansett Bay. Since that time CRMC has partnered with various agencies to conduct a RAS every three years. To acquire funding that addresses the problem of AIS in RI, CRMC promulgated the RI Aquatic Invasive Species Management Plan as approved by the federal Aquatic Nuisance Species Task Force in 2007 (RAIS Plan). CRMC then developed and implemented the Invasive Species Monitoring Project in 2009, which prioritizes the following tasks:

- Monitor floating docks for the presence, abundance, and spread of AIS in RI's coastal waters
- Determine the impact of AIS on native species by investigating larval settlement and competition
- Monitor for the presence of the Chinese Mitten crab by conducting plankton tows in estuarine rivers
- Monitor for the presence of invasive Grass Shrimp at various sampling sites in RI's coastal waters
- Determine the impact of AIS on eelgrass by sampling eelgrass beds in RI's coastal waters.

CRMCs' dock monitoring task provides RI with a database for AIS. Larval settlement and competition studies show the measurable impact of AIS on native species. CRMC has partnered with other institutions to conduct pilot projects and collaborated with the EPA AED to investigate the efficacy of monitoring eelgrass beds, and with RWU to implement methods to sample commercial vessel ballast water for the presence of AIS.

FY 2015 Funding: No state funding is currently available. Federal Funding is vulnerable to disruption.

Management Values:

- Characterizes the nature and extent of marine AIS infestation to inform management decisions to control their introduction and spread.
- Continues surveillance at select marine or estuarine sites that are of concern due to ecological and/or economic importance.

Implemented by: CRMC, RIDEM, RINHS, URI WW and NBNERR

Used by: CRMC, NBNERR, RINHS, RIDEM, EPA, RWU, NOAA, USFW, NPS

Data Available at: <http://www.crmc.ri.gov/invasives.html>

It's important because . . .

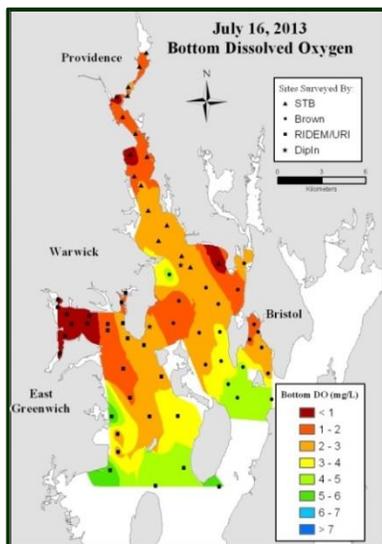
Invasive species compete with native species for habitat and resources. Controlling and eradicating invasive species is more economical and effective when discovered early through monitoring surveys. The last RAS documented over 50 species at each site sampled in RI, with many being non-native or cryptogenic species.



Barnacles and other aquatic organisms encrust a bumper and chain at Port Edgwood Marina, Cranston, RI. Photo Credit: CRMC.

Narragansett Bay Dissolved Oxygen Field Surveys (Boat Surveys)

Description: Brown University, RIDEM, URI, and Save The Bay, in cooperation with additional partners have conducted boat-based surveys to evaluate the spatial extent of hypoxic conditions. These surveys are conducted every summer during neap tides when tidal mixing and dissolved oxygen are expected to be lowest and include temperature, salinity, dissolved oxygen, chlorophyll and turbidity data. Seventy-five stations are monitored throughout the Providence and Seekonk Rivers, Greenwich Bay, and the East and West Passages of Narragansett Bay. NBC collects DO, temperature, salinity, density, depth, fluorescence and photosynthetic active radiation (PAR), chlorophyll, and turbidity data at five Providence River and upper bay stations. NBC added fluorescence in June 2013, which is a proxy for chlorophyll concentrations and allows comparison with physical samples collected at seven Bay stations. NBC samples weekly from Memorial Day to Labor Day and twice per month for the remainder of the year.



DO readings in summer 2013. View larger image at <http://www.geo.brown.edu/georesearch/insomniacs/july162013BottomDO.html> Map Credit: Brown University.

FY 2015 Funding: No funding is available for the spatial surveys.

Management Values:

- Generates cross section of the water column to determine periods of high salinity stratification which can lead to low DO.
- Provides a comprehensive temporal and spatial dataset that complements the time-series dataset generated by the NBFSMN system.
- Provides information on the inter-annual variability and severity of hypoxic and anoxic events in the Bay.

Implemented by:

NBEP, NBC, Brown University, Save The Bay, RIDEM, and URI GSO

Used by:

RIDEM, NBC, EPA, URI GSO, NOAA CHRP, and researchers

Data Available at:

www.geo.brown.edu/georesearch/insomniacs/index.html
<http://snapshot.narrabay.com/app/WaterQuality/Profiles>

It's Important because . . .

DO is critical to the animals that live in Narragansett Bay. When DO levels drop too low, hypoxic and even anoxic conditions can cause physiologic stress, forced migrations, and even death. DO levels are impacted by stormwater runoff and wastewater treatment methods. The boat surveys target neap tides when hypoxic conditions are most likely to occur to help assess the effectiveness of management decisions and investments in capital improvement projects.



Brown University student, Maria Hernandez, collecting monitoring station data during summer 2013. Photo Credit: Brown University.

Narragansett Bay Water Quality (Fixed-Site Monitoring Network)

Description: The NBFSMN is a multi-agency collaborative that equips, operates, and conducts data analysis and reports on multi-station monitoring networks for temperature, salinity, dissolved oxygen, turbidity and chlorophyll. The system also collects data on water quality parameters across the Bay, with a focus on the upper bay. Buoy operations are primarily from May-October to monitor during the recruitment season. During 2013, the NBFSMN operated eight buoys and four shore-based sites, with four land-based stations and one buoy operated year-round. The NBFSMN takes readings every 15 minutes, with five stations providing real-time data online.

FY 2015 Funding: **Funding is unstable for the long term.** The Clean Water Act SRF program funds monitoring in critical areas, but it is necessary to develop alternate funding sources. Supplemental funding from NBC and NBNERR appears stable.

Management Values:

- Provides high-resolution water quality data throughout the bay, both temporally and spatially and provides early warning of hypoxic events.
- Tracks changes to Bay water quality during warm weather, which is expected to improve as wastewater treatment upgrades are implemented and pollutant loadings reduced.
- Provides critical data for the state assessment of water quality impairments in upper and mid-Narragansett Bay.
- Generates data to improve understanding of eutrophication and hypoxia.

Implemented by: RIDEM, URI GSO, NBC, NBNERR, URI CI, EPA, NOAA

Used by: RIDEM, URI, NBC, NBNERR, NBEP, environmental managers, researchers, regulatory agencies, academic institutions and interested public

Data Available at: <http://www.dem.ri.gov/bart/stations.htm> (data archives)
<http://snapshot.narrabay.com/app/> (real-time for the 2 NBC operated stations)
www.neracoos.org (real-time for 2 URI GSO and RIDEM in NBFSMN operated stations)
www.nbnerr.org (real-time for 1 NBNERR operated station that participates in NBFSMN)
<http://nerrsdata.org/get/realTime.cfm?stationCode=NARTBWQ>
<http://www.dem.ri.gov/bart/netdata.htm> (processed datasets 2003–2013)

It's important because . . .

2013 had more rainfall than average, which resulted in a high freshwater inflow to the Bay from rivers and as stormwater runoff. These conditions make hypoxic conditions and associated fish kills, like we saw in Greenwich Bay in 2003, more likely. This monitoring effort allowed us to monitor DO levels for environmental impacts, but also helps determine if our investments in green infrastructure and improvements to wastewater treatment facilities are paying off.



NBC staff collecting data from one of the thirteen buoys in Narragansett Bay. In 2008, RIDEM designated an additional 7.62 square miles of mid Narragansett Bay as impaired due to low DO based on information obtained from the NBFSMN. Photo credit: NBC.

River & Stream Flows

Description: The RI Stream Gage Network is comprised of 35 stream gages and provides continuous river and stream flow data. USGS operates and maintains gages under contracts with RIDEM, WRB, and other entities including the Providence Water Supply Board. Data include long-term statistical analyses specific to figures generated by each gage in the network, and are among the most widely used in the water programs. The 2013 federal sequestration had an impact on a vital streamflow gage on the Wood River. Operation of this gage, which is relied upon by the NWS for flood forecast modeling, was interrupted with posting of data suspended in April 2013. Subsequently, both the WPWA and RIEMA stepped in to provide stop-gap funding that allowed normal operations to resume in August 2013. Looking ahead, USGS has increased the allocation of funding from its National Streamflow Information Program (NSIP) and targeted it to continuation of this gage which has now been included in the joint funding agreement between RI and USGS.

FY 2015 Funding: **Rising costs to the state may require cuts to this program in the future.** BRWCT, WRB, PWSB, and Ocean State Power are partner contributors.

Management Values:

- Protection of public safety and emergency (e.g., floodplain) management.
- Drought and water supply management and planning.
- Water quality & quantity modeling and pollutant loading calculations.
- Development of water quality restoration plans.
- Water resource management.
- Development of minimum flow standards.

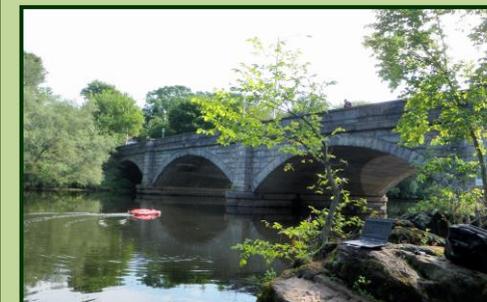
Implemented by: USGS, RIDEM, WRB, PWSB and local sponsors

Used by: RIDEM, WRB, USGS, PWSB, NBC, RIEMA, FEMA, EPA, NRCS, ACOE, Local Emergency Managers, and researchers

Data at: <http://waterdata.usgs.gov/ri/nwis/current/?type=flow>

It's important because . . .

Reliable stream flow data provides essential data for flood warnings and forecasts, preparing for and managing droughts, drinking water management, determining irrigation withdrawal limits, hydroelectric power production, wastewater discharges and reservoir releases. It also establishes minimum stream flow standards, and helps manage floodplains. Stream flows have a major impact on water quality, sedimentation rates, and also determines the types of organisms to inhabit a particular area. Stream and river flows also determine how pollution will interact within the aquatic environment.



A USGS hydrographer is using a remote control to collect stream flow information from a gage location on the Blackstone River. Photo Credit: USGS

Salt Marshes

Description: In 2012, a monitoring protocol was created to assess RI salt marshes. The protocol is part of a 3-tiered approach for salt marsh assessment. Tier 1 is a landscape scale, GIS based assessment (data analysis is currently underway and will be completed in 2014); Tier 2 is a fairly rapid field-based assessment; and Tier 3 is a more intensive, research-based assessment encompassing investigations being conducted by many institutions including URI, EPA, and USFWS. The Tier 2 assessment protocol was developed and implemented with input from many local, state and federal experts. Contrary to the paradigm of a typical southern New England salt marsh, which should predominantly be comprised of high marsh meadow, RI salt marshes have become dominated by short form *Spartina alterniflora*. This signals that a major ecological transition is occurring in RI's salt marshes. The change is likely due to accelerated sea level rise and several consecutive years of higher than average tides.

FY 2015 Funding: **Funding is not stable for 2015 efforts.** Initial funding for development and implementation of the assessment was provided by the RI Coastal and Estuarine Trust Fund, as well as US Fish and Wildlife Service Coastal Program. The current assessments and goals are to conduct the assessment on a three-year cycle.

Management Values:

- Salt marshes provide valuable habitat for wildlife, protecting shorelines from erosion, and provide buffers for our coastal waters and salt ponds.
- Data are critical to resource managers in order to understand and mitigate the effects of sea level rise on salt marshes

Implemented by: NBNERR

Used by: NBNERR and Save The Bay

Data Available at: Available upon request from NBNERR and Save The Bay

It's important because . . .

Salt marshes are some of the most biologically productive ecosystems in the world. They are coastal wetlands that are rich in marine life, and support many popular fisheries species. They are often the first lines of defense for coastal communities and habitats against sea level rise and tidal inundation. In order to support long-term adaptation planning, accurate and quantitative monitoring of marsh habitats is required to predict how these systems will change over time.



Scientists and volunteers assessing a local Rhode Island salt marsh plant community. Photo credit: Save The Bay and Narragansett Bay National Estuarine Research Reserve.

Saltwater Beach Water Quality

Description: The RIDOH Beach Program oversees monitoring and public health notifications for 71 licensed saltwater beaches in RI. Sources of contamination at beaches include outdated septic systems, cesspools and holding tanks, wildlife and waterfowl, and stormwater runoff. The RIDOH Beach Program uses the federal indicator organism, *Enterococci*, to determine safe water quality conditions at Rhode Island swimming waters. Beach water quality monitoring efforts are dedicated entirely to saltwater beaches because the state's only available source of funding for this monitoring requirement is EPA's Beaches Environmental Assessment and Coastal Health Act (BEACH) program, which requires that its funds be dedicated to saltwater beaches. In addition to samples collected by beach facility operators, RIDOH applies a risk-based monitoring assessment to enhance public health protection.

Summer 2013 Beach Closure Summary

111 saltwater beach closure days
 36 saltwater beach closure events
 19 saltwater beaches closed to swimming

FY 2015 Funding: **No state funding currently available.** Three of the five sampling points were not monitored during 2013 due to the potential for reductions in federal funding. Only licensed saltwater beaches were monitored by the RIDOH. Funds are available to sustain monitoring through 2015, but future federal funding is uncertain.

Management Values:

- Finds and eliminates sources of contamination at licensed saltwater facilities.
- Develops preemptive closure protocols to better protect public health.
- Evaluates monitoring and notification methods currently in place.

Implemented by: RIDOH Beach Program

Used by: RIDOH, RIDEM, EPA, NBC, municipalities, and the general public

Data at: <http://www.health.ri.gov/beaches/>
<http://beaches.health.ri.gov/swim/>

It's important because . . .

Beaches are a vital component of RI's tourism economy. Saltwater beaches cannot operate without being certified for safe swimming conditions. The state and wastewater ratepayers have made significant investments in capital improvements in order to reduce nitrogen inputs and stormwater runoff, which can negatively impact beaches and cause beach closures. Beach monitoring not only protects human health, but allows us to ensure that our investments are paying off.



A popular Rhode Island beach visited by locals and tourists during the 2013 season. Photo Credit RIDOH Beach Program.

Shellfish Growing Areas – Coastal Waters

Description: About 95% of Rhode Island’s coastal waters including RI and Block Island Sounds are designated for shellfishing uses. The RIDEM Shellfish Growing Area Monitoring Program provides an extensive dataset on pathogens in these waters. The program assures compliance with the USFDA’s National Shellfish Sanitation Program (NSSP) by collecting samples from 17 shellfish growing areas and analyzing them for fecal bacteria. The growing areas include most of Narragansett Bay, its shellfish harboring tributaries, all of the south shore coastal salt ponds, Little Narragansett Bay, and Block Island. The frequency of sampling varies with the management status of the growing area with all open and conditional areas sampled at least six times per year. There are 303 fixed stations with 9 to 39 stations sampled in each growing area. The program conducts required sanitary shoreline surveys of all shellfish growing areas as well as routine bio-toxin monitoring. The program also administers emergency shellfish closings that may result from severe weather events due to flooding and associated wastewater overflows or malfunctions. These events require follow up sampling and acceptable bacteria results for the impacted area to reopen.

FY 2015 Funding: RIDEM state funds.

Management Values:

- Provides data necessary to manage shellfish growing areas, permit harvesting and the interstate sale of shellfish.
- Protects public health by ensuring shellfish are harvested from areas with acceptable water quality.
- Evaluate success of infrastructure investments.

Implemented by: RIDEM and RIDOH Laboratory

Used by: RIDEM, CRMC, USDA, FDA and NBC

Data at: Upon request from RIDEM Office of Water Resources. More information at <http://www.dem.ri.gov/programs/benviron/water/shellfish/index.htm>

It’s important because. . .

This monitoring effort ensures shellfish are harvested from waters with acceptable water quality. It is required for the economically important commercial shellfish industry to operate in RI. As a result of the NBC ongoing combined sewer overflow (CSO) abatement project and other investments in improving water quality, there was a 36% increase in the number of acre-days that the upper bay was open to shellfishing in 2013 as compared to 2004, as year having comparable rainfall.



In 2013, RIDEM completed the rebuilding of its 23 foot boat utilized to monitor shellfish growing areas. Photo Credit: RIDEM

Shoreline Erosion, Accretion & Sediment Transport

Description: The current CRMC Shoreline Change Maps document changes from 1939 to 2004, and are available online. Updated maps covering the entire RI shoreline are planned for 2014 using 2011 ortho-photos, 2011 LiDAR data, 2012 eelgrass aerial photo images and new post-Sandy aerial photo images. Updated Shoreline Change maps will be prepared as part of the upcoming CRMC Shoreline Change (Beach) Special Area Management Plan (SAMP). See: <http://www.beachsamp.org/>

Hurricane Sandy in October 2012, resulted in significant shoreline erosion along the RI coast, especially along the southern shore from Westerly to Narragansett. Shoreline erosion processes will be characterized as part of the CRMC Shoreline Change SAMP. Sea level rise and flood inundation scenarios will also be analyzed to inform planning efforts and decision-making regarding public and private infrastructure and natural resources.

FY 2015 Funding: **Funding is unstable.** Partial funding has been secured to initiate data collection but full funding is still being sought. CRMC and BRWCT support provided via funding for the Shoreline Change SAMP.

Management Values:

- Shoreline change maps allow CRMC to track and establish regulatory setbacks from eroding shorelines and planning for public infrastructure and new building construction.
- Provides valuable planning information for local government and other entities.

Implemented by: CRMC, URI Coastal Resources Center, URI Dept. of Geosciences

Used by: State agencies, municipal government, planners, consultants and property owners

Data at: http://www.crmc.ri.gov/maps/maps_shorechange.html

It's important because . . .

In RI coastal communities, shoreline erosion and sea level rise are compromising the integrity of major portions of the natural and developed coastline, a vital role in the economy.



Comparison of shoreline erosion at the same Green Hill Beach property. Photo Credits: CRMC.

Toxic Contaminants in Freshwater Fish: Mercury

Description: One of RI's largest environmental data gaps is the evaluation of toxic contaminant concentrations in freshwater fish tissues. RI has yet to establish a fully supported program to assess fish tissue and the public health risks associated. In the interim, collaborations by the RIDEM OWR and Division of Fish and Wildlife with the EPA AED continue to sample a subset of water bodies. In 2013, Keech, Tiogue and Larkin Ponds were sampled. The resulting data are used to identify whether consumption advisories to protect public health are needed. The data indicate if mercury levels in freshwater fish tissue are elevated. Researchers then use this data to improve the understanding of the fate and impact of contaminants in the environment. This data are also used in the statewide water quality assessment process. RIDEM has made a commitment to sample a subset of RI lakes and ponds, particularly those publicly accessible to boats, for fish tissue contamination. The program design will be implemented over a five-year time frame. Additionally, RIDEM is collaborating with NEIWPC for regional monitoring of mercury in fish tissue aimed at evaluating progress on implementation of the regional mercury TMDL.

FY 2015 Funding: **The program is not provided with annual base support.** RIDEM has received a one-time amount of funding as part of a court settlement that will support sampling in 2015.

Management Values:

- Protects public health.
- Determines if waters are suitable for fish consumption and regulates whether public health advisories are needed.
- Tracks trends in concentrations of mercury in fish tissues over time.

Implemented by: RIDEM OWR in collaboration with RIDEM Fish and Wildlife, and EPA AED

Used by: RIDEM, RIDOH, researchers, outdoor recreationalists, and general public

Data Available at: Data from 2013 not yet available.
<http://www.health.ri.gov/healthrisks/poisoning/mercury/about/fish/>
<http://www.neiwpc.org/mercury/mercurytmdl.asp>

It's important because . . .

Mercury is a metal that is odorless and tasteless in fish. Ingesting fish that contains high levels of mercury is dangerous to human health, particularly pregnant mothers and young children. Expanding this monitoring program would allow identification of those waters in which fish tissue contamination presents a health and safety risk and allow RI to better inform the public of such dangers through fish consumption advisories.



Children fishing in the Wood Pawcatuck Watershed for popular freshwater fish, such as trout and bass. Photo Credit: Wood Pawcatuck Watershed Association

Volunteer Monitoring – Surface Waters

Description: URI WW, the largest scientist-led volunteer monitoring program in RI, has grown to over 250 sites and 350 volunteers. In 2013, program volunteers monitored 65 lakes and ponds from May through October. With almost 150 lakes covering over 20 acres throughout RI, there remains a need to expand the program to address water bodies that are currently unassessed. Volunteer data generated on rivers, streams and coastal waters provides information on water conditions supplementing the State's periodic rotating assessments, and characterizes water quality conditions, that local organizations such as the Salt Ponds Coalition rely on. Monitoring includes measurement of water clarity, algae concentrations, dissolved oxygen, temperature, alkalinity, pH, nutrients and bacteria. Currently a relational database, funded by the URI CI, is being developed to enhance timely availability of data and customized reports.

FY 2015 Funding: **\$40,000 shortfall due to ending of USDA grants.** Local sponsors may not be able to participate due to budget constraints. RIDEM has provided a grant to support this program, but it has been level funded since 1999. URI Cooperative Extension provides significant salary support. Funding after 2015 is threatened.

Management Values:

- Monitors and assesses water quality in lakes and ponds for which there is little other water quality data collected by other state or nongovernmental partners.
- Provides data to supplement state watershed assessments and allows tracking of changes in water quality as pollution management actions are implemented.
- Identifies new water pollution problems as well as high quality waters.
- Contributes to the refining and updating of nutrient water quality criteria and standards.
- Supports municipal and state TMDL implementation and stormwater management.

Implemented by: URI WW, URI Cooperative Extension, watershed, municipal and conservation organizations

Used by: RIDEM and watershed organizations

Data Available at: <http://www.uri.edu/ce/wq/ww/data/DataTable.htm>

It's important because . . .

Volunteer-based monitoring is the primary source of water quality information in RI lakes, ponds and beaches. It also supplements river and coastal monitoring. URI WW volunteers help track conditions at times when often no other monitoring is occurring. These data are shared with RIDEM to help them prioritize restoration efforts and also meet U.S. EPA data reporting requirements. Local partners use the results to understand, protect and restore RI waters.



URI WW volunteers monitoring Belleville Pond, in North Kingstown, RI. Photo Credit: URI WW.

Wadeable Rivers & Streams –Rotating Assessments

Description: RIDEM conducts monitoring of wading rivers and streams via a rotating basin monitoring strategy. A portion of the state is monitored each year. Improvements continue to be made in field techniques, station selection, documentation, quality assurance, and safety. Parameters are tailored at each station to meet management needs. In 2013, sampling occurred at 60 stations in the northern Rhode Island watersheds of the Blackstone Moshassuck Rivers and their tributaries, and included chemical, physical and biological parameters.

FY 2015 Funding: **Funding is unstable.** RIDEM relies on EPA funding to implement this program. Reductions in federal funding threaten the continuation of this program.

Management Values:

- Assessment of water quality in wadeable rivers and streams.
- Provides data to support permitting decisions.
- Provides data to support development of water quality bio-criteria.
- Documents nutrient inputs to lakes and estuaries for TMDL and restoration planning.
- Delivers valuable data that no one else is collecting.

Implemented by: RIDEM, NEIWPCC, RI DOH, ESS Group

Used by: RIDEM, EPA, watershed organizations, and researchers

Data at: RIDEM Office of Water Resources upon request

It's important because . . .

Long term monitoring efforts in wadeable rivers and streams enables Rhode Island experts to track trends and patterns within watersheds. It also allows scientists to identify specific river segments and streams that exhibit poor water quality or degraded aquatic habitat so proper management and restoration plans can be initiated.



2013 RIDEM seasonal intern, Liz Futoma, assisting in monitoring and data collection efforts in wadeable rivers and streams throughout Rhode Island. Photo Credit: RIDEM.

Appendix A – RIEMC Partner Organizations



Brown University was founded in 1764 and is an Ivy League institution specializing in medicine, engineering, public health and professional studies. Brown University has a mission to serve the community, nation and the world by discovering, communicating and preserving knowledge and understanding in a spirit of free inquiry.

<http://www.brown.edu/>



The Rhode Island **Coastal Resources Management Council (CRMC)** is the State's federally-designated coastal zone management agency. The CRMC manages and plans for the preservation of the coastal resources of the state and is responsible for the management and permitting of all activities within tidal waters, including dredging, and along shoreline features and their contiguous areas. The CRMC, in collaboration with many partners, manages the marine aquatic invasive species program, maintains shoreline change maps depicting erosion and accretion along the coast, and assesses the impacts of sea level rise on Rhode Island's coasts.

www.crmc.ri.gov



The **Environmental Protection Agency Atlantic Ecology Division (EPA AED)** conducts research to enhance the understanding of the effects of human activity on land and waters of the Atlantic seaboard. Researchers collect and analyze data to provide tools for diagnosing and predicting the effects of these activities on aquatic resources and wildlife. EPA AED provides research support to EPA Program & Regional Offices and state & local governments.

<http://www.epa.gov/aed/>



The mission of the **Narragansett Bay Commission (NBC)** is to protect and sustain water quality in Narragansett Bay and its tributaries by providing safe and reliable wastewater collection and treatment services at a reasonable cost. NBC's water quality monitoring programs are essential to this mission, particularly monitoring of dissolved oxygen, nutrients, bacteria, and benthic habitats. Its website contains monitoring data and represents a comprehensive look at water quality in Upper Narragansett Bay. NBC serves as vice chair of the RIEMC.

<http://snapshot.narrabay.com/app/>



The **Narragansett Bay Estuary Program (NBEP)** conducts marine monitoring efforts, and provides assistance to state agencies and the RI Bays, Rivers, and Watersheds Coordination Team in developing and implementing marine monitoring plans. Summer dissolved oxygen distributions are measured by NBEP in a collaborative effort to map the extent and severity of hypoxia (low oxygen) throughout the Bay. The NBEP also helped to conduct aerial summertime macro algae surveys using monthly high resolution, GPS stamped, digital photography. Surveys are conducted monthly during low spring tides from June-September each year.

www.nbep.org/



The **Narragansett Bay National Estuarine Research Reserve (NBNERR)** collects a comprehensive set of abiotic and biological monitoring data. Water quality data are collected continuously around Prudence Island as part of the national System-wide Monitoring Program. These data are complemented by continuous monitoring of meteorological data at the weather station near Potter Cove and by monthly nutrient and chlorophyll sampling at four water quality sites. NBNERR is also tracking changes at two of the most pristine salt marshes on Prudence Island in response to climate change and sea level rise. The biological parameters regularly monitored by NBNERR include eelgrass and macro algae distribution and cover, benthic fauna, invasive crabs, nekton in estuarine habitats, and songbirds and ticks in upland habitats.

www.nbnerr.org



The **Rhode Island Department of Environmental Management's Office of Water Resources (RIDEM OWR)** monitors, protects and restores rivers, lakes, wetlands, groundwater, and coastal waters in order to support healthy communities of fish, plants, and other aquatic life, as well as sustain ecosystem services such as fishing, swimming, and drinking water supplies. RIDEM OWR is responsible for using water quality monitoring data to assess the conditions of Rhode Island's surface waters in accordance with the federal Clean Water Act. The results of the assessments of the condition of surface waters are available online and specific data can also be requested from the Surface Water Quality Assessment Program. RIDEM serves as vice chair of the RIEMC.

<http://www.dem.ri.gov/programs/benviron/water/quality/index.htm>



The mission of the **Rhode Island Department of Environmental Management's Marine Fisheries Section** (RIDEM Marine Fisheries Section) is to research and monitor marine species to support the effective management of finfish and shellfish of commercial and recreational importance.

<http://www.dem.ri.gov/topics/mftopics.htm>



The mission of the **Rhode Island Department of Health** (RIDOH) Beach Program is to protect the public from illness associated with swimming in contaminated bathing waters. The Beach Program achieves this goal by licensing recreational bathing beaches throughout the state. It furthers this mission by assisting beach owners and managers with finding and eliminating sources of contamination. The Beach Program collects various types of environmental data including Enterococci levels, water temperature, bather load, beach conditions, precipitation, seaweed load, illness complaints, etc.

<http://www.health.ri.gov/>



The **Rhode Island Natural History Survey** (RINHS) collects and distributes information on the location and viability of animal and plant species and natural communities in Rhode Island. Ongoing monitoring focuses on rare species and natural communities and invasive species.

<http://rinhs.org/>



Save The Bay (STB) protects, restores, and improves the ecological health of the Narragansett Bay region, including its watershed and adjacent coastal waters, through an ecosystem-based approach to environmental action. STB also defends the right of the public to use and enjoy the Bay and its surrounding waters, and fosters an ethic of environmental stewardship among people who live in or visit the Narragansett Bay region. STB conducts monitoring at two natural eelgrass bed sites in the Bay and sends its data to the SeagrassNet database, a world-wide monitoring database and web site. Save The Bay uses data from natural eelgrass sites to compare with monitoring data conducted at transplant bed sites.

www.seagrassnet.org/research#percentcountry



State of Rhode Island Division of Planning consists of three main components: the Statewide Planning Program, the Office of Housing and Community Development, and the Water Resources Board. The Water Resources Board and the Water Resources Board Corporate have authority in planning, developing, and managing public water supplies. These two agencies support the proper development, protection, conservation, and use of the state's water resources while providing for economic development and protection for the environment.

<http://www.planning.ri.gov/>



The Nature Conservancy (TNC) was founded in 1951 with a mission to conserve the lands and waters on which all life depends and advance conservation around the world. TNC-Rhode Island added the Ocean and Coastal Conservation program in 2007, to bring together experts from around the state and across the country to protect and restore the health of Rhode Island's marine environment.

www.nature.org



The **University of Rhode Island Coastal Institute (URI CI)** is a neutral venue where knowledge is advanced, issues discussed, information synthesized, and solutions developed for the sustainable use and management of coastal ecosystems. The geographic scope of the Coastal Institute is broadly defined to include continental shelves, inland or partially enclosed seas, estuaries, bays, lagoons, beaches, and terrestrial and aquatic ecosystems within watersheds that drain into coastal waters. The conceptual scope of the Coastal Institute includes the environmental, economic, ethical, and cultural dimensions of coastal environments and their governance. The Coastal Institute serves as chair of the RIEMC.

<http://web.uri.edu/coastalinstitute/>



The **University of Rhode Island Graduate School of Oceanography (URI GSO)** is an internationally respected oceanographic institution in regards to ocean education and research. The main interests include marine geology, geophysics, biology, atmospheric and ocean chemistry, and physics.

<http://www.gso.uri.edu/>



The **University of Rhode Island Environmental Data Center (URI EDC)** operates within the Department of Natural Resources Science at the University of Rhode Island. The URI EDC specializes in 1) the collection, storage, analysis, display, and distribution of geospatial data and 2) teaching, instruction, and training in the use of geospatial technologies. The URI EDC works closely with the Rhode Island Geographic Information System (RIGIS) Consortium and regional entities on the coordination of geospatial data acquisition and distribution that supports environmental monitoring efforts throughout Rhode Island. URI EDC was part of a consortium through USGS to collect high resolution elevation (LIDAR) data covering all of Rhode Island. These data are immediately applicable in flood hazard mapping, sea level rise modeling, ecological climate change habitat assessments, and alternative energy siting.

www.edc.uri.edu



The **University of Rhode Island Watershed Watch (URI WW)** program works with RIDEM, watershed organizations, and local communities to assess water quality, and provide information for more effective management of critical water resources. The URI WW produces quality data for a broad range of parameters for over 250 monitoring sites on lakes, ponds, reservoirs, rivers, streams, salt ponds, and marine waters statewide. Field monitoring is conducted by trained volunteers typically from May through October either weekly or bi-weekly following well-established and documented methods, and processed in a state certified laboratory. Data are summarized in on the URI WW website with design of a new database underway.

www.uri.edu/ce/wq/ww/Data.htm

Appendix B - RI Comprehensive Environmental Monitoring Strategy

The RI Comprehensive Environmental Monitoring Strategy consists of:

- An inventory of existing monitoring programs
- An outline of additional monitoring programs the state needs
- A list of indicators that will be used to measure the health of the marine habitats of the state
- A list of data standards and protocols that will be used on a reasonable and consistent basis by monitoring programs that contribute data to the state monitoring system
- A mechanism for data sharing among all monitoring programs that enables both monitors and users to securely access monitoring data via the Internet and to retain the integrity of such data
- A plan to provide data from the state marine monitoring system for disaster prevention, preparedness, response and recovery efforts in the marine environment
- A communications strategy to provide for public access to monitoring data

(RIGL 46-31)